E35. FIRE ALARM AND DETECTION SYSTEM

E35.1 General

E35.1.1 This Section specifies the scope of work, manufacture, supply, design and installation, testing, commissioning of the Fire Alarm and Detection System.

E35.1.2 The system shall be an intelligent addressable fire alarm and detection system. NFPA 130 shall be used as the guiding standard for the fire alarm and detection system for underground stations and the system shall be designed in an integrated manner in accordance with NFPA-72. For Elevated stations, Depots & RSS, NBC & IS 2189 shall be used as guiding standard and design of the Fire alarm System.

E35.1.3 **Scope of Work**

The scope of the work is to supply, installation, testing and commissioning of intelligent addressable fire alarm and detection system in compliance with codes and standard mentioned in this specification, Outline design Criteria and International best practices for all underground stations, elevated stations, Depots & RSS etc.

The Addressable Fire alarm system will comprise of the following:

- Micro-processor based Main Fire Alarm Panel
- Sub Alarm Panel/ Repeater Panel
- Addressable Multi-sensor Detector, smoke detectors, heat detectors, Duct detector , Beam detector etc.
- Addressable manual call points
- Addressable Hooter cum strobe (either addressable or made addressable through control module)
- Batteries and charger
- Electrical wiring, conduits, trunking and accessories
- Communication driver at the FACP for interfacing with the BMS
- Voltage free fire alarm signals through voltage free normally close contacts from the fire alarm system to the BMS and connecting cables between the fire alarm system and BMS for all interfaces.

The Addressable Main Alarm Panel will be minimum 4 loop for RSS/ Depots/Elevated Stations & minimum 8 loops for Underground Stations with a Loop capacity of minimum 250 devices/detectors as per manufacturer design and UL listing. The panel will be located in the station control room and will have LCD/LED alpha numeric display. PC based Workstation is required for event log of Main Fire alarm Panel only at underground stations.

The fire alarm panel will have the capability to process and evaluate incoming signals from addressable devices such as smoke detectors, heat detectors, duct detector, combined optical and heat detectors, beam detectors, manual call point and I/O modules etc. via Fire Survival Cables confirming to BS 7846:2009, BS 6387 CWZ having withstand capability of 3 hours at 950 deg C for UG stations and FRPVC insulated copper wires as per IS 694 in

GI conduits or FRLSH PVC insulated copper conductor cables as per IS1554 for elevated stations ,Depots and RSS. Fault isolators will be provided after every 20 devices.

The Fire Alarm System will be provided with input modules for interface with flow switches and relay module for interface with the BMS system and Output Module to Hooter cum strobe.

Fire Alarm System shall be capable of integration with:

- Public address and voice alarm system
- Stoppage to lifts to next determination level
- Stoppage of all Escalators
- Tripping of HVAC system
- Input signal from Fire Pumps operation status through pressure switches
- To provide signal for dis-alarming of AFC (automatic fare collection) gates
- To be seamlessly interfaced with SCADA system
- Audio and strobes signal to areas in the station building in case of alarm

E35.3 Technical and Installation Requirements

E35.3.1 Quality Control

E35.3.1.1 Provide equipment which are products of manufacturers who have made these products for a period of at least ten years, Complete System shall be the latest developed products which have been listed by UL. The system components such as control panel, detectors, line break isolator, response indicators, repeater panel, Mimic panel, modules, battery, Two-way Talkback System (Only for Depots) and all fire alarm devices shall be of the same manufacturer and under one family design duly approved/listed by UL. All Fixing accessories like back-boxes etc. shall either be the same manufacturer or of superior quality duly certified by OEM and approved by Engineer.

E35.3.2 Control Panel

E35.3.2.1 The fire alarm control panel (FACP) shall be multi-zone control panel of the intelligent analogue addressable type, complete with power supply, battery charger, batteries.

E35.3.2.2 The Fire Alarm Control Panel shall be located within the Station Control Room (SCR) or DCC, capable of interface with a Workstation for the Fire Detection & Suppression system. All the fire detectors, alarm devices and interfaces to other systems shall be connected via this panel.

E35.3.2.3 The FACP shall be analogue addressable in a lockable housing with illuminated function keys and capable of full “stand-alone” operation. The FACP housing shall be to a minimum protection rating of IP 54.

E35.3.2.4 The FACP shall be minimum 4 Loop for RSS/ Depots/Elevated Stations & minimum 8 loops for Underground Stations loop control panel with loops expandable feature for all stations and of intelligent addressable type with a loop capacity of minimum 250 devices/ detectors as per manufacturer’s design and UL listing complete with all alarm loop cards

and input / output control interface, at least 120 LCD/LED character display or greater, easily operable with acknowledgement, reset and silence facility.

E35.3.2.5 Detection devices shall be connected via loops with a maximum acceptable length of 1.2 km or suitable length as per NFPA/NBC (IS). The FACP shall have indicators for information, isolation (including device isolated), alarms and faults (including system fault, device fault, and external fault and processor fault).

E35.3.2.6 Activation of Manual call points or detectors shall be identified on the FACP identifying the loop number and detector address number including the associated Fire Alarm zone. This information shall be provided via a textual message on a separate screen integral to the FACP. Fire alarm panels shall be lockable with alarm/reset functions; On/Off controls and alarm disable controls. A facility shall be provided to allow operating access to authorized personnel. This shall be via key or password access.

E35.3.2.7 The FACP shall be self-checking and shall have the facility to identify faulty/ contaminated devices or system malfunctions such that faulty status/condition shall not be confused with fire alarms. The loss or failure of any detector or alarm device shall be identified and displayed within 60 seconds.

E35.3.2.8 The processor shall be capable of polling all field devices on a loop within three seconds.

E35.3.2.9 A facility shall be provided to isolate a single device on a loop or a group of devices on a loop on a temporary basis. An illuminated warning indication shall be provided on the FACP, which shall remain lit until the isolation is removed.

E35.3.2.10 The FACP shall have an integral clock, which shall be synchronized with the Station centralized clock system (provided by others). A facility shall be provided to allow for an external logging printer to be connected. The printer shall be located within the SCR. The station FACP shall be equipped with monitoring/relay points to relay status and alarm messages to the SCADA system.

E35.3.2.11 Relays points shall be provided for:

a) FAP healthy signal,

b) Fire alarm condition,

c) Fire zone of such alarm condition,

d) Fire condition link to PA automatic messaging,

e) Non-synchronizing clock.

E35.3.2.12 These relay signals shall be connected to the station communications equipment under the signaling and communications contract.

E35.3.2.13 FACP shall be capable of interfacing with other systems including but not limited to:

a) Ventilation Control System: The FACP shall send signals to the Ventilation Control Panel advising of zones in FIRE condition. The operation of dampers and fans etc. in the event of a fire in a particular zone/s shall be carried out by the ventilation control system,

b) Sprinkler Systems: The system shall monitor water pressure switches and valve tamper switches for wet stand pipes etc. as required. The FACP shall receive signals from the sprinkler flow switches to identify activation,

c) Clean Agent Based Panel & Transformer Flooding System: The FACP shall receive signals from the individual Gas suppression system control panels to identify activation of clean agent based panel/transformer flooding system.

d) FACP shall also interface with Public address and voice alarm system, lifts, Escalators, AFC gates, Electrical rooms, ECS, Fire pumps, SCADA system and all other systems as per requirement.

E35.3.2.14 The response to alarms from various combinations of the detectors, flow switches, or manual call points shall, via the dedicated microprocessor, shall be capable of initiating performance of such other functions as required like:

a) Alert Station staff,

b) Alert Line controller,

c) Initiate operation of Fire Suppression Equipment,

d) On confirmation of Station Manager, initiate operation of Automatic Public Address System message,

e) Release Smoke stop doors held open,

f) Allow any emergency exit fastenings to open on transmission of the Evacuation signal,

g) Initiate illumination of Station No – Entry signs on transmission of the Evacuation signal (via SCR and Telecommunications),

h) Initiate closure of Fire shutters,

i) Initiate smoke extraction measures.

j) Capable to initiate signal for operating any other emergency devices as per requirement.

E35.3.2.15 All detector and bell circuits shall be continuously monitored and a fault on any of these shall be indicated in the Main Fire Alarm Panel.

E35.3.2.16 The FACP shall be capable of control and monitoring of flow switches for Fire sprinkler system and control and monitoring of Gas suppression system.

E35.3.2.17 Each system shall provide at least 25 % spare capacity for future expansion.

E35.3.2.18 Access rights for Fire Alarm Control Panel with all necessary Hardware & Software to be provided to DMRC for any change, addition/deletion or modification in the system. The access shall be unconditional and manufacturer to provide necessary support to DMRC including training to DMRC personnel for the same. Any hardware required for software access shall be a part of the system without any cost implication and without any requirement for periodic renewal. The manufacturer is required to provide all software upgradations free of cost to DMRC during the entire life of the product.

The installation and commissioning of the FACP shall be done by manufacturer or their approved channel partner. The manufacturer will also be required to ensure overall supervision of the fire detection cabling and detector/ device fixing works.

E35.3.3 Battery Charger and Batteries

A 24 V DC trickle type battery charger and batteries shall be provided. The unit shall incorporate Trickle charger assembly, Rotary type selector switch, Suitably rated fuse,

Sealed Maintenance Free battery as per UL listing, Rectifiers and DC output voltage stabilizer as required.

The unit shall be suitable for use on a 240 V AC single phase power supply and shall automatically maintain the 24 V DC batteries in a state approximate to full charge and at the same time to compensate for the standing load. The charger shall cater for re-charging the battery from fully-discharged condition to fully-charged condition in not more than 24 hours.

Battery shall be of sealed maintenance free battery as per UL Listing requiring no maintenance throughout the normal life of the battery and shall be of capacity capable of maintaining the system in normal working condition for at least 48 hours without recharging and subsequently operating in the "alarm" condition continuously for at least one hour.

E35.3.3.4 72 hours back up shall be provided to the indication lamp of the “sprinkler power loss”.

E35.3.3.5 In selection of battery capacity, a deterioration factor of 0.9 minimum shall be applied.

E35.3.4 Break-glass Units / Manual Call Point

E35.3.4.1 Manual call point shall comply with NFPA/NBC(IS) and shall be UL approved/listed. They shall be addressable type and shall be arranged to operate automatically upon pressing call point switch. The cover shall be locked in position with a special key and the glass panel shall be clipped firmly into place. It shall be manufactured in bright red compliant material, measuring 85 x 85mm with 50mm overall depth or as approved/required by engineer. Operation shall be via a plastic membrane (non-breakable) with wording on method of operation in white lettering. The cover shall be etched in black lettering in Hindi and English “FIRE”, the letters measuring not less than 10mm high.

E35.3.4.2 The surface of the Manual call point shall be provided with a LED indicator. It shall light up upon activation of the Manual call point. The operation of any call point connected to the system shall cause the station FACP to enter the alarm state within three seconds.

E35.3.4.3 Contacts shall be of silver or approved non-deteriorating alloy, for normally close/open system. The voltage and current ratings of the contacts shall be marked within the unit.

E35.3.4.4 The units shall be of the flush mounting type and suitable for direct connection to the type of wiring system therein specified without the addition of unsightly surface boxes, glands and adaptors. Special boxes compatible with the conduit system shall be provided where necessary for installation of the call points.

E35.3.4.5 Manual call point shall be positioned at a height of 1.2m or as per NFPA/NBC(IS) at strategic points throughout the station such that they are clearly visible from front and sides as practicable and Manual call point shall be located so that one is within 60 meters of any point in the station. At every entrance and in public areas manual call point at

distance of 60 mtr or as per NFPA/NBC(IS) have to be provided. Provide flush plates for the recess mounting units.

E35.3.4.6 The alarm bells and flashing light units shall actuate upon receipt of a fire alarm signal from any of the Manual call points or detection systems.

E35.3.4.7 Manual call points installed outdoor shall be of weatherproof type complying with IP66.

E35.3.4.8 Each Manual call point shall be complete with built-in testing slot, such that testing can be carried out by insertion of the test key without removing the glass front cover of the unit

E35.3.5 Detectors with associated base

E35.3.5.1 General

a) Unless otherwise specified, smoke detectors shall be of multi sensor type.

b) Detectors shall be UL listed, multi-sensor. The internal circuits shall be of solid state device and shall be hermetically sealed to prevent their operation from being impaired by dust, dirt, humidity, corrosion or mechanical shock. All circuitry shall be protected against typical electrical transients and electromagnetic interference.

c) Each detector shall carry a built-in address.

d) There shall be a built-in magnetic test/any other mock test facility in each intelligent device.

e) Built-in testing facility shall be provided based on NFPA 72.

f) The detector base shall have a positive mechanical means to hold the removable portion of the device. However, such provision shall provide a simple means to remove the detector from the base, either by hand or by the use of a special tool that can plug-in and/or remove the detector head from a distance of up to 6 m above floor level. Required tool to be provided by vendor (one for each station / Depot / RSS).

g) Detector base shall be compatible for connection of all types of analogue addressable detectors and shall have the facility to drive a remote visual alarm indicator which shall be provided for all concealed detectors. Remote indicator shall be compatible with the detector so that the operation of the indicator will not impair or affect the brightness of the detector's built-in LED.

h) There shall be LEDs on the detector head so that alarm condition of the detector can be seen clearly from any direction or angle.

i) The designed operating range of detectors shall be between 0^{o}C and 50^{o}C and up to 95% RH non-condensing or as per NFPA/NBC(IS).

j) There shall be at least 3 levels (high, medium and low) of sensitivity, as approved by the agency listed or by Delhi Fire and Emergency Services, which can be selected at any time at the FS control panel or by automatic day/night sensitivity change over program which shall be built into the FS control panel.

k) Detector shall be low profile, no more than 60mm in height or as approved by Engineer including the base to minimize dust accumulation at detector head, resulting from the pattern of airflow.

l) The remote indicator with labelling shall be provided for all detectors installed above false ceiling as specified in clause (g) of this Specification.

m) Labels shall be provided adjacent to all detectors with appropriate letters indicating the corresponding address.

E35.3.5.2 Multi-Sensor Detectors

a) The multi sensor detector shall be a microprocessor based and operate on light scattering principle, containing an emitter and photo sensor. The scattered light reaching the photo sensor shall be proportional to the smoke density inside the detection chamber. It will combine both optical smoke and heat detector technology to detect clear burning fire products, which hitherto could only be easily detected by ion-chamber detectors. The detectors will not operate on a rate of rise of temperature alone. It shall be UL listed.

b) The detector shall utilize advanced algorithms with time based analysis to provide early warning and an accurate analysis of alarm situations.

c) Under normal ambient conditions, the optical detector will behave as a normal optical detector. Only when a rapid rise in temperature is detected, the sensitivity of the detector shall increase together with the presence of smoke shall confirm a fire condition, which will be transmitted as a fire alarm level.

d) The detector will be fully compensated for temperature, humidity and barometric changes in the environment. All electronic components shall be hermetically sealed to prevent their operation from being impaired by dust, dirt, humidity, corrosion or mechanical shock. All circuitry must be protected against typical electrical transients and electromagnetic interference. The detector will be fully operable between -20^{o}C and + 70^{o}C and up to 95% relative humidity non-condensing or as specified by NFPA/NBC(IS).

e) The Sensitivity shall be adjustable by means of a pre-set control only accessible by use of a special tool. Built-in wind-shields will be provided to ensure that air velocity of up to 10 meters / second do not affect the proper operation of the detector. The Combined Optical smoke & Heat detectors will be installed in the Mechanical Plant room areas.

E35.3.5.3 Heat Detectors

a) Heat detector shall be an analogue addressable type designed to raise an alarm when the temperature is at a rate-of-rise of 8 °C per minute or higher or at a fixed alarm temperature of 57 °C. It shall be UL listed and Delhi Fire and Emergency Services approved.

b) The detector shall employ two matching thermal sensing elements in a bridge configuration to give a response, which depends both on absolute temperature and rate of change of temperature. The reference and sensing thermal sensors

shall be fabricated under identical conditions to ensure good matching and tracking with both temperature and ageing.

E35.3.5.4 Probe Type Smoke Detectors

a) Probe type smoke detectors shall be UL listed and installed in the supply or return air duct of all AHU/ PAU and ventilating fans as stipulated in the relevant Specification, and/or as shown on the Drawings.

b) Installation details shall comply with NEMA and NFPA standards for UG Stations & NBC(IS) for Elevated stations, Depots & RSS.

c) An audible and visual alarm signal shall be provided at the Station Control Room of the respective station which upon receipt of a signal from the probe type smoke detector shall initiate the audible and visual alarm on the FS control panel and shut off the corresponding ventilating fans, fan units of the AHU and/or fan units of PAU.

d) Detectors shall be supplied with multi-sensor or photo-electronic detector heads and complete in all respects with all required components and accessories.

e) Each smoke probe unit shall comprise a perforated inlet tube across the inside of the duct at 90^0 to the air flow and an expansion chamber containing an ionization or photo-electronic smoke detector.

f) The smoke probe unit shall contain a clear polycarbonate cover for convenient visual inspection.

g) The smoke probe units shall be either of the same addressable analogue type or conventional type ionization/photoelectric smoke detectors as specified with a suitably designed duct adapters. The whole assembly shall be suitable for monitoring air movement of up to 25 m/s.

i) The complete assembly (smoke detector with duct adapter) shall be supplied as a single unit.

j) Connection of remote indicator shall be also available and compatible with the smoke probe unit so that the operation of the indicator shall not impair or affect the brightness of the detector's built-in LED.

E35.3.5.5 Hooter cum Strobe (either addressable or made addressable through control module)

a) All the areas of Underground station, elevated station, depot & RSS shall be provided with sounder cum visual strobe units rather than public movement area. Public movement area shall be provided with strobe unit.

b) The unit shall be wall mounted, approved color, suitable for operation on 24V with following features.

c) Visual Characteristics: The visual strobe shall consist of Xenon flash tube with associated lens / reflector. The feature selectable candela outputs (15, 15/75, 30, 75 or 110). The flash rate shall not exceed two flashes per second (2Hz) and nor less than one flash per second (1 Hz) throughout the listed operating range of appliances or as per NFPA/NBC(IS) and UL.

d) The light pattern shall be disbursed so that it is visible above and below the strobe and from a 90 degree angle on both sides of the strobe.

e) Sounder pulse rate and decibel level above the ambient shall comply with NFPA/NBC(IS) standards. The unit shall be tapped for 1/4, 1, 2 and 4 watts outputs.

f) Strobe shall be placed wall mounted in corridors no more than 4570 mm (15 feet) from the end of a corridor with 30.48 m (100 feet) maximum distance between strobes or as per NFPA/NBC(IS). Where there is an obstruction to the viewing path in the corridors, such as a cross-corridor door or ceiling elevation change, consider the obstruction as defining a new corridor.

Strobe Unit

a) Visual Characteristics: The visual strobe shall consist of Xenon flash tube with associated lens / reflector. The feature selectable candela outputs (15, 15/75, 30, 75 or 110). The flash rate shall not exceeds two flashes per second (2Hz) and nor less than one flash per second (1 Hz) throughout the listed operating range of appliances.

b) The light pattern shall be disbursed so that it is visible above and below the strobe and from a 90 degree angle on both sides of the strobe.

c) Strobe shall be placed wall mounted in corridors no more than 4570 mm (15 feet) from the end of a corridor with 30.48 m (100 feet) maximum distance between strobes. Where there is an obstruction to the viewing path in the corridors, such as a cross-corridor door or ceiling elevation change, consider the obstruction as defining a new corridor.

Flashing Light Units

(a) Flashing light units shall be of flush mounted pattern complete with red indicating lights.

(b) Each unit shall consist of one tungsten bulb and shall be fitted with all necessary flashing and control provisions. The unit shall be suitable for 24 V DC operations.

(c) The dimensions, construction and design details of the unit shall be in accordance with section 6-4 of NFPA 72 or other standards as acceptable to Delhi Fire and Emergency Services.

(d) Flashing light unit installed outdoor shall be of weatherproof type and shall be designed to IP55 or better.

E35.3.7 Fire Alarm Cables

E35.3.7.1 For underground stations Detector cable loops shall be fire survival screened cables complying with BS 7846:2009, BS 6387 CWZ for underground stations and it shall be “Class A” wiring as per NFPA 72. The Contractor shall submit calculation on the overall current consumption and voltage drop in each detection loop in normal and alarm condition to substantiate their equipment selection.

E35.3.7.2 All detection loops/network wiring shall be minimum size of 1.5mm^2 copper conductor, twisted pair, screened, fire survival cables complying with BS 7846:2009, BS 6387 CWZ having withstand capability of 3 hours at 950 deg C.

E35.3.7.3 All 24V DC power supply lines shall be minimum size of 2.5mm^2 conductor, twisted pair screened fire survival cables complying with BS 7846:2009, BS 6387 CWZ having withstand capability of 3 hours at 950 deg C .

E35.3.7.4 For elevated stations/Depots/RSS, cabling to be FR PVC insulated wires as per IS 694 in GI Conduits or FRLSH PVC insulated cables as per IS 1554 with copper conductors of cross section 1.5 sqmm or above as per BoQ .

E35.3.8 Interfacing Relay Module

E35.3.8.1 Signals to control other systems by means of dry contacts shall be equipped with a 24V DC relay, with dry contact rated at not less than 2A 240 VAC. The relay and terminal block shall be housed in a covered galvanized steel or stove enamel steel box with adequate size to house all relays but in no case smaller than 110mm by 100mm by 50mm or as approved by engineer. Terminals shall be labelled clearly by means of silk screened or engraved lettering in metal or plastic plate.

E35.3.9 Workstation & Printer (Only for Underground Stations)

The workstation shall be 21 inches LED monitor and appropriate with latest configuration printer with software. Intel core i7 Processor with 3.0 GHZ or higher, 4 GB RAM or above, 1 TB SATA HDD, Integrated Sound & Graphics Media Accelerator, optical scroll mouse , multimedia keyboard ,52x DVD Read / Write, Dual LAN card, 2 Serial port, 1 parallel port, 4 USB Ports, All hardware driver as required for smooth operation, Windows 7/XP 32 bit Desktop preloaded operating system with standard MS Office package, & along with latest antivirus version with updated security pack and minimum 3 year product licence validity, Auto recovery and auto archive software and suitable for operation on 230 volts A/C. 50 Hz,

A hard copy multi-colour graphics laser printer for recording graphic displays and associated dynamic data having Print speed - Black: up to 20 ppm; colour: up to 4 ppm, First page out - 18 seconds black, 29 seconds colour, Resolution - 600 by 600 dpi, Memory - 64 MB built-in SDRAM; expandable to 192 MB with one open memory SDRAM DIMM slot, Duty cycle - 30,000 pages per month, Media, Types Paper (plain, letterhead, bond, colour, rough, pre-printed, recycled), Glossy Media, Cover Paper, Colour LaserJet Transparencies, labels, envelopes, and card stock, Compatibility - Interfaces Hi-Speed USB 2.0, IEEE 1284-B complaint parallel port, Languages - PCL 6 and Postscript level 3 emulation with automatic language switching, Font capabilities - 80 True Type TM internal scalable PCL 6 fonts; 80 True internal.

E35.3.10 Monitor Modules

E35.3.10.1 Addressable contact monitoring module shall communicate via the detection cable loop with the FA control panel for continuous monitoring of any NO or NC dry contacts connected including break glass, flow switch and repeating dry contact signals from gas flooding system and gas detection system. LED indication shall be provided to show the status of the module.

E35.3.11 Control Modules

E35.3.11.1 Control module shall provide an addressable output for a separately powered alarm indicating circuit or for a control relay and housed in covered galvanized steel or stove enamel steel box with sufficient size to house all modules.

E35.3.11.2 The control module shall provide a supervised indicating circuit where indicated on the Drawings. Any open/short circuit fault shall be detected/highlighted/displayed at the FA control panel. Subsequent fire alarm signals shall activate the appropriate controls and signaling devices despite of the fault conditions.

E35.3.11.3 The control module shall act as a control relay where required.

E35.3.11.4 The control module shall contain a LED which blinks upon being scanned by the FA control panel. Upon activation of the module, the LED shall be latched on.

E35.3.11.5 Status of control module shall be fed back to FA control panel and print out automatically once it is activated.

E35.3.12 Fault Isolator Modules

E35.3.12.1 Fault isolator modules shall detect and isolate a short-circuited segment of a fault-tolerant loop.

E35.3.12.2 The module shall automatically detect a return-to-normal condition of the loop and restore the isolated segment.

E35.3.12.3 Modules shall be provided for every 20 field addressable devices to limit the extent of devices affected in the event of a short-circuit. A minimum of two fault isolator modules shall be provided for one detection line loop.

E35.3.13 Repeater Panels

E35.3.13.1 Remote repeater panels for repeating all alarm status indication with LCD display shall be provided at the specified location and shall be Delhi Fire and Emergency Services approved.

E35.3.13.2 The repeater panel shall be fully stand-alone complete with power supply, charger/batteries. The Repeater Panel will have its own micro- processor, software, and memory capabilities and provide indication for alarmed and troubled/faulted condition in each loop. All software (i.e. Programs and data system configuration) will be held in non-volatile ROM / EPROM.

E35.3.13.3 The repeater panel shall be provided with warning buzzer which shall activate when an alarm occurs in the fire control room and a push switch shall be provided for silencing the warning signal. Lamp test control switch shall also be provided in the panel.

E35.3.13.4 The panel shall contain an integral backlit LCD display of minimum 120 characters as per this Specification. LCD display shall be viewable through the panel door.

E35.3.13.5 The repeater panel enclosure shall be flush mounted and all electronics shall be contained in the enclosure. Access to the repeater panel switches shall be protected by key-switch.

E35.3.13.6 The panel construction shall be as per Specification. One repeater panel has to be provided at each firemen’s staircase.

E35.3.14 Fire Zone Mimic Panel

E35.3.14.1 An LED Fire Zone Mimic Panel shall be located in the Firemen's Staircase adjacent to the auxiliary FAP.

E35.3.14.2 This panel shall provide a pictorial representation of the Station Layout identifying the zone boundaries and is intended to aid the fireman in the identification of the area of the station in fire condition.

E35.3.14.3 In the event of a detector in a particular zone going into fire condition the associated Zone LED shall illuminate on the mimic panel.

E35.3.15 Response Indicator

Response indicator of LED type shall be provided for above false ceiling and below false floor detectors and these shall be mounted outside/ inside the rooms wherever asked for by the Contractor/Employer representative for indication of fire through detector in the room. The design & colour shall be as per the standard.

E35.3.16 In RSS, for areas with room height more than 5m, UL listed beam detector to be provided and integrated with the main fire alarm system of RSS.

E35.3.17 Aspiration based Fire Detection System

For areas in Stations/RSS/Depots etc. where ceiling height is very high i.e. double height & triple height areas, aspiration based Fire Detection system may be provided.

Aspiration system shall be UL Listed with UL Listed Power supply having in-built battery back-up. Aspiration system shall be integrated with the mail Fire Alarm Control Panel.

Pipe, Hole & System design calculation duly vetted by manufacturer shall be submitted for approval.

The entire installation shall be as per relevant NFPA guidelines.

E36. Clean agent gas based high temperature polymer tube based protection system

E36.2 CLEAN AGENT BASED FLOODING SYSTEM FOR ELECTRICAL PANEL PROTECTION

E36.2.1 General

E36.2.1.1 The scope covers Supply, Installation, Testing and Commissioning of Automatic clean agent based Flooding System complete for electrical panels with flexible fire detection tubing, cylinder, valves, integration with Main Fire Alarm Control Panel for status monitoring etc. The scope of work includes, but not limited to the following

- Providing Direct Panel Gas Flooding System with flexible fire detection/ discharge tubing inside the panels.
- Clean agent storage cylinder for flooding gas inside the panels.
- Audio-visual annunciation devices for indicating incidence of fire.
- Any other item required to the successful commissioning of the system.

E36.2.1.2 The electrical panel fire suppression system shall be complete with Direct Clean Gas storage cylinders for required capacities, extinguishing agent as specified, fire detection tubing, filling and end-of-line adaptors, pressure switches, control equipment, Clean Agent Cylinder/Valve Assembly, Cylinder Mounting Bracket and all necessary accessories to protect the Electrical panel in case of fire. The system will have an interface with Main Fire Alarm and Control Panel. In case of fire in the concerned Panel, indication of Fire / discharge status should come in Main Fire Alarm and Control Panel. System Provider/Vendor has to submit authorization for use of clean agent/gas from the manufacturer.

E36.2.2 Design Requirements

E36.2.2.1 All the detecting devices, alarm, indicating devices, containers and other related equipment shall have required approvals & Authorization.

E36.2.2.2 All installations shall conform to NFPA requirements.

E36.2.2.3 Clean Agent should be used with below mentioned properties

(a)The Clean Agent should have Zero Ozone Depletion Potential. (ODP = 0)

(b) The Clean Agent should not have Global Warming Potential of more than 1.

(c) The Clean Agent should be a low pressure agent.

E36.2.3 System Equipment

E36.2.3.1 Tubing should be UL Listed.

The tubing shall be installed throughout the Electrical Panel with one end connected to the top of the Clean Agent container valve. The tubing shall be pressurized with Dry Nitrogen to 150 psig and maintains the system in the “OFF” position. The tube shall burst at temp. 100-120 degree C. The tubing shall perform three functions:

Heat Detection, System Activation and Clean Agent discharge.

E36.2.3.2 Clean agent Container

- Design, fabricate, certify and stamp containers in accordance with the requirements of NFPA (DOT). Containers shall be standard model and size of ease of replacement and addition.
- Each storage container shall be equipped with a nickel–plated brass valve, a pressure gauge to monitor container pressure, and a quarter-turn ball valve that interfaces with the detection tubing. The quarter-turn ball valve shall be kept closed at all times when the container is not in service.
- All container valves shall be equipped with a pressure relief valve (rupture disc) device in compliance with DOT requirements.

E36.2.4 Technical and Installation Requirements

E36.2.4.1 Provide sufficient amount of Extinguishing Agent to Inert the Micro environment being protected considering the following when computing volume to verify suitability and to establish design limitations:

- Volume of hazard area.
- Specific volume of Clean Agent.
- Discharge time and flow rates.
- Design concentration and design factors.
- Detector/discharge tubing placement.

E36.2.4.2 Interface system with main control fire alarm system and BMS.

E36.2.4.3 All doors and holes in the enclosed/equipment should be closed or sealed to maintain the tightness of enclosure.

E36.2.4.4 The clean agent based Pre-Engineered automatic direct fire suppression system shall be with required approvals & Authorization.

E36.2.4.5 Each clean agent pre-engineered automatic system is equipped with its own detection/discharge tubing. Vendor to submit detailed drawings & calculations based on NFPA & Specifications for Approval.

E36.2.4.6 The unit shall be a self-contained and shall be equipped with its own non-electric automatic detection system to detect the fire and agent release system into the Electric panel to suppress the fire.

E36.2.4.7 The Clean Agent is stored in DOT steel cylinders as a liquefied compressed gas, super-pressurized with Dry Nitrogen to 150 psig at 70oF. The ambient operating temperature range for all system components should be 0 degree C to 54 degree C.

E36.2.4.8 Each container is equipped with a nickel–plated brass valve, a pressure gauge to monitor container pressure, and a quarter-turn ball valve that interfaces with the Detection Tubing. In addition, the container valve shall be equipped with a pressure relief (rupture disc) device in compliance with DOT requirements.

E36.2.4.9 Provide wall-mounted painted steel bracket to mount the container/valve assembly in a vertical (upright) position. Each bracket should be equipped with at least two integral quick-clamp straps as per manufacturer standard practice.

E36.2.4.10 Install equipment as indicated on the approved shop drawings, and in accordance with requirements of NFPA-70 and NFPA-2001.

E36.2.4.11 All the necessary accessories required for operation of system shall be part of supply from single Manufacturer and the complete system shall have proven track record and International Third Party Approvals like UL, FM or any other reputed certification.

E36.2.4.12 The installation and commissioning of the system should be by Manufacturer or their authorised channel partner. The final connections between equipment and system detection tubing should be under direct supervision of factory trained and certified representative of manufacturer.

E36.2.4.13 It shall be so designed that it does not affect the IP ratings of electrical panels. The Sub-Contractor has to coordinate with manufacturer of electrical panels for provision of holes to run the tube and brackets for mounting the tube. The entry of tube inside the panel shall be through suitable size of connector.

E36.2.4.14 The tubing shall be manufactured from specially processed polymer material to achieve the desired heat detection and delivery characteristics. Provide minimum two runs of fire trace tube along with any two sides of every compartment of the panel.

E36.2.4.15 The tubing shall be capable of working even when contaminated with oil, dust and debris as long as the contamination will allow the heat to pass through the tube.

E36.2.4.16 Distribution of Detection Tubing shall be ensured in each compartment of the Panel viz. Busbar Section, Switchgear Section and Cable Alleys etc. with routing on any two sides. Mounting/ installation of the detection tube to be as per manufacturer design.

E36.3 CLEAN AGENT BASED FLOODING SYSTEM FOR TRANFORMER ENCLOSURE PROTECTION

E36.3.1 General

E36.3.1.1 The scope covers Design, Supply, Installation, Testing and Commissioning of Automatic clean agent based indirect fire suppression system for Dry Type Transformer enclosure complete with storage cylinders, in-direct valves, detection tubing as per NFPA-2001 including its safety guidelines with respect to “Hazards to Personnel”, electrical clearance and environmental factors. The scope of work includes, but not limited to the following

- Clean agent storage cylinder**.**
- Fire detection tubing and spray nozzles
- Manual discharge facility
- Interface with Fire Alarm System & BMS.
- Any other item required to the successful commissioning of the system

E36.3.2 Technical and Installation Requirements

E36.3.2.1 The system shall be a clean agent pre-engineered automatic indirect Fire Suppression System and shall be UL/FM Approved products and approval by Local Fire Authority.

The installation and commissioning of the system should be by Manufacturer or their authorised channel partner. The final connections between equipment and system detection tubing should be under direct supervision of factory trained and certified representative of manufacturer.

E36.3.2.2 The system shall be self-contained and have its own non-electric automatic detection system, which when actuated shall automatically release the suppression agent into the transformer cabinet.

E36.3.2.2 Interface system with BMS.

E36.3.2.3 The system shall be complete in all respects. It shall include agent storage container, detection tubing, discharge nozzles, fittings manual release, abort stations, audible and visual alarm devices, and any other operations necessary for a functional Clean Agent suppression system.

E36.3.2.4 The System shall detect, control and extinguish the fire and also simultaneously give audio visual indication on the control panel.

E36.3.2.5 Storage containers shall be located as near as possible to hazard area but shall not be exposed to fire.

E36.3.2.6 Storage containers shall be carefully located so that they are not subjected to mechanical, chemical or other damage.

E 36.3.3 System Operation

E36.3.3.1 The system must operate automatically and its operation shall be as per following sequence

When the temperature of detection tube installed inside the Cabinet will increase to above 100 degree C or the detection tube comes in the direct contact of flame, the tube shall burst and initiates ILP Valve which allows the diffusion of extinguishing medium which is Clean Agent gas through strategically placed pipes & nozzles.

E36.3.3.2 The system shall be designed for In Direct discharge of extinguishing agent through the pipes and nozzle when the tube rupture occurs. The diameter of tube for indirect discharge shall be as per calculations and manufacturer recommendations but shall not be less than 6mm under any condition.

E36.3.3.3 The Contractor shall carry out the calculation and appropriate fill density to be arrived at basis of the same. Vendor to submit detailed drawings & calculations based on NFPA & Specifications for Approval.

E36.3.3.4 The design & calculation shall be checked & certified by manufacturers trained design engineer. The calculation is the only guarantee that the system shall work, provided the system is installed exactly as per the design.

E36.3.3.5 These documents shall be prepared by a fully experienced person and qualified in the design of gas based fire suppression system.

E36.3.4 Equipment Specifications

E36.3.4.1 Cylinder

- Design, fabricate, certify and stamp containers in accordance with the requirements of NFPA (DOT). Containers shall be standard model and size of ease of replacement and addition.

E36.3.4.3 Discharge Hose

- The Discharge Pipe should be high pressure braided hose with heavy duty adopters. The nozzle should be made of Brass/Gun Metal and should have 180 degree discharge pattern.

E36.3.4.8 System and Detection Tube

- The System will be UL/FM approved product
- Clean Agent should be used with below mentioned properties
- The Clean Agent should have Zero Ozone Depletion Potential. (ODP = 0)
- The Clean Agent should not have Global Warming Potential of more than 1.
- The Clean Agent should be a low pressure agent.

The detection tube shall be manufactured from specially processed polymer material to achieve the desired heat detection and delivery characteristics. The tube shall be capable of working even when contaminated with oil, dust and debris as long as the contamination will allow the heat to pass through the tube.

DETAILS of PANELS IN WHICH SUPRESSION SYSTEM IS TO BE PROVIDED: The following is an indicative list of Panels for providing Fire suppression system -

S. No.	Underground Stations	Elevated Stations	Depots	RSS
1	DB-100/200	MDB (Main Distribution Board)	Main & Emergency Panels in Depot Sub-Station	33KV MV Panel
2	DB-110/210	EPP (Essential Power Panel)	Main & Emergency Panels in Fire Pump Room	ACDB, DCDB,Battery Charger
3	DB-120/220	FPP (Fire Pump Panel)	Main & Emergency Panels in DCC Building	Dry type Transformer
4	DB-150/250	33 KV MV Panel	33KV MV Panel	
5	DB-151/251			
6	DB-111/211			
7	DB-155/255			
8	DB-Lift-ATS			
9	DB-UPS-ATS			
10	DB-180/280			
11	DB-290			
12	DB-260			
13	DB-WTP			
14	DB-MTP			
15	DB-APFC			
16	DB-130/230			
17	DB-140/240			
18	DB-170/270			
19	DB-310			
20	DB-330			
21	DB-131/231			
22	DB-132/232			
23	DB-Cap-130/230			
24	DB-Cap-170/270			
25	DB-Sync Panel			
26	Transformer			

E36.3.4.9 Control Box - Every unit of Panel/Transformer flooding system has to be provided with a Control Box for giving Audio/Visual Alarm and interface with panel/Transformer flooding system for accepting gas release signal and further relay of the same to FACP. The control box enclosure

shall be at least IP 54. Wiring of the Control Box shall be FS type as per BS 6387 for Underground Staions / FRPVC as per IS 694 and shall be minimum 2.5 sqmm. The control box shall be fire red in colour having 2mm thick CRCA sheet with powder coated finish. The unit shall contain indication for System Healthy, Mains Healthy and Gas Release. The unit shall also have signal silence button. All components such as Hooter, Strobe, Indication Lamps, Chip shall be of superior make subject to approval by Engineer. Third party test reports for IP and Functionality of the system to be submitted before approval. The system shall be supplied and certified by OEM of the flooding system or their authorized vendor.