

24.0 FIRE DETECTION, ALARM & PROTECTION SYSTEM**24.1 INTRODUCTION.**

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 1 x 660 MW Unit and its auxiliary plants to reduce consequential damages by containing and extinguishing the same. Bidder's scope of work covers system design, engineering, manufacturing, supply, assembly, packing, transportation FOR Site including shop painting, final painting at site, freight and transit insurance as applicable for all materials and equipment,, warehousing, field construction, erection, connecting piping and wiring, cabling, shop and site tests, putting them into successful commissioning of the entire fire detection and protection system including supply of all fire extinguishing equipment and systems, fire detectors, manual call points, heat sensing cables, all local, remote and repeater panels, computers and peripherals, hardware and licensed versions of software as detailed hereunder, meeting all code requirements to make the system complete and all other services as specified in relevant sections in accordance with the intent and requirements of this specification. A comprehensive Fire Detection, Protection & Alarm System shall be provided by the Bidder covering all the areas of the power plant.

Various types of protection systems and associated equipment / system components shall be completely in compliance with the regulations of Tariff Advisory Committee (TAC) of India/NFPA. **The Fire detection, Protection & Alarm system shall be designed in line with the guideline stipulated in NFPA-850 & IS-3034.** BIDDER shall also obtain necessary approvals from the local statutory body and authorised fire protection and detection system insurance agencies as applicable for the complete system. This include discussions with authorised approving agencies, arranging inspection at site, revision / modifications carried out at site as suggested by the authorities/ Owner for obtaining complete approval of the system and ensure maximum discount for insurance premium to Owner. The responsibility of getting approval from statutory body & TAC accredited professionals rests exclusively on Bidder. This include discussions with authorised approving agencies, arranging inspection at site, revision / modifications as suggested by the authorities for obtaining complete approval of the system and ensure maximum discount for insurance premium to Owner. Any other additional equipment not specifically mentioned in the technical specification but is found necessary to meet the requirements of TAC & local statutory body and also for safe and sound operation of the plant are to be included at no extra cost to Owner. It is Bidder's responsibility to take care of all Site routing / modifications as suggested by approving agency and Owner related to fire protection and detection system during erection and commissioning time without any price implication to Owner.

Filtered Water shall be used for firefighting system. The fire pumps shall be installed in the Clarified water pump house. Fire water pumps shall draw their supply from Clarified water reservoir. Pumps shall be installed in such a manner that water available in the reservoir for fire water requirements is atleast equivalent to the quantities as specified.

Effective capacity of fire water storage shall be decided based on TAC requirements. However the effective capacity, in any case, shall not be less than 2500 cum with all accessories as specified.

24.2 SYSTEM DESCRIPTION

The complete system is divided into the following systems:-

- i) Fire Protection System
- ii) Fire detection and alarm system
- iii) Fire Station and Other facilities.

24.3 FIRE PROTECTION SYSTEM:-

Following types of Fire Protection system shall be provided.

- i) Hydrant System.
- ii) Automatic High and Medium Velocity Water Spray Systems.
- iii) Automatic Fixed Foam system for Fuel Oil storage Tanks.
- iv) Automatic inert Gas system.
- v) Portable and Mobile Fire Extinguishers.

24.4 DESIGN CRITERIA**24.4.1 CODES AND STANDARDS**

The Complete Fire detection and protection system shall be designed in Conformity with Tariff Advisory Committee (TAC) / IS 3034 / NFPA, USA. Any other Standard which are not mentioned in the technical specification but are found necessary to meet the requirement of TAC and also for safe and sound operation of the plant are to be included at no extra cost to the employer.

All equipment in the entire fire protection & detection system shall have the approval from one of the followings:

- i) UL of USA
- ii) LPCB-UK
- iii) BIS-India
- iv) FM-USA
- v) VDS- Germany

However, the design and installation of complete system and requirement shall be approved by statutory authorities.

24.4.2 DESIGN PHILOSOPHY FOR HYDRANT SYSTEM.

The Plant is covered under "Ordinary Hazard" according to TAC. The Hydrant System of Fire Protection essentially consists of a large network of pipe with suitable number of Ring Mains, both underground and over ground which feeds water to number of hydrants valves – indoor as well as outdoor and to number of outdoor type fixed installations and Water Monitors. Water in the pipe network shall be kept pressurised by jockey pump arrangement. These hydrant valves / Water Monitors shall be located throughout the entire powerhouse and other buildings. Hosepipes of suitable lengths fitted with standard accessories like branch pipes, nozzles etc. are kept in "Hose Boxes" along with each Hydrant for both indoor & outdoor. When the fire hoses are coupled to the hydrant valves through the instantaneous coupling, jet of water will be directed towards the fire. Where the height of the Hazard is more than 15 mtr corresponding Hydrants will be replaced by 75mm Water Monitors.

- 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 230 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.

B.9 Lubricating Oil System

Automatic pressure lubrication shall be provided by a crankshaft driven oil pump.

B.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/NFPA.

B.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

24.4.7 DESIGN PHILOSOPHY FOR FIRE DETECTION, ALARM, PROTECTION AND CONTROL SYSTEM.

24.4.7.1 GENERAL

- a) PLC based Fire Water control panel for Fire Water Pumps located in Fire Water pump house for operation of the Fire water pressurizing and pumping system. Separate parallel redundant UPS with battery shall be provided for PLC based control system.

- b) Fire Protection, Detection and Alarm Panel shall be located in the Central Control Room. Each of the Panels shall be provided with a Operating work station with colour graphic Software and printer. Fire response programme shall be integrated with the colour graphic software in order to display all the Detector Loops with their Dynamic Status. Summary of Alarm page shall also to be configured. Alarms with Beeper are to be configured in each Monitor Station with facility for acknowledgement.
 - c) Fire Detection and Alarm Panel in the Central Control Room shall be provided with hardwired contacts for Group Alarms for the fire Protection, detection & Alarm system and to be connected to the DDCMIS.
 - d) One(1) No Sub Fire alarm shall be located in Coal Handling Control room to take care of alarms etc in Coal handling area.
 - e) A separate parallel redundant Uninterruptible Power Supply (UPS) unit with Battery Back up shall be provided with the Fire Alarm Panel in CCR, which shall provide Power to the Operating work station & printer with Fire alarm Panel. Technical Requirements and features of the Operating work station, printer and UPS shall be provided as per NIT.
- Bidder may also consider redundant UPS feeders in main plant UPS for OWS & printer located in CCR instead of separate UPS.
- e) Satellite Fire Alarm Panels wherein all connections from the Fire Detectors and Manual call Points of the respective areas shall be terminated.
 - f) Repeater Master Fire Alarm Panel to be located in the Fire Station. All annunciations of local Fire Detection and Alarm Panels in CCR including their respective satellite Fire Alarm panels, Fire Alarm Panel in CHP and Grouped Annunciations etc shall also be made available in the Master Fire Alarm Panel.
 - g) This panel is to be provided with an operating work station with colour graphic software and printer. Fire response programme shall be integrated with the colour graphic software in order to display all the Detector Loops with their Dynamic Status. Summary of Alarm page shall also to be configured. Alarms with Beeper are to be configured in the Monitor Station with facility for acknowledgement.
 - h) A parallel redundant Uninterruptible Power Supply (UPS) unit with Battery Back up shall be provided with the Master Fire Alarm Panel which shall provide Power to the Operating work station & printer with Fire alarm Panel. Technical Requirements and features of the Operating work station, printer and UPS are provided in the Vol V of the Specification.
 - i) All Fire protection, Detection and Alarm Panels in CCR, CHP, Satellite Fire Alarm Panels and Repeater Master Fire Alarm Panel in Fire Station shall be integrated through Dual Redundant Optical Fibre Data Highway connected in Ring Main Topology. The technical requirements of such FO based communication cable are elaborated in Volume V of the specification.

- j) Two (2) sets (1 working & 1 standby, 100% capacity each) of 24 Volt (2x12V) Automotive type battery with charger for each diesel engine driven fire water pumps primarily for starting the engine.
- k) Two (2) sets (1 working & 1 standby, 100% capacity each) of 24 Volt sealed type maintenance free lead-acid battery with charger for each Satellite fire alarm panel, Fire Detection and Alarm panels in CCR, CHP, Satellite Fire Alarm Panels and Repeater Master Fire Alarm Panel in Fire Station.
- l) Supply, laying and connection of FRLS power, control and instrumentation cables required for complete fire protection system and Fire survival cables (950°C. for 3 hours) for CHP area.
- m) Adequate no. of Back-lit maintained type emergency exit signs as per TAC.
- n) Emergency Voice Communication System, adequate number of fireman's telephones and speakers. Speakers shall be provided in strategic locations throughout the Plant. Pre recorded voice messages shall be sounded through these Speakers to alert the people. Telephone set shall be provided in each Fire Alarm Panel. As minimum, Speakers shall be provided in Central Control Room, Coal and Ash Handling Plants, DM Water Plant, CW Pump House.

The Fire Protection, detection and Alarm System shall comply with NFPA - 72/72E and IS: 2189 standards. The Fire protection, detection, alarm and Control System shall consist of various type detectors, Control Cabling, Fire Alarm Panels, Central Monitoring station, repeater Panels, PLC control Panels and Local Panels(For Deluge Valves etc).

- a) The fire Alarm, protection and Detection system shall be hot redundant microprocessor based, analogue addressable type.
- b) Selection of temperature rating of heat detectors shall be based upon maximum ambient temperature of about 50°C for outdoor equipments (Like Transformers, boiler burner fronts, fuel oil tanks etc) and about 40°C for indoor equipments like Coal conveyors, Cable galleries, Fuel oil Pump House etc.

Fire detection and alarm System shall cover the following area & system :-

- a) Multi sensor type Smoke detection System.
 - All Switchgear/MCC/Control rooms of Main Plant Building, ESP, switchyard control room building, CHP Control room, APH Control room various auxiliary building like ash handling system, compressed air system, CW/ACW system, condensate polishing plant, water treatment plant, Pump Houses, Service, Admin building, Battery room etc.
 - Below false ceiling area of all air conditioned rooms in main plant building, service building, ESP building, various control rooms of auxiliary buildings etc.

- b) Multi criteria type smoke detectors for above false ceiling for all air conditioned areas.
- c) However combination of both multisensor and photoelectric smoke detectors for above and below false ceiling of inert gas protected areas and various cable galleries protected by MVW Spray System.
- d) Linear Heat sensing Cable (Digital type) detection system for coal conveyors, and cable galleries covered under MVW Spray Systems.
- e) Quartzoid Bulb heat detection system for equipments protected by HVW Spray system, LDO/HFO, pump House etc protected by MVW Spray System.
- f) Probe type heat detectors for Fuel Oil HFO and LDO Tanks.
- g) 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. The heat detectors shall be suitably mounted on fire water pipes covering an open area.
 - Battery and battery charger rooms.
 - Oil filled type L.T. Transformers (up to and including 2500 KVA rating) However, no oil filled L.T. Transformer has been envisaged inside power house.
 - Dry type L.T. Transformers located anywhere in the plant area.
 - Batteries & UPS rooms.
 - Pantry & Canteen area.
- h) PLC based Local Fire Water control panel for Fire Water Pumps located in F.W pump house for operation of the Fire water pressurizing and pumping system. This shall be connected to DDCIMS in Main Control room thru fiber optic cables.
- i) Main Fire Detection, Protection and Alarm Panel for each Unit to be located in the Central Control Room in Power House. Each of the Panels shall be provided with a operating work station with complete Software and A4 sized B/W printer. Fire response programme shall be integrated with the colour graphic software in order to display all the Detector Loops with their Dynamic Status. Summary of Alarm page shall also to be configured. Alarms with Beeper are to be configured in each Monitor Station with facility for acknowledgement.
- j) Fire Detection and Alarm Panel in the Central Control Room shall be provided with hardwired contacts for Group Alarms for the fire detection system and to be connected to the DDCMIS of the respective unit.
- k) All connections from the Fire Detectors and Manual call Points of the respective areas shall be terminated to their respective Fire Alarm Panel.
- l) Repeater Fire Alarm Panel to be located in the Fire Station. All annunciations of local Fire Detection and Alarm Panels in CCR including their respective satellite panels, Fire Alarm Panel in CHP and Grouped Annunciations etc shall also be made available in the Master Fire Alarm Panel as well as in repeater panel.

- m) Main/Sub Fire alarm panel is to be provided with a operating work station with colour graphic software and A4 sized B/W printer. Fire response programme shall be integrated with the colour graphic software in order to display all the Detector Loops with their Dynamic Status. Summary of Alarm page shall also to be configured. Alarms with Beeper are to be configured in the Monitor Station with facility for acknowledgement.
- n) A parallel redundant Uninterruptible Power Supply (UPS) unit with suitable Battery Back up shall be provided with the Master Fire Alarm Panel which shall provide Power to the operating work station & printer of the Panel. Technical Requirements and features of the OWS, printer and UPS are provided in the Vol V of the Specification.
- o) All Fire Detection and Alarm Panels in CCR, CHP, and Repeater Fire Alarm Panel in Fire Station shall be integrated through Dual Redundant Optical Fibre Data Highway connected in Ring Main Topology. The technical requirement of such FO based communication cable are elaborated in Vol. V of the specification.
- p) PLC based panel at fire water pump house, electronic based panel at foam and booster pump house shall indicate the status of each pump, system pressure, operation system, failure of starting of pumps, healthiness & failure of batteries/ chargers, main supply, low level of fuel oil of diesel engines, tripping of pumps, low level / very low level of water level in the water supply system, status of batteries & chargers of panels and diesel engines etc. Alarms from these panels shall also be available to operator at fire alarm addressable panels, central monitoring station and DDCMIS.
- q) Two (2) sets (1 working & 1 standby, 100% capacity) of 24 Volt (2x12V) Automotive type Ni-Cd battery with charger for each diesel engine driven fire water pumps primarily for starting the engine .
- r) Two (2) sets (1 working & 1 standby, 100% capacity) of 24 Volt (12x2V) sealed type maintenance free lead-acid battery with charger for each Satellite fire alarm panel, Fire Detection and Alarm panels in CCR, CHP and Master Fire Alarm Panel in Fire Station.
- s) Supply, laying and connection of FRLS power, control and instrumentation cables required for complete fire protection system and Fire survival cables (950°C. for 3 hours) for CHP area.
- t) Adequate no. of Back-lit maintained type emergency exit signs as per TAC shall be provided in all staircases of the building coming under plant battery limit.
- u) Emergency Voice Communication System, adequate number of fireman's telephones and speakers. Speakers shall be provided in strategic locations throughout the Plant. Pre recorded voice messages shall be sounded through these Speakers to alert the people. Telephone set shall be provided in each Fire Alarm Panel. As minimum, Speakers shall be provided in Central Control Room, Coal and Ash Handling Plants, DM Water Plant, CW Pump House.

- v) The panel at coal handling plant control room shall exhibit alarms from detection and protection from coal handling plant and all other auxiliary building/areas. Further, all panels shall also be hooked-up with Fire alarm panel at Central Control room for alarm purpose.
- w) The central monitoring station to be located at Central Control Room and coal handling plant control room and shall cover the fire detection and protection system of the complete (all the areas) plant. This shall give audio-visual annunciations for fire in each of the risk area / equipment/ status of the fire protection system as well as system operator open /short circuit status of detector or control cabling etc. Further, this shall activate a hooter/sounder in each of the area provided with fire/smoke detection system.
- x) Alarms from all the fire alarm addressable panels shall be repeated simultaneously in repeater panel at Fire station.
- y) Dual action type Manual Call Points shall be provided at strategic locations at indoor and outdoor (preferably in Coal handling plant).
- z) Sounder cum flashers shall be required at the exit gates along with the hooters/sounders along with Manual Call points. With each Manual Call Point, hooter/Sounder flashers shall be considered. The distance between consecutive MCP and Hooter shall be in such fashion that a person should not travel more than 30 mtr distance from the nearest one.
- aa) Response indicators shall be employed for the showing the status of the detectors placing above false ceiling.
- ab) Bidder shall refer Vol. V for complete C & I requirements of Fire Detection, protection & Alarm system.
- ac) All instruments, detectors, cables and control equipments etc shall ensure high availability, high reliability, low down time and ease of maintenance.
- ad) Complete Fire protection, detection & Alarm system shall be designed in such a way that any failure in cable, detector or any component used in system, wire break, short circuit etc will not impact on the system and the Fire protection, detection & Alarm system shall be available 100% all the time round the year.

24.4.7.2 DESIGN:-

1.0 Detectors (Microprocessor Based)

- a) 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.
- b) 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 (fail safe type).

- c) 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.
- d) The various fire detectors serving a particular area / zone of plant may be wired-up in group and one common signal for each area/zone shall be 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.
- e) The detectors shall be located where the largest combustion gas concentration can be expected.
- f) 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.
- g) 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.
- h) 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.
- i) 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.
- j) Make and type of detectors shall be subject to Purchaser's approval.
- k) The indigenous detectors shall have the approval of ISI/ISO in addition to the approval of FM/UL/FOC. Detectors and panels shall be preferably from the same manufacturer for compatibility.
- l) The detectors shall not be effected by temperature, humidity, air flows.

A. 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/cum.
- c) The detectors shall be of Multisensor type with a combination of photo electric and heat sensing elements. The multicriteria smoke detector provides photo electric 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.
- f) The design Coverage area for smoke detectors to be considered shall not exceed 25m² for A/C area per each detector and 35-40 m² for non A/C areas.

B. 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.
- j) All the detectors shall comply style-7 fashion as per NFPA-72 standard.
- k) Inbuilt indicating lamp shall be provided to indicate operation of the detector.

C. Linear Heat Sensing Cable

- a) Linear Heat sensing cable shall be SS braided digital type (For Coal conveyors for Cable galleries/ spreader rooms. All cable shall be SS braided.

D. Frangible (Quartzoid) Bulb Type Detector

- a) The design shall be dual action type with the provision of key resetting.
- b) Dual-color LED blinking for annunciation.
- c) The MCP shall be made of M.S/ABS body.
- d) The manual call points shall be provided at each entry & exit point of control rooms, UPS rooms, battery rooms, and other critical & mandatory locations specified else where in the specification.
- e) The manual call point enclosure shall be completely dust, weather and vermin proof. The housing of the electronic circuitry shall have minimum IP 65 protection. The complete unit shall be suitable for wall/column mounting with necessary mounting accessories.
- f) Clear inscription reading (in English) "FIRE ALARM - IN CASE OF FIRE PUSH" shall be provided for each manual call point unit, either on the enclosure or on a separate metal plate mounted behind the glass cover. The metal plate for inscription shall not tarnish under the atmospheric conditions
- g) Type of manual call point shall be intelligent Addressable Analog type.
- h) 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.
- i) The Manual Pull station shall be addressable type, the address and the location of the same shall be annunciated in the panels on operation.



G. Power Module

- a) The Power Module shall be provided with AC to DC conversion circuits and the battery charger circuits. The panel which requires more than 16 Amp, A.C. power supply shall be suitable to receive 415 Volts $\pm 10\%$, 3-Phase, 50 Hz $\pm 5\%$, 3-wire power supply through MCB. Other panels having requirement of equal to and less than 16 Amp., A.C. power supply shall be suitable to receive, 240 Volt $\pm 10\%$, single phase, 50 Hz $\pm 5\%$, phase and neutral, through MCB.
- b) The panel shall have in-built stabilized power supply unit for its electronic circuitry which rectifies A.C. power supply to D.C. for system operation. Power supply to the detectors, manual call points, external hooters etc. shall be provided in the panel.
- c) The automatic with manual over-ride change over inclusive of all metering, control, indication and interlock system shall be provided.
- d) Parallel redundant (2 x 100% rating) Regulated power supply modules shall be used for operation of various components / cards. LED indications for system ON and blow fuses shall be provided on the Facia of Power Module.

H. Monitor Module

- a) The monitor module shall be provided with all circuits which shall be able to monitor the various conditions / status of power supply section continuously. The monitor module shall be plug-in type.

I. Control Module

- a) The Control Module shall be provided for hooking-up with Power Module, Monitor Module and Zone Module and for proper controlling of system of Fire Protection Zonal System. The Control Module shall be plug-in type.

J. Zone Module

- a) Zone Module provided shall be of intelligible and addressable type. The zone module shall function as the interface between the various types of intelligent addressable analogue type fire detectors connected in the field and the panel circuits. Zone module shall comprise of necessary circuits for continuously monitoring the detectors, line cabling, the circuit for open, short and fire condition with audio-visual alarm. Facility for testing and isolation through push button shall be provided for zone module to simulate the open and short circuit of the cable connected between detector and the panel and fire condition with audio-visual alarm. Audio-visual alarm for each zone module in case of withdrawal or taking out of zone module from the connected system shall be provided. Zone module shall be designed in such a way that even after detection of fire from one detector located in a zone, the same zone shall be in operation for detecting fire. All the Zonal Fire Panels shall be networked through Fibre Optic Link with the Main Fire Detection and Alarm panel in CCR.

Note : 20% spare wired channel shall be provided in each module.



K) Realy Modules

- i) No of contacts per relay shall be 2 SPDT or DPDT.
- ii) 20% spare wired relay shall be provided in each relay module.
- iii) The relay Module shall be plug-in type.

L) Loop Sounder/Hooter

- i) Loop Sounder/Hooters shall be intelligent addressable and electronic type.
- ii.) Loop sounder/hooters shall be provided with each Fire alarm panel, section indicating panel, Satellite Fire Alarm Panels & Repeater panel.
- iii.) The system shall have provision to annunciate any one or all the loopsounder/hooters on any given condition.
- iv.) The sound intensioty/volume shall be more than 85 dB at one meter distance and 5 dB above the back groud noise/sound at one meter distance.
- v.) Colour of case shall be red.
- vi.) Pitch, tone & volume of sound shall be adjustable.
- vii.) Type of tone shall be selectable. (Minimum 4 types of tones shall be provided).

2.0 Fire Panels**A. Satellite Fire Protection, Detection & Alarm Panels**

- i) Satellite fire panels will be used to cater for the fire detection, deluge valve operation, associated annunciations system and power supply distribution network for the Fire Protection system. These panels shall be based on intelligent addressable Microprocessor based technology. These panels shall be strategically located in different areas of the Power Plant considering zone wise fire detection and fire fighting system.
- ii) The system shall be operable from each fire detector network, automatic deluge valve right upto each local zonal fire panels, Manual Call Points provided in the area /equipment shall also be hooked up with such type of Local Fire Panels.
- iii) Number of Satellite Fire Panels will be minimum as indicated in Vol V of specification and as finalized during detailed engineering. Any more no. of panels as required shall also be provided.

B) Fire Detection, Alarm & Protection Panels in Central Control Room.

- i) The Fire Detection and Alarm Panel for the unit shall be based on intelligent addressable redundant microprocessor based technology and will be used to hook up with each of the Satellite Fire Alarm panels. The Panel with its operating work station, Monitor, printer and Peripheral devices shall

detect, display and annunciate electrical fault (open or short circuit), individual detector wise and Group Zone wise Fire Annunciation Satellite fire panels. in addition to monitoring its own detection system. The Fire Detection and Alarm Panel shall also supervise, monitor and annunciate the condition of the circuitry of the fire detection system through Satellite fire panels.

- ii) The monitor of the fire detection and alarm panels in CCR shall be located on the operator's control desk of the respective units in the Central control Room.
- iii) One number of Fire Detection and Alarm Panel complete with all accessories as described above and other items to make the installation complete is to be provided for the unit.
- iv) Fire Detection and Alarm Panel shall have microprocessor based annunciation system. It will supervise; monitor the detection circuit through the Satellite Fire Panels.
- v) Fire Detection and Alarm Panel shall detect and display both Fault and Fire alarm from each Satellite Fire Panels. The Fire Panels shall supervise, monitor and annunciate the condition of the entire circuitry up to the detectors through Satellite Fire Panels.
- vi) The Fire Detection and Alarm Panel shall be indoor, air insulated, metal clad, floor/Wall mounting type.

C) Repeater Alarm Panel in Fire Station

- i) The Repeater Fire Alarm Panel used to repeat, monitor, supervise and annunciate whatever fire and fault alarms annunciations coming in the fire detection and alarm panel of central control room. This panel shall also monitor supervise the circuitry between the Fire Alarm Panels in CCR, Sub Fire alarm panel in CHP. The repeater panel shall be located in the Plant Fire Station.
- ii) One number of Repeater Fire Panel complete with all hardware and accessories and requisite software is to be provided, in the Fire Station.

D) Local Fire Water Control Panel (PLC Based)

The Local Control Panels shall be provided for the following services:

- i) Auto manual control, interlock, indication supervision and HW annunciation for Fire Fighting Equipment (Fire Pumps, Jockey Pumps etc.) located inside the FW Pump House. Complete operation of the Diesel engine driven pumps shall also be performed from this panel.

The following feature shall also be provided in Local Fire Panels, Main Fire Panels and Repeater Panel :

- i) Actuation of any of above push buttons shall activate the corresponding Audio/Visual indications.
- ii) External audio-alarms (if any) shall not come on during the testing period.

- iii) No relay/contactors shall get energised during TESTING PERIOD to avoid spurious tripping / actuation / simulation of alarms in the associated equipment.
- iv) The performance and characteristics of audio-visual annunciation system shall conform to BS, NFPA codes.

Local Control Panel for Fire Water System / Diesel Engine Driven Pumps and other Fire Protection Equipment located Fire Water Pump House and a local control panel for electric & diesel engine driven Booster pump.

- i) Local Control Panel for the service called for shall be indoor, air insulated, metal clad, floor or wall or column mounting type. Type of mounting shall be determined by the Bidder depending upon layout convenience and size of the panel.
- ii) The panel shall be fabricated out of 2 mm thick CRCA sheets. Degree of protection of the panel enclosure shall be IP-54. Lockable front door with proper gasketing shall be provided.
- iii) Power module shall be provided with parallel redundant AC to DC conversion circuits and the battery charger circuits. The panel shall have in-built parallel redundant stabilizer power supply unit for its electronic circuits which rectifies AC power supply to 24 volt DC for system operation.
- iv) The automatic with manual over-ride changeover inclusive of all metering, control, indication and interlock system shall be provided.
- vi) All controls, interlocks, indications and annunciation system shall be provided for safe and trouble-free operation of the Plant / equipment supplied.

The Panel shall be provided with the following features as minimum:

- One (1) Auto-Start Control Section for auto start of electric driven fire pumps, jockey pumps and one (1) no. auto-start control section for diesel engine driven pumps shall be provided inclusive of following gadgets as minimum :
- Auto and Manual Selector Switch for each electrical driven fire pump, jockey pump and air compressor (if applicable).
- Manual Start / Stop Push Button for each drive.
- Indicating Lamp showing power – ON
- Indicating Lamp showing power – ON / OFF
- Engine r.p.m. Indicator
- Lubricating oil pressure indicator

- Engine Cooling Water temperature – “in and out” indicator.
- Differential Pressure Indicator across strainer.
- Voltmeter / Ammeter in Battery Charging circuit. Ammeter for each Electrical motor.
- Hardware for diesel engine driven pump's control system.
- Any other instrumentation and control required as per system demand and as per design criteria & guidelines specified in C&I part, Vol. V.
- All annunciations as listed elsewhere and as required for safe and trouble-free operation of the plant / equipment supplied.
- The operation of control panel for Booster Pumps located in the Booster Pump House shall be similar to that of FW pump Panel.

Specific Requirements for Local Fire Panels

- Local Fire panels shall be indoor, air insulated, metal clad, floor, wall or column mounted type. Type of mounting shall be determined by the Bidder depending upon layout convenience, type, rating and duty involved in each category of panels.
- Each local fire panel shall be fabricated out of 2 mm thick CRCA sheets. Degree of protection of the panel enclosure shall be IP-54. However the hooter box to be mounted to the top of each panel shall have degree of protection IP-40.
- The front door shall be provided with either toughened glass or acrylic transparent sheet over the lockable full door with proper good quality of gasketing arrangement and with proper lock or equivalent so as to maintain degree of protection of IP-54.
- The components, which are to be fixed inside the cubicle, shall be so located on separate swing compartment in such a way that component and zone modules are clearly visible through glass or acrylic transparent sheet.
- The panel shall be designed in a truly modular concept with each zone represented by a module in order to minimize the wiring inside the panel and to minimize the breakdown time of the system.
- Each intelligent addressable local fire panel shall be capable of operating the intelligent addressable detectors and provided with the following plug-in type modules.
- Panel shall be designed on solid-state circuitry with provision of zone printed circuit cards, which shall be coated, for prevention against corrosion with suitable gold plated connectors for proper contacts. Gold plating shall be in the order of 4 to 6 microns.
- System of fire alarm shall be based on two-wire circuit system. Number of zones per panel shall be provided as per actual system requirement.

Each zone card shall be independent. Repetition of Fire Alarm and "Open and Short Circuit" of cables shall be provided in the panel.

- "Fire Detection Operated" signal shall be generated in the panel and shall be provided in the panel for hook-up with Owner's air-conditioning system, ventilation system, coal conveying system etc. The panel shall have provision for hook-up with external hooter, siren also.
- The panel shall have Ammeter and Voltmeter for 24 V D.C. System.
- UPS 230 Volts Volts Bus System shall be provided in the panel for solenoid operated valve required for Fire Fighting System in Coal Conveyors.
- All the Fire and Fault indications / alarms for the various zones and / or groups of zones shall be made available as electrically potential-free contact of adequate rating at the terminal strips of the Local Fire Panel for repetition of the same at Repeater Panel and Main Fire Panels.
- For each deluge valve, module shall be provided in panel in similar to Fire Detection System with the audio-visual alarm for (a) Detector circuit water pressure low, (b) Deluge valve operated (i.e. FIRE).
- The coal conveyor system shall be equipped with solenoid type Deluge Valve (SDV) to be operated automatically through fire detection system. Each SDV shall be provided with limit switch contacts to indicate actual operation of the solenoid operated valve in the panel. Since these connecting cables are to be run with other cables, the signal interference shall be avoided.

3. Microprocessor based Fire Alarm System

Bidder shall quote for a microprocessor based system to achieve the functional requirements as indicated above.

System Required

A) Panel System

- i) The 100% hot standby redundant micro processor based fire detection and fire alarm system shall be designed such as to have built in redundancy to ensure availability at all times.
- ii) The system shall basically comprise of the followings:
 - Fire alarm panels housing the main processor units and plug in modules.
 - Addressable type detectors shall be hooked up to the panel.
 - Main and standby power supply units.
 - Operating terminals.
 - Printer.

- iii) The control unit shall be of modular design, by means of plug in cards along with future expansion facility, exact tailoring of detector zones and control outputs to the actuation devices as required.
- iv) The control unit shall be micro processor based and controlled by a programme contained in nonvolatile memory (EPROM).
- v) Licensed version of Run and Edit mode of Software for the Fire Alarm panels, PLC System and Human Machine Interface System shall be provided.
- vi) The control unit shall be suitable for accepting inputs from addressable type detector. It shall also have the facility to monitor the contact inputs.
- vii) All the detection circuits shall be monitored against open circuit, short circuit and ground faults. For any malfunction in any detection line the control unit shall initiate a trouble signal for that detection line.

Further, the following criteria shall also be met.

- Fault in one detection line shall not affect the functioning of other detection lines.
 - A single open circuit, short circuit or ground fault shall not inhibit the detection capability of the detection circuit. Suitable circuitry / modules shall be provided.
 - The control unit shall pin point the location of fault for ease of maintenance.
 - The alarm display unit, in the event of fire shall indicate the zone no. and zone description. It shall be possible to define the zones through software.
- viii) The control unit shall be capable to process and evaluate incoming signals from addressable devices such as automatic heat/smoke detectors, manual call points etc. via four wire line circuits. The control unit shall be compatible with the detection line impedances.
 - ix) Each addressable line module shall have its own microprocessor-based circuit, working independently from the central processor unit located in the control unit.
 - x) In the event of an alarm or a fault condition it shall be possible to determine the exact device address at the control unit by means of numerical display. The device address shall comprise of the line number, device number and zone number.
 - xi) The detector shall be exchangeable without any change of programme.
 - xii) It is Bidder's responsibility to include required number of zone modules for the addressable detector.
 - xiii) Any special type of cable required for the detection system shall be provided by the Bidder.

- xiv) Provision for a Remote Electronic Hooter with intelligent Control Module shall be made and the Hooter Unit shall be placed in a convenient location to draw attention to the people in the locality.

B) Detector System

- i) Selection of detectors as per the requirements for that area and indicated previously. However some general criteria are elaborated additionally below for Bidder's guidance.
- ii) Selection of type and number of detectors shall be based on type of combustible and ignition source, type of environment and type of risks involve. The detector shall determine whether a fire condition exists in the room / area where the detector is located. In case of fire, the audio-visual fire alarm will be generated at Central Control Room as well as initiate signal to operate a Hooter located at convenient place in the Power House Building, along with repeat display at fire alarm panel in Fire Station.
- iii) Bidder shall consider area, ceiling height and type of ceiling construction for selection of optimum detector number and their placement. Other factors like ventilation, ambient temperature, radiation etc. are also to be taken into consideration.
- iv) Guidelines in various standards such as NFPA-72, IS:2189, AERB standards etc. shall be followed. Detectors shall comply style-7 of NFPA.
- v) Multi criteria smoke/heat detectors shall be intelligent analogue addressable type and shall have bi directional communication capability with the control panel. The accessory if required for the programming of the detector's address shall be provided. Further it shall be possible to change the detector sensitivity, calibration and identification from the control panel.

C) Additional Features

Followings are the additional features required :

- i) A Operating work station with a keyboard and a A4 sized colored Laser printer. The monitor is essentially a 24 inch LED colour monitor which shall be hooked up to the main fire alarm control panels and shall display the alarm, prewarning, faults, system diagnostics and data logging system. A print of the data logged can be taken on demand.
- ii) All the panels shall be standalone floor mounted type and as per design criteria & guidelines specified in C&I part, Vol. V

24.4.7.4 OPERATIONAL PHILOSOPHY & TECHNICAL REQUIREMENT:-

Each of the Addressable Fire Alarm panel shall be able to communicate with one another as well as with repeater annunciation panel and PLC based control panel located IN Fire Water Pump House. The detectors or other devices of any other unit/area shall be addressable only from the respective Addressable Fire Alarm Panel, so that each of the Addressable Fire Alarm Panel is under the control of designated operating personnel at that location. Facility to operate

booster pumps, foam system pumps and fire water pump house shall be provided from OWS based monitoring station.

At least 10% spare loop shall be provided in each of the addressable type fire alarm panel located in unit control room and in CHP control room with complete loop card and all other accessories so that OWNER can expand the system in future. Further, at least 10% of loop capacity be left free in each of the connected loop in all the panels, so that, additional devices may be connected to the system in any of the loop by OWNER in future.

Fire system (as a whole including PLC control systems) shall be provided with necessary interface hardware and software for dual fibre optic connectivity & interconnection with station wide LAN for two-way transfer of signals for the purposed of information sharing. The information shall be made available though on Ethernet link following TCP/IP standard. The system shall be OPC compliant. The exact data structure shall be as decided during detailed engg. All required plant data shall be transferred to /from through the ensuring complete security. The exact number of points to be transferred through the above communication link and the format of the data shall be finalized during detailed engineering.

System Functional Requirement

The fire alarm panel shall evaluate the signals received from the detectors and shall handle the following functions:

1. System self monitoring and fault signaling.
2. Transmission of alarm and fault signals to the respective fire alarm panels and as well as in the repeater panel in fire station. Further, the panel shall activate hooter / sounds in each of the area locally provided with fire/smoke detection system. Further, the system shall enable operation of spray system from the panel through monitoring station when the system operation is selected under remote, manual mode.
3. Initiate control functions like stoppage of conveyor, closure of fire doors, shutdown of draft fans, air-conditioning and ventilation plant/ equipment, opening smoke extraction vents, switching on smoke extraction equipment, emergency lighting etc.
4. Triggering stationary extinguishing systems such as clean agent system.
5. Supervising of unauthorised removal of a detector head from its base and giving a fault alarm on the control panel.
6. Supervising and monitoring the detection cabling, to indicate fault conditions in case of open/short circuit in the wiring.
7. Supervising by a separate annunciation window, changeover from mains supply to battery supply. "Mains On" indication shall be continuously on, as long as the main supply is available.
8. Facilitating simulation of fire conditions to enable the testing of circuits (without creating actual fire) under the test mode from the fire Alarm panel

9. The control unit shall contain all the systems main switches lamps and fuses. Switches and lamps shall be easily identified even in closed casings.
10. All the circuits from the detectors to the panels and the circuits from panels to the actuating/operating devices of the respective extinguishing system shall be of closed loop type and shall be supervised for open-circuiting and shortcircuiting of cables. The cable fault shall be audio-visually annunciated on the panels. Separate hooters with different tones shall be provided for 'fault' alarms and 'fire' alarms.
11. Actuate solenoid valve in spray system in case of fire from respective fire alarm panel. **For achieving this if any additional hardware is required like relays, power supply and cables, the same shall be provided.**

Analog Addressable Fire Detection and Alarm System shall also meet the following functional requirements:

- i. Each of the system shall support analog addressable detectors of all types, non-addressable type detectors / devices along with its addressable interface units / modules, **Video display units** etc.
- ii. Each of the devices and/or detectors shall be individually, uniquely and continuously addressable by the panel to which it is connected.
- iii. Detectors shall be interrogated for sensitivity settings from the control panel, logged for sensitivity changes indicating the requirement for cleaning and tested by a single technician using the field test routine. Sensitivity of each of the detectors made available in the panel shall be adjustable from the panel.
- iv. The system shall be capable of self-adjustment to compensate for the accumulation of contaminants that would change the detector sensitivity in either a more or less sensitive direction to prevent false indications or failure to alarm in the actual fire conditions. The system shall annunciate a trouble condition when any analog addressable smoke detector reaches 80% of its alarm threshold due to gradual contamination, signaling the need for service and eliminating unwanted alarm.
- v. Continuous supervision/monitoring of all the circuits and its components shall be made available from the panel for open, short circuits and grounding.
- vi. The system shall be able to recognize and indicate an alarm condition in a degraded mode of operation, in the event of processor failure or the loss of system communications to the circuit interface panels.
- vii. The system shall be programmable at site and required hardware shall be included in the scope of supply. The system software Programs shall be password protected and shall include full upload and download capability. During program upload or download the system shall retain the capability for alarm reporting. The system shall download to a OWS for program editing. The software shall be eligible for the Owner to add the spare loop provided in the fire alarm panel or addition of additional devices/detectors in and of loop in any of the fire alarm panel.

- viii. The system shall support the use of color interactive History Reporting video display terminal for the display of information in an appropriate format.
- ix. The system shall include software for system database, historical event log, logic and operating system. The system shall require no manual input to initialize in the event of a complete power down condition. It shall return to an on line state performing all programmed functions upon power restoration.
- x. Software logic modules and system database shall be programmable using a windows compatible program on OWS. It shall be possible to program or edit the system database off site after down loading from the panel.
- xi. All detectors shall incorporate internal automatic temperature compensation to overcome the effects of either high or low ambient temperatures in the installed environment on the detector sensitivity. The detectors shall be tested at a specified frequency by raising the detector sensitivity level to the alarm threshold, to check the operation of the detector without system alarming automatically by the control panel.
- xii. In an alarm or trouble condition the following shall occur on the monitoring station:
 - 1. Sound an audible.
 - 2. Write details of the actuation to a system log file on the OWS.
 - 3. Print the details of the actuation to the system printer.
 - 4. Activate the color graphic display system controls, providing functions such as zooming, scrolling of Alarms, troubles, etc.
- xiii. System configuration shall be menu driven and capable of being operated by a person with no previous computer programming experience.

Panel Display Requirements.

System display shall consist of minimum 80 character back lighted alphanumeric LCD display readable at any angle. Thirty-two character customer defined custom messages shall describe the location of the active device. In addition to the above, the following features shall be available.

- a. The system shall be capable of programming to allow troubles occurred and restored in the system to be automatically removed from the display queue, eliminating the necessity for individual acknowledging of these events. This feature shall not affect the historical logging of events as programmed.
- b. As a minimum an LED display for "Alarm", "Audible Silenced", "Supervisory", "Trouble", "Security", "Power On", And "Partial System Disabled".
- c. Touch activated membrane switches for "Alarm Acknowledge", "Audible Silence", "Supervisory Acknowledge", "Security Acknowledge", "Reset", "Display Hold", And "Display Next".
- d. All membrane switches shall be tactile with audible feedback when pressed.

SYSTEM SOFTWARE REQUIREMENTS

- i) The software shall control the operation, function and display of the graphic system and provide for automatic boot up and run from the hard disk drive of the computer.
- ii) All project specifics actuating device programming shall be capable of being carried out on site via password access.
- iii) The system shall monitor all alarm, supervisory; trouble and security conditions detected by the fire alarm control panel and provide separate disk based files, for each condition. These logs may be enabled, disabled, or cleared with password access. This log information is not to be lost upon power failure or fire alarm control panel reset. A utility file shall be provided to sort the log data by date or by device and display this information either on the screen or the system printer.
- iv) Selective memory storage up to 800 events, shall be stored in flash memory and displayed, printed or downloaded by classification for selective event reports.
 - a. Software shall allow selection of events to be logged, including; inputs as alarms, troubles, supervisors, securities, status changes and device verification; out puts, as audible control and output activation; action, as reset, set sensitivity, arm/disarm, override, password, set time and acknowledge.
 - b. Audible and visual indications shall be generated when memory is 80% and 90% full to allow downloading of data. The system shall be programmable circular logging, assuring that at least the last 400 events will always be stored in non-volatile memory.
- v) Software has driven logic for adjusting the alarm threshold windows on detectors to compensate for accumulating contamination and keep detector response sensitivity constant. The software shall compensate for either oversensitized or desensitized units, raising a system flag when a detector approaches the allowable limits of adjustment, indicating a requirement for cleaning.
 - a. Values shall be stored in non-volatile memory allowing activation of all tracking functions within 90 sec of system initiation from a "cold boot". During the boot sequence, alarms from detectors programmed with the feature shall be suppressed.

When the full data history is active all devices shall be checked and any active alarms displayed.

- b. The control panel shall place each detector in the system in an alarm condition, transparent to the system user, every twenty-four hours as a dynamic check of the accuracy of the alarm threshold setting. Upon reception of the alarm report, the system detector shall be restored to its pretest state.
- c. The system shall be capable of monitoring the stage of detectors and displaying a message when a detector is approaching the limits of adjustment as a result of contaminates. A second message

shall be displayed when the detector reaches the limits of adjustment due to these contaminate.

- d. The system shall be capable of recognizing that a detector has been cleaned, initiating a series of tests to determine if the cleaning was successful and display a detector cleaned message, readjusting that detectors normal sensitivity setting reference.
- vi) When an alarm or trouble is registered at the fire alarm control panel the graphics system shall display the first screen image for the first actuated device. The system shall be capable of zooming in for further information if required. At all times when in the alarm or trouble mode the fire control panel status i.e. number of current alarms and or troubles is to be displayed on the graphics screen.

Detection System for Coal Conveyors

- a. The LHS cable detector for each conveyor to be provided for both forward and return conveyors and shall be mounted as per the standard practice of the manufacturer/ supplier. The mounting arrangement shall be designed such a way that the same shall not hinder the normal operation and maintenance. Suspension of LHSC through flexible chains is a preferred arrangement. Further, LHS cable shall also be provided for return side of conveyors inside the bunker house.
- b. The detection zone/loop divisions of LHSC system shall match with the MVW spray system.
- c. Wet type QB detection system shall also be employed in addition to LHS Cable.
- d. Upon detection of fire either by QB detector or LHSC detector, the spray system shall be initiated. It shall also initiate spray system for the two adjacent zones after a time delay settable at site.
- e. The LHSC detector shall be provided with suitable interface unit, which shall generate/ make the signal compatible with fire alarm panel.
- f. The infra red type (IR) detectors shall be suitable for detecting moving fires in coal conveyors.
- g. The IR detector shall stop the conveyor upon detection of fire and give audiovisual annunciation locally and in fire alarm panel.
- h. The IR detector shall be outdoor type weather proof and shall be able to function continuously in heavily coal-dust prone atmosphere without regular maintenance.
- i. The IR detector shall be designed to reject deceptive phenomenon such as electric arc, heaters, artificial light sources (HPSV/LPSV/incandescent lamps etc.) Sunlight etc. while retaining the inherent detection characteristics.
- j. Each of the IR detectors shall be provided with its own purging arrangement using blowers, hoses, etc and required power supply shall be

derived from the fire alarm panel. Alternatively, bidder to each of the IR detector shall be provided by the bidder.

- k. The performance of the proposed IR detector model for detecting moving fires shall be demonstrated to Owner as per test procedure acceptable to Owner before supply of the same at site. Such demonstration test shall be conducted in a typical coal conveyor test set up at works or in a plant.
- l. Min two (2) Nos Solar Blind Infra-red detectors with inbuilt air purging unit as per specification shall be used in each coal conveyor gallery and tunnel for detection of moving fire.

Detection System of Cable Galleries

- a. In cable galleries, MVW spray system shall be actuated either by detection of fire by Linear Heat sensing cable detectors or by fire signal from smoke (after cross zoning) detection system. Apart from the automatic operation of spray system in the detected zone the adjacent two zones shall also be sprayed with water automatically after a set time delay simultaneously.
- b. LHSC detector shall run in a zig-zag fashion (with an included angle of minimum 90 degree atleast) in each of the top tray, bottom tray and in every alternate trays. Mounting arrangement of LHSC detector shall be as per recommendation/proven practice of manufacturer.
- c. The detection zone/loop divisions shall match with MVW spray zones.

24.4.8 Control and Instrumentation

For technical features and requirements of the control and instrumentation items including Field instrument, Panels and Panel mounted instruments, annunciators, PLC and other hardware and peripherals under scope of supply for the Fire water system, Bidder shall refer the relevant clauses of the Volume V – Instrumentation & Control Works

24.4.8.1 Battery and Battery Charger

24.4.8.1.1 Battery

- a) Battery to be located in FW Pump house shall be suitable to meet starting requirements of Diesel Engine driven pumps. Besides these all controls, indications, annunciations etc. (including multiplication of process interlock relays and auxiliary relays) shall have power supply from 24 V (2 × 12 V-2x100%) & Battery and Battery Charger unit(2x100%)
- b) Satellite Fire Panels are located strategically in the power. All controls, interlock, indication, annunciation system etc. for Fire Detection system shall have power supply from 24V (2x12V) Battery and Battery charger Unit. The Battery for each Satellite Fire Panel compatible with UL standard shall be located in the bottom portion of the same panel.
- c) All controls, interlocks, indications, annunciation system etc. for each of the Fire Detection and Alarm Panels (located in Central Control room) and the Repeater Panel (located in Fire Station), shall have power supply from 24 V (2x12V) 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 OWS with Printer in the central control room shall be powered up by the respective UPS Power of the Plant Instrumentation and Control System.

- d) 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.
- e) The Battery driven Power supply shall be available to local zonal fire panels, 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.
- f) 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 45°C and 8°C respectively.

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

24.4.8.1.2 Battery Charger

For design and construction of Battery Charger refer Volume : V

24.4.8.1.2.1 Layout of Battery & Battery Charger

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

24.4.8.1.2.2 Fittings & Accessories

Each battery shall be furnished with necessary accessories required.

24.4.8.2 Contact Rating and Contact Multiplication for Pressure Switch/Limit Switch of Valves

- a) Contact rating of 10 Amps. at 240V A.C. or 0.5 Amp. at 220V DC is required to operate different circuits. If the same rating is not available from process switch contacts of the fire protection system, suitable auxiliary contactor/relay shall be included in the offer and provided in the respective panels to get the suitable number of contacts which can meet the current rating stipulated above.
- b) Further if the number of the process switch contacts of Fire Protection System are not adequate to meet the requirement for "System of Operation", annunciation and monitoring system, the same shall be included in the offer and provided in the respective Panels to get the

suitable number of contacts which can also meet the current stipulated above.

24.4.8.3 Interlock Between "Fire Protection System" and Coal Handling Plant and Ventilation and Air Conditioning System

- a) In case of fire in any Zone of conveying system in coal Handling Plant, fire detector of that particular zone will operate at a preset value and an alarm will be annunciated in the Fire Alarm Panel located in Coal Handling Building. Simultaneously, the conveyor motor of the particular conveying system will be tripped automatically through IR Detector.
- b) In order to achieve this, "Detector Operated Digital Signal" will be generated in the Fire Panel by the Bidder (i.e. successful Bidder) with the help of auxiliary contactor/relay for interlock purpose to trip the conveyor motor. This signal shall be provided in the form of potential free (not changeover type) 1NO + 1NC contact combination for trip of each such conveyer motor.
The list of such inputs required shall be developed by the successful Bidder.
- c) In case of fire in a zone/area where ventilation fans and/or Air-conditioning Ducts are installed similar "Detector Operated Digital Signal" shall be generated in the nearby Fire Panel. This digital signal shall also be generated in the form of potential free (not change-over type) 1NO + 1NC contact combination with the help of auxiliary contactor/relay for automatic trip or closing of each such ventilation fan-motor, fire damper of ventilation fan/duct, damper motor of Air-conditioning duct, blower motor of corresponding Air handling unit & compressor motor of chiller unit.
- d) The list of such inputs required shall be developed by the successful Bidder.
- e) The auxiliary contactor/relay required as mentioned in clause nos. a) and b) above shall have 24V D.C. power supply system provided in the respective Fire Protection Zonal Panels.
- f) Number of contacts for the auxiliary contactor/relay shall be 4NO + 4NC. The contact rating of each such auxiliary contactor/relay shall be of 10 Amps. at 240V A.C. or 0.5 Amp. at 220V D.C.
- g) Since the false ceiling of above area shall act as return duct of Air conditioning and since roof extractor is used without any ducting arrangement for ventilation system, detectors for air conditioning duct and ventilation duct are not envisaged. If Ducts will be decided during detail engineering, the same shall be required.

24.4.8.4 Annunciation System

- a) A Board Sequence of Annunciation System shall be as per the following Table :

Status	Visual Display	Audio Signal
NORMAL	OFF	OFF

FAULT	ON WITH BLINKING	ON
ACCEPT	ON (STEADY)	OFF
NORMAL BEFORE ACCEPT	ON WITH BLINKING	ON
FAULT CLEAR BUT NOT RESET (after ACCEPT)	ON (STEADY)	OFF
RESET WHEN FAULT IS CLEARED	OFF	OFF
RESET WHEN FAULT IS NOT CLEARED	ON (STEADY)	OFF

- b) The detector zone connections shall be supervised to indicate fault condition in case of removal of one or more fire detectors from the detector base.
- c) All cabling between detector and the panel shall be supervised so as to indicate fault condition in case of open/short in detector cabling with a direct fault condition. The tone of this audio-alarm shall be distinct and different from that of zone wise fire alarm.
- d) The printed circuit cards provided for individual fire-zone shall be coated for prevention against corrosion. Gold plated connectors shall be provided for proper contacts.
- e) Separate set of "Accept", "Test" & "Reset" push buttons shall be provided for "Fault Alarm" and "Fire Alarm" systems.
- f) Each panel shall be provided with a hooter/buzzer, which shall have dual toners for differentiating the fire alarm with the fault alarm.
- g) Facility shall be provided for connection of external electrical hooter/gong, which shall be energised in case of fire alarm condition within any of the zones provided on the panel. The input for the hooter/gong shall be 24 Volt D.C.
- h) Fire Detection and Alarm Panels and Master Fire Alarm Panel shall also have "Fault Alarm" & "Fire Alarm" system. For this purpose potential free contacts shall be provided in the respective Satellite Fire panels for hook-up between Fire Detection and Alarm Panels/ Master Fire Alarm Panels and each Satellite Fire Panel.
- i) Each zone module shall have a facility for diagnostic check of all the related circuitry for their operation healthiness. The same shall be accomplished through the following push buttons :

a) Fire, b) Open, c) Short, d) Insulation level.

Fire proof sealing/Fire Stop/Fire Protection Coating System

The fire-proof sealing/fire stop system/fire protection coating system is required to prevent spreading of fire from one place to another (or one zone

to another) through the openings in wall/floor, cables laid in trays / racks and openings below Electrical Switchgear / MCC / Distribution Boards / Cabinets / Panels etc.

Fire-proof Sealing System

The material/components used for fire-proof sealing system shall be provided to meet the following requirements:

- a) Life expectancy should not be less than 30 years from the date of installation.
- b) Free from shrinkage or cracking or asbestos in composition and should achieve smoke and gas tightness during fire and should be modifiable.
- c) Not to generate toxic gas and harmless to the personnel handling the system.
- d) Prohibition of production of acid or alkali during gas generation.
- e) Will not produce suffocating/corrosive gas.
- f) Repellant to pest/ rodent/ termite.
- g) Expansion co-efficient - very low, which is to be comparable with masonry concrete.
- h) Not soluble/reactive to acid, water, alkali.
- i) Thermal conductivity - low.
- j) The material in contact with the cables in the fire-proof sealing system shall be compatible with the material used for outer sheath of cables.
- k) It should not have any adverse effect on the cables and should not alter the current carrying capacity of the cables.
- l) Retrofit in design to accommodate not less than 15% more addition of cables depending upon the size of cables, physically and chemically stable.
- m) Capable of withstanding vibrations, drop-loads, foot traffics, mechanical loads, etc.
- n) Non-hygroscopic, non-inflammable and shall not get affected over a period of time due to humidity, moisture and ozone etc. and should not contain volatile solvents which may cause a fire hazard during application.
- o) The fire rating shall not be less than three (3) hours and the system shall be stable after application of water jet in the exposed side in order to extinguish fire.

Fire Protection Coating to be Applied On Installed Cables

- a) The cables shall be coated with fire protection material of 2 mm dry thickness at the strategic locations as follows so as to limit the spread of fire:

- i) At fire stops in walls and floors on either side upto 500 mm length.
 - ii) At fire stops below Electrical Switchgears / MCCs / Panels / Cabinets etc. on one side coating of 500 mm length i.e. on the cable vault side/cable trench side.
 - iii) Length of 500 mm on all sides of the junction/crossing of cabling work in open cable routes/cable trench.
 - iv) In fire risk areas and where specified at suitable intervals as decided upon site conditions in open cable routes.
 - v) Where necessary and specified at site at intervals along cable routes in cable trenches.
 - vi) The coating shall be applied evenly on the cables only.
- b) The fire protection coating shall have the following properties / composition:
- i) Asbestos free, non-volatile, not eatable by vermin, harmless and non-irritant to skin of human.
 - ii) Not affecting the current carrying capacity of the cables and the properties of the installed cables.
 - iii) It shall delay fire damage to cables and prevent flame spreading meeting the requirement of IEC-332-1 & IEEE- 383.
 - iv) Coating material shall show no signs of cracking and peeling when the coated cable is bent to the radius of minimum 12 times the diameter of the maximum sized cable at 180°C.
 - v) The limiting oxygen index of the material shall not be less than 35% as per ASTM D-2863.
 - vi) Life expectancy equivalent to the cable installations.

The various openings in the cable vault, vertical / horizontal raceways of cables penetrating walls / floors and the bottom of Electrical Switchgears / MCCs / Distribution Boards / Cabinets / Panels shall be provided with fire stop systems. Cables passing through the openings at various locations are laid on various tiers of the cable trays/racks in the bunch formation. In case, for the purpose of installation of seal system, steel frames are required to be fabricated and fixed in the openings, the fabrication of frame and fixing of the same shall have to be done by the Bidder. The necessary steel section for fabrication of frames shall be supplied by the Bidder without any extra cost. Any, civil works required to be done in the openings shall be carried out by the Bidder. Bidder shall also include one set of tools and accessories required for addition or removal of cables after the seal is made. This shall include special tools, compound injection guns, spray guns, etc.

Power and Control Cables

Fire survival Power and Control Cables shall be of following types :

a) Power Cables

750V grade heavy duty mineral insulated copper sheathed copper conductor cable with outer covering of LSF material equivalent to BICC Fire Safe, conforming to BS:6207. The cables shall be rated for 950°C. for three hours and shall meet with requirements of CWZ class as per BS:6387. Minimum cross-section shall be 2.5 Sq.mm.

b) Control Cables (for fire detection)

Survival cables shall be similar to the above except that voltage grade shall be 500V in place of 750V. In addition the cables shall have high degree of immunity from electromagnetic interference. Minimum cross section shall be 1.5 Sq.mm.

FRLS Power and Control Cables**a) Power Cables**

1.1 kV grade 85°C. rating heavy duty power cable with stranded Aluminium/Copper conductors, HRPVC insulation, extruded PVC inner sheath, round wire armour and extruded FRLS PVC overall sheath. Minimum cross-section shall be 2.5 Sq.mm. Cu. and 16 Sq.mm. Al.

b) Control Cables

1.1 kV grade, 70°C. rating control cables with stranded copper conductor, PVC insulation, extruded PVC inner sheath round wire armour, overall extruded FRLS PVC sheathed. Minimum cross-section shall be 1.5 Sq.mm. Cu.

Instrumentation Cables

- a) Bidder to refer Vol. V, Chapter 9 for details of instrumentation cables. For any binary or Analog signals, instrumentation cables shall be used as per design criteria & guidelines specified in Vol. V, Chapter 9.
- b) In Fire Protection & Detection system, Loop wiring & Panel networking shall be designed meeting the NFPA Style 7 requirements.

24.4.8

CIVIL SUPPLY

- a) Design and construction of Fire Water pump house including foundation of fire water system equipments (viz, pumps & motors, diesel engine, compressor etc.)
- b) Excavation, preparation of bed and backfilling with compaction for laying underground pipelines and underground cables (where approved by purchaser).
- c) Construction of RCC valve chamber as required.

- d) Construction of shed for deluge valve, Booster Pump House as per specification. The shed shall be of masonry enclosed structure with minimum four inch (4") RCC Roof.
- e) Construction of pylon support including foundation for spray water ring and water circuit for detection of H.T. Transformer, Oil tanks etc.
- f) Design & construction of foundation of clarified/ fire water reservoir mentioned above.
- g) Adequate no. of staircases as per National Building Code (NBC) and TAC.

24.4.9 ELETRICAL, CONTROL & INSTRUMENTATION

Complete Electrical, Control & Instrumentation system for safe and reliable operation of the system shall be included as per design criteria & guidelines specified in Volume IV & Volume V.

- n) Fire stops/fire ceiling of two (2) hours rating at 750°C in wall/floors.
- o) Fire stops below switchgear / MCC / Switchboards, junction boxes / panels / cabinets etc. which are floor-mounted type.
- p) Fire retardant coating of thirty (30) minutes rating at 750°C to be applied for installed cables.
- n) Fire barrier / baffle wall in transformer yard, fire barriers for compartmentalizing the cable spreader rooms, fire proof door.
- q) Materials for fire barrier walls/baffle wall in Transformer Yard.
- r) Materials for fire barrier for compartmentalizing the cable spreader rooms.
- s) Materials for fire proof doors.

24.4.10 Fire station & other facilities

Fire station is to be provided with facilities to park fire tenders, fire control room, fire officer room, store, dormitory for fire staff etc. Repeater Master Fire Alarm panel is provided in the fire station to monitor and control the fire in power station. This panel is provided with audio-visual alarms regarding status of fire in different areas, status of deluge valves, repeat annunciations from main fire detection and alarm panel in unit control room, PLC based panel fire water control cum alarm panel in fire water pump house & in foam pump house.

Fire station building shall have provisions of all the equipments required for smooth O&M of fire personals as per statutory regulations and norms. Service water, potable water, clarified/fire water line for filling fire tenders,