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SPECIFICATION
FOR

AUTOMATIC FIRE DETECTION & ALARM SYSTEM FOR SIGNALLING &TELECOMINSTALLATIONS

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Abstract SPECIFICATION FOR AUTOMATIC FIRE DETECTION & ALARM SYSTEM FORSIGNALLING&TELECOMINSTALLATIONS		

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0.0 FOREWORD

0.1 This specification is issued under the fixed serial number followed by the year ofadoption as standard or in case of revision, the year of latest revision.

0.2 This specification requires reference to the following specifications:

IRS: S: 23	Electrical signaling and interlocking equipment
RDSO/SPN/144	Safety and Reliability requirement of electronic signaling equipment
IS: 2175	Fixed Heat sensitive fire detector for use in automatic fire alarm system
IS: 11360	Smoke detectors for use in automatic electrical fire alarm system
IS: 2189	Selection, Installation and Maintenance of automatic fire detection and alarm system- code of practice
IS: 2190	Selection, Installation and Maintenance of First-Aid Fire Extinguishers-Code of Practice
IS: 2878	Fire Extinguisher, Carbon Dioxide Type (Portable And Trolley Mounted) — Specification
NFPA 72	National Fire Alarm and Signaling Code
NFPA 76	Standard for the Fire Protection of Telecommunication facilities
EN 54-1, 2,3,4, 7, 10,11, 13, 14, 16, 17, 18, 20, 21, 22, 23, 24&29	Control and Indication Equipment, Fire Alarm Devices- Control & Indicating Equipment, Sounders, Power Supply Equipment, Multi-sensor detectors, Aspirating Smoke Detector, Resettable line type heat detectors, Manual Call Points & Input/ Output Devices
RDSO/SPN/218	Automatic Fire Suppression System for SignallingInstallations

0.3 Whenever reference to any specification appears in this document, it shall be taken as a reference to the latest version of that specification unless the year of issue of the specification is specifically stated.

0.4 This specification is intended to cover the technical provisions and it does not include all the necessary provisions of a contract.

0.5 Abbreviations Used:

Abbreviation	Expansion
AC	Alternating Current
AFDAS	Automatic Fire Detection & Alarm System
ASM	Assistant Station Master
BSC	Base Station Controller
CCTV	Close Circuit Television
CPVC	Chlorinated Polyvinyl Chloride
CPU	Central Processing Unit
DC	Direct Current
DG	Diesel Generator
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
GSM	Global System for Mobile Communication
Hz	Hertz
IEC	International ElectroTechnical Commission
IR	Infrared
IS	Indian Standard
ISO	International Organization for Standardization
KV	Kilovolt
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LHS	Linear Heat Sensing Cable
LHD	Linear Heat Detector
LPCB	Loss Prevention Certification Board
MSC	Main Switching Center
NFPA	National Fire Protection Association
NO/NC	Normally Open/Normally Closed
OEM	Original Equipment Manufacturer
OFC	Optical Fiber Cable
OI	Other Items
PLC	Programmable Logic Control
PC	Personal Computer
RDSO	Research Designs and Standards Organization
r.t.v.	Response Threshold Value
S&T	Signalling& Telecom
TCP/IP	Transmission Control Protocol/Internet Protocol
UL	Underwriters Laboratories
USB	Universal Serial Bus
UV	Ultraviolet

1.0 SCOPE

1.1 This document sets forth general, operational, technical and performancerequirements of Automatic Fire Detection & Alarm System (AFDAS) forSignalling&Telecominstallations.

2.0 GENERAL REQUIREMENTS

2.1 Automatic Fire Detection & Alarm System (AFDAS) shall consist of all or any ofthe following:

(a) Probe type Bimetallic Heat detectors for Diesel Generator enclosure.
(b) UV & IR flame detectors for Diesel Oil Storage room.
(c) Heat and Smoke multi sensors for Diesel Generator room, Power Supply Room, Relay Rooms, ASM Room and other rooms connected withSignalling Installations, as required.
(d) Heat and Smoke multi sensorsfor CCTV Control & Equipment Rooms, Way side StationOFC Room/Quad Repeaters,and other rooms connected with Telecom Installations as required.
(e) Linear Heat Sensing (LHS) cable along with its interface module (for cable trays, cable troughs& cable bunch etc.)

or

Linear Heat Detection System with its interface module (for cable trays, cable troughs, & cable bunch etc.)

(f) Aspirating (air sampling) type smoke detectorfor RelayRooms.Aspirating (air sampling) type smoke detectorforMajor Telephone Exchanges, Satellite Hubs,Data Centre location&Main Switching Centre (MSC),Base Station Controller (BSC) for MTRC, Test Room/Telecom Control Room and Main OFC Junction Equipment Room.
(g) Control Panel - For reading the signals from sensors/detectors, givingaudio/visual alarms.
(h) Other Items (OI) - like Manual Call Points at the entry and exit of variousrooms,connecting cables, relays, Audio Visual alarms etc. necessary for commissioning & reliable operationof the AFDAS.

2.2 The AFDAS shall be modular in structure, so that any fault in any of the modules can be set right by simply replacing the Faulty Module, with a spare.

2.3 The AFDAS shall be self-checking & diagnostic type. It shall continuously monitor the health of the sensors/ detectors & the complete system including battery. The data regarding health & event shall be logged in the system with date & time stamp, which can be downloaded to a PC/ Laptop at later stage. The system should have capacity to store data for up to a minimum of 512 fire events and other events. The Control

Panel shall be networkable to the Zonal/Divisional Railway headquarters preferably over TCP/IP and shall have clock synchronization facility.

2.4 The detectors shall be suitable for installation in electrical cabinets, transformers, inverters, cable trays, electronic equipment, power equipment rooms, relay rooms, or any other enclosed areas, which are vulnerable for fire as deemed fit byIndian Railways.

2.5 The system shall be suitable to detect fire/ fire like situation in relay room, power equipment room, Diesel generator room, Oil Storage room, ASM room (inside Operating/Maintainer panel and change over panel) and other rooms pertaining to S&Tinstallation, electronic equipment, electrical wiring etc., and generate audio visual alarms.

2.6 The AFDAS shall work satisfactorily & reliably over the entire range of following environmental parameters**:**

2.6.1 Temperature range shall be as per the limits specified in the concerned Para.

2.6.2 Humidity: 0 to 85 % (This is as per Para No. A26.1 of NFPA 72).

2.6.3 In dusty, sandy, and desert conditions, the OEMs shall specify the frequency for cleaning of the detectors, after installation to avoid false alarms.

2.7 Loop controllers shall have built in interference nullifier so that separate EMI control circuit is not required. The loop distancemaybe a minimum of 1.2 Km or as per the recommendation of the manufacturer.

or

Radio frequency /electromagnetic interference and electromagnetic compatibility must be available. The limits for EMI shall be 2KV (±10%), 5 KHz (±20%) for Power supply ports and 1KV (±10%), 5 KHz (±20%) for input/output signal, data and control ports (IEC 61000 4-4).

2.8 In case it is felt necessary by the railways to add more or additional sensors to the existing Fire Alarm System, the sensors/ detectors covered in this specification shall be backward and forward compatible for future expansions.

2.9 The Automatic Fire Detection and Alarm System covered in this specification shall also be able to generate requisite commands to activate ‘Automatic Fire Suppression System’, where provided.

2.10 It shall be possible to extend the alarm to remote location.

2.11 The working of the equipment shall not cause interference to other electrical/electronic circuits/systems.

2.12 The AFDAS shall have provision to provide sufficient sets of Programmable Potential Free NO/NC contacts (minimum 3 NO and 3 NC for each room where AFSS is installed), to trigger the Automatic Fire suppression system through logical function as per RDSO/SPN/218/2016 or latest pertaining to Signalling Installations, if provided, switching off the power supply to power equipment /relay room (if required) and for interfacing with the existing Data Logger system. The Current carrying capacity of NO and NC contacts shall be at least 500mA.

2.13 The system shall not degrade the performance of relays, power equipment, wiring, cables etc. when subjected to Fire Detection & Alarm process.

2.14 The system shall be capable of working in non-air-conditioned environment in the installationincluding Aspirating (air sampling) type smoke detector. It shall be suitable for installation on AC/ DC electrified and non-electrified sections. It shall be suitable in all areas including where locomotives having thyristor controlled single phase or 3-phase induction motors haul passenger or freight trains and where chopper controlled EMU stocks are operated.

2.15 The general principles of the Automatic Fire Detection & Alarm System (AFDAS) shall be as follows**:**

2.15.1 The response time for alarm generation from the time of detection by sensors/detectors shall not exceed ten seconds (NFPA 72 Edition 2016 Para 10.11.1). It shall reliably transmit the detected signal to the Control Panel, so that it can translate this detected signal into suitable alarm signal and warn the railway personal for taking corrective action.

2.15.2 It shall Indicate or display the location of fire, status of detectors with all stages of alarms.

2.15.3 It shall be possible to expand the system by minimum 20% in future in terms of various types of sensors subject to minimum of two sensors in each category.

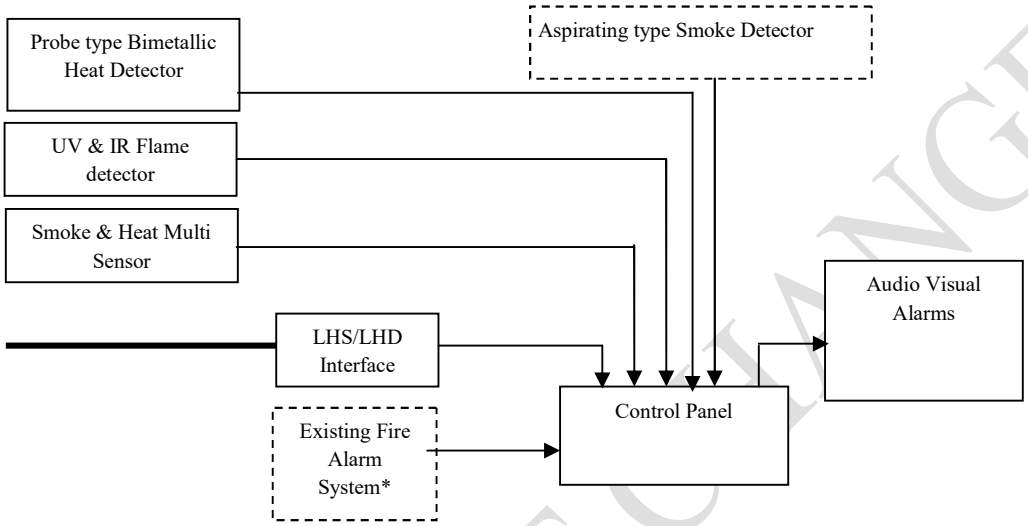
2.16 Power Supply Arrangements for AFDAS:The primary source of supply shall be 110V/230V AC to be given by Railways. In case, failure of primary power supply the system shall work on Secondary power source (battery backup) as part of the system. The minimum cut off voltage for primary shall be specified by OEM. Whenever the primary power supply fails to provide minimum voltage required for operation, the secondary source of power supply shall automatically provide power within 10 seconds (Clause 10.6.6.1 ofNFPA 72 Edition 2016).

2.17 The System design shall not incorporate use of any radioactive material. A declaration shall be submitted by the supplier in this regard at the time of product approval**.**

2.18 It should be feasible to cover both Signalling& Telecom installations with Single Automatic Fire Alarm & Detection System and common control panel where both installations are located close by like way side stations or any other location. Otherwise independent Automatic Fire Alarm & Detection System shall be provided.

2.19 In case Automatic Fire Alarm & Detection System is provided for a signalling or telecom installation, it should be feasible to extend to nearby signalling or telecom installation.

3.0 GENERAL ARRANGEMENT OF AUTOMATIC FIRE DETECTION & ALARM SYSTEM (AFDAS)



* The existing Fire Alarm System may be any system conventional or addressable, if already provided, prior to this scheme.

4.0 TECHNICAL REQUIREMENTS

4.1 GENERAL

4.1.1 The AFDAS may consist of Probe type Bimetallic Heat Detectors, UV&IR Flame Detectors and Heat& Smoke Multi Sensors which shall be installed, at critical locations to detect smoke, temperature rise & absolute temperature & send the signal to Control Panel. The AFDAS shall be an addressable system with facility to program cross zoning of detectors. In addition, Linear HeatSensing cable or Linear Heat Detector shall be laid in cable trays, battery boxes, power equipment etc.for heat detection & sending the signal to the Control Panel through an Interface. On getting the signals from abovedetectors/ sensors, Control Panel shall give Audio Visual Alarms to the railwaypersonnel to actuate Fire Extinguishing System manually. The AFDAS shall alsohave a feature to trigger 'Automatic Fire Suppression System' (if provided) whenthe suppression system is interfaced with AFDAS.

4.2 DETECTORS IN DIESEL GENERATOR ENCLOSURE/OIL STORAGE ROOM

4.2.1 PROBE TYPE BI-METALLIC HEAT DETECTOR FOR DIESEL GENERATOR ENCLOSURE

4.2.1.1 Probe type bi-metallic resettable type heat detectorsshall be used for diesel generator enclosure.

4.2.1.2 The actuating temperature shall be as per the model number offered by the manufacturer. Same shall be considered in type/acceptance test. The manufacturer may specify as many models as possible. The probe type bi-metallic heat detector shall be chosen by the purchaser such that the temperature rating of the detector shall be at least 11°C above the maximum operating temperature of the diesel generator (Ref: Clause no. 17.6.2.3 of NFPA 72-2016).

4.2.1.3 It shall be able to detect temperature and shall communicate alarm signal to Control Panel when temperature rises above the defined value.

4.2.1.4 The insulation resistance of the detector shall not be less than 10M ohm.

4.2.2 UV and IR FLAME DETECTORS FOR OIL STORAGE ROOM

4.2.2.1 Diesel Oil Storage room shall be provided with UV and IR flame detector to facilitatedieselfire detection.

4.2.2.2 The range of flame detector shall be at least 10m.

4.2.2.3 The response time of the flame detector shall be less than 10 seconds.

4.2.2.4 The flame detector shall be resettable.

4.2.2.5 It shall not give false alarm under solar or electrical light conditions.

4.2.2.6 It shall be UL or FM or Vds or LPCB approved/listed.

4.2.2.7 The flame detector shall be able to communicate the fault and fire event to the control panel.

4.2.2.8 The flame detector shall be suitable for operation in a temperature range of 0-49^{o}C.

4.2.2.9 The insulation resistance of the flame detector shall not be less than 10M ohm.

4.3 HEAT & SMOKE MULTI SENSOR FOR POWER EQUIPMENT ROOM,BATTERY ROOM, ASM ROOM, RELAY ROOMS, DIESEL GENERATOR ROOMS

4.3.1 Heat & Smoke multi sensor shall be robust, rugged& suitable for surfacemounting.

4.3.2 Heat & Smoke multi sensor shall incorporate state of art optical chamber providing efficient & accurate detection of fire with high level of reliability & high immunity to spurious signal. The sensitivity of the Heat & Smoke multi sensor shall vary with the ambient conditions including dust particles to reduce false alarms.

4.3.3 Heat & Smoke multi sensor shall incorporate integral LED indicator to show the status of the detector.

4.3.4 Each Heat & Smoke multi sensor shall have suitable indications for indicating Normal Healthy Mode & Alarm Indication mode.

4.3.5 The detector’s alarm condition shall be visible from a distance of 6 Meters (normal condition as per clause 3.1 of IS: 11360) and shall be visually different from the indications of the other conditions.

4.3.6 The insulation resistance of the detector shall not be less than 10M ohm.

4.3.7 Failure of any indicator shall not prevent the detector from emitting fire signal

indicating the existence of fire.

4.3.8 The Detector / devices must have inbuilt fault isolator or alternate arrangement at detector level which shall isolate the detector in case of short circuit or open circuit in the loop.

4.3.9 The detectors shall be addressable and resettable type.

4.3.10 It shall detect the fixed heat above 58°C and the rate of temperature rise (between 6°C/minute to11.1°C/minute) independently in addition to the photo electric smoke detection.

4.3.11 The detectors shall be provided with means for mounting (on ceiling/wall) securely and independent of any support from the attached wiring.

4.3.12 Plastic, if used for detector, shall not start softening, deforming, or melting at a temperature lower than 95°C as per Clause 4.2 of IS: 2175-1988.

4.3.13 Smoke detector in this multi-sensor shall be able to detect smoke and shall communicate alarm signal to Control Panel when optical density of smoke/obscuration falls within the limit as follows:

Limit	%obs/m	%obs/ft
Lower	1.6	0.5
Upper	12.5	4.0

4.3.14 The ratio of highest r. t. v. and lowest r. t. v. shall not exceed 1.6 in the least favorable direction, i.e. the direction opposite to the beam of LED.

4.3.15 The smoke and heat multi sensors can be provided in power equipment room, battery room, ASM room, relay rooms, diesel generator rooms, CCTV Control & Equipment Rooms, Way side Station OFC Room/Quad Repeaters and other rooms of S&Tinstallations, as required.

4.4 ASPIRATING (AIR SAMPLING) TYPE SMOKE DETECTOR

4.4.1 The air sampling–type detector system shall be able to withstand dusty environments by onboard monitored air filtering, Auto cleaning facility in optical chamber, electronic discrimination of particle size or other listed methods or combinations thereof. The detector should be capable of providing time delays (< 10 seconds) of alarm outputs to eliminate nuisance alarms due to transient smoke conditions. The detector should also provide facilities for the connection of monitoring equipment for the recording of background smoke level information necessary in setting alert and alarm levels and delays. It shall have event logging facility with date and time stamp.

4.4.2 Air Sampling Type detector shall use LASER or High-power LED. This type of detector shall use piping or tubing distribution network that shall run from the detector to the

areas to be protected. The aspiration fan in the detector housing shall draw air from the protected area and back to the detector through air sampling ports, piping or tubing. At the detector, the air shall be analyzed for fire products.

4.4.3 The detector shall have the capability of generating four alarm signals depending upon level of smoke detected, for example

Example (1):
Stage 1 – 0.5 to 0.95% obs/m
Stage 2 – 1.0 to 1.45% obs/m
Stage 3 – 1.5 to 1.95% obs/m
Stage 4 – ≥ 2.0% obs/m

Example (2):

Stage 1 – 30% of Alarm Stage 4
Stage 2 – 50% of Alarm Stage 4
Stage 3 – 70% of Alarm Stage 4
Stage 4 – ≥ 2.0% obs/m

4.4.4 The value of the smoke levels may beadjusteddepending upon the site conditions.

4.4.5 The piping or tubing to air sampling ports shall be laid depending upon the floorarea detailed as below:

4.4.5.1 Required number of sampling point shall be provided on either side of each - relay rack, cable termination rack, Air Conditioner, 230V AC Used and unused points etc.

4.4.5.2 Maximum transport time from the most remote port to the detection unit of an air samplingsystem shall not exceed 60 seconds.

4.4.5.3 Minimum sensitivity settings above ambient airborne levels for the air samplingsystem installed shall be as follows:

4.4.5.3.1 Alert condition: 0.2 percent per foot obscuration (effective sensitivityat each port).

4.4.5.3.2 Alarm condition 1.0 percent per foot obscuration (effective sensitivity ateach port).

4.4.6 It shall be suitable for operation in a temperature range of 0-49^{o}C.

4.4.7 The aspiration type smoke detector should be UL or FM or Vds or LPCBlisted/approved.

4.5 PIPING STANDARDS

4.5.1 The pipes used in the pipe network shall be made of CPVCand shall be listed/approved by UL or FM or Vds or LPCB or tested with appropriate equivalent standard to cater for ceiling temperature of 69^{o}C.The pipe and their assemblies such as couplings, unions, elbows, tees, end caps, capillary tubes, sampling ports, mounting brackets shall be as per the recommendation of manufacturer of Aspirating (Air Sampling) type smoke detector.

4.5.2 All distribution piping shall be installed by qualified individuals using acceptedpractices and quality procedures.

4.5.3 In cabinet and above cabinet sampling shallalso be planned as per request ofthe purchaser.

4.5.4 The system integrator shall carry out the piping design and validate the samewith a hydraulic flow calculation generated by using the UL or FM or Vds or LPCBapproved software. The appropriate fill density shall be arrived at based on thesame.

4.5.5 The design & calculation shall be checked & certified bymanufacturer/manufacturer trained design engineer.

4.5.6 Plans and calculations shall be approved prior to installation.

4.6 LINEAR HEAT SENSING (LHS) CABLE

4.6.1 Temperature sensitive cable also known as Linear Heat Sensing Cable shall be laid in all cable trays located in Power Equipment room, Relay room and Telecom room. Signal about alarm temperature shall be sent to Control Panel by LHS interface moduleattached with cable system.

4.6.2 Linear Heat Sensing cables shall be of temperature sensitive insulatedwire type.

4.6.3 This linear heat sensing shall be in the form of continuous cables consisting ofconductors / cores and shall be of analogue type.

4.6.4 Each core of analogue Linear Heat Sensing cable shall be insulated with a negative temperature coefficient material (Clause 5.1.1.4 of IS: 2189-2008). An outer sheath of high temperature, flame retardant PVC insulation, shall protect the cores. The outer sheath or metallic braid shall not affect theperformance of the heat sensor.

4.6.5 The Linear Heat Sensing cable for each zone / roomshall be connected to an electronic interface module, which shall sense the temperature variations by continuously monitoring the resistance of the negative temperature coefficient core insulation. The electronic interface module shall be located suitably in thearea being protected.

4.6.6 The analogue linear heat sensing cable of every zone shall be continuously monitored for open and short circuit. A breakage, disconnection or a short between cores shall initiate a FAULT alarm on the fire alarm panelof ControlPanel.

4.6.7 LHS cable shall be resettable type.

4.6.8 The design of the analogue, linear heat sensing cableand correspondingelectronic sensing circuits shall be such that the cable length and the numberofrequired loops should be set up to provide optimal coverage for the desiredregion with cable length ranging from 10m to 200 m. The system shall bedesigned to have an optimum sensitivity.

4.6.9 For a given length of sensing cables,it shall be possible to set the alarm temperature at 70°C with an Interface Module and with a tolerance not to exceed ±8.3°C.

4.6.10 The Linear heat sensing cableshould have strong capability to withstand themechanical damage, tensile, water, corrosion andelectromagneticinterference.

4.6.11 Linear heat sensing cable should be UL or FM or Vds or LPCB approved/listed.

4.7 LINEAR HEAT SENSING (LHS) INTERFACE MODULE

4.7.1 LHSInterface should be a microprocessor/microcontroller/PLC based device that communicatesbetween LHS Cable and Control Panel. It should be an intelligent device that willmonitor LHS cable for continuity and over temperature fire signatures.Performance of the linear heat sensing cable along with its interface moduleshall be immune to changes in ambient temperature.

4.7.2 An increase in temperature at any location along the LHS cable's length shall lower the resistance between conductors in the cable. The change in resistance shall be detected by the interface module, which will trigger an alarm at the Control Panel if the temperature rises above a preset threshold.

4.7.3 The LHSinterface shall be able to distinguish between a Short Circuit Condition & an Actual Fire Event in order to prevent unwanted activation of fire alarm system, in case of an accidental short circuit fault by damage to the sensor or field wiring.

4.7.4 The LHSinterface shall supervise the sensing cable for alarm temperature condition, open & short circuit to generate a fault condition which shall be displayed on the interface module faceplate by the 2 LED indicators: FIRE LED & FAULT LED.

4.7.5 The LHS interface module shall be suitable for operation in a temperature range of 0-49°C.

4.7.6 Linear heat interface module should be UL or FM or Vds or LPCB approved/listed.

4.8 LINEAR HEAT DETECTOR (LHD) and its interface module

4.8.1 Temperature sensitive detector also known as linear heat detector maybe laid in all cable trays located in Power Equipment room and relay room. Signal about alarm temperature shall be sent to Control Panel by LHD interface moduleattached with Linear Heat Detection system.

4.8.2 Linear Heat Detector shall be of temperature sensitive hollow metallic pneumatic tube type.

4.8.3 The Linear Heat Detector should have strong capability to withstand themechanical damage, tensile, water and corrosion andelectromagneticinterference.The LHD shall be made of hollow tube of non-corrosive metal/alloy.

4.8.4 The Linear Heat Detector for each zone / room shall be connected to an electronic interface module, which shall constantly monitor the pressure inside the hollow metallic tube (LHD) and sense the temperature variations by continuously monitoring the pressure. The change in pressure shall be detected by the interface module, which will trigger an alarm at the Control Panel if the temperature rises above a preset threshold.The electronic interface module shall be located suitably in the area being protected.

4.8.5 The linear heat detector of every zone shall be continuously monitored for breakage and obstruction. A breakage, disconnection or obstruction shall initiate a FAULT alarm on the fire alarm panel of Control Panel.

4.8.6 LHD shall be resettable type.The LHD shall be reusable after detecting the alarm condition.

4.8.7 The LHD shall provide optimal coverage for the desiredregion with detector length ranging from 10m to 200 m or more. The system shall bedesigned to have an optimum sensitivity.

4.8.8 For a given length of LHD it shall be possible to set the alarm temperature at 70°C with an Interface Module and with a tolerance not to exceed ±8.3°C.

4.8.9 The LHD interface shall supervise the detector for alarm temperature condition and damage to generate a fault condition which shall be displayed on the interface module faceplate by suitable means.

4.8.10 The LHD interface shall be suitable for operation in a temperature range of 0-49°C.

4.8.11 Linear heat Detection system(detection tube and its interface module) should be UL or FM or Vds or LPCB approved/listed.

4.9 CONTROL PANEL

4.9.1 Detection, actuation, and control system shall have provision for automatic as well as manual operation. Provision for manual operation shall also be provided in addition to automatic operation.

4.9.2 The Control Panel shall be the central processing unit of the system, receiving and analyzing signals from Probe type bimetallic heat detectors, UV&IR flame detectors, Heat and Smoke multi sensors, LHS/LHD Interface, Aspirating Type Smoke Detectors and Manual Call Points, for providing audible and visual information to the user.

4.9.3 It shall have suitable audio-visual alarms for drawing attention/indicating variousevents.

4.9.4 It shall also have the capability to electronically/electrically activate and releaseFire Extinguishing System, if used any.

4.9.5 The Control Panel should normally be located in Station Master's Room or as per requirement of purchaser.

4.9.6 The Control Panel shall have provision to provide sufficient input ports for connecting varioussensors/detectors along with their interfaces, if any, & shall have provision to provide sufficient outputports for controlling fire extinguishing system, operating/switching off electricalunits and shall have provision for remote monitoring in network. The systemshall be approved byUL or FM or Vds or LPCB. The software shall be ableto monitor the health of each detector and other devices along with control panel. It shall also have clock synchronization facility.

4.9.7 There shall be preferably one Control Panel for a station. However, at stationshaving bigger relay room & power equipment room deploying more number ofsensors/ detectors, more than one Control Panels can be provided but there shallbe a main Control Panel also to control fire extinguishers, to provide alarms, foruser interaction etc. of the entire installation through the individual ControlPanels.

4.9.8 The control panel shall be designed to work on power supply of 110V/230V AC +10%, -15% with DCbattery backup of adequate capacity. The control panel shall have in-built charging facility for DC battery backup for at least 24 hours for operating the system at quotient load and then 15 minute under fire or emergency condition at maximum connected load (Cl. 10.6.7.2.1.2 of NFPA 72 Edition 2016). Addressable modules can be used if required to connect electronics of LHS interface module and Aspiration Type Smoke Detector to the control panel.

4.9.9 The Control Panel shall have means for the user to visualize and interact with the complete Automatic Fire Detection and Alarm System layout through a user friendly software executable on a standard Windows based Personal Computer.

4.9.10 The front panel of the Control Panel shall have the facility of buzzer silence, alarm silence and alarm activate, lamp test & reset. The front panel shall also indicate the status like fire, fault, disable, test, supply, primary supply fault, secondary supply fault (battery fault) and earth fault by respective LEDs/other suitable means.

4.9.11 In case of low battery, the system shall give audio visual indication in the control panel.

4.9.12 The Control Panel shall be able to communicate and display the exact number of the Sensor, which has activated the Fire Detection System, for pinpoint location of the seat of fire.

4.9.13 It shall be possible to download data and extend alarms from Control Panel through suitable ports like RS485/RS232/USB/TCP/IP into a PC/Laptop at the installation andremote location operating on Windows platform. The software for downloading and analyzing fault data shall be provided & shall be compatible with the latest windows operating system.

4.9.14 Audio Visual Indication shall be provided on the control panel and get activated in case of fire/smoke, trouble/fault and for supervisory functions. The audio indication may be frompiezo electric buzzer and visual indication may be LED indication and/or LCD display.

4.9.15 Operating devices such as system isolate switches and ancillary equipment; including shutdown equipment; dampers and door closures, required for successful system performance should be considered integral parts of the system. All ancillaries should incorporate manual reset facilities. The exact number of controls required shall be specified by the purchaser as per the site conditions.

4.9.16 The software preferably should have the capability for the following 4 levels of actions:

4.9.16.1 **Level 1** – When Stage 1 signal is received from aspirating type smoke detector or an alarm is received from single detector wired in cross zoned manner, it shall activate an audio visual indicationin control panel.

4.9.16.2 **Level 2** – When Stage 2 signal is received from aspirating type smoke detector it shall activate audio visual alarm (Hooter and Strobe) in the SM Room.

4.9.16.3 **Level 3** – When Stage 3 signal is received from aspirating type smoke detector or an alarm is received from manual call point; itshall activate all audio visual alarms (Hooter and Strobe) to alert Railway Staff for extinguishing the fire and shutting off the power supply ofsignallingand telecom system, if required.

4.9.16.4 **Level 4** –When Stage 4 signal is received from aspirating type smoke detector or an alarm is received from any other detector such as cross zoned multi sensor,cross zoned probe type bimetallic heat detector, cross zoned UV&IR Flamedetector and independent LHS/LHD module shall initiate all audio visual alarm (Hooter and Strobe) within 10 seconds and the automatic suppression system, ifprovided shall getactivated after a time delay adjustable by user up to 10minutes in multiples of 0.5 minutes.

4.9.17 The control panel should have provision to connect a GSM module and the system(s) shall sendSMSs on GSM network to not less than 5 preselected GSM mobile numbers in case of Level 2, Level 3 and Level 4 signals or as desired by the user . Themobile numbers shall be configurable. SMS shall be generated within 30seconds of the control panel receiving the detection signals and if the sendingfails, subsequent sending of SMS shall be tried by the system immediately. TheSIM required for the GSM modem shall be provided by the purchaser. The GSMmodem shall be from reputed make and compatible to Quad-band GSM 850,900, 1800 and 1900 MHz. It shall work onpower supply of the AFDAS with suitable power supply adapter. It shall be ableto withstand operating temperature 0°C to 49°C and humidity up to 85%. TheGSM Module shall be an optional item and shall be supplied as per request ofthe purchaser.

4.9.18 The Audio Visual Indication of Control Panel shall have means to indicate the room i.e. RelayRoom or Power Equipment Room or DG Room etc., from where the alarm situationhas been reported and shall also indicate the location of sensor in that roomwhich has reported the alarm situation. The Control Panel shall activate the fireextinguisher, if used any, of that room only for extinguishing the fire.

4.9.19 The front panel shall have character display (LED/LCD) and alphanumeric keyboard.

4.9.20 For Signalling installations at major yards (more than 400 routes and important Junction stations)control panel must have the provisions for working in degrade mode, i.e. during the failure of communication between loop control circuitry and CPU of the control panelshall operate the audio-visual and other output devices in case of an alarmis detected.

4.9.21 For Signalling installations at smaller yards (less than 400 routes and non-critical stations) control panel without degrade mode may be used on discretion of the purchaser.

4.10 Audio Visual Alarm (Hooter and Strobe):

4.10.1 Audio visual alarm (Hooter and Strobe) shall be provided with Control Panel where required.

4.10.2 Audio visual alarm system (Hooter and Strobe) shall get activated in case of fire/smoke.

4.10.3 Visual Alarms (Strobe): It shall be preferably flashing type RED/WHITE Color.

4.10.4 Audio Alarms (Hooter): It shall be preferably with Piezo-electric type sounder. The sound level shall be preferably adjustable type up to 90dB at a distance of 1m.

4.10.5 Audio and Visual alarms (Hooter and Strobe) can be extended to ESM duty room, subject to condition that it shall not be beyond the maximum loop distance.

4.11 FIRE SURVIVAL CIRCUIT INTEGRITY CABLES

4.11.1 The electrical characteristics of all cable, such as voltage drop, current carrying capacity, impedance and, where appropriate, ability to transmit data shall besuitable for the system.

4.11.2 The Circuit Integrity cable specification for AFDAS is as follows:

4.11.3 Armored copper cables of minimum 2Core x 1.5 sq.mm having cross linkableLowsmoke halogen free inner & outer sheath, 1000V rated, twisted shallbe used when the entire circuit is not within the same building.

4.11.4 Unarmored copper cables of minimum 2Core x 1.5 sq.mm having cross linkableLow smoke halogen free sheath, 500V rated, twisted with ATCuninsulated circuit protective conductor shall be used when the entire circuit is within the same building.

4.11.5 Armored and unarmored shall have anti-rodent outer sheath with Low SmokeProperties.

4.11.6 Armored&unarmored (CI) cables should meet fire performance test

undersimultaneous action of Flame, water stress and impacts on single sampleat 950°C for minimum 2 hours, certified by LPCB or equivalent. Vendor shallsubmit certificate for the same.

4.11.7 The cables used shall be exclusively for fire detection system. The multi-corecables shall not be shared for other low voltage or high voltage circuits.

4.11.8 Cables connected to detectors shall be given 'S' loop on both the sides of thedetectors which shall be properly clamped to the ceiling. Loop shall also be leftwhere cables connect sounders, panels, dampers, etc. Appropriate 2 hours firerated glands shall be provided where the cable enters the junction box**.**

4.11.9 All the cables shall be tagged with colour band for proper identification.

4.11.10 The cable manufacturer should provide test certificate related to themanufacturing of fire resistant wires & cables from UL or FM or Vds or LPCBor BREGlobal or any recognized lab by Government of India. The vendor shall also giveself -certification in this regard.

4.12 MANUAL CALL POINTS

4.12.1 Manual call points must be mounted visibly along escape and rescue routes (e.g.exits, passageways, stairwells) and be easily accessible.

4.12.2 It shall be installed at a height of 1400 mm ±200 mm measured from the middleof the manual call point to the floor.

4.12.3 Manual call points must be sufficiently lit with daylight or another light source(including emergency lighting). Lighting shall be provided by the purchaser.

4.12.4 It shall be addressable and resettable.

4.12.5 Visual indication of normal operation and activated operation shall be available.

4.12.6 It shall have inbuilt fault isolatoror alternate arrangement which shall isolate the Manual Call Point in case of open/short circuit fault within it.

4.13 CROSS ZONING

4.13.1 Two adjacent detectors at a particular location shall be addressed for different zones.

4.13.2 If only one detector is triggering the control panel, it shall give audio visual indication in the control panel.

4.13.3 If Air Sampling type Detector is provided in the relay room, then stage-3 signal shall be considered as fire like situation. Cross zoning is not applicable for this detection system.

4.13.4 If both the adjacent detectors are triggering the control panel, then fire like situation shall be accepted and fire alarm system shall act accordingly.

4.14 SITING AND SPACING OF DETECTORS

4.14.1 A minimum of two probe type bi-metallic heat detectors shall be provided inside the Diesel Generator enclosure. Each detector shall be addressed /wired in cross zoning manner.

4.14.2 A minimum of two UV&IR flame detectors shall be provided in the Diesel Oil storage rooms. Theinter-distance between two UV&IR detectors shall be at 10m subject to a minimum of two numbers in a room. Each detector shall be addressed /wired in cross zoning manner.

4.14.3 One number Smoke and heat multi sensor shall be provided on either side of each - relay rack, cable termination rack, each IPS equipment, each power panel, Change over panels, Operating Panel, Maintainer Panel, 230V AC Points used or unused, above Air Conditioner and other locations where fire like situation can arise. Adjacent sensor shall be wired/addressed in different zones. If one detector only identifies fire like situation, then control panel shall provide only audio visualindication at control panel. If both the adjacent detector provides the trigger for alarm, then the control panel shall treat as fire like situation.

4.14.4 Manual call points shall be provided at each entrance/exit.

4.15 SPARES

The following mandatory spares shall be supplied for each installation:

4.15.1 10% for modules, detectors, and loop cards, subject to minimum of one number for each installation.

4.15.2 The CPU card and Power Supply card, minimum one numberas spare shall be provided for everyfive installations, subject to a minimum of one numberfor less than five installations.

5.0 FIRE SUPRESSION

5.1 For fire suppression, railways shall provide one 4.5 kg capacity, IS 2878:2004, carbon dioxide extinguisher for every 100 m^2 of floor area or part thereof with minimum of two extinguishers so located as to be available within 10 m radius inaddition to Automatic Fire Suppression System. (IS: 2190 - Annexure-B).

6.0 REQUIREMENTS TO BE FULFILLED BY MANUFACTURER BEFOREAPPROVAL

6.1 Certificates/ Approvals/ Experience of the product / manufacturer

6.1.1 The manufacturer must be certified with ISO 9001 (the scope of the ISO Certification has to specifically refer to the manufacturing of the products related to AFDAS). The copy of the certification shall be provided by the manufacturer. The manufacturer in this specification shall at least manufacture the Control Panel, Heat and Smoke Multi Sensor, Audio Visual alarms and Manual Call Point. The manufacturer may outsource the left over items of AFDAS from other firmsbut shall be responsible for the complete system functioning. The outsourced firms shall be ISO 9001 certified and the certification shall refer to the manufacturing of products being outsourced.

6.1.2 In case, where OEMs are not listed/approved by UL or FM or Vds or LPCB, the equipment may be listed/approved from any ISO 17065 accredited body which is authorized for carrying out fire detection system certification.

6.2 The manufacturer shall guarantee for supply of spares including outsourced items during life of the equipmentfor minimum 10years from the date of supply& extend maintenance support, if required by the Railway/purchaser.

6.3 The manufacturer shall supply detailed instructions for proper installation of the system. The manufacturer shall depute his engineers/supervisors to purchaser’s site during the installation of the equipment.

6.4 The manufacturer shall associate themselves during commissioning, testing, and field trials of the system.

6.5 The manufacturer shall install & commission the system at the locations identified by RDSO for field trials. The detailed field trials to ascertain the suitability of the system shall be carried out by RDSO and Zonal Railways before considering the manufacturer for approval.

6.6 The manufacturer will also offer special tools and instruments for testing effectiveness of detectors separately, which may be required for maintenance. These tools shall be listed out by the firm and shall be included in the approval letter of RDSO.

6.7 The manufacturer shall submit recommended list of spares required for satisfactory maintenance and operation of the AFDAS.

6.8 The manufacturer shall submit design manual for the system containing detail functioning of each item and its sub-assembly giving following details about:

6.8.1 Testing procedure

6.8.2 Diagram & layout.

6.8.3 Write up on the working of Automatic Fire Detection and AlarmSystem

6.9 The manufacturer shall supply the user's manual for maintenance and troubleshooting.

6.10 The manufacturer shall be responsible for carrying out improvements andmodifications at his own expense on all the equipment supplied, provided suchmodifications / improvements are decided to be necessary for meeting therequirements of reliability, performance, and safety etc., jointly betweenmanufacturer and purchaser.

6.11 For the purpose of technical decisions on improvements/ modifications etc. onequipment, the final authority from the purchaser's side shall be RDSO**.**

7.0 INSPECTION AND TESTING

7.1 Type, Acceptance and Routine tests on AFDAS and itssub-units, including outsourced items; as and when required,shall be conducted by concerned agencies as mentioned in the subsequent clauses.

7.2 Initial Type test shall be conducted by RDSO as per RDSO's vendor approval processes to verify that product meets the design and performance requirement of the specification. Acceptance test shall be carried out by inspecting agencies nominated to accepta supply lot**.** Routine Test for the complete/sub system shall be carried out by Manufacturer.

7.3 Type Test

7.3.1 For type test, one complete system consisting of AFDAS shall be subjectedto following tests as applicable:

7.3.1.1 Visual Inspection as per clause 9.2.
7.3.1.2 Performance test as per clause 9.3.
7.3.1.3 Reverse Polarity test as per clause 9.4.
7.3.1.4 System level tests as per clause 9.5.

7.3.2 Any other tests shall be carried out as considered necessary by RDSO.

7.3.3 One complete system as a prototype sample as per guidelines of RDSO shall be tested for this purpose. The equipment shallsuccessfully pass all the type tests for proving conformity with this specification. The prototype sample forAFDAS may consist of followings:

i. Probe type Bi-metallic Heat Detectors (2 Nos.) of each type
ii. UV & IR Flame Detectors (2 Nos.)
iii. Heat & Smoke Multisensors (4 Nos.)
iv. Aspiration (Air Sampling) type Smoke Detector with CPVC piping & accessories (1 No.)
v. LHS/LHD with its interface module (1 set)
vi. Manual Call Point (2 Nos.)
vii. Control Panel (2 Nos.)
viii. Audio Visual Alarm (Hooter cum Strobe) (2 Nos.)

ix. Fire Survival Circuit Integrity Cable (As required)
x. GSM Modem (1 No.)
xi. Battery (2 Sets)

7.4 **Acceptance Test**

7.4.1 Acceptance test shall be carried out on 20% of the lot offered (Minimum 2 ofeach lot).

7.4.1.1 Visual Inspection as per clause 9.2.
7.4.1.2 Performance test as per clause 9.3.
7.4.1.3 Reverse Polarity test as per clause 9.4.

7.5 **Routine Test**

7.5.1 For Routine test, complete system shall be subjected to following tests by manufacturer.Proper record for the same shall be maintained by the manufacturer.

7.5.1.1 Visual Inspection as per clause 9.2.
7.5.1.2 Performance test as per clause 9.3.
7.5.1.3 Reverse Polarity test as per clause 9.4.

8.0 TEST EQUIPMENT

8.1 The firm shall have all essential Testing Equipment as per latest STR to facilitatetesting as per Routine/acceptance test format approved by RDSO**.**

9.0 TEST PROCEDURE

9.1 The test procedure shall be based on the system design. The methodologies tobe adopted for various tests shall be decided taking into account the systemdesign/configuration proposed by the manufacturerwhich shall be approved by RDSO**.**

9.2 **Visual Inspection**

9.2.1 The unit shall be checked for proper workmanship, proper fitment in itsenclosure,connections, and dimensions as agreed between manufacturer andpurchaser.

9.2.2 Each equipment of the system shall be visually inspected to ensure compliancewith the requirement of clauses of this specification. The visual inspection shallbroadly include:

9.2.3 **System Level Checking:**

9.2.3.1 Constructional details.

9.2.3.2 Dimensional check.
9.2.3.3 General workmanship.
9.2.3.4 Configuration.

9.2.4 **Card Level Checking:**

9.2.4.1 General track layout&workmanship.
9.2.4.2 Quality of soldering and component mounting.
9.2.4.3 Conformal Coating.
9.2.4.4 Legend printing.

9.2.5 **Module Level Checking:**

9.2.5.1 Indications and displays.
9.2.5.2 Mounting and clamping of connectors.
9.2.5.3 Proper housing of cards.

9.3 **Performance Test**

9.3.1 Automatic Fire Detection and Alarm System (AFDAS) shall be able to detect and respond as per the following conditions-

9.3.1.1 When a Diesel fire like situation is created at a distance of 10m for UV and IR flame detector shall respond within 10 seconds.
9.3.1.2 When temperature exceeds the manufacturers specified limit for Probe type bi-metallic heat detectors within the tolerance limit of ±8.3°C.
9.3.1.3 When the rate of temperature rise at the heat and smoke multi sensor exceeds 6°C per minute but not exceed 11.1°Cper minute regardless of the actual temperature.
9.3.1.4 When temperature at the heat and smoke multi sensor exceeds a pre-determined value of 58°C.
9.3.1.5 When smoke obscurationat the heat and smoke multi sensor is within the limit as specified in Cl. 4.3.13.
9.3.1.6 When LHS cable/LHD senses temperature at 70°C±8.3°C.
9.3.1.7 When Aspirating (air sampling) Type Smoke Detector detects smoke with various levels of smoke for various stages.
9.3.1.8 Whether Alert condition is generated when smoke at the sampling port is 0.2% per foot obscuration for Aspirating (air sampling) Type Smoke Detector.
9.3.1.9 Whether Alarm condition is generated when smoke at the sampling port is 1.0% per foot obscuration for Aspirating (air sampling) Type Smoke Detector.
9.3.1.10 When Manual Call Point is actuated, all audio visual alarm (Hooter and Strobe) shall be initiated.
9.3.1.11 All the above detectors shall be resettable.
9.3.1.12 All the above detectors shall be addressable.
9.3.1.13 Heat & smoke multisensor and manual call point shall have provision for fault isolation (in-built or alternate arrangement).
9.3.2 The performance test of control panel shall be carried out to meet the clauses in this specification.

9.4 **Reverse Polarity Test**

9.4.1 The unit shall be functional after applying the rated DC at secondary power source for one minute in the reverse polarity.

9.5 **System Level Tests**

9.5.1 Test certificate for smoke/heat/Flame sensitivity of the detectors from UL or FM or Vds or LPCB shall be submitted by OEM. However, RDSO reserves the right to test the smoke/heat sensitivity parameters listed in the specificationon single sample detector.

9.5.2 The firm shall also give self-certification for the heat/smoke sensitivity parameters.

9.5.3 Probe type Bi metallic Heat Detector, UV&IR Flame Detector, Heat & Smoke Multi Sensors, Linear Heat Sensing Interface Module, Aspirating type smoke detectors, Manual Call Point and Control Panel shall be tested as per Sl. No. 1 (temp range 0°C to 49°C), 2 (49°C), 3 (0°C), 4 (humidity 85%), 5 (humidity 85%), 6 (humidity 85%), 7, 10& 12 of Clause No. 9.3 and Insulation Resistance test as per clause 9.5of Specification RDSO/SPN/144/2006 or latest on single sample.

9.5.4 Control Panel andFire survival Circuit Integrity Cable shall be tested for High Voltage Withstand Test as per clause no. 9.6 of Specification RDSO/SPN/144/2006 or latest on single sample.

9.5.5 **Other Items:**

9.5.5.1 Fire survival Circuit Integrity Cable – Certified Lab report fromUL or FM or Vds or LPCBor BRE Global or any recognized lab by Government ofIndia.

9.5.5.2 Fasteners & Piping – Flame Proof - Certified Lab report fromUL or FM or Vds or LPCBor any recognized lab by Government of India.

9.5.6 The manufacturer shall furnish results of all the tests and inspection carried outinternally and in the presence of Railways representative to RDSO, whenever asked for.

10.0 MARKING AND PACKING

10.1 The following information shall be clearly marked at a suitable place on eachequipment**:**

10.1.1 Name and Address of the manufacturer.

10.1.2 Year of the manufacture.

10.1.3 Serial number of Equipment.

10.1.4 Specification number

10.1.5 Connection diagram of the equipment on the side of the cover of control panel.

10.2 The equipment and its sub-assemblies shall be packed such thatit can withstand bumps and jerks encountered in a road/rail journey**.**

11.0 DOCUMENTATION

11.1 The following documents shall be supplied along with each system -

11.1.1 Guaranteed performance data.
11.1.2 One copy of Installation and maintenance manual. This should include the following information –

11.1.2.1 Schematic block diagram showing mounting arrangement of various modules/PCB.
11.1.2.2 Details of Hardware e.g. schematic diagrams of the system details for each type of assembled PCB and part list.
11.1.2.3 Mechanical drawings of every unit.
11.1.2.4 Details/procedure of trouble shooting of AFDAS.
11.1.3 Dos & Don'ts (Pocket size laminated cards)
11.1.4 The vendor shall arrange for pre-installation, pre-commissioning and maintenance check lists for successful installation, commissioning, and maintenance of the AFDAS system.

12.0 WARRANTEE

12.1 The manufacturer shall give a warrantee of 24 months from the date of supply forthe equipment supplied under this specification**.**

13.0 TRAINING

13.1 The manufacturer shall impart suitable training in operation & maintenanceinspection & testing of the AFDAS**.**

14.0 INFRINGEMENT OF PATENT RIGHTS

14.1 Indian Railways shall not be responsible for infringement of patent rights due tosimilarity in design, manufacturing process, use of components used in design,development of manufacturing of such equipment and any other factor whichmay cause such dispute**.**

15.0 VENDOR –CHANGES IN APPROVED STATUS

15.1 All the provisions contained in RDSO's ISO procedure laid down in DocumentNo. QO-D-8.1-11 latest version (titled "Vendor- Changes in approved status") and subsequent versions/amendments thereof, shall be binding and applicable on the successful

vendor/vendors in the contracts floated by Railways to maintain quality of products supplied to Railways.