
ANNEXURE - I TO PY 55182 Rev 00

SECTION-II

TECHNICAL SPECIFICATION

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**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 proposed 1 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 outbreak 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 m³ 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 m³ 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.
- 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 m² or one heat detector for every 50m² 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 in each Fire detection and alarm & Repeater panel. Information / data from these Fire detection alarm cum MIMIC panels 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 (\pm) 10% and frequency variation of (\pm) 5% occurring separately or combined voltage and frequency variation of (\pm) 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 its 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 (\pm) 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 shall be of Steel made of 5000 m³ 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 upstream 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/Cm² 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 outgoing 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, annunciators 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 greater 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. Vendor 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 ->		For Pressurization of fire water system	Fire Hydrant & Spray System
			b) <- Fire spray water system ->			
2.00.00	Duty	:	<------ Intermittent ----->			
3.00.00	Location	:	<------ Indoor ----->			
4.00.00	Number of Pumps Required	:	a) Hydrant Pump – 1 No.	Hydrant Pump – 2 Nos. Out of two one (1) is standby for hydrant system.	Two (motor driven)	Two nos. for individual area
			b) High Velocity Water Spray Pump – 1 No	Common standby for HVW & MVW Spray Water System – 1 No		
			c) Medium Velocity Water Spray Pump – 1 No.			
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			

DEVELOPMENT CONSULTANTS

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		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% NiCl 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% NiCl 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 Storage 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 compressed 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	<div>←----- ERW -----→</div> <div>(i) (ii) (iii) (iv)</div>			
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° - 150°

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

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° C to 70 °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° C to 150°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 mm² for connection of fire detectors in parallel.

Fire survival cable 12 C x 1.5 mm² for connection between transformer signal box/ marshalling box to control box and control box to FEC.

Fire survival cable 4 C x 1.5 mm² 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 N₂ 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 mm² cable.
- ii) Connecting PNRV to signal box, using Fire survival cables 4C x 1.5 mm²
- iii) Connections to FEC for 230V AC single-phase panel light supply, using fire survival cables 4C x 1.5 mm²
- iv) Connections from relay panel to control box using fire survival cables 4Cx1.5mm²
- v) Connections from DC source to control box directly or through DC-DC connector, using fire survival cables 4C x 1.5 mm²
- vi) Connections between signal box to control box and between control box to FEC using fire survival cables 12 C x 1.5 mm²

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 acceleration 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 less than 5 mm at base and not less 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-1

Sl. No	SYSTEM	CONTROL SYSTEM	CONTROL & MONITORING		DDCMIS INTERFACE	PERIPHERAL	REMARKS
			LOCAL CONTROL (LCR)	DDCMIS (CCR)			
A. BTG AUXILIARY SYSTEMS							
i.	DM Cooling Water System	DDCMIS based	---	OWS	---	---	
ii.	Turbine Oil Purification System	DDCMIS based	---	OWS	---	---	
iii.	Condensate Polishing Unit	Common DDCMIS based RTU at Regeneration area	OEWS	OWS	---	<ul style="list-style-type: none">One (1) no. OEWS,One (1) no. printerBack-up control Desk with colored MIMIC, PB lamps, Hardwired Annunciation	
iv.	Online Condenser Tube Cleaning System	Common DDCMIS based	LCP	OWS	---	<ul style="list-style-type: none">LCP with coloured MIMIC ,Annunciation Windows ,PB's and indication lamps.	
v.	Self Cleaning Filter	DDCMIS based	---	OWS	---	---	
vi.	Chemical Dosing System	DDCMIS based	LCP	OWS	Hardwired	<ul style="list-style-type: none">Local control panel with PB, lamps, Hardwired Annunciation	
B. OFF-SITE PLANTS							
i.	Coal Handling Plant	<ul style="list-style-type: none">PLC basedRIO	OWS	---	Redundant Bidirectional OPC link for monitoring through common DDCMIS network	<ul style="list-style-type: none">Two (2) OWS,One (1) no. OEWS,One (1) no. printerFour (4) LVSBack-up control desk with colored mimic, PB, lamps, Hardwired AnnunciationOne (1) no. OWS in CCR	One OWS each shall be placed on Common Control desk in CCR.
ii.	Ash Handling Plant	<ul style="list-style-type: none">PLC basedRIO	OWS	---	Redundant Bidirectional OPC link for monitoring through common DDCMIS network	<ul style="list-style-type: none">Two (2) OWS,One (1) no. OEWS,One (1) no. printerTwo (2) LVSBack-up control desk with colored mimic, PB, lamps, Hardwired AnnunciationOne (1) no. OWS in CCR	One OWS each shall be placed on Common Control desk in CCR.

SL. No	SYSTEM	CONTROL SYSTEM	CONTROL & MONITORING		DDCMIS INTERFACE	PERIPHERAL	REMARKS
			LOCAL CONTROL (LCR)	DDCMIS (CCR)			
iii.	Mill Reject System	PLC based	OWS	---	Redundant Bidirectional OPC link for monitoring through common DDCMIS network	<ul style="list-style-type: none"> One (1) no. OEWS, One (1) no.OWS One (1) no. printer Backup control desk with colored MIMIC, PB, lamps, Hardwired Annunciation 	
iv.	Fuel Oil Handling System	DDCMIS (RTU) based	OWS	OWS	---	<ul style="list-style-type: none"> One no. (1) OEWS Backup Control Desk with colored mimic, PB, lamps, Hardwired Annunciation 	
v.	Raw Water Transportation System	PLC based (RTU of PT PLC)	LCP	---	Redundant Bidirectional OPC link for monitoring through common DDCMIS network	<ul style="list-style-type: none"> Local control panel with colored mimic, PB, lamps, Hardwired Annunciation 	
vi.	Pre-Treatment Plant & Sludge Disposal System	PLC based	OWS	---	Redundant Bidirectional OPC link for monitoring through common DDCMIS network	<ul style="list-style-type: none"> One (1) OWS, One (1) no. OEWS, One (1) no. printer Back-up control desk with colored mimic, PB, lamps, Hardwired Annunciation One (1) no. OWS in CCR 	One OWS each shall be placed on Common Control desk in CCR.
vii.	Filtered Water Transportation System (DM Make-up, CW Make-up, Filter back-wash, service water, potable water system)	DDCMIS (RTU) based	LCP	OWS	---	<ul style="list-style-type: none"> Local control panel with colored mimic, PB, lamps, Hardwired Annunciation 	
viii.	De-Mineralization Plant & Potable Water Treatment Plant	PLC based	OWS	---	Redundant Bidirectional OPC link for monitoring through common DDCMIS network	<ul style="list-style-type: none"> Two (2) OWS, One (1) no. OEWS, One (1) no. printer Two (2) LVS Back-up control desk with colored Mimic, PB, lamps, Hardwired Annunciation One (1) no. OWS in CCR 	One OWS each shall be placed on Common Control desk in CCR.
ix.	CW Treatment System & CW Chlorination System	Common PLC based	GUI	OWS	Redundant Bidirectional OPC link for monitoring	<ul style="list-style-type: none"> GUI Hardwired Annunciation 	

SL. No	SYSTEM	CONTROL SYSTEM	CONTROL & MONITORING		DDCMIS INTERFACE	PERIPHERAL	REMARKS
			LOCAL CONTROL (LCR)	DDCMIS (CCR)			
					through common DDCMIS network		
x.	DM Transportation System (DM Transfer, Storage, Boiler Fill, Hotwell Make-up)	DDCMIS (RTU) based	LCP	OWS	---	<ul style="list-style-type: none"> Local control panel with colored mimic, PB, lamps, Hardwired Annunciation 	
xi.	CW/ACW System	DDCMIS (RTU) based	OEWS	OWS	---	<ul style="list-style-type: none"> One (1) no. OEWS, One (1) no. printer 	
xii.	Waste Water Treatment System	<ul style="list-style-type: none"> PLC based RIO 	OWS	---	Redundant Bidirectional OPC link for monitoring through common DDCMIS network	<ul style="list-style-type: none"> Two (2) OWS, One (1) no. OEWS, One (1) no. printer Two (2) LVS Back-up control desk with Mimic, PB, lamps, Hardwired Annunciation 	
xiii.	Sewage Treatment System	PLC Based	LCP	---	Redundant Bidirectional OPC link for monitoring through common DDCMIS network	<ul style="list-style-type: none"> Local control panel with colored mimic, PB, lamps, Hardwired Annunciation 	
xiv.	Fire Water System	PLC based	OWS	---	Redundant Bidirectional OPC link for monitoring through common DDCMIS network	<ul style="list-style-type: none"> One (1) OWS, One (1) no. OEWS, Hardwired Annunciation 	
xv.	Compressed Air System	Common DDCMIS (RTU based) Redundant μ P based (for each compressor)	OEWS GUI	OWS	---	<ul style="list-style-type: none"> One no. (1) OEWS GUI for for each Compressor Back-up control Desk with colored MIMIC, PB lamps, Hardwired Annunciation 	

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SL. No	SYSTEM	CONTROL SYSTEM	CONTROL & MONITORING		DDCMIS INTERFACE	PERIPHERAL	REMARKS
			LOCAL CONTROL (LCR)	DDCMIS (CCR)			
kvi.	Sump Pumps/ Miscellaneous Pumps	PLC based	LCP	---	Redundant Bidirectional OPC link for monitoring through common DDCMIS network	<ul style="list-style-type: none"> Local control panel with colored mimic, PB, lamps, Hardwired Annunciation 	

.

ATTACHEMENT-2 TO ANNEXURE-I OF PY 55182 Rev 00

PANELS , DESKS , RACKS AND JUNCTION BOXES

1.00.00	GENERAL REQUIREMENT
1.01.00	ENCLOSURES FOR INSTRUMENTS AND OTHER EQUIPMENT
1.01.01	All panels, cabinets, distribution boxes, junction boxes, terminal boxes and all other field mounted equipment / enclosures shall have suitable environmental protection as detailed in Section-I of this volume of the specification.
1.02.00	SURFACE PREPARATION & PAINTING
1.02.01	All sheet metal panel/ desk exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below.
1.02.02	Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale and all other residue due to the fabrication operation. Oil, grease and salts etc. shall be removed from the panels by one or more solvent cleaning methods prior to blasting.
1.02.03	Two spray coats of inhibitive epoxy primer surfacer shall be applied to all exterior and interior surfaces, each coat of primer surfacer shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colors for exterior and interior surfaces shall conform to the following shades: <ul style="list-style-type: none"> • Exterior – Opaline green shade 275 of IS: 5 or equivalent international code.. • Interior - Brilliant White.
1.02.04	Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections, shall not be acceptable.
1.03.00	WIRING
1.03.01	All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks. All intercommunications between sections of panels/desks shall be furnished.
1.03.02	Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized ink print shall be used with cross- identification.
1.03.03	All wire termination shall be made with insulated sleeve and crimping type lugs. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs will not be accepted. Wires shall not be looped around the terminal screws or studs.

- 1.03.04 Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables. Internal wiring shall be grouped so that all outgoing wiring to each particular remote location is terminated on adjacent terminal blocks. Interior wiring and jumperings shall be arranged so that external connections can be made from internal side of terminal blocks. Common connections shall be limited to two (2) wires per terminal.
- 1.03.05 Wiring shall be arranged to ensure free access to all instrument or devices for maintenance. No wire shall be routed across the face or rear of any device in a manner, which will impede the opening of covers or obstruct access to leads, terminals or devices
- 1.03.06 Wires shall be dressed and run in trays or troughs with clamp-on type covers. Wirings may be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.
- 1.03.07 Shield wires shall be terminated on separate terminal blocks. Common connections shall be limited to two wires per terminal. Signal circuit shields shall be grounded at the power supply end only or as recommended by manufacturer.
- 1.03.08 All low level signal cables shall be separately bundled to from control cable and maintained at 300 mm minimum spacing from control bundles.
- 1.03.09 Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.
- 1.03.10 Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt shall be electrically and physically isolated from other AC and DC wiring. Shielded wires used in such cases for panel internal wiring shall be continuous and ungrounded with the shield terminated individually and separately in panel terminal block.
- 1.03.11 Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue failure of the conductor.
- 1.03.12 Internal wiring in factory pre-wired electronic systems cabinets may be installed according to the Contractor's standard wire size, insulation, and method of termination on internal equipment. Insulation for all wiring, including circuit board wiring, back panel wiring, power supply wiring and interconnecting cables between devices shall pass the vertical flame test per IPCEAS-1981. Identification of conductors may be done by insulation color-coding identified on drawings or by printed wiring lists.

- 1.04.00 TERMINAL BLOCKS
- 1.04.01 All terminal blocks shall be rail mounted/ post mounted type, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 Deg C. The terminal blocks in field mounted junction boxes, instrument enclosures racks etc. shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room termination/ marshalling cubicles shall be suitable for post mounted cage clamp connection at the field input end. The exact type of terminal blocks to be provided by Bidder shall be subject to Owner.
- 1.04.02 All terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, small partitions, transparent covers, support brackets, distance sleeves, warning level, marking etc. For RTDs ring - tong type lugs shall be used at Junction Boxes.
- 1.04.03 The characteristics of the terminal blocks shall be as follows.
- i) High contact force, independent of conductor cross-section and large contact surface area.
 - ii) Integrated self-loosening protection to avoid shifting of contact surface that may allow contamination of connection point.
 - iii) Inspection and maintenance free (resistant to thermal aging and vibration)
 - iv) Low and constant voltage drop
- 1.04.04 The insulation of the terminal blocks shall be of suitable thermoplastic material.
- 1.04.05 The spacing between Terminal blocks channels in panels and cubicles shall be adequate for routing the cable troughs and to allow adequate free workspace for termination and removal of wires. The terminal blocks shall be arranged with atleast 100 mm clearance between two sets of terminal blocks and junction box walls.
- 1.04.06 Signals of different voltage levels shall be clearly segregated by providing separate rows to each type of signal and by using terminal blocks of different color for each type of signal and by providing barrier strips between them.
- 1.04.07 Terminal blocks shall be provided with white marking strips / self-adhesive marker cards and where permitted by the safety codes and standards, shall be without covers. Power terminals and high voltage (above 48 volts) terminals shall have protection covers. All terminals shall be provided with permanent terminal identification numbers on both sides.
- 1.04.08 At least 20% spare unused terminals shall be provided on each terminal block for circuit modifications and for termination of all conductors in a multi-conductor control cable.

- 1.04.09 The bottom of the terminal block shall be at least 200 mm above the cable gland for bottom entry type panels.
- 1.04.10 For extending 24 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.
- 1.04.11 Other requirements of the terminal blocks are as follows:
- i) The last terminal in a rail-mounted assembly shall be closed with an end plate and end bracket.
 - ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.
 - iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.
 - iv) It shall be possible to use jumper plugs through the above test plug socket to connect adjacent terminals. Adequate number of short circuit jumper plugs shall be provided for the purpose.
 - v) Where more than one connection to a terminal block is required, two tier terminals shall be used.
- 1.05.00 GROUNDING
- 1.05.01 Separate Protective and Electronic system ground as required shall be provided.
- 1.05.02 All panels, desks, cabinets shall be provided with a continuous bare copper ground bus (Frame ground), bolted to the panel structure at bottom on both sides and effectively ground the entire structure. The bolts shall face inside of panels.
- 1.05.03 For electronic system cabinets the electronic system ground bus (Electronic ground) shall be similar but insulated from the cabinet and shall be separately connected to the system ground. The same ground may be used to earth the shield of shielded signal cables, otherwise a separate ground bus shall be provided for connecting the signal cable shields. Cable shields shall be grounded at the panel end only and shall never be left open. The electronic ground between panels of a shipping section shall be firmly looped.
- 2.00.00 **CONTROL DESKS & PANELS**
- 2.01.00 GENERAL
- 2.01.01 All control desk, panels etc. shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, utility receptacles, grounding, ventilation, space heating, anti-vibration pads, internal piping &

- accessories as required for completeness of the system.
- 2.01.02 The design shall conform to the EN ISO 11064 (Ergonomical design of Control Room), Part 1, 2 and 3.
- 2.01.03 The exact dimensions, material, construction details, grounding, general arrangement etc. shall be as per actual requirement and shall be finalized during detail engineering and subjected to Owner's approval.
- 2.01.04 Incoming power supply feeders shall be duplicated. Alarm shall be provided for failure of a power supply feed.
- 2.01.05 For Control desk/ panel mounted instruments/ devices etc. which are to be powered from UPS, all required conversion of interface equipments/ accessories to make such devices compatible with UPS supply shall be provided. All necessary hardware like input switches/ fuse unit for each feeder as well as switch fuse unit for each instrument/ device on the power supply line shall be provided. From UPS redundant feeders shall be provided with suitably rated MCB and provision of fast auto changeover of UPS feeders.
- 2.01.06 Crating of the panels and desks shall be suitable for protection against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have adequate protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.
- 2.01.07 Nameplate
- a) Nameplate shall be provided for instrument or device mounted on the panel.
 - b) Nameplates for panels shall be provided both in front and rear.
- 2.02.00 CONTROL DESK
- 2.02.01 Control desk shall be free standing, floor mounting, table top type with doors at back and shall be constructed of 3 mm thick (minimum) CRCA steel or Aluminium extrusion. Aluminium structure shall be anodized or powder coated paint finish. The top surface of control desk shall be 30 mm (minimum) thick with the top 12 mm (minimum) of acrylic solid surface and the remaining 18 mm of laminated medium density fibre (MDF) board.
- 2.02.02 Monitors with retractable keyboard shall be provided on the desk. Desk shall be arranged in arc-like shape without any sharp edges. Edges shall be extruded PVC or rounded post-formed laminate.
- 2.02.03 Desks shall be of modular, scalable and industrially ruggedized design and shall have connections for PA system handsets & telephone sets.
- 2.02.04 Desks shall have concealed cable trays for wire dressing. Both Horizontal & Side Managers (2 separate horizontal cable routing wire baskets for power & data cables) shall be provided.

Each User station will be provided with 2 separate power distribution units (1 for Main line & 1 for UPS line). Each power distribution unit will have 6 points of 5/13 Amp sockets, Mains MCB On/Off Switch & Indicator.

Adequate heat management provision for Exhaust of heat from within the Console Desk Assembly shall be provided. There will be multiple fans provided in the Main Control Desk. Each Fan will be of 230 VAC 250 CFM Ball Bearing based. Ventilation louvers will be provided on both Front & Rear Modesty with special Air Filters. Adequate space for CPU & Other equipments placed with in the desk.

- 2.02.05 Design shall include Earthing bolts.
- 2.02.06 Back installed items shall be suitably concealed from front view.
- 2.02.07 All operator workstations for SG, TG, Auxiliaries & Off-site Plants shall be mounted on this Control Desk. The cabling / wiring between OWS & CPUs, power supply cables etc. shall be aesthetically routed and concealed from view.
- 2.02.08 **HARDWIRED DEVICES ON CONTROL DESK (DRAW OUT SECTION)**

Release and Lamp Test push buttons shall be provided for a set of push buttons (decided during detail engineering stage). Depending on the type of control/ function, required number of push buttons/ indicating LEDs & their color, push button stations shall be selected. The size of push button stations shall be 24 x 48 mm or 25 x 50 mm and shall have service inscription details at the front. Emergency push buttons (with cover) shall be mounted on top of Control Desk.
- 2.03.00 **BACK UP PANEL**
- 2.03.01 Construction shall be from CRCA steel of thickness not less than 3mm.
- 2.03.02 Upright back-up panel shall be provided where hardwired devices shall be mounted on a mosaic grid type console. The mosaic grid tiles shall be of 24 mm x 48 mm (or 25 mm x 50 mm) size, made of heat & flame retardant, self extinguishing and non-hygroscopic material with flat matt finish without glare and non reflecting type.
- 2.03.03 DDCMIS Back-up Panel (referred as Unit Control Panel-UCP) shall also mount annunciation fascia (minimum 500 nos.) and the flame monitoring cameras along with other hardwired devices as decided during detail engineering stage by Owner. Color coding shall also subject to Owner's approval.
- 2.03.04 Colored Mimic for different Off-site plant control systems (as enumerated elsewhere in this specification) and hardwired annunciation system shall also

be mounted on the back up panels.

2.04.00 PANELS/CABINETS

2.04.01 All DDCMIS system modules, power supply components and other Local Control panels (PLC/Relay based) shall be housed in cabinets as specified below.

2.04.02 The cabinet mounted equipments shall be fully assembled, installed in mounting racks, wired and fully tested as per specification requirements and Owner approved drawings prior to shipment to the project site.

2.04.03 The Bidder shall ensure that the cabinets are complete & ready for installation before dispatch from manufacturing works. The installation work at project site for these cabinets shall only involve connections through multi-pair cables from marshalling cabinets (wherever provided) to system cabinets and inter-cabinet/cabinet to Control Desk/ Back up Panel.

2.04.04 All electronic cards, network components, power supply modules etc. located shall be suitably housed in cabinets and shall be neatly arranged in sub-racks. Network components shall be visible in door closed condition (e.g. Glass doors etc.) as approved by Owner.

2.04.05 Bidder shall design the cabinet internal arrangement, floor cutout and cable gland plate such that all the cables entering or leaving the cabinet can be properly glanded in the gland plate.

2.04.06 The packaging density of panels shall be such that the temperature rise within the panels shall never exceed 10°C above ambient even under worst operating conditions. Cooling Fans shall be provided wherever required and this shall be of industrial grade.

2.04.07 TECHNICAL PARTICULARS

- | | | | |
|----|--------------------------|---|---|
| 1. | Material of Construction | : | Cold Rolled Coal Annealed (CRCA) steel sheet |
| 2. | Thickness of Sheet | : | a) 2.0 mm for faces supporting instruments / terminals
b) 1.6 mm for other sides and top |
| 3. | Construction | : | Welded throughout as per approved National Standards |
| 4. | Post welding operation | : | a) Grounding of all welds to smoothness
b) Rounding of corners |

- : c) Cleaning of weld spatters
- 5. Panel height : 2300 mm (approx)
- 6. Corners : 7 mm inner radius
- 7. Dimensional Tolerances :
 - a) In height & length - 3 mm
 - b) In height between adjacent sections - 2 mm
 - c) Total for a group - 6 mm
- 8. Doors : Double, recessed, turned back edges, full height front & rear
 - i) Thickness of Sheet : 2 mm
 - ii) Hinges : Stainless steel
 - iii) Door latches : Three point type
 - iv) Door gaskets : Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure
 - v) Opening of the doors : Outward
 - vi) Louvers : With removable wire mesh to ensure dust and vermin proof
- 9. Gland plates : Removable in sections
4 mm thick (bottom)
- 10. Cable entry : Bottom
- 11. Hardware :
 - a) Anti vibration pad- 15 mm
 - b) Predrilled base channel ISMC – 100 or equivalent for all sides
 - c) Stainless steel buff- finished 2 mm thick kick plate for all sides
 - d) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws
 - e) Rubber strips to ensure air

tightness between kick plate and finished floor

f) Lifting hook / Eye bolt

g) Drawing pocket

h) Door switch, lamps, thermostat, heaters and industrial grade cooling fans,, illumination fixtures

- | | | |
|---------------------------------|---|--|
| 12. Name Plate | : | Both at front and back surface of the panel |
| 13. Fixing of name plate | : | Stainless steel pan head screws |
| 14. Name plate material | : | Laminated phenolic (3 layers) |
| 15. Lettering | : | Black with white engraved |
| 16. Mounting of terminal blocks | : | Vertical angle support bracket tack welded on sheet steel plate, screwed on internal wall of enclosure |

2.05.00 FURNITURE

All the furnitures in the Central / Local control Room (s), Engineers' rooms, Instrument laboratory , SWAS Room & any other rooms with C&I equipments located in different plant buildings under Bidder's scope shall be included in Bidder's scope of supply. Bidder shall provide following industrial grade furniture items as a minimum from reputed manufacturers/suppliers meeting International Standards. The furniture shall be modular and latest with ease of operational features. The furniture shall be modern, aesthetically designed, modular, flexible, space saving and future safe.

2.05.01 WORK STATION FURNITURE

Modular work station furniture, suitable for mounting servers & historians, programmer stations, PC based systems, printers (A4/A3 color laserjet) etc. shall be provided.

2.05.02 PC RACK

PC Racks shall be provided to mount CPUs of workstations/PCs of OWS/LVS etc. in control room. For each PC / workstation / monitor at least one chair shall be included.

2.05.03 CHAIRS

Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/gas lift) shall be provided for the operators, unit-in-charge & other personnel in control room area. These shall be designed for sitting for long duration such that these are comfortable for the back.

2.05.04 TABLES

Industry standard computer tables shall be provided & shall be as approved by Owner during detailed Engineering. Glass top teak wood horse shoe shaped table with vertical file mounting arrangement (two layers to house approx. 40 Nos of files and lockable drawers at both ends) for Engineering Room shall be provided.

2.05.05 ALMIRAHs

Steel Almirahs shall be provided for keeping documents in the documentation room. Glass doors for each rack shall be provided such that the documents are visible from outside. Size of the rack shall be sufficient to easily fit technical manuals. The exact details shall be approved by Owner during detailed Engineering.

2.05.06 KEYPAD

One keypad per unit shall be provided for the storing of keys of relevant areas of the unit in the control room.

2.05.07 LOCKERS

Suitable lockers shall be provided in the room adjacent to the control room for storing of personal articles of control room personnel. Also, lockers of bigger size shall be provided in documentation Room for storing of personal documents. Details shall be finalized and approved by Employer during detailed engineering.

3.00.00 LVS PANEL

3.01.00 An arc shaped Large Video Screen (LVS) panel shall be supplied for mounting large video screens in number of tiers in various Control rooms as specified elsewhere in this specification.

Bidder shall provide and fix ACP cladding around the LVS screen including covering the LVS back side and LVS stand. The cladding will be from floor finish to 600 mm above LVS screen like a self-standing partition with necessary openings for system requirement. ACP paneling shall be with 304 grade & approx. 0.5 mm mirror finish SS strip.

3.02.00 The profile, dimensions and the general arrangement shall be finalized & approved by Owner during detailed engineering. Recommendations, if any, for the control room lighting in order to ensure continuous proper viewing of the LVS screen by the operator & shift incharge (without any fatigue) shall be

- clearly brought out by the Contractor in his offer, alongwith all relevant details/basis.
- 3.03.00 Any other requirement for proper LVS mounting & functioning & viewing shall also be specifically brought out by the Contractor in his offer, along with all relevant details.
- 4.00.00 **LOCAL INSTRUMENT RACK (LIR) & LOCAL INSTRUMENT ENCLOSURE (LIE)**
- 4.01.00 GENERAL
- 4.01.01 Devices (Transmitters/ Switches) located in the field shall be suitably grouped together to the extent possible and installed in the LIE (Closed Rack) and LIR (Open Rack) in Boiler/TG Building and Off-site plant areas.
- 4.01.02 Racks and enclosure shall be factory prefabricated & painted and shall complete with internal piping, tubing, manifold, isolation valves, blowdown valves, integral junction box, illumination etc.
- 4.01.03 No more than six instruments shall be grouped in a single rack / enclosure.
- 4.01.04 Racks shall be installed above the tapping points for air, flue gas and coal air mixture application whereas for applications such as for water and steam, racks to be installed below the source point.
- 4.01.05 Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air /gas piping.
- 4.01.06 Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging
- 4.01.07 Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping.
- 4.01.08 Earth stud shall be furnished at rack for safety grounding.
- 4.02.00 LOCAL INSTRUMENT ENCLOSURE (LIE)
- 4.02.01 Enclosure shall be free standing type. Racks shall be adequately reinforced to ensure true surfaces and to provide support. Major load - bearing posts shall be suitably supported by gusset plates or moment members.
- 4.02.02 Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy painted to shade gray. Base frame shall be made of ISMC 100 and black colour finish.
- 4.02.03 2" NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters at accessible height. Center posts or any

member, which would reduce access, shall be avoided.

- 4.02.04 Double leaf interlocking front opening doors with three point locking shall be provided and shall be arranged for maximum possible access to the interior. Key shall be of identical for all enclosures.
- 4.02.05 Doors shall have concealed quick removal type pinned stainless steel hinges and locking handles. Gaskets shall be used between all mating sections to achieve dust and weather proof enclosure rated for IP-65 including the internal junction box. All enclosures shall have access doors on front side.
- 4.02.06 Removable type bulkhead plates of thickness not less than 6 mm shall be mounted at the racks with suitable high temperature gasket. Impulse lines within the enclosures shall be properly clamped.
- 4.02.07 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings within transmitter racks both open and closed type, is admissible.
- 4.02.08 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..
- 4.02.09 Each rack shall be provided with one receptacle, light fixtures with wire guard and one lighting switch each at instrument & Junction box compartments with wire guard. Lighting switches may be door actuated & mounted inside the panel. Outlet box, switch box and device covers shall be of galvanized stamped steel. Light switches and receptacles shall be installed inside the enclosure on the wall near the latch side of the enclosure door. Light fixtures shall be installed on the ceilings of the enclosures.
- 4.02.10 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.
- 4.02.11 Vibration dampeners shall be installed for supporting each enclosure. The loading at each corner of the enclosure shall be determined by actual test weighting when construction is complete to determine the correct length of each dampener for proper loading of the dampener in accordance with manufacturer's recommendations
- 4.03.00 LOCAL INSTRUMENT RACK (LIR)
- 4.03.01 Rack shall be free standing type constructed from 6 mm thick steel channel frame provided with a canopy to protect the instrument from dripping water or

falling objects and shall be epoxy painted. Canopy shall be of CRCA steel sheet of at least 3 mm thickness.

- 4.03.02 Rack Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable fenders grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project to protect instrument from accidental contact during personnel movement. Center posts or any member, which would reduce access, shall be avoided.
- 4.03.03 2" NB galvanized pipes laid horizontally and supported at two end channels shall be employed at working accessible height for mounting of instruments.
- 4.03.04 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings are admissible.
- 4.03.05 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..

Each rack shall be provided with one receptacle, one light fixture with wire guard and one lighting switch. Outlet box, switch box and device covers shall be galvanized stamped steel. Light fixtures shall be installed on the canopy of the rack

- 4.03.06 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.

4.04.00 JUNCTION BOX

- | | | |
|----------------------|---|--|
| 1. Type of Enclosure | : | Dust tight & weatherproof conforming to IP 65 |
| 2. Material | : | 3 mm sheet steel / fiberglass reinforced polyester(UV stabilized) |
| 3. Type of Cover | : | Solid unhinged with retention chain / Screwed at all four corners |
| 4. Paint | : | i) Exterior : Opaline green shade 275 of IS: 5
ii) Interior - Brilliant Glossy White. |

- Surface / Two (2) inch Pipe stanchion
5. Mounting : (At a dry compartment at one side of the enclosure / rack with front opening type door)
6. Cable Entry : 3 mm (min) Bottom / side Gland plate
7. Gasket : Neoprene
8. Grounding : Brass earth lug with green screw head
External-2 nos , Internal-1no. (M6)
9. Number of Drain Holes : Two at bottom capped
10. Identification : Label for JB and Tags for cable
11. Accessories : Rail mounted cage clamp type screwless terminals (suitable for conductor size up to 2.5sq.mm of suitable voltage grade) with markers and 20% spare terminals
- a) conductor size up to 2.5sq.mm of suitable voltage grade) with markers and 20% spare terminals
- b) Cable gland (Brass) & raceways
- c) Ferrules & lugs (Brass)
- d) Aluminum back panel
- e) Canopy at top
- f) Mounting brackets
- g) bolts and nuts made of brass etc.

**ATTACHEMENT-1 TO ANNEXURE-I OF
PY 55182 Rev 00**

**PROGRAMMABLE LOGIC CONTROLER (PLC) /
PROPRIETARY CONTROL SYSTEM**

1.00.00 GENERAL

- 1.01.00 Each of the relevant BOP areas and different auxiliary systems shall be provided with dedicated PLC or proprietary control systems for overall operation and control.
- 1.01.01 The Common DDCMIS network shall also control and monitor the packages envisaged for PLC based local control systems. Operator workstations shall be provided in CCR for the overall control and monitoring of each system through network.
- There shall be redundant bidirectional OPC link between this Common DDCMIS network and each Package PLC including PADO for monitoring / performance activities.
- These areas have been indicated with other details in Section-V of this volume of the specification.
- 1.02.00 These control systems shall conform to high standard of engineering meeting all applicable codes and standard, design and workmanship and shall meet the functional requirements in all respects and shall be capable of performing satisfactorily in continuous commercial operation under the specified environmental condition.
- 1.03.00 Further this part of the specification details the common technical and functional requirements applicable for all the systems unless specified elsewhere in the specification. Only specific requirements are indicated in this section .However ,Bidder shall also adhere to the Section-VI , Subsection A (DDCMIS) of this volume of the specification for other basic and detailed scope & services , philosophy & technical requirements of different hardwares and softwares including response time , loading , interface , redundancy criteria , display , logs ,spares criteria , drawings and document submission etc.
- 1.04.00 All local PLCs shall be supplied from one manufacturer for all plants and shall provide single unified hardware and software platform for realizing all the control and monitoring functions.
- 1.05.00 In general local PLC, ,Proprietary control system by third party system integrators shall not be allowed and only main PLC/ Proprietary control system manufacturer shall be allowed to do the design engineering , system integration etc. Owner will be the final authority in allowing third party system integrators , if required , for only small applications
- 1.06.00 Common DDCMIS shall basically control and monitor the BOP package systems , as detailed in section V of the volume of specification , through the workstations from the Central Control Room (CCR) during normal operation of the plant.. However, local control and monitoring facility of the equipments from the respective package control room and local panels shall also be available. However, if required, based on operator choice, normal and emergency operation from the local PLC system shall also be done. The control room operator shall have also access to common database for all the packages.

- 1.06.01 The redundant upper level network of each Package PLC system will be connected to redundant server to be located in Plant Engineer's room. Suitable Fibre optic cable shall be used for redundant interconnections.
- 1.06.02 The hot redundant Server shall continuously update all the inputs. The switchover to the hot standby Server shall be smooth and bump less with proper indication to the operator.
- 1.06.03 In addition to local PLC Workstations , programming activities for control systems of all the packages including set point change , logic build up & modifications , graphics build up & modifications etc . shall also be achieved through Common DDCMIS network workstation.
- 1.06.04 Common DDCMIS Network workstations stations, local workstations shall have access to the processor of the individual package control system for programming. Programming shall not require special computer skills. On the programming console, it shall be possible to do the programming, self-diagnostics, testing of sequence, simulation and any sequence modification.
- 1.06.05 All the screens as available in the local package monitors will be also available one to one basis in the Common DDCMIS network screens. Alarm monitoring / reporting, generation of logs, trends, calculations, printing of logs & reports etc. shall be available in local workstations as well as in remote Common DDCMIS network workstations .In case of failure of Common DDCMIS network, control and monitoring of the individual packages shall still be possible from the Operator Work Stations in the respective package control room
- 1.06.06 There shall be flexibility in operation from CCR Common DDCMIS network operator workstations. Any of the BOP packages can be controlled and monitored from any of the workstations. .
- 1.06.07 The system shall permit carrying out of the on-line dynamic test and self-diagnostic checks while maintaining safe condition and without endangering the safety of equipment without having any influence on the process being controlled.

2.00.00 GENERAL TECHNICAL REQUIREMENTS

- 2.01.00 Bidders scope of supply shall include , but not limited to , Hot standby local PLC / Proprietary control & monitoring system for each of BOP areas and shall consist of IO cards, remote and Local IO rack, control rack, redundant Power supply modules, redundant communication /networking and interconnection Cables, redundant processor and communication cards, redundant Servers, operator work stations / GUI , LVS , printer, redundant networking hardware, redundant interface hardwares / softwares with DDCMIS , MCS , PADO etc. , system cabinets ,startup, commissioning, mandatory and recommended spares, drawing, documents and training to owner's personnels at site and at vendors works etc.
- 2.02.00 All types of programming packages shall be licensed with facility of editing and configuration. For each of the PLC / proprietary control system, the programming software shall be supplied in a laptop for each package

preloaded with package in addition to other types of devices such as CD, DAT etc.

2.03.00 In addition to the Operator and/ cum Engineering workstations , Bidder shall also supply LCD screen based display unit, control switches and other operational keys (GUI). Bidder shall also provide minimum of one no. laptop computer for each PLC based package and with latest hardware configuration and loaded with suitable operating , application program including licensed softwares as a backup engineering cum programming and configuration station. This loaded laptop shall be handed over by Bidder well in advance of FAT to Owner's head office at Hyderabad .

2.04.00 The System shall allow dependable and effective control of the process equipment and shall be designed for maximum integrity and reliability. Integrity shall be maintained by providing a dual hot redundant system .The System shall have a capability to monitor and take actions for distributed functions from a central location.

2.05.00 The control & Instrumentation shall be through dedicated microprocessor based PLC ,Common DDCMIS network ,proprietary system for the each of the respective plants covering the total functional requirement of sequence control, regulatory control, interlock & protection, monitoring, alarm, data logging.

2.06.00 The loop cycle time shall be less than 1 sec for close loops and open loops. The switchover from main controller to redundant controller shall be bumpless; and shall be within one cycle time i.e. within 50 msec.

2.07.00 Each controller shall have 40% functional capacity to implement additional functional blocks over and above implemented logic / loops under worst loading conditions.

2.08.00 Field Input/Outputs

The System shall meet the following I/O card requirements.
The maximum number of inputs / outputs to be connected to each type of module shall be as follows:

a)	Analog input module	8
b).	Analog output module	8
c)	Binary input module	16
d)	Binary output module	16

2.09.00 Communications System

2.09.01 The Bidder shall include a dual hot redundant communication system

2.09.02 The data highway speed shall be 1000 Mbps.

2.10.00 Operator Interface

Operator Work Station (OWS) / GUI / LVS shall perform control monitoring and operation of all auxiliaries/ drives . However , Push button stations are

also to be provided with RIOs as detailed out in Section V of this volume of the specification .

- 2.11.00 Interface with Common DDCMIS system
- Each PLC , proprietary control systems shall be interfaced to Common DDCMIS network with bidirectional OPC link .The link shall be redundant.
- 2.12.00 PLC shall be of latest version and all the modules like Control modules, communication modules, IO modules, network interface modules etc., modules shall be from the same family of hardwares and softwares and shall be sourced from Bidder's Original Principial's works.
- 2.13.00 PLC shall have also , but not limited to, the following requirements ,
- 2.13.01 I/O LAN Speed shall be minimum 5 Mbps - 100 MBPS on Deterministic LAN.
- 2.13.02 I/Os shall be Rack based and not Din Rail Mountable .
- 2.13.03 Processors and I/Os shall be of same family.
- 2.13.04 Channel Level Diagnostics for DI/DO, AI & AO shall be provided . Each individual Channel healthiness shall be monitored at workstation / GUI level.
- 2.13.05 All PLC I/O Rack Power Supplies shall be redundant. Only Bulk power supply redundancy will not be acceptable.
- 2.13.06 Processor shall have minimum 256 PID loops execution capability. Minimum memory shall be 10 MB. It should be 32 Bit.
- 2.13.07 SOE module (if applicable) must stamp and store 250+ events at card level.
- 2.13.08 PLC shall store tag details and bit word addresses on upload of logic as well as tag descriptions.
- 2.13.09 I/O Bit forcing in Primary to reflect in secondary immediately. (single scan update)
- 2.13.09 Remote I/O Rack outside control room shall be on Fiber Optic communication only.
- 2.13.10 Processor shall be self learning in case of failure. No need to configure and program replaced processor.
- 2.14.00 Operating work stations must be Runtime license/servers. Client server architecture no acceptable.
- 2.15.00 Each operator work station must have minimum 8000 tags handling capability.
- 2.16.00 Auto Tuning feature of PIDs at PLC controller level shall be available.
- 2.17.00 Floating IP selection of Controller under PLC processor switchover condition

- 2.18.00 Automatic Program update on secondary on loading to Primary Processor.
- 2.19.00 Programming facility shall be available from Remote IO stations.
- 2.20.00 Processor shall support minimum 22000 IO handling capacity in Redundant configuration.
- 2.21.00 Online editing of Program shall be possible.
- 2.22.00 Processors shall be Hot back up.
- 2.23.00 Automatic synchronization of primary processor/controller of PLC with secondary processor/controller.
- 2.24.00 Bumpless switchover to secondary processor/controller of PLC when the primary fails.
- 2.25.00 Power supply module redundancy shall be true power supply redundancy
- 2.26.00 Automatic program and data equalization of primary processor/controller of PLC.
- 2.27.00 Automatic 'Forcing Bit' update in the secondary processor/controller of PLC when any Forcing is applied in the primary processor/controller of PLC. (Forcing Bit Table of both the PLCs must be automatically synchronised.)
- 2.28.00 Communication speed of 5 Mbps between PLC and I/O module network
- 2.22.00 Softwares
- The latest version of all necessary applications and networking software shall be supplied for the system. The software tool shall have facility to interface with third party software packages. Window base operating system shall be provided. The system shall be OPC compliant. Easy upgradation and future expansion facility shall be available.
- All softwares used shall be licensed versions only. All software user licenses shall be valid for entire life of power plant. User shall not have to pay any recurring license fee during the usage period of the system.
- It shall be possible to upgrade the installed system with the latest available version of the software model during the plant life.
- 2.23.00 Redundant Uninterrupted Power Supplies (UPS) shall be provided for each Local PLC.. UPS specification shall be as per requirements indicated in Section V of this specification.