PRODUCT STANDARD

BHEL, HYDERABAD –32.
PROJECT ENGINEERING & SYSTEMS DIVISION

PY51150

Rev No. 13

PURCHASE SPEC FOR PUMPS & MOTOR

Ref. Doc		Revisions :14 Refer to record of revisions :	Prepared : -sd- R RAVI KANTH	Checked -sd- GIRISH	Approved : -sd- SIVA PRASAD	Date : 04.09.15

Please refer specification, PEMC-06481 & annexures for details on Vertical Fire water Pump (Hydrant-Spray water Pumps) with drives. Material Codes for these Pumps applicable for this project marked in Yellow color.

VARIANT TABLE

Variant No.	Item	Material code	Job Specification	Project
01	Motor for OILY & WASTE water pumps	PY9751150019	PEMC-05522	OIL-Duliajan
02	Motors for OILY & WASTE water pumps	PY9751150027	PEMC-05797	OIL-Duliajan
03	HRSG Boiler Feed pump with drive	PY9751150035	PEMC 05923	CPCL-GT/HRSG, Manali
04	Blow Down Transfer Pump for UB and UB area	PY9751150043	PEMC-06051	CPCL- UB and GT+HRSG, Manali
05	Blow Down Transfer Pump for UB and HRSG area	PY9751150051	PEMC-06051	CPCL- UB and GT+HRSG, Manali
06	Spares for CEP	PY9751150060	PEMC 06110	ONGC-HAZIRA
07	CEP with Drive Motor	PY9751150078	PEMC 06110	ONGC-HAZIRA
08	Spares for Blow Down Transfer Pump for UB Pckg.	PY9751150086	PEMC 06051	CPCL- UB
09	VHP BFP with Drive Motor	PY9751150094	PEMC 06182	ONGC-HAZIRA
10	Spares for VHP BFP	PY9751150108	PEMC 06182	ONGC-HAZIRA
11	LP BFP with Drive Motor	PY9751150116	PEMC 06182	ONGC-HAZIRA
12	Spares for LP BFP	PY9751150124	PEMC 06182	ONGC-HAZIRA
13	CW Pump with Drive Motor	PY9751150132	PEMC 06214	ONGC-HAZIRA
14	Mand spares for CW Pump	PY9751150140	PEMC 06214	ONGC-HAZIRA
15	ACW Pump with Drive Motor	PY9751150159	PEMC 06214	ONGC-HAZIRA
16	Mand spares for ACW Pump	PY9751150167	PEMC 06214	ONGC-HAZIRA
17	DM GT ACC PUMP WITH DRIVE MOTOR	PY9751150175	PEMC 06225	CPCL- HRSG Pckgs.
18	Oily waste water collection pit pumps with drive motor in the transformer area near STG, GTG & GT#3	PY9751150183	PEMC-06233	ONGC-Hazira
19	Void			
20	Void			
21	HRSG Blowdown collection pit pumps with drive motor near HRSG area	PY9751150213	PEMC-06233	ONGC-Hazira
22	CT overflow & drain pit including SSF backwash collection pit pumps with drive motor in CT area	PY9751150221	PEMC-06233	ONGC-Hazira
23	Mandatory spares for Oily waste water collection pit pumps with drive motor in the transformer	PY9751150230	PEMC-06233	ONGC-Hazira

	area near STG, GTG, GT#3			
24	Void			
25	Void			
26	Mandatory spares for HRSG Blowdown collection pit pumps with drive motor near HRSG area	PY9751150264	PEMC-06233	ONGC-Hazira
27	Mandatory spares for CT overflow & drain pit including SSF backwash collection pit pumps with drive motor in CT area	PY9751150272	PEMC-06233	ONGC-Hazira
28	Dewatering Pump	PY9751150280	PEMC-06263	ONGC-Hazira
29	Normal make up water pump with drive motor	'PY9751150299	PEMC-06267	ONGC-HAZIRA
30	Emergency make up water pump with drive motor	'PY9751150302	PEMC-06267	ONGC-HAZIRA
31	Steam cond tr Pump with drive motor	'PY9751150310	PEMC-06267	ONGC-HAZIRA
32	CT sump make up water pump with drive motor	'PY9751150329	PEMC-06267	ONGC-HAZIRA
33	Mand spares for Normal make up water pump with drive motor	'PY9751150337	PEMC-06267	ONGC-HAZIRA
34	Mand spares for Emergency make up water pump with drive motor	'PY9751150345	PEMC-06267	ONGC-HAZIRA
35	Mand spares for Steam cond tr Pump with drive motor	'PY9751150353	PEMC-06267	ONGC-HAZIRA
36	Mand spares for CT sump make up water pump with drive motor	'PY9751150361	PEMC-06267	ONGC-HAZIRA
37	DM water Storage tank fill Pump	PY9751150370	PEMC-06280	ONGC-HAZIRA
38	Mand spares for DM water Storage tank fill Pump	PY9751150388	PEMC-06280	ONGC-HAZIRA
39	Booster Pump with drive motor	PY9751150396	PEMC-06350	BHADRADRI
40	Mand Spares for Motor Driven Booster Pump.	PY9751150400	PEMC-06350	BHADRADRI
41	Booster Pump with Diesel Engine drive.	PY9751150418	PEMC-06350	BHADRADRI
42	Mand Spares for Diesel Engine Driven Booster Pump.	PY9751150426	PEMC-06350	BHADRADRI
43	Supervision of Erection & Commissioning of Motor driven Pump	PY9851150436	PEMC-06350	BHADRADRI
44	Supervision of Erection & Commissioning of Diesel Engine driven Pump	PY9851150444	PEMC-06350	BHADRADRI
45	Hydr-Spry Pump _motor_Bhadradri	'PY9751150450	PEMC-06481	BHADRADRI
46	Hydr-Spry Pump_Engine_Bhadradri	PY9751150469	PEMC-06481	BHADRADRI
47	Spray water Pump With Motor Drive	PY9751150477	PEMC-06377	BHADRADRI
48	Spray water Pump With Diesel Engine Drive	PY9751150485	PEMC-06377	BHADRADRI
49	Jockey Pump With Drive Motor	PY9751150493	PEMC-06377	BHADRADRI

50	Mand Spare_Pump_Motor_Engine	PY9751150507	PEMC-06481	BHADRADRI
51	Mand Spares for Jockey Pump With Drive Motor	PY9751150515	PEMC-06377	BHADRADRI
52	Supervision of Erection & Commissioning of Motor driven Hydrant Pump	PY9851150525	PEMC-06481	BHADRADRI
53	Supervision of Erection & Commissioning of Diesel Engine driven Hydrant Pump	PY9851150533	PEMC-06377	BHADRADRI
54	Supervision of Erection & Commissioning of Motor driven Spray water Pump	PY9851150541	PEMC-06377	BHADRADRI
55	Supervision of Erection & Commissioning of Diesel Engine driven spray water Pump	PY9851150550	PEMC-06377	BHADRADRI
56	Supervision of Erection & Commissioning of Motor driven Jockey Pump	PY9851150568	PEMC-06377	BHADRADRI

HYDERABAD

PRODUCT STANDARD

BHEL, HYDERABAD –32.
PROJECT ENGINEERING – MECHANICAL

PY 51150

Rev No. 13

RECORD OF REVISIONS

Rev. No.	Date	Revision Details	Revised By	Approved By
00	03.02.15	FRESH ISSUE	-sd-	-sd-
01	28.03.15	Variant 02 added	-sd-	-sd-
02	13.05.15	Variant 03 added	-sd-	-sd-
03	02.06.15	Variant 04 & 05 added	-sd-	-sd-
04	18.06.15	Variant 06 & 07 added	-sd-	-sd-
05	03.07.15	Variant 08 to 12 added	-sd-	-sd-
06	11.07.15	Variant 13 to 16 added	-sd-	-sd-
07	15.07.15	Variant 17 added	-sd-	-sd-
08	21.07.15	Variant 18 to 27 added	-sd-	-sd-
09	30.07.15	Variant 28 added	-sd-	-sd-
10	05.08.15	Variant 29 to 36 added	-sd-	-sd-
11	10.08.15	Variant 37 & 38 added	-sd-	-sd-
12	24.08.15	Variant 39 to 42 added	-sd-	-sd-
12	28.08.15	Variant 43 & 44 added	-sd-	-sd-
13	04.09.15	Variant 45 to 56 added	R Ravi Kanth	

Ref. Doc

TECHNICAL PURCHASE SPECIFICATION

FOR

HYDRANT –SPRAY WATER PUMPS INCLUDING DRIVES

[VERTICAL TURBINE TYPE]

CUSTOMER : **TELANGANA STATE POWER GENERATION CORPORATION (TSGENCO)**

PROJECT : **BHADRADRI THERMAL POWER STAION 4 x 270 MW**

CONSULTANT : **M/S DEISEIN INDIA PVT LTD**

Ref. Doc

DOCUMENTS TO BE SUBMITTED WITH THE BID:

The bidder must submit the following documents along with their bid so as to enable BHEL to evaluate their offer.

a) Duly filled in Pump datasheet for Hydrant-Spray water Pump

b) Duly filled in motor datasheet for Hydrant-Spray water Pump

c) Duly filled in Diesel engine data sheet for Hydrant-Spray water Pump.

d) Tentative GADs of all pumps & drive assembly

e) Performance curves for Pump & Drives for various conditions as per clause no 7.0.0.

f) Un-priced copy of price in attached BHEL price bid formats indicating quoted/ not quoted against each row & column.

g) Equipment qualification criteria / PTR / Reference Lists

h) Checklist

i) Deviation list [if any]

In case the above mentioned documents are not submitted with the offer, the offer of the bidder may be liable for technical rejection.

Ref. Doc

TECHNICAL PURCHASE SPECIFICATION FOR HYDRANT-SPRAY WATER PUMP ASSEMBLY INCLUDING DRIVES

1.0.0. INTENT OF SPECIFICATION:

This specification specifies the requirement of Design, Engineering, Manufacturing, Assembling, Inspection, Testing at manufacturerôs works and Delivery properly packed and painted for transport of **Hydrant-Spray water Pumps (Fire water Pump) of vertical turbine type** including drives with all accessories as specified in the scope of work and as required for the safe and trouble-free operation of equipment to be installed at site.

2.0.0 SPECIAL NOTES TO BIDDERS:

2.0.1
This specification shall be read in conjunction with its enclosures. In case of any discrepancy arising between this specification & its enclosures, the most stringent of all shall be followed and shall over-ride others. Further, if a requirement in this specification or its enclosures, calls for decision of owner/BHEL, it shall be bidderôs sole responsibility to clearly bring out the same distinctively in his technical tender offer, so as to enable owner/BHEL to furnish their decision. If such a requirement is not duly addressed by bidder during tender stage and same comes out during order execution stage, it shall be binding on the bidder to comply with the decision furnished by owner/BHEL then, without any cost, delivery, or any other commercial implications.

2.0.2
Any additional equipment, material, etc., which are not specifically mentioned here, but are required to make the supplied equipment complete in all respect, in accordance with the intent of this technical specification, contractual agreement, statutory requirements, relevant/applicable codes/standards, good engineering practices, and for safe and trouble-free operation, shall be deemed to be covered under the scope of this specification.

2.0.3
The Bidder shall accept full responsibility for the completeness and for the faultless working of all the equipmentôs. These shall be executed on the basis of proven design principle and in accordance with the latest state of the art in such a manner that the purpose to be served by the Pump unit is fulfilled in every respect and a maximum of operational dependability and efficiency are assured. Standardization of equipment, materials etc. shall be employed in the design. Care shall be taken to ensure safe operation as well as simplicity of assembling and dismantling of all parts of the plant.

2.0.4
Bidder shall quote strictly as per the scope of supply and requirements of this specification.

2.0.5
Bidder offer shall be strictly as per these specification requirements. Unsolicited or Alternate offers from the bidders will not be entertained.

2.0.6
In case bidder feels that it is necessary to exclude some components of scope of supply or some of the features of specification requirements due to any technical constraints, bidder shall bring the same to the notice of purchaser during pre-bid stage and take their prior approval before submission of their bid.

2.0.7
Incase Bidder is unable to offer due to any specific requirement of specification, Bidder shall bring out the same in their regret letter. Otherwise it will be considered that non participation by the bidder is attributable to reasons other than any specification requirements.

3.0.0 APPLICATION OF SYSTEM:

3 noôs [3 Working] of motor driven Main Hydrant Pump are envisaged for supplying water to Hydrant header from the fire water storage sump.

2 noôs [2 Stand by] of Diesel Engine driven Hydrant Pump are envisaged for supplying water to Hydrant header from the fire water storage sump.

2 noôs [2 Working] of motor driven Main Spray water Pump are envisaged for supplying the water to the spray water system from the Fire water storage sump.

1 noôs [1 Stand by] of Diesel Engine driven Spray water Pump are envisaged for supplying the water to the spray water system from the Fire water storage sump.

Location of Pump, Motor & Diesel Engine: Fire water pump house, Indoor

4.0.0 SCOPE OF SUPPLY:

The scope of supply for this enquiry is as given below.

Please refer to the enclosed Schematic [Annexure-1] for above mentioned Hydrant -Spray water Pump with Drives for general clarity on scope of supply. The system shall be provided as per P&ID taking Into all requirements including for testing, painting, documentation, sub vendor list, equipment specifications etc., specified in this specification and enclosures.

No. of Pump & Drive Assembly:

(i) 5 No of Motor Driven Hydrant-Spray water Pump [Vertical turbine type].
(ii) 3 No of Diesel Engine Driven Hydrant-Spray water Pump. [Vertical turbine type].

The scope of supply for each pump & motor/ Diesel Engine drive assembly is as given below.

4.1.0 Pump:

Centrifugal, Vertical turbine type pump complete with all accessories as per this specification and annexures.

Pump Performance Requirement:

a) Performance requirement, Design and construction of the pump shall be guided by the TAC/LPA recommendations & as per `Data Sheet-As Annexure-02ô enclosed customer specification.

b) Pumps shall be capable of furnishing not less than 150 % of rated capacity at a head of not less than 65 % of the rated head. The shutoff head shall not exceed 140 %.

c) Pump-Motor sets shall be capable of continuously delivering the rated output for the voltage variation of (±) 10% and frequency variation of (±) 5% occurring separately or combined voltage and frequency variation of (±) 10% (absolute sum).

Pump Constructional Features:

a) The design and Testing Standards of the Pumps shall conform to the standards as indicated in the TAC/LPA recommendation.

b) The pumps shall comply with the regulations of Tariff Advisory Committee (TAC)/LPA and National Fire Protection Association (NFPA), USA as applicable.

c) Parts of pumps like impeller, shaft sleeve, wearing ring etc. shall be of non-corrosive metal preferably of brass or bronze or stainless steel.

d) Drive Unit Power rating for the fire water pumps shall be selected such that it is equal to higher of the two conditions:

i) 110% of the duty point power requirement.
ii) Motor input power required at 150% of the duty point capacity of pump

4.2.0 Motor:

Suitable Drive Motor complete with terminal box, canopy, space heater, cable glands, lugs, earthing lugs and all other accessories required as per Customer specification.

Performance requirement, Design and construction of the Motor shall be guided by the TAC/LPA recommendations.

Motor rated 160 kW & above are connected to 6.6 kV system
Motor Rating Less than 160 kW: 415 V is 3 Ph, 50 Hz.
LT motor 110kW and above shall be ACB controlled.

Following Points to be taken care while selecting Motor:

-Area classification - Safe Area
- Type of protection - Weather proof (WP)
- Degree of Protection motors - IP 55

4.3.0 A) Coupling between Pump and Motor:
Coupling between pump and motor shall comply with the following.

a) Coupling shall be as per manufacturer's standard
b) Metallic, Non-lubricated, flexible element type (i.e. either diaphragm or disc type)
c) With Non sparking type coupling guard
d) With spacer
e) With a minimum service factor of 1.5

B) Coupling between Pump & Diesel engine:
Gear drive conforming to approval standard of Factory Mutual system or right angled gear drive class no 1338 hall to be used between pump & Diesel engine.

4.4.0 Diesel Engine :

Performance requirement, Design and construction of the diesel engine shall be guided by the TAC/LPA recommendations.

Engines, after correction for altitude and ambient temperature, shall have bare engine horsepower rating [at its duty point at rated R.P.M] equivalent to the higher of the following two values.
a) 20 % in excess of the maximum brake horsepower required to drive the pump at its duty point.
b) The brake horsepower required driving the pump at 150 % of its rated discharge.

Derating Factors considered by the manufacturer to arrive at the shaft power of the diesel engine at site, shall not be less than the following for normally aspirated engines only:
揑鶵 3% for each 305 metre elevation above MSL (Ref. NFPA, Volume-2, 1978).
b) 1% for each 5.6 0 C rise in air temperature above 15.6 0 C (Ref. NFPA, Volume-2, 1978).

The base power rating of the diesel engine shall be referred to any accepted datum like BS/SAE Standard condition or equivalent. In any case, horsepower rating shall not be higher than the limit set by Tariff Advisory Committee.

The Engine shall be:
a) Compression ignition mechanical direct injection type, capable of being started without the use of wicks, cartridges, heater plugs or ether, at an engine room temperature of 7 Deg C and shall accept full load within 15 seconds from the receipt of the signal to start.
b) Naturally aspirated, supercharged or turbo-charged and either **air or water-cooled**. In the case of charge air cooling by means of a belt-driven fan or of a belt driven auxiliary water pump there shall be multiple belts such that should half the belts break, the remaining belts would be capable of driving the fan or pump.

c) Capable of operating continuously on full load at the site elevation for a period of six hours.
d) Provided with an adjustable governor to control the engine speed within 10% of its rated speed under any condition of load up to the full load rating. The governor shall be set to maintain rated pump speed at maximum pump load.
e) Provided with an in-built tachometer to indicate R.P.M. of the engine.

Note: *Any manual device fitted to the Engine that could prevent the engine starting shall return automatically to the normal position.*

Diesel Engine with following accessories to be included:

1. Diesel Engine
2. DC Motor to start engine
3. Battery and Battery charger
4. Day oil Tank with required piping
5. Silencer with insulation (Approx. 10 to 15 m)
6. Diesel Engine Control Panel
7. Suitable 1 phase 240 Volt fuel pump (portable) to be provided to fill up diesel oil from Diesel Drum received from supplier of Diesel. This pump should also have facility to be operated by hand, in case electricity fails.

Following Auxiliary equipment to be included in bidder scope:

a) A sludge and sediment trap
b) A fuel level gauge
c) An inspection and cleaning hole.
d) A filter between the fuel tank and fuel pump mounted in an accessible position for cleaning.
e) Means to enable the entire fuel system to be bled of air. Air relief cocks are not allowed; screwed plugs are permitted.
h) Two sets of belts (where used)
i) One complete set of engine-joints, gaskets and hoses,
l) One inlet valve and one exhaust valve

Air filtration:
The air intake shall be fitted with a filter of adequate size to prevent foreign matter entering the engine.

Exhaust system:
The exhaust shall be fitted with a suitable silencer and the total backpressure shall not exceed the engine maker's recommendation. When the exhaust system rises above the engine, means shall be provided to prevent any condensate flowing into the engine. For details pls refer annexure-1.

Engine shut-down mechanism:
This shall be manually operated and return automatically to the starting position after use.

4.4.1 Starting

a) The engine shall be capable of both automatic and manual start.

b) Automatic cranking shall be effected by a battery driven D.C. motor having high starting torque to overcome full engine compression. Starting power shall be supplied from two (2) sets of storage batteries.
One (1) set of battery is for automatic starting of the engine and the other provided for manual starting. A selector switch shall be provided at the automatic starting control panel to select any of the two (2) sets of battery for manual/auto starting of the engine.

The automatic starting arrangement shall include, as a safeguard, a "Repeat Start" feature so that if the pinion of the starting motor does not engage the flywheel at the first attempt, it is automatically retracted and after a short pause again will advance towards the flywheel.

This repeat start cycle will continue until five (5) kicks after which there will be suitable annunciation. The battery capacity shall be adequate for ten (10) consecutive starts without recharging with a cold engine under full compression.

c) Arrangement for both trickle and booster charge of the batteries shall be provided. When the engine starts running, provision should be kept to ensure that the charger is automatically disconnected and the battery is charged by engine dynamo.

Each diesel engine shall be provided with two (2) battery charger units of air cooled design. Each charger unit shall be capable of charging one (1) set of battery at a time. Provision shall, however, be kept so that any of the charger units of a particular engine can be utilised for charging any one of the two (2) batteries of that engine.

4.4.2 Governing System

a) The engine shall be fitted with a speed control device that will control the speed under all conditions of load.

b) The governor shall offer following features:

i) Engine should be provided with an adjustable governor capable of regulating engine speed within 10% of it's rated speed under any condition of load up to the full load rating. The governor shall be set to maintain rated pump speed at maximum pump load. (Refer Fire Protection Manual by TAC/LPA).

ii) Engine shall be provided with an over speed shut-down device. It shall be arranged to shut-down the engine at a speed approximately 20% above rated speed and for manual reset, such that the automatic engine controller will continue to show an over speed signal until the device is manually reset to normal operating position. (Refer NFPA).

c) The governor shall be suitable for operation without external power supply.

4.4.3 Fuel system

a) The diesel engine will run on High Speed diesel oil, analysis of which has been indicated elsewhere in specification.

b) Each engine shall be provided with fuel oil tank having storage capacity sufficient to run the engine at full load for at least six (6) hours.

c) For each compression ignition engine driven pump set, there shall be individual fuel tank and fuel feed pipes.

d) A suitable 1 phase 240 Volt fuel pump (portable) to be provided to fill up diesel oil from Diesel Drum received from supplier of Diesel. This pump should also have facility to be operated by hand, in case electricity fails.

e) The engine fuel tank shall be of welded steel constructed to relevant Indian or Foreign Standard for Mild Steel Drums. The tank shall be mounted above the engine fuel pump to give gravity feed unless otherwise recommended by the manufacturer. The tank shall be fitted with an indicator showing the level of the fuel in the tank. The capacity of the tank shall be sufficient to allow the engine to run on full load for 4 hrs at full load engine operation.

f) Any valve in the fuel feed pipe between the fuel tank and the engine shall be placed adjacent to the tank and it shall be locked in the open position. Pipe joints shall not be soldered and plastic tubing shall not be used.

4.4.4 Lubricating oil system

Automatic pressure lubrication shall be provided by a crankshaft driven oil pump, taking suction from a sump and deliver pressurized oil through cooler and fine mesh filters to a main supply header fitted in the bed plate casing. High pressure oil shall be supplied to main and big end bearings, cam-shaft bearings, cam-shaft chain and gear drives, governor, auxiliary drive gears etc. Valve gear shall be lubricated at reduced pressure through a reducing valve and the cams by an oil bath. The above lubricating oil sump shall be equipped with adequate heaters having thermostat control to maintain the lubricating oil at recommended temperature for maintaining oil at low viscosity.

4.4.5 Cooling water system

The cooling water system shall confirm to any one of the systems specified in Fire Protection Manual of the Regional committee of the Tariff Advisory Committee / LPA / NFPA. The Contractor shall clearly indicate in his offer the type of cooling system adopted. In case fire water is used as a cooling media by tapping of the water from the fire water pump discharge (before the pump discharge valve), the capacity of the fire pump shall be increased, so that the net capacity meets the specification requirement.

Note:
1) *Cooling by water from the discharge of fire pump (taken off prior to the pump discharge valve) direct into the engine cylinder jackets via a pressure reducing device to limit the applied pressure to a safe value as pacified by the engine manufacturer. The outlet connection from this system shall terminate at least 150 mm above the engine water outlet pipe and be directed into an open tundish so that the discharge water is visible.*
2) a heat exchanger, the raw water being supplied from the fire pump discharge (taken off prior to the pump discharge valve) via a pressure-reducing device, if necessary, to limit the applied pressure to a safe value as specified by the engine manufacturer. The raw water outlet connection shall be so designed that the discharged water can be readily observed. The water in the closed circuit shall be circulated by means of an auxiliary pump driven from the engine and the capacity of the closed circuit shall not be less than that recommended by the engine manufacturer. If the auxiliary pump is belt driven there shall be a multiple belt so that should half the belts break, the remaining belts shall be capable of driving the pump.
3) a frame or engine mounted air cooled radiator with a multiple fan belt driven from the engine. When half the belts are broken the remaining belts shall be capable of driving the fan. The water in the closed circuit shall be circulated by means of an auxiliary pump driven by the engine and the capacity of the closed circuit shall be not less than that recommended by the engine manufacturer.
4) direct air cooling of the engine by means of multiple belt driven fans. When half the belts are broken the remaining belts shall be capable of driving the fan.
5) In case of systems described in (2) (3) & (4) above a failure actuated audio-visual alarm shall be incorporated.

4.4.6 Instrumentation & control

The diesel engine shall be provided with adequate instrumentation. These shall include but not limited to the following:
a) Temperature indicator (contact type) in cooling water inlet and outlet.
b) Temperature indicator in lubricating oil outlet from the oil cooler.
c) Pressure gauges (contact type) for lubricating oil system.
d) Differential pressure gauges (contact type) across strainers/ filters.
e) Speed indicator.
f) Running hour meter.
g) Dip stick type lubricating oil sump level indicator.
h) Gauge glass type Fuel Oil Tank level indicator.
i) Voltmeter & Ammeter in dynamo type battery charging circuit

4.4.7 Requirement of batter and battery charger for diesel engine driven Hydrant/ Spray water pump:

The Battery shall have the capacity to start the Diesel engine at least for eleven starts. Further Battery shall have capacity to meet auxiliaries & other loads of Local Control Panel (if any) for a minimum period of 10 hours. Minimum Ampere-hour capacity of the Battery shall be selected accordingly.

The Battery driven Power supply shall be available to main and repeater fire alarm panel shall be designed to provide supply for a minimum period of 10 hours. Minimum ampere hour capacity of the Battery shall be selected accordingly.

Bidder shall compute the ampere hour capacity at suitable discharge rate based on above duty and furnish the calculation along with the Bid which shall consider the duty cycle and 25% & 15% compensation for ageing & unforeseen future growth respectively of each battery unit. The maximum and minimum ambient shall be 42Deg C and 11.7 Deg C respectively. The minimum voltage at the end of the load cycle shall not be less than 1.8 volts per cell.

4.5.0 Suction Strainer: Suction strainer at pump bell mouth as per manufacturerôs recommendation suitable for this application.

4.6.0 Suitable base frame with fixing bolts for pump & motor (Variant 01), Pump & Diesel Engine (Variant 02). The pumping set(s) shall be securely mounted on a robust bedplate and shall be free from vibration at all variations of load.

4.7.0 Inter connecting Piping & Instrumentation :

Interconnecting piping and instrumentation as per P&I D **[Annxure-1]**
Consisting of following as minimum as indicated in P&I D:

Flanges & Companion flanges with necessary nuts, bolts & gaskets & bolts at all terminal points.
(Please refer P&I D **[Annexure-1]**

Fittings shall be as mentioned below:

Flanges**:** ASTM A 105

Fittings**:** Up to 1 ½ò ASTM A 105 and above 1 ½ò ASTM A 234 Gr.WPB.

Note**:** All fittings and flanges for galvanized pipes shall be galvanizes as per 4736.

4.8.0 Necessary foundation bolts, nuts, sleeves, shims/grouting pads etc.

4.9.0 Counter flanges with gaskets and fasteners, suitable reducers/expanders to meet BHEL discharge pipe size.

4.10.0 VIBRATION MONITORING PROBES :

Vibration monitoring system is applicable for HT drives & Pumps associated with it. However, no probes are in the scope of supply of the bidder. Provision shall be made on Pumps, Motor & Diesel Engine for mounting vibration probes.

Key Phasor ï Notch provision for pump, motors & Diesel Engine shaft shall be 30 mm (Length) x 15 mm (Width) x 3 mm (Depth).

Bidder to indicate the Alarm and trips value in RMS to be reflected in VMS panel

4.11.0 Winding RTD, Bearing RTD & Temperature Gauges to be provided for all HT Motors
Bearing RTD & Temperature Gauges to be provided for all Diesel Engines
Bearing RTD & Temperature Gauges to be provided for all Pumps

Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.

4.12.0 No. of Junction Boxes: (Applicable in case of HT Motor): 1 No. for Motor [Generally it is integral part of Motor] & 1 no for each Pump.

4.13.0 Sump model study: Not Applicable

4.14.0 Reverse rotation monitoring system: Not Applicable

4.15.0 Lateral analysis: Not required

4.16.0 Torsional analysis: Not required

4.17.0 Complete Unit Test [String Test]: Not required. However bidder to conduct performance test of pump with job motor/diesel engine as per specification requirement.

4.18.0 First Fill of Lubricant: In scope of supply of Bidder

4.19.0 SS piping for flushing plan: SS-316 piping shall be provided for flushing plan as per specification.

4.20.0 Local gauge board (As required)

4.21.0 Vent with 3 way SS isolating valve

4.22.0 Drain connection with valve

4.23.0 Eye-bolts, lifting tackle etc.

4.24.0 All other items necessary for safe and smooth running of Pump & accessories required to make the supplied equipment complete in all respect.

4.25.0 COMMISSIONING SPARES, MANDATORY SPARES & SPECIAL TOOLS AND TACKLES.

Commissioning spares for Hydrant-Spray water Pump assembly:

Five sets (One set for each pump & motor assembly) of commissioning spares for hydrant-Spray water Pump with drive motor shall be quoted as per manufacturer's recommendation. Commissioning spares shall contain Minimum *1 Set of O rings & gaskets* for each Pump & drive assembly.

Three sets (One set for each pump & Diesel Engine assembly) of commissioning spares for hydrant-Spray water Pump with Diesel Engine shall be quoted as per manufacturer's recommendation. Commissioning spares shall contain Minimum *1 Set of O rings & gaskets* for each Pump & drive assembly.

1 set stands for requirement for one no. of pump & drive assembly. Bidder to furnish the list along with the offer.

Any commissioning spare required over and above the recommended commissioning spares during commissioning shall be supplied free of cost by the equipment vendor. Refer annexure-5

Mandatory Spares for Hydrant-Spray water Pump with drives:

For details refer Price Bid Formats of Hydrant-Spray water Pump. (Annexure-5).

Note:

A) If any of below items indicated by the specified name are not applicable, bidder to offer alternative item serving the same function as per equipment's design and indicate below the item being replaced.

B) If bidder is not able to meet the above note, then bidder may mention "Not Applicable". However, if found applicable during detailed engineering stage or alternative item as per equipment design can serve the same function, bidder to supply the specified quantity without any delivery and commercial implications to BHEL.

C) One set of 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.

D) One set of 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.

For Pump:

Complete Bowl Assembly: 1 Set
Impeller: 1 Set
Shafts: 1 Set
Casing wear rings: 1 set
Impeller wear rings: 1 set
Shaft sleeves: 2 set
Shaft Coupling: 1set
Shaft nuts & keys: 1set
Lantern Ring: 1 set
Bell mouth Liner: 1 set
Bearing: 1 set
Pump & motor Coupling: 1 set

For Motor:

Driving End Bearing: 1No. (or 1Set as applicable) for each type and rating of Motor
Non-Driving End Bearing: 1No. (or 1Set as applicable) for each type and rating of Motor
Cooling Fan Internal & External: 1Set for each type and rating of Motor
Bearing Temperature Gauge Driving & Non-Driving End: 1Set for each type and rating of Motor
Phase-Segregated Terminal Box: 1Set for each type and rating of Motor
Neutral End Terminal Bushing with Fasteners: 1No. for each type and rating of Motor
RTD for Bearing Temperature: 1No. for each type and rating of Motor
Motor Space Heater: 1No. for each type and rating of Motor
Complete Set of Coupling: 1Set for each Application

For Diesel Engine:

Element for lub oil Filter: 2 Nos.
Element for Fuel Filter: 2 Nos.
Outer Element for Air cleaner: 2 Nos
Inner Element for Air cleaner: 2 Nos.
Turbo-charger: 1No.
Engine - starter Motor: 1No.
Injector: 2 Nos.
Piston rings & liner set: 2Sets

For Instrumentation:
Transmitters/ Gauges/Switches etc. along with relevant accessories: 10% of total or at least two (whichever is higher) for each type along with accessories.
Temperature Element (RTD/Thermo-couple) with thermo well: 10% of each type, range and immersion length. Minimum 5 nos.

Special Tools and Tackles: for Hydrant-Spray water Pump with drives:

1 set for Pumps with Drive Motors
1 set for Pumps with Diesel Engines

The bidder shall furnish a complete 1 set of all special tools, wrenches etc. with necessary tools boxes as required for operation and maintenance [disassemble, assemble, or maintaining the unit] of the hydrant Pump, Spray water pump & jockey supplied, as a part of scope of supply. **Bidder shall furnish a list of such tools along with offer for the system.** Prices for the special tools and tackles shall be part of main scope of supply. No separate price shall be offered for the same. Refer Annexure-5.

5.0.0 OPTIONAL PRICES: Please Refer to Attached Price Bid Format.

6.0.0 EQUIPMENT QUALIFICATION CRITERIA (EQC)

Bidder to submit the Equipment Qualification Criteria for vertical fire water (Hydrant-Spray water) Pump detailed below:
The vendor shall be an established manufacturer of Centrifugal pumps & having adequate engineering, manufacturing & testing facilities for pumps.

The pump model offered shall be from the existing pump model series in the regular manufacturing range of vendor. The mechanical as well as hydraulic performance [including NPSHR] for the complete range of operation of the offered model shall have been established in the shop test. The offered pump model shall meet the minimum service & manufacturing experience specified as below.

Pump shall be identical or validly similar in terms of Power Rating, Hydraulic Performance [Including NPSHR], Inlet Flow, Differential Head, Operating Pressure & Temperature, Pumping Liquid, Speed, Number & Type Of Impellers, Mechanical Design, Materials, Bearing Span [Applicable For Between Bearing Pumps],Column Length [Applicable For Vertical Suspended Pumps], etc. as compared to at least TWO UNITS of the proposed model designed, manufactured, tested and supplied from the proposed manufacturing plant in the seven years and at least ONE of these units shall have successfully operated in the field for at least 8000 hours individually without any major problem as on the date of issue of enquiry.
Bidder to furnish dully filled in proforma as per Annexure-9

7.0.0 TECHNICAL DETAILS/REQUIREMENTS:

7.1.1 Design Parameters of the Hydrant-Spray water Pump

Sl. No.	Description	Unit	Rated Condition
1	Temperature Of Fluid	Deg. C	Ambient Pls refer site details as per 7.2.0
2	Capacity Of each pump	m3/hr	410
3	Pump Differential Head	mwc	105
4	Available Pressure at centre line of Suction nozzle of Pump	mwc	10.36

7.2.0 SITE DETAILS:

Elevation above MSL: 89 m
Monthly highest temperature: 44.9 ºC
Monthly lowest temperature. : 12.9 ºC
Rainfall Average. 1031 mm
Max. : 100 mm/ hr
Mean Wind speed: 5.8 kmph
Relative Humidity Max: 82%
Min: 35%
Seismic Zone: Zone-III as per IS- 1893 (Part-IV)
(As per Section II of Volume II A of e-PCT/TS/K/02/2014-15 for Kothgudem TPS)

Ref. Doc

7.3.0 TECHNICAL PARAMETERS:

For Hydrant Pump with Drives (Motor & Diesel Engine)

Sl. No.	**Pump**	Hydrant-Spray water Pump with Drive Motor	Hydrant-Spray water Pump with Diesel Engine
A	BHEL Material code	PY9751150450 for Pump & Motor PY9751150507 for Mandatory spare	PY9751150469 for Pump & Diesel Engine PY9751150507 for Mandatory spares
B	Number of Pumps	5 Noôs	3 Noôs
C	Drive	Motor	Diesel Engine
D	Direct drive	Yes	Gear drive conforming to approval standard of Factory Mutual system or right angled gear drive class no 1338 hall to be used between pump & Diesel engine.
E	Parallel operation	Yes	Yes
F	Auto Start facility for the standby	Yes	Yes
G	Pump type	Centrifugal, Vertical turbine type	Centrifugal, Vertical turbine type
H	Pump Standard	HIS/IS 5120/ Equivalent standard as per Customer Spec. The pumps shall comply with the regulations of Tariff Advisory Committee (TAC)/LPA and National Fire Protection Association (NFPA), USA as applicable.	HIS/IS 5120/ Equivalent standard as per Customer Spec. The pumps shall comply with the regulations of Tariff Advisory Committee (TAC)/LPA and National Fire Protection Association (NFPA), USA as applicable.
I	Coupling Standard	Refer clause no 4.3.0-A	Refer clause no 4.3.0-B
J	Sealing arrangement	Mechanical seal as per manufacturer Standard	Mechanical seal as per manufacturer Standard
K	Drive Standard	IS-325/ IS-12615/ IEC-60034, duly taking into consideration of enclosed BHEL & Customer / Consultant specification. Design and construction of the Motor shall be guided by the TAC/LPA recommendations.	IS -10000, BS- 5514 and as per standard practice of diesel engine manufacturerôs association of USA. Design and construction of the diesel engine shall be guided by the TAC/LPA recommendations.
L	Strainer	As per clause no 4.5.0	As per clause no 4.5.0
M	Max allowable pressure drop in suction strainer 50% clogged condition		
N	**Material of construction**		
a)	Pump	Casing : 2.5% Ni CI as per IS:210 Gr.FG 260 Casing liner : 2.5% Ni CI as per IS:210 Gr. FG 260 Impeller : ASTM - A 743 GR. CF 8 M Wearing rings : SS-304 Pump shaft : AISI 410(Hardened) Gland : 2.5% Ni CI as per IS:210 Gr.FG 260	Casing : 2.5% Ni CI as per IS:210 Gr.FG 260 Casing liner : 2.5% Ni CI as per IS:210 Gr. FG 260 Impeller : ASTM - A 743 GR. CF 8 M Wearing rings : SS-304 Pump shaft : AISI 410(Hardened) Gland : 2.5% Ni CI as per IS:210 Gr.FG 260

		Base plate : Carbon Steel as per IS-2062 Wetted Fasteners : SS-316 Companion Flange : ASTM A105	Base plate : Carbon Steel as per IS-2062 Wetted Fasteners : SS-316 Companion Flange : ASTM A105
b)	Suction strainer	Refer Annexure-1	Refer Annexure-1
c)	Flange	Refer Annexure-1	Refer Annexure-1
d)	Pipe	Refer Annexure-1	Refer Annexure-1

Note: *Other Details of Pump, motor & Diesel engine shall be as per attached BHEL data sheets for Pump (Annexure-2),Data sheets for Motor (Annexure-3) & Data sheets for Diesel Engine (Annexure-4) respectively.*

08.00 QUALITY PLAN & INSPECTION AGENCY & TESTING:

8.1.0. Quality plan:

Quality plan will be reviewed during detailed Engineering stage with respect to Inspection, standard Engineering practices & Specification Requirements and various tests and stages of inspection and appropriate agencies for Inspection will be Intimated. Bidder to abide by the same.

Further, bidder to take the requirements specified in enclosed BHEL & Customer/Consultant Specification as per [Annexure-11].

For guide lines & typical format please refer **Annexure- 15**.

8.2.0 Inspection agency:

BHEL/Third Party appointed by BHEL/Customer/Contractor
The various review/witness/observation stages by individual agencies (or) Group of Agencies as above will be in line with approved quality plan**. Also refer Annexure-11.**

8.3.0 Testing:

The design and Testing Standards of the Pumps shall conform to the standards as indicated in the TAC/LPA recommendation.
However following to be consider as a minimum requirement:
Capacity higher than 30 kw, one in three pumps shall pass a performance test to DIN 1944 class II, with measurements taken at 0%, 50%, 80%, 100%, and 120% of specified discharge at rated speed. The Results have to be certified in a workshop certificate 2.3 to DIN 50049. For pumps of a capacity higher than 100 kw, the shop tests shall be compulsory; test certificate 3.1 B in accordance with DN 50049.

For details pls refer **Annexure-10 & 11 & 15.**
However, Performance tolerance shall be as mentioned below:

Rated head at rated point : Zero negative tolerance
Shut-off head : Zero negative tolerance. Positive tolerance acceptable till 140% of rated head.
Rated BKW : Zero positive tolerance

Note: For Customer hold point & material dispatch clearance certificate, pls refer Annexure 11

9.0.0 PAINTING:

Painting shade for pump, motor & diesel engine: IS536 as per IS5
For details pls refer Annexure 12.

Ref. Doc

10.0.0 MARKING, PACKING AND DESPATCH:

10.1.0 Marking

a) All items shall be marked (stamped/etched) in accordance with the applicable code/standard/specification. In addition, the item code, if available, shall also be marked.

b) For ease of identification, the color of painted strip (wherever required) shall be as per the applicable standard.

c) Paint or ink for marking shall not contain any harmful metal or metal salts which can cause corrosive attack either ordinarily or in service. Special items/smaller items shall have attached corrosion resistant tag providing salient features.

10.2.0 Despatch

a) All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for transportation by ship/rail or trailer. The equipment shall be wrapped in polythene sheets before being placed in crates/cases to prevent damage to the finish. Crates/cases shall have skid bottom for handling.

b) Special notations such as 'Fragile', 'This side up', 'Center of gravity', 'Weight', 'Owner's particulars', 'PO Nos.' etc. shall be clearly marked on the package together with other details as per purchaser order.

c) The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains/high ambient temperature, unless otherwise agreed.

d) The following minimum packing procedures shall be followed :

- All items shall be dry, clean and free from moisture, dirt and loose foreign material of all kinds.
- All items shall be protected from rust, corrosion, and mechanical damage during transportation, shipment and storage.
- Rust preventive on machined surfaces to be welded shall not be harmful to welding and shall be easily removable with a petroleum solvent.
- Ends shall be suitably protected, and the protectors shall be securely and tightly attached.
- Each variety and size of item shall be supplied in separate packaging marked with the purchase order no., item code (if available), and the salient specifications.
- Carbon steel, LTCS and low alloy steel valves shall be painted with one coat of inorganic zinc silicate primer.
- Prior to shipment components of the unit shall be completely cleaned, Flange faces and other machined surfaces shall be protected by coating with easily removable rust preventive. All the equipments shall be properly packed to prevent damage during transit damage, loading, unloading and storage.
- All electrical, instrumentation etc, shall be properly packed to prevent damage during transit due to vibration, physical contact, moisture ingress, rainwater and pilferage.
- All the items which the Bidders considered liable to be damaged during shipment or storage, shall be packaged for separate shipment. If instruments are removed from the panel, they and their connection shall be suitably tagged to ensure simple re installation at the job site. Each instrument shall be sealed in plastic bags containing moisture absorbing dessicants.
- It shall be bidderôs sole responsibility to protect all the material during period of dispatch, storage and erection against corrosion, incidental damage due to vermin, sunlight, rain, high temperature, humid atmosphere, rough handling in transit and including delays in transit. Bidder shall be responsible for any damage to equipment/material due to above reasons.
- Spare parts shall be packaged separately and clearly marked as óSpare Partsô

Bidder to note that Packing and Forwarding shall be as per manufacturing standard meeting the requirement is acceptable. Packing shall be suitable for outdoor storage: More than 6 months. Being minor the same shall be discussed during Detail Engineering. Also refer annexure-13.

11.0.0 SUB VENDORS:

As per attached **Annexure 13**

Bidder shall follow Customer approved sub vendors list. Please refer to Annexure -13.

In case of any specific practical difficulty, bidder is requested to bring out the same with proper reason for not following vendor list.

For other items for which sub vendors are not specified, bidder can follow their standard vendors. However they have to ensure the Proven Track record of the sub vendors and Bidder to take prior approval of BHEL for the same.

12.0.0 DOCUMENTATION:

12.1.0 Master document list

Please refer Annexure-7

1. A master documentation shall be prepared during kick off meeting identifying all the DOCUMENTS / DRAWINGS to be submitted by the bidder as part of documentation.
2. Bidder shall ensure submission of all documentation as per approved Master Document List.
3. Bidder to note that the dates of submission of all the documents shall be finalized by him considering the time required for approval of various documents at Purchaserôs end.
   It shall be solely bidderôs responsibility to get approval on the entire document from purchaser to meet project schedule.

12.2.0 DRAWING APPROVAL / REVIEW CATEGORY:

1) The master document list shall clearly identify the class of review to be performed against each document.
2) Following classes of review shall be followed for all the documents engineered by the bidder

- APPROVAL (A)

Approval is mandatory and bidder cannot proceed without obtaining Purchaserôs approval.

- INFORMATION / RECORDS (I)

This type of documents shall be submitted to Purchaser for his information. Bidder can proceed if Purchaserôs comments are not received within 14 working days of receipt in Purchaserôs office.

However, if any deviation to contract specification for any design deficiency is detected in the course of review after stipulated period, it shall be the responsibility of the bidder to see that such deviations and deficiencies are corrected to ensure compliance to contract without any cost and time implication to purchaser

12.3.0 DRAWINGS REVIEW AND APPROVALS

12.3.1 Bidder to understand that efficient handling of drawings and documents to be prepared by him under the contract is the key to the timely completion of the Pump and drive package. By accepting the contract the bidder undertakes to ensure that all drawings and documents to be submitted by him to the Purchaser / End Customer shall be of professional quality and conforming to the contractual requirements.

12.3.2 Bidder to note that the dates of submission of all the documents shall be finalized by him considering the time required for approval of various documents at Purchaserôs end. It shall be solely bidderôs responsibility to get approval on the entire document from purchaser to meet project schedule.

12.3.3 Computer aided design and drafting shall only be used except in exceptional cases where manual drafting may be resorted to, if unavoidable.

12.3.4 All the dimensions should be in metric units.

12.3.5 Each drawing submitted by the bidder shall be clearly marked with the name of the Owner, the unit designation, the specifications, title, the specification number and the name of the Project with revision

No. and date. If standards, catalogue pages are submitted the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawings shall be in English.

12.3.6 All documents before forwarding to Purchaser will have to be vetted in detail by bidder. Document received without vetting will be returned without review. Also any inaccuracies/mistakes found will not only be rectified by the bidder but the bidder shall remain liable for bearing charges towards efforts spent by Purchaser for discussing the same. Delay owing to these shall be to the account of bidder

12.3.7 The bidder shall thoroughly review and approve all sub-vendor documents, before forwarding to Purchaser

12.3.8 Only the approved drawings duly stamped and signed by a competent engineer of bidder shall be submitted to purchaser for review.

12.3.9 Documents submitted without meeting pre-requisite requirements will be returned without review.

12.3.10 Review of drawings and documents issued by bidder shall be carried out by Purchaser / End customer.

12.3.11 Approval/ review of the drawings/ documents by the Purchaser /End customer would be only limited to the review of compatibility with basic designs and concepts.

12.3.12 The approval and /or review by the Purchaser /End customer shall not be construed by the bidder as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and drawings.

12.3.13 The sole responsibility of the correctness of Design, Engineering shall lie with the bidder, irrespective of the fact that the Drawings / Documents submitted are reviewed or not by the Purchaser /End customer.

12.3.14 The bidder shall correct all faulty designs & constructions detected at any stage of work (irrespective of the fact whether drawings related to such faulty designs & or constructions are approved by purchaser), without any cost and time implication to the Purchaser.

12.3.15 The Bidder shall be responsible for and shall pay for any alterations of the Work to be accrued out by other agencies due to any discrepancies, errors or omissions in the Drawings or other Particulars supplied by him whether such drawings or particulars have been approved by the BHEL/ End customer or not.

12.3.16 Revisions in drawings/documents shall be clearly marked within clouds. No revision without clouding shall be recognized and the same shall not be considered reviewed and approved. All revised drawings / documents shall be associated with comments compliance report,

12.3.17 Normally all drawings / documents shall be reviewed by the purchaser with 14 working days of receipt of drawing at Purchaserôs end. 14 days shall be reckoned from the date of receiving the hard copies of the documents at purchaserôs center.

12.3.18 However, for all documents where multi-disciplinary activity is involved, the bidder, after submission for Purchaserôs review, shall in his own interest, visit Purchaserôs office for discussion for expeditious review of documents.

12.3.19 In absence of visit of bidderôs engineering team at Purchaserôs office approval/review time shall be 15 working days.

12.3.20 During detailed Engineering stage, bidder to furnish list of drawings as per Master Document format (Annexure-7).

12.4.0 NO. OF COPIES OF EACH DOCUMENT TO BE FURNISHED:

All the documents shall be submitted as given below:

SL NO.	DESCRIPTION	NO. OF COPIES / PIECES TO BE SUBMITTED	WHEN TO SUBMIT
1)	Initial drawings/documents under approval and information category.	Soft copy only	Within 2 weeks of placement of order
2)	BHEL shall furnish their observation on submitted documents	Soft copy only	Within 2 weeks of document submission
3)	*Revised drawings/documents incorporating BHELôs comments. ***Vendor to incorporate all BHEL comments so that further revisions can be minimized.**	Soft copy only	Within 1 weeks of receipt of commented Drawings from BHEL

4)	BHEL shall furnish their observation on submitted documents	Soft copy only	Within 2 weeks of document submission
5)	Final Drawings/documents	17	Within 2 months of placement of order.
6)	Erection Documentation	5	1 month before dispatch of equipment. The list of documents identified under master document list for erection to be furnished in 5 noôs of folders
7)	Draft O & M Manuals without test certificates	2	At least 2 months before the delivery date of equipment
8)	Revised O & M Manuals with Test Certificates to be submitted to BHEL (Hyderabad)	17	Within one month before the delivery date of equipment
9)	Final O&M manuals in a CD Also refer annexure-14.	3	Within one month after dispatch of equipment after BHEL concurrence on soft copy.

NOTE:

1) The above schedule for drawings approval is indicative only. Bidder to furnish a bar chart for erection of Pump and drive as per the agreed delivery requirement of project. This schedule also shall indicate drawing submission and approval schedules meeting the delivery schedule of the equipment. Bidder and BHEL shall put all efforts to meet the planned schedules.
2) The O&M manuals shall contain the following as minimum :-
   a) The identification details of the equipment like BHEL P.O. No., Vendorös Job Identification No., full contact address with telephone, fax, & e-mail details.
   b) Brief description of the system.
   c) System unloading, storage erection, start up, commissioning, shut down requirements.
   d) System operating and maintenance requirements.
   e) Operational & environmental safety instructions.
   f) Final data sheets and drawings.
   g) Test reports and certificates.
   h) O&M manuals, catalogues of the equipment & instrumentation.
   i) Recommended 3 years operational spares
3) The draft O&M manual may be submitted without test reports.

13.0.0 CONFLICTS IN SPECIFICATION REQUIREMENTS:

In case of any conflict between this specification and Annexure the most stringent will govern.

14.0.0 DEVIATIONS FROM THE SPECIFICATION:

a) Bidders shall comply with various requirements of this specification. Bidders can bring out only those deviations which are impractical to meet, for our review.
b) In case, bidders are bringing out any deviations to Customer/Consultant specifications, same are acceptable provided these deviations are also regularly accepted by Customer/Consultant for their direct orders on bidders. During detailed engineering stage if it is found that any deviation brought out by bidder is not a regular deviation accepted by Customer/Consultant, the particular deviation brought out by bidder will not be considered as an acceptable deviation.
c) Bidders may please note that unless the deviations are specifically brought out under deviations clause, it will be considered that no deviations are taken, even if they are mentioned elsewhere directly/indirectly in the offer.

15.0.0 PRICE BID FORMAT:

15.1.0 Bidder to indicate his offer as per Price Bid format enclosed as Annexure-5.

All the items included in the price bid format shall be quoted as per tender specification and pre-bid clarifications, if any. Responsibility of ensuring correctness & completeness of scope of supply as per specification requirement solely lies with bidder.

The equipment supplied shall be complete in all respects. The bidder shall not be eligible for any extra payment in respect of such mountings, fittings, fixtures and accessories if required for the safe and reliable operation of the equipment.

Only main items shall be considered for price bid evaluation. Optional items (RO ï rate only) shall not be considered for price bid evaluation, Prices quoted by the bidder shall remain firm till the successful handing over of the Pump package to end customer. Any request for upward revision of price during any intermediate stage before handing over the plant to end customer will be summarily rejected by BHEL.

Bidder to quote only base rates for all the items, Applicable taxes and duties shall be indicated separately.

The Priced Bid shall be submitted in Original (without any copy) duly signed and stamped on each page in a separate sealed envelope super scribing ñPrice Bid ï Do not Openò This shall not contain any condition whatsoever failing which the Bids shall be liable to be rejected. In case of any correction, the bidder shall put its signature and its stamp. Eraser fluid will not be allowed for making any correction. Bidder shall confirm to the un-priced bid as part of their offer.

16.0.0 GENERAL:

Even though, the requirements are specified in detail to the extent possible, bidder to apply good engineering practices in the design, selection of equipment, fabrication, painting, inspection & testing, dispatch of the system, wherever same is not clearly spelt out.

Any additional equipment, material, etc., which are not specifically mentioned here, but are required to make the supplied equipment complete in all respect, in accordance with the intent of this technical specification, contractual agreement, statutory requirements, relevant/applicable codes/standards, good engineering practices, and for safe and trouble-free operation, shall be deemed to be in Bidder scope only.

Compliance with this specification shall not relieve bidder of the responsibility of furnishing material and workmanship to meet the specified conditions. Accordingly, bidder to furnish their comments, if any, on this specification in their offer.

Ref. Doc

17.0.0 ANNEXURES:

Following input documents and specifications are enclosed to facilitate the bidder to furnish the offer and ensure compliance:

Annexure No.	Description
01	Schematic for Vertical Fire water Pumps & piping specifications
02a	BHEL format Pump Data Sheet for Hydrant-Spray water Pump with Motor
02b	BHEL format Pump Data Sheet for Hydrant-Spray water Pump with Diesel Engine
03	BHEL format Motor Data Sheet for Hydrant-Spray water Pump
04	BHEL format Diesel Engine Data Sheet [for Hydrant-Spray water Pump]
05	Price Bid Format for Hydrant-Spray water Pump with Drives.
06	Check List for Hydrant-Spray water Pump
07	BOM Standard Format & Master DOC List Format for Hydrant-Spray water Pump with drives
08	Customer specifications for FIRE PROTECTION SYSTEM & PUMPS
09	Experience Record Proforma
10	Customer specifications for Motor & general electrical requirement
11	Inspection & Testing at Manufacturers works
12	Painting
13	Sub-vendor List
14	Miscellaneous Specification
15	QAP guide Line & Formats

RECORD OF REVISIONS

Rev. No.	Date	Revision Details	Revised By	Approved By
00	02.09.15	FRESH ISSUE	RAVI KANTH	GIRISH

Ref. Doc.

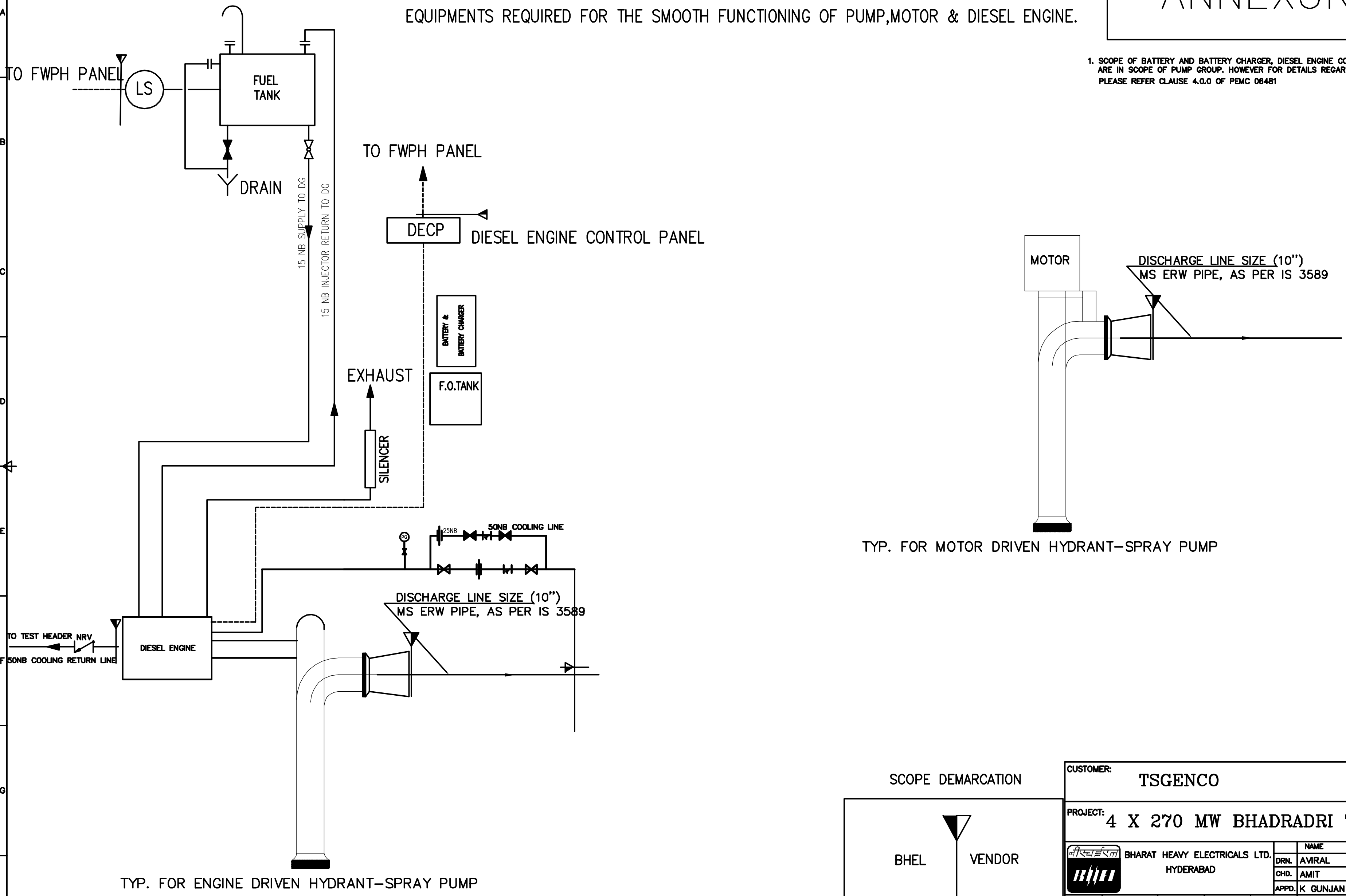
ANNEXURE - 1

SCHEMATICS FOR VERTICAL FIRE WATER PUMPS & SPECIFICATION

ANNEXURE–1

NOTE: THIS IS JUST A TYPICAL SCHEMATIC. BIDDER TO SUPPLY ALL THE NECESSARY EQUIPMENTS REQUIRED FOR THE SMOOTH FUNCTIONING OF PUMP,MOTOR & DIESEL ENGINE.

1. SCOPE OF BATTERY AND BATTERY CHARGER, DIESEL ENGINE CONTROL PANEL, FUEL TANK ARE IN SCOPE OF PUMP GROUP. HOWEVER FOR DETAILS REGARDING SCOPE OF SUPPLY PLEASE REFER CLAUSE 4.0.0 OF PEMC 06481



SCOPE DEMARCATION

BHEL	VENDOR

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY

INVENTORY NO | SIGN. AND DATE | REF. DRG. NO. 13910000138 | COMPUTER FILE NAME 13910103930-S01-R01.DWG

CUSTOMER: TSGENCO

PROJECT: 4 X 270 MW BHADRADRI TPS

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	AVIRAL	–SD–	18.08.15	
CHD.	AMIT	–SD–	18.08.15	N.A.
APPD.	K GUNJAN	–SD–	18.08.15	

DEPT.	UNTOL. DIMS. GR.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PE&SD CODE 450	9/M/Y	N.T.S	N.A.	N.A.	N.A.	N.A.

TITLE: SCHEME FOR HYDRANT AND SPRAY PUMP

CARD CODE: NA

DRG. NO. PESD/BHD/001

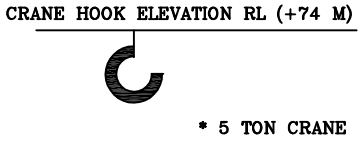
CUST. DRG. NO. ___________

SHT. No 01 | NO. OF SHT. 01

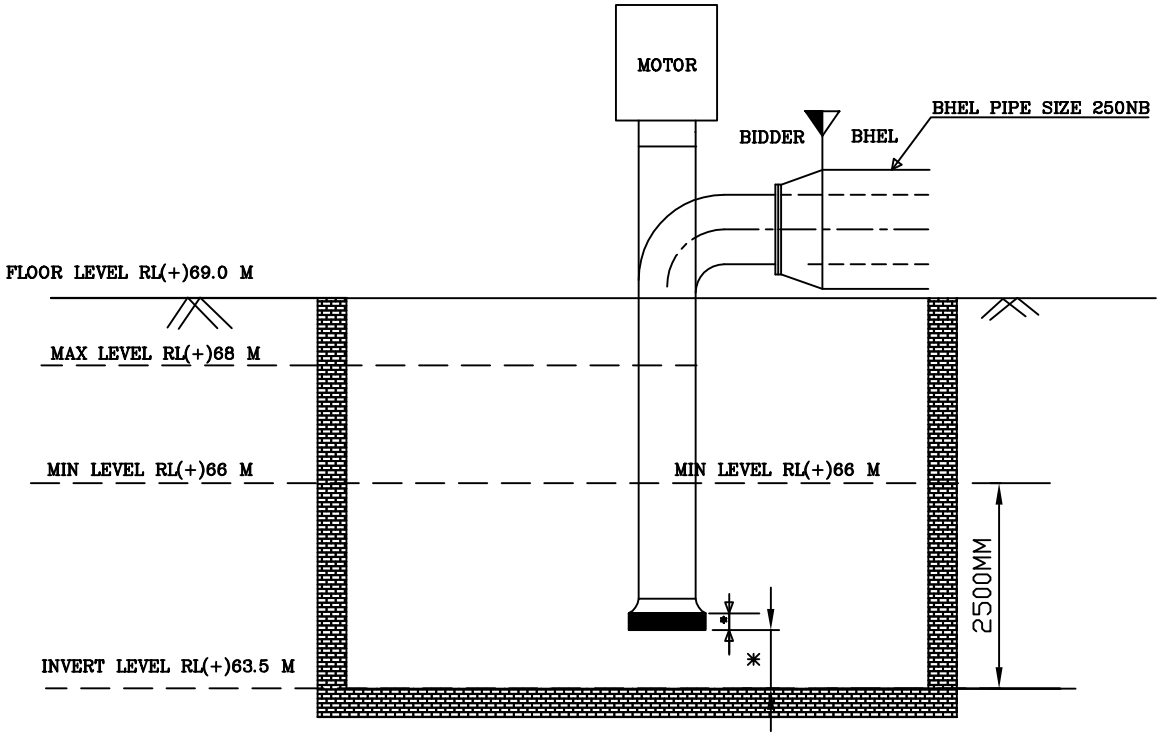
REV. 00

REV.	DATE	ALTERED CHD/APPD	REV.	DATE	ALTERED CHD/APPD	REV.	DATE	ALTERED CHD/APPD	REV.	DATE	ALTERED CHD/APPD	REV.	DATE	ALTERED CHD/APPD	REV.	DATE	ALTERED CHD/APPD	REV.	DATE	ALTERED CHD/APPD	REV.	DATE	ALTERED CHD/APPD
ZONE			ZONE			ZONE			ZONE			ZONE			ZONE			ZONE			ZONE		

MOTOR DRIVEN PUMP



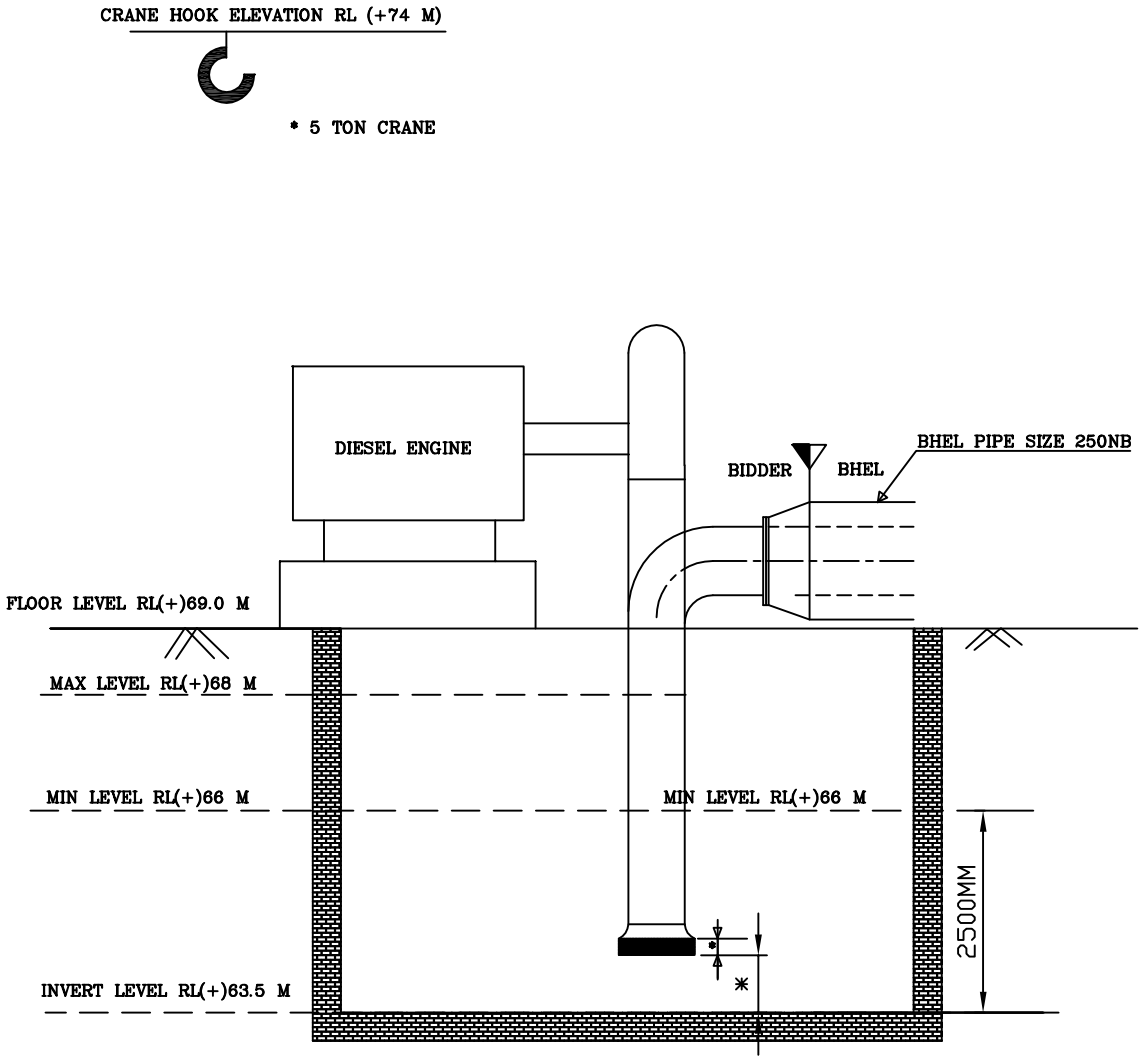
* 5 TON CRANE



Note : a) Bidder to select Pump such that the Min submergence level lies below the Min level.
b) Bidder to confirm that the Pump can be lifted with the given crane hook level elevation.
C) Crane capacity is 5 Ton for maintenance of the Pumps. Bidder to Comment.

* Bidder to furnish.

DIESEL ENGINE DRIVEN PUMP



Note : a) Bidder to select Pump such that the Min submergence level lies below the Min level.
b) Bidder to confirm that the Pump can be lifted with the given crane hook level elevation.
C) Crane capacity is 5 Ton for maintenance of the Pumps. Bidder to Comment.

* Bidder to furnish.

ANNEXURE - 2

VERTICAL FIRE WATER PUMPS DATA SHEETS

CUSTOMER: TSGENCO
PROJECT:4 x 270 MW BHADRADRI THERMAL POWER STATION
CONSULTANT: M/S DEISEIN INDIA PVT LTD

DATA SHEET FOR HYDRANT-SPRAY PUMP - MOTOR DRIVEN

Sl.no	Description	BHEL Requirement (if any)	<Bidder's> Offer
GENERAL DATA			
1	Service	**Hydrant Pump** : For supplying water to Hydrant header from the fire water storage tank. **Spray Pump**: For supplying the water to the spray water system from the Fire water storage sump.	
2	Variant No.	45 for Pump with Motor , 50 for Mandatory spares of Pump with Motor	
3	BHEL Material code	PY9751150450 for Pump & Motor PY9751150507 for Mandatory spare	
4	Number of Pumps	5 nos	
5	Location	Indoor, Fire Cum Clarified Water Pump House	
6	Duty	Intermittent	
7	Drive	Motor	
8	Pumping fluid	water	
9	Fluid Operating Temperature	Ambient [Refer site details as mentioned in spec clause no 7.4.0 PEMC 06481	
10	Elevation for top of intake structure ie. FFL	RL (+) 69.0 M	
11	Elevation of sump invert level	RL (+) 63.5 M	
12	Sump depth (Top of intake structure to sump invert level)	5.5 M	
13	Pump bell mouth [bottom] level from sump invert level	Bidder to furnish	
14	Pump Strainer [bottom] level from sump invert level	Bidder to furnish	
15	Pump first stage impeller eye level from sump invert level	Bidder to furnish	
16	Pump internal losses (assumed)	0.5 MWC. Bidder to furnish exact data	
17	Elevation of sump minimum water level	RL (+) 66.0 M	
Add	Elevation of sump maximum water level	RL (+) 68.0 M	
18	Elevation of minimum submergence level	Bidder to Furnish	
Add	Crane hook level	RL (+) 74.0 M. Bidder comment on the crane hook level	
CONSTRUCTION FEATURES OF PUMP			
19	Pump Type	Centrifugal, Vertical Turbine Type	
20	Pump Model No.	Bidder to furnish	
21	No. of Stages of pump	Bidder to furnish	
22	Rated Speed of Pump (rpm)	1500 rpm	
23	Rated speed of drive (rpm)	1500 rpm	
24	Design Standard of pump	HIS/IS 5120/ Equivalent standard as per Customer Spec. The pumps shall comply with the regulations of Tariff Advisory Committee (TAC)/LPA and National Fire Protection Association (NFPA), USA as applicable.	
25	Sealing arrangement	Mechanical seal as per Manufacturer's Standard	
26	Suction Specific Speed at rated flow	Bidder to furnish	
27	Type of axial thrust balancing arrangement	Note:Axial thrust balancing device to be designed for pump shut-off operation	
28	Type of main bearings for pump	Bidder to furnish	
29	Main bearings lubrication		
30	Type of thrust bearings for pump		
31	Thrust bearing lubrication		

Sl.no	Description	BHEL Requirement (if any)	<Bidder's> Offer
	Note: 1) Water for motor cooling and bearing cooling, if required, shall be tapped from the discharge of the pumps. All piping, valves, strainer, instruments etc. required for this purpose shall be provided by the vendor.		
32	Direction of rotation of Pump	Bidder to furnish	
33	Direction of rotation of Motor	Bidder to furnish	
34	Design pressure of suction side Kg/cm2	Bidder to furnish	
35	Casing Mounting	Bidder to furnish	
MATERIAL OF CONSTRUCTION			
36	Casing : 2.5% Ni CI as per IS:210 Gr.FG 260 Casing liner : 2.5% Ni CI as per IS:210 Gr. FG 260 Impeller : ASTM - A 743 GR. CF 8 M Wearing rings : SS-304 Pump shaft : AISI 410(Hardened) Gland : 2.5% Ni CI as per IS:210 Gr.FG 260 Base plate : Carbon Steel as per IS-2062 Wetted Fasteners : SS-316 Mechanical Seal : As per Manufacturer's Standard Companion Flange : ASTM A105		
COUPLING			
37	Flexibile coupling standard	Manufacturer Standard	
38	Type of coupling	Metallic, non-lubricated, flexible element type (i.e. either diaphragm or disc type) with spacer	
39	Non sparking type couplign guard	Yes	
40	Service factor for the coupling	1.5	
FORCED LUBE OIL SYSTEM(Not Applicable)			
41	LO system applicable [Yes/No]		
42	LO System Standard(If Applicable)	As per Manufacturing Standard	
43	LO System capacity	lpm	
44	415V AC power for AOP	kw	
45	415V AC power for heater	kw	
46	Lube oil requirement of motor, lpm (If required)	Bidder to furnish	
GEAR BOX			
47	Not Applicable.		
FLUSHING & COOLING PLANS [if applicable]			
48	Flushing Plan - API-610 plan no.		
49	SS 316 piping provided for flushing plan		
50	Cooling Water Quantity-Pump	Refer Note below	
51	Cooling Water Quantity-Los kid	Refer Note below	
52	Cooling Water Quantity- Motor	Refer Note below	
53	Cooling Plan (API-610 plan no.)	Refer Note below	
54	Coolign water supply parameters	Refer Note below	
	Note:Cooling water for pump & motor bearing, if required, shall be tapped from the discharge of the pumps. All piping, valves, strainer, instruments etc. required for this purpose shall be provided by the vendor.		
55	**ARC VALVE**	Not applicable	
SUCTION STRAINER			
56	Suction strainer at Bell Mouth	As per the manufaturer's standard	
VIBRATION MONITORING PROBES & REVERSE ROTATION MONITORING SYSTEM			
57	Not Applicable	However bidder to provide provision for vibration probes as per clause no 4.10.0 of PEMC-06481	
BEARING & WINDING RTD'S AND TEMPERATURE GAUGES			

Sl.no	Description	BHEL Requirement (if any)	<Bidder's> Offer
58	Bearing & Winding RTD's and Temperature Gauges	Applicable. Refer Clause no 4.11.0 of PEMC-06481	
PUMP PERFORMANCE CURVE			
59	Parallel operation	Yes	
60	Pump rated head	105 mlc	
61	Pump shut off head	Shall be continuously rising towards shut-off head.	
62	Pump shut off head/rated head	The shutoff head shall not exceed 140 % inclusive of all tolerances	
63	BEP of the offered pump, M3/Hr	Bidder to furnish	
64	Thermal minimum flow , m3/Hr	Bidder to furnish	
65	Stable minimum flow, m3/Hr	Refer Note below	
	Note:minimum continuous stable flow without exceeding the vibration limits as stipulated in HIS.		
66	Preferred operating range	25% to 130%	
67	Allowable operating range	Bidder to furnish	
68	Pump End of the curve flow, m3/hr	Bidder to furnish	
69	Impller type	Semi open	
70	Pump rated impeller dia, mm	Bidder to furnish	
71	Pump max. impeller dia, mm	Bidder to furnish	
72	Min. 5% head rise possible	As per API guide lines	
73	Pump minimum impeller dia., mm	Bidder to furnish	
74	BLO flow	NA	
75	BLO pressure	NA	
76	BLO safety valve set pressure	NA	
77	Suction safety valve set pressure	NA	
78	Dry critical speed	rpm	
79	Wet critical speed	rpm	
80	GD2 value pump	Kgm^2	
81	GD2 value coupling	Kgm^2	
82	Weight Kg - Pump + base plate - Strainer - Drive - LO Skid[if applicable]	Bidder to furnish	
DRIVE RATING			
83	Drive	Motor	
84	BKW at the rated point	Bidder to furnish	
85	BKW at end of curve	Bidder to furnish	
86	Selected drive rating, KW	Bidder to furnish	
87	Slected drive rating:	Drive Unit Power rating for the fire water pumps shall be selected such that it is equal to higher of the two conditions: i) 110% of the duty point power requirement. ii) Motor input power required at 150% of the duty point capacity of pump Motor shall be suitable for pump starting with discharge valve fully open.	
88	Selected drive rating meets BKW at end of curve		
PUMP DESIGN PARAMETERS			
	Rated condition		
89	Flow (m^3/hr)	410 m^3/hr	
90	Differential Head (mlc)	105 mlc	
	Note: Pumps shall be capable of furnishing not less than 150 % of rated capacity at a head of not less than 65 % of the rated head.		

Sl.no	Description	BHEL Requirement (if any)	<Bidder's> Offer
91	Temperature of pumping fluid	Ambient [Refer site details as mentioned in spec clause no 7.2.0 PEMC 06481	
92	Density of pumping fluid	Ambient [Refer site details as mentioned in spec clause no 7.2.0 PEMC 06481	
93	Efficiency (Hot & Cold) %	Bidder to furnish	
	Note:Negative tolerance on efficiency of pump at rated capacity is not acceptable.		
94	Available Pressure at centre line of Suction nozzle of Pump	10.36 mwc	
95	NPSH(A) at pump suction nozzle(mlc)	9.39 mwc	
96	NPSH(R) (mlc)	Bidder to furnish	
97	NPSH(A) - NPSH(R)	Minimum 1 m of margin between NPSH(A) & NPSH(R) to be maintained up to 150% of rated flow.	
98	Pump BKW (Hot & Cold) kw	Bidder to furnish	
NOISE LEVEL & VIBRATION LEVEL			
99	Noise level	85 DBA at 1.5 m distance, in any direction for complete train	
100	Vibration	As per specification	
PERFORMANCE TEST STANDARD			
101	Performance test standard	As Per enclosed specification & for tolerance please refer Sl. No. 8.3.0 of PEMC-06481	
102	Maximum Allowed Working Pressure	Kg/cm^2 g, Bidder to furnish	
103	Max. Allowed Casing Pressure $Kg/cm^2(g)$	Kg/cm^2 g, Bidder to furnish	
104	Hydraulic test pressure of casing $Kg/cm^2(g)$	Kg/cm^2 g, Bidder to furnish	
EQUIPMENT QUALIFICATION CRITERIA			
105	Duly filled in Equipment Qualification Criteria	As per relevant clause of PEMC-06481	
INTERCONNECTING PIPING & INSTRUMENTATION & JUNCTION BOXES			
106	Scope of Piping and instruments considered in line with P&I D	As Per P & ID (Annexure-1)	
107	MOC of piping considered in line with P&I D	As Per P & ID (Annexure-1)	
108	Required expanders/Reducers & counter flanges considered at all the terminal points in line with P&I D	As Per P & ID (Annexure-1)	
109	Junction boxes	As per PEMC - 06481	
110	Pump Suction nozzle - Size - Rating - Standard - Facing - Location	Bidder to specify	
111	Pump Discharge nozzle - Size - Rating - Standard - Facing - Location	Bidder to specify	
112	ARC valve inlet/outlet/recirculation sizes - Size - Rating - Standard - Facing - Location	NA	

Sl.no	Description	BHEL Requirement (if any)	<Bidder's> Offer
113	BLO nozzle - Size - Rating - Standard - Facing - Location	NA	
114	Pump Cooling water inlet/outlet sizes - Size - Rating - Standard - Facing - Location	Bidder to specify	
115	LO Skid Cooling water inlet/outlet sizes(if applicable) - Size - Rating - Standard - Facing - Location	Bidder to specify	
116	BHEL Pipe size-suction	Refer Annexure-1	
117	BHEL Pipe size-discharge	Refer Annexure-1	
118	Vent/Drain connection		
ADDITIONAL REQUIREMENTS			
119	Lateral Analysis	NA	
120	Torsional Analysis	NA	
PAINTING			
121	Painting	As per PEMC - 06481	
PACKING AND FORWARDING			
122	Packing & Forwarding	As per PEMC - 06481	
Sub vendors			
123	Sub vendors	As per PEMC - 06481	
Deviations from spec			
124	All the deviations offered.		

CUSTOMER: TSGENCO
PROJECT:4 x 270 MW BHADRADRI THERMAL POWER STATION
CONSULTANT: M/S DEISEIN INDIA PVT LTD

DATA SHEET FOR HYDRANT-SPRAY WATER PUMP - DIESEL ENGINE DRIVEN

Sl.no	Description	BHEL Requirement (if any)	<Bidder's> Offer
GENERAL DATA			
1	Service	For supplying water to Hydrant header from the fire water storage Sump	
2	Variant No.	46 for Pump with Diesel Engine , 50 for Mandatory spares of Pump with Diesel Engine	
3	BHEL Material code	PY9751150469 for Pump & Diesel Engine PY9751150507 for Mandatory spare	
4	Number of Pumps	3 nos	
5	Location	Fire Cum Clarified Water Pump House	
6	Duty	Intermittent	
7	Drive	Diesel Engine	
8	Pumping fluid	water	
9	Fluid Operating Temperature	Ambient [Refer site details as mentioned in spec clause no 7.4.0 PEMC 06481	
10	Elevation for top of intake structure ie. FFL	RL (+) 69.0 M	
11	Elevation of sump invert level	RL (+) 63.5 M	
12	Sump depth (Top of intake structure to sump invert level)	5.5 M	
13	Pump bell mouth [bottom] level from sump invert level	Bidder to furnish	
14	Pump Strainer [bottom] level from sump invert level	Bidder to furnish	
15	Pump first stage impeller eye level from sump invert level	Bidder to furnish	
16	Pump internal losses (assumed)	0.5 MWC	
17	Elevation of sump minimum level	Refer Annexure-1	
Add	Elevation of sump maximum water level	RL (+) 68.0 M	
18	Elevation of minimum submergence level	Refer Annexure-1	
Add	Crane hook level	RL (+) 74.0 M. Bidder comment on the crane hook level	
CONSTRUCTION FEATURES OF PUMP			
19	Pump Type	Centrifugal Vertical Turbine Type	
20	Pump Model No.	Bidder to furnish	
21	No. of Stages of pump	Bidder to furnish	
22	Rated Speed of Pump (rpm)	1500 rpm	
23	Rated speed of drive (rpm)	<2300 rpm	
24	Design Standard of pump	HIS/IS 5120/ Equivalent standard as per Customer Spec. The pumps shall comply with the regulations of Tariff Advisory Committee (TAC)/LPA and National Fire Protection Association (NFPA), USA as applicable.	
25	Sealing arrangement	Mechanical seal as per Manufacturer's Standard	
26	Suction Specific Speed at rated flow	Bidder to furnish	
27	Type of axial thrust balancing arrangement	Note:Axial thrust balancing device to be designed for pump shut-off operation	
28	Type of main bearings for pump	Bidder to furnish	
29	Main bearings lubrication		
30	Type of thrust bearings for pump		
31	Thrust bearing lubrication		
	Note: 1) Water for bearing cooling, if required, shall be tapped from the discharge of the pumps. All piping, valves, strainer, instruments etc. required for this purpose shall be provided by the vendor. Refer Annexure-1		
32	Direction of rotation of Pump	Bidder to furnish	

Sl.no	Description	BHEL Requirement (if any)	<Bidder's> Offer
33	Direction of rotation of Diesel Engine	Bidder to furnish	
34	Design pressure of suction side Kg/cm2	Bidder to furnish	
35	Casing Mounting	Bidder to furnish	
MATERIAL OF CONSTRUCTION			
36	Casing : 2.5% Ni CI as per IS:210 Gr.FG 260 Casing liner : 2.5% Ni CI as per IS:210 Gr. FG 260 Impeller : ASTM - A 743 GR. CF 8 M Wearing rings : SS-304 Pump shaft : AISI 410(Hardened) Gland : 2.5% Ni CI as per IS:210 Gr.FG 260 Base plate : Carbon Steel as per IS-2062 Wetted Fasteners : SS-316 Mechanical Seal : As per Manufacturer's Standard Companion Flange : ASTM A105		
TYPE OF COUPLING			
37		Gear drive conforming to approval standard of Factory Mutual system or right angled gear drive class no 1338 hall to be used between pump & Diesel engine.	
FORCED LUBE OIL SYSTEM(Not Applicable)			
38	LO system applicable [Yes/No]		
39	LO System Standard(If Applicable)	As per Manufacturing Standard	
40	LO System capacity	lpm	
41	415V AC power for AOP	kw	
42	415V AC power for heater	kw	
43	Lube oil requirement of Diesel Engine, lpm(If required)		
GEAR BOX			
44	Not Applicable.		
FLUSHING & COOLING PLANS [if applicable]			
45	Flushing Plan - API-610 plan no.		
46	SS 316 piping provided for flushing plan		
47	Cooling Water Quantity-Pump	Refer Note below	
48	Cooling Water Quantity-Los kid	Refer Note below	
49	Cooling Water Quantity- Diesel Engine	Refer Note below	
50	Cooling Plan (API-610 plan no.)	Refer Note below	
51	Coolign water supply parameters	Refer Note below	
	Note:The Contractor shall clearly indicate in his offer the type of cooling system adopted. In case fire water is used as a cooling media by tapping of the water from the fire water pump discharge (before the pump discharge valve), the capacity of the fire pump shall be increased, so that the net capacity meets the specification requirement.. All piping, valves, strainer, instruments etc. required for this purpose shall be provided by the vendor.		
52	ARC VALVE	Not Applicable	
SUCTION STRAINER			
53	Suction strainer at Bell Mouth	As per the manufacturer's standard	
VIBRATION MONITORING PROBES & REVERSE ROTATION MONITORING SYSTEM			
54	Not Applicable	However bidder to provide provision for vibration probes as per clause no 4.10.0 of PEMC-06481	
BEARING & WINDING RTD'S AND TEMPERATURE GAUGES			
55	Bearing & Winding RTD's and Temperature Gauges	Applicable. Refer Clause no 4.11.0 of PEMC-06481	
PUMP PERFORMANCE CURVE			
56	Parallel operation	Yes	
57	Pump rated head	105 mlc	
58	Pump shut off head	Shall be continuously rising towards shut-off head.	
59	Pump shut off head/rated head	The shutoff head shall not exceed 140 %.	

Sl.no	Description	BHEL Requirement (if any)	<Bidder's> Offer
60	BEP of the offered pump, M3/Hr		
61	Thermal minimum flow , m3/Hr		
62	Stable minimum flow, m3/Hr	Refer Note below	
	Note:minimum continuous stable flow without exceeding the vibration limits as stipulated in HIS.		
63	Preferred operating range	25% to 130%	
64	Allowable operating range	Bidder to furnish	
65	Pump End of the curve flow, m3/hr	Bidder to furnish	
66	Impller type	Semi open	
67	Pump rated impeller dia, mm	Bidder to furnish	
68	Pump max. impeller dia, mm	Bidder to furnish	
69	Min. 5% head rise possible	As per API guide lines	
70	Pump minimum impeller dia., mm	Bidder to furnish	
71	BLO flow	NA	
72	BLO pressure	NA	
73	BLO safety valve set pressure	NA	
74	Suction safety valve set pressure	NA	
75	Dry critical speed	rpm	
76	Wet critical speed	rpm	
77	GD2 value pump	Kgm^2	
78	GD2 value coupling	Kgm^2	
79	Weight Kg - Pump + base plate - Strainer - Drive - LO Skid[if applicable]	Bidder to furnish	
DRIVE RATING			
80	Drive	Diesel Engine	
81	BKW at the rated point	Bidder to furnish	
82	BKW at end of curve	Bidder to furnish	
83	Selected drive rating, KW	Bidder to furnish	
84	Slected drive rating:	Engines, after correction for altitude and ambient temperature, shall have bare engine horsepower rating [at its duty point at rated R.P.M] equivalent to the higher of the following two values. a) 20 % in excess of the maximum brake horsepower required to drive the pump at its duty point. b) The brake horsepower required driving the pump at 150 % of its rated discharge.	
85	Selected drive rating meets BKW at end of curve		
PUMP DESIGN PARAMETERS			
	Rated condition		
86	Flow (m^3/hr)	410 m^3/hr	
87	Differential Head (mlc)	105 mlc	
	Note: Pumps shall be capable of furnishing not less than 150 % of rated capacity at a head of not less than 65 % of the rated head.		
88	Temperature of pumping fluid	Ambient [Refer site details as mentioned in spec clause no 7.2.0 PEMC 06481	
89	Density of pumping fluid		
90	Efficiency (Hot & Cold) %		
	Note:Negative tolerance on efficiency of pump at rated capacity is not acceptable.		
91	Available Pressure at centre line of Suction nozzle of Pump	10.36 mwc	
92	NPSH(A) at pump suction nozzle(mlc)	9.39 mwc	
93	NPSH(R) (mlc)		
94	NPSH(A) - NPSH(R)	Minimum 1 m of margin between NPSH(A) & NPSH(R) to be maintained.	
95	Pump BKW (Hot & Cold) kw	Bidder to furnish	

Sl.no	Description	BHEL Requirement (if any)	<Bidder's> Offer
NOISE LEVEL & VIBRATION LEVEL			
96	Noise level	105 DBA at 1.5 m distance, in any direction for complete train	
97	Vibration	As per specification	
PERFORMANCE TEST STANDARD			
98	Performance test standard	As Per enclosed specification & for tolerance please refer Sl. No. 8.3.0 of PEMC-06481	
99	Maximum Allowed Working Pressure	Kg/cm^2 g	
100	Max. Allowed Casing Pressure $Kg/cm^2(g)$	Kg/cm^2 g	
101	Hydraulic test pressure of casing $Kg/cm^2(g)$	Kg/cm^2 g	
EQUIPMENT QUALIFICATION CRITERIA			
102	Duly filled in Equipment Qualification Criteria	As per relevant clause of PEMC-06481	
INTERCONNECTING PIPING & INSTRUMENTATION & JUNCTION BOXES			
103	Scope of Piping and instruments considered in line with P&I D	As Per P & ID (Annexure-1)	
104	MOC of piping considered in line with P&I D	As Per P & ID (Annexure-1)	
105	Required expanders/Reducers & counter flanges considered at all the terminal points in line with P&I D	As Per P & ID (Annexure-1)	
106	Junction boxes	As per PEMC - 06481	
107	Pump Suction nozzle - Size - Rating - Standard - Facing - Location	Bidder to specify	
108	Pump Discharge nozzle - Size - Rating - Standard - Facing - Location	Bidder to specify	
109	ARC valve inlet/outlet/recirculation sizes - Size - Rating - Standard - Facing - Location	NA	
110	BLO nozzle - Size - Rating - Standard - Facing - Location	NA	
111	Pump Cooling water inlet/outlet sizes - Size - Rating - Standard - Facing - Location	Bidder to specify	

Sl.no	Description	BHEL Requirement (if any)	<Bidder's> Offer
112	LO Skid Cooling water inlet/outlet sizes(if applicable) - Size - Rating - Standard - Facing - Location	Bidder to specify	
113	BHEL Pipe size-suction	Refer Annexure-1	
114	BHEL Pipe size-discharge	Refer Annexure-1	
115	Vent/Drain connection		
ADDITIONAL REQUIREMENTS			
116	Lateral Analysis	NA	
117	Torsional Analysis	NA	
PAINTING			
118	Painting	As per PEMC - 06481	
PACKING AND FORWARDING			
119	Packing & Forwarding	As per PEMC - 06481	
Sub vendors			
120	Sub vendors	As per PEMC - 06481	
Deviations from spec			
121	All the deviations offered.		

ANNEXURE - 3

VERTICAL FIRE WATER PUMPS – MOTOR DATA SHEETS

CUSTOMER: TSGENCO

PROJECT:4 x 270 MW BHADRADRI THERMAL POWER STATION

CONSULTANT: M/S DEISEIN INDIA PVT LTD

DATA SHEET FOR MOTOR OF HYDRANT- SPRAY WATER PUMP

Sl.no.	Description	BHEL Requirement (if any)	<Bidder's> Offer
1	Application	To drive Hydrant Pump & Spray water Pump	
2	No of Units	5 nos	
3	Manufacturer		
4	Type of Motor	Motors shall be general purpose, constant speed, squirrel cage, three/single phase,	
5	Specification & codes	IS-325/ IS-12615/ IEC-60034, duly taking into consideration of enclosed BHEL & Customer / Consultant specification. Design and construction of the Motor shall be guided by the TAC/LPA recommendations.	
6	Designation & Frame size		
7	Mounting	Vertical	
8	Motor weight [Kg]		
9	Motor GD Sq. Kgm sq		
10	Service Factor		
11	Motor Rating		
12	Phase	3 - Phase	
13	LO System Standard(If required)		
14	**Rated values:**		
	a)Voltage	6.6 kV	
	b)Frequency	50 Hz	
15	**Permissible variations:**		
	a)Voltage	(+/-)/10%	
	b)Frequency	(+)3% to (-)5%	
	c)Combined	10% (absolute sum)	
16	Permissible unbalance in supply voltage		
17	No of poles / synchronous speed	As per Manufacturer recommendations	
18	**Supply system Fault level:**		
	a)LT Motors	~~50 kA for 1 sec~~	
	b)HT Motors	40 kA for 1 sec	
19	Duty cycle	Continuous & shall also be suitable for long period of inactivity.	
20	Installation	Fire water pump house, Indoor However, Motor shall be of weather-proof construction with canopy.	
21	**Power factor:**		
	a)Rated Power factor		
	b)Power Factor during Starting		
	c)Power factor at 100%Load		
	d)Power factor at 75% Load		
	e)Power factor at 50% Load		
22	**Efficiency:**		
	a)Efficiency at 100%Load		
	b)Efficiency at 75% Load		
	c)Efficiency at 50% Load		

Sl.no.	Description	BHEL Requirement (if any)	<Bidder's> Offer
23	**Time:**		
	a)Time to attend Full speed @ Full load		
	b)Time to attend Full speed @ without load		
	c)Safe stall time under Hot/cold condition @ 100% of rated voltage		
	d)Safe stall time under Hot/cold condition @ 110% of rated voltage		
	e)Locked rotor wuth stand time hot/cold @ 80% of rated voltage		
	f)Locked rotor wuth stand time hot/cold @ 100% of rated voltage		
	g)Locked rotor wuth stand time hot/cold @ 110% of rated voltage		
	h)Starting Time with 100%/80% V with Load		
	i)Starting Time with 100%/80% V without Load		
	j)Hot thermal withstand time at 110% of the rated voltage		
	k)No of Consucutive Hot start		
24	Full load current [Amps]		
25	Starting Current as % of FLC	600% subject to IS tolerance.	
26	Method of Starting	DOL	
27	Ambient Temperature	For the purpose of equipment design, reference ambient temperature shall be taken as 50°C. Other site conditions shall be as indicated in the Lead Specification	
28	**Insulation:**		
	a)Class of Insulation	Class F	
	b)Temp. rise by resistance method	Temperature rise ltd. to class B	
29	Type of Cooling		
30	Method of cooling	The motor shall be self ventilated type, either totally enclosed fan cooled IC 411(TEFC), totally enclosed tube ventilated IC 511(TETV) or closed air circuit air- cooled IC 611(CACA). For large capacity motors not available with above type of cooling may be accepted with IC 81W or IC 91W, closed air circuit water cooled (CACW) subject to the approval of the owner.	
31	Area classification for motor	Safe Area	
32	**Earthing Conductors:**	As per Specification	
	a)Material		
	b)Size [mm]		
33	Shaft orientation & mounting symbol		
34	**Bearing:**		
	a)Make		
	b)Type of DE bearing		
	c)Type of NDE bearing		
	d)Permissible temp rise for bearing [Deg C]		
	e)Type of lubrication of Bearing		

Sl.no.	Description	BHEL Requirement (If any)	<Bidder's> Offer
	Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Bearings shall be rated for minimum service life of 40,000Hrs.Further Details pls refer to specifications of Motor.		
35	Vibration Level	The maximum double amplitude vibrations for HT motors upto 1500 rpm shall be 25 microns and 15 microns upto 3000 rpm. For 415V motors, maximum double amplitude vibrations upto 1500 rpm shall be 40 microns and 15 microns upto 3000 rpm	
All HT motors shall be provided with vibration pads for mounting of vibration detectors. Vibration monitoring devices shall be provided on DE and NDE side in x&y direction with remote DCS monitoring, alarm and tripping			
36	Permissible vibration limits [Mm/sec]		
37	Whether CTs required for differential protection		
38	Degree of Protection	IP 55	
39	Rotation as seen from non driven end		
40	Dierction of rotation	All motors shall be suitable for bi-directional rotation.	
41	Full Load Current/No load current		
42	Full load Speed		
43	**Torque:**		
	a)Full Load Torque Kg.m	a) Bidder to furnish [Refer Note-4]	
	b)Starting Torque as % of full load torque	b)Minimum 110%	
	c)Pull Out Torque as % of full load Torque		
44	**Terminal Box:**		
	a)Degree of protection	IP 55	
	b)Short time-Current [kA-RMS]		
	c)Short time-Time [Sec]	0.25	
	d)Dynamic[kA-Peak]		
	e)Terminal Box location	As per specification	
	Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. for HT motors. For details pls refer specification.		
45	**Cable Details:**	During Detailed engg.	
	a)Type		
	b)Size		
	c)No. of cores		
46	**Winding:**		
	a)Starter Winding connection during continuous running		
	b)Type & No. of Terminals		
	c)Recommended temperature setting for stator winding [Alarm]		
	d)Recommended temperature setting for stator winding [Trip]		
47	**Space Heater:**	Required for all motors above 30kw	
	a)No & location		
	b)Volt & KW rating	240 V	
	c)Cable details	During Detailed engg.	
	Note: Motors of rating 30 kW and above shall be provided with space heaters, suitably located for easy removal or replacement. The space heater shall be rated for 240 V, single phase, 50 Hz, and sized to maintain the motor internal temperature above dew point when the motor is idle.		
48	Separate terminal boxes shall be provided for space heaters, resistance temperature detectors and vibration probes, neutral point of the star windings	To be provided by Bidder	

CUSTOMER: TSGENCO

PROJECT:4 x 270 MW BHADRADRI THERMAL POWER STATION

CONSULTANT: MAYDEISEIN INDIA PVT LTD

Sl.no.	Description	BHEL Requirement (if any)	<Bidder's> Offer
49	12 nos simplex RTDs for winding temperature detection [4 nos per phase]		
50	2 nos duplex RTDs for bearing temperature detection		
51	Dual dial type temperature indicator for bearings		
52	Grounding Pads on Motor Body/TB	The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer	
53	Vibration monitoring system	Not Applicale. Only provision shall be provided as per specification.	
54	**Voltage:** a)Minimum permissible voltage during starting at FL		
	b)Minimum permissible voltage for 5 mnt running without over heating		
55	**Losses:** a)Friction,Windage & stray losses (kw)		
	b)Copper loss (kw)		
	c)Iron loss (kw)		
	d)Guaranted losses (kw)		
56	Painting	The painting of all electrical equipment shall be as follows: Epoxy based with suitable additives. The thickness of finish coat shall be minimum 80 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 80 microns shall be acceptable for finish coat. Paint shade shall be as per Customer specification.	
57	Energy efficient class	Motors efficiency class shall be IE1, IE2 as per latest version of IEC-60034 as per Customer Specification.	
58	Noise level	85 DBA at 1.5 m distance, in any direction for complete train	
59	Treatment against rust and corrosion		
60	Suitable Cable Glands	To be provided by Bidder	
	Cable lugs	To be provided by Bidder	
	Note: Cable lugs and Cable glands shall be supplied by vendor along with the main equipment for all the cables (including BHEL cables and vendor cables) being terminated at motor end. Glands shall be Flame proof/wweather proof (as per motor category) double compression type Nickel plated Brass(ET) shall be provided with back nut and PVC shroud Lugs shall be tinned copper heavy duty lug Cable dimensions shall be furnished during detail engineering, accordingly glands, lugs shall be supplied		
61	No. of Starts	Two hot starts in succession with motor initially at normal runningtemperature.	

CUSTOMER: TSGENCO

PROJECT:4 x 270 MW BHADRADRI THERMAL POWER STATION

CONSULTANT: MADEISEIN INDIA PVT LTD

Sl.no.	Description	BHEL Requirement (If any)	<Bidder's> Offer
62	Tests	Routine and Type Tests are to be conducted in presence of customerôs representative as per IS:325 and in addition,any special test called for in the driven equipment specification shall be performed and required copies of test certificates are to be furnished for approval.	
63	Tropicalisation	All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.	
64	All performance figures are subject to tolerance		
65	Thermal characteristics,Starting characteristics & negative sequence characteristics to be furnished.		
66	Dimesional drawing to be furnished.		

Notes:

1. Separate Data Sheets shall be furnished for each category of motors - hard copy duly signed and with seal shall be furnished along with the offer. Soft copy shall shall also be furnished.
2. Data sheets in end customer formats also shall be furnished separately.
3. Bidder to fill up the column for bidder's data completely. Only for items like capability parameters, if not specified by BHEL, shall be indicated as "NA". Bidder to indicate his details wherein "<Bidder.....>" is indicated above.
4. The requirement for vacant spaces left in column for 'BHEL Requirement' shall be considered as per BHEL specification and subsequent correspondences. Only certain special requirements have been indicated in the 'BHEL Requirement' column.

ANNEXURE - 4

VERTICAL FIRE WATER PUMPS – DIESEL ENGINE DATA SHEETS

DATA SHEET for <Bidder to indicate>

Bidder's Offer No. & Dt. : <Bidder to indicate>
Bidder's Name : <Bidder to indicate>
Bidder's Doc. Rev. No. & Dt. :<Bidder to indicate>
BHEL Enq. No. :<Bidder to indicate>
BHEL Enq. Date : <Bidder to indicate>

Sl.no.	Description	BHEL Requirement (if any)	<Bidder's> Offer
1	Name of Manufacturer		
2	Model Reference		
3	Duty	Intermittent	
4	Type	Compression ignition, mechanical direct injection, multi cylinder and four stroke cycle and cold starting type etc. as per clause no 4.4.0 of PEMC-06481	
4	Drive Standard	IS -10000, BS- 5514 and as per standard practice of diesel engine manufacturerôs association of USA. Design and construction of the diesel engine shall be guided by the TAC/LPA recommendations.	
5	Site output rating of Engine BHP	Engines, after correction for altitude and ambient temperature, shall have bare engine horsepower rating [at its duty point at rated R.P.M] equivalent to the higher of the following two values. a) 20 % in excess of the maximum brake horsepower required to drive the pump at its duty point. b) The brake horsepower required driving the pump at 150 % of its rated discharge.	
7	Derating factors for site conditions applicable on standard engine rating		
	a) Altitude %	3% for each 305 metre elevation above MSL (Ref. NFPA, Volume-2, 1978).	
	b) Ambient temperature %	1% for each 5.6° C rise in air temperature above 15.6° C (Ref. NFPA, Volume-2, 1978).	
	c) Relative Humidity %		
	d) Any other factor %		
	e) Total Deration %		
8	Operating speed rpm	Not more than 2300 rpm	
9	Bore mm		
10	Stroke mm		
11	Mean Piston Speed m/s		
12	Total swept volume litres		
13	Mean effective pressure Kg/cm2		
14	Fuel consumption at		

Sl.no.	Description	BHEL Requirement (if any)	<Bidder's> Offer
	i) 100% load gm/kW Hr		
	ii) 75% load gm/kW Hr		
	iii) 50% load gm/kW Hr		
15	Permissible over load for full duration		
	a) 30 sec %		
	b) 60 sec %		
	c) 1 hour %		
16	Lube oil consumption at		
	i) 100% load gm/kW Hr		
	ii) 75% load gm/kW Hr		
	iii) 50% load gm/kW Hr		
17	Jacket water temperature at engine inlet Deg. C		
18	Jacket water temperature at engine outlet Deg. C		
19	Jacket water flow rate m3/hr		
20	Lub. oil temperature at Lub. oil cooler inlet Deg.C		
21	Lub. oil temperature at Lub. oil cooler outlet Deg.C		
22	Exhaust gas flow rate and temperature at turbo-charger outlet		
	i) 110% Load m3/hr & Deg.C		
	ii) 100% Load m3/hr & Deg.C		
	iii) 75% Load m3/hr & Deg.C		
	iv) 50% Load m3/hr & Deg.C		
23	Allowable back pressure on Turbocharger outlet mm of WC		
24	Engine thermal efficiency at		
	i) 100% load %		
	ii) 75% load %		
	iii) 50% load %		
	iv) 25% load %		
25	Max. step load allowable %		
26	Maximum noise level at 1.5 meter away from engine	105 DBA at 1.5 m distance, in any direction for complete train	
27	Maximum exhaust noise level at ground level db		
28	Maximum vibration at any point of assembled DG Set mm/s		
29	Weight of Diesel Engine Kg		
30	Weight of Coupling Kg		
31	Weight of Base frame Kg		

Sl.no.	Description	BHEL Requirement (if any)	<Bidder's> Offer
32	Dry weight of fully assembled Set Kg		
33	Weight of fully assembled DG set filled with water, fuel oil, lub oil etc. kg		
34	Weight and name of Heaviest part to be lifted during maintenance Kg		
35	GD2 for complete DG Set Kgm2		
36	Overall dimension of Diesel Engine		
37	Overall dimension of assembled		
38	Dynamic loading of Set		
39	Set starting time i.e., ready to take load after óStartô impulse		
40	Quality of Jacket water required		
41	Quantity of first fill of jacket water m3		
42	Volume of combustion air required m3/min		
43	Volume of ventilation air required to limit the temp, rise in the DG plant to 5 deg. C m3/min		
44	Engine driven auxiliaries with power consumption kw		

Notes :		
1. Hard copy duly signed and with seal shall be furnished along with the offer. Soft copy shall shall also be furnished. 2. Bidder to fill up the column for bidder's data completely. Only for items like capability parameters, if not specified by BHEL, shall be indicated as "NA". Bidder to indicate his details wherein "<Bidder.....>" is indicated above. 3. The requirement for vacant spaces left in column for 'BHEL Requirement' shall be considered as per BHEL specification and subsequent correspondences. Only certain special requirements have been indicated in the 'BHEL Requirement' column.		

ANNEXURE - 5

PRICE BID FORMATS

	BHARAT HEAVY ELECTRICALS LIMITED **R.C.PURAM, HYDERABAD-502032**				
	PROJECT ENGINEERING & SYSTEMS DIVISION				
	PRICE FORMAT (R00) FOR HYDRANT - SPRAY WATER PUMP WITH DRIVES **(MOTOR & DIESEL ENGINE)** **FOR CUSTOMER : TSGENCO** **PROJECT : 4 x 270 MW BHADRADRI THERMAL POWER STATION** **CONSULTANT :M/S DEISEIN INDIA PVT LTD**				
SL NO	ITEM DESCRIPTION	QTY	UNIT	UNIT RATE (RS.)	TOTAL (RS.)
	Bidder's Name : <Bidder to indicate> **Bidder's Offer No. & Dt. : <Bidder to indicate>** **Bidder's Ref No. & Dt. :<Bidder to indicate>** **BHEL Enq. No. & date :<Bidder to indicate>**				
I	**MAIN OFFER** **[Note:Prices for individual items to be quoted as indicated in the price bid format.]**				
A	**MATERIAL SUPPLY: HYDRANT-SPRAY WATER PUMP WITH MOTOR**				
A.1	Hydrant-Spray water Pump along with drive motor assembly complete with all accessories as per specification.	5	Set		
A.2	**Commissioning spares**				
	Commissioning spares as per manufacturer's recommendation. Minimum 1 Set of O rings & gaskets, for each pump & drive assembly 1 set stands for requirement for one no. of pump and drive assembly Bidder to furnish the list along with the offer. **(Ref. Note-6)**	5	Set		
B	**MATERIAL SUPPLY: HYDRANT-SPRAY WATER PUMP WITH DIESEL ENGINE**				
B.1	Hydrant pump-Spray water Pump along with Diesel Engine Complete with all accessories as per specification. [**Refer Note-9**]	3	Set		
B.2	**Commissioning spares**				
	Commissioning spares as per manufacturer's recommendation. Minimum 1 Set of O rings & gaskets, for each pump & drive assembly 1 set stands for requirement for one no. of pump and drive assembly Bidder to furnish the list along with the offer. **(Ref. Note-6)**	3	Set		
C	**Special tools & tackles**				
C.1	**Special tools & tackles for Pump and Motor**				
	Special tools & tackles as per manufacture recommendations. 1 set stands for requirement for each pump, drive and other accessories. Bidder to furnish the list along with offer.	1	Set		

	BHARAT HEAVY ELECTRICALS LIMITED **R.C.PURAM, HYDERABAD-502032**				
	PROJECT ENGINEERING & SYSTEMS DIVISION				
	PRICE FORMAT (R00) FOR HYDRANT - SPRAY WATER PUMP WITH DRIVES **(MOTOR & DIESEL ENGINE)** **FOR CUSTOMER : TSGENCO** **PROJECT : 4 x 270 MW BHADRADRI THERMAL POWER STATION** **CONSULTANT :M/S DEISEIN INDIA PVT LTD**				
SL NO	ITEM DESCRIPTION	QTY	UNIT	UNIT RATE (RS.)	TOTAL (RS.)
	Bidder's Name : <Bidder to indicate> **Bidder's Offer No. & Dt. : <Bidder to indicate>** **Bidder's Ref No. & Dt. :<Bidder to indicate>** **BHEL Enq. No. & date :<Bidder to indicate>**				
C.2	**Special tools & tackles for Pump and Diesel Engine**				
	Special tools & tackles as per manufacture recommendations. 1 set standas for requirement for each pump, drive and other accessories. Bidder to furnish the list along with offer.	1	Set		
D	**MANDATORY SPARES:** **Note:Prices for individual items to be quoted as indicated in the price bid format.**				
D.1	**For Pump:**				
	a) Complete Bowl Assembly	1 set of each type/size/rating			
	b) Impellers	1 set of each type/size/rating			
	c) Shafts	1 set of each type & Size			
	d) Casing wearing Ring	1 set of each type/size/rating			
	e) Impeller wearing Ring	1 set of each type & Size			
	f) Shaft sleeve	2 set of each type/size/rating			
	g)Shaft Coupling	1 set of each type/size/rating			
	h) Shaft nut & key	1 set of each type/size/rating			
	i) Lantern Ring	1 set of each type/size/rating			
	j) Bell mouth Liner	1 set of each type/size/rating			
	k) Bearing	1 set of each type/size/rating			
	l) Pump Motor Coupling	1 set of each type/size/rating			
D.2	**For Motor:**				
	a) Driving End Bearing	1 No			
	b) Non-Driving End Bearing	1 No			
	c) Cooling Fan Internal & External	1 set			
	d) Bearing Temperature Gauge Driving & Non-Driving End	1 set			
	e) Phase-Segregated Terminal Box	1 set			
	f) Neutral End Terminal Bushing with Fasteners	1 No			

	BHARAT HEAVY ELECTRICALS LIMITED **R.C.PURAM, HYDERABAD-502032**				
	PROJECT ENGINEERING & SYSTEMS DIVISION				
	PRICE FORMAT (R00) FOR HYDRANT - SPRAY WATER PUMP WITH DRIVES **(MOTOR & DIESEL ENGINE)** **FOR CUSTOMER : TSGENCO** **PROJECT : 4 x 270 MW BHADRADRI THERMAL POWER STATION** **CONSULTANT :M/S DEISEIN INDIA PVT LTD**				
SL NO	ITEM DESCRIPTION	QTY	UNIT	UNIT RATE (RS.)	TOTAL (RS.)
	Bidder's Name : <Bidder to indicate> **Bidder's Offer No. & Dt. : <Bidder to indicate>** **Bidder's Ref No. & Dt. :<Bidder to indicate>** **BHEL Enq. No. & date :<Bidder to indicate>**				
	g) RTD for Bearing Temperature:	1 No			
	h) Motor Space Heater	1 No			
	i) Complete Set of Coupling	1 set			
D.3	**For Diesel Engine :**				
	a) Element for lub oil Filter:	2	No		
	b) Element for Fuel Filter:	2	No		
	c) Outer Element for Air cleaner:	2	No		
	d) Inner Element for Air cleaner:	2	No		
	e) Turbo-charger:	1	No		
	f) Engine - starter Motor:	1	No		
	g) Injector:	2	No		
	h) Piston rings & liner set:	2	Set		
D.4	**Instrumentation:**Transmitters/ Gauges/Switches etc. along with relevant accessories: 10% of total or at least two (whichever is higher) for each type along with accessories. Temperature Element (RTD/Thermo-couple) with thermo well: 10% of each type, range and immersion length. .Minimum 5 nos.	1	Set		
E	**Supervison charges for erection & commissioning at site**				
E.1	Per diem rate for the supervision of Erection & commissioning of Hydrant-Spray Pump [Refer Note 10]	16	Days		
E.2	Travel expenses (inclusive of all other charges like visa fee (if applicable), insurance etc) from / to vendor works to site for Engineer per visit for supervision of erection & commissioning of Hydrant-spray Pump [Refer Note 10]	8	Visit		
E.3	Per diem rate for the supervision of Erection & commissioning of Motor for Hydrant-spray Pump[Motor driven] [Refer Note 10]	10	Days		
E.4	Travel expenses (inclusive of all other charges like visa fee (if applicable), insurance etc) from / to vendor works to site for Engineer per visit for supervision of erection & commissioning of Motor for Hydrant-Spray Pump[Motor driven][Refer Note 10]	5	Visit		
E.5	Per diem rate for the supervision of Erection & commissioning of Diesel engine of Hydrant-Spray Pump(Diesel Engine driven) [Refer Note 10]	6	Days		
E.6	Travel expenses (inclusive of all other charges like visa fee (if applicable), insurance etc) from / to vendor works to site for Engineer per visit for supervision of erection & commissioning of Diesel Engine for Hydrant-Spray(Diesel Enginedriven) [Refer Note 10]	3	Visit		

BHARAT HEAVY ELECTRICALS LIMITED
R.C.PURAM, HYDERABAD-502032

PROJECT ENGINEERING & SYSTEMS DIVISION

PRICE FORMAT (R00) FOR HYDRANT - SPRAY WATER PUMP WITH DRIVES
(MOTOR & DIESEL ENGINE)
FOR CUSTOMER : TSGENCO
PROJECT : 4 x 270 MW BHADRADRI THERMAL POWER STATION
CONSULTANT :M/S DEISEIN INDIA PVT LTD

SL NO	ITEM DESCRIPTION	QTY	UNIT	UNIT RATE (RS.)	TOTAL (RS.)
	Bidder's Name : <Bidder to indicate> **Bidder's Offer No. & Dt. : <Bidder to indicate>** **Bidder's Ref No. & Dt. :<Bidder to indicate>** **BHEL Enq. No. & date :<Bidder to indicate>**				
II	**Optional Items**	--	--		
F	**3 Years Recommended Spares**				
	Rrecommended spares list for three years normal operation along with unit price breakup for Pump, Drives & other accessories. **(List with price break up to be enclosed)** (1 set stands for quantity required for the replacement of one pump, drive (or) accessories)	As per List	Set		
	TOTAL				

Notes:

1) **Main offer** consists of those items which will be part of main order after successful bidder is identified. **Optional Items** consists of those items which need to be quoted by bidder but may or may not be ordered by BHEL. Bidders are instructed to provide the pricing details listed under **Main offe**r and **Optional items** as per the prescribed format.

2) Prices quoted by bidders for items under **main offer : Sl. No. I [A to E]** will be considered for evaluation of lowest and successful bidder.

3) For all items including Optional items, prices to be furnihsed in the prescribed format for each individual item. No combined prices or common prices will be accepted and such bids may not be considered for evaluation.

4) Bidder must not change the above indicated item description, quantity & units. He should only fill the unit rates & total price.

5) The price format is only for basic price . All other commercial charges for packing, freight, transportation, insurance, taxes & duties etc., shall be separately indicated.

6) Any commissioning spare consumed over and above the recommended commisioning spares, during commissioning shall be supplied free of cost by the equipment vendor.

7) Reference document: BHEL spec no. **PEMC 06481** Rev 00 and subsequent correspondences.

8)Referring to sl no D;
A) If any of above items indicated by the specified name are not applicable, bidder to offer alternative item serving the same function as per equipment's design and indicate below the item being replaced.
B) If bidder is not able to meet the above note, then bidder may mention "Not Applicable". However, if found applicable during detailed engg. stage or alternative item as per equipment design can serve the same function, bidder to supply the specified quantity with out any delivery and commercial implications to BHEL.

9)Bidder to include acessories & auxiliary equipments as per clause no **4.4.0**

BHARAT HEAVY ELECTRICALS LIMITED
R.C.PURAM, HYDERABAD-502032

PROJECT ENGINEERING & SYSTEMS DIVISION

PRICE FORMAT (R00) FOR HYDRANT - SPRAY WATER PUMP WITH DRIVES
(MOTOR & DIESEL ENGINE)
FOR CUSTOMER : TSGENCO
PROJECT : 4 x 270 MW BHADRADRI THERMAL POWER STATION
CONSULTANT :M/S DEISEIN INDIA PVT LTD

SL NO	ITEM DESCRIPTION	QTY	UNIT	UNIT RATE (RS.)	TOTAL (RS.)
	Bidder's Name : <Bidder to indicate> **Bidder's Offer No. & Dt. : <Bidder to indicate>** **Bidder's Ref No. & Dt. :<Bidder to indicate>** **BHEL Enq. No. & date :<Bidder to indicate>**				

10) Referring to Sl no E.1 TO E.2, Hydrant-Spray water pump, For the purpose of L1 bidder evaluation, total no of 16 man days for Pump will be covered in 8 visits [2 man days for each Pump & 1 visit for each pump] have been considered. However, either or both of the number of man days or number of visits may change on either side based on the actual site requirement. Bidder to note that payment against Sl.No E.1 TO E.2 above shall be made as per the actual number of visits and man days required for the supervision of the complete E&C activities as per these diem rates.

Referring to Sl no E.3 TO E.4, Motor , For the purpose of L1 bidder evaluation, total no of 10 man days for Pump will be covered in 5 visits [2 man days for each Motor & 1 visit for each motor] have been considered. However, either or both of the number of man days or number of visits may change on either side based on the actual site requirement. Bidder to note that payment against Sl.No E.3 TO E.4 above shall be made as per the actual number of visits and man days required for the supervision of the complete E&C activities as per these diem rates.

Referring to Sl no E.5 TO E.6, Diesel Engine , For the purpose of L1 bidder evaluation, total no of 6 man days for Pump will be covered in 3 visits [2 man days for each Diesel Engine & 1 visit for each Diesel Engine] have been considered. However, either or both of the number of man days or number of visits may change on either side based on the actual site requirement. Bidder to note that payment against Sl.No E.5 TO E.6 above shall be made as per the actual number of visits and man days required for the supervision of the complete E&C activities as per these diem rates.

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Purchase Order for supply of main items, (A to D) shall be placed by BHEL-Hyderabad.

Purchase Order for Supervison charges for erection & commissioning (Sl no E) shall be placed by BHEL-site as per the site requirement.

ANNEXURE - 6

CHECK LISTS

ANNEXURE-6

CHECKLIST FOR OFFER FOR HYDRANT-SPRAY PUMP WITH DRIVES (MOTOR/DIESEL ENGINE)

Description	Enclosed (Yes/ No)
Bidder to confirm that Performance requirement, Design and construction of the Pump shall be guided by the TAC/LPA recommendations.	
Bidder to confirm that Performance requirement, Design and construction of the Motor shall be guided by the TAC/LPA recommendations.	
Bidder to confirm that Performance requirement, Design and construction of the Diesel Engine shall be guided by the TAC/LPA recommendations.	
Bidder to confirm to furnish duly filled Pump, Motor & Diesel Engine datasheets.	
Bidder to comment on design standard of Diesel engine as mentioned in the specification.	
Bidder to confirm to the scope of supply as per BHEL specs PEMC- 06481	
Bidder to confirm that all the counter flanges along with gaskets & stud nuts at all the terminal point shall be in their scope.	
Bidder to furnish a list of commissioning spares. (Refer Cl no 4.25.0 of PEMC- 06481)	
Bidder to furnish a list of special tools & tackles (Refer Cl no 4.25.0 of PEMC- 06481)	
Bidderôs confirmation required for furnishing a list of 3 year recommended spares in their offer separately with optional price.	
Reference list/Equipment Qualification criteria as per clause no 6.0.0 of PEMC-06481. Bidder to furnish dully filled in proforma as per Annexure-9	
Bidder to highlight specific comments on the inspection requirements wrt scope of supply. (Refer Cl no 8.0.0 of PEMC- 06481)	
Bidder to highlight any deviation wrt the sub vendor list with proper justification. (Refer Cl no 11.0.0 of PEMC- 06481)	
Bidder to check the master document list and submit all the required documents as per the master document list (Annexure-7) without fail and take the approval of BHEL/Customer/Consultant	
Bidders to comment on the instrumentation requirement as per P&ID (Annexure -1) based on their experience. If any other instruments are required as per good engg practice, bidder to highlight the same.	
Deviation list to the specification. All other requirements except for the deviation brought out under deviation list, have been taken into consideration.	
Bidder to quote as per BHEL price format only. Price quoted as per the price bid format, clearly indicating all the applicable items are quoted, and not applicable items are clearly highlighted. Un priced copy of the same is enclosed. [Refer Annexure-5]	
Confirm that all rotating equipment shall be procured from the approved vendors listed in the bid package. [Refer Annexure-13]	
Confirm that all consumables, chemicals, lubricants etc. for startup and commissioning have been included in the Bidderôs proposal. Confirm Compliance	
Confirm that all Inspection & acceptance, type Tests as required for each equipment, as per specification and Codes attached.	

SIGNATURE:
NAME:
DESIGNATION:
COMPANY:
DATE:

ANNEXURE - 7

BOM & MDL

MASTER DOCUMENT LIST

System Name:	Supplier:	Project:		Supplier Doc. No.	
Hydrant-Spray Pump with Drives (Motor & Diesel Engine)		Supplier Job No.	BHEL PO No.	Rev No.	
			Date	Date	

LIST OF SUPERCIDED DRAWINGS / DOCUMENTS	S	NO COMMENTS	1
LIST OF ACTIVE DRAWINGS / DOCUMENTS	A	COMMENTS AS MARKED CLEARED FOR MANUFACTURE	2
LIST OF DRAWINGS/DOCUMENTS UNDER PREPARATION	UP	COMMENTS AS MARKED	3
LIST OF DESEIN / APPROVED DRAWINGS	ADS	RETAINED FOR INFORMATION	4

SL. NO.	DRAWING/ DOCUMENTS	DWG. NO.	APPR (A/I)	SCHEDULE OF SUBMISSION	REV	SENT BY VENDOR (SOFT COPY)	HARD COPY RECEIVED FROM VENDOR	COMMENTS SEND TO VENDOR	STS	PENDING WITH (BHEL/VENDOR)	BHEL APP STATUS	REMARKS
MECHANICAL												
1	Pump GA drawing		A									
2	Pump Cross Sectional Drawing		I									
3	Pump P&ID		A									
4	Motor GA drawing		I									
5	Coupling GA Drawing & Details		I									
6	~~Strainer GA Drawing and details~~		A									
7	Mechanical Seal GA Drawing and details		I									
8	Diesel Engine GAD		A									
9	P&ID & Schematics for Diesel engine		A									
DATASHEET, OTHER DETAILS & CURVES												
1	Pump Data Sheet (BHEL Format)		A									
2	Motor Data Sheet (BHEL Format)		A									
3	Diesel Engine Data Sheet		A									

SL. NO.	DRAWING/ DOCUMENTS	DWG. NO.	APPR (A/I)	SCHEDULE OF SUBMISSION	REV	SENT BY VENDOR (SOFT COPY)	HARD COPY RECEIVED FROM VENDOR	COMMENTS SEND TO VENDOR	STS	PENDING WITH (BHEL/VENDOR)	BHEL APP STATUS	REMARKS
4	**Diesel Engine Performanve curves**		I									
5	**Pump Performance curve**		I									
6	**Motor Curves**		I									
7	**T-S Curve**		I									
8	**Instrument datasheets [TG,RTD etc as per scope of supply]**											
9	**Balancing_LP test & ultrasonic test procedure**		I									
10	**Performance Test Procedure**		A									
11	**NPSH test procedure**		I									
12	**Vibration test procedure**		I									
13	**Temperature rise test procedure**		I									
14	**Hydro Test Procedure**		I									
15	**NDE Test Procedure**		I									
16	**Painting proccedure**		I									
17	**Packing List**		I									
18	**datasheet of Cable glands & lugs**		I									
19	~~**VMS documents**~~		I									
20	~~**Reverse Rotation Monitoring documents**~~		I									

SL. NO.	DRAWING/ DOCUMENTS	DWG. NO.	APPR (A/I)	SCHEDULE OF SUBMISSION	REV	SENT BY VENDOR (SOFT COPY)	HARD COPY RECEIVED FROM VENDOR	COMMENTS SEND TO VENDOR	STS	PENDING WITH (BHEL/VENDOR)	BHEL APP STATUS	REMARKS
CALCULATION												
1	~~Strainer Area calculation~~		I									
2	~~Strainer Pressure Drop calculation~~		I									
MISCELLANEOUS												
1	BILL OF MATERIAL		A									
2	BILLING BREAKUP		A									
3	~~ELECTRICAL LOAD LIST~~		I									
4	QUALITY ASSURANCE PLAN		A									
5	SUB VENDOR LIST		A									
6	COMMISSIONING SPARES LIST		I									
7	LUBE OIL SCHEDULE		I									
PROCEDURES & MANUAL												
1	OPERATION & MAINTENANCE MANUAL (Soft Copies & Hard copies)		A									
2	STARTUP PROCEDURE		I									
3	SURFACE PREPARATION & PAINTING SPECIFICATION		I									
4	ERECTION PROCEDURE		I									
5	COMMISSIONING PROCEDURE		I									
6	FAT PROCEDURE		I									

SL. NO.	DRAWING/ DOCUMENTS	DWG. NO.	APPR (A/I)	SCHEDULE OF SUBMISSION	REV	SENT BY VENDOR (SOFT COPY)	HARD COPY RECEIVED FROM VENDOR	COMMENTS SEND TO VENDOR	STS	PENDING WITH (BHEL/VENDOR)	BHEL APP STATUS	REMARKS
7	**INSPECTION/TESTS REPORTS/CERTIFICATE**		I									
8	**WELDING PROCEDURE (If any)**		I									
9	**BAR CHART FOR CW Pump PACKAGE**		I									

ANNEXURE-8

EXTRACTIONS FROM CUSTOMER SPECIFICATION FOR PUMP

VOLUME-IIIE

SECTION-II

TECHNICAL SPECIFICATION FOR FIRE PROTECTION SYSTEM

CONTENT

ATTACHMENT

VOLUME: IIIE

SECTION-II

TECHNICAL SPECIFICATIONS FOR FIRE DETECTION, ALARM AND PROTECTION SYSTEM

1.00.00 GENERAL INFORMATION

This section covers the requirements envisaged for Fire Detection and Protection System including Alarm and Communication which will be used to control any outbreak of fire in the proposed1 x 800 MW Sri Kothagudem Thermal Power Station (KTPS), Stage-VII, Unit-12 for Telangana State Power Generation Corporation Limited (TSGENCO) at Kothagudem, Telangana to reduce consequential damages by containing and extinguishing the same. This section of the Specification shall have two parts – Fire Extinguishing System and Fire Detection & Alarm System. Bidder's scope of work covers supply, erection, commissioning and testing of the entire fire detection, alarm and protection system including supply of all fire extinguishing equipment and systems, fire detectors, manual call points, linear heat sensing cables, all local, remote Fire detection alarm cum MIMIC panels , repeater fire alarm panels, PCs and peripherals, hardware and licensed versions of software as detailed hereunder, meeting all code requirements to make the system complete.

2.00.00 CODES AND STANDARDS

The system shall be designed keeping in view the recommendations of Tariff Advisory Committee (TAC) of Insurance Companies of India/LPA India/NFPA USA. Any other International Standard having equivalent stringent codes may also be considered. However, the system shall be approved by statutory authorities.

3.00.00 SYSTEM DESCRIPTION

For protection against fire, all yard equipment will be protected by a combination of hydrant system, automatic sprinkler spray system (emulsifier system), fixed foam system for oil handling areas, automatic high velocity and medium velocity sprinkler spray system, auto-modular clean agent system for control rooms apart from portable and mobile fire extinguishers located at strategic areas of plant buildings and adequate Passive Fire Protection measures.

Fire extinguishing system is broadly divided into following sub-systems:

3.01.01 **Hydrant System**

The Hydrant System of Fire Protection essentially consists of a large network of pipe, both underground and over ground which feeds water to a number of hydrants valves – indoor as well as outdoor and to a number of outdoor type fixed installations. Water in the pipe network is kept pressurized by hydro-pneumatic tank and jockey pump arrangement. These hydrant valves are located in the entire power station including all the auxiliaries and buildings in the plant area. Hosepipes of suitable lengths fitted with standard accessories like branch pipes, nozzles etc. are kept in "Hose Houses" (for outdoor hydrants) and in "Hose Boxes" (for indoor hydrants). When the fire hoses are coupled to the hydrant valves through the instantaneous coupling, jet of water is directed towards the fire. Hydrant system protects the following building/facilities.

a) Raw Water Pump House

b) Entire Power House including Boiler Area and Turbine House.

c) Mill Building.

d) Mill reject system compressor house.

e) ESP Control Building.

f) Generator & Unit transformer, Station Transformers in transformer Yard, switchyard area.

g) CW Pump House including chlorination plant and dosing pump house.

h) DG & Compressor building.

i) HFO & LDO/ HSD unloading and transfer pump house, pressurizing pump house area, HFO, LDO/HSD Day tank area.

j) DM plant

k) Coal Handling Plant including conveyors, TPs, Coal stack yard etc.

l) Ash water pump house.

m) Ash Slurry Pump House

n) Ash Handling Plant Electrical cum Control Room

o) Ash Handling Plant Compressor Room

p) Fly Ash Vacuum Pump House

q) AHP Chemical House in AHP Clarifier Area

r) Effluent treatment Plant.

s) Stores.

t) Clarified Water Pump House

u) Filtered water Reservoir and Pump House

v) Sludge Sump & Pump House

w) Filter Backwash Waste Sump & Pump House

x) Chemical House

y) Chlorination Building

Note: Buildings not specifically identified above but required to be covered by hydrant system shall also be included in the scope of the Bidder.

3.01.02 **High Velocity Water Spray System (HVWS System)**

a) Category- A

This system shall automatically detect, control and extinguish any out-break of fire and simultaneously give audible alarm. The system shall also be designed for remote operation. Water line forms a ring around the equipment to be protected with projected outlets at various selected points fitted with the specially designed nozzles. The water supply to the HVW spray system is controlled by deluge valve, which shall be operated hydraulically. This valve is normally closed by water pressure in the water piping. The same water pipe forms a ring around the equipment to be protected and frangible bulb type detectors are mounted on this water line at selected places. When the surrounding temperature rises more than the rated temperature of the detector, detector quartzoid bulb collapses releasing water and consequently pressure in water line will fall sharply. This fall of pressure opens the deluge valve and water starts projecting out from the projectors. Local audible alarm shall be produced by water motor alarm gong. The operation of the Deluge Valve shall be annunciated in the Local Zonal Fire Alarm Panel as well as in the Central Fire detection alarm cum MIMIC panel.

The system shall also have a manual over riding facility along with regular testing facility

Category – A type HVW Spray Protection shall be provided for the following equipment:

- Three (3) nos. single phase generator transformer.
- Two (2) nos. Unit transformers.
- Unit and Station Auxiliary transformers as per design requirement.

- Spare Generator Transformer

b) Category- B

In this system fire shall be detected by use of heat detectors, flame detectors depending upon the area. Upon detection of fire, HVW Spray System shall be brought in operation automatically by opening deluge valves.

Category – B type HVW Spray System shall be provided for the following areas:

- Turbine oil tanks and purifiers.
- Boiler Firing Floors.
- Lube oil piping in turbine areas.
- Generator seal oil system.
- Lube oil system for turbine driven boiler feed pumps.
- All oil filled transformer below 10 MVA.

3.01.03 **Medium Velocity Water Spray System**

This system essentially consists of a network of sprayers fitted with a special deflector to give required angle of discharge for the water around the area to be protected. The sprayers discharge a cone of water spray consisting of medium size droplets of water. The droplet size shall be so designed to achieve efficient cooling of the flame zone by evaporation and sufficiently large to penetrate the flame so as to reach and cool surfaces heated by the fire. The operation of the deluge valves in MVW Spray System shall be annunciated in the respective local zonal panels and in the central Fire detection alarm cum MIMIC panel with repeat alarm at fire station buildings. For avoiding overall flooding of the area, in the event of fire, only the two adjacent zones on either side shall only operate.

The Medium Velocity Water Spray System shall be provided for the protection of following areas:

- All conveyor galleries, transfer points, and bunker bay conveyors in coal handling plant. In this connection, it may be noted that full length of each conveyor both top and bottom belt shall be protected with MVW Spray System.

  Spray system for coal conveyor galleries shall be divided in several zones fed through individual deluge valves. Spray system for each zone shall consist of spray nozzles mounted, on a water network. Spray system shall cover both forward and return belts of conveyor including hoppers, feeders & head end pulley. Detection system shall consist of quartz bulb detectors, IR detectors, LHS cables.

- Cable vault and cable galleries of main plant, switchyard control room, and ESP control room. Detection system shall consist of smoke detectors, LHS cables.

- Fuel oil storage and day tank area, DG set diesel tanks.

3.01.04 **Fixed Foam Protection System**

Water based automatic activated low expansion foam protection system shall be provided for HFO & LDO/ HSD storage and day tanks.

Foam protection systems are based on the principle of blanketing the burning surface of oil stored inside the tanks by pouring foam mixed with water, enabling to cut-off the oxygen to the burning fuel thus achieving immediate Extinguishments of fire.

Foam concentrate will be pumped from the foam concentrate storage tank by two (1W + 1S) foam pumps to foam proportioner skids one provided for each fuel oil (FO) tank. Pressurized water connection is provided to the eductor of each foam proportioner skid. In the event of fire, the foam system for respective tank shall be automatically activated on detection of fire by ROR/Probe type heat detectors provided inside the FO tanks. Water will start flowing through the eductor where foam concentrate is induced and mixed with the flowing water in definite proportion.

This foam water mixture flows to tank, where the foam solution expands by sucking air from the atmosphere and foam thus formed fills the oil surface inside tank by suitably designed deflectors.

3.01.05 **Inert gas flooding system / Auto modular clean agent system**

One centralized total flooding type clean inert gas extinguishing system shall be provided for the following areas as a protection for fire damage.

- Control room, Control equipment room, computer room and other electrical and electronic equipment rooms.

The inert gas flooding system for the above areas shall consist of battery of inert gas storage cylinders of adequate capacity, which shall be located suitably at a centralized location. Discharge nozzles shall be provided on the gas distribution pipe network suitably located on the areas to be protected.

In the event of fire, the fire detectors initiate an alarm in the local panel, and main fire alarm panel. Simultaneously, the detection signal opens the valves automatically and the protected area is filled up by rapid injection of required quantity of inert gas through the pipe network and discharge nozzles to create a homogenous air/inert gas atmosphere within.

The pipe network shall be connected to a gas manifold, through a manually operated valve. The manifold shall be connected to a group of inert gas cylinders

3.01.06 Portable and mobile (wheel mounted) fire extinguishers, such as soda acid type, pressurized water type, carbon-dioxide type, foam type , dry chemical powder type shall be located at strategic locations throughout the plant area.

3.02.00 Microprocessor based addressable analog type multi criteria smoke detectors connected in cross-zoning principle as per NFPA recommendation and in two wires circuitry shall be provided in the following areas:

- All cable Spreader Rooms & Cable Vaults, cable gallery in powerhouse and in all ancillary plant buildings.
- All Electrical Switchgear/MCC Rooms located in Power House and in all ancillary plant buildings.
- Central Control Rooms, Control equipment room housing DDCMIS, UPS etc. and in all ancillary plant building control rooms.

3.03.00 Heat detection system (microprocessor based analogue addressable based heat detector) shall be provided in the following areas in order to avoid spurious operation of the smoke detectors due to fumes, smoke & dust which are present in these areas:

- Battery and battery charger rooms.
- Turbine oil tanks and purifiers.
- Boiler Firing Floors.
- Lube oil piping in turbine areas.
- Generator seal oil system.
- Lube oil system for turbine driven boiler feed pumps.
- All oil filled transformer below 10 MVA.

3.04.00 Quartzoid bulb detector shall be used in all transformers rated more than 10 MVA.

3.05.00 Heat sensing cable, as detector shall be used for coal conveyor gallery including bearings and both drive pulley and non-drive pulley, transfer points. This shall be used in whole length of top belt and bottom belt (in a zig-zag fashion). These detectors shall also be used for tripping the conveyor drives.

3.06.00 Solar Blind Infra-red detectors with inbuilt air purging unit shall be used in coal conveyor gallery for detection of moving fire. Rate of rise cum fixed

temperature heat detectors shall be used for Boiler burner fronts, turbine oil tanks and HFO and LDO/HSD storage day tank inside. Heat detectors shall be analogue addressable type.

3.07.00 The entire Power House Building and the outdoor yard of plant have been divided into a number of zones with a few addressable manual call points in each zone. The outdoor call points shall be installed on approximately 1M high angle iron supports for ease of operation. The manual call points inside the Power House Building shall be suitable for wall mounting. Manual call points of "break glass push button station type" or "lever type" shall be provided specifically in the following areas:

a) Switch gear and MCC room in Power house.

b) Outdoor transformer yard.

c) All floors in power House, including Boiler House.

d) All areas of boiler house.

e) Coal bunker and coal mill area.

f) Transfer points.

g) All pump houses namely CW Pump House, Ash Water Pump House, Fire Water Pump House etc.

i) All buildings like Compressor and DG area etc.

Adequate number of manual call points along with automatic fire alarm system shall be provided for the respective areas. Location of the manual call points shall be near to the respective areas. Annunciations from the manual call points shall be received to the nearest satellite fire alarm panel and directly on the fire alarm panels located in the Control room and fire station.

3.08.00 All detectors shall be located and spaced as per NFPA-72E and shall be UL/FM approved. On receipt of impulse from the detectors, in the event of fire, suitable annunciation signals shall be exhibited in the respective repeater fire panels as well as Main and Master Fire Panels. The areas including electrical control rooms, switchgear rooms, cable vault, coal conveyors etc shall be suitably sectionalized as far as the fire detection is concerned and as such the affected Zone can also be spotted.

3.09.00 Passive Fire Protection System for all outdoor transformers and indoor transformers having rating more than 10 MVA, Cable Vault, Cable Spreader Room & Enclosed Cable Risers (Cable Shafts) shall be provided.

3.09.01 The Transformer to be protected by automatic High Velocity Water Spray System shall be separated from each other by explosion proof barrier walls of 120 minutes fire rating so that fire in one does not affect the adjacent Transformers.

3.09.02 The Cable Spreader Room and Cable Vault shall be divided into a smaller

risk zones. These zones shall be separated by 120 minutes rating fire barrier walls.

3.10.00 For containment of fire and preventing it from spreading in cable galleries, unit wise fire barriers with self-closing fire doors will be provided. In addition, all cable entries / openings in the cable galleries, tunnels, floors will be sealed with non-inflammable / fire resistant sealing materials to prevent fire propagation for at least three (3) hour. Fire protection cable coating compound over cables at switchgear entry points, power station building entry points and trays shall be provided to prevent damage from fire for at least thirty (30) minutes. The number of fire doors as prescribed by the TAC/LPA shall be provided. Atleast two fire escape exit openings to the open areas shall be provided for the TG area as prescribed by the TAC/LPA.

3.11.00 Back Lit maintained type emergency "exit light" shall be provided in control room, control equipment rooms, switchgear and MCC rooms, battery charger rooms, escape stair case in power house and transfer points in coal conveyor area and other buildings in the plant. These shall be switched on upon detection of fire.

3.12.00 Addressable analog smoke detector shall also be provided in all false ceiling in power house i.e. Control room, Control equipment room, ESP control room.

3.13.00 “First aid fire protection system" shall be provided for Power house.

3.14.00 Gas sensing fire detectors working on air sampling shall be provided for all control rooms, and control equipment room.

3.15.00 Provision should be kept for automatic closing of fire dampers in ventilation ducts or tripping of related ventilation fans as required on detection of fire.

3.16.00 The main source of water to the fire pumps and jockey pumps shall be from steel made fire water storage tank which is to be sized by the EPC contractor based on TAC/LPA guideline. However, the minimum capacity of the steel tank shall be 5000 m^3 with two compartments . The Water for both hydrant and High/Medium Velocity Water Spray System shall be supplied by six (6) nos. automatic firewater pumps. Out of six (6) pumps two (2) nos. motor driven working hydrant pumps and one (1) no. diesel engine driven standby hydrant pumps for hydrant system and one (1) no. motor driven and one (1) no. diesel engine driven (both are working) spray pumps for HVW & MVW spray water system and one (1) no. diesel engine driven pump is common standby for spray system. Out of these six (6) nos. fire water pumps three nos. (3) will be motor driven and three (3) nos. will be diesel engine driven. The pumps will be started automatically in proper sequence when a large quantity of water flows out from pressurized water circuit. There shall be adequate arrangement of meeting up system leakages and at the same time the system pressure shall be maintained by providing a hydro pneumatic tank along with two (2) nos. motor driven jockey pumps, one (1) working and one (1) standby and two (2) nos., one (1) working & one (1) standby compressors. Booster Pumps shall be provided as per the TAC/LPA guidelines. However, the no. of pumps and their capacity, head etc. are to be finally decided by the Contractor during detail engineering stage.

3.17.00 If water pressure in the hydrant pipe network is not adequate to maintain minimum 3.5 kg/cm² (g) at the hydraulically furthest hose station at elevated floors of boiler houses and turbine building, then 2x100% motor driven booster pumps shall be provided for individual areas for supplying pressurized water to the hose stations. Booster pumps are installed online to the branch header to riser pipes. The booster pumps if required shall start through pressure switch when pressure on their discharge side falls below the set pressure.

3.18.00 Adequate separating distances will be maintained between different process blocks and hazardous equipment. To prevent fire from spreading through ventilation & air conditioning ducts, dampers with auto closing arrangements will be provided at appropriate locations. FRLS power and control cables will be used.

3.19.00 **Nitrogen Injection System**

Nitrogen Injection Fire Prevention and extinguishing system designed for oil filled transformer (for Generator Transformer) shall prevent tank explosion and the fire during internal faults resulting in the arc where tank explosion will normally take few seconds after arc generation and also to extinguish the external oil fires on transformer top cover due to tank explosion and/ or external failures like bushing fires, due to OLTC fires and fire from surrounding equipments.

Nitrogen Injection System shall be provided along with the emulsifiers for the transformers.

The system shall work on the principle of DRAIN and STIR and on activation, shall drain a pre determined quantity of oil from the tank top through outlet valve, to reduce the tank pressure and inject nitrogen gas at high pressure from the lower side of the tank through the inlet valves to create stirring action and reduce the temperature of top oil surface below flash point to extinguish the fire.

Conservator tank oil shall be isolated during the bushing bursting, tank explosion and oil fire, to prevent aggravation of oil fire.

Transformer isolation shall be an essential pre condition for activation of the system.

The system shall be designed to operate manually, in case of failure of power source.

The details including Design, description, control, scope, etc. of this system are attached with Annexure-IX of this specification.

3.20.00 Two (2) nos. Mobile Fire tenders shall be envisaged for this project. However as no fire station is envisaged, these two (2) nos. mobile fire tenders shall be placed in the new fire Station of the unit of this project. For details of Fire Tender, refer to Annexure-X of this Volume.

4.00.00 **OPERATIONAL PHILOSOPHY**

4.01.00 **Hydrant System**

4.01.01 Operation of hydrant system shall be semi-automatic. A pressurized hydrant main shall be maintained through the combination of hydro pneumatic tank, jockey pumps and compressors. When the header pressure of fire water pumps falls below a preset limit, diesel engine driven fire water pump placed in "auto mode" shall be automatically cut-in. If the header pressure is not built-up even after the running of diesel engine driven pump and falls further down, this low pressure shall actuate another pressure switch which in turn shall cut in automatically the standby Diesel Engine driven hydrant pump. In each case above, if any of the above pumps is not started even after the signal from pressure switch is through, "pump fails to start" alarm shall be annunciated in the local control panel.

4.01.02 Hydro-pneumatic tank shall be filled up with water up to 2/3rd portion of its height. Air space shall be kept above the water- filled portion. The hydro-pneumatic tank will be equipped with necessary level switches and pressure switches. Minor leakage in the pressurized fire water system shall be replenished from hydro-pneumatic tank. When the level of hydro pneumatic tank is low, jockey pump shall be started automatically to replenish the level of water in the tank. Jockey pump shall be cut-out automatically when the level of water in the hydro pneumatic tank reaches its higher limit. Pressure switches provided in the hydro pneumatic tank shall be interlocked with the cut-in/cut-out operation of compressor which is used to maintain a constant pressure in the hydro pneumatic tank and there by to the whole fire fighting system.

4.02.00 **Spray Water System**

4.02.01 Operation of Spray Water System shall be automatic.

4.02.02 Header pressure of spray water system shall be maintained at a constant value with the help of hydro pneumatic tank as stated earlier in case of hydrant system.

4.02.03 When the pressure of spray water system falls down to a preset value, it will actuate a pressure switch which in turn shall send starting signal to the motor/ diesel engine driven HVW/ MVW spray water pump for automatic starting. If the pressure falls further below, common standby Diesel Engine driven pump shall be started automatically from the signal of it's pressure switch. Further, if necessary to arrest the falling pressure pumps for hydrant system shall also be started automatically and deliver water to the spray water system.

In each case above, "pumps fail to start" alarm shall be annunciated in LCP if any pump does not start even the start-up of signal from it's pressure switch is through.

4.02.04 Any Fire water pump, if started automatically, shall not be stopped without manual intervention.

4.02.05 In case of detection of fire in HT transformer, "deluge valve" in spray water line shall be opened automatically and spray water system shall come into operation fully automatically. Operation shall be annunciated.

4.02.06 In all other areas of spray water system, detection of fire shall produce annunciation in the respective local fire panel and the spray water system shall be brought into operation by opening automatically the deluge valves of the particular area.

4.03.00 **Inert Gas Flooding System**

Nitrogen Injection Fire Prevention and extinguishing system designed for oil filled transformer (for Generator Transformer) shall prevent tank explosion and the fire during internal faults resulting in the arc where tank explosion will normally take few seconds after arc generation and also to extinguish the external oil fires on transformer top cover due to tank explosion and/ or external failures like bushing fires, due to OLTC fires and fire from surrounding equipments.

4.04.00 Fire Alarm Panel

Bidder shall provide necessary local control panels for the fire protection system, which shall contain the following components and perform the following functions as minimum.

4.04.01 Fire water pumping and pressurizing system

Hot redundant PLC based system shall be provided for control and monitoring of hydrant system and spray water system. The system shall be provided with Graphic User Interface (GUI) with LCD screen based display unit , control switches and other operational keys and hardwired annunciation system. Necessary hardwired interface along with cables shall be provided for remote Operation & monitoring in the Main Fire Alarm Panel & workstations to be located in CCR .

4.04.03 Fire alarm detection and protection system

Hot redundant Microprocessor based Fire detection alarm cum MIMIC panels shall be provided in the following locations

i) Master Fire detection alarm cum MIMIC panel along with PC based operator station, 24 inch TFT LCD monitor, A3/A4 color laser jet printer , in fire station.

ii) Main Fire detection alarm cum MIMIC panel along with PC based operator station , 24 inch TFT LCD monitor , A3/A4 color laser jet printer , in CCR

iii) Repeater Fire detection alarm cum MIMIC panels , one each , in local area rooms eg , DM plant , AHP , CHP , CW pump house etc.

4.04.04 Volume VI of this specification shall be referred for technical requirements of different items eg. operator station, printer , panel , field instruments , cable

etc.

5.00.00 SCOPE OF WORK

5.01.00 Mechanical

a) One (1) no. automatic electric motor driven horizontal centrifugal fire water pumps with accessories for hydrant service.

b) Two (2) no. automatic diesel engine driven horizontal centrifugal fire water pumps with accessories for hydrant service.

c) One (1) no. automatic electric motor driven horizontal centrifugal fire water pumps with accessories for high velocity spray service.

d) One (1) no. automatic diesel engine driven horizontal centrifugal fire water pumps with accessories for medium velocity spray service.

e) One (1) no. automatic diesel engine driven horizontal centrifugal fire water pumps with accessories for common standby service for both HVW and MVW spray service.

f) Two (2) nos. (1 working + 1 standby) automatic electric motor driven vertical centrifugal jockey pumps.

However, the no. of hydrant and spray pumps shall be finalized by the EPC bidder during detail engineering.

g) Two (2) nos. electric motor driven vertical centrifugal type booster pumps (1W+1S) with accessories, as required, for individual area.

h) One (1) no hydro pneumatic tank and one (1) fire water storage tank of 5000 m^3 capacity with two (2) compartments.

i) Two (2) nos. (1 working + 1 standby) air compressor.

The capacity and head of hydrant, spray and jockey pumps and the sizing of compressors and hydro-pneumatic tank shall be finalized by the EPC bidder during detail engineering.

j) One centralized inert gas flooding system for the areas specified, complete with cylinder rack, gas manifold, pressure reducing stations, detection system components and panel, nozzles, piping, fittings and valves.

k) Foam tank skids for foam concentrate storage, complete with foam concentrate feed pumps, piping, fittings, valves, tank sludge trap and sludge disposal arrangement, safety valves, pressure gauges, level transmitter, level indicator and other required accessories.

l) Foam proportional skids, complete with skid base frame, foam and water piping, deluge valve, adductor, foam nozzles, ROR heat

detector and alarm system, local alarm panel and other required accessories for the protected areas as specified elsewhere in the specification.

m) Required nos. of portable fire extinguisher.

n) Outdoor hydrant valves with hoses, solid jet/triple purpose/fog type branch pipes with nozzles and quick coupling as required for the entire outdoor hydrant system specified. The equipment shall be as per specification.

o) Indoor hydrants (landing valves) with hoses, triple purpose branch pipe with nozzles and quick coupling end & "hose boxes" as required for the entire indoor hydrant system specified as per TAC/LPA rules.

p) Out of total nozzles provided in indoor & outdoor hydrant system, at least 10% shall be "fog type" and balance shall be of ordinary type.

q) The number of hose houses and hoses shall be as per TAC/LPA stipulations.

r) 32 mm NB connections for first aid hose reels, first aid hose reels along with branch pipe fitted with nozzles and quick coupling ends and isolating valves, hose boxes as required for the entire first aid fire protection system specified.

s) Sets of hydraulically operated deluge valves with bypass valve, isolating valve & test valve for all HT transformers as specified.

t) Sets of solenoid operated deluge valves with bypass valve, isolating valve & test valve for entire spray system for coal conveyors, turbine lub oil tank, boiler burner front and cable vault/spreader rooms.

u) Two (2) nos. of basket type strainers to be located at the discharge of spray water pumps.

v) Sets of Chrome plated frangible bulb type detectors for areas identified elsewhere in the specification.

w) Sets of addressable analog optical type of smoke detection arranged in X-zoning fashion for areas identified in the specification.

x) Sets of addressable analog multi criteria smoke detectors arranged in X-zoning fashion for areas identified in the specification.

y) Sets of Analogue Addressable type heat detectors for the areas identified in specification.

z) Solar blind Infrared detectors with inbuilt air purging unit for each conveyor. Dual wavelength Infrared flame detectors for boiler burner fronts and turbine oil tanks.

aa) Lot of linear heat sensing cables (non-electrically operated Fibre Optic LHSC) for the areas mentioned in the specification.

bb) Gas sensing fire detectors working on air sampling for all control rooms and control equipment room.

cc) Required nos. of addressable manual call points for the areas mentioned in the specification.

dd) Lot of open sprayers for HVW & MVW spray system.

ee) For periodic testing of deluge valve, one frangible bulb detector with GI pipe & isolating valve connected to detector network shall be provided for each of HT transformers.

ff) One (1) no. of siren of 10 KM range (minimum diametric).

gg) Complete lot of pipelines including all fittings for

- Entire hydrant system.
- Entire spray water (both HVW & MVW) system including network of sprayers.
- Entire compressed air piping for pressurising hydro pneumatic tank.

hh) Lot of cut-off gate valves, globe type instrument root valves and discharge valves for pumps & also for compressors. NRV's as required for firewater & compressed air lines.

ii) RCC Pipe enclosures/hume pipes of appropriate class for buried pipelines for all road crossings, rail crossing & for all places where bulldozer may operate.

jj) Vents and drains as required. Vent and drain valves shall be lockable type and drain lines shall be terminated to nearest surface drain.

kk) Pressure break-down orifices as required for hydrant system, spray system and first-aid-fire protection system.

5.02.00 **Civil**

For civil works refer to Volume VII.

5.03.00 **Electrical**

All electrical equipment and accessories as required for this system shall be supplied. These equipment and accessories shall meet the technical requirements of individual equipment specification covered under “Electrical Equipment & Accessories - Volume V” of this Bid Document.

5.04.00 **Control and Instrumentation**

Scope of supply shall not be limited to the following:

5.04.01 All field mounted instruments viz. process transmitters, local indicators / gauges,process switches, sensors, converters, etc. along with accessories as per specification and approved P & ID. All process transmitters shall be smart type with HART protocol.

5.04.02 All type of analogue addressable Fire sensors / detectors and associated detector loop cable and addressable interface modules.

5.04.03 Floor mounted vertical Fire detection alarm cum MIMIC panel & repeater panels complete with panel, racks, redundant electronic modules, redundant power supply units, battery & battery charger, redundant CPU module, zone modules, redundant communication modules, display units, indicating lamps, relays, communication / networking & interconnection cables, prefabricated cables, network components etc. in fully wired condition with all accessories viz, terminal blocks, gland plates, base channel, anti-vibration mountings etc.

5.04.04 PC based Operator station

5.04.05 A3 / A4 Laser Jet type Printer .

5.04.06 Hot redundant PLC.

5.04.07 Industrial grade Laptop based engineering station loaded with all latest version licensed software required for programming, troubleshooting and analysis for Fire detection alarm cum MIMIC panel & Repeater panel. This laptop shall also have licensed Office documentation software and Antivirus software.

5.04.08 Licensed version of all software for the Fire detection alarm cum MIMIC panels , PLC systems, MMI & Peripherals etc.

5.04.09 Ergonomically designed Control desks complete with all accessories and operator's chair for all Operator stations.

5.04.10 24V DC (2X12V DC) Battery and Battery charging units for each Fire detection and alarm panel & repeater panel .

5.04.11 240V AC, 50Hz, +/- 1% Mini UPS system for Operator station of Fire detection alarm cum MIMIC panel & Repeater Panels.

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5.04.12 Optical fiber cable, networking hardware comprising of LIU & Media converter to establish communication link in between the Fire detection alarm cum MIMIC panel & Repeater panel.

5.04.13 Complete process hook up materials such as. Impulse pipes & tubes of different grades, pneumatic tubing, stub, root valves, instrument isolation & blow down drain valves, valve manifolds, gauge valves, fittings, stands, brackets, supports, stanchions, frames, racks, foundation bolts, nuts and others erection hardware as applicable for installation of all field instruments /

racks.

5.04.14 All instrument racks, gauge board, Junction boxes and enclosure complete with all accessories. Canopy shall be provided for all outdoor applications.

5.04.15 All safety grounding cable

5.04.16 All instrumentation signals, control, power, detector loop cable, special, prefabricated cable, fiber optic cable , Linear heat sensing cable and grounding cable with all accessories such as cable glands, lugs, ferrules etc. as required for interconnecting Bidder's supplied Instruments, panels, annunciators, junction box or any other equipments
within Bidder's scope of supply.

5.04.17 All perforated trays, flexible & rigid conduits, cable tray supports and hangers, cable accessories including pull / cable boxes, inspection covers, lugs, ferrules,fittings etc for the above cables.

5.04.18 All special tools and tackle viz. Copper cable splicing & crimping tool, Optical fiber splicing & jointing tool kit, Hand held programmer / calibrator (HART) for configuration of smart Transmitter, Fire detector testing kits as required for erection, commissioning & maintenance.

5.04.19 Supply of all start-up / commissioning spares.

5.04.20 All consumables like lubricants, tapes, markers, printer papers etc. up to handing over of I&C system.

5.04.21 Any other hardware / software, not mentioned explicitly, but essential for successful completion of work shall be considered in the scope of the Bidder.

5.04.22 Scope of Works

All items supplied by Bidder shall be erected, tested and commissioned by Bidder The quality of erection work shall conform to industry standards and shall take into cognizance of dust & water ingress.

5.04.23 Volume VII of this specification shall be referred for technical requirements of different items eg. operator station, printer , panel , field instruments , cable etc.

6.00.00 DESIGN BASIS AND INPUT

6.01.00 Mechanical

6.01.01 Hydrant System

a) Provision of "double headed hydrants" as per the configuration of "risk area" shall be acceptable.

b) Spacing of hydrant (outdoor) shall be 45 M in general and for internal

hydrant/landing valves spacing shall be 30 M (max.)

c) Pressure at each hydrant point (both outdoor & indoor) shall be minimum 3.5 Kg/Sq.cm(g).

d) Based on total nos. of hydrants (outdoor), nos. of branch pipes, triple purpose nozzles & hoses shall be determined as per guideline of TAC/LPA.

e) Based on total nos. of indoor hydrants (landing valves), nos. of hoses branch pipe, triple purpose nozzles & hose boxes shall be determined as per guideline of TAC/LPA.

6.01.02 **Spray Water System (HVW & MVW System)**

a) Minimum pressure at HVW nozzles and MVW nozzles shall be 3.5 bar and 1.4 bar respectively. Maximum pressure at HVW nozzles and MVW nozzles shall be 5 bar and 3.5 bar respectively. However, for cable vaults, same shall be as per TAC/LPA regulations.

b) Water density for top & bottom conveyor belt shall be 10.2 lpm/ sq.m.(min.)

c) Water density for all surfaces of Transformer shall be 10.2 lpm/Sq.m only.

d) Water density for Cable Spreader Room/ Cable Vault shall be 12.2 lpm/sq.m. (min.) of cable tray area.

e) For turbine oil tank and purification area, burner front water density shall be 10.2 lpm/sq.m. (min.).

f) Chrome plated nozzles shall be arranged in the form of ring to all transformers and nos. of such rings/tiers shall be decided considering maximum gaps between two (2) consecutive tier of rings as 3.0 M. The distance of the deluge valves from the transformers shall be approx. 6 metres.

g) All nozzles shall be open sprayer type and chrome plated.

h) No. of nozzles for any particular risk shall be selected considering the characteristic of nozzles provided by the bidder and also the density of water needed to protect completely the risk as per sl. no. (b) to (e) above/NFPA.

i) Cable vaults/cable spreader rooms shall be suitably zoned. Total water requirement for each zone shall be limited to one-third the capacity of each spray water pump.

j) Conveyor belt shall be suitably zoned. Length of each zone shall be so selected such that water requirement of each zone shall be limited to one-third the capacity of each spray water pump and in case of fire, three (3) zones (one forward and one backward and the zone under

fire) shall be flooded.

6.01.03 **Inert gas flooding system**

a) Proprietary inert gas shall be used for inert gas flooding system.

b) The centralized inert gas flooding system shall be designed considering the single largest protected volume.

c) Required number of pressure reducing stations shall be provided in the gas manifold for gas pressure reduction from cylinder pressure to required gas flooding pressure.

d) The inert gas flooding system and its components shall be designed as per NFPA 2001 recommendations.

e) The cylinder rack shall be designed to accommodate sufficient number of inert gas cylinders so that the largest protected volume can be flooded.

6.01.04 **Detection System (Microprocessor Based)**

a) Coverage of Frangible bulb type detectors, Infra red type heat detectors and multi criteria smoke detectors shall be considered. One smoke detector for every 100 m^2 or one heat detector for every 50m^2 of the compartment area shall be considered.

b) Solar blind IRD with inbuilt air purging unit shall be 3 nos. minimum for each conveyor, 1 no. each at a distance of 1-2 M from tail end and head end and 1 no. at middle. However, same shall be verified with the covering range indicated by the manufacturer.

c) Linear heat sensing cable shall be provided along the whole length of the top belt and bottom belt of each conveyor and on bearing and pulley of driving and non driving ends.

6.01.05 **General**

a) Each zone of cable spreader room shall be provided with one (1) no. cut-off quick opening type Deluge valve.

b) Each zone of conveyor belt shall be provided with one (1) no. Solenoid operated deluge valve.

c) Water velocity in Fire water pipes shall be as per TAC/LPA recommendation.

d) Frictional drop shall be calculated based on Hazen-Williams equation considering "C" as 120. Hardy-cross Method shall be applied to find out total frictional drop during selection of pump head. 10% margin in frictional head shall be considered during pump head selection.

e) Actual pipe size & TDH of pumps shall be selected by Bidder based on "design basis & inputs" specified herein and as approved by the Owner/Consultant.

f) Cut-off gate valves shall be provided for each small and big loops on as required basis.

g) Pressure break-down orifice shall be provided as necessary to restrict pressure of all hydrant point upto 3.5 Kg/cm.sq.(g).

h) Water sprayer shall be placed in such a way so that the "spray cone" overlaps each other. This is applicable for all transformers, cable vaults, conveyor belts and other areas where MVW or HVW spray system has been asked for.

6.02.00 Fire Detection Panel and repeater panel ,Linear Heat sensing cable

6.02.01 Fire Detection, Alarm and Protection system proposed through the Fire detection and Repeater panels shall provide continuous surveillance against fire in the areas of plant. All Fire detection and repeater panels shall be colored MIMIC based.

6.02.02 The Main Objectives of the of these panels are as follows:

a) To detect fire in its early stages and activate or alert for implementation of Emergency action, thus protecting personnel and equipment.

b) To provide an appropriate level of monitoring in the event of fire and audiovisual annunciation at respective Fire detection alarm cum MIMIC panel Repeater panel and the PC based operator station.

c) Opening of the deluge valve in case of fire detection.

d) The sensing of fire is accomplished through various types of fire detectors / LHS cable.

e) To ensure high reliability and availability of the system with quick and exact identification of the fire location without false alarm.

f) To provide contact output in the loop / from fire detection and protection panel & repeater panel for fire protection & other systems viz. opening of deluge valves, tripping of Ventilation System Fans / Dampers / Air Handling Units / tripping of belt conveyor / activating foam system / inert gas flooding system on detection of fire in specific area for effective fire protection.

6.02.03 Fire detection and alarm & Repeater cum MIMIC panel shall be provided in accordance with all codes and standards to annunciate fire alarm signals from fire protection and detection systems provided for the facility, annunciate system / device fault and to provide supervisory functions as required.

6.02.04 In case of fire, the audio-visual fire alarm shall be generated at Fire detection

and alarm & Repeater panel and also initiate a signal to operate hooter(s) in the area where the fire signal is detected.

6.02.05 Indication (bright LED type) and Graphic Display (LCD type) shall be provided ineach Fire detection and alarm & Repeater panel . Information / data from these Fire detection alarm cum MIMIC panel s shall also be available in a dedicated computer based operator station in.. This computer shall be an UL/FM Listed PC used to display event information from the network in a text and graphical format. Graphic screens shall be created with a built-in drawing utility of the protected area and are linked to fire alarm devices. Should a device go into alarm, the appropriate graphic floor plan is displayed along with operator instructions. This shall provide a quick and easy way to inform operators of a fire's location in the buildings. The computer shall have features including event logging, event history tracking, fire panel programming and control.

6.02.06 Each Fire detection alarm cum MIMIC panel shall be capable of operating in stand-alone mode. All Fire detection alarm cum MIMIC panel, Repeater panels and PC based operator stations shall be connected by a dedicated fault tolerant Local Area Network (LAN) through redundant Fiber optic communication cable.

6.02.07 Fire detection alarm cum MIMIC panel shall have multiple loop processing capability. Each area / zone shall be
monitored by one independent loop and a loop shall not be shared between different zones. Each Fire detection alarm cum MIMIC panel shall have additional capacity of handling at least ten alarms per zone, requiring only field wiring, as a spare for future modification or expansion.

6.02.08 The Fire detection alarm cum MIMIC panel shall continuously monitor the status of the detectors and connecting lines. The panel shall evaluate the analogue information received from each addressable detector and compare with set value to check for alarm condition.

6.02.09 Fire detection alarm cum MIMIC panel comprises of loop interface boards with specified loop capacity. The individual elements (detectors / sensors / control / fault isolation modules / interface modules) are looped together and connected to the loop interface board on the Fire detection alarm cum MIMIC panel on a 2-wire circuit (class B wiring).

6.02.10 Minimum indications to be provided on the Fire detection alarm cum MIMIC panel shall be Fire , Fault , Isolate , Pre-alarm, Multiple alarms.

6.02.11 Minimum controls to be provided on the Fire detection alarm cum MIMIC panel shall be Push button -Acknowledge , Push button- Reset , Push button -Test ,Push button - switch -Isolate.

6.02.12 Minimum information to be provided on the panel shall be Detector identification number, Connecting line identification number, Zone / Area description, Detector in isolated condition

6.02.13 Display of the status of the detector, sequence of the events, alarm and trouble summary etc. shall be displayed on the display unit of Fire detection

alarm cum MIMIC panel and as well as on the operator station and printer.

6.02.14 Alarms and indications of Fire detection alarm cum MIMIC panel s are repeated in the repeater panel. Repeater panels shall be provided with a 24" LCD display unit indicating major events, alarm, trouble etc., which shall repeat the information related to sector / area,zone, floor Elevation, room no. and detector no. etc., which are being displayed in the related Fire detection alarm cum MIMIC panel. Repeater panels shall allow acknowledgement of all alarm
signals generated by fire alarm system.

6.02.15 The fire detection and alarm system shall be in normal operation even during mains 240V AC power failure. The stand by DC power supply from the battery in Fire detection alarm cum MIMIC panel shall be capable of maintaining the system in normal operation & in alarm condition for a period of not less than 48 hours after the failure of mains supply.

6.03.00 **Electrical**

6.03.01 The automatic fire detection and alarm system shall be designed with electronics having built-in redundancy to ensure availability at all times.

6.03.02 Bidder shall offer microprocessor based Intelligent/ analogue addressable type fire detection and alarm system. Fire alarm system working on microprocessor based system shall have dual redundant fibre optic data highway.

The fire detection and alarm system shall essentially consist of Fire detection alarm cum MIMIC panels with respective CRT Key Board Stations located in CCR, Fire detection alarm cum MIMIC panel, Master Fire Alarm Panel with CRT Key Board Station located in Fire Station, Satellite Fire Alarm panels located in various Plant areas, detectors, Manual Call stations, alarm devices, accessories, wiring and all connections to devices.

6.03.03 The Fire detection alarm cum MIMIC panels in CCR and the Satellite Fire Alarm Panels shall be used for fire detection, associated annunciation system, power supply distribution etc. of the fire protection system. Satellite Fire Alarm panels shall be strategically located in different areas of the Power Plant considering zone-wise detection.

The Fire detection alarm cum MIMIC panels in CCR and the Satellite Fire Alarm Panels shall be microprocessor based and their primary function shall be to raise an effective alarm by visual and audible means upon receipt of an alarm signal from any of its detection circuit(s) and to activate any device(s) that may be connected to the system(s).

Each detection circuit shall be continuously monitored for fire and fault. Alphanumeric indications shall be provided for fire and fault. Facility shall also be provided for simulation, for test purposes, of these conditions by operation of a control switch, which shall also have a facility to isolate and reset the alarm-receiving group.

6.03.04 The Fire detection alarm cum MIMIC panels located in CCR shall be used to

hook-up with each Satellite Fire Alarm Panel to indicate group zone-wise fire annunciation from Satellite Fire Alarm Panels. Fire detection alarm cum MIMIC panels shall also supervise, monitor and annunciate the abnormal condition of the circuitry of the fire detection system through local panels.

6.03.05 External circuit supervision shall not require additional wires other than the pair used for detection or alarm. These two wires shall provide both supervision and alarm signals.

6.03.06 Upon activation of any detection device installed in the circuit, the system shall automatically report the status and initiate the sequence of operations with the following functions as minimum :

a) Sound an alarm on audible devices.

b) Notify automatically central fire station.

c) Light an indicating lamp on device initiating the alarm.

d) Display "zone" and / or device no. on the panel with defined message.

e) Activate the output relays for shutdown of ventilation/air- conditioning system, coal conveyor etc. as per requirement.

f) Actuate in fire protection devices & deluge valves etc.

6.03.07 Alarm shall have priority over trouble. All trouble conditions shall be reported to include the zone / device no., location etc.

6.03.08 In the event of detection of fire, auxiliary systems like ventilation, air-conditioning may require shutdown. For this purpose potential free contacts from the output of the fire protection system shall be made available in the local / main fire panel and terminated in the terminal block

6.03.09 The Fire detection alarm cum MIMIC panels as well as Master Fire Alarm Panel shall have provision and facilities for connection to Intel i5 (or latest version at the time of supply) WIN NT (or latest at the time of supply) based Personal Computer with SVGA Monitor and dot matrix printer to be provided by the Bidder. Fire response program shall be furnished on screen and automatic action shall be initiated by keyboard / mouse operation.

6.04.00 **Civil**

6.04.01 Buried piping shall be laid generally at a depth of 1.0 M below grade. In case of road crossing, same shall be 1.5 M minimum.

6.04.02 Construction of Valve chamber for under ground pipes, Hose house and shed for deluge valves and compressor as per good engineering practice.

7.00.00 **DESIGN AND CONSTRUCTION**

7.01.00 **Fire Water and Jockey Pumps**

7.01.01 **Performance Requirement**

a) Performance requirement for the pumps shall be guided by the `Data Sheet' enclosed in this section and TAC/LPA recommendation.

b) Pumps shall be capable of furnishing not less than 150 % of rated capacity at a head of not less than 65 % of the rated head. The shut-off head shall not exceed 120 % of rated head in the case of horizontal pumps and 140 % in the case of vertical turbine type pumps.

c) Pump-Motor sets shall be capable of continuously delivering the rated output for the voltage variation of (±) 10% and frequency variation of (±) 5% occurring separately or combined voltage and frequency variation of (±) 10% (absolute sum).

7.01.02 **Constructional Features**

a) The design and Testing Standards of the Pumps shall conform to the standards as indicated in the TAC/LPA recommendation.

b) The pumps shall comply with the regulations of Tariff Advisory Committee (TAC)/LPA and National Fire Protection Association (NFPA), USA as applicable.

c) Drive Unit Power rating for the fire water pumps shall be selected such that it is equal to higher of the two conditions:

i) 110% of the duty point power requirement.

ii) Motor input power required at 150% of the duty point capacity of pump

7.02.00 **Diesel Engine**

7.02.01 Performance requirement of the diesel engine shall be guided by TAC/LPA recommendations.

7.02.02 The engine shall be capable of operating continuously on full load at the site conditions for a period of at least six (6) hours.

7.02.03 The engine shall be naturally aspirated, super charged or turbo-charged as recommended by the manufacturer. (Ref. Fire Protection Manual by TAC/LPA).

7.02.04 The continuous engine brake horse power rating (after accounting for all auxiliary power consumption) at the site conditions shall be at least 20% greater than the brake horse power required to drive the pump at it's duty point at rated R.P.M. and in no case less than the brake horse power required to drive the pump at 150% of rated discharge or at any condition of operation of pump. Deaerating Factors considered by the manufacturer to arrive at the shaft power of the diesel engine at site, shall not be less than the following for

normally aspirated engines only:

a) 3% for each 305 metre elevation above MSL (Ref. NFPA, Volume-2, 1978).

b) 1% for each 5.6° C rise in air temperature above 15.6° C (Ref. NFPA, Volume-2, 1978).

The base power rating of the diesel engine shall be referred to any accepted datum like BS/SAE Standard condition or equivalent. In any case, horsepower rating shall not be higher than the limit set by Tariff Advisory Committee.

7.02.05 Design and construction of the diesel engine shall be guided by the TAC/LPA recommendations.

7.02.06 **Starting**

a) The engine shall be capable of both automatic and manual start.

b) Automatic cranking shall be effected by a battery driven D.C. motor having high starting torque to overcome full engine compression. Starting power shall be supplied from two (2) sets of storage batteries. One (1) set of battery is for automatic starting of the engine and the other provided for manual starting. A selector switch shall be provided at the automatic starting control panel to select any of the two (2) sets of battery for manual/auto starting of the engine.

The automatic starting arrangement shall include, as a safeguard, a "Repeat Start" feature so that if the pinion of the starting motor does not engage the flywheel at the first attempt, it is automatically retracted and after a short pause again will advance towards the flywheel.

This repeat start cycle will continue until five (5) kicks after which there will be suitable annunciation. The battery capacity shall be adequate for ten (10) consecutive starts without recharging with a cold engine under full compression.

c) Arrangement for both trickle and booster charge of the batteries shall be provided. When the engine starts running, provision should be kept to ensure that the charger is automatically disconnected and the battery is charged by engine dynamo.

Each diesel engine shall be provided with two (2) battery charger units of air cooled design. Each charger unit shall be capable of charging one (1) set of battery at a time. Provision shall, however, be kept so that any of the charger units of a particular engine can be utilised for charging any one of the two (2) batteries of that engine.

7.02.07 **Governing System**

a) The engine shall be fitted with a speed control device that will control the speed under all conditions of load.

b) The governor shall offer following features:

i) Engine should be provided with an adjustable governor capable of regulating engine speed within 10% of it's rated speed under any condition of load up to the full load rating. The governor shall be set to maintain rated pump speed at maximum pump load. (Refer Fire Protection Manual by TAC/LPA).

ii) Engine shall be provided with an over speed shut-down device. It shall be arranged to shut-down the engine at a speed approximately 20% above rated speed and for manual reset, such that the automatic engine controller will continue to show an over speed signal until the device is manually reset to normal operating position. (Refer NFPA).

c) The governor shall be suitable for operation without external power supply.

7.02.08 **Fuel System**

a) The diesel engine will run on High Speed diesel oil, analysis of which has been indicated elsewhere in specification.

b) Each engine shall be provided with fuel oil tank having storage capacity sufficient to run the engine at full load for at least six (6) hours.

c) For each compression ignition engine driven pump set, there shall be individual fuel tank and fuel feed pipes.

d) A suitable 1 phase 240 Volt fuel pump (portable) to be provided to fill up diesel oil from Diesel Drum received from supplier of Diesel. This pump should also have facility to be operated by hand, in case electricity fails.

7.02.09 **Lubricating Oil System**

Automatic pressure lubrication shall be provided by a crankshaft driven oil pump, taking suction from a sump and deliver pressurized oil through cooler and fine mesh filters to a main supply header fitted in the bed plate casing. High pressure oil shall be supplied to main and big end bearings, cam-shaft bearings, cam-shaft chain and gear drives, governor, auxiliary drive gears etc. Valve gear shall be lubricated at reduced pressure through a reducing valve and the cams by an oil bath. The above lubricating oil sump shall be equipped with adequate heaters having thermostat control to maintain the lubricating oil at recommended temperature for maintaining oil at low viscosity.

7.02.10 **Cooling Water System**

The cooling water system shall conform to any one of the systems specified in Fire Protection Manual of the Regional committee of the Tariff Advisory Committee / LPA / NFPA. The Contractor shall clearly indicate in his offer the type of cooling system adopted. In case fire water is used as a cooling media by tapping of the water from the fire water pump discharge (before the pump discharge valve), the capacity of the fire pump shall be increased, so that the net capacity meets the specification requirement.

7.02.11 **Instrumentation & Control**

The diesel engine shall be provided with adequate instrumentation. These shall include but not limited to the following:

a) Temperature indicator (contact type) in cooling water inlet and outlet.

b) Temperature indicator in lubricating oil outlet from the oil cooler.

c) Pressure gauges (contact type) for lubricating oil system.

d) Differential pressure gauges (contact type) across strainers/ filters.

e) Speed indicator.

f) Running hour meter.

g) Dip stick type lubricating oil sump level indicator.

h) Gauge glass type Fuel Oil Tank level indicator.

i) Voltmeter & Ammeter in dynamo type battery charging circuit.

7.03.00 **Air Compressors**

7.03.01 Air Compressors shall be designed for intermittent operation with high efficiency to satisfy the requirement as specified in the data sheets.

7.03.02 Compressor shall be mounted on an air receiver of suitable size so that delivery air pressure is kept within (±) 5% of rated pressure without excessive start-stop operations in the working cycle.

7.03.04 **Instrumentation and Miscellaneous Accessories**

The package air compressor and drive shall be supplied complete with the following instrumentation and accessories as minimum.

a) Discharge air pressure gauge.

b) Pressure switch to control actuation of compressor drive motor.

c) Starter for drive motor.

d) Pressure relief valve.

e) Drain valve.

f) Delivery valve.

7.04.00 **Fire Water Storage Tanks and Hydro-pneumatic Tank**

7.04.01 Fire Water Storage tanks hall be of Steel made of 5000 m^3 capacity with two compartments.

7.04.02 Design of Hydro pneumatic tank shall conform to IS-2825/ASME Section-VIII, Div.1. Design pressure should be the maximum expected pressure to which the vessel may be subjected plus 5% extra margin. Maximum expected pressure for vessel placed in the discharge line of pumps shall be based on the shut off head of the pump plus static head at pump suction, if any.

7.04.03 Design temperature of vessel shall be 10°C higher than the maximum temperature that any part of the vessel is likely to attain in course of operation.

7.04.04 Corrosion allowance of 2 mm (minimum) on shell and dished ends shall be considered while designing the tank. Suitable mill-allowance shall also be considered for shell and dished ends. Thinning/scaling allowance of 2 mm (minimum) shall be considered for dished ends.

7.04.05 Plates shall be cold rolled through plate bending machine by several number of passes to true curvature and joined by welding.

7.04.06 Tank seams shall be so positioned that they do not pass through vessel connections. Inside seam weld shall be ground smooth, suitable for application of corrosion resistant coating.

7.04.07 All welding shall be as per IS-816 or equal. Bidder shall state clearly in his proposal the make and type of welding rods necessary for construction work.

7.04.08 The tank should preferably be fabricated complete and tested at Manufacturer's works to ensure better workmanship.

7.04.09 **Tank Connections**

a) Bidder shall furnish all pipe material required for vessel connections. All flanged connections should be supplied complete with matching counter flanges, nuts, bolts and gasket materials.

b) Bolts and nuts shall be of hexagonal head conforming to IS-1367 or equal.

c) Gaskets shall be full-face type.

d) Level gauge with isolating valve shall be provided.

e) All connection as required for pressure gauge, pressure switch, level switch etc.

f) Manholes/inspection hole shall be provided in the tank for providing easy access into the same.

g) Suitable ladders attached to the tank shall be provided for easy access to various instruments mounted there on.

7.05.00 **Piping, Fittings, Valves and Specialties**

7.05.01 All pipelines under Bidder's scope of work shall be sized considering flow velocities as per TAC/LPA.

7.05.02 Design condition of piping and material of construction, galvanization etc. for pipes and fittings, handling different fluid shall conform to piping data sheet enclosed.

7.05.03 Pipes shall be provided with vent connection and vent valves at all high points and drain connection & drain valves at all low points. Drain valves shall be lock-closed type.

7.05.04 All pipe bends shall be long radius forged elbow and having bend radius R=1.5D.

7.05.05 Hangers and supports shall be capable of carrying the sum of all concurrently acting loads. They shall be designed to provide the required supporting effects and allow pipe lines movements as necessary. All guides, anchors, braces, dampener, expansion joint and structural steel to be attached to the building/structure/ trenches etc. shall be provided. Type of hangers and components for all piping shall be selected by Contractor and approval of the same shall be obtained from the Purchaser.

7.05.06 All piping system shall be capable of withstanding the maximum pressure arising from any condition of operation and testing, including water hammer effects.

7.05.07 Gate, Globe and check valves shall be used respectively for isolation, regulation and non-return services in general for compressed air and water line upto a certain size as indicated in valve data sheet. Suitable size of drain valves shall be used in drain lines.

7.05.08 All valves shall be suitable for service conditions i.e. flow, temperature and pressure under which they are required to operate.

7.05.09 Gate valves shall be outside screw rising spindle type

7.05.10 Gate valves shall be provided with hand wheel, position indicator, pressure-equaliser for valves 350 mm NB and above and drainage arrangement. Locking facility shall also be required where necessary. Gate valve shall be provided with back seating bush to facilitate gland renewal during full open condition. Globe valve shall have adequate profile for controlling action, check valve shall be swing check type and shall have arrow inscription to show the direction of flow.

7.05.11 Whenever any valve is found to be so located that it cannot be approached manually from the nearest floor/gallery/platform, hand wheel with floor stand or chain operator shall be provided for the same.

7.05.12 For the operation of valves located in the valve pits, suitable arrangement shall be provided to operate the valves from the ground level (i.e. from the top of Valve Pit). For this purpose wrench-operated valve may be looked for.

7.05.13 **Safety Relief Valves**

Design and construction shall be as per Volume : II-D, Section-II.

7.05.14 **Deluge Valves**

Deluge valves shall be used for automatic HVW spray system and MVW spray system. In automatic HVW Spray System, deluge valve in spray water line shall be kept closed normally by water pressure. Same water line will form the water circuit of fire detector. When the detector quartzoid bulb collapses in the event of fire, the water pressure in the deluge valve will fall resulting in the opening of deluge valve. Fast acting butterfly valves shall be provided as a bypass valve to the deluge valve, so that the butterfly valve can be operated manually in the event of fire, if there is any malfunction of deluge valve. Isolation valves on upsteam and downstream side of deluge valve shall be provided.

But the deluge valves, which will be used in the MVW spray system shall be of solenoid-operated type, will remain normally closed but in the event of fire, the solenoid will be energised to open the valve.

Wherever deluge valves are located, they shall be located in protective room For further details of Specification of all valves mentioned above, Data Sheet shall be referred to.

7.05.15 **Strainers**

a) For basket strainer details Data Sheet shall be referred to.

b) Y-type Inline Strainer (If required) - Body shall be constructed of mild steel as per IS:2062 (tested quality). Strainer wires shall be of stainless steel AISI:316, 18 BWG, 30 mesh. Blowing arrangement shall be provided with removable plug at the outlet. Screen open area shall be at least 4 times pipe cross-sectional area at inlet.

7.05.16 **Hydrant Valve (Outdoor) & Stand Post Assembly**

The general design of hydrant valve shall conform to IS:5290 type A and shall be suitable for outdoor operation and for further details data sheet shall be referred to.

The general arrangement of outdoor stand post assembly, consisting of a column pipe and a hydrant valve with a quick coupling end shall be as approved by the Regional Committee of the Tariff Advisory Committee/NFPA.

7.05.17 **Indoor Hydrant Valves (Internal landing valves)**

The general arrangement of the indoor hydrant valves (also known as internal landing valves) shall be as approved by the Regional Committee of the Tariff Advisory Committee/NFPA.

The general design of hydrant valve shall conform to IS:5290 Type-A and shall be suitable for indoor operation. It shall be identical with hydrant valves (outdoor) as outlined above to facilitate interchangeability.

7.05.18 **Hydrant Valves for First Aid Fire Protection System**

The Water Supply connection for the first aid hose reels shall be taken/tapped from the closest hydrant riser.

The general design and construction of the hydrant valves for first aid fire protection system shall conform to IS: 5290 Type-A and shall be suitable for indoor operation.

7.05.19 Hoses, nozzles, branch pipes and hose boxes

a) The first aid hose shall be provided with cotton-reinforced hoses as per IS: 884 with corrugated external surfaces. Each fire hose shall be provided with quick coupling, branch pipes, nozzles, spanners, etc. The hoses for the internal and external hydrant system should be Rubber impregnated woven jacketed type conforming to IS:636 Type-II.

b) Branch pipes shall be constructed of Stainless steel (SS-304) and have rings at both the ends. One end of the branch pipe will receive the quick coupling while the nozzle will be fixed to the other end.

c) The nozzle sizes shall be of not less than 16mm (or 5/8 inch.) in diameter, nor more than 25 mm (or 1 inch.) in diameters for indoor and outdoor hydrants and 6.35 mm (or 1/4 inch) for first aid fire protection system.

d) 2 Nos. 15m long Hose pipe fitted with quick coupling ends, branch pipes, nozzles, spanner etc. shall be kept in a hose box, which shall be located near point of use. The furnished design must meet the approval of the Regional Committee of the Traffic Advisory Committee/NFPA. The general design and construction of instantaneous couplings, branch pipes and nozzles shall comply with IS:903 (latest revision).

e) All instantaneous couplings, shall be of identical design (both male and female designs shall be utilised) so that any one can be interchanged with another. One male/female combination shall get locked in by mere pushing of the two valves together but will provide leak tightness at a pressure of 21 Kg/sq.cm. Designs employing screwing or turning to have engagement shall not be accepted.

7.05.20 **First Aid Hose Reels (Small Bore Hose Reels)**

a) First aid hose reels shall be provided inside the power house building only to provide facilities of preliminary fire fighting by people other than fire personnel.

b) At each floor 32 mm (or 1 and 1/4 inch) diameter first aid hose connection shall be provided from the hydrant risers. The first aid hose reels shall comprise of one no. SS (AISI- 304) isolation valve, reinforced (cotton) rubber hose pipe and one no. SS (AISI-304) nozzle (with isolation arrangement) duly mounted on a swing type (90 deg. min) hose reel.

c) The number and distribution of hose reels shall be such that the whole or each floor is protected and that no part of the floor is more than 6m (or 20 ft.) distant from a hose nozzle when the hose is fully extended.

7.05.21 All instrument root valves shall be stainless steel Gr. 316 globe type.

7.06.00 **Detectors (Microprocessor Based)**

7.06.01 Detectors shall be intelligent analogue addressable type. Detectors shall be housed or mounted in suitable enclosures in such a way that their performance is in no way affected. Special maintenance procedures, if any, required for the satisfactory operation of the detectors shall be clearly described.

7.06.02 In case detectors having electrical contact signal output on sensing fire, it shall be noted that the contact shall be "NC" type so that under fire conditions, this contact will open to initiate fire alarm system.

7.06.03 Normally the detectors, which has sensed fire and operated to give fire alarm could be easily located by the numbering scheme both on the detectors and zone-panel, for fire alarm system.

7.06.04 The various fire detectors serving a particular area/zone of plant may be wired-up in group and one common signal for each area or zone is transmitted to the zone indicating panel. The number of detectors to be installed shall be governed by total area to be protected, type of building construction, air movement, ceiling construction and sensitivity required.

7.06.05 The detectors shall be located where the largest combustion gas concentration can be expected.

7.06.06 It shall be possible to replace any type of detector head by a different type detector without requiring change in cabling/panel wiring and condition of the zone originally covered by the detector, thereby making it possible for a smoke detector to be replaced by either heat or flame type or vice versa.

7.06.07 All detectors shall be provided with built-in response indicating Lamp/LED which shall give local visual indication, in dense smoke condition when it will operate. The failure of lamps shall not prevent the function of detector.

7.06.08 The exact location of detectors shall be coordinated with other services like air-conditioning grills, light fittings, cable trays etc. to provide aesthetically pleasing appearance. The return air paths of air conditioning shall be avoided for detector location.

7.06.09 In such areas where detectors themselves are not easily accessible, the remote response indicators outside the enclosed areas shall be provided to indicate the fire condition.

7.06.10 Make and type of detectors shall be subject to Purchaser's approval.

7.06.11 The indigenous detectors shall have the approval of ISI/ISO in addition to the approval of FM/UL/. Detectors and panels shall be preferably from the same manufacturer for compatibility.

7.06.12 The detectors shall not be effected by temperature, humidity, air flows.

7.06.13 **Multi Criteria Smoke Detectors**

a) The multi criteria smoke detectors shall be capable of sensing the fire in the incipient or smoldering stage itself, long before the fire matures to a visible flame. For achieving this requirement, the detector shall be capable of sensing visible combustion gases (in the form of smoke) or invisible combustion gases, which are the only clues for a long time in smoldering fires.

b) The detectors shall be sensitive to very low smoke densities of the order of 0.05 gm/cu.m.

c) The detectors shall be of Multisensor type with a combination of photoelectric and heat sensing elements. The multicriteria smoke detector provides photoelectric sensing and heat sensing combined in a single sensor/base assembly. The multisensor base provides two sequentially addressable points, automatically assigned with one address selection.

d) The sensitivity of multicriteria smoke detectors shall be selected depending upon the environmental condition.

e) For further specification of multicriteria smoke detector, data sheet shall be referred to.

7.06.14 Rate-of-Rise and Fixed Temperature Heat Detector (IC Type)

a) The detector shall be solid thermal detector.

b) It shall operate on electronic-principle to provide precise fire detection.

c) The detector shall be of integrated circuit design enclosed in a robust moulded base.

d) It shall be completely moisture proof and air tight with exposed metal part specially treated to allow the device to be used in particularly

corrosive atmospheres.

e) The detector should work on rate-of-rise and fixed temperature modes of operation.

f) It shall have no moving mechanical parts.

g) The detector shall be either surface mounted or with the body concealed above the ceiling and only the detecting element in view.

h) The rate-of-rise detector shall function when the rate of temperature increase exceeds a pre-determined value, around 7 to 8 Deg C per min. This detector shall be designed to compensate with the normal changes in ambient temperature, less than 6.7 Deg C per min., which are expected under non-fire conditions.

i) For further details, data sheet shall be referred to.

7.06.15 Detection System by Linear Heat Sensing Cable

a) Linear Heat sensing cable shall be non-electrically operated optical fibre type.

b) The detector system shall consist of an optical fibre sensor and the detection unit. The detector unit shall house the electronic circuitry that interfaces with the optical fiber sensor.

c) The optical fibre shall be connected to the detector unit in a single continuous loop to ensure redundancy and full coverage of the protected zones even if the cable is broken/cut/damage at one point.

d) The fire or excessive temperature condition shall be sensed by the fibre. The detector unit shall recognize the change in optical transmittance of the fiber and cable breaker Fire/Alarm condition shall be identified within 1 mtrs locational accuracy.

e) For details of linear heat sensing cable, data sheet shall be referred to.

7.06.16 **Frangible (Quartzoid) Bulb Type Detector**

a) In frangible bulb type detectors a small amount of gas along with heat sensitive liquid (colored) is entrapped and hermetically sealed. This detector shall generally be mounted on the pressurized water line which forms a ring around the equipment to be protected. When the surrounding temperature rises more than the rated temperature of the detector, the gas inside the detector shall expand and as a result the quartzoid bulb shall collapse releasing water and consequently pressure in the water line shall fall sharply. This fall in pressure will give signal/annunciation in the Panel.

b) The frangible bulb shall be capable of withstanding the hydraulic test pressure (19 Kg/Cm^2 g) in normal practice.

c) Type and make of frangible bulb shall be of Owner's choice /approval.

d) For further details data sheet shall be referred to

7.06.17 **Infra red Spark/Ember Detector**

a) The detector must respond satisfactorily even when the lens, through which the detection is sensed are covered with coal dust or oily dust substance.

b) The detectors shall be designed to work satisfactorily in the event of vibration in any axis.

c) To prevent false alarms, the detectors shall be provided with purge air facility to keep the lines clean.

d) Facility for remote response indication shall be envisaged in each detector.

7.06.18 **Infra Red Flame Detector**

The Dual wavelength Infrared Flame Detector shall be provided in Boiler Burner front and Turbine Oil tanks to provide an alarm in case of fire.

7.06.19 **Gas Sensing Fire Detector**

Gas sampling type fire detectors working on the principle of air sampling shall be provided for early detection of fire in the high value control rooms.

7.07.00 **Manual Call System of Fire Alarm (Intelligent Addressable Type)**

7.07.01 Each Manual Call point unit shall comprise of a push button of reputed make enclosed in a M.S Box. The push button shall have minimum 1 NO and 1NC contact. The push button shall not be shrouded and the same shall be projected out from the surface the MS box. This whole assembly of push button in MS box shall again be enclosed in an external MS enclosure with all sides covered except the front side. The front side shall be sealed with breakable glass cover using neoprene or equivalent gasket.

The glass cover shall be fixed in such a way that the actuating push button is kept depressed (with NC contact closed and NO contact Open) so long as the glass cover is intact. In case of fire, when glass cover is broken to give fire warning, the push button shall be released due to spring action hence giving remote fire alarm through NC contact which is now changed over. The status of the change over of contact may be conveyed digitally also.

7.07.02 The MS Box and the external MS enclosure shall be completely dust, weather and vermin proof. The housing of the electronic circuitry shall have minimum IP 65 protection

7.07.03 The complete unit shall be suitable for wall/column mounting with necessary mounting accessories.

7.07.04 Clear inscription reading (in English) "FIRE ALARM - IN CASE OF FIRE BREAK GLASS" shall be provided for each manual call point unit, either on the MS enclosure or on a separate metal plate mounted behind the glass cover. The metal plate for inscription shall not tarnish under the atmospheric conditions.

7.07.05 Each manual call point unit shall be provided with the following accessories:

i) An iron hammer of sufficient weight, which could be used to break the glass cover. The iron hammer shall be suspended on a hook fixed to the external MS enclosure by means of a non-corrodible iron chain of sufficient length and play to facilitate easy breaking of the glass cover.

ii) Two numbers diametrically opposite earthing studs located on the outside surface of the external MS enclosure.

iii) An identification number (on a number plate) which will be invariably same as the number given to the fire alarm, indicating point on the Zonal and Main Fire Alarm panel. The identification number shall match with the address of the intelligent addressable Manual call point for easy identifying the Call Point unit.

iv) A dust sealing gland or equivalent on the external MS enclosure for outgoing cable from the unit.

v) A compression type cable terminating brass gland of reputed make for out going cable from the internal MS enclosure.

vi) In addition to this a red lamp Response Indicator shall be provided which will light up on actuation of manual call point to locate the manual call point station, which is operated.

7.08.00 **Control and Instrumentation**

For features and requirements of the control and instrumentation items including field instrument, Panels and Panel mounted instruments, relays, annunciators, selector switches, PLCs and other hardware and peripherals under scope of supply for the Fire Detection and Protection system. Bidder shall also refer the relevant clauses of the Volume VI of this Specification.

Specifications and data sheets for Detectors are furnished at the end of present Specification volume.

7.09.00 **Battery and Battery Charger**

7.09.01 **Battery**

a) Battery to be located in Plant Service Water Pump House shall be suitable to meet starting requirements of Diesel Engine driven pumps. Besides these all controls, indications, annunciations etc. (including multiplication of process interlock relays and auxiliary relays) shall have power supply from 24 V (2 X 12 V) Battery and Battery Charger

unit.

b) All controls, interlocks, indications, annunciation system etc. for each of the Fire detection alarm cum MIMIC panels (located in Central Control room) and the Repeater Panel (located in Fire Station), shall have power supply from 24 V (2 X 12V) Battery and Battery Charging Units. The Battery of each of the above Panels shall be located in the bottom portion of the same Panel. The PC with Printer in the central control room shall be powered up by the respective UPS Power of the Plant Instrumentation and Control System.

c) Diesel Engine Driven Fire Water Pump

The Battery shall have the capacity to start the Diesel engine at least for eleven starts. Further Battery shall have capacity to meet auxiliaries & other loads of Local Control Panel (if any) for a minimum period of 10 hours. Minimum Ampere-hour capacity of the Battery shall be selected accordingly.

d) The Battery driven Power supply shall be available to main and repeater fire alarm panel shall be designed to provide supply for a minimum period of 10 hours. Minimum ampere hour capacity of the Battery shall be selected accordingly.

e) Bidder shall compute the ampere hour capacity at suitable discharge rate based on above duty and furnish the calculation along with the Bid which shall consider the duty cycle and 25% & 15% compensation for ageing & unforeseen future growth respectively of each battery unit. The maximum and minimum ambient shall be 42°C and 11.7°C respectively.

The minimum voltage at the end of the load cycle shall not be less than 1.8 volts per cell.

7.09.02 **Battery Charger**

For design and construction of Battery Charger refer Volume V.

7.09.03 **Layout of Battery & Battery Charger**

a) The battery and charger of the respective panels shall be an integral part of each of the main fire panel / local fire panel / repeater panel.

b) Bidder shall indicate his own layout of 24 volt Battery and Charger to suit the space available.

7.09.04 Fittings & Accessories

Battery

Each battery shall be furnished with necessary accessories required.

8.00.00 **INSPECTION AND TESTING**

8.01.00 **Pipes/Fittings**

8.01.01 Hydraulic test or Eddy Current test shall be carried out at manufacturer works on pipes as per IS: 1239 Part 1/ IS: 3589. Fittings (bends, elbow, etc.) shall be as per IS 1239 Part 2 or equivalent specification.

8.01.02 Butt welds joints on buried as well as on above ground pipes shall be subjected to radiographic inspection as per TAC/LPA's manual.

8.02.00 **Water and Air Line Valves**

8.02.01 All valves shall be tested as per relevant design code of valve.

8.02.02 Valve trim material shall be subjected to NDT if diameter is equal to or grater than 50 mm.

8.02.03 Air tests shall be conducted as per applicable codes to detect seat leakages.

8.02.04 As cast heat marks shall be provided on castings and must be co-related with test certificates.

8.03.00 **Hydrant Valves and Stand Post Assembly**

8.03.01 The stand post assembly along with the hydrant valve (valve being open and outlet closed) shall be pressure tested to detect any leakage.

8.03.02 Flow test shall be conducted on the hydrant valves. The flow through the valve shall not be less than 900 liters/min. Vender may submit type test report of similar size of valves duly certified by reputed TPIA (eg Lloyds, BV etc) or by ISI

8.03.03 Leak tightness test of the valve seat shall be conducted.

8.04.00 **Indoor Hydrant Valves (Internal landing valves)**

Each internal landing valve shall be tested for pressure, flow and leak tightness as in clause no. 8.03.00 above.

8.05.00 **Hydrant Valves for First Aid Fire Protection System**

Each hydrant valve for first aid fire protection system shall be tested for pressure, flow and leak tightness as in clause no. 8.03.00 above.

8.06.00 **Fire Water Monitors**

Tests shall be done on Fire Water Monitor as per Code and Data Sheet.

8.07.00 **Hoses, Nozzles, Branch Pipes and Hose Boxes**

8.07.01 Rubber lined impregnated woven jacketed hoses shall be tested as per IS-636, Type-II and first aid fire protection hose shall be tested as per IS-444.

In both cases, following tests shall be included.

a) Percolation test b) Pressure test c) Burst test

The branch pipe, coupling and nozzles shall be subject to a hydrostatic test pressure to detect any leakage.

8.08.00 **Strainers**

Pressure drop test shall be carried out for basket strainers as well as Y-type line strainers.

8.09.00 **Battery and Battery Charger**

All equipment and components thereof shall be subject to shop tests as per relevant IS/IEC standards. The tests shall also include dielectric tests on Battery Charger.

8.10.00 **Fire detection alarm cum MIMIC panels and Repeater panels**

8.10.01 All equipment shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards.

8.10.02 Routine Tests

The tests for the panels shall include but not necessarily limited to the following :

a) Operation under simulated service condition to ensure accuracy of wiring, correctness of control schemes/annunciation system and proper functioning of the equipment/devices and continuity test of printed circuit cards.

b) All wiring and current carrying part shall be given appropriate High Voltage Test.

c) Routine test shall be carried out on all equipment such as contactors, relays, switch, fuse, instrument transformers, meters etc.

d) Power frequency withstand test shall be performed on control/ secondary wiring.

8.10.03 Type Test

Type test on typical section of a panel consisting of Transformer Panel, Power pack module unit, Control and operation unit, Annunciation unit etc. shall be performed as per relevant IEC/Fire codes.

8.10.04 Auxiliary Equipment

All component parts and auxiliary equipment such as space heater, insulator etc. shall be routine tested as per relevant IS/IEC.

8.11.00 **Type Tests on Fire Proof Sealing System and Fire Stop System**

The type tests for fireproof sealing system for floor/wall opening/fire stop system for bottom of Electrical Switchgear MCCs/Panel are as under:

a) Fire rating test

b) Hose stream test

c) Accelerated ageing test

d) Fire rating test on the penetration seal system built of accelerated aged components followed by Hose Stream Test.

e) Temperature rise test for cable in the fire stop.

f) Water absorption test followed by fire rating test.

g) Flame resistance test for fire protection coating material.

h) Anti-rodent Test.

The detailed test procedures for each of these tests are to be submitted by the bidder and is subject to approval by Owner/ Consultant.

9.00.00 **DRAWING, DATA AND MANUALS TO BE SUBMITTED BY BIDDER**

9.01.00 **Drawings to be Submitted by the Bidder**

9.01.01 Flow diagram showing the complete fire protection scheme with associated controls for the following :

i) Hydrant System both Indoor and Outdoor.

ii) Automatic type High Velocity Water Spray System with quartzoid bulb detection system in pressurized water loop.

iii) Automatic type Medium Velocity water spray system with digital type heat sensing cable as detector.

iv) Multicriteria smoke detection system arranged in cross-zoning principle.

v) Heat Detection System (IC type).

vi) Diagram showing the lubricant system etc.

9.01.02 Schematic and wiring diagram for Battery Charger.

9.01.03 Layout arrangement of battery with catalogues.

9.01.04 Mounting arrangement of battery charger.

9.01.05 Typical general arrangement drawing showing constructional features, space required in front & back, Power/Control/Signal Cable entry points, etc. of local fire panels, main fire panel, repeater fire panels and local control panel.

9.01.06 Typical Control Schematic diagram for solenoid operated valves, drive motors, Fire-detector circuits.

9.01.07 Contact multiplication diagram for hook-up with Air-conditioning System, Ventilation System, Coal Handling System.

9.01.08 Typical Annunciation System Schematic Diagram along with control and instrumentation scheme of the Fire Protection System.

9.01.09 Layout arrangement of Battery Charger inside.

9.01.10 Typical drawings for Fireproof Sealing System indicating fixing details and dimensions.

9.01.11 Write up on control and operating philosophy of complete Fire Fighting System.

9.01.12 System configuration of Fire water pumping & pressurizing system , Fire alarm detection & protection system etc. along with interface technique of other systems.

9.01.13 Proposed GA drawing of different panels.

9.01.15 I/O list

9.01.16 Technical data sheets

9.01.17 Bill of Materials

9.01.18 P&I diagrams

9.01.19 Details of Spares

9.01.20 Details of Training

9.01.21 Filled up Bid Proposal Sheets

9.01.22 Deviation Sheet.

9.02.00 **Data and Curves**

9.02.01 Battery cell voltage characteristics and data for different discharge rates.

9.02.02 Schedule of projectors in MVW spray system and various types of detectors i.e. quartzoid bulb, smoke detector, heat detectors & fire sensing cable, indicating nos. selected for each type of equipment/area.

9.02.03 Technical Leaflets on fireproof sealing system and Fire Protection Coating System.

9.02.04 Type Test Certificate for all the tests specified elsewhere in the specification.

9.03.00 **Design Basis & Back-up Calculations to be submitted by Bidder after award of contract**

9.03.01 Final version of all drawings and data submitted along with bid.

9.03.02 Back-up calculation for no. of quartzoid bulb detectors provided for detection of fire in transformers.

9.03.03 Back-up calculation for no. of multi criteria smoke detectors (optical type arranged in X-zoning fashion), provided for cable spreader room/cable vault/switchgear room/ control room etc.

9.03.04 Back-up calculation of IC type heat detectors provided for Indoor/outdoor type LT Transformers (Rating less than 10MVA).

9.03.05 Back-up calculation of heat sensing cable provided for detection in coal conveyor.

9.03.06 Basis of selecting no. of high velocity spray nozzles in LT transformer. One typical calculation each type of transformer shall be furnished.

9.03.07 Basis of selecting no. of medium velocity sprayer nozzles in coal conveyor, cable spreader room etc. One typical calculation in each case shall be furnished.

9.03.08 Pipe sizing calculation including thickness calculation considering allowable velocity of fluid in pipe line as furnished in "Design basis and input".

9.03.09 All civil/structural design calculations as applicable within civil scope of work.

9.03.10 Calculation for sizing of Battery and Battery chargers for each category of service.

9.03.11 Detail dimensional drawings of various panels , cabinets , equipment , components / sub assemblies with internal views.

9.03.11 Complete layout diagrams with foundation details of all panels , cabinets etc.

9.03.12 Junction Box / Rack GA & schedule and Instrument / JB location drawing.

9.03.13 Complete interconnection and cable schedule

9.03.14 JB / Panel Wiring drawings

9.03.15 Power Distribution Drawing

9.03.16 Pneumatic / Process Hookup drawing.

9.03.17 Complete loop and Logic diagrams

9.03.18 Logs and Graphics

9.03.19 List of special tools and tackle

9.03.20 List of consumables

9.03.21 Erection drawings and documents

9.03.22 Calibration and shop test certificates

9.03.23 QAP

ANNEXURE-I

DATA SHEET FOR FIRE WATER PUMPS

			Elec. Motor Driven	Diesel Eng. Driven	Jockey Pumps	Booster Pumps, if required
1.00.00	Service	:	a) ←- Fire Hydrant System -→ b) ← Fire spray water system →		For Pressurization of fire water system	Fire Hydrant & Spray System
2.00.00	Duty	:	←---------- Intermittent ----------→			
3.00.00	Location	:	←---------- Indoor ----------→			
4.00.00	Number of Pumps Required	:	a) Hydrant Pump – 1 No. b) High Velocity Water Spray Pump – 1 No c) Medium Velocity Water Spray Pump – 1 No.	Hydrant Pump – 2 Nos. Out of two one (1) is standby for hydrant system. Common standby for HVW & MVW Spray Water System – 1 No	Two (motor driven)	Two nos. for individual area
5.00.00	Pump Performance Requirement					

			Elec. Motor Driven	Diesel Eng. Driven	Jockey Pumps	Booster Pumps, if required
a)	Performance standard	:	<---------- Hydraulic institute standard ---------->			
b)	Rated capacity (Cu.m/hr.)	:	410	410	By Bidder	By Bidder
c)	Total head, (MLC) not less than	:	Bidder shall decide to meet TAC/LPA requirements		Bidder shall decide to meet TAC/LPA requirements	Bidder shall decide to meet TAC/LPA requirements
d)	Rated speed (rpm) Max.	:	<---------- 1500 ----------→			
e)	Permissible tolerance in rated capacity (%)	:	←---------- As per IS : 5120 ----------→			
f)	Permissible tolerance in efficiency at rated capacity (%)	:	←---------- No negative tolerance ----------→			
g)	Range of operation	:	←---------- 25% to 130%----------→			
6.00.00	Design standard	:	←----------HIS/ IS 5120/Equivalent Standard----------→			
7.00.00	Impeller type	:	←----------Semi open----------→			
8.00.00	Type of gland lubrication and sealing	:	←----------By Bidder----------→			
9.00.00	Shaft sealing arrangement	:	←---------- Mechanical seal ----------→			

			Elec. Motor Driven	Diesel Eng. Driven	Jockey Pumps	Booster Pumps, if required
10.00.00	Axial thrust balancing device to be designed for pump shut-off operation	:	←---------- Yes ----------→			
13.00.00	Type of pump-motor connection	:	←----------Direct ----------→			
14.00.00	Type of coupling	:	←---------- Flexible Coupling ----------→			
15.00.00	Mode of pump starting	:	←-- Discharge valve fully open ---→			
16.00.00	Material of Construction					
	a) Casing	:	← 2.5% NiCI as per IS:210 Gr. FG 260 →			
	b) Casing liner	:	←---------- Do ----------→			
	c) Impeller	:	<--------ASTM - A 743 GR. CF 8 M-------→			
	d) Wearing rings	:	<------ SS-304 -------→			
	e) Pump shaft	:	←--------- AISI 410 (Hardened) ----------→			
	f) Gland	:	← 2.5% NiCI as per IS:210 Gr. FG 260 →			
	g) Base plate	:	←----- Carbon Steel as per IS-2062 -----→			
	h) Mechanical Seal	:	<----- As per Manufacturer's Standard-------→			
	i) Wetted Fastners	:	←---------- SS-316 ----------→			

			Elec. Motor Driven	Diesel Eng. Driven	Jockey Pumps	Booster Pumps, if required
	j) Companion Flange	:	←----- Carbon Steel as per IS-2062 -----→			
17.00.00	Supply of accessories & services					
	a) Base plate	:	←---------- Yes ----------→			
	b) Foundation bolts, nuts, sleeves etc.	:	←---------- Yes ----------→			
	c) Suction & Discharge companion flanges with bolts, nuts & gaskets	:	←---------- Yes ----------→			
	d) Priming connection with 3 way SS isolating valve	:	←---------- Yes ----------→			
	e) Suction & Discharge pressure indicator	:	←---------- Yes ----------→			
	f) Vent with 3 way SS isolating valve	:	←---------- Yes ----------→			
	g) Pump-motor coupling and guard	:	←---------- Yes ----------→			
	h) Drain connection with valve		←---------- Yes ----------→			
	i) Eye-bolts, lifting tackle etc.	:	←---------- Yes ----------→			

ANNEXURE-II

DATA SHEET
FOR
DIESEL ENGINE

1.00.00	**GENERAL INFORMATION**		
1.01.00	Service	:	Plant Service Water Pump House
1.02.00	Designation	:	Internal combustion Diesel Engine.
1.03.00	Type	:	Compression ignition, mechanical (air less) direct injection, multi cylinder and four stroke cycle and cold starting type.
1.04.00	No. of engine required	:	Three (3)
1.05.00	Duty	:	Intermittent
1.06.00	Location	:	Indoor
2.00.00	**ENGINE PARAMETERS**		
2.01.00	Nominal output of engine at site operating under ambient conditions	:	Bidder to indicate during detailed engineering.
2.02.00	Speed of the engine	:	Not more than 2300 rpm.

ANNEXURE-III

DATA SHEET
FOR
AIR COMPRESSOR

1.00.00	Service	:	For Pressurization of Hydro pneumatic Tank
2.00.00	Number required	:	Two (2) (1- working + 1- standby)
3.00.00	Type	:	Oil free, water cooled, Rotary Screw Compressor.
4.00.00	Duty	:	Intermittent from receiver pressure
5.00.00	Location	:	Indoor
6.00.00	Drive		Electric motor as per Volume V and V-Belt drive

ANNEXURE-IV

DATA SHEET
FOR
FIRE WATER STORAGE TANK & HYDRO-PNEUMATIC TANK

Description	:	Hydro-pneumatic Tank	Type	:	Vertical Cylindrical
Installation	:	Outdoor			
Fabricated	:	At shop	Water space capacity	:	To be indicated by Bidder
Construction	:	Welded	Working Pressure	:	Discharge pressure of Compressor
Steel	:	As per IS-2002 Gr. 2A	Design & Testing Code	:	IS-2825/ASME Section VIII Div. I
(*) Plate Thickness (Min.)	:	To be indicated by Bidder			
Shell (for all Houses)	:	Bidder to indicate			
Dished ends	:	Bidder to indicate			
Corrosion Allowance	:	2.0 mm (Min.)			
Joint Efficiency Factor	:	0.85			

Description	:	Fire Water Storae Tank	Type	:	Vertical Cylindrical
Installation	:	Outdoor	Nos.	:	1 (one) with 2 (two) compartments
Fabricated	:	At shop	Water space capacity	:	To be indicated by Bidder. However, minimum capacity of the tank shall be 5000 m^3.
Construction	:	Welded	Working Pressure	:	Atmospheric

Steel	:	As per IS-2002 Gr. 2A	Design & Testing Code	:	IS-2825/ASME Section VIII Div. I
(*) Plate Thickness (Min.)	:	To be indicated by Bidder			
Shell (for all Houses)	:	Bidder to indicate			
Dished ends	:	Bidder to indicate			
Corrosion Allowance	:	2.0 mm (Min.)			
Joint Efficiency Factor	:	0.85			

(*) Bidder to indicate plate thickness after giving back-up calculation as per ASME SEC.VIII DIV.-I, Boiler & PV Code/ IS 2825.

ANNEXURE-V

DATA SHEET FOR PIPING, FITTINGS, VALVES AND SPECIALTIES

A. PIPING AND FITTINGS

1.00.00	Type	Buried pipes	Overground pipes normally full of water	Overground pipes normally empty but periodically charge with water & foam system applications	Overground compressd air pipes
		(i)	(ii)	(iii)	(iv)
2.00.00	Material	M. S. ERW pipes as per IS-1239, Part – 1 heavy grade (for pipes of sizes 150 mm NB or below) and IS-3589 Gr.410 ERW (For sizes 200 mm NB and above) or equivalent and galvanized as per IS 4736 for pipes normally empty and periodically charged with water and foam system application.			
3.00.00	Piping Thickness	Pipes for sizes 200 NB & above shall conform to IS: 3589 Grade 410. The final thickness shall not be less than that specified as per IS: 3589 as indicated below.			

Nominal Pipe Size (mm)	Outside Diameter (mm)	Wall Thickness (mm)
200 NB	219.1	6.3
250 NB	273	6.3
300 NB	323.9	7.1
350 NB	355.6	8.0
400 NB	406.4	8.0
450 NB	457	8.0
500 NB	508	8.0
600 NB	610	8.0

Note : a) To prevent soil corrosion buried pipes shall be properly lagged with two coat and corrosion protective tapes of minimum thickness of 4 mm (in two layers) of coal tar type as per AWWA C 203 / IS :15337.

b) Over-ground pipes normally empty but periodically charged with water, foam system applications & compressed air shall be galvanized as per IS : 4736.These pipes shall be provided with one coat of primer and three coats of chlorinated rubber paint.

3.00.00	Size	As per final design and engineering by Bidder and approved by Owner. However Bidder shall consider velocity of fluid in the pipeline & other criteria as indicated elsewhere for selection of pipe size.			
4.00.00	Construction	←---------- ERW ----------→			
		(i)	(ii)	(iii)	(iv)
5.00.00	Joints	Butt-welded for size 65 mm NB & higher as per ANSI B 16.9 and socket welded for sizes up to 50 m NB as per ANSI B16.11		Screwed flange as required for dismantling purposes for sizes 65 mm NB & above as per ANSI B 16.5 and screwed socket for sizes 50 mm NB & below. Welding on GI Pipes/fittings would be permitted provided the same is carried out by means of special electrodes suitable for the above application and the same shall be approved by the employer. After welding, welded portions shall be applied with three coats of zinc silicate treatment/rich paint over one coat of suitable primer. Further the contractor shall provide proper zinc paint at the point of welding.	
6.00.00	Fittings				
	Ratings/Wall thickness	Minimum thickness to match with that of pipe for pipe size 65 mm NB and above. For pipe size above 150 mm NB, minimum thickness shall be 6 mm. For pipe size 50 mm NB & below rating shall be 3000 lbs or wall thickness matching with that of corresponding pipe.			
	Material	The material shall conform to ASTM A234 Gr. WPB or ASTM A 105 or equivalent.			

Note :

1) All fittings and flanges for galvanized pipes shall be galvanized.

2) Unless otherwise specified, all elbows/bends shall be long radius type.

3) The fittings shall be galvanized as per IS: 4736 for galvanized pipe application. In case of branching connections from GI mains for spray piping network socket may be welded for more than two pipe reductions instead of standard tees.

4) Fabricated fittings shall not be acceptable up to pipe size of 300 NB. For sizes 350 NB & above, fittings may be fabricated as per BS: 2633/BS: 534.

5) Working and test pressure of piping & fittings shall be as per IS or relevant international standards.

B. VALVES

I. Gate, Globe & Check Valve

1. Basic Design Code

a)	Gate Valve	:	i)	IS-14846 for sizes 65 mm NB to 300 mm NB
			ii)	IS-2906 for sizes 350mm NB and above
b)	Globe Valve	:	BS EN-13789	
c)	Check Valve	:	BS-1868	

2. Construction : Cast body and bonnet/cover.

3. Material of Construction for Gate and Globe Valve

a)	Body and bonnet Material for Gate and Globe valve cover		IS-210 Gr. FG 260.
b)	Trim/disc.	:	IS-210 Gr. FG 260.
c)	Stem	:	Stainless steel to AISI-410 13% Cr. St.

4. Material of Construction of Check Valve shall be as given below:

a)	Body, Bonnet & Cover	:	ASTM-A-216 Gr. WCB
b)	Trim/Disc	:	13% Cr. Steel as per ASTM-A-182 Gr. F6 Heat treated and Hardened, min. Hardness-250 HB.
c)	Back seat & Hinge Pin	:	13% Cr. Steel as per ASTM-A-182 Gr. F6.

Note: Gate, globe and check valve of size 50 mm NB & below shall be of forged CS body as per API 602(Gate valve), BS 1868(Check valve) and BS 1873(Globe valve). These valves shall have socket welded ends. Valves will be provided with locking arrangements.

II. Deluge Valve

1.	Type		:	Differential pressure type with diaphragm & clapper assemblies.
2.	Code/Standard		:	As applicable.
3.	Material of construction			
	a)	Body	:	CI conforming to IS-210 Gr. FG-260
	b)	Valve internal	:	Brass/bronze

4. Water motor alarm gong shall be provided for hydraulically operated Deluge valve. For solenoid operated deluge valve, same is not required.

C. **HYDRANT VALVE (OUT DOOR)/LANDING VALVE (INTERNAL HYDRANT VALVE) / HYDRANT VALVE FOR FIRST AID FIRE PROTECTION SYSTEM**

1.	Type		:	Female oblique type with the outlets angled towards ground.
2.	Code/Standard		:	IS-5290 Type-A
3.	Material of Construction			
	a)	Body	:	SS-304
	b)	Stop valve	:	SS-304
	c)	Spindle	:	SS-304
	d)	Seat	:	SS-304

D. **WATER MONITORS**

1.	Type		:	Fixed type
2.	Code/Standard		:	IS: 8442
3.	Flow		:	2500-2700 litre/min at 7 Kg/Sq.cm
4.	Rotation of body			
	a)	Horizontal	:	360°
	b)	Vertical	:	+ 105°- 20°
5.	Throw of monitors			
	Horizontal		:	55 - 60 M
	Vertical		:	25 - 30 M

6. Material of construction

a)	Base flange	:	M.S. conforming to IS: 6392
b)	Reducer	:	M.S. conforming to IS: 1239 Part-II
c)	Water nozzle	:	SS304

E. **FIRE HOSE FOR INTERNAL AND OUTDOOR HYDRANTS**

1.	Type	:	Impregnated woven jacketed
2.	Code/Standard	:	IS-636 Type II
3.	Wt. (gm/M)	:	Not more than 250
4.	Coil diameter	:	Not more than 44 Cm. (for 30 M long)

F. **FIRE HOSE FOR FIRST AID FIRE PROTECTION SYSTEM**

1.	Manufacturer	:	As per approved make
2.	Type	:	Corrugated external surface, reinforced rubber hose pipe.
3.	Code/Standard	:	IS-884

G. **BRANCH PIPES AND NOZZLES**

1.	Manufacturer	:	As per approved make
2.	Type	:	Triple purpose, solid jet and Fog type
3.	Code/Specification	:	IS-2871 for branch pipe and IS- 952 for Fog Nozzles.

4. Material of construction

a)	Branch pipe	:	SS AISI-304 & Construction as per IS-2871
b)	Nozzle	:	SS-304
c)	Diffuser	:	SS-304 & Construction as per IS-2871
d)	Fog Nozzle	:	SS-304 & Construction as per IS-952.

H. **HOSE BOXES/CABINET (INDOOR)**

1.	Manufacturer	:	As per approved make.
2.	Material of construction	:	MS 16 SWG & 3 mm thick glass panel in

front door with lock & two keys.

3.	Size	:	To accommodate a pair of hoses one branch pipe, nozzles, spanner etc.
4.	Mounting	:	Wall/Column/Pedestal mounted

I. **HOSE BOXES/CABINET (FIRST-AID FIRE PROTECTION)**

1.	Manufacturer	:	As per approved make.
2.	Material of construction	:	MS 16 SWG & 3 mm thick glass panel in front door with lock & two keys.
3.	Size	:	To accommodate One (1) no. of hose with end fittings, one branch pipe, nozzles, spanner etc.
4.	Mounting	:	Wall/Column/ Pedestal mounted

J. **STRAINERS**

1.	Type		:	Simplex basket type
2.	Material of construction			
	a)	Body	:	MS fabricated IS:2062 tested quality
	b)	Internal	:	SS (AISI 316), 30 mesh suitably reinforced

K. **SPRAY NOZZLES FOR HVW AND MVW SPRAY SYSTEM**

1.	Manufacturer		:	As per approved make
2.	Type		:	Open head type / open nozzle solid cone
3.	Discharge angle		:	60^{o} - 150^{o}
4.	K - factor		:	Bidder to indicate
5.	Flow rate		:	Bidder to indicate
6.	Material of construction			
	a)	Body	:	SS-304
	b)	Insert	:	SS-304

ANNEXURE-VI

DATA SHEET FOR HOSE HOUSE

1.00.00	Service	:	To accommodate the hoses for outdoor hydrants with nozzles, branch pipes, spanner etc.
2.00.00	Location	:	Outdoor, to be strategically located in the entire plant area.
3.00.00	Number	:	As per TAC/LPA requirement

ANNEXURE-VII

DATA SHEET
FOR
DELUGE VALVE SHED

1.00.00	Service	:	To accommodate deluge valves of transformers rating more than 10 MVA, deluge Valves of coal conveyor and cable galleries etc. fire protection system.
2.00.00	Location	:	Outdoor. Bidder to select the suitable locations based on piping layout.
3.00.00	Number	:	Bidder to indicate

ANNEXURE-VIII

DATA SHEET FOR DETECTORS

A. MULTI CRITERIA SMOKE DETECTORS

1.00	Manufacturer	:	As per approved make
2.00	Type	:	Combination of Photo electric sensing and heat sensing, intelligent Analogue Addressable.
3.00	Code/Specification	:	NFPA-72E/BS-5839/IS
4.00	Sensitivity	:	Preset at factory/Adjustable at site (as per UL-268).
5.00	Temperature range	:	1.6 Deg.C to + 60 Deg.C
6.00	Humidity range	:	15% to 90% RH
7.00	Air velocity	:	0 to 300 ± 25 feet/minute
8.00	Plug in type detector to be provided	:	Yes
9.00	No. of terminals on detector on mounting base	:	Bidder to indicate
10.00	Area covered by single detector	:	Bidder to indicate
11.00	Operating voltage	:	24 volt D.C.
12.00	Inbuilt indicating lamp to indicate operation of the detector provided	:	Yes [Separate response indicators mounted on false ceiling to be provided for smoke detectors mounted above false ceiling]
13.00	Material of detector body	:	Metallic/Plastic
14.00	Detector is approved by UL/FOC/FM/TAC/LPA	:	Yes
15.00	Detector Base	:	Mounting box (if applicable) Double Compression gland.
16.00	Coverage area	:	Considering maximum spacing as per

IS: 2189

B. **HEAT DETECTORS**

1.00.00	Manufacturer	:	As per approved make
2.00.00	Type	:	Fixed temperature cum rate of rise type, intelligent Addressable Analog
3.00.00	Sensitivity	:	Preset at factory/Adjustable at site
4.00.00	Operating temperature range	:	54°C. to 60°C.
5.00.00	Humidity range	:	5% to 90% RH
6.00.00	Detector automatically resets after actuation	:	Yes
7.00.00	Area covered by single detector	:	Bidder to indicate
8.00.00	Operating voltage	:	24V DC
9.00.00	Type of contacts	:	Silver
10.00.00	Principle of operation	:	As per Specification
11.00.00	Detector approved by FOC/FM/UL/TAC/LPA	:	Yes
12.00.00	Detector Base	:	Mounting box (if applicable) Double Compression gland.
13.00.00	Coverage area	:	50 Sq.m per detector (Max.) / Maximum spacing as per IS-2189
14.00.00	Special cable	:	To be provided

C. **QUARTZOID BULB DETECTORS**

1.00.00	Manufacturer	:	As per approved make
2.00.00	Type	:	Frangible bulb type
3.00.00	Operating temperature	:	79°C
4.00.00	Material of Construction		
	a) Frame	:	Bronze (ASTM B 145) Class-5A

			Leaded gun metal, Chrome plated
	b) Bulb	:	Glass filled with heat sensitivity liquid (coloured)
	c) Deflector	:	Brass
	d) Cap	:	Copper
	e) Seal	:	Teflon/Rubber
5.00.00	Working pressure	:	3.5 Kg/Sq. cm (g) minimum
6.00.00	Detector approved by TAC/LPA/FOC/UL/FAS/NFPA	:	Yes

D. **LINEAR HEAT SENSING CABLE**

1.00.00	Manufacturer	:	As per approved make	
2.00.00	Type	:	Non-electrically operated Fibre Optical type linear heat sensing cable. It shall be totally immuned to EMI/RFI	
3.00.00	Operating voltage	:	24 Volt D.C.	
4.00.00	Ambient temperature	:	-20^{o} C to 70 ^{o}C	
5.00.00	Operating temperature	:	Programmable type, with combination of fixed temperature and Rate of Rise in temperature.	
6.00.00	Cable Optical Parameter	:	62.5/125 µm graded index, Multimode Fiber	
7.00.00	Cable Jacket	:	Steel Type (for conveyor)	Thermoplastic (for cable tray)
	i) Nominal Cable Diameter	:	3.2mm	4 mm
	ii) Maximum weight	:	33 kg/km	23 kg/km
	iii) Minimum Bending Radius	:	75 mm	63 mm
8.00.00	Typical Performance	:		
	i) Sampling Resolution	:	1.0 meter	
	ii) Measurement Time	:	10 sec for 4 kms	
	iii) Measurement Range	:	-20^{o} C to 150^{o}C	

9.00.00	Detector/Control Unit Condition	:	LED for Power ON/Fault/Alarm It shall have freely programmable Relay Contact, minimum 16 nos.
10.00.00	Enclosure for Detector Unit	:	Weather tight and gasketed, IP-54 or better
11.00.00	All accessories such as fittings, fastenings, sleeves, straps, staples, clips (mounting) rings, test terminals, Junction Box etc. as may be required for interconnection of linear heat detector cables as well as interconnection to Control and Power Cable	:	Yes
12.00.00	Linear Heat Detector approved by FOC/FM/UL/ TAC/LPA/NFPA/VDS/LPCB	:	Yes
13.00.00	Interface	:	PC Interface via Ethernet/Mod-bus output etc.
14.00.00	Fire Detection	:	Unit should be able to detect abnormal/hot spot within 1 mtrs. Span. Further it shall be able to measure both side of the FO LHS cable in the event of wire break. So as to ensure continued fire protection over the entire length.

E. **INFRARED DETECTORS**

1.00.00	Manufacturer	:	As per approved make.
2.00.00	Type	:	Infrared Spark/Ember detectors, (Solar Blind) Intelligent analogue addressable with inbuilt air purging unit.
3.00.00	Operating Voltage	:	24V DC
4.00.00	Ambient Temperature	:	8°C to 45°C
5.00.00	Temperature Range	:	- 40°C to 60°C
6.00.00	Nominal Response Time	:	75 m.Sec. (Max.)
7.00.00	Sensitivity	:	1.0- 5.0 Microwatt shall be Field Adjustable
8.00.00	Dimensions	:	As per manufacturer's standard.

9.00.00	Enclosure	:	Dust and Water proof.
10.00.00	Mounting	:	To be mounted in protective sheet metal housing above conveyor.
11.00.00	Quiescent Current	:	10 mA/As per manufacturer standard.
12.00.00	Alarm Current	:	20 mA/As per manufacturer standard.
13.00.00	Acceptance Angle	:	120°/As per manufacturer standard
14.00.00	Spectral Response	:	0.8 to 2.0 Micron/As per manufacturer standard.
15.00.00	Half Power Cone Vision	:	90°/As per manufacturer standard.
16.00.00	All accessories such as air purging facilities for cleaning lens, protective housing mounting hinge & latch, J. Box Glands etc. as required.	:	Yes
17.00.00	Detector shall be solar blind	:	Yes

F. **INFRARED FLAME DETECTORS**

1.00.00	Manufacturer	:	As per approved make
2.00.00	Type	:	Dual wavelength Infrared flame detectors.
3.00.00	Application	:	Boiler Burner Fronts and Turbine Oil Tanks
4.00.00	Operating voltage	:	24V DC
5.00.00	Ambient temperature	:	8°C to 45°C
6.00.00	Temperature range	:	-40°C to 60°C
7.00.00	Response time	:	Flame - 20 Sec.
8.00.00	Sensitivity	:	One (1) foot diameter flame at 35 foot distance.
9.00.00	Field at view	:	90 Degrees
10.00.00	Quiescent current	:	7.5 mA/As per manufacturer's standard.
11.00.00	Alarm current	:	25 mA/As per manufacturer's standard
12.00.00	Stability	:	Bidder to indicate

13.00.00	Dimensions	:	As per manufacturer's standard
14.00.00	Mounting	:	Bidder to indicate in the offer itself.
15.00.00	Enclosure	:	Dust and weather proof
16.00.00	All accessories such as air purging facilities for cleaning lens, protective housing, bracket etc. as required	:	Yes

G. **GAS SENSING FIRE DETECTORS**

1.00.00	Manufacturer	:	As per approved make
2.00.00	Type	:	Gas sensing fire detectors working on air sampling
3.00.00	Application	:	All control rooms and control equipment room
4.00.00	Operating voltage	:	24V DC
5.00.00	Ambient temperature	:	8°C. to 45°C.
6.00.00	Relative Humidity	:	0.95%, non condensing
7.00.00	Sensitivity	:	0.006 to .06% obscuration per foot
8.00.00	Maximum Transport time	:	120 seconds
9.00.00	Detector Current	:	300 mA
10.00.00	Dimensions	:	Bidder to indicate
11.00.00	Mounting	:	Bidder to indicate in the offer itself
12.00.00	Enclosure	:	Dust and weather proof
13.00.00	All accessories as required	:	Yes

ANNEXURE-IX

Technical Specifications for Nitrogen Gas Injection System for Oil Filled Transformer

1. **Operation Controls**

The system is to be provided with automatic control for fire protection and fire extinction, beside automatic control remote electrical push button control on control box and local manual control in the fire-extinguishing cubicle is provided.

2. **System Activating Signals**

Transformer isolation through master trip relay or circuit breaker (HV & LV in series). Besides, two electrical signals to be provided in series, for activating the system as under:

i) For prevention :
Differential relay
Buchholz Relay paralleled with pressure relief valve or RPRR.

ii) For Extinction :
Fire Detector
Buchholz Relay paralleled with pressure relief valve or RPRR.

3. **System Equipment**

A. Fire extinguishing cubicle (FEC) to be placed on plinth at about minimum 5 meter away from the transformer, shall consist of:

i) Nitrogen cylinder with regulator and falling pressure electrical contact manometer.

ii) Oil drainpipe with mechanical quick drain valve.

iii) Electro mechanical control equipments for oil drain and predetermined regulated nitrogen release.

iv) Pressure monitoring switch for back up protection for nitrogen release.

B. Control box with activating, monitoring devices and line faults indicators (to be placed in the control room).

C. Pre-stressed non-return valve (PNRV) to be fitted in the conservator pipe line, between conservator and buchholz relay operating mechanically on transformer oil flow rate with electrical signal for monitoring.

D. Fire detectors to be fixed on transformer tank top cover for sensing fire.

E. Signal box to be fixed on transformer sidewall for terminating cable connections from fire detectors and PNRV.

4. **Other Requirements for System Installation**

A. Oil drain and nitrogen openings with gate valve on transformer tank, flanges with dummy piece in conservator pipe and fire detector brackets on transformer top cover.

B. Spare potential free contacts for system activating signals i.e. Differential relay, Buchholz relay, PRV/ RPRR, Transformer isolation.

C. Pipe connections between transformer to fire extinguishing cubicle and fire extinguishing cubicle to oil pit.

D. Cabling on transformer top cover. All fire detector to be connected in parallel and inter cabling between signal box to control box and control box to FEC.

E. Plinth for FEC, Oil pit with capacity as 10% of total oil quantity of transformer.

5. **Technical Details**

Fire Extinction Period
On Commencement of Nitrogen injection: Maximum 30 seconds
On system activation up to post cooling: Maximum 3 minutes

Fire Detectors heat sensing temperature: 141 ° C

Heat Sensing Area: 800 mm radius

Pre-stressed non-return valve setting for operation: Minimum 60 litre per minute.

6. **Power Source**

Control Box: 220V DC

Fire Extinguishing cubicle: 240V AC, 40W

7. **Cabling**

Fire survival cables 4 C x 1.5 mm ^{2} for connection of fire detectors in parallel.

Fire survival cable 12 C x 1.5 mm ^{2} for connection between transformer signal box/ marshalling box to control box and control box to FEC.

Fire survival cable 4 C x 1.5 mm ^{2} for connection between control box to DC supply source and FEC to AC supply source, signal box/ marshalling box to pre-stressed non-return valve connection on transformer.

SCOPE OF SUPPLY & INSTALLATION ACTIVITIES FOR NITROGEN INJECTION FIRE PROTECTION SYSTEM FOR TRANSFORMER

A. System Equipments

1. Fire extinguishing cubicle with base frame and containing oil drain assembly, nitrogen cylinder, electro mechanical control unit for oil drain and nitrogen release, pressure monitoring switch for back up protection for release of nitrogen, detectors necessary for monitoring system, flanges with gate/ butterfly valves on top panel for connecting pipe connections from transformer, panel lighting etc.

2. Control box for monitoring system operation, automatic control and remote operation, with alarms, indication light switches, push buttons, audio signals, line fault detection suitable for tripping and signaling on 220V DC supply.

3. Pre-Stressed non-return valve (PNRV) working mechanically on transformer oil flow rate, with proximity switch for remote alarm indication and with visual position indicator.

4. Required no. of fire detectors rated for 141°C for heat sensing each fitted with two number cable glands.

5. Signal box for terminating cable connections from PNRV and fire detectors.

B. Other Material Requirements

1. FRLS cable 4 C x 1.5 mm² for fire detector connections.

2. Fire survival cables 12 C x 1.5 mm² for connections between transformer - control box.

3. Fire survival cables 4 C x 1.5 mm² for signals from relay panels to control box, panel lighting, PNRV connections on transformer etc.

4. Pipe connections between transformer and FEC, ERW class ‘C’ pipes with bends, flanges, other fittings and gate/ butterfly valves as required.

5. Pipe connections with fittings for connection between FEC – oil pit.

6. Mandatory Spares: 1 No. spare N_2 cylinder for each sub station 3 No. Heat Sensors for each system 1 set Hose pipes with fittings.

C. Installation of System

1. Civil Work

i) Plinth for fire extinguishing cubicle.

2. Pipe Connections between Transformer, FEC and Oil Pit

i) Oil drainpipe connections between outlet valve provided on the transformer tank and the flanges provided on FEC top panel.

ii) Drainpipe connections between oil drainpipe bottom (in FEC) to the oil pit.

iii) Nitrogen injection pipe connections between inlet openings on transformer tank and flange provided on FEC top panel.

3. **Cabling**

i) Connecting all fire detectors in parallel and terminating in signal box, using fire survival cables 4 C x 1.5 mm ² cable.

ii) Connecting PNRV to signal box, using Fire survival cables 4C x 1.5 mm ²

iii) Connections to FEC for 230V AC single-phase panel light supply, using fire survival cables 4C x 1.5 mm ²

iv) Connections from relay panel to control box using fire survival cables 4Cx1.5mm ²

v) Connections from DC source to control box directly or through DC-DC connector, using fire survival cables 4C x 1.5 mm ²

vi) Connections between signal box to control box and between control box to FEC using fire survival cables 12 C x 1.5 mm ²

D. Pre-Commissioning Tests

Pre-Commissioning tests shall be carried out jointly by system manufacturer and the purchaser or his representative prior to commissioning the system.

Note: This system shall be provided in addition to the Spray System for the transformers

ANNEXURE-X

FIRE TENDER

1.00.00 GENERAL INFORMATION

1.01.00 The Fire Tender to be supplied under this section shall be used for general protection against fire for this unit of the power plant.

1.02.00 The quantity of Fire Tender shall be two (2) numbers. The Fire tenders shall be located in the fire station of this unit of the plant.

2.00.00 BASIC FEATURES

Fire Tender shall have following basic features in line with NFPA - 414 and IS - 950, to combat the emergency situation for fire fighting in the plant. Fire Tender shall be equipped with following basic equipment.

2.01.00 Chasis

The fire tender will be mounted on a vehicle and shall have an all wheel drive for good mobility over cross country conditions.

The gross vehicle weight (GVW) rating of the chassis to be used shall exceed actual gross weight of fully loaded vehicle by at least 500 Kg.

2.02.00 Engine

The vehicle shall be diesel driven and able to develop sufficient power to achieve the required rate of acceleration of 64 Km/h in 55 second and a maximum speed of 72 Km/h, when fully laden. The accleration time shall be achieved on ambient temperature varying from 0 to 50°C and at elevation upto 600 m without engine preheating.

The engine shall be equipped with a governor which shall be set at not more than maximum permissible rev/min recommended for the engine at no load.

Each engine shall be equipped with a complete and separate starting system of 24 V type. An alternator and rectifier capable of delivering a minimum of 30 A at 24 V shall be provided.

2.03.00 Power Take Off

When the pump is powered by the vehicle engine, it should be driven through a suitable mechanical power take off (PTO). The PTO should be so designed that it transmits the full requirements of power for driving the pump. The power transmission should be uninterrupted even though the transmission gear may be shifted or the clutch released or the transmission is placed in any of its speed ranges. When a power take off pump drive is used, there shall be sufficient engine power both to operate the pump at the required rate

of discharge estimated at 134 KW (180 hp) and to propel the vehicle while creeping.

2.04.00 Vehicle Drive

The drive shall provide that transmission of power from the engine fly-wheel to the wheels of vehicle with such multiplication of torque that the vehicle is capable of traveling at specified acceleration and speed.

The suspension system shall be designed to allow the vehicle loaded or unloaded, to travel at high speeds over load surfaces or over rough unimproved terrain.

Fuel tank shall be of not less than 200 litre capacity. It shall be of rugged construction securely located and easy floor maintenance.

The vehicle shall be equipped with sufficient capacity compressor; with reservoir to ensure supply of dry air for brakes and pneumatic controls.

2.05.00 Water Tank

A water tank of 4500 litres (min.) capacity shall be mounted on the chasis in a manner keeping in view the proper load distribution on the axles. It shall be fabricated out of mild steel sheet of thickness not les than 5 mm at base and notless than 3 mm for the remaining portion, it shall be treated with corrosion resisting compound. Epoxy treatment should be given to inside of the tank. four lifting eyes shall be provided on the shell of the tank to enable the tank to be lifted off the vehicle for repairs/replacement as necessary.

The tank shall be fitted with manhole cum filling orifice of 450 mm dia. on top of the tank fitted with removable strainer.

2.06.00 Hose Reel

One first aid hose reel shall be provided and mounted so as to be accessible for use from left side of the appliance.

2.07.00 Pump

The pump shall preferably be made of any suitable alloy, compatible with aqueous film forming foam and protein foam compound, with stainless steel shaft suitable for use with brackish water. The pump shall be capable of delivering not less than 1800 l/min of water at a pressure not less than 8.5Kg/f (cm2), when operated from a suction lift of 1.5ml. the pump shall be of single stage/double stage and closed impeller type where the impeller is hydraulically balanced to reduce any thrust.

2.08.00 Primer

The primer shall be capable of a suction lift of 7 m in not more than 30 secs. using 100 mm suction hose.

2.09.00 Foam Equipment

A foam compound tank of 500 litter (minimum) capacity shall be mounted on the chassis, in addition to the water tank and as a separate distinct unit which can be removed separately for replacement.

The foam tank shall have its top dished with funneling arrangement provided to enable easy filling from 20 litre drum. The manhole for the tank shall be used for foam filling which shall have a stainless steel strainer. Means shall be provided for automatic vending of foam compound tank when the foam is being produced or the tank is being filled.

Automatic proportioning arrangements shall be provided where the present induction ratio of foam compound/water solution and flow of water are automatically varied merely by opening and closing monitor/handling. A foam monitor shall be mounted on the roof of the cab in such a manner that it can be manually operated by crew.

All parts of appliances shall be of good workmanship and shall have streamlined finish.

The appliance shall be painted “Fire Red” on the outside with the Fire Service insignia painted in gold and black.

2.10.00 Following accessories also to be provided :

a) One electrically operated siren 24 volts, to be mounted externally.

b) Fog Lamps Two. These shall be low mounted in front of the appliance.

c) Reversing light, one - It shall be suitably situated to assist reversing.

d) Wind screen Wiper Electrically operated of approved design.

e) VHF Radio Telephone set Bracket. A self contained VHF transmitting/ receiving set for communication.

f) All tools required for normal maintenance shall be supplied.

g) Users Hand Book and part identification manual.

h) Aluminium ladder shall be provided in the fire tender.

3.00.00 SCHEDULE OF EQUIPMENT TO BE CARRIED WITH THE FIRE TENDER

SL. NO.	ITEM	QUANTITY
1.	Armoured suction hose 100 mm dia complete with round thread coupling 2.5 m long (see IS : 3549 - 1983 and IS : 902 - 1974)	4 length
2.	Suction strainer for above (see IS : 907 - 1984)	1 No.
3.	Basket strainer for item 2 (see IS : 3582 - 1984)	1 No.
4.	Suction wrenches (see IS : 4643 - 1984)	1 pair
5.	Hose. 63 mm and 30 mm long with instantaneous couplings (see Type II of IS : 636 - 1979 and IS : 903 - 1984)	4 length
6.	Hose bandages (see IS : 5612 (Part-2) - 1977)	12 No.
7.	Hose clamps (see IS : 5612 (Part-1) - 1977)	6 No.
8.	Dual propose jet and diffuser nozzle with instantaneous connection (see IS : 28713582 - 1983)	2 No.
9.	Branch pipe (see IS : 903 - 1984)	2 No.
10.	Nozzles of sizes (see IS : 903 - 1984)	
	a) 12 mm	1 No.
	b) 19 mm	1 No.
11.	Nozzle spanner (see IS : 903 - 1984)	2 No.
12.	Dividing breechings (see IS : 5131 - 1986)	1 No.
13.	Dual head stand pipes (see IS : 5714 - 1981)	1 No.
14.	Hydrant valve key and bar (see IS : 910 - 1980)	1 No.
15.	9 kg. capacity suitable for fighting metal fires in charged condition with applicator (see IS : 11833 - 1986)	2 No.
16.	Self contained portable emergency lights working on rechargeable batteries	2 No.
17.	Insulated plier with rubber gloves pair tested to 20000 Volts (see IS : 3650 - 1981)	2 No.
18.	Copper bolt (see IS : 5200 - 1969)	1 No.

SL. NO.	ITEM	QUANTITY
19.	Hacksaw 300 mm adjustable with 5 spare blades each (see IS : 5169 - 1969)	2 No.
20.	Sledge hammer 5 kg. (see IS : 841 - 1983)	1 No.
21.	Hooks (see IS : 927 - 1981)	1 No.
22.	Crow bar (see IS : 704 - 1984)	1 No.
23.	Axe, drift and rescue (see IS : 273 - 1983)	1 No.
24.	Axe. Felling (see IS : 703 - 1966)	1 No.
25.	Fireman's axe with belt firemen and pauches firemen (see IS : 926 - 1970)	5 No.
26.	Quick release knife (see IS : 5486 - 1985)	5 No.
27.	Longline, hemp/ manila 50 mm circumference, 30 m long (see IS : 1084 - 1983)	Length
28.	Shortline, hemp/ manila 50 mm circumference, 15 m long (see IS : 1084 - 1983)	Length
29.	Lifting and pulling machine, 3 tonnes (see IS : 5604 - 1984)	1 No.
30.	Hook grab	1 No.
31.	First Aid Box	1 No.
32.	Blanker smothering	1 No.
33.	VHF radio telephone set	2 No.
34.	Motorized barrel transfer pump	1 Set
35.	Hydraulic rescue tools	1 Set
36.	Compressed air positive pressure type breathing apparatus, 30 minutes working duration (see IS : 10245 (Part-2) - 1982)	1 No.
37.	Fire proximity suits complete with head wear, hand wear and foot wear	2 No.

ANNEXURE - 9

EXPERIENCE RECORD PROFORMA

EXPERIENCE RECORD - CENTRIFUGAL PUMP (VERTICAL TURBINE TYPE MULTISTAGE)

ITEM. :

ITEM NUMBER. :

VENDOR. :

INSTRUCTIONS TO BIDDERS:

1. This proforma duly filled in shall be submitted for each item separately, along with the bid.
2. Since the information requested in this proforma will be utilised to assess provenness of offered model, it is in the interest of the equipment manufacturer to pick up those cases out of total list of references which most closely match with the offered model. The equipment manufacturer shall also ensure that each & every information asked for is furnished and the same is correct and complete in all respects.

   Incorrect information furnished in this proforma shall render the bid liable for rejection.
3. While furnishing the materials, where asked for, the equipment manufacturer shall furnish ASTM equivalents also.
4. For the referred installations, the equipment manufacturer shall indicate the name of the person (along with his address, telephone no., fax no./email-id etc.) who may be contacted by the Purchaser / his representative, if felt necessary.
5. The equipment manufacturer shall also furnish along with the bid his standard reference list for the offered equipment model manufactured and supplied by him.
6. The equipment manufacturer shall clarify the meaning of each letter / digit used in the model designation below:

EXPERIENCE RECORD PROFORMA

Description of Model designation system:

SL. NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS			REMARKS
			Ref.- 1	Ref.-2	Ref.-3	
1.	2.	3.	4.	5.	6.	7.
1	**GENERAL**					
1.1	Cross reference to manufacturer's Standard Reference list	----				
1.2	Make					
1.3	Model Number					
1.4	Number of units supplied					
1.5	Type of driver (Electric Motor / Steam Turbine / Gas Turbine / IC Engine)					
1.6	Driver rated kW / Speed(rpm)					
1.7	Drive (Fixed Speed / Variable Speed / Variable Frequency)					
1.8	Shop where pump is designed, manufactured, packaged, tested & supplied with address					
2	**OPERATING CONDITIONS**					
2.1	Fluid handled					
2.2	Fluid temperature (Min / Max) EC					
2.3	Capacity (m^3/hr)					
2.4	Maximum Suction pressure (kg/cm²,a)					
2.5	Differential Pressure, Rated (kg/cm²)					
2.6	NPSHR (m)					
2.7	Efficiency					
2.8	BKW					
2.9	Minimum Continuous Stable Flow, (m^3/hr)					
2.10	Rated Speed					

2.11	Speed range for variable speed drive					
SL. NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS			REMARKS
			Ref.- 1	Ref.-2	Ref.-3	
1.	2.	3.	4.	5.	6.	7.
2.12	MAWP outer casing (kg/cm²G) @ 15EC @ pumping temperature					
3	**CONSTRUCTION**					
3.1	No. of stages					
3.2	Casing split - Outer casing (Axial / Radial)					
3.3	Casing split - Inner casing (Axial / Radial)					
3.4	First Impeller Type (Single flow / Double flow)					
3.5	Impeller diameter - Rated/ Maximum / Minimum (mm)					
3.6	Impeller mounting (Inline / Back to back)					
3.7	Balancing Device used (Balance drum / Balance disc / Others)					
3.8	Type of Radial Bearings (Antifriction / Sleeve / Tilting Pad / Others)					
3.9	Type of Thrust Bearings (Taper land / Tilting Pad / Others)					
3.10	Span between bearings (mm)					
3.11	Shaft diameter under: Seals / Bearings (mm)					
3.12	Whether rotor is rigid or flexible?					
3.13	Shaft Sleeve provided between impeller (interstage bushings) - Yes / No					
3.14	Shaft Sleeve provided under seals - Yes / No					
3.15	Whether the proposed model and reference models have identical hydraulic design (for impeller / diffuser / volute)					
3.16	Type of lubrication (Pressurised / Splash / Ring / Oil mist / Grease)					

EXPERIENCE RECORD PROFORMA

3.17	Lubrication system (API-610 / API-614 / Manufacturer Standard)					
3.18	Type of mechanical seal (Single / Double)					
SL. NO.	PARAMETER	INFORMATION ON PROPOSED MODEL	INFORMATION ON REFERRED EXISTING INSTALLATIONS			REMARKS
			Ref.- 1	Ref.-2	Ref.-3	
1.	2.	3.	4.	5.	6.	7.
3.19	API Sealing Plan No.					
3.20	API Cooling Plan					
4	**MATERIAL OF CONSTRUCTION**					
4.1	Outer Casing					
4.2	Inner Casing					
4.3	Impellers					
4.4	Shaft					
4.5	Shaft Sleeves - interstage					
4.6	Shaft Sleeve under seals					
5	**OTHER INFORMATION ON INSTALLATIONS**					
5.1	Date of supply of entire unit					
5.2	Date of commissioning of entire unit					
5.3	No. of operating hours completed as on the date of issue of material requisition					
5.4	Major Problems encountered					
5.5	Name of plant					
5.6	Purchaser's Name and Address					
	Name (Company / Organization)					
	Name of Contact Person					

	Address					
	Telephone No.					
	Fax No.					
	email-id					

ANNEXURE-10

CUSTOMER SPECIFICATIONS FOR MOTOR &
GENERAL ELECTRIC EQUIPMENT

VOLUME : V-A

TECHNICAL SPECIFICATIONS
FOR
ELECTRICAL EQUIPMENT AND ACCESSORIES

CONTENTS

VOLUME V-A : TECHNICAL SPECIFICATIONS FOR ELECTRICAL EQUIPMENT & ACCESSORIES

VOLUME : V-A

SECTION-I

GENERAL ELECTRICAL SPECIFICATION

CONTENT

ATTACHMENTS

VOLUME : V-A
SECTION-I
GENERAL ELECTRICAL SPECIFICATION

1.00.00 GENERAL REQUIREMENT

1.01.00 General

1.01.01 Contractor shall provide fully compatible electrical system, equipments, accessories and services for the entire station/plant in his scope as well as those specifically required by the Owner.

1.01.02 All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and International Codes & Standards, in particular the Indian Statutory Regulations.

1.01.03 Drawings and annexure appended to this specification shall form part of this specification and supplement the requirements specified herein. This specification shall be read and construed in conjunction with the drawings and annexure to determine the scope of work and terminal points.

1.01.04 It is not the intent to specify completely herein all details of the system or equipment. Nevertheless, the system/equipment shall be complete and operative in all aspects and shall conform to highest standard of engineering, design and workmanship.

1.01.05 Any system, material or accessory which may not have been specifically mentioned but which is necessary or usual for satisfactory and trouble-free operation and maintenance of the equipment shall be furnished without any commercial implication to the Owner.

1.01.06 In case of a conflict between this Section (GENERAL ELECTRICAL SPECIFICATION) and the other Sections of Volume V-A & Volume V-B, the stipulation under this Section shall prevail, unless the Owner advises otherwise on a specific issue at the Bidding stage.

1.01.07 Proposal Data Sheets

The Proposal Data Sheets annexed to this specification shall be filled in without any ambiguity by typing in appropriate place on each page. These pages must be properly signed by authorized representative of the Bidder as verification of the data and submitted along with the bid to form part of the Bidder's formal proposal.

1.01.08 Guaranteed Performance

The performance figures quoted in Technical Particular Sheets shall be guaranteed within the tolerance permitted by relevant standards. In case of failure of the equipment to meet the guarantee, the equipment may be liable for rejection at any stage.

1.01.09 Deviation

Should the Bidder wish to deviate from this specification in any way, he shall draw specific attention to such deviation. All such deviations shall be clearly mentioned on the Deviation sheet enclosed, with reference to the respective clause of the specification. Unless such deviations are recorded in the Deviation sheets and submitted with the offer, it shall be taken for granted that the offer is made in conformity with this specification in all respects.

1.01.10 Drawing Approval

Before starting manufacture of any equipment, the contractor shall have to take approval of relevant drawings and data from Engineer in writing. Any manufacture done prior to the approval of drawings/data shall be rectified in accordance with the approved drawings/data by the Contractor at his own cost and the equipment shall be supplied within the stipulated period.

1.01.11 Site Condition

For the purpose of equipment design, reference ambient temperature shall be taken as 50°C. Other site conditions shall be as indicated in the Lead Specification.

1.01.12 The Contractor shall furnish calculations of maximum loading and fault levels under the most onerous conditions for the various equipment/systems as defined elsewhere in the specification to prove adequacy of their parameters. In case any equipment or system is found to be inadequate, it shall be changed/ modified without any additional financial liability to the Owner.

1.01.13 Transformer voltage ratios, taps, impedances and tolerances thereon, shall be so optimized so that the auxiliary system voltages under various grid and loading conditions are always within permissible limits and equipment are not subjected to unacceptable voltages during operation and starting of large motors such as MDBFP etc. The vector groups of the transformers shall be so selected that all the buses of particular voltage level have same vector throughout the plant.

1.01.14 Responsibility of coordination with electrical agencies /TAC/Pollution control board/Electrical Inspectorate and obtaining all necessary clearances shall be of the contractor.

1.01.15 Special Tools & Tackles

A set of special tools & tackle which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment shall be supplied.

The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.

1.01.16 Spares

(a) The Bidder shall submit a list of recommended spare parts for three (3) years satisfactory and trouble-free operation, indicating the itemized price of each item of the spares. The final quantity shall be decided during placement of order.

(b) The Bidder shall quote and supply mandatory spare parts as per list attached in Vol. IIA, Sec.8. The final quantity shall be decided during placement of order.

(c) Each list shall be complete with specification, make, identification number, unit rate, quantity etc.

1.02.00 **Codes & Standards**

1.02.01 Equipment

Requirement of conformance with Codes and Standards is described in individual Sections.

1. 02.02 Installation

All electrical installation work shall comply with the provisions of the Indian Electricity Act, the Indian Electricity Rules as amended up to date, relevant IS Codes of Practice and recommendations of the Tariff Advisory Committee (TAC). In addition, other rules or regulations applicable to the work shall be followed. In case of any discrepancy, the more restrictive rules shall be binding.

1. 02.03 Nothing in this enquiry specification shall be construed to relieve the Contractor of his responsibility to abide by the Standards or Codes.

1.03.00 **Environmental Conditions**

1.03.01 The equipment will be installed in hot humid and tropical atmosphere highly polluted with coal dust and fly ash.

1.03.02 Sensitive relay and other electrical and electronic devices shall be located in controlled environment such as control room, electronic equipment room etc. as applicable.

1.03.03 For equipment installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in determining the design ambient temperature.

1.04.00 **Auxiliary Voltages**

1.04.01 Auxiliary AC voltage supply arrangement shall have 11 kV, 3.3 kV and 415V systems. It shall be designed to limit voltage variations as given below under worst operating condition:

a) HT & LT AC System - ± 10%
b) 220V DC - -15% to +10%

1.04.02 Following auxiliary voltages will be envisaged for LT auxiliary power, control and instrumentation.

a) 240 V ± 10%, 1 Ph, 50 Hz +3% to -5%

b) 220 V DC +10% to (-) 15%, two wire, ungrounded

c) 240 V, 1 Ph, 50 Hz, UPS System

d) 24 V / 48 V DC, as required

1.04.03 Nominal voltage of main DC system shall be 220V. DC batteries shall be designed for continuous float operation with trickle charging, hence all the associated components like batteries, battery chargers, DC motors, relays, contactors, timers etc shall be suitable for continuous operation at the maximum continuous battery float voltage including suitable temperature correction factors.

In addition, the bidder may propose 48V or 24V systems as per requirements of control and instrumentation of his equipment and design.

1.05.00 **Equipment Protection**

1.05.01 The Contractor shall design the plant with the primary objective to mitigate the damage of the plant and equipment during fault or system disturbances.

1.05.02 Automatic trip functions will be initiated for isolation of fault, which could cause immediate and severe damage.

1.05.03 Every effort shall be made to avoid unnecessary trip. There will be annunciation to alert the operator to take corrective action in time.

1.05.04 At least two protective devices, preferably operating in parallel on different principles, will be utilized in protecting major equipment, where possible.

1.05.05 Major protections envisaged for various equipment are listed under relevant sections of this specification.

1.06.00 **Type & Rating of Equipment**

1.06.01 Number of types and sizes of standard products like motors, switchgear and control gear components etc. shall be kept to a minimum so that the requirement of spares is reduced.

1.06.02 Equipment shall be rated for the load and duty cycle of the intended service Circuit breakers and fuses shall be rated to withstand and interrupt the maximum fault current at the point of application in the circuit.

1.07.00 **Control Philosophy for plant Electrical System**

1.07.01 In line with the present-day practice centralised control of the electrical system/equipment has been envisaged for the plant. Control of electrical system of main plant and EHV breakers of generator bay shall be provided from DDCMIS with soft HMI. The details of the same are specified in relevant sections of Control and Instrumentation.

1.07.02 Generator will be controlled from Central Control Room in the Power House. However, bus selection for generator shall be done from Switchyard Control Room by operation of associated disconnecting switches.

1.07.03 400kV side of Standby Transformer feeder, when fed from 400kV switchyard, shall be controlled from Switchyard Control Room. OLTC control for such Standby Transformer shall also be done from Switchyard Control Panel.

1.07.04 Control & metering of Generator, GT, UT, ST etc. will be from Central Operating Console as well as from ECP. The protection of above shall be effected through redundant (2x100%) numerical protection relays. Separate set of CTs & PTs shall be used for implementation of such redundancy. Protection of GT, ST, UT shall be achieved through discrete numerical relay protection. Two (2) groups of different make numerical protection relays shall be adopted for Generator protection relays.

1.07.05 The control, indication, metering and monitoring of the electrical auxiliary power distribution system comprising of 11 kV & 3.3 kV circuit breakers (except those for motor feeders), 11/3.6kV Auxiliary transformers, LT transformers, 415 V switchgear breakers for incomers and bus couplers, DG system, etc. shall be achieved from operator's consoles through DDCMIS/PLC and ECP (as applicable). For details relevant section of C & I shall be referred.

1.07.06 All equipment/components, viz., transducers, etc. required to interface with plant DDCMIS/PLC system shall be provided in switchgear/control panels. The minimum protection required for different equipment and system are indicated in other Sections.

1.07.07 STOP pushbutton shall be provided in the local control panel for motors and this STOP annunciation signal shall be provided to the DDCMIS by hardware connection.

1.07.08 Control panels for service systems like Ash, C.W. pumps, ash dyke etc. shall be located in the respective control room. In addition, some local panels shall be provided near respective system/equipment such as boiler feed pump, hydrogen seal oil system, electrostatic precipitator, PMCC, ash dyke PMCC etc.

1.07.09 In case of internal faults in the generator transformer both turbine and generator will automatically trip. For faults external to the generator and transformer, the generator transformer breaker will open and the turbine, generator shall operate on house load.

1.07.10 Suitable unit interlock and protection scheme shall be developed to ensure safety of equipment and stable operation of the unit within permissible limits. Apart from this, the Generator Transformer, the Unit Transformer and the Standby Transformer have to be provided with necessary safety interlock.

1.07.11 In case of tripping of the unit, Fast bus change over scheme is proposed to change supply of the Boiler and the Turbine Auxiliaries from Unit to Standby system automatically and thereby avoiding trip out of the Boiler and providing uninterrupted supply to vital Turbine auxiliaries. Under this `Fast bus change over' scheme the Boiler shall be operating with 60% HP-LP Bypass even if there is trip out of Turbine & Generator.

1.07.12 Suitable operational logic shall be developed to operate and control the unit from Central Control Room along with its sub-group and sub-loop control. House load operation of this Unit has been contemplated.

1.08.00 **Scheme For Auxiliary Power Distribution**

1.08.01 Owner has chosen ‘Generator Circuit Breaker Scheme’ for the project as indicated in the Electrical Single Line Diagram enclosed with the specification documents.

1.08.02 Auxiliary Power Distribution scheme shown in the attached Electrical Single Line Diagram is for the Bidder’s guidance. The Bidder shall develop his own scheme maintaining the reliability and redundancy criteria. It shall be subject to the Owner’s acceptance.

1.08.03 In order to ensure safe shut down of the plant under emergency condition and to provide backup in case of total power failure, one (1) Diesel Generating set shall be provided.

1.08.04 Overall system shall be such that failure of any unit auxiliary like transformer, DC battery, Battery charger and DG set shall not reduce the plant's generating capability or affect the safe shut down requirements of the unit.

1.08.05 Wherever plant auxiliary supply is extended outside the plant boundary, suitable isolation through transformer shall be done.

1.09.00 **Islanding Scheme**

The unit shall be designed to operate in islanding mode of operation by tripping all the lines and the unit shall run with the available plant load under such condition. Necessary control philosophy shall be submitted by the Bidder.

1.10.00 **Power Evacuation**

The generated power will be stepped up to 400kV and evacuated through 400KV transmission lines. For new unit at KTPS (Kothagudem), power evacuation will be through 3 nos. new 400kV lines.

1.11.00 **Insulation Level**

The insulation level for the transformer windings and bushings shall be as under :

	Winding		Bushing	
Highest System Voltage	Rated Power Freq. withstand Voltage (kVrms)	Rated lightning Impulse withstand Voltage (kVp)	Rated Power freq. withstand voltage (kV rms)	Rated lighting Impulse withstand Voltage (kVp)
0.433 kV	3		3	
3.6 kV	10	40	10	40
7.2 kV	20	60	20	60
12 kV	28	75	28	75
17.5 kV	38	95	38	95
24kV	50	125	50	125
36kV	70	170	70	170
72.5 kV	140	325	140	325
145kV	275/*	650	275	650
245kV	395*	950/1050**	460	1050
420kV	630/*	1425/1570**	630	1425

* In case of non-uniformly insulated (refer IEC 60076-3, Table D.2)

**Chopped Wave BIL

1.12.00 **Neutral Grounding**

1.12.01 Neutral earthing equipment shall be designed duly taking into account the maximum permissible operating voltage of the generator, voltage rise on load throw off (subsequent to detection of earth fault) field suppression time, ferro resonance, etc. The generator shall be grounded through distribution transformer with secondary loading resistor, limiting the earth fault current to about 5-10 A and to restrict the over voltages caused due to capacitive currents. The neutral earthing equipment shall be rated to carry this current for at least 5 minutes considering the generator terminal voltage under maximum field forcing conditions.

1.12.02 11 kV/3.3kV system earthing shall be low resistance earthed type to limit earth fault current to 300A. The resistor shall be rated to carry this current at least for 10 seconds.

400kV system is solidly grounded.

Neutrals of Generator Transformers (on 400kV side) and all LT Transformers (415V) shall be solidly earthed through bolted links.

220V DC system shall be kept ungrounded.

Diesel generator shall also be kept ungrounded (earthing through PT).

1.13.00 **Motor Voltage**

The voltage level for motors shall be as follows:

a) Up to 0.2 kW - 240V AC / 415V AC

b) Above 0.2 kW and up to less than 175 kW - 3 ph, 415V AC

c) 175 kW and up to less than 1500 kW - 3 ph, 3.3KV AC

d) 1500 kW & above - 11 kV

415V or 3.3 kV may be adopted by the bidder for the drives in the range of 175-210 kW.

3.3 kV AC supply for CHP conveyor motors of rating above 160 kW is to be used.

The voltage rating of the drives indicated above is for basic guideline. Minor variations can be accepted on case to case basis based on techno-economic considerations of the various sub-systems.

Voltage rating for special purpose motors viz, VFD and screw compressors, shall be as per manufacturer's standard. All the motors ratings on Stacker/ Reclaimer shall be 415V AC supply only.

1.14.00 **Tropical Protection**

1.14.01 All electrical equipment, accessories and wiring shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

1.14.02 Fine mesh screen of corrosion resistant material shall be furnished on all ventilating openings to prevent entry of insects.

1.15.00 **Enclosure Protection**

1.15.01 Degree of protection of enclosures as per IS:13947 shall be as follows:

	Item	Degree of Protection
1	11kV & 3.3kV Switchgears	IP4X
2	415V MCC / DBs / Fuse Board	IP52 for indoor and IP65 for outdoor
3a	Motor	IP55
3b	Motor Actuator	IP65
4a	Control and Relay Panel in AC area	IP3X
4b	Control and Relay Panel in normal area	IP42
5a	Pushbutton Station/Kiosk/Panel - Indoor	IP55
5b	-Do - Outdoor	IP65
6	Indoor Junction boxes for cables / wires	IP55
7	Outdoor lighting fixtures	IPW55
8	Battery Charger Panel	IP42

1.15.02 In fire hazardous areas like gas/ liquid fuel storage/ handling areas, lighting fixtures, switchgears shall be of tested and certified flame proof design.

1.16.00 **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 80 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 80 microns shall be acceptable for finish coat. Paint shade shall be as per technical specification.

Paint shade of finish coat shall be as per Section-X of Volume – IIA: Lead Specification.

1.17.00 **Redundancy**

The Contractor shall develop the system configuration based on the concept that failure of any one auxiliary transformer or supply feeder will not affect full load operation or start up/shut down of the unit.

1.18.00 **Quality Assurance**

1.18.01 The Contractor shall follow his standard procedures for quality assurance and control. A copy of the said standard procedures shall be submitted to the Owner / Purchaser for his reference. However, Owner / Purchaser reserves the right to review the same and give his observations, if any, for compliance.

1.18.02 The procedures shall be in such a form as to clearly delineate the manufacturing sequence, inspection points, tests and test procedures, acceptable ranges / values, reference drawings etc.

1.18.03 The Owner / Purchaser shall inform the Contractor as to which of the inspection points and tests shall be witnessed. As a minimum, inspection and testing of the finished equipment shall be made prior to shipment, unless specifically waived by the Owner / Purchaser. The contractor shall give at least fifteen (15) days advance notice regarding readiness of the equipment.

1.18.04 Manufacturing and quality control procedures shall be available for audit to the Owner / Purchaser and/or its representative at the place of manufacture.

1.18.05 The Owner / Purchaser reserves the right to inspect the equipment at the point of manufacture and witness factory and other such tests as may be necessary to ensure conformance to the specification.

1.18.06 The Owner / Purchaser reserves the right to inspect the Contractor's facilities prior to award of contract.

1.18.07 The Owner / Purchaser reserves the right to witness any or all of the tests stipulated in the relevant standards and this specification.

1.18.08 The Owner / Purchaser may conduct surveillance of the Contractor's facilities for compliance to his standard procedures of Quality Assurance and Quality Control while work on the specified equipment is in progress.

1.19.00 **Drawings / documents for Approval**

1.19.01 The Contractor shall submit his Master Deliverable Schedule considering the priority of the listed documents with respect to the project execution schedule to enable the Owner's Consultants (DCPL) to plan manpower deployment. The documents in the Schedule should be marked in two categories viz. (a) 'For Approval' (A) and (b) 'For Reference' (R).

1.19.02 The Contractor shall assign the basic engineering documents in 'For Approval' category and obtain approval of those documents prior to submittal of corresponding detail engineering documents. For the Bidder's guidance - such documents shall include, but not limited to the following:

a) Master Deliverable List – Electrical with schedule of submission
b) Electrical key single line diagram for the entire plant indicating rating of equipment
c) Electrical system study (load flow, short circuit, motor starting) with software output.
d) Diagram of Generator, GT, UT & ST with Metering & Protection
e) Design Memorandum & Sizing Calculation for–
    i. Generator and Excitation System
    ii. GCB
    iii. Generator Busduct
    iv. GT, UT, ST and other auxiliary transformers
    v. MV busduct
    vi. DC System
    vii. DG Set
    vii. UPS
    viii. HT & LT Switchgears
    ix. HT & LT Cables
f) General Technical Particulars (GTP) of all electrical equipment
g) Logic diagram for Generator, GT, UT, ST.- Protection & Annunciation
h) Logic diagram for HT & LT Switchgears – Incomer, Tie, Bus-coupler, Feeders, Drives
i) Test protocol for all electrical equipment
j) Integrated unit protection scheme
k) Relay setting calculation for Generator, Transformer, 11kV/3.3kV/0.415kV system relay panels
l) CT and VT calculations for Generator circuit
m) Electrical single line diagram for auxiliary power distribution system
n) Design Memorandum - Grounding system
o) Design Memorandum – Lightning protection system
p) Design Memorandum – Cable raceway system
q) Design Memorandum – Station lighting system
r) Design Memorandum – Chimney & Cooling Tower electrical
s) Cable numbering scheme
t) Drive control & measurement philosophy and Plant Control Philosophy
u) Layout for -
    i. Transformer Yard
    ii. 400kV Switchyard
    iii. HT & LT Switchgear Rooms
    iv. Electrical Control Rooms
    v. Battery & Battery Charger Rooms
    vi. Inter-plant Cable Raceway

vii. Area Lighting
viii. Station Grounding Mat

u) All drawings/data relevant to the equipment like QAP, Guaranteed Technical Particulars, General Arrangement Drawing, Bill of Material, Foundation Plan, Single Line Diagram, Control Schematic, Wiring Diagram, Sizing calculations, etc. shall be furnished for approval of Owner/Owner's Consultant.

1.19.03 The Owner's Consultants may review a document assigned in 'For Reference' category as they deem necessary and furnish comments for compliance by the Contractor.

2.00.00 SCOPE OF SUPPLY & WORK

2.01.00 General

2.01.01 The scope of work related to electrical system is an intrinsic part of the total EPC Contract.

The Bidder's 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, in-plant 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 indicated in subsequent sections of Volumes – V-A, V-B & IIC (Generator) for one (1) unit and balance of plant (BOP) as indicated in this chapter. The scope includes all interface/ interconnections with the electrical systems under this contract as required for main plant, balance of plant, switchyard and other systems mentioned elsewhere. Electrical scope shall be as described briefly in the following clauses but not limited to it.

2.01.02 Scope of work shall also cover the design, manufacture, assembly, testing at manufacturer's works/laboratory, supply, delivery, properly packed for transport to site, storing at site of mandatory spares, 3 years O & M spares as detailed hereinafter in subsequent sections of Volumes- V-A, V-B & IIC as required for efficient and trouble free operation.

2.02.00 Generator and Auxiliary System

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

2.02.02 Complete hydrogen cooling, carbon dioxide and nitrogen gas systems as applicable including the necessary piping and pipe supports, valves, measuring system along with the control panel and gas cylinders.

2.02.03 Complete seal oil system including the necessary tanks, pumps, motors, coolers, strainers, piping and pipe supports, valves, measuring system along with control panel.

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

2.02.05 Complete excitation system (brushless or static type) with main exciter, excitation transformer, thyristors, pilot exciter, 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.

2.03.00 **Generator Busduct and MV Busduct**

(a) Generator Busduct and Auxiliary equipment –Three phase busduct will run from generator terminals upto generator circuit breaker and from generator circuit breaker to generator transformer with intermediate tap-off connection to Unit/Standby Transformers and V.T. & S.P. cubicles. Delta run of busduct shall be achieved prior to connection with 1-phase GTs. Neutral side busduct run will terminate at the Neutral Grounding Transformer (NGT) cubicle. CTs shall be provided both phase & neutral sides of busduct.

(b) Medium Voltage Busduct

The standard equipment ratings have been specified in the relevant Sections.

2.04.00 **Generator Circuit Breaker**

A set of Generator Circuit Breaker alongwith one spare pole complete with all associated equipment, isolator on GT side and earth switches on both sides.

2.05.00 **Transformers**

S.No.	Equipment Name	Rating / Parameters/Quantity
1.	Power Transformers	
a)	Generator Transformers	330 MVA(minimum), 1-ph, as per SLD & system requirement
b)	Standby/Startup Transformers	as per SLD & system requirement
c)	Unit Transformers	as per SLD & system requirement
2.	Auxiliary Oil filled Transformers	as per SLD & system requirement
3.	Indoor Transformers (Cast Resin Dry type)	as per SLD & system requirement
4.	High voltage transformer-rectifier sets for ESP	as per system requirement
5.	NGR	as per system requirement
6.	Spare Oil for Transformer/ Reactor	10% of total oil for all Transformers

2.06.00 **Switchgear**

2.06.01 **11kV and 3.3kV Switchgear**

The scope shall include 11kV & 3.3kV Switchgear boards as required for power distribution to plant auxiliaries. Typical key single line diagram for auxiliary power supply is enclosed. The design and sizing criteria of the Switchboards shall be as described later in this Section.

All the Switchboards (each section) shall have two (2) nos. transformer feeder and two (2) nos. motor feeder of highest rating as spares.

SPBD tie connection among the 11kV unit and standby switchboards shall be provided in order to augment redundancy,

Owner would prefer supply of MV Switchgear from a single manufacturer.

2.06.02 **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 is enclosed. The design and sizing criteria of the Switchboards shall be as described in subsequent clauses. The major LT Switchgear shall include the following:

- 415 Volt Switchgears
- 415 Volt Motor Control Centers
- 415 Volt AC Distribution Boards
- 220 V DC /48 V DC Distribution Boards
- 415 Volt AC Fuse Boards
- 220 Volt DC Fuse Boards
- Local Motor Starters, Local Control Panels, Local Push Button Stations, Telescopic Trolley/ Welding / Lighting Transformers
- LV Bus ducts

The scope includes the following features:

(a) 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.

(b) All switchgears, MCCs, AC/DC boards, etc., shall have at least twenty (20%) per cent of starter modules/MCCB module or at least one module (whichever is higher) of each physical size as spares, equipped for the rating of the largest auxiliary fed from that size of module.

(c) L.V. switchgear shall have duplicate supply source through two incoming line breakers and one bus section breaker, with provision of slow auto changeover from one source to the other in case of failure of one source. Manual provision of planned in-phase transfer, supervised by synchro-check relay, shall also be kept for all L.V. Switchgear.

(d) LT PCC/PMCC for ESP shall have upstream dry / oil type LT Transformers, connected by non-segregated phase bus duct. These transformers shall be fed from 11kV unit switchgears. There shall be one MCC/ACP for each pass of ESP.

(e) Combined Local Starter Panels (CLSP) for group of Ventilation fans (up to and including 5.5 kW motors).

Owner would prefer supply of LT Switchgears and LT Bus ducts from maximum two different manufacturers.

2.06.03 **Numerical Relay Networking**

The Contractor's scope of work shall include the following for all the 11kV, 3.3kV and LV Switchgears for the 800MW unit. The communication architecture and design criteria have been explained elsewhere in the specification.

The Contractor's scope of work shall include the supply, delivery, installation, testing and commissioning of the following:

a) Communicable Numerical Relays (both MV and LV Switchgears) conforming to IEC 61850 protocol.

b) Data Concentrators with redundant Servers (not more than 100 relays shall be connected to one such Data Concentrators); 50 Nos of additional relays (Owner's requirement) shall be considered while designing Data Concentrators

c) LAN Network along with 61850 Ethernet Switches for both MV & LV Switchgears

d) HMI station (with Operator Work Station, Engineering Workstations and printers)

e) Fiber Optical cable & HDPE Conduit (length as required), Terminal equipment such as LIU, etc. (quantity as required), GPS (Two Nos) and Laptops (at least 10 Nos)

f) Any other equipment required to the intended specification

g) Suitable gateway to interface DDCMIS and Numerical relay network (at Data concentrator level)

The typical configuration of such a proposed system is enclosed. The numerical relay network shall include relays on all MV & LV switchgears being supplied under this package. Data concentrators shall be distributed functionally and geographically and shall be interconnected through Fibre Optic cables. Required number of FO ports for interface to DDCMIS with Fibre Optic cables shall be made available on all Data concentrators. Provision for connection and arrangement for termination of Fibre Optic cables from DDCMIS at Data concentrator end shall be made.

2.07.00 **DC System**

2.07.01 Lead acid plante type batteries and battery chargers, with the battery taking over and catering to all the loads connected to the D.C. system, including emergency loads for main plant, switchyard and all other areas in the scope of the contractor, as per system requirement.

2.07.02 Following DC systems shall be supplied to cater to various DC loads in the plant:

a) Two nos. 220V batteries with each battery having Float & Float cum Boost chargers, each rated for 100% capacity for the main plant loads and one 100% capacity Standby Boost charger.

b) 220V battery with Float & Float cum Boost chargers each rated for 100% capacity to meet CHP requirement.

c) 220V battery with Float & Float cum Boost chargers each rated for 100% capacity to meet loads of other far-away auxiliary systems like AWRS, make-up water, ash silo (if any) etc.

d) Two nos. 220V batteries, each battery having Float & Float cum Boost chargers, each rated for 100% capacity for 400kV Switchyard.

e) Two nos. 24V batteries, each battery having Float & Float cum Boost chargers, each rated for 100% capacity for plant DCS system.

2.07.03 Design / sizing criteria shall be as described in subsequent clauses of this Section.

2.07.04 DC System shall be supplied from a single manufacturer.

2.08.00 **Motors**

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

2.09.00 **Electrical Actuators**

Electric actuators with integral starters along with associated accessories etc shall be supplied on as required basis for Valves / Dampers to meet the functional and the other specification requirement

2.10.00 **Variable Frequency Drives**

Variable Frequency Drive (VFD) shall be supplied for ID Fan and any other drive as specified elsewhere or if required by practice. VFD shall be microprocessor based digital controlled with necessary motor protection etc. To minimize the harmonic affects on source side necessary Auxiliary Isolation Transformers shall be provided wherever VFD's are used.

Variable Voltage Variable Frequency (VVFD) Drives shall be considered for controlling Stacker- Reclaimer machine and other equipments as required for Coal Handling Plant.

2.11.00 **Cabling**

2.11.01 Cabling work, but not limited to the 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 trestles, cable trays and fittings, 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) Trefoil cable clamps.

(g) Junction boxes.

(h) Galvanized steel pipes/ HDPE/ Hume pipes/ PVC pipes

(i) Miscellaneous items like M.S. sections etc. as required

(j) Fire proof cable penetration sealing system for cable galleries, cable exits etc.

2.11.02 3.3kV power supply to Stacker/ Reclaimer through land mounted junction box, flexible trailing cable with cable reeling drum, transformer mounted on the mobile equipment.

2.11.03 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.

2.11.04 Power and Control cable interconnection charts shall also be prepared by bidder and submitted for review.

2.12.00 **Cables**

2.12.01 **HT Power Cables**

HT power cables required to feed the transformer feeders, motor feeders and inter-stage connection with feeders shall be a indicated in typical key single line diagrams for Aux Power Supply, along with necessary termination, lugs and/ glands.

2.12.02 **LT Power and Control Cables**

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

2.12.03 **Fire Survival Cables**

Fire Survival Cables, suitable for a minimum temperature of 750 deg. C for 3 hours, for both power & control, shall be provided for the following –

i. DC emergency lube oil pump

ii. DC hydrogen seal pump

iii. Turbine lube oil pump/barring gear

iv. DC emergency lighting for main building and service building

v. DC cables for battery to charger & DC distribution boards

vi. Jacking oil pump

vii. Emergency turbine trip in control room

viii. Boiler Turbine : Generator inter trip which include the interconnection between -

- Boiler master fuel trip and turbine trip relays
- Generator trip relays & turbine trip relays
- Generator trip relays & generator breaker
- Generator trip relays & field breaker
- Generator trip relays & unit auxiliary transformer breaker
- Incomer cables for DG board, emergency board, DC lighting board etc.

2.13.00 **Grounding & Lightning Protection**

2.13.01 Scope of grounding system for the power station complex includes in principle:

a) System grounding to facilitate ground fault relaying and to reduce the magnitude of transient over voltage

b) Equipment grounding to provide protection to personnel from potential caused by ground fault currents and lightning discharges.

c) Electronic Equipment grounding for multiple purpose of signal return, safety, EMI control, and antenna function

2.13.02 System grounding involves grounding of the neutrals of generators, transformers, DG sets etc. as discussed in Clause No. 1.12.00.

2.13.03 Scope also includes stable ground grid for grounding of equipment and structures and for maintaining the step and touch potentials within safe limits. An earth mat buried at a suitable depth of 1.0m below the ground will be laid in and around the power station including transformer yard and switchyard. All metallic parts of equipment, supposed to be kept at earth potential, will be connected to the grounding mat. Buildings, structures, transmission towers, plant railroad tracks, the perimeter fencing will also be connected to the grounding mat. The grounding mat will be interconnected with each other with in the plant area. Switchyard earth mat and main plant earth mat shall be connected at minimum two (2) places with test links.

2.13.04 Grounding of equipment body is to be adopted to provide protection to personnel from potential caused by ground fault currents and lightning discharges. Electrical equipment shall be earthed at two points.

2.13.05 Electronic grounding will be a separate earthing system consisting of a number of deep driven earthing rods interconnected with insulated cables and insulated risers are to be installed. This system will be totally isolated from the power equipment earthing mesh risers described above and will be located underground vertically below the electronic equipment room.

2.13.06 Lightning protection system will be installed for protection of the buildings/ structures and equipment against lightning discharge. This will be achieved by providing lightning masts on stacks, cooling towers, power house building, towers in switchyard, flood light towers etc. and connecting these with ground grid.

2.14.00 **Station Lighting**

Station lighting system for the complete plant, buildings and equipment, Lighting fixture complete with lamps & 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 shall be in the scope of contract.

2.15.00 **DG Set**

2.15.01 One (1) no. Diesel Generator set alongwith acoustic enclosure of stationary type suitable for outdoor installation to be provided. DG sets shall normally be started from plant DDCMIS located in central control room with provision of manual control from D.G. control room.

2.15.02 DG set rating shall be finalized by the EPC contractor for this 800 MW Power plant to serve as emergency power for safe shut down in case of total grid failure, taking into account the following 415 V essential auxiliaries/services :

1	Barring gear	7	BFP Lub Oil Pump
2	AC Emergency Lub Oil Pump	8	Flame Scanner Cooling Air Fan
3	AC Jacking Oil pump	9	Emergency Light & Lift
4	I.D. Fan Lub Oil Pump	10	Station Battery Charger (220V DC & 24V DC)
5	F.D. Fan Lub Oil Pump	11	UPS
6	A.C. Seal Oil Pump	12	Valve & Damper DBs, Soot blower MCC

2.15.03 Separate DG building shall be provided to accommodate DG sets, AMF panels, Auxiliary MCC, Battery & Battery charger, PCC, Protection & Metering panel, Fuel Oil day tank etc.

2.16.00 **EHV Switchyard**

2.16.01 Scope of work is for the supply, erection, testing and commissioning of 400kV air insulated switchyard as shown in the Single Line Diagram. The switchyard shall be complete with a self-contained switchyard control building.

2.16.02 Scope of work shall comprise but not limited to, the design, engineering, manufacture, testing and inspection at manufacturer's works, packing, supply, transportation, transit

insurance, delivery to site, unloading, storage and equipment erection including associated civil and structural works.

2.16.03 400kV switchyard shall have two main bus. Synchronizing of Generator Transformer & protection scheme shall be developed by bidder accordingly. 400kV switchyard shall generally employ one and half breaker switching scheme as indicated in the enclosed Single Line Diagram.

2.16.04 400kV circuits that are required to be created in the switchyard are shown in the enclosed Single Line Diagram.

2.16.05 Equipment and materials broadly in scope of supply and erection:

a) 420 kV SF6 Circuit Breakers

b) 420 kV Disconnecting switch with and without earth switches

c) 420 kV Current Transformers (CTs)

d) 420 kV Capacitive Voltage Transformers (CVTs) / Electromagnetic Voltage Transformer (EMVT)

e) 360 kV Lightning Arresters (LAs)

f) Tubular Bus bars, Twin moose ACSR conductors

g) Tension Insulator & Suspension Insulator string assembly sets

h) Conductor Spacers, Clamps & connectors, sag compensators

i) Bus Post and Disc insulators

j) ACSR Conductors & shielding wires

k) Bay marshalling boxes / AC kiosks

l) Junction box for CT and CVT

m) OLTE & associated equipment (as applicable)

n) Switchyard relay, control and metering panels. The protection system shall be coordinated with the overall protection system of the Plant.

o) Complete Substation Automation System (SAS) consisting of Bay Control Unit, data acquisition system, monitors, printers, fibre optic cable with terminal and interface along with necessary operating and application software.

2.16.06 Scope shall include but not limited to complete switchyard gantry structures, support, platform and miscellaneous structures, switchyard fencing, trenches and complete civil works considering the following:

a) Galvanized steel structures for CB, DS, CT, CVT, EMVT, LA, etc.
b) Galvanized steel gantry structures for main buses.

2.16.07 Scope shall also include the following:

a) Flood Light towers in new and extension areas of 400 kV switchyard.

b) Complete earthing grid (inclusive of supply of MS rod and GI flat) for earthing of all switchyard equipment.

c) Complete direct stroke Lightning Protection using Lightning Mast and/or shield wire and its connection to earth mat.

d) Armored Power and control cables, cabling (including interpole and interpanel), cable support angles, cable trays and accessories as necessary for cable erection such as glands, lugs, clamps for cables, ferrules, cable ties, hume pipe etc. Cable route markers for buried cable trench are also included in the scope.

e) Switchyard Control room (also see clause no. 2.16.01)

f) Substation Automation System (SAS based on IEC 61850 protocol) for control and protection of all 400kV bays

g) AC and Ventilation for control room building

h) ABT based energy metering system for all 400kV feeders.

i) Time synchronization equipment for switchyard and GRP.

j) Islanding scheme for entire 400 KV switchyard bays

k) Protection panels for Generator, GT, UT (GRP) to be located in corresponding CER and to be networked as per the SAS Architecture Drawing. One number generator DR with both slow and fast scan feature to located in GRP

l) All interconnecting facilities between substation automation system and Generating plant control system (Main Plant DDCMIS)

m) All third party interfaces with RLDC and OS Control room as per tender drawing for SAS Architecture

n) Interface between Protection Panels and OLTE system

o) AC & DC power supply system for entire EHV system Bay equipments

2.16.08 Equipment like breaker, Isolators, earth switch, CT, CVT, LA, insulators etc. shall have similar current/voltage rating irrespective of bay capacity to minimize spares and inventory.

2.16.09 All protections of 400kV system as per relevant tender SLDs shall be provided. Protection system shall be provided with Numerical relays compliant with IEC 61850 protocol.

2.16.10 Equipment and materials to be supplied by the Contractor shall form a complete 400kV switchyard. It is in the interest of the Contractor to acquaint himself with the site conditions and scope before submission of offer.

2.16.11 List of items mentioned under the scope is not exhaustive. Any item/items which are not specifically mentioned herein but are required to make the switchyard complete in all respects for its safe, efficient, reliable and trouble free operation shall also be deemed to be included and the same shall be supplied and erected by the Contractor.

2.17.00 **Energy Management System**

2.17.01 The scope includes Energy Management System (EMS) for accounting of the electricity to various segments of electrical system.

2.17.02 EMS will measure, record and display Apparent Power, Phase wise voltage, kW & kVA (reactive) at peak kVA, Power Down Time, Average Power Factor, Line Currents etc. Data collected from various meters will be displayed through various MMI pages of the EDMS system in Control Room.

2.17.03 The location of these meters will be as under following the Central Electricity Authority Regulation guideline:

- At a point after the generator stator terminals and before the tap-off to the UTs.
- On each incoming feeder (excluding tie feeders) of HT buses.
- On LV side of each incoming transformer feeder of LV buses.
- On each incoming feeder of emergency MCC buses from DG PCC and
- On all HT motor feeders.

2.17.04 EMS will generate Power Generation/Consumption and PLF Reports (Shift wise, Daily, Weekly, Monthly & Yearly basis), Single Line Diagram, Breaker on/off status and Load Flow and Reactive Power Flow Report as the minimum.

2.17.05 The system shall be complete with all necessary equipment and accessories like meters as per clause no 2.17.02, Communication Servers, Data Viewers / Operator Console with Printer, RS 485 to TCP/IP Converter, TCP/IP to FO Converter with FO Outputs, Light Interface Unit , Fibre Optics & HDPE Cables, TCP/IP Switches, CAT 5 HUB Cable, Twisted RS 485 Cable etc.

2.18.00 **Erection & Testing Equipment**

2.18.01 It shall be Contractor's responsibility to arrange all the erection and testing equipment as required at the erection stage and thereafter at the pre-commissioning and commissioning stages.

2.18.02 The Contractor's/his sub-contractors' testing equipment to be used at the pre-commissioning and commissioning stages must have valid calibration certificates available for the Owner's examination on demand.

2.18.03 The scope also includes electrical testing/laboratory instruments required by the Owner for his use after plant handover. Details of such electrical testing/laboratory instruments are given in separate Section of this Specification.

2.19.00 **Construction Power**

Owner will arrange power source free of cost at 11 kV level at one point. Street lighting and distribution system to be done by EPC contractor. High mast lighting and adequate lighting from safety point of view is to be provided in the construction area by the EPC contractor.

2.20.00 **Tests**

2.20.01 Various routine, type and acceptance tests shall be carried out on each equipment as listed in the individual sections.

All the tests shall be carried out in the presence of the Owner's representative unless

the witnessing of tests is waived beforehand by the Owner.

The contractor shall give minimum 15 days advance notice of the date when the tests would be carried out.

2.20.02 The contractor shall obtain the Owner's approval for the type test procedure before conducting the type test. The procedure shall specify the test set up, instrument to be used, acceptance norms, interval of recording etc. for the type test to be carried out.

In case the contractor has conducted any of the specified type tests on similar equipment within the last five (5) years as on the date of bid opening, he may submit type test report during detail engineering for waive of conducting such test. This clause shall be applicable to only those type tests which are so indicated in the individual sections. For these tests, only reports are to be submitted.

In case the contractor is not able to submit report of the type test(s) conducted within last five (5) years from the date of bid opening or in the case of type test(s) reports are not found to be meeting to specification requirement, the contractor shall conduct all such test(s) under this contract at no additional cost to the Owner either at third party facility or in presence of Owner's representative and submit the reports for approval.

2.20.03 For short circuit test, proto-type of similar design and of same capacity with documentary evidence shall be submitted for customer approval.

2.20.03 For newly designed equipment, type test shall be conducted at CPRI or Government approved laboratory at the Contractor's cost.

2.20.04 Certified reports of all the tests carried out at the works shall be furnished in six (6) sets to the Owner for approval.

2.20.05 The equipment shall be dispatched from works only after receipt of Owner's written approval of the test reports and MDCC.

2.21.00 **Mandatory Spares**

Contractors scope shall include Mandatory Spares of all equipments as mentioned in the relevant portion of Technical Specification and under Vol. IIA, Sec.-8.

2.22.00 **Scope of Design Work**

2.21.01 Complete basic design engineering and detail design engineering for the plant is in the scope of the EPC Contractor.

2.21.02 Contractor's output of basic design engineering work need to be submitted for review and approval of the Owner/Owner's Engineer. Accordingly, the Contractor's documents containing outputs of the basic design engineering work that need to be submitted 'FOR APPROVAL' are listed in Clause No.1.19.02.

2.21.03 Detailed design engineering shall be in conformity with and based on the approved basic engineering documents only. The Contractor shall submit detail engineering output in the form of drawings, data, curves & manuals in two categories: 'For Reference' and 'For Approval'. Those are listed in individual Sections of Volume V-A and Volume V-B.

3.00.00 **LAYOUT CRITERIA**

3.01.00 **Transformer Yard**

3.01.01 Generator Transformers, Unit Transformers, Unit Auxiliary Transformers and Standby Transformers, Station Auxiliary Transformers will be installed in transformer yard. Spare Generator Transformer shall be placed in transformer yard at a suitable location.

3.01.02 Aux. power transformers for BOP systems will be installed in respective areas of CHP, AHP etc. Only LT dry type (AN cooled) transformers shall be located inside a building.

3.01.04 One or if required two main rail track parallel to power house building shall be provided. It will be interconnected with the rail track in unloading bay. From main track, several branch tracks will be laid up to individual transformer location.

3.01.03 Layout shall allow removal of any transformer on rail track without affecting other transformers, equipment and structure.

3.01.05 Jacking pads will be provided at each right-angled connection of rail track right up to unloading bay.

3.01.06 GT & UT centre lines shall match with the centre line of generator isolated phase busduct. Reasonable space shall be kept in between the transformers and the Power House wall on 'A' row, for convenient and easy handling.

3.01.07 Baffle wall in between single phase GT unit, GT & UTs and between UATs & SATs shall be provided as per applicable codes.

Fire Wall in between other Aux. Power Transformer located in CHP, AHP and Water system areas shall be provided as per applicable codes like TAC recommendations.

Recommendations of TAC shall be followed regarding fire rating of Powerhouse walls/Pump House wall (as applicable) adjacent to transformers depending on the distance of the transformers.

3.01.08 Symmetry shall be maintained for transformer layouts to achieve more or less identical arrangement for each unit, in case of a multiple-unit station.

3.01.09 Equipment layout and cable routing as prepared by the successful bidder shall be subject to revisions upon review by the Owner's Engineer to achieve a neat layout, adequate working space all around, better aesthetics, or to meet statutory regulation and codes. Required changes shall be done by the successful bidder without any commercial implication.

3.01.11 Routing of 11kV and 3.3kV segregated phase busducts, both indoor and outdoor, will be so designed as to cause no interference with any other equipment, cable trays, pipe racks, etc.

3.01.12 Each transformer yard shall be fenced with gate for controlled movement of personnel as well as for removal of transformer without dismantling busduct or cable boxes.

3.02.00 **Criteria of Oil Pit for Transformer**

An oil soak pit under the transformer and a common oil pit (unitized) outside the transformer yard / building at a distance ≥ 2.5 m from the fencing shall be provided for transformer containing ≥ 2000 litre of oil.

3.02.01 Oil Pit under Transformer and its Cooler Bank

a) Gravel filled open oil pit will be provided under each transformer and its cooler bank. The pit shall be such that it can take oil / water surge of 1/3 of the volume of the transformer oil when filled with gravel of size 60 mm.

b) Each pit will be connected to the drain line of at least 150mm diameter stoneware pipe with a minimum slope of 1:96 leading to common oil pit. Level of the pit under the transformer shall be such that there will not be permanent accumulation of oil/water.

3.02.02 Common Oil Pit

A common oil pit (unitized) shall be provided for GT, ST, UTs, UATs and SAT in transformer yard. For other HT aux. power transformers a common oil pit (unitized) shall be provided in transformer yard near respective pump house. All the oil pits shall be connected to the drain line of waste water treatment system.

a) Volume of the oil pit upto bottom level of the oil pit shall be calculated based on : (a) Oil quantity of the largest transformer, (b) Quantity of the water for sprinkler system based on 10.2lit/min/sq.meter of the largest transformer surface area (Ref: TAC manual for water spray system) and 10 minutes operation of spray water system (ref : NFPA 850),.and (c) Quantity of rainwater collected from all associated pits (assumed 5-7% of total oil quantity of associated transformers)

b) The common oil pit will be closed type of water-proof concrete construction.

c) Pit will be provided with two (2) sump pumps. Discharge rate of each pump shall be at least equal to the discharge rate of high velocity water spray system provided for fire-fighting of the transformer. The sump-pump shall have automatic operation by float switch with manual over-riding facility.

d) The sump-pump outlet will be connected to oil-water separator.

f) Transformer fire/drainage of oil will be considered for only one transformer at a time.

3.03.00 **Layout Requirement for BOP Auxiliary Buildings**

3.03.01 CHP Electrical cum Control buildings shall be preferably two (2) storied building. The ground floor shall be used as cable vault room. The first floor (minimum floor level at 3.5metre above cable vault finished floor level) shall accommodate electrical/ communication/monitoring equipment. It shall also accommodate CHP fire fighting panel and HVAC equipment as applicable with associated equipment.

3.03.02 Wagon tippler control room for each wagon tippler shall be located near track. Control room wall facing the track shall be provided with glass panes to have a full view of the coal unloading operation.

3.03.03 Separate Control rooms will be provided at C.W. pump house, ESP control building, Vacuum pump building, Fly ash conveying compressor building, Ash slurry and Ash Water pump house complex, Fuel oil pump house , DM plant building (as required), etc. Control rooms will be generally provided at the same floor level of switchgear room with access between the two.

3.03.04 For areas where Switchgear/MCC /Control Rooms are located at upper floor without any cable spreader room below, adequate height shall be provided for rooms below to accommodate overhead cable racks inside room.

3.03.05 Separate rooms shall be provided for batteries with lay down space for one identical battery set. Battery charger and D.C. distribution board will be located in different room.

3.03.06 Two covered stairs shall be provided on opposite sides of all multistoried building.

3.04.00 **Equipment Layout**

3.04.01 Flexibility shall be kept for handling of equipment without obstruction both during erection and maintenance. Adequate handling facilities, space, door/ rolling shutter of adequate width and height shall be provided for the purpose.

3.04.02 Generator circuit breaker (GCB) shall be located inside the Power House building. If the layout demands locating the GCB at an elevated level, an all-around working platform of adequate size at that level with a permanent staircase shall be provided.

3.04.03 **Layout Requirement for Switchgear Rooms**

a) The following clearances shall be maintained for Switchboards:

		HT Switchboard	LV Switchboard
a)	Front Clearance		
	For one Row of Swgr	2.0m (Min)	1.5m (Min)
	For two Rows of Swgr facing each other	2.5m (Min)	2.0m
b)	Back Clearance		
	For single front	1.5m(Min.)	1.0m (Min.) (c)*
	For double front	NA	1.5m (Min.)
c)	Side Clearance	Min. 800mm plus width of one panel	

b) HT Switchboard clearances shall be followed wherever both LT & HT switch boards are in the same room.

c) * Minimum clearance of 1500 mm shall be provided on rear of panel for single front boards where rear door width is less than 1500 mm and where cable trench/trays below is not obstructed by column foundation/columns.

d) Where the specified front clearance is not adequate for movement of any electrical equipment like dry type L.T. transformers, the same shall be increased to suit transformer dimensions.

3.04.04 Generally all electrical room shall be provided with 2 doors in addition to the shutters provided for handling transformer, switchgear, panels etc.

3.04.05 Air-conditioned rooms shall be provided with double door.

3.04.06 All busduct shall enter the PCC/PMCC from either top or from side.

3.04.07 Clearance of 1500 mm in between adjacent panels in a row or from the side wall/door shall be so decided that handling of shipping section of any board is not obstructed.

3.04.08 Cable spreader room floors shall have all openings properly ridged to prevent water drainage into the room below. In addition proper facilities shall be provided at cable spreader floor to drain the water in case of operation of sprinkler system.

3.05.00 **Interplant Cable Routing**

3.05.01 Interplant cable routing will be on overhead cable trays on pipe cum cable trestle or on cable trestle except where approved by purchaser/consultant. In exceptional case, small stretch of outdoor run of interplant cable routing may be taken through cable trench only with the Owner's prior approval.

3.05.02 Only in specific areas where number of cables are too small compared to the route length, cables may be directly buried underground with prior approval by Owner.

3.05.03 Space for accommodating additional trays, which may come in future, shall be provided in the cable route. The Contractor shall provide such trays without any extra cost implication to purchaser.

3.05.04 Cable trestles shall have a minimum 600mm clear walk way all along its routes and shall have maintenance platforms as required.

3.05.05 Cable in CHP area shall be generally routed through the conveyor gallery / tunnel, TP / Buildings by separate supporting structures, Pipe cum cable bridge. The cables shall be laid in vertical trays.

3.05.06 The bottom of the steel supporting structure shall be generally at 2.5 m above the grade level except for road crossing and rail crossing where the same shall be 8.0 m and 9.0m respectively above finished grade level.

3.05.07 Routing of cables shall be designed taking care of the following:

(a) Separate trays shall be provided for H.T., L.T., control and instrumentation and FS cables.

(b) LT mutlicore power cables shall be laid touching each other in single layer & touching formation.

(c) LT single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil centre lines.

(d) Control and instrumentation cables shall be laid in maximum of two layers formation.

(e) Single core HT power cables shall be laid on trefoil formation with a distance of four times the diameter of cable between trefoil centre lines.

(f) Multi core HT power cables shall be laid in single layer & touching formation.

(g) Normally cable trays shall be designed with 70% fill-in criteria and conduit 40% fill-in criteria.

(h) Separate cable tray shall be provided for Fire Survival cables.

4.00.00 **SIZING CRITERIA FOR ELECTRICAL EQUIPMENT**

4.01.00 **Generator**

4.01.01 Generator and its excitation system shall have a capability at least matching the declared maximum continuous rated output of the associated steam turbine for the design maximum secondary cooling water temperature (ECW temperature) at/with:

(a) all power factors between 0.85 lagging and 0.95 leading

(b) +3% to -5% frequency variation,

(c) terminal voltage variation of +/- 5% and

(d) combined voltage & frequency variation of 5%.

4.01.02 It shall be ensured that when the Generator is working at this capability and design maximum secondary cooling water temperature (ECW temperature), no part of the Generator shall attain a temperature in excess of the temperature limits specified for Thermal Class 130 (B) insulation as per IEC-60034.

4.01.03 Also the generator and its excitation system shall be capable of continuous stable operation without any excessive temperature rise at the peak output of the associated steam turbine under VWO & HP heater out condition, etc. as available for design maximum secondary cooling water temperature (ECW temperature) at /with

(a) all power factors between 0.85 lagging and 0.95 leading

(b) +3% to -5% frequency variation,

(c) terminal voltage variation of +/- 5% and

(d) combined voltage & frequency variation of 5%.

Temperature of different parts may exceed those permissible for Thermal Class 130 (B) insulation under such operating conditions, but shall be lower than those permissible for Thermal Class 155 (F) insulation as per IEC-60034.

4.01.04 Capacity with one gas cooler out

Generator shall be capable of delivering at least two-third of the rated and maximum continuous MVA with ten (10) percent of tubes in each cooler plugged without exceeding the temperature limits of thermal class 130 (B) and thermal class 155 (F) respectively.

4.02.00 **Generator Transformer**

4.02.01 Rating of the Generator Transformer shall be suitable for continuous stable operation of unit at the rated nominal output at all power factors between 0.85 lagging and 0.95 leading. The minimum rating of the each single phase GT shall be 330 MVA (1-Phase).

4.02.02 Further the Generator transformer shall be rated for evacuation of peak net output (peak output of the generator under VWO/ HP heater out condition etc. less 50% of unit auxiliary power consumption i.e. one of the unit board fed from Standby Transformer) as indicated above at Clause 4.01.03, at all power factors between 0.85 lagging and 0.95 leading, continuously.

4.03.00 **Unit & Standby Transformers**

4.03.01 **Unit Transformer**

a. Unit transformers would be sized to meet the loads corresponding to auxiliaries required to meet the peak load requirements of the unit.

b. Each unit transformer shall be sized for the following:

The loads of a set of unit auxiliaries (including MDBFP) corresponding to 60% BMCR operation plus
The connected station load plus
Owner's load of *6.3MVA* for other purposes like colony etc. (if specified elsewhere), plus
Loads due to outage of largest rated outgoing transformer feeder on other bus, plus
10% margin on the aforesaid mentioned sum
Multiplied by no load voltage correction factor as defined later

c. The minimum ONAF rating of each Unit Transformer shall be 50MVA.

4.03.02 **Stand by Transformer**

a. The Stand by transformer shall be sized to cater outage of one fully loaded Unit Transformer under the condition specified above plus any other loads connected on each winding/station bus. A margin of 10 % and no load voltage correction factor as defined later shall be considered.

b. The minimum ONAF rating of each Stand-by Transformer shall be 100MVA.

4.03.03 Rating of each Unit Transformer shall be so chosen as to limit transient voltage dip on DOL starting of the largest rated 11kV motor (may be the BFP motor), to less than 20% while also limiting the maximum MV Switchgear fault level to 50kA(rms).

4.03.04 No Load Voltage Correction Factor (= Transformer No Load voltage/ rated bus Voltage) shall be used for sizing of all transformers i.e.
Transformer size = the calculated size X no load voltage correction factor (11.5/11, 3.6/3.3, 0.433/0.415).

4.03.05 All the transformers shall be sized based on the maximum load expected to be fed by the transformers. All auxiliary transformers except Unit and Standby Transformers shall be sized so as to have 20% margin at design ambient conditions after considering final load requirements at peak conditions.

4.03.06 The successful bidder shall determine voltage regulation and short circuit levels through system study considering various conditions of operations, to ensure that these are within permissible value.

4.04.00 **Auxiliary and LT Transformers**

Adequate number of auxiliary transformers shall be provided to meet the demand on 3.3kV and 415V systems under most onerous conditions, with the criteria that each 3.3kV / 415V switchgear / MCC / DB shall be fed by 2x100% transformers / feeders, and these shall be rated to carry the maximum load expected to be imposed.

CHP auxiliary transformers shall be sized to meet the demand on simultaneous operation of both the streams.

4.05.00 **Bus ducts and Cables**

4.05.01 The short circuit rating of the generator main busduct will correspond to higher of the fault current contributions from generator or transformer side while the tap-off busducts will be designed for sum of the fault contributions from generator and GT side.

4.05.02 HT and LT power cables shall be selected on the basis of current carrying capacity, short circuit rating and permissible maximum voltage drop at equipment terminals during normal operation and starting conditions. Voltage drop of the cable during motor starting condition shall be limited to 15% and during full load running condition shall be limited to 3 % of the rated voltage. Other outgoing feeder /transformer feeder shall be limited to 3%.

4.05.03 Cables and bus ducts feeding switchboards from transformers shall be sized based on transformer rating and considering the maximum negative voltage variations envisage in the specifications. All derating factors applicable shall be taken into consideration.

4.05.04 Cables and bus ducts feeding transformers shall be sized based on current ratings of transformer at the minimum voltage tap of the transformer. All derating factors applicable shall be taken into consideration.

4.05.05 All other cables/bus-ducts shall be sized based on the load demand under most onerous conditions.

4.05.06 Cables shall be derated for the site ambient and ground temperatures, grouping and soil resistivity and cable laying configuration.

4.05.07 Cables, for circuit breaker controlled feeders, shall withstand the short circuit current for the fault clearing time. 0.16 sec. for outgoing feeder, 0.5 sec. for tie breaker and 1.0 sec. for Incomer.

4.05.08 For the fuse/MCCB/Circuit breaker protected circuits, the cable size shall depend upon full load current subject to voltage drop limited to 3% during running of all feeders and 15% during starting for motor feeders. In addition, transformer regulation shall also be considered for loads fed from 415V PMCC. In case of other out going feeder voltage drop shall be limited to 3%. For welding receptacle, 3% running drop shall only be considered.

4.05.09 For loads fed from local panels, the total running voltage drop in cable from 415V PMCC to local panel and from local panel to individual motor shall be limited to 3% at full load motor current while the same during starting shall be limited to 15%.

4.05.10 Current rating of motor feeder/cables should be at least 125% of full load current.

4.05.11 For Flap Gate, Rack & Pinion Gate, Electrical Hoist - 3% running drop and 10% starting drop shall be considered with reference to 415 V bus voltage.

4.05.12 Minimum size of control cables shall be 2.5 sq. mm copper and for power cable shall be 6.0 sq.mm aluminium.

4.06.00 **DC System**

4.06.01 Procedure for estimating battery capacities shall be as per guide-lines stipulated in latest revision of IEEE Std. 485 for Lead acid Battery. Derating factor for prolonged float charging shall be duly taken into account, as applicable, in estimating battery capacity.

4.06.02 Sizing of all batteries except those for the Switchyard shall be done based on different types of continuous and intermittent loads including motor starting for the complete emergency duration specified as per the system requirement. All intermittent loads shall be considered with minimum 1 minute duration. The no. of cells, end cell voltage shall be considered based on the minimum and maximum voltage window and cable drop etc as per system requirement. Minimum electrolyte temperature for battery sizing purpose shall be considered as 5ºC lower than the annual mean lowest ambient temperature of the site.

4.06.03 Total DC load shall include load for Owner's facilities also, as identified elsewhere in the Specification.

4.06.04 DC scheme shall ensure that each critical load is fed from two different bus sections. DCDBs shall provide adequate number of feeders on each section.

4.06.05 Each of the batteries shall be sized to supply total DC load of that area at an acceptable voltage for at least ten (10) hours under complete blackout condition. The minimum size of battery for BTG area shall be 1500AH for lead acid Planté type.

4.06.06 CHP battery shall be sized to supply DC lighting for at least one hour under complete blackout condition.

4.06.07 Sizing of Switchyard battery shall take into account the emergency lighting in Switchyard control room for a period of 1 hour. In addition to this all continuous DC loads of relay & control panels/OLTE panels and interlocking coils of isolators/earth switches shall be considered including requirement of line bays (where applicable), for a duration of 3 hours. Battery should be sized considering the worst of the following conditions:

(i) Simultaneous operation of the maximum number of breakers & associated equipments in case of bus fault in the switchyard.

(ii) Operation of Breaker failure relay (LBB relay)

4.06.08 Float charger shall be sized to carry the total DC continuous load and the trickle charging current of the battery plus a 25% margin. The charger shall also be capable of delivering the rated load under the specified voltage and frequency variations of incoming AC supply.

4.06.09 Boost/Float-cum-boost charger shall be sized to restore the fully discharged battery to full charge condition in ten (10) hour for lead-acid battery with 25% margin over maximum charging rate or to operate as a float charger with duty requirement, whichever is greater.

4.07.00 **DG Set**

4.07.01 DG set shall be able to meet safe shut down of the plant under emergency condition and in case of total power failure. It shall be sized to meet 100% of essential load requirements of the generating unit including starting of the largest motor (DOL) with other loads connected without exceeding the permissible starting voltage drop. Some of the vital station auxiliaries/systems like battery chargers of switchyard, auxiliary

supplies of instrument/plant air compressors, emergency air conditioning and ventilation system loads shall also be fed from DG set supply.

4.07.02 Minimum size of DG shall be 1500kVA.

4.08.00 **UPS System**

UPS System provides a regulated and uninterrupted single phase A.C. power, within specified tolerances, to critical station loads during normal and emergency operation. Capacity of inverter output shall be computed by the contractor considering the above requirement. 25% spare margin shall be kept on the total of above requirement. UPS shall be 415V AC, 3 phase input and 240V AC, 1 phase output.

The UPS system shall have 2x100% parallel redundant chargers and inverters, 2x100% PLANTE type battery bank, bypass line transformers and voltage stabiliser, static switch, manual bypass switch, 2x100% AC/DC distribution boards, other necessary protective devices and accessories.

4.09.00 **Electrical Laboratory Equipment**

Electrical laboratory equipment shall be supplied for testing various electrical equipment/devices during operation and maintenance of plant.

5.00.00 **PROVEN-MAKE CRITERIA FOR ELECTRICAL EQUIPMENT**

5.00.01 To read “Bidder/Contractor” in place of “Sub-vendor” in the following clauses in case the Bidder himself is the OEM.

5.01.00 **Isolated Phase Busduct**

5.01.01 Sub-vendor should have designed, manufactured, type tested, supplied, erected and commissioned Isolated Phase Bus duct for a turbo-generator of at least 500MW, which is in successful operation for a period of not less than two (2) years as on date of Techno-Commercial bid opening.

And

5.01.02 Sub-vendor should have firm Purchase Order for manufacture and supply of Isolated Phase Bus duct for a turbo-generator set of at least 660MW as on date of Techno-Commercial bid opening.

5.02.00 **Power Transformers**

5.02.01 Sub-vendor should have designed, manufactured, installed / supervised installation and commissioned/supervised commissioning of at least two (2) nos. (one each at two different project sites) of 400 kV or above class Generator Transformers of at least (a) 200 MVA capacity per single phase unit or (b) 330MVA capacity three phase transformer as a single unit, which should be in successful operation for at least two(2) years as on date of Techno-Commercial bid opening.

Or

5.02.02 Sub-vendor who have designed, manufactured, installed/supervised installation and commissioned/supervised commissioning of at least two (2) no. 220 kV or above class transformer which are in successful operation for two (2) years as on date of Techno-Commercial bid opening and have established manufacturing facilities for 400 kV class transformers based on technological support of its associate or collaborator, can also be considered Qualified provided his associate or collaborator

meets the qualifying requirement stipulated at 5.02.01 above. The associate will be fully responsible for design, testing, supply, erection, commissioning and putting into satisfactory operation.

5.03.00 **Auxiliary Oil Filled/ Dry type Transformers**

5.03.01 Sub-vendor should have manufactured & supplied at least two numbers (one each at two different project sites) of at least highest offered rating oil filled transformers which must be in successful operation for a period of at least two (2) years as on date of Techno-Commercial bid opening.

5.03.02 Sub-vendor should have his own facilities for conducting all routine and type tests as per IS: 2026 (except short circuit test).

5.03.03 The transformer considered for the above (cl. no. 5.03.01) should have been successfully short circuit tested.

5.04.00 **11 kV & 3.3kV Switchgears**

5.04.01 Sub-Vendor should have designed, manufactured and supplied at least one hundred (100) numbers of 11kV and /or 3.3kV Switchgear panels complete in all respects with fault rating of at least 50kA for one (1) second and 125kA (peak), which are in successful operation for a period of at least two (2) years as on date of Techno-Commercial bid opening.

5.04.02 Sub-Vendor should have manufactured and supplied at least one hundred (100) numbers of Vacuum Circuit breakers for 11kV and /or 3.3kV panels with a rating of 50kA rms BREAKING, 125kA peak MAKING and 50kA withstand for one (1) second, which shall be in successful operation in 3.3kV or higher voltage application for a period of at least two years as on date of Techno-Commercial bid opening.

5.04.03 Sub-Vendor's associate or collaborator meets requirement stipulated at 5.04.01 & 5.04.02 stipulated under Route 1.

5.04.04 The associate will be fully responsible for design, supervision of manufacturing and testing, and satisfactory operation of the equipment.

5.05.00 **LT Switchgear**

5.05.01 Sub-Vendor should have manufactured and supplied at least a total of five hundred (500) nos. draw out type air circuit breaker panels and / or draw out motor control centre panels complete in all respects with fault rating of at least 50 kA for 1 sec. and 105 kA (peak) under a single order and these panels shall be in successful operation for a period of not less than two (2) years as on date of Techno-Commercial bid opening.

5.06.00 **Numerical Relays & Networking**

5.06.01 Numerical Relays shall be offered from a Manufacturer who has manufactured and supplied and successfully configured at least 100 No's of Numerical Relays complying with IEC 61850 used for application in Feeder Protections/Transformer Protections/Motor protections. These relays shall be in successful operation for at least one (1) year as on date of Techno-Commercial bid opening.

5.06.02 The Numerical Relay Network system be offered from a Integrator /Manufacturer who has designed and successfully done FAT for a network on IEC 61850 with least 100 nos of Communicable Numerical Relays prior to date of Techno-Commercial bid opening.

5.07.00 **HT Motor**

5.07.01 **CW Motor**

The CW pump drive motors should be sourced from a manufacturer who have supplied at least two nos. of 11KV or above, vertical, DOL started squirrel cage induction motors of cooling type specified having rating 2000KW or more and motor speed not exceeding 500 rpm synchronous, which are in successful operation for at least two (2) years as on the date of Techno-Commercial bid opening.

5.07.03 **BFP Motor**

The offered Squirrel cage Induction motor shall be from such a manufacturer who has manufactured and supplied motor of 10MW or above rating, which is in successful operation in at least one (1) plant for a period not less than one (1) year as on the date of Tech no-Commercial bid opening.

5.07.04 **ID Fan Motor**

The offered Squirrel cage Induction motor shall be from such a manufacturer who has manufactured and supplied motor of 4MW or above rating, which is in successful operation in at least one (1) plant for a period not less than one (1) year as on the date of Techno-Commercial bid opening.

5.08.00 **LT Control Cables**

Sub-Vendor should have manufactured and supplied as on date of Techno-Commercial bid opening the following:

(a) At least 300 km of PVC insulated, PVC sheathed stranded copper conductor 1.1 kV grade cables in one single contract

(b) At least one (1) km of Flame retardant low smoke cables.

5.09.00 **LT Power Cables**

Sub-Vendor should have manufactured and supplied as on date of Techno-Commercial bid opening the following:

a) At least 100 km of aluminium conductor, XLPE insulated, PVC sheathed power cables of 1.1 kV or higher grade in one single contract

b) At least 100 km of aluminium conductor, PVC insulated, PVC sheathed power cables of 1.1 kV or higher grade in one single contract

c) At least one (1) km of flame retardant low smoke cables.

d) 1.1kV or higher grade power cable of minimum 630sq.mm. conductor size.

5.10.00 **HT Cables**

Sub-Vendor should have manufactured and supplied following cables, as on date of Techno-Commercial bid opening

(a) At least 50kms of XLPE insulated power cables of 6.35/11 kV or higher

voltage grade, executed in one or more orders.

(b) At least one (1) km of flame retardant low smoke cables of any voltage level.

5.11.00 **DG Sets**

Sub-Vendor should have supplied at least two (2) numbers of DG set of rating not less than 1250 kVA, at least one (1) each at two (2) different installations, which should be in successful operation for at least two (2) years as on date of Techno-Commercial bid opening. The make of the DG set (Alternator and Engine) shall be same as that of reference plant DG set.

5.12.00 **DC Batteries**

Sub-Vendor should have manufactured and supplied at least two (2) numbers of highest offered rating or above of high discharge type Plante positive plate type battery at least one (1) each at two (2) different industrial installations, which should be in successful operation for at least two (2) years as on date of Techno-Commercial bid opening.

5.13.00 **Battery Charger**

Sub-Vendor should have manufactured and supplied at least two (2) numbers of static automatic voltage regulator type Battery Chargers of highest offered rating or above, at least one (1) each at two (2) different industrial installations, which should be in successful operation for at least two (2) years as on date of Techno-Commercial bid opening.

5.14.00 **Generator Circuit Breaker (GCB)**

Sub-Vendor should have designed, manufactured, tested, supplied, erected & commissioned/supervised erection and commissioning of at least two numbers of generator circuit breakers (sulphur hexaflouride) of ratings not below that offered for this project, which are in successful operation for at least two (2) years as on date of Techno-Commercial bid opening. The ratings will constitute of:

a) Rated voltage and current rating.

b) Rated short circuit current carrying capability for one (1) second.

c) Rated short circuit peak making and latching current carrying capability.

d) Rated symmetrical RMS short circuit current interrupting capability.

The type (sulphur hexaflouride) and rating of breaker offered should also have been successfully type tested as on date of Techno-Commercial bid opening.

5.15.00 **400kV Switchyard Equipment (AIS)**

5.15.01 SF6 Circuit Breakers being offered should be from manufacturer who has manufactured and supplied minimum fifteen (15) nos. of SF6 Circuit Breakers of offered voltage class or higher, and which must have been in successful operation for a minimum period of two (2) years as on date of Techno-Commercial bid opening.

5.15.02 Disconnecting switches being offered should be from manufacturer who has manufactured and supplied minimum thirty (30) nos. of Disconnecting switch of offered voltage class or higher, suitable for air insulated substation/ switchyard and which must have been in successful operation for a minimum period of two (2) years as on date of Techno-Commercial bid opening.

5.15.03 400kV Instrument Transformers being offered should be from manufacturer who has manufactured and supplied minimum fifteen (15) nos. of single phase Instrument Transformers of offered voltage class or higher, suitable for air insulated substation/ switchyard and which must have been in successful operation for a minimum period of two (2) years as on date of Techno-Commercial bid opening.

5.15.04 400kV Surge Arrestors being offered should be from manufacturer who has manufactured and supplied minimum fifteen (15) nos. of single phase Surge Arrestors of offered voltage class or higher, suitable for air insulated substation/ switchyard and which must have been in successful operation for a minimum period of two(2) years as on date of Techno-Commercial bid opening.

5.15.05 The Erection Contractor must have supplied, constructed, installed and commissioned at least two 400 kV substations each having at least 5 number bays as a turnkey supplier and such substations must have been in successful commercial operation for at least two years as on date of Techno-Commercial bid opening.

5.16.00 **Substation Automation System & Protective Relays**

5.16.01 The Substation Automation System offered with distributed architecture should have been in successful operation in at least one (1) Substation/Switchyard of not less than 220 kV class for a minimum period of one(1) year as on date of Techno-Commercial bid opening.

5.16.02 The Generator Protection Relays, the Bay Protection Units including the Busbar protection and the energy metering System offered should be from manufacturer(s) who have manufactured and supplied the offered type of devices for respective equipment, which must have been in successful operation in a 500 MW or above unit / 220 kV class or above Substation/Switchyard for a minimum period of one (1) year as on the date of Techno-Commercial bid opening.

ANNEXURE-A

TECHNICAL PARAMETERS FOR ELECTRICAL SYSTEM

1.00 E.H.V. SYSTEM DATA

a) 400kV SYSTEM

1	Type of busbar scheme to be adopted	Two main bus
2	System voltage to be adopted	400 kV
3	System Earthing	Solidly grounded
4	Short circuit level	40 kA
5	Maximum system voltage	420- kV
6	Minimum system voltage	380 kV
7	Number of outgoing feeder lines	Refer Specification.
8	B.I.L. for equipment	1425 kVp
9	Short circuit current duration for which the substation have to be designed	1 sec.

2.00 M.V. SYSTEM DATA

1	Voltage System	11 kV & 3.3 kV
2	System of earthing to be adopted for both unit and station system	Resistance grounding
3	Limiting Ground Fault current Value	300 Amp.
4	Type of Bus transfer scheme to be followed for change over from one source to other.	Fast bus transfer followed by slow bus transfer for 11kV for various Switchboard as specified. Slow bus transfer for 3.3kV or as specified.
5	Type of switchgear to be selected	Vacuum circuit breaker
6	a) Connection between transformer and 11 kV& 3.3 kV switchgear	Busduct
	b) Connection between transformer and 11 kV & 3.3 KV NGR	Cable
7	Short circuit current	11kV - 50 kA 3.3kV – 50kA
8	Duration of short circuit current	1 sec.

3.00 L.V. SYSTEM DATA

1	Nominal 3 phase voltage to be selected for L.V. system	415 V
2	System Earthing	Solidly grounded
3	Type of Breaker to be selected	Air break
4	Type of outgoing feeder switching device in L.T. MCC	MCCB
5	M.C.C. type	Single front/Double front Fully draw out type
6	Short circuit level for 1 sec	50 kA

4.00 **DC SYSTEM DATA**

1	Nominal voltage to be selected for DC system	220 V
2	Type of Incoming / outgoing feeder switching device	Double pole Switch-Fuse
3	DCDB type	Single front/Double front Fixed type
4	Short circuit level for 1 sec	To be decided by Bidder 25 kA (minimum)

5.00 **UPS SYSTEM DATA**

1	Nominal voltage to be selected for UPS system	240 V, 1-Ph, 50 Hz, AC
2	Type of Incoming / outgoing feeder switching device	MCCB
3	UPSDB type	Single front, Fixed type, Modular construction
4	Short circuit level for 1 sec	To be decided by bidder 25 kA (minimum)

VOLUME: V-A

SECTION-II

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

CONTENT

VOLUME: V-A

SECTION-II

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

1.00.00 **SCOPE**

1.01.00 This section covers the general requirements of the drive motors for power station auxiliary equipment.

1.02.00 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.

1.03.00 In case of any discrepancy, the driven equipment specification shall govern.

2.00.00 **CODES & STANDARDS**

2.01.00 All motors shall conform to the latest applicable IS, IEC and CBIP Standards/ Publications except when otherwise stated herein or in the driven equipment specification.

2.02.00 Major standards, which shall be followed, are listed below other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed:

i) IS-325

ii) IS-12615

iii) IEC-60034

3.00.00 **SERVICE CONDITIONS**

3.01.00 The motors will be installed in hot, humid and tropical atmosphere highly polluted at places with coal dust and/or fly ash.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.

3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 **TYPE AND RATING**

4.01.00 **A.C. Motors**

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

4.01.02 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.

4.01.03 LT motor & HT motor name-plate rating at 50°C shall have at least 15% margin and 10% margin respectively over the input power requirement of the driven equipment at rated duty point unless stated otherwise in driven equipment specification.

4.01.04 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.

4.01.05 Motors efficiency class shall be IE1, IE2 as per latest version of IEC-60034.

4.02.00 **D.C. Motors**

4.02.01 D.C. motor provided for emergency service shall be shunt/compound wound type.

4.02.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability.

Starter panel complete with all accessories shall be included in the scope of supply.

5.00.00 **PERFORMANCE**

5.01.00 **Running Requirements**

5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.

5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.

5.01.03 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.

5.02.00 **Starting Requirements**

Motor shall be designed for direct online starting at full voltage. Breakaway starting current as percentage of full load current for various motor rating shall not exceed the given below-

Motors up to 1500kW	-	600% subject to IS tolerance of plus 20%.
Motors above 1500kW	-	450% not subject to any positive tolerance.

5.02.01 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

5.02.02 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals except mill motor. Mill motor shall start with rated load and accelerate to full speed at 85% of the rated voltage at the motor terminals.

5.02.03 a) Two hot starts in succession with motor initially at normal running temperature.

b) Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction.

5.02.04 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage.

5.03.00 **Stress During Bus Transfer**

5.03.01 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.

5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.

5.04.00 **Locked Rotor Withstand Time**

5.04.01 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 3 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.

5.04.02 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.

5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

6.00.00 **SPECIFIC REQUIREMENTS**

6.01.00 **Enclosure**

6.01.01 All motor enclosures for outdoor, semi-outdoor & indoor application shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction with canopy.

6.01.02 For hazardous area approved type of increased safety enclosure shall be furnished.

6.02.00 **Cooling**

6.02.01 The motor shall be self ventilated type, either totally enclosed fan cooled IC 411(TEFC), totally enclosed tube ventilated IC 511(TETV) or closed air circuit air- cooled IC 611(CACA).

6.02.02 For large capacity motors not available with above type of cooling may be accepted with IC 81W or IC 91W, closed air circuit water cooled (CACW) subject to the approval of the owner.

6.03.00 **Winding and Insulation**

6.03.01 All insulated winding shall be of copper.

6.03.02 All motors shall have class F insulation but limited to class B temperature rise.

6.03.03 Windings shall be impregnated to make them non-hygroscopic and oil resistant.

6.04.00 **Tropical Protection**

6.04.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

6.04.02 All fittings and hardwares shall be corrosion resistant.

6.05.00 **Bearings**

6.05.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Bearings shall be rated for minimum service life of 40,000Hrs.

6.05.02 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.

6.05.03 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.

6.05.04 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.

6.05.05 Grease lubricated bearings shall be pre-lubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication. LT motors 15kW and above shall be provided with external greasing arrangement.

6.05.06 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.

6.05.07 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.

6.05.08 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.

6.05.09 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.

6.06.00 **Noise & Vibration**

6.06.01 All HT motors shall be provided with vibration pads for mounting of vibration detectors. Vibration monitoring devices shall be provided on DE and NDE side in x&y direction with remote DCS monitoring, alarm and tripping.

6.06.02 The maximum double amplitude vibrations for HT motors upto 1500 rpm shall be 25 microns and 15 microns upto 3000 rpm. For 415V motors, maximum double amplitude vibrations upto 1500 rpm shall be 40 microns and 15 microns upto 3000 rpm.

6.06.03 The noise level shall not exceed 85db (A) at 1.5 meters from the motor.

6.07.00 **Motor Terminal Box**

6.07.01 Motor terminal box shall be detachable type and located in accordance with Indian Standards clearing the motor base- plate/ foundation

6.07.02 Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. for HT motors and 90 Deg. for LT motors unless otherwise approved.

6.07.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.

6.07.04 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.

6.07.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.

6.07.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.

6.07.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.

6.07.08 For 11000V and 3300V motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.

6.07.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.

6.07.10 The gland plate for single core cable shall be non-magnetic type.

6.07.11 Minimum clearances to be provided between phase to phase and phase to earth shall be as under-

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

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

6.08.00 **Grounding**

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

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

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

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

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

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

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

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

Rating			Cable Size
Above	Up to		

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

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

6.10.00 **Rating Plate**

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

a) Temperature rise in Deg.C under rated condition and method of measurement.

b) Degree of protection.

c) Bearing identification no. and recommended lubricant.

d) Location of insulated bearings.

7.00.00 **ACCESSORIES**

7.01.00 **General**

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

7.02.00 **Space Heater**

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

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

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

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

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

7.03.00 **Temperature Detectors**

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

7.03.02 11000V and 3300V motor bearing shall be provided with duplex type temperature detectors.

7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.

7.03.04 Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DDCMIS connectivity.

7.03.05 0.5 sq.mm annealed tinned copper conductor complying with IS-1554(Part-1). shall be used for RTD/BTD wiring.

7.04.00 **Indicator/Switch**

7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:

a) 11000 V and 3300V motor bearing temperature.

b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.

7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used. CACW motor shall be provided with water leakage detector with remote alarm and tripping.

7.04.03 Alarm switch contact rating shall be minimum 2.0 A at 220V D.C. and 10A at 240V A.C.

7.05.00 **Current Transformer for Differential Protection**

7.05.01 Motor 1000 kW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure.

7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.

7.06.00 **Accessory Terminal Box**

7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.

7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit owner’s cable connections.

7.07.00 **Drain Plug**

Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 **Lifting Provisions**

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

7.09.00 **Dowel Pins**

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

7.10.00 **Painting**

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

8.00.00 **TESTS**

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

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

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

b. Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test.

c. Polarization Index Test as per IS: 7816 as routine test

d. Test for suitability of IPW– 55(Weather proof) as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu to test, provided the test motor is identical to motor being supplied. Second numeral test shall be carried out on one motor of each type and rating.

e. Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box.

f. Test for noise level as routine test.

g. Test for vibration as routine test.

h. Tan delta measurement on coils.

i. Surge withstand test for inter turn insulation.

j. Test to diagnose rotor bar failure during manufacture.

k. Over speed test as routine test.

l. Temperature rise test.

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

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

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

9.00.00 **DRAWINGS, DATA & MANUALS**

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

9.02.00 **To be Submitted with the bid**

a) List of the motors

b) Individual motor data sheet as per format of the proposal data sheets.

c) Scheme & write-up on forced lubrication system, if any

d) Type test report

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

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

ANNEXURE-A

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

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

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

Note-

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

2.0 RANGE OF VARIATION

A.C. Supply :

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

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

D.C. Supply :

Voltage	:	187 to 242 Volt

ANNEXURE-11

INSPECTION &TESTING AT MANUFACTURERS WORKS

6.00.00 **INSPECTION AND TESTING**

6.01.00 The Contractor shall carry out the following specific tests and inspections to ensure that the equipment furnished lies in strict conformance with the specification and also in accordance with applicable codes/standards and good engineering practice.

a) Identification and Testing

i) All materials used for pump construction shall be of tested quality. Material shall be tested as per the relevant standards and test certificates shall be made available to the Owner.

ii) Tests for each pump included under this section shall include but not be limited to the following :

- The entire surface of the impeller castings shall be subjected to Dye Penetration Test as per ASTM Specification no.: E165-65.
- Shaft shall be subjected to Dye Penetration and Ultrasonic Tests.
- Wearing rings shall be subjected to Dye Penetration Test.
- Verification of material, witnessing of pouring, casting and inspection of finalized fabricated/cast castings.
- Inspection of finished castings for impeller and verification of materials.
- Inspection of pump shaft and verification of material.
- Witnessing of NDT/review of NDT reports.
- Static balancing test for impeller and dynamic balancing of complete rotating parts as per ISO- 1940.
- Complete Inspection of assembled pump.

b) Hydrostatic Testing

The pump casing shall be hydrostatically tested at 150% of the shut-off pressure. Pressure shall be maintained for a period of not less than one (1) hour. While arriving at the above values maximum suction pressure shall be taken into account.

c) Performance Test at Shop

i) Each pump shall have to be tested to determine the performance curves of the pumps. These tests are to be conducted in presence of Owner's representative as per the requirements of the Standards of Hydraulic Institute of USA (ASME-Power Test Code PTC 8.2/BS-599) or any other equivalent standard but the tolerances on head discharge and power shall be as specified in HIS, USA.

ii) Performance tests are to be conducted to cover the entire range of operation of the pumps. These shall be carried out to span 130% of rated capacity up to pump shut-off condition. A minimum of five combinations of head and capacity are to be achieved during testing to establish the performance curves, including the design capacity point, shut-off point and the two extremities of the range of operation as specified in the annexures. After completion of performance test, all pumps shall be stripped down for inspection of internals.

iii) Tests shall be conducted with actual drive motors being furnished.

iv) NPSH tests are to be conducted on one pump of each type at 3% head drop conditions, if specified in the pump Annexures.

v) Mechanical run test shall be carried out on all pumps to determine the vibration levels, noise levels etc. This test shall be conducted at site also. However, test value at site shall be used for the acceptance of the equipment.

7.00.00 DRAWINGS, DATA, CURVES AND INFORMATION

7.01.00 The Bidder shall submit the following along with his formal proposal besides the different information plate required as indicated elsewhere in this section.

7.01.01 Drawings

a) General arrangement drawings showing the principal dimensions, weight and location of the suction and discharge connections of the pumps offered. Details of lubrication and sealing arrangement shall be included.

b) Typical cross-section drawing showing various components of the pumps offered materials of construction etc.

7.01.02 Data and Curves

a) Determination of pump total dynamic head and rated capacity as per guidelines specified in Section-I of this Volume. Detailed calculations shall be shown by the Bidder.

b) Anticipated performance curves showing the following characteristics :

i) Capacity vs. head

ii) Capacity vs. power

iii) Capacity vs. efficiency

iv) Capacity vs. NPSH required

v) System resistance curves

c) Speed vs. torque curve of the pump corresponding to recommended mode of pump starting superimposed on speed vs. torque curves of the drive unit corresponding to 80%, 90%, 100% of the rated voltage (applicable only in the cases of pumps with drive motor power rating of 100 KW and above).

d) Completely filled-in Technical particulars enclosed under Volume-IX of this specification.

7.02.00 The successful Bidder shall furnish the following drawings/data for Purchaser/Engineer's approval after award of the contract.

7.02.01 Final versions of all the drawings, documents as specified in clause no. 7.01.00 above.

7.02.02 Pump foundation details along with all design loads, direction and points of application.

7.02.03 Test reports, test certificates and other particulars.

7.02.04 All other applicable drawings and documents as specified in Volume-IIA of this specification.

b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.

c) Non-destructive examination results /reports including radiography interpretation reports.

d) Factory tests results for testing required as per applicable codes and standards referred in the specification.

e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.

f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

g) Stress relief time temperature charts.

h) Inspection reports duly signed by QA personnel of the Owner and Contractor for the agreed inspection hold points. During the course of inspection, the following will also be recorded :

i) When some important repair work is involved to make the job acceptable.

ii) The repair work remains part of the accepted product quality.

i) Letter of conformity certifying that the requirement is in compliance with finalised specification requirements.

4.00.00 **INSPECTION, TESTING AND INSPECTION CERTIFICATES**

4.01.00 The Owner’s Engineer, or his duly authorised representative and/or an outside inspection agency acting on behalf of the Owner shall have access inside the workshops, test labs, establishments 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 Owner’s Engineer 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.

4.02.00 The Contractor shall give the Owner’s Engineer/ Authorized Inspector twenty one (21) days written notice for “CHP” / “W” points of any material being ready for testing by owner’ engineer / Authorized inspector. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Engineer/ Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection. If owner’s Engineer / Authorised Inspector fail to attend the inspection, next mutually convenient date for test shall be agreed with Contractor. Contractor shall, in

ANNEXURE-12

PAINTING

VOID

ANNEXURE-13

SUB VENDOR LIST

	APPROVED VENDORS FOR INSTRUMENTS (FROM PMD)	
PMD No	PMD Desc.	Vendor Name
PE.EP.001	BATTERY CHARGER	AMARA RAJA POWER SYSTEMS LTD
PE.EP.001	BATTERY CHARGER	CHHABI ELECTRICALS P LTD.
PE.EP.001	BATTERY CHARGER	DUBAS ENGINEERING PVT LTD.
PE.EP.001	BATTERY CHARGER	HBL POWER SYSTEMS LTD
PE.EP.001	BATTERY CHARGER	KERALA STATE ELECTRONICS
PE.EP.001	BATTERY CHARGER	STATCON POWER CONTROLS LTD.
PE.IN.520	DIFFERENTIAL PRESSURE INDICATOR / GAUGES	A.N. INSTRUMENTS PVT. LTD.,
PE.IN.520	DIFFERENTIAL PRESSURE INDICATOR / GAUGES	ASHCROFT INDIA PVT. LTD.
PE.IN.520	DIFFERENTIAL PRESSURE INDICATOR / GAUGES	BAUMER TECHNOLOGIES
PE.IN.520	DIFFERENTIAL PRESSURE INDICATOR / GAUGES	GENERAL INSTRUMENTS CONSORTIUM
PE.IN.520	DIFFERENTIAL PRESSURE INDICATOR / GAUGES	HIRLEKAR PRECISION ENGG. PVT. LTD.
PE.IN.520	DIFFERENTIAL PRESSURE INDICATOR / GAUGES	SAMSON CONTROLS PVT LTD.,
PE.IN.520	DIFFERENTIAL PRESSURE INDICATOR / GAUGES	SWITZER PROCESS INSTRUMENTS
PE.IN.520	DIFFERENTIAL PRESSURE INDICATOR / GAUGES	WALCHANDNAGAR INDUSTRIES LIMITED
PE.IN.540	LEVEL GUAGES (MAGNETIC TYPE)	V AUTOMAT AND INSTRUMENTS PVT LTD
PE.IN.540	LEVEL GUAGES (MAGNETIC TYPE)	SCIENTIFIC DEVICES (BOMBAY) PVT. LT
PE.IN.540	LEVEL GUAGES (MAGNETIC TYPE)	J.N.MARSHALL LTD
PE.IN.540	LEVEL GUAGES (MAGNETIC TYPE)	D.K.INSTRUMENTS (P) LTD.,
PE.IN.548	LEVEL TRANSMITTER (ELECTRONIC - SMART)	V AUTOMAT AND INSTRUMENTS PVT LTD
PE.IN.548	LEVEL TRANSMITTER (ELECTRONIC - SMART)	CHEMTROLS INDUSTRIES LTD.,
PE.IN.548	LEVEL TRANSMITTER (ELECTRONIC - SMART)	DRESSER VALVE INDIA PVT.LTD.
PE.IN.561	RESISTANCE TEMPERATURE DETECTORS (RTD & THERMOCOUPLES)	BAUMER TECHNOLOGIES
PE.IN.561	RESISTANCE TEMPERATURE DETECTORS (RTD & THERMOCOUPLES)	DETRIV INSTRUMENTATION
PE.IN.561	RESISTANCE TEMPERATURE DETECTORS (RTD & THERMOCOUPLES)	EXOTHERM INSTRUMENTS
PE.IN.561	RESISTANCE TEMPERATURE DETECTORS (RTD & THERMOCOUPLES)	GOA INSTRUMENTS INDUSTRIES
PE.IN.561	RESISTANCE TEMPERATURE DETECTORS (RTD & THERMOCOUPLES)	PROTECH CONTROL INSTRUMENTS
PE.IN.561	RESISTANCE TEMPERATURE DETECTORS (RTD & THERMOCOUPLES)	PYRO ELECTRIC INSTRUMENTS GOA
PE.IN.561	RESISTANCE TEMPERATURE DETECTORS (RTD & THERMOCOUPLES)	TEMPSENS INSTRUMENTS (I) PVT.LTD.
PE.IN.561	RESISTANCE TEMPERATURE DETECTORS (RTD & THERMOCOUPLES)	THERMAL INSTRUMENT INDIA
PE.IN.574	THERMOMETERS	FORBES MARSHALL (HYD) PVT LIMITED,
PE.IN.574	THERMOMETERS	GOA INSTRUMENTS INDUSTRIES
PE.IN.574	THERMOMETERS	ASHCROFT INDIA PVT. LTD.
PE.IN.574	THERMOMETERS	H.GURU INSTRUMENTS(S.I)PVT.LTD
PE.IN.574	THERMOMETERS	WALCHANDNAGAR INDUSTRIES LIMITED
PE.IN.574	THERMOMETERS	SCIENTIFIC DEVICES (BOMBAY) PVT. LT
PE.IN.574	THERMOMETERS	BAUMER TECHNOLOGIES
PE.IN.574	THERMOMETERS	GENERAL INSTRUMENTS CONSORTIUM
PE.IN.574	THERMOMETERS	A.N. INSTRUMENTS PVT. LTD.,
PE.IN.574	THERMOMETERS	PROTECH CONTROL INSTRUMENTS
PE.IN.579	TEMPERATURE TRANSMITTER	ABB LIMITED, HYD

PMD No	PMD Desc.	Vendor Name
PE.IN.579	TEMPERATURE TRANSMITTER	EMERSON PROCESS MGT (I) PVT LTD
PE.IN.579	TEMPERATURE TRANSMITTER	HONEYWELL AUTOMATION INDIA LIMITED
PE.IN.579	TEMPERATURE TRANSMITTER	YOKOGAWA INDIA LIMITED
PE.IN.586	LEVEL TRANSMITTER (RADAR, NON-CONTACT TYPE)	MAGNETROL INTERNATIONAL N.V.
PE.IN.586	LEVEL TRANSMITTER (RADAR, NON-CONTACT TYPE)	ENDRESS & HAUSER GMBH + CO.
PE.IN.586	LEVEL TRANSMITTER (RADAR, NON-CONTACT TYPE)	PUNE TECHTROL PVT LTD
PE.IN.586	LEVEL TRANSMITTER (RADAR, NON-CONTACT TYPE)	SAAB ROSEMOUNT TANK GUAGING
PE.IN.586	LEVEL TRANSMITTER (RADAR, NON-CONTACT TYPE)	HONEYWELL AUTOMATION INDIA LIMITED
PE.IN.586	LEVEL TRANSMITTER (RADAR, NON-CONTACT TYPE)	VEGA INDIA LEVEL & PRESSURE MEASURE
PE.MP.013	FUEL OIL FINE FILTERS	EPE PROCESS FILTERS &
PE.MP.013	FUEL OIL FINE FILTERS	FIL SEP EQUIPMENTS PVT. LTD.
PE.MP.013	FUEL OIL FINE FILTERS	FILTER CONCEPT PVT. LTD.
PE.MP.013	FUEL OIL FINE FILTERS	NIRMAL INDUSTRIAL CONTROLS PVT LTD
PE.MP.013	FUEL OIL FINE FILTERS	PALL INDIA PVT. LTD.,
PE.MP.013	FUEL OIL FINE FILTERS	PETROMAR ENGINEERED SOLUTIONS
PE.MP.013	FUEL OIL FINE FILTERS	VIZAG FILTERS (P) LTD
	APPROVED VENDORS LIST FOR MOTORS (FROM PMD)	
FOR LT MOTOR		
PE.EP.005	LT MOTORS (SAFE AREA)	ABB LIMITED, HYD
PE.EP.005	LT MOTORS (SAFE AREA)	ALSTOM T&D INDIA LIMITED
PE.EP.005	LT MOTORS (SAFE AREA)	BHARAT BIJLEE LTD, MUMBAI
PE.EP.005	LT MOTORS (SAFE AREA)	CROMPTON GREAVES
PE.EP.005	LT MOTORS (SAFE AREA)	KIRLOSKAR ELEC.CO.LTD
PE.EP.005	LT MOTORS (SAFE AREA)	LAXMI HYDRAULICS PVT. LTD.
PE.EP.005	LT MOTORS (SAFE AREA)	SIEMENS INDIA LTD SECBAD.
FOR HT MOTOR		
HT MOTOR SHOULD BE PROCURED FROM BHEL BHOPAL ONLY. NO OTHER MAKE IS ACCEPTABLE		

Sl.no	Material Description	Vendor	Remarks
10	Butterfly Valve (CAST IRON & CS)	DURGA VALVES PRIVATE LIMITED, SECUNDERABAD, TELANGANA	Approved
		L & T VALVES LIMITED, HYDERABAD, TELANGANA	Approved
		BOTELI VALVE GROUP COMPANY LTD., CHINA	Not Acceptable
		ASHWATHI CONTROLS PVT. LTD., AHMEDABAD, GUJARAT	Not Acceptable
		INSTRUMENTATION LTD, PALAKKAD, KERALA	Approved
		FOURESS ENGINEERING (I)PVT.LTD, HYDERABAD, TELANGANA	Approved
		WEIR BDK VALVES, HUBLI, KARNATAKA	Approved
		UNIQUE VALVES LIMITED, PUNE, MAHARASTRA	Not Acceptable
		INTER VALVE (INDIA) LTD.,PUNE, MAHARASTRA	Approved
		DEMBLA VALVES LTD., THANE, MAHARASTRA	Approved
		DYNAMIC VALVES PVT. LTD., NAVI MUMBAI, MAHARASTRA	Not Acceptable
		HI-TECH BUTTERFLY VALVES INDIA, INDORE, MADHYA PRADESH	Not Acceptable
		LEADER VALVES LIMITED, JALANDAR, PUNJAB	Not Acceptable
		GALAXY CONTROLS PVT LTD., CHENNAI, TAMIL NADU	Not Acceptable
		ADVANCE VALVES PVT.LTD. GREATER NOIDA, UTTAR PARDESH	Approved
		KAMALA VALVES & ENGINEERING, HOWRAH, WEST BENGAL	Not Acceptable
		VENUS PUMP & ENGINEERING WORKS, HOWRAH, WEST BENGAL	Approved
11	Fire Water Pumps (Vertical)	KIRLOSKAR BROTHERS LTD, HYDERABAD, TELANGANA	Approved
		KSB PUMPS LIMITED,HYDERABAD, TELANGANA	Approved
		SULZER PUMPS INDIA LTD., HYDERABAD, TELANGANA	Approved
		WILO MATHER & PLATT PUMPS PVT. LTD.,HYDERABAD, TELANGANA	Approved
		JYOTHI LIMITED., VADODARA, GUJARAT	Approved
		FLOWMORE LIMITED, GURGOAN, HARYANA	Approved
		BHARAT PUMPS & COMPRESSORS LTD., NAINI, UTTAR PRADESH	Approved
		WPIL LIMITED, KOLKATTA, WEST BENGAL	Approved
12	ELECTRICAL HOIST	SOUTHERN PLANTAIDS PVT LIMITED, HRDERABAD, TELANGANA	Not Acceptable
		GRIP ENGINEERS PVT. LTD., HYDERABAD, TELANGANA	Approved
		ROCK WELL HOISTO CRANES PVT. LTD., NEW DELHI	Approved
		CENTURY CRANE ENGINEERS, PALWAL, HARYANA	Approved
		EDDYCRANES ENGINEERS PVT., MUMBAI, MAHARASTRA	Approved
		MM ENGINEERS PVT. LTD., COIMBATORE, TAMIL NADU	Not Acceptable

Chief Engineer
Thermal Projects Construction
TSGENCO, Vidyut Soudha,
Khairatabad, Hyderabad-82

Sl.no	Material Description	Vendor	Remarks
13	EOT CRANES	SHIVPRA CRANES PVT. LTD.,HYDERABAD, TELANGANA	Not Acceptable
		GRIP ENGINEERS PVT. LTD.HYDERABAD, TELANGANA	Approved
		ROCK WELL HOISTO CRANES PVT. LTD., NEW DELHI	Approved
		ANUPAM INDUSTRIES LIMITED, ANAND, GUJARAT	Approved
		WMI CRANES LTD., BANGALORE, KARNATAKA	Approved
		EDDYCRANES ENGINEERS PVT., MUMBAI, MAHARASTRA	Approved
		TUOBRO FURGUSON (INDIA) PVT. LTD., KOLKATA, WEST BENGAL	Approved
14	Control Cables	UNIVERSAL CABLES LTD, HYDERABAD, TELANGANA	Approved
		THERMO CABLES LIMITED, HYDERABAD, TELANGANA	Approved
		KEC INTERNATIONAL LIMITED, HYDERABAD, TELANGANA	Not Acceptable
		NICCO CORPORATION LTD HYD, HYDERABAD, TELANGANA	Approved
		POLYCAB INDUSTRIES PVT.LTD., HYDERABAD, TELANGANA	Approved
		CORDS CABLE INDUSTRIES LTD., NEW DELHI	Approved
		CMI LIMITED, NEW DELHI	Not Acceptable
		KEI INDUSTRIES LIMITED, NEW DELHI	Approved
		DELTON CABLES LIMITED, NEW DELHI	Approved
		PARAMOUNT COMMUNICATIONS LTD, NEW DELHI	Approved
		SPECIAL CABLES PVT. LTD., NEW DELHI	Approved
		SRIRAM CABLES PVT. LTD., NEW DELHI	Not Acceptable
		GEMSCAB INDUSTRIES LTD., NEW DELHI	Not Acceptable
		SUYOG ELECTRICALS LTD, VADODARA, GUJARAT	Not Acceptable
		ELKAY TELELINKS LIMITED, FARIBADAB, HARYANA	Approved
		RAVIN CABLES LTD, MUMBAI, MAHARASTRA	Not Acceptable
		ASSOCIATED CABLES PVT LTD., MUMBAI, MAHARASTRA	Not Acceptable
15	Diesel Engine	Greaves Cotton (R&H) - Pune	Approved
		Cummins- Kothrud / Viman Nagpur	Approved
		Caterpillar - USA	Approved
		Ashok Leyland - Chennai (For booster Pump)	Approved
		KOEL - Pune (For booster pump)	Approved

Chief Engineer
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TSGENCO, Vidyut Soudha,
Khairatabad, Hyderabad-82

ANNEXURE-14

MISC CUSTOMER SPECIFICATION

to placement of Letter of Intent. This approved list will be binding to the bidder. In the said list, Owner reserves the right to include reputed/reliable vendors of his own choice. Regarding the various other sub-vendors, the list would be submitted within six (6) months of the award of the contract that shall be scrutinized by the Owner to accord approval. In such list Owner reserves the right to include vendors of his own choice. No further vendor approval will be given after twelve (12) months. On the quality plans, the customer hold points will also be identified based on which Owner would give clearance for the manufacture to proceed further.

Quality assurance/Inspection group of Owner or its representative would issue a material despatch clearance certificate (MDCC) after the inspection clearance which will enable the Contractor to despatch the equipment and claim the payment. In the despatch programme, the Contractor shall indicate a schedule of estimated programme, tonnages specifically identifying various oversize dimensioned consignments (ODC). Further the Contractor will also be required to ensure at all stages of shipment that packing of all shipments despatched are suitable for ocean freight to India, handling at the port of entry, inland transportation and preservation at site upto erection. All despatch details & item lists shall be made available to both Owner & site immediately after shipping.

The Contractor shall also expedite all despatches from their own works/works of their sub-vendors, so as to match with the various activities mentioned at 1.04.03 above.

1.04.05 Construction Management

Based on the L-1 Master Network Programme, within two (2) months of the issue of Letter of Intent, the Contractor shall submit a programme of construction/ erection/ commissioning, either in continuation with the manufacture and despatch or separately for the implementation. These programmes would be amplified showing when the civil drawings shall be released by him and construction of civil works shall be completed by him to facilitate start of erection and subsequent activities and shall form the basis for site execution and detailed monitoring. The three monthly rolling programme with the first month's programme being tentative based on the site conditions would be prepared based on these L-3 programmes. The Contractor shall also be involved along with the Owner to tie up detailed resource mobilisation plan over the period of time of the contract matching with the performance targets.

The L-3 programme would be jointly finalised by the site in charge of the Contractor with the Owner's project coordinator as well as the site planning representative. The erection programme will also identify the sequential erectable tonnages that are required for various equipment which should be taken care of in the despatch programmes.

Erection and commissioning of the equipment shall also be done under the supervision of experts from the respective equipment/ system supplier.

1.04.06 Spares Management

owner for review / approval. These Quality Plans / procedures will detail out, for all 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.

2.04.00 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc. will be subject to Owner's approval without which manufacture shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, Owner/Authorised representative shall identify customer hold points (CHP), test/checks which shall be carried out in presence of the Owners Engineer or his authorised representative and beyond which the work will not proceed without consent of Owner/Authorised representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and major deviations in the form of Non Conformity Report shall be referred to Owner/Authorised representative for approval and dispositioning.

2.05.00 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 Owner's Engineer/ Authorised representative for “CHP” and “W” points marked in quality plans , and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC). For items which is not under owner’s inspection the contractor shall apply for despatch clearance (MDCC) from owner by submitting their internal inspection reports and quality records

2.06.00 All materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report. These certificates and reports shall indicate the sheet serial numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it.

2.07.00 Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record, mechanical property test results shall be furnished.

2.08.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section - IX (latest edition) or other International equivalent standard acceptable to the Owner.

All brazers, welders etc. employed on any part of the contract at Contractor's/ Sub-Contractor's works or at site shall be qualified as per ASME Section-IX (latest edition) or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner / his authorised representative or owner approved Third Party Inspection Agency(TPIA). Previously qualified WPS & PQR shall be acceptable if witnessed by owner’s approved TPIA.

For welding of pressure parts and high pressure piping coming under IBR purview, the requirements of IBR shall also be complied with.

5.00.00 OPERATING MANUALS AND MAINTENANCE INSTRUCTIONS

5.01.00 The Contractor shall provide at least six (6) months before the time of commissioning and before taking over of the plant and equipment, all necessary maintenance manuals and operating instructions. The instruction manual shall be submitted in the form of one (1) soft copy in CD and 15 hard copies as per distribution schedule (Annexure-1).

5.02.00 The information provided, which shall be contained in loose leaf stiff backed covers, shall include :

a) A complete inventory of all main items of plant, with identification details.

b) Service manuals for all plant and equipment giving full descriptions of the main items and auxiliary items such as power packs, hydraulic equipment, actuators, lubricating pumps, etc.

c) A separate electrical manual covering items such as switchgear, cabling, instrumentation, controls, cabling layouts and wiring diagrams.

d) A schedule of recommendations for routine maintenance of all electrical and mechanical equipment, recommended inspection point, information on detection, cause and rectifications of troubles & faults.

e) A lubrication schedule with all necessary drawings diagrams to identify the lubrication points.

f) Manufacturer's literature.

5.03.00 The instruction manual shall be subject to the approval of Owner.

6.00.00 PLANT HANDBOOK

The Contractor shall submit to the Engineer, a preliminary plant handbook preferably in A-4 size sheets which shall contain the design and performance data of various plant, equipment and systems covering the complete project including single line flow diagrams, within twenty four (24) months from the date of his acceptance of the Letter of Intent. The final plant handbook complete in all respects shall be submitted by the Contractor six (6) months before start-up and commissioning activities. The plant handbook shall be submitted as per distribution schedule.

7.00.00 CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVAL PROCEDURE

7.01.00 Within fifteen (15) days to one month of issue of Letter of Intent (LOI) by the Owner, the Contractor shall furnish a schedule of drawings and design

12.00.00 PLANT LIFE AND MODE OF OPERATION

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

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

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

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

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

Cold start-up (>72 hrs. shutdown)	:	6 per year
Warm start-up (between 10 to 72 hrs. of shutdown)	:	40 per year
Hot start-up (less than 10 hrs. shutdown)	:	160 per year

13.00.00 PACKAGING & MARKING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of railway wagon sizes in India should be taken account of. The details of various wagons normally available with Indian Railways for transportation of heavy equipment shall be considered by the Bidder. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

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

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

The above indicates the dimensions which can be normally transported on the

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

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

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

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

14.00.00 **PROTECTION**

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

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

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

piping, tubing and conduit shall be sealed and taped.

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

15.00.00 ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT

15.01.00 Environment Protection

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

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

15.01.01 For Liquid Effluent

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

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

15.01.02 For Air Emission

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

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

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

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

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

15.02.00 **Noise Level Requirement**

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

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

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

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

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

16.00.00 **INSPECTION AND TESTING**

16.01.00 **Inspection and Tests during Manufacture**

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

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

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

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

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

ANNEXURE-15

QAP GUIDE LINES & FORMAT

VOLUME : IIA

SECTION-VII

QUALITY ASSURANCE REQUIREMENTS

CONTENT

VOLUME : IIA

SECTION-VII

QUALITY ASSURANCE REQUIREMENTS

1.00.00 QUALITY ASSURANCE PROGRAMME

1.01.00 To ensure that the equipment and services under the scope of Contract whether manufactured or performed within the Contractor's works or at his Sub-contractor's premises or at the Owner's site or at any other place or work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Owner/Authorised representative after discussions before the award of contract. A quality assurance programme of the Contractor shall generally cover the following :

a) His organisation structure for the management and implementation of the proposed quality assurance programme.

b) Documentation control system.

c) Qualification data for Bidder's key personnel.

d) The procedure for purchase of materials, parts, components and selection of Sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.

e) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.

f) Control of non-conforming items and system for corrective actions.

g) Inspection and test procedure both for manufacture and all site related works.

h) Control of calibration and testing of measuring and testing equipments.

i) System for quality audit.

j) System for indication and appraisal of inspection status.

k) System for authorising release of manufactured product to the Owner.

l) System for handling storage and delivery.

m) System for maintenance of records.

n) 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 format enclosed at Annexure-I to this section for Owners approval

o) Internal standards, if referred in the quality plans shall generally be compatible with National / International standards and shall be mentioned in the quality plans. Alternatively bidder shall furnish extracts of the internal standards detailing out acceptance norm for the product / material.

2.00.00 GENERAL REQUIREMENTS - QUALITY ASSURANCE

2.01.00 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 Owner/Consultant. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder, separately in the format attached at Annexure-I and will be submitted to Owner/Authorised representative for approval. Schedule of finalisation of such quality plans will be finalised before award.

Contractor shall furnish list of Manufacturing Quality Plans of major equipments indicating proposed inspection catagorisation indicating items that will be offered for Owner’s inspection etc and the Field Quality Plans

2.02.00 Manufacturing Quality Plan for all the major equipment will detail out their respective important components, their in-process various tests/inspection & final inspection / tests, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's Quality Control organization. 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 are to be comprehensibly documented by Contractor.

Manufacturing Quality Plan for all major equipments/ items will be approved by owner. In these approved quality plans, Owner / Authorised representative shall identify customer hold points (CHP), test / checks which shall be carried out in presence of the Owners Engineer or his authorised representative and beyond which the work shall not proceed without consent of Owner / Authorised representative in writing. Inspection/ Test reports are to be submitted to owner as specified in final approved Manufacturing Quality Plans.

2.03.00 Field Quality Plans / Procedures for all field activities shall be submitted to

owner for review / approval. These Quality Plans / procedures will detail out, for all 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.

2.04.00 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc. will be subject to Owner's approval without which manufacture shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, Owner/Authorised representative shall identify customer hold points (CHP), test/checks which shall be carried out in presence of the Owners Engineer or his authorised representative and beyond which the work will not proceed without consent of Owner/Authorised representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and major deviations in the form of Non Conformity Report shall be referred to Owner/Authorised representative for approval and dispositioning.

2.05.00 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 Owner's Engineer/ Authorised representative for “CHP” and “W” points marked in quality plans , and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC). For items which is not under owner’s inspection the contractor shall apply for despatch clearance (MDCC) from owner by submitting their internal inspection reports and quality records

2.06.00 All materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report. These certificates and reports shall indicate the sheet serial numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it.

2.07.00 Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record, mechanical property test results shall be furnished.

2.08.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section - IX (latest edition) or other International equivalent standard acceptable to the Owner.

All brazers, welders etc. employed on any part of the contract at Contractor's/ Sub-Contractor's works or at site shall be qualified as per ASME Section-IX (latest edition) or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner / his authorised representative or owner approved Third Party Inspection Agency(TPIA). Previously qualified WPS & PQR shall be acceptable if witnessed by owner’s approved TPIA.

For welding of pressure parts and high pressure piping coming under IBR purview, the requirements of IBR shall also be complied with.

2.09.00 All non-destructive examination (NDT) shall be carried out in accordance with LIST OF STANDARDS FOR REFERENCE as given below in this section.

The NDT operator shall be qualified as per SNT-TC-IA (of American Society of non- destructive examination). Results of NDT for the list major equipments / items identified for owner's inspection shall be properly recorded and submitted for review and approval. Other items not covered under owner's inspection, contractor shall review and approve the NDT results and such reports shall be submitted to owner in the final documentation of the items / equipments

2.10.00 All the sub-vendors proposed by the Contractor for procurement of major bought out items including castings, forgings, semi-finished and finished components/equipment list of which shall be drawn up by the Contractor and finalised with the Owner shall be subject to Owner's approval. Quality Plans of the successful vendors shall be discussed, finalised and approved by the Owner/Authorised representative and form part of the Purchase Order between the Contractor and the Vendor.

2.11.00 All the purchase specifications for the major bought-out items, list of which shall be drawn up by the Contractor and finalised with the Owner shall be furnished to the Owner for comments and subsequent approval before orders are placed.

Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-vendor's quality management and control activities. The Contractor shall provide all necessary assistance to enable the Owner carry out such audit and surveillance.

Quality audit/approval of the results of tests and inspection will not prejudice the right of the Owner to reject equipment not giving the desired performance after erection and shall not in no way limit the liabilities and responsibilities of the Contractor in earning satisfactory performance of equipment as per specification.

2.12.00 Quality requirements for main equipment shall equally apply for spares and replacement items.

2.13.00 Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the approval of the Owner.

2.14.00 For quality assurance of all civil works refer to the specifications for civil works.

3.00.00 **QUALITY ASSURANCE DOCUMENTS**

3.01.00 The Contractor shall be required to submit two (2) copies and two (2) sets of microfilms / CDs of the following Quality Assurance documents within three (3) weeks after despatch of the equipment:

a) Material mill test reports on components as specified by the specification.

b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.

c) Non-destructive examination results /reports including radiography interpretation reports.

d) Factory tests results for testing required as per applicable codes and standards referred in the specification.

e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.

f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

g) Stress relief time temperature charts.

h) Inspection reports duly signed by QA personnel of the Owner and Contractor for the agreed inspection hold points. During the course of inspection, the following will also be recorded :

i) When some important repair work is involved to make the job acceptable.

ii) The repair work remains part of the accepted product quality.

i) Letter of conformity certifying that the requirement is in compliance with finalised specification requirements.

4.00.00 **INSPECTION, TESTING AND INSPECTION CERTIFICATES**

4.01.00 The Owner’s Engineer, or his duly authorised representative and/or an outside inspection agency acting on behalf of the Owner shall have access inside the workshops, test labs, establishments 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 Owner’s Engineer 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.

4.02.00 The Contractor shall give the Owner’s Engineer/ Authorized Inspector twenty one (21) days written notice for “CHP” / “W” points of any material being ready for testing by owner’ engineer / Authorized inspector. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Engineer/ Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection. If owner’s Engineer / Authorised Inspector fail to attend the inspection, next mutually convenient date for test shall be agreed with Contractor. Contractor shall, in

no case proceed with the test without owner or his authorized inspectors, unless the witnessing is officially waived and advised Contactor to proceed with the test. Contractor shall forthwith forward duly certified completed test report and a product quality certificate in six (6) copies to owner upon completion of such test.

4.03.00 The Engineer or Inspector shall within fifteen (15) days from the date of Inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract / QAP or other approved quality documents. 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 confirm in writing to the Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the contract / QAP or other approved quality documents.

4.04.00 When the factory tests have been completed at the Contractor's or sub-contractor's works, the Engineer/Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests excluding the test completion date subject to submission of all certified documents related to the test, If the tests are not witnessed by the Engineer/Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Engineer/Inspector. Failure of the owner’s Engineer/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 Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract / QAP or other approved quality documents.

4.05.00 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, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the owner’s Engineer/Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contract / QAP or other approved quality documents. Contractor and shall give facilities to the owner’s Engineer/ Inspector or to his authorised representative to accomplish testing.

4.06.00 To facilitate advance planning of inspection in addition to giving inspection notice as per Clause 4.02.00, the Contractor shall furnish quarterly inspection programme indicating proposed 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.

LIST OF STANDARDS FOR REFERENCE

a) International Standards Organisation (ISO).

b) International Electro-technical Commission (IEC).

c) American Society of Mechanical Engineers(ASME)

d) American National Standards Institute (ANSI).

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

f) American Institute of Steel Construction (AISC).

g) American Welding Society (AWS).

h) Architecture Institute of Japan (AIJ).

i) National Fire Protection Association (NFPA).

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

k) Japanese Electro-technical Committee (JEC).

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

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

n) Instrument Society of America (ISA).

o) National Electric Code (NEC).

p) Heat Exchanger Institute (HEI).

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

r) Hydraulic Institute (HIS).

s) International Electro-Technical Commission Publications.

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

u) Applicable German Standards (DIN).

v) Applicable British Standards (BS).

w) Applicable Japanese Standards (JIS).

x) Electric Power Research Institute (EPRI).

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

z) Bureau of Indian Standards Institution (BIS).

aa) Indian Electricity Rules.

bb) Indian Boiler Regulations (IBR).

cc) Indian Explosives Act.

dd) Indian Factories Act.

ee) Tariff Advisory Committee (TAC) rules.

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

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

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

ANNEXURE-I
FORMAT OF QUALITY ASSURANCE PROGRAMME

VENDOR'S LOGO , NAME & ADDRESS	MANUFACTURING QUALITY ASSURANCE PLAN	DOC NO:	XXXXX-CAL-QAP-M-0001				
	-	REV NO :	0	1	2	3	4
	ITEM :	DATE :					

CLIENT :		LOCATION :	
PROJECT :		REFERENCE PURCHASE ORDER NO. & DT :	
VENDOR :		REFERENCE APPROVED DATA SHEET :	
SUB VENDOR :		REFERENCE APPROVED DRAWING. NO. :	

ABBREVIATIONS :

QAP - QUALITY ASSURANCE PLAN,	MATL - MATERIAL,	AGENCY :
CR - CRITICAL,	APP - APPROVED,	1 - DCPL/PROJECT AUTHORITY
MA - MAJOR,	DWG - DRAWING,	2 - SUPPLIER
MI - MINOR	SUPL - SUPPLIER,	3 - SUB-SUPPLIER
SPEC - SPECIFICATION,	PROC - PROCEDURE	4 - MANUFACTURER
TC - TEST CERTIFICATES		5 - THIRD PARTY INSPECTION AGENCY
P - PERFORM		
w - WITNESS		
V - VERIFY		
CHP - CUSTOMER HOLD POINT		

GENERAL REMARKS

1 THE ITEMS WHICH ARE FALLING UNDER ANY STATUTORY AUTHORITY'S (LIKE I.B.R. ETC.) SCOPE SHALL BE SUBJECTED TO THAT STATUTORY AUTHORITY'S INSPECTION CLEARENCE.

NOTES:

1. EXACT MATERIAL / PROCESS / INSPECTION / TESTS FOLLOWED BY THE MANUFACTURER SHALL BE SPECIFIED
2. EXACT REFERENCE DOCUMENT/ACCEPTANCE STANDARD SHALL BE SPECIFIED
3. IN CASE SPECIFIED ACCEPTANCE STANDARD / NORMS IS OTHER THAN NATIONAL / INTERNATIONAL STANDARDS

. STANDARD / COPY OF THE ACCEPTANCE NORMS FOLLOWED BY THE MANUFACTURER SHALL BE SUBMITTED FOR REVIEW RECORD

4 FINAL INSPECTION DOSSIER SHALL BE PREPARED BY MANUFACTURER & SHALL BE ENDORSED BY INSPECTIONTION AGENCY

	Prepared by			Checked by			Approved By		
Revision	R0	R1	R2	R0	R1	R2	R0	R1	R2
DATE									

VENDOR'S LOGO, NAME & ADDRESS	ITEM :	DOC NO:			
		REV NO :	R0	R1	R2
		DATE :			

SL NO.	DESCRIPTION	CHECKS			CATEGORY	REF DOCS	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
		TYPE	METHOD	QUANTUM					P	W	V	
1	2	3	4	5	6	7	8	9	12	13	14	15
1.00												

Notes:

Prepared by				Checked by			Approved By		
Revision	R0	R1	R2	R0	R1	R2	R0	R1	R2
DATE									

QAP GUIDELINES & FORMAT

`

(ANNEXURE 6 to PEMC 06377)

The QAP format and guidelines for filling up the format shall be used by vendor for preparation and submission of QAP after order placement.

Note :

1. Typical /Indicative /Standard QAP(s) for equipment /package attached is reference document and to use by successful bidder in future for preparation and submission of QAP for BHEL /CUSTOMER approval.

2. No deviation to reference document is acceptable.

GUIDELINES TO VENDORS FOR PREPARATION OF QUALITY ASSURANCE PLAN

1. QAP shall be made in landscape mode on A4 size paper as per the format enclosed. Font size shall be minimum 10.

2. Each page of QAP shall contain the following information.
   a) Vendorôs name & address.
   b) Customer: BHEL, Hyderabad.
   c) Project.
   d) BHEL Product Standard Number/revision number as referred in P.O.
   e) BHEL Purchase Order Number & Date.
   f) Product as per P.O. description.
   g) QAP Number (unique and shall not repeat)/revision number/date.
   h) Page number and number of pages

3. QAP shall contain four parts / stages as follows.
   a) Raw materials and bought out items.
   b) In process Control / Inspection.
   c) Final assembly, Inspection & Testing.
   d) Painting, preservation & packing.

4. Under óComponentô, indicate name of the component (say casing, rotor, pressure gauge, etc).

5. Under óCharacteristicsô, indicate appropriately (say chemical analysis, mechanical properties, NDT (UT,DP etc.), hydrostatic test, calibration check etc.)

6. Under óClassô, indicate minor, major or critical depending on the importance of characteristic.

7. Under óType of checkô, indicate appropriately (say chemical, mechanical, UT, DP etc.)

8. Under óQuantum of checkô, indicate appropriately (say 100%, 10%, sample, per melt, per heat, all pieces etc.)

9. Under óReference documentô and óAcceptance normsô, appropriate National & International standards, BHEL standards, approved drawing references etc. should be indicated. It is not correct to mention as ñVendorôs internal standards or Vendorôs standard practice etc.ò. If vendorsô internal standards are referred, same shall be in line with BHEL Spec. indicated in the P.O. These may require review & approval by our Engineering dept.

10. Under óFormat of recordô, indicate appropriately supplierôs test certificate, calibration certificate, lab report, inspection report etc.

11. Please refer óAgencyô in QAP format.
    Under P: Perform, W: Witness, V: Verify
    Indicate against each characteristic 1: (BHEL CQS/Nominated inspection agency), OR
    2: (Vendor / Sub vendor)
    Note: Performing agency is normally vendor or his sub vendor (Legend 2). Where

witness points are indicated in specification, P.O., Drawing etc., for such operations, under Witness (W) column use 1. Under 'Verify' column, use code1.

12. Under óDô please put (ã Tick) against each characteristic where vendor proposes to submit test certificate/report etc. OR as required as per BHEL Specification.

13. Vendorôs signature & stamp should be available on each page of QAP.

14. Vendor should read the BHEL Product Standard thoroughly and QAP should be made only inline and relevant to the Specification & Approved Drawings.

15.The following operations/characteristics/check points may be included (AS APPROPRIATE)

a) Visual check
b) Dimensional check
c) Mechanical and Chemical properties.
d) Surface preparation before painting (by chemical cleaning, sand blasting, shot blasting etc. as the case may be.)
e) Painting check for shade, Dry Film Thickness (DFT), Adhesion/ peel off test etc.
f) Check for correctness for all components mounted as per General arrangement Drawing, Bill Of Materials (BOM), etc. for range, rating, make, color, size, location as per GA, quantity, label description including tag nos., annunciator facia, loose components, accessories, spares etc.
g) Verification of test certificate for protection class for the enclosures.
h) Mechanical functioning of switches.
i) Continuity of earthing and provision of earth points.
j) Colour coding of wiring, size, tightness & dressing of wiring.
k) Review of test certificates of assembled items, raw materials, internal test reports etc.
l) Witness of functional checks, which may include mechanical run & electrical run, H.V.test, IR measurement, Electrical and Mechanical tests etc.
m) PQR, WPS, Welder Qualification Record, welding records (fit up, DP) etc.
n) Material identification (for punch marks of serial numbers, Heat No, Melt No, Inspector's stamp etc.)
o) Hydraulic Pressure Test, Pneumatic Pressure Test, Liquid Penetration Examination and other Non Destructive Tests.
p) Tests on Galvanised items (Visual, Hammer Test, Knife Test, Thickness, Pierce Test (Copper sulphate test), Hydrogen evaluation test, Stripping test (for Mass of Zinc coating)
q) All tests as per BHEL Product Standard & approved drawings including Type tests and Routine tests on individual items and on System as a whole.
r) Packing and Preservation.

16. **QAP Format shall be as per customer.**

17. Typical Manufacturing QAP for Pump, Motor & Diesel Engine are attached. Vendor shall submit these QAPs after PO placement for BHEL Approval. Same will be reviewed by BHEL in line with BHEL/Customer/Consultant specifications.

Typical Quality Plan for Vertical Pump

SL NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD		AGENCY			REMARKS
					2 (vendr)	1 (client)					P	W	V	
1	2	3	4	5	6		7	8	9	D*	** 10			11
1.0	***RAW MATERIAL INSPECTION***													
1.1	Bowl, Bell Mouth, Impeller/ Wear ring (if applicable)	Chemical Properties	Critical	Chemical Analysis	1 sample/ heat	--	Relevant Material Specificationn as per Apprd.Data Sheet / Appd..Drg.		MTC	√	2	-	1	Refer Note - 1, 2
		Mechanical Properties	Critical	Mechanical Tests	1 sample/ heat	--	--Do--		MTC	√	2	-	1	--Do--
		Visual	Major	Visual	100%	--	MSS-SP-55			--	2	-	--	
1.2	Bar stock for Shafts, couplings and Shaft Sleeves	Chemical Properties	Critical	Chemical Analysis	1 sample/ heat	--	Relevant Material Specificationn as per Apprd.Data Sheet / Appd..Drg.		MTC	√	2	-	1	Refer Note- 3
		Mechanical Properties	Critical	Mechanical Tests	1 sample/ heat	--	--Do--		MTC	√	2	-	1	--Do--
1.3	Shaft	Internal defects	Major	UT*	100%	--			UT Report	√	2	-	1	* For Shaft Dia. > 40 mm
1.4	Plate material for Column pipe Taper Col. Pipe & Discharge Head	Chemical & Mech. Properties	Critical	Chemical & Mech. Check	1 Sample	One per	Approved Datasheet/Drawi	As per Datasheet	MTC	*	2	-	1	In case, co-related TCs are not available, quantum of check
		Internal defects	Major	UT*	100%	--	ASME Sec. V SA 578 level A	ASME Sec. V SA 578 level A	NDT Report	*	2	-	1	* For Plate Thk.. > 20 mm
1.5	Thrust Bearing Housing & Thrust Pad**	Chemical & Mech. Properties	Major	Chemical & Mech. Check	1 sample/ heat	--	Relevant Material Specificationn as per Apprd..Drg.		MTC	√	2	-	1	** Not applicable for Antifriction Bearings
1.6	*STRAINER*	*Check of Material Grade*	*Major*	*Check of Material Grade*	1 Sample per Batch	--	*Approved Datasheet/Drawing*		*Compliance Cerificate*	√	2	-	1	

SL NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD		AGENCY			REMARKS
					2 (vendr)	1 (client)					P	W	V	
1	2	3	4	5	6		7	8	9	D*	** 10			11
2	**IN PROCESS INSPECTION**													
2.1	WPS/PQR/WPQ for pressure retaining fabricated items	Welding Procedure & Welder qualification	Major	Qualification records	--	--	ASME sec. IX	ASME sec. IX	Test reports	*	2	-	1	Documents to be submitted for review
2.2	Fabricated Items	Stress Relieving of Butt Joiunts >35mm thk	Major	Verification of HT Chart	100%	--	see remarks	see remarks	HT Register	*	2	-	1	Heat to 620°C @150°C/Hr soak for 2hrs upto 2" thk furnace cool to 300°C and then cool in still air
		RT of full penetration Butt joints***	Major	Radiography	See remark	--	ASME Sec. V	ASME sec. VIII Div. 1, UW 51/52		*	2	-	1	*** Spot RT covering 10% of Butt weld length for Thk. 10-20 mm & 100% for thk. More than 20 mm
2.3	DP check on welds	DPT on machined surfaces	Major	NDT	100%	--			DPT Report	√	2	-	1	
2.4	Parts listed in 1.1 to 1.3 after machining	Cleaning, Deburring, Surface Defect & Finish	Major	Visual	100%	--	Manufacturing Drawing			--	2	--	--	
		Dimensions	Major	Measurement	100%	--	--Do--		IR	--	2	--	--	
		DPT on machined surfaces	Major	NDT	100%	--			DPT Report	√	2	-	1	
2.5	Bowl, Column Pipe & Discharge Head	Hydrotest	Major	Leak Tightness	100%	--	Approved Data sheet/HI 2.6	No Leakage	Hydrotest Certificate	√	2	-	1	Test Pressure = 1.5 X Shut off Head & Test Dur.= 30 min.
2.6	Impeller, Pump & Motor	Balancing	Major	Balancing	100%	--	ISO 1940 Gr. 6.3		IR	√	2	-	1	
3.0	***FINAL INSPECTION & TESTING***													
3.1	*Performance Test With one of the JOB Motor*	Q Vs H, Q Vs η,Q Vs P, Noise & Vibration Level	Critical	Performance Test	100%	1 per Type	Appd. Data sheet / Test Procedure. 2.6		Test Report	√	2	1	1	CHP, Refer note no. 6,7 & 8

SL NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD		AGENCY			REMARKS
					2 (vendr)	1 (client)					P	W	V	
1	2	3	4	5	6		7	8	9	D*	** 10			11
3.2	Strip Test - In case of abnormal noise during Perf. Test	Check for wear & rubbing	Major	Visual	100%	100%	No undue wear & rubbing		Inspection Report	√	2	1	1	CHP, Refer note no. 9
3.4	Complete Pump	Overall dim. Check	Major	Visual	1/type/model		Approved GA Drg.		Dim. Report	√	2	-	1	
		QA Documentation	Major	Verification	100%	100%	Approved Data sheet/Quality Plan		Dim. Report	√	2	-	1	CHP
4	***PRESERVATION & PACKING***													
4.1	PRESERVATION & PACKING	Painting, *Completeness of PUMP* , Packing & Despatch	Major	Visual	100%	--	Technical spec./ Approved Datasheet		Packing Slip	–	2	–	-	

REMARKS

1 NO WELD REPAIRS PERMISSIBLE ON CI CASTING

2 AS CAST/PUNCHED HEAT NOS. SHALL BE PROVIDED FOR CORELATION

3 IN CASE OF CO RELATED TC'S ARE NOT AVAILABLE THEN QUANTUM OF CHECK WILL BE ONE SAMPLE FROM EACH BAR.

4 THIS QAP IS ALSO APPLICABLE FOR SPARES

5 MATERIAL SHALL BE AS PER APPROVED CS DRG./ DATA SHEET

6 VIBRATION & NOISE LEVEL FOR RECORD PURPOSE ONLY. HOWEVER THEIR VALUES AS PER SPECIFICATIONS ARE GUARANTEED AT SITE.

7 TOLERANCE ON SHUT OFF HEAD IS AS PER TABLE 14 OF API 610

8 THE PERFORMANCE TEST WILL BE CARRIED OUT WITH REDUCED SUSPENSION LENGTH DUE TO CONSTRAINTS OF SUMP DEPTH

9 STRIP TEST - INCASE OF ABNORMAL NOISE OBSERVED DURING PERF. TEST PUMP WILL BE STRIPPED DOWN FOR VISUAL INSPECTION OF IMPELLER & WEAR SHALL BE OFFERED FOR VISUAL INSPECTION FOR WEAR / RUBBING MARKS

*LEGEND : * RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. : 1Customer, 2:Vendor / Sub Vendor; P: Perform, W:Witness and V: Verification of Reports*

VENDOR'S NAME & ADDRESS:	**MANUFACTURING QUALITY PLAN**		QP. NO.:	
	CUSTOMER: BHEL, HYDERABAD – 32. PROJECT: PRODUCT: LT MOTOR	BHEL P.O.NO.: P.O.DATE: BHEL SPEC: REV:	REV NO:	DATE:
			PAGE 1 OF 9	

SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY P	AGENCY W	AGENCY V	REMARKS
1.0	**RAW MATERIALS & BOUGHT OUT ITEMS**												
1.1	COPPER CONDUCTOR	a. PHYSICAL PROPERTIES (Elongation, Springiness, Abrasion Test, Mandrel Winding Test etc)	Major	Mechanical	1 sample/lot	Tech Spec/ Approved Datasheet/ Approved Drawing	Tech Spec/ Approved Datasheet/ Approved Drawing	Manufacturer's Test Certificate	✓	2	--	1	
		b. ELECTRICAL PROPERTIES (BDV Test, Electrical Resistance, Continuity Test, Heat Shock Test etc)	Major	Electrical	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	
		c. DIMENSIONAL CHECK (Bare conductor dia., Overall dia. etc)	Major	Visual	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	
1.2	SLOT INSULATION	a. MECHANICAL PROPERTIES (Thickness, Tensile Strength, Elongation etc)	Major	Mechanical	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	
		b. ELECTRICAL PROPERTIES (BDV Test etc)	Major	Electrical	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	

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VENDOR'S NAME & ADDRESS:	**MANUFACTURING QUALITY PLAN**	QP. NO.:	
	CUSTOMER: BHEL, HYDERABAD – 32. PROJECT: PRODUCT: LT MOTOR	BHEL P.O.NO.: P.O.DATE: BHEL SPEC: REV:	REV NO: DATE: PAGE 2 OF 9

SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY P	AGENCY W	AGENCY V	REMARKS
		c. DIMENSIONAL CHECK (Thickness etc)	Major	Visual	1 sample/lot	Tech Spec/ Approved Datasheet/ Approved Drawing	Tech Spec/ Approved Datasheet/ Approved Drawing	Manufacturer's Test Certificate	✓	2	--	1	
1.3	INSULATING SLEEVINGS	a. DIMENSIONAL CHECK (Bore diameter, Wall Thickness etc)	Major	Visual	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	
		b. ELECTRICAL PROPERTIES (BDV Test, Insulation, Resistance etc)	Major	Electrical	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	
1.4	VARNISH & RESIN	a. DENSITY	Major	Physical	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	
		b. VISCOSITY	Major	Physical	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	
		c. DRYING TIME	Major	Thermal	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	
		d. SHELF LIFE	Major	Visual	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	
1.5	SHAFT	a. DIMENSIONAL CHECK (Outer Diameter etc.)	Major	Visual	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	

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SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY P	AGENCY W	AGENCY V	REMARKS
		b. CHEMICAL PROPERTIES	Major	Chemical	1 sample/lot	Tech Spec/ Approved Datasheet/ Approved Drawing	Tech Spec/ Approved Datasheet/ Approved Drawing	Manufacturer's Test Certificate	✓	2	--	1	
		c. MECHANICAL PROPERTIES (Hardness, Tensile Strength, Elongation etc)	Major	Mechanical	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	
		d. ULTRASONIC TEST*	Major	NDT	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	*As applicable
1.6	STAMPING STEEL	a. PHYSICAL PROPERTIES (Bending Test, Stacking Factor etc)	Major	Mechanical	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	
		b. ELECTRICAL PROPERTIES (Permeability, Specific Core Loss, Insulation Resistance etc)	Major	Electrical	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	
		c. DIMENSION (Thickness, etc.)	Major	Measurement	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	
		d. THICKNESS OF COATING	Major	Measurement	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	

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VENDOR'S NAME & ADDRESS:	**MANUFACTURING QUALITY PLAN**	QP. NO.:	
	CUSTOMER: BHEL, HYDERABAD – 32. PROJECT: PRODUCT: LT MOTOR	BHEL P.O.NO.: P.O.DATE: BHEL SPEC: REV:	REV NO: DATE: PAGE 4 OF 9

SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY P	AGENCY W	AGENCY V	REMARKS
1.7	DIE CAST ROTOR	a. CHEMICAL COMPOSITION (for Aluminium Ingot, etc)	Major	Chemical	1 sample/lot	Tech Spec/ Approved Datasheet/ Approved Drawing	Tech Spec/ Approved Datasheet/ Approved Drawing	Manufacturer's Test Certificate	✓	2	--	1	
		b. DIMENSIONAL CONFORMITY (Core length, Diameter etc.)	Major	Mechanical	100%			Inspection Record	✓	2	--	1	
		c. SURFACE FINISH (Free from blow holes, cracks etc)	Major	Visual	100%			Inspection Record	✓	2	--	1	
1.8	CASTINGS – BODY, END SHIELDS etc.	a. MECHANICAL PROPERTIES (Hardness, Tensile Strength etc)	Major	Mechanical	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	
		b. SURFACE FINISH	Major	Visual	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	
		c. DIMENSION	Major	Visual	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	
1.9	BEARINGS	a. TYPE & MAKE	Major	Verification	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	
1.10	PAINTS	a. TYPE OF PAINT	Major	Review	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	

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SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY P	AGENCY W	AGENCY V	REMARKS
		b. SHADE	Major	Review	1 sample/lot	Tech Spec/ Approved Datasheet/ Approved Drawing	Tech Spec/ Approved Datasheet/ Approved Drawing	Manufacturer's Test Certificate	✓	2	--	1	
		c. VISCOSITY	Major	Review	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	
		d. DRYING TIME	Major	Review	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	
		e. DRY FILM THICKNESS	Major	Review	1 sample/lot			Manufacturer's Test Certificate	✓	2	--	1	
2.0	**INPROCESS INSPECTION**												
2.1	MACHINED END SHIELDS	a. SURFACE FINISH (Free from blow holes & cracks etc)	Major	Visual	100%	Tech Spec/ Approved Datasheet/ Approved Drawing	Tech Spec/ Approved Datasheet/ Approved Drawing	Inspection Record	✓	2	--	1	
		b. DIMENSIONS	Major	Mechanical	100%			Inspection Record	✓	2	--	1	
2.2	BODY	a. HYDRAULIC PRESSURE TESTING*	Major	Mechanical	100%			Inspection Record	✓	2	--	1	* For Flame Proof Motor
2.5	WOUND STATOR	a. H.V. TEST	Major	Electrical	100%			Inspection Record	✓	2	--	1	
		b. INSULATION RESISTANCE	Major	Electrical	100%			Inspection Record	✓	2	--	1	
		c. SURGE TEST	Major	Electrical	100%			Inspection Record	✓	2	--	1	

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SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY P	AGENCY W	AGENCY V	REMARKS
		d. Polarity	Major	Electrical	100%	Tech Spec/ Approved Datasheet/ Approved Drawing	Tech Spec/ Approved Datasheet/ Approved Drawing	Inspection Record	✓	2	--	1	
2.7	ROTOR	a. CONCENTRICITY	Major	Mechanical	100%			Inspection Record	✓	2	--	1	
		b. DYNAMIC BALANCING	Major	Mechanical	100%			Inspection Record	✓	2	--	1	
2.8	SPACE HEATER (if applicable)	a. INSULATION RESISTANCE	Major	Electrical	100%			Inspection Record	✓	2	--	1	
		b. H.V. TEST	Major	Electrical	100%			Inspection Record	✓	2	--	1	
		c. RESISTANCE	Major	Electrical	100%			Inspection Record	✓	2	--	1	
		d. WATTAGE TEST	Major	Electrical	100%			Inspection Record	✓	2	--	1	
3.0	**FINAL INSPECTION & TESTING**												
3.1	ROUTINE TEST	a. MEASUREMENT OF RESISTANCE ON WINDINGS OF STATOR AND WOUND ROTOR & SPACE HEATER	Major	Electrical	100%	Tech Spec/ Approved Datasheet/ Approved Drawing	Tech Spec/ Approved Datasheet/ Approved Drawing	Test Report	✓	2	1	--	
		b. INSULATION RESISTANCE TEST BEFORE AND AFTER H.V. TEST ON WINDING & SPACE HEATER	Major	Electrical	100%			Test Report	✓	2	1	--	

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SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY P	AGENCY W	AGENCY V	REMARKS
		c. H.V. TEST ON WINDING & SPACE HEATER	Major	Electrical	100%	Tech Spec/ Approved Datasheet/ Approved Drawing	Tech Spec/ Approved Datasheet/ Approved Drawing	Test Report	✓	2	1	--	
		d. PHASE SEQUENCE & DIRECTION OF ROTATION	Major	Electrical	100%			Test Report	✓	2	1	--	
		e. NO LOAD TEST	Major	Electrical	100%			Test Report	✓	2	1	--	
		f. REDUCED VOLTAGE RUNNING UP TEST*	Major	Electrical	100%			Test Report	✓	2	1	--	*for Squirrel Cage Motors
		g. LOCKED ROTOR TEST	Major	Electrical	100%			Test Report	✓	2	1	--	
		h. OPEN CIRCUIT VOLTAGE RATIO OF STATOR AND ROTOR WINDINGS*	Major	Electrical	100%			Test Report	✓	2	1	--	*for Slip Ring Motors
3.2	TYPE TEST	a. ALL TESTS MENTIONED IN ROUTINE TEST	Major	Electrical	1 motor in batch			Type Test Certificate	✓	2	--	1	
		b. FULL LOAD TEST to determine efficiency, power factor and slip	Major	Electrical	1 motor in batch			Type Test Certificate	✓	2	--	1	
		c. TEMPERATURE RISE TEST	Major	Electrical	1 motor in batch			Type Test Certificate	✓	2	--	1	

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SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY P	AGENCY W	AGENCY V	REMARKS
		d. LOAD TEST AT 125%, 100%, 75%, 50%, 25% LOAD (including measurements to allow calculation of efficiency and power factor at above loads, etc)	Major	Electrical	1 motor in batch	Tech Spec/ Approved Datasheet/ Approved Drawing	Tech Spec/ Approved Datasheet/ Approved Drawing	Type Test Certificate	✓	2	--	1	
		e. MOMENTARY OVERLOAD TEST	Major	Electrical	1 motor in batch			Type Test Certificate	✓	2	--	1	
		f. STARTING CURRENT	Major	Electrical	1 motor in batch			Type Test Certificate	✓	2	--	1	
		g. MEASUREMENT TO ALLOW CALCULATION OF PULL-OUT TORQUE	Major	Electrical	1 motor in batch			Type Test Certificate	✓	2	--	1	
		h. OVERSPEED TEST	Major	Electrical	1 motor in batch			Type Test Certificate	✓	2	--	1	
		i. DEGREE OF INGRESS PROTECTION	Major	Mechanical	1 motor in batch			Type Test Certificate	✓	2	--	1	
		j. VIBRATION TEST	Major	Mechanical	1 motor in batch			Type Test Certificate	✓	2	--	1	
3.3	FINAL INSPECTION	a. DIMENSIONAL CHECK	Major	Visual	100%			Inspection Record	✓	2	1	--	

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SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY P	AGENCY W	AGENCY V	REMARKS
		b. LOCATION OF TERMINAL BOX WITH ALL ACCESSORIES	Major	Visual	100%	Tech Spec/ Approved Datasheet/ Approved Drawing	Tech Spec/ Approved Datasheet/ Approved Drawing	Inspection Record	✓	2	1	--	
		c. VERIFICATION OF NAME PLATE RATING	Major	Visual	100%			Inspection Record	✓	2	1	--	
		d. PAINTING	Major	Visual	100%			Inspection Record	✓	2	1	--	
3.4	Statutory Certificates (if applicable)	BIS/CPRI/CIMFR/DGMS/CCOE/PESO	Major	Review	100%			Statutory Test Certificate	✓	2	--	1	
4.0	**PRESERVATION & PACKING**												
4.1	MOTOR	a. PACKING (Soundness)	Major	Visual	100%	Tech Spec/ Approved Datasheet/ Approved Drawing	Tech Spec/ Approved Datasheet/ Approved Drawing	Packing List	✓	2	--	1	
		b. CASE MARKING	Major	Visual	100%			Inspection Record	✓	2	--	1	

NOTE:-

1. **This MQP should be read along with specification (latest revision), approved drawings & approved data sheet.**
2. **Drawing/data sheet shall prevail over quality plan for contradiction if any between quality plan and drawing/specification.**
3. **All test certificates/reports reviewed and certified by TPI/BHEL shall be submitted to BHEL as documentation package.**
4. **All type test reports submitted shall not be older than 5 yrs from the date of purchase order.**
5. **Any project/customer specific requirements which shall be notified have to be fulfilled by the vendor at the time of execution of order.**

ABBREVIATIONS:-

BDV: Break Down Voltage	IP: Ingress Protection	CIMFR: Central Institute of Mining & Fuel Research
OD: Outer Diameter	HV: High Voltage	DGMS: Directorate General of Mines Safety
ID: Internal Diameter	TC: Test Certificate	CCOE: Chief Controller of Explosives
BIS: Bureau of Indian Standards	CPRI: Central Power Research Institute	PESO: Petroleum and Explosives Safety Organisation

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Typical Quality Plan for HT Motor

SL. NO.	COMPONENT AND OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERNCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARK
									BHEL	CUST	TPIA	
1	2	3	4	5	6	7	8	9		10		11
1.0	**BROUGHT OUT ITEMS-Shaft Forging, Magnetic Sheet Steel, Stator Winding Copper, Rotor Winding Copper**											
		Properties as per Drg./Spec.	Major	Chem./Mech./Elect./ NDT	Sample	Specification/ Drawing	Specification /Drawing	CC	R	--	--	Stock Items- BHEL QC Certificate of comformance will be submitted
2.0	**IN-PROCESS INSPECTION**											
2.1	**STATOR COMPLETE**											
2.1.1		Measurement of resistance of RTDs, HV & IR of stator winding	Major	Electrical	100%	TI	TI	TR	P	--	--	
2.1.2		Inter turn insulation surge voltage (Baker) test	Major	Electrical	100%	INSK46004	INSK46004	TR	P	--	--	
2.1.3		Tan delta test	Major	Electrical	100%	ITS-489/INSK-46004	ITS-489/INSK-46004	TR	P	--	--	>5kV, Values for information only
2.2	**ROTOR COMPLETE**											
2.2.1		Insulation Resistance, Resistance measurement (SRIM Type)	Major	Electrical	100%	Drg./Data Sheet	Drg./Data Sheet	TR	P	--	--	
2.2.2		Dynamic Balancing at Rated Speed	Major	Measurement	100%	ISO 1940 Gr. 2.5	ISO 1940 Gr. 2.5	TR	P	--	--	Subject to test plant limitation

SL. NO.	COMPONENT AND OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERNCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARK
									BHEL	CUST	TPIA	
1	2	3	4	5	6	7	8	9		10		11
3.0	**ASSEMBLED MOTOR -ELECTRICAL TESTS**											
3.1.	**ROUTINE TESTS-**											
3.1.1		Verification of DOR, Name Plate, TERMINAL Box location	Major	Electrical	Each Motor	OGA drawing	OGA drawing	TR	P	W	---	
3.1.2		Measurement of resistance of stator (rotor for SRIM Type)	Major	Electrical	Each Motor	IS325/IS4029	IS 325/data Sheet	TR	P	W	---	
3.1.3		IR before and after HV test	Major	Electrical	Each Motor	IS325/IS4029	IS 325/data Sheet	TR	P	W	---	
3.1.4		HV Test	Major	Electrical	Each Motor	IS325/IS4029	IS 325/data Sheet	TR	P	W	---	
3.1.5		Polarization Index	Major	Electrical	Each Motor	IS325/IS4029	IS 325/data Sheet	TR	P	W	---	3.3 kV and above motors-PI not less than 2
3.1.6		No load running of motors and measurement of current, Voltage, Power input,& Speed, Slip	Major	Electrical	Each Motor	IS325/IS4029	IS 325/data Sheet	TR	P	W	---	
3.1.7		Locked Rotor Test at suitable reduced voltage measurement of Current, Volatge and Power Input (rotor Current for SRIM)	Major	Electrical	Each Motor	IS325/IS4029	IS 325/data Sheet	TR	P	W	---	
3.1.8		IR & HV test of Space Heater. & Space heater, RTD/BTD resistance.	Major	Electrical	Each Motor	IS325/IS4029	IS 325/data Sheet	TR	P	W	---	
3.1.9		Shaft voltage measurement during no load run	Major	Electrical	Each Motor	Drawing	Drawing	TR	P	W	---	Applicable for horizontal motors only
3.2.0		Open Ckt. Test (for SRIM) Only	Major	Electrical	Each Motor	IS325/IS4029	IS 325/data Sheet	TR	P	W	---	
3.2.1		Vibration Test during no load run	Major	Electrical	Each Motor	IS325/IS4029	IS12075	TR	P	W	---	
3.2.2		Reduced voltage running up test	Major	Electrical	Each Motor	IS325/IS4029	IS 325/data Sheet	TR	P	W	---	

SL. NO.	COMPONENT AND OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERNCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARK
									BHEL	CUST	TPIA	
1	2	3	4	5	6	7	8	9	10			11
3.2	**TYPE TESTS-**											
3.2.1		All test covered in Routine Test	Major	Electrical	One Motor	IS325/IS4029	Data Sheet	TR	P	W	---	**Type test report of similar frame no. motor will be furnished. In absence of type test report test will be conducted & report will be furnished for review**
3.2.2		Noise Measurement during no load run	Major	Electrical	One Motor	IS12065	Data Sheet	TR	P	W	---	
3.2.3		Temp Rise by Test	Major	Electrical	One Motor	IS325/IS4029	Data Sheet	TR	P	W	---	Subject to test plant limitation
3.2.4		Calculation of efficiency by summation of loss method at 1/2, 3/4 & full load	Major	Electrical	One Motor	IS325/IS4029	Data Sheet	TR	P	W	---	QAP Cl. No.3.2.4,3.2.5, 3.2.7- are not possible for 2 pole (3000RPM) and above 900 KW motors. As motors shall be tested by mixed frequency method
3.2.5		Full load measurement of current, Voltage, Power Input,& , Slip, PF at 50%, 75% & 100%	Major	Electrical	One Motor	IS325/IS4029	IS325/Data Sheet	TR	P	W	---	
3.2.6		Over speed Test at 120% of rated speed	Major	Electrical	One Motor	IS325	Data Sheet	TR	P	W	---	
3.2.7		Starting torque, starting current and pull out torque calculation	Major	Electrical	One Motor	JEC-37	Data Sheet	TR	P	W	---	Based on no load reading
3.2.8		Momentary Over Load test	Major	Electrical	One Motor	IS325/IS4029	IS325/Data Sheet	TR	P	W	---	Shall be performed on 4 & 6 pole motors if current will be <=125 Amps.

SL. NO.	COMPONENT AND OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERNCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARK
									BHEL	CUST	TPIA	
1	2	3	4	5	6	7	8	9		10		11
4	**ASSEMBLED MOTOR - FINAL INSPECTION**											
4.1	**FINISHED ASSEMBLED MOTOR**											
4.1.1		Shaft Centre Height, Keyway and shaft extension dimensions	Major	Measurment	100%	Drawing	Drawing	IR	P	–	–	
4.1.2		Check for fitment of all components and accessories	Major	visual	100%	OGA Drawing	OGA Drawing	CC	P	–	–	
4.2	**PAINTING AND PRESERVATION**											
4.2.1		Check for painting	Major	Visual/Measurement	100%	Drawing	Drawing	CC	p	–	–	
5.0	**DOCUMENTS FOR SUBMISSION**											
	(1) Final Routine Test Certificates (2) Type Test Certificates (3) Cimfr And Ccoe Certificates (4) Degree of protection of enclosure (5) Fault level withstand capacity.											

Typical Quality Plan for Diesel Engine

Sr. No	Components	Characteristic	Type of Check	Quantum of Check	Acceptance Norms	Documents to be submitted	GCL	Client / TPI
1	Crankshaft	Material	Chemical & Mechanical	Sampling	As per GCL Drawing	Compliance Certificate / Test Report	P	R
		Measurment	Dimensional measurment	100.00%	As per GCL Drawing	Compliance Certificate	P	R
		Crack Test	NDT (MPI)	100.00%	No Cracks are acceptable	Compliance Certificate / Test Report	P	R
2	Connecting Rod	Material	Chemical & Mechanical	Sampling	As per GCL Drawing	Compliance Certificate / Test Report	P	R
		Measurment	Dimensional measurment	100.00%	As per GCL Drawing	Compliance Certificate	P	R
		Crack Test	NDT (MPI)	100.00%	No Cracks are acceptable	Compliance Certificate / Test Report	P	R
3	Cylinder Block/Crank case with Liners	Pressure Test	Pressure Test	100.00%	No Leakages acceptable	Compliance Certificate / Test Report	P	R
		Material	Chemical & Mechanical	Sampling	As per GCL Drawing	Compliance Certificate / Test Report	P	R
		Measurment	Dimensional measurment	100.00%	As per GCL Drawing	Compliance Certificate	P	R
4	Cylinder Head	Pressure Test	Pressure Test	100.00%	No Leakages acceptable	Compliance Certificate / Test Report	P	R
		Material	Chemical & Mechanical	Sampling	As per GCL Drawing	Compliance Certificate / Test Report	P	R
		Measurment	Dimensional measurment	100.00%	As per GCL Drawing	Compliance Certificate	P	R
5	Engine Performance test	Testing	Performance	100.00%	BS-5514 / ISO 3046 / IS 10000	Engine Test Report with RPM, Torque, BHP, Exhaust Temp, Noise & vibration	P	W

Diesel Tank

S.NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECKED	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	SCOPE OF INSPECTION			REMARKS
								M	C	N	
1	Finish Product	Workmanship	Visual	100%	N.A.	Free from Defects	IR	P	W	R	
		Dimension/Size	Measurement	100%	Appr. Datasheet/Drg.	Appr. Datasheet/Drg.	IR	P	W	R	

LEGENDS: REVIEWED & APPROVED