SPECIFICATION
FOR

AUTOMATIC FIRE DETECTION & ALARM SYSTEM
FOR
SIGNALLING INSTALLATIONS

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**Abstract**
SPECIFICATION FOR AUTOMATIC FIRE DETECTION & ALARM SYSTEM FOR SIGNALLING INSTALLATIONS

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DRAFT SPECIFICATION FOR AUTOMATIC FIRE DETECTION & ALARM SYSTEM FOR SIGNALLING INSTALLATIONS

0.0 FOREWORD

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

0.2 This specification requires reference to the following specifications:

| IRS: S23    | Electrical signaling and interlocking equipment         |
| RDSO/SPN/144| Safety and Reliability requirement of electronic signaling equipment |
| IRS: S-93/96(A) | Valve regulated (sealed) lead acid stationary battery for S&T installations |
| 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 Signalling Code |
| NFPA 76    | Standard for the Fire Protection of Telecommunication facilities |
| EN 54-2,3,4,7,11 & 18 | Control and Indication Equipment, Fire Alarm Devices-Sounders, Power Supply Equipment, Smoke detectors, Manual Call Points & Input/ Output Devices |
| RDSO/SPN/216| Automatic Fire Suppression System for Signalling Installations |

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.

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1.0 SCOPE

1.1 This document sets forth general, operational, technical and performance requirements of Automatic Fire Detection & Alarm System (AFDAS) for signalling installations.

2.0 GENERAL REQUIREMENTS

2.1 Automatic Fire Detection & Alarm System (AFDAS) shall consist of all or any of the 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, Non-air conditioned Relay Rooms, ASM Room, and other rooms connected with signalling installations.
(d) 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.)
(e) Aspirating (air sampling) type smoke detector for air-conditioned Relay Rooms preferably.
(f) Control Panel - For reading the signals from sensors/detectors, giving audio/visual alarms.
(g) Other items (OI) - like Manual Call Points at the entry and exit of various rooms, connecting cables, relays, Audio Visual alarms etc. necessary for commissioning & reliable operation of the AFDAS.

2.2 The AFDAS shall be designed to work on power supply of 24V DC ±20% as well as 110V/230V AC ±20% 110V/230V AC ±10%, ±15% as well as 24V DC ±10%, ±15%. The control panel shall have in-built charging facility to have 24V DC battery backup (VRLA as per IBS: S-93/96(A) or latest) for at least 24 hours. It shall power the aspiration type detection system, the Linear Heat Sensing Cables and all detectors, Manual Call Points etc., which constitute AFDAS. Addressable modules can be used if required to connect electronics of LHS device and Aspiration system to the control panel.

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 1000 fire events and 1000 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, invertors, cable trays, electronic equipments, power equipment rooms, relay rooms, or any other enclosed areas, which are vulnerable for fire as deemed fit by Indian 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 Signalling installation, 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 distance may be 1.2 KM or as per the requirement of the purchaser.

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 In case of low battery, the system shall give alarm and indication.

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 installation except for 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 Para 23.6.1.1 NFPA 72 Edition 2018 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 personnel for taking corrective action.

2.15.2 It shall monitor the health of the system.

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

2.15.4 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 24V DC-110V/230V AC and Secondary source of supply shall be 110V/230V AC 24V DC. 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 (NFPA 72 Edition 2016 Para 10.6.6.1). The control panel, detectors, audio-visual alarm devices, LHS devices, Aspiration system shall be separately wired.

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

4.0 TECHNICAL REQUIREMENTS

4.1 GENERAL

4.1.1 The AFDAS shall have 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 zonning of detectors. In addition, Linear Heat Sensing cable or Linear Heat Detector shall be laid in cable trays, battery boxes, power equipments etc. for heat detection & sending the signal to the Control Panel through an Interface. In Air-conditioned Relay Rooms only preferably, Aspiring Smoke detectors shall also be installed for early detection of smoke. On getting the signals from above detectors/ sensors, Control Panel shall give Audio Visual Alarms to the railway personnel to actuate Fire Extinguishing System manually. The AFDAS shall also have a feature to trigger ‘Automatic Fire Suppression System’ (if provided) when the 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 detectors as per IS 2189 shall be used for this purpose.
4.2.1.2 It shall be suitable to use above 56°C and at least up to 100°C. The triggering temperature shall be more than the highest operating temperature of the Diesel Generator can work as per manufacturer’s instruction booklet of Diesel Generator. 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.

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, which may be set at an interval set by the user.

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 facilitated fire 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/FM/VE/EN/LPCB-UL or FM or Vds or LPCB approved/listed.

4.2.2.7 The flame detector shall provide potential free contact in the event of alarm. 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°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, NON-AIRCONDITIONED 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 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.

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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 type.

4.3.10 It shall detect the fixed heat above 58°C and the rate of temperature rise (10°C/minute) independently in addition to the photo electric smoke detection.

4.3.11 It shall be resettable type.

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

4.3.13 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.

4.3.14 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 exceeds 0.1dB/m (10 m visibility) as per Clause 5.2.1 of IS: 2189-2008.

4.3.15 The response threshold value (r. t. v.) of smoke detection in this detector shall not be less than 0.05 dB/m and the ratio of highest r. t. v. and lowest r. t. v. shall not exceed 1.6 as per Clause 4.2 of IS: 11360-1985.

4.3.16 The smoke and heat multi sensors can be provided in power equipment room, battery room, ASM room, non air-conditioned relay rooms, diesel generator rooms, and other rooms of Signalling installation.

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. It shall also have clock synchronization facility.
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:

- 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

4.4.4 The value of the defined smoke levels above for various stages of alarm can be changed depending upon the site conditions.

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

4.4.5.1 One number sampling point shall be provided on either side of each - one-way-relay rack, cabinet 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 sampling system shall not exceed 60 seconds.

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

- Alert condition: 0.2 percent per foot obscuration (effective sensitivity at each port).
- Alarm condition: 1.0 percent per foot obscuration (effective sensitivity at each port).

4.4.6 It shall be suitable for operation in a temperature range of 0-49°C.

4.4.7 The aspiration type smoke detector should be UL or FM or VdS or LPCB listed/approved.

4.5 PIPING STANDARDS

5.1 The pipes used in the pipe network shall be made of copper, preferably with 25mm dia (±5%) and 1mm (±5%) thickness to cater for ceiling temperature of 69°C and their assemblies such as couplings, unions, elbows, tees, end caps, capillary tubes, sampling ports, mounting brackets and they shall be tested in accordance with ASTM E 814.

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

4.5.3 In cabinet and above cabinet sampling shall also be planned as per request of the purchaser.
4.5.4 The system integrator shall carry out the piping design and validate the
same with a hydraulic flow calculation generated by using the
UL/EN/FMAVde/LPCB/UI,
or FM or Vds or LPCB approved software. The appropriate fill density shall be arrived
at based on the same.

4.5.5 The design & calculation shall be checked & certified
by manufacturer/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 and relay room. Signal
about alarm temperature shall be sent to Control Panel by LHS interface
module attached with cable system.

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

4.6.3 This linear heat sensing shall be in the form of continuous cables consisting
of copper conductors / 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 temperaturé, flame retardant PVC insulation, shall protect the cores. The outer
sheath, as well as the metallic braid shall not affect the performance of the heat
sensor.

4.6.5 The Linear Heat Sensing cable for each zone / room shall 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 the area 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 panel of Control Panel.

4.6.7 LHS cable shall be retestable type.

4.6.8 The design of the analogue, linear heat sensing cable and
corresponding electronic sensing circuits shall be such that the cable length and the
number of required loops should be set up to provide optimal coverage for the
desired region with cable length ranging from 10m to 200m. The system shall
designed to have an optimum sensitivity.
4.6.9 For a given length of sensing cable(s) it shall be possible to set the alarm temperature at 70°C with an Interface Module and with a tolerance not to exceed ±5%.

4.6.10 The Linear heat sensing cable should have strong capability to withstand the mechanical damage, tensile, water and corrosion and electromagnetic interference.

4.6.11 Linear heat sensing cable should be brought from UL/FM/UL/FM, EN/LPCBUL or FM or Vds or LPCB approved/listed sources.

4.7 LINEAR HEAT SENSING (LHS) INTERFACE MODULE

4.7.1 LHS Interface should be a microprocessor/microcontroller/PLC-based device that communicates between LHS Cable and Control Panel. It should be an intelligent device that will monitor LHS cable for continuity and over temperature fire signatures. Performance of the linear heat sensing cable along with its interface modules shall be immune to changes in ambient temperature.

4.7.2 The alarm temperature shall be 70°C.

4.7.3 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.

4.7.4 The LHS Interface 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.

4.7.5 The LHS Interface 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.

4.7.6 LED indicators shall also be provided for normal system operation, faults, pre-alarm, and fire - alarm status.

4.7.7 It shall be suitable for operation in a temperature range of 0-49°C.

4.8 LINEAR HEAT DETECTOR (LHD) AND ITS INTERFACE MODULE

4.8.1 Temperature sensitive detector also known as linear heat detector shall be 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 module attached 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 thermal damage, tensile, water and corrosion anode electromagnetic interference. 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 of 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 optimal coverage for the desired region with detector length ranging from 10m to 200 m or more. The system shall be designed 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 ±5%.

4.8.9 The alarm temperature shall be 70°C.

4.8.10 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.

4.8.11 It shall be suitable for operation in a temperature range of 0-49°C.

4.8.12 Linear heat Detection system should be brought from UL or FM or VdS or LPCB approved/listed sources.

4.8.2 CONTROL PANEL

4.8.2.1 Detection, actuation, and control system shall have provision for automatic as well as manual operation. Where they are automatic, provision shall also be made for manual operation.

4.8.2.2 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 Interface, Aspirating Type Smoke Detectors and Manual Call Points, providing audible and visual information to
the user.

4.8.4.9.3 It shall have suitable audiovisual alarms for drawing attention/indicating various events.

4.8.4.9.4 It shall also have the capability to electronically/electrically activate and release Fire Extinguishing System, if used any.

4.8.4.9.5 The Control Panel should be located in Station Master's Room.

4.8.4.9.6 The Control Panel shall have sufficient input ports for connecting various sensors/detectors along with their interfaces, if any, & shall have sufficient output ports for controlling fire extinguishing system, operating/switching off electrical units and shall have provision for remote monitoring in network. The system shall be approved by UL/EN/FM/Vds/LPCBUL or FM or Vds or LPCB. The software shall be able to monitor the health of each detector and other devices along with control panel. It shall also have clock synchronization facility.

4.8.4.9.7 There shall be preferably one Control Panel for a station. However, at stations having bigger relay room & power equipment room deploying more number of sensors/detectors, more than one Control Panels can be provided but there shall be a main Control Panel also to control fire extinguishing, to provide alarms, for user interaction etc. of the entire installation through the individual Control Panels. In order to cater more than one room, the control panel should have the Loop expandability.

4.8.4.9.8 The AFDAS shall be designed to work on power supply of 24 V DC ± 20% as well as 110VAC/230V AC ± 10%. The control panel shall have an in-built charging facility to have 24 V DC battery backup (VRLA as per IRS: S-93/96(A) or latest) for at least 24 hours. It shall power the aspiration type detection system, the Linear Heat Sensing Cables and all detectors, Manual Call Points etc., which constitute AFDAS. Addressable modules can be used if required to connect electronics of LHS interface module and Aspiration Type Smoke Detector to the control panel.

4.8.4.9.9 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.

4.8.4.9.10 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, battery fault, secondary supply fault, and earth fault by respective LEDs/other suitable means.

4.8.4.9.11 The Control Panel shall have sufficient sets of Potential Free NO/NC contacts (minimum 4 NO and 3 NC for each zone); to trigger the Automatic Fire suppression system 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 at least 500mA. The Control Panel shall be able to communicate and display the exact number of the Sensor or the Part of the Linear Heat Sensing Cable, which has activated the Fire Detection System, for pinpoint location of the seat of fire.

4.9.12 The Control Panel 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.

4.9.13 It shall be possible to download data or extend alarms from Control Panel through suitable ports like RS232/USB or TCP/IP into a PC/Laptop/remote 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 Alarm:**

4.9.14.1 Audiovisual alarm shall be provided along with Control Panel.

4.9.14.2 Audiovisual alarm system shall get activated in Control Panel in case of fire/smoke.

4.9.14.3 Audiovisual alarm shall be provided with provision of resetting the hooter from Control Panel. However, visual alarm shall continue to be lit till such time the alarm conditions exist.

4.9.14.4 Visual Alarms: It shall work on 24V DC and shall be preferably flashing type RED Color.

4.9.14.5 Audio Alarms: It shall work on 24V DC and shall be preferably with Piezoelectric type sounder with tone type of Fire-Engine. The sound level shall be preferably adjustable type up to 90db at a distance of 1m.

4.9.14.6 Audio and Visual alarms can be extended to ESM duty room, subject to condition that loop distance doesn’t exceed beyond 1.2Km.

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, it shall activate a visual alarm near control panel.

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

4.9.16.3 **Level 3** – When Stage 3 signal is received from aspirating type smoke detector shall activate an alarm condition in the Fire Alarm Control Panel to initiate Railway Staff for extinguishing the fire and shutting off the power supply to signalling system, if required.

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<td></td>
<td>Prepared By: Raviyad Singh, JE (D)/Signal</td>
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<td>Checked By: R.P. Singh, AGS/Signal 49</td>
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<td></td>
<td>Issued By: S. Pawan Kumar, Director/Signal 49</td>
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4.8.16 **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 sensor, cross zoned UV&IR Flamedetector and independent LHS module, the automatic suppression system, if provided shall get activated after a time delay adjustable by user up to 10 minutes in multiples of 0.5 minutes.

4.8.17 **4.9.17 The control panel should have a GSM module and the system(s) shall send SMSs 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.** Thermobile numbers shall be configurable. SMS shall be generated within 30 seconds of the control panel receiving the detection signals and if the sending fails, subsequent sending of SMS shall be tried by the system immediately. The SIM required for the GSM modem shall be provided by the purchaser. The GSM modem shall be from reputed make and compatible to Quad-band GSM 850,900, 1800 and 1900 MHz. It shall support GPRS class 10 and shall work on power supply of the AFDAS with suitable power supply adapter. It shall be able to withstand operating temperature 0°C to 49°C and humidity up to 85%. The GSM Module shall be an optional item and shall be supplied as per request of the purchaser.

4.8.18 **4.9.18 The alarm of Control Panel shall have means to indicate the room i.e. Relay Room or Power Equipment Room or DG Room etc., from where the alarm situation has been reported and shall also indicate the location of sensor in that room which has reported the alarm situation. The Control Panel shall activate the fire extinguisher, if used any, of that room only for extinguishing the fire.**

4.9.19 **4.9.19 The front panel shall have character display (LED/LCD) and alphanumeric keyboard.** The control panel shall also work in degrade mode, i.e., the failure of the control panel shall operate the audio-visual and other output devices in case of an alarmed detected.

4.10 **Audio Visual Alarm (Hooter cum strobe):**

4.10.1 **Audio visual alarm (Hooter cum strobe) shall be provided in the loop with Control Panel where required.**

4.10.2 **Audio visual alarm system (Hooter cum strobe) shall get activated in case of fire/smoke.**

4.10.3 **Visual Alarms (Strobe):** It shall be preferably loop powered and shall be preferably flashing type RED Color.

4.10.4 **Audio Alarms (Hooter):** It shall be preferably loop powered and shall be preferably with Piezo-electric type sounder with tone type of Fire-Engine. The sound level shall be preferably adjustable type up to 90db at a distance of 1m.

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

4.04.11 FIRE SURVIVAL CIRCUIT INTEGRITY CABLES

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

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

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

4.04.11.4 Unarmored copper cables of minimum 2Core x 1.5 sq.mm having cross linkable Low smoke halogen free insulation and sheath, 500V rated, twisted with ATC uninsulated circuit protective conductor of 1.5 sq.mm, aluminum tape screening shall be used when the entire circuit is within the same building.

4.04.11.5 Armored and unarmored shall have anti-rodent outer sheath with Low Smoke Properties.

4.04.11.6 armored&unarmored (Cl) cables should meet fire performance test under simultaneous action of flame, water stress and impacts on single sample at 950°C for minimum 2 hours, certified by LPCB or equivalent. Vendor shall submit certificate for the same.

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

4.04.11.8 Cables/wiring shall be laid down in metallic/rigid PVC conduits. PVC Conduits shall be used only in concealed spaces.

4.04.11.9 Cables connected to detectors shall be given 'S' loop on both the sides of the detectors which shall be properly clamped to the ceiling. Loop shall also be left where cables connect sounders, panels, dampers, etc. Appropriate 2 hours fire-rated glands shall be provided where the cable enters the junction box.

4.04.11.10 All the cables and wires shall be tagged for proper identification. Wires shall be identified by ferrules at junction and cables by colour bands at every 3 midistance.

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

Signature

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Designation: ASI/Signal - A231

Issued By: S. Pavan Kumar
Designation: Dir(3)/Signal - A231
4.10.12  MANUAL CALL POINTS

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

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

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

4.10.12.4  It shall be addressable.

4.10.12.5  It shall be resettable.

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

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

4.11  CROSS ZONING

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

4.11.14.3.2  If only one detector is triggering the control panel, it shall give visible alarm.

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

4.11.14.3.4  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.

4.11.14.3.5  If alarm is received from LH5 cable controller or Manual Call point it shall be treated as fire like situation. Cross zoning is not applicable for this system.

4.13  SITING AND SPACING OF DETECTORS

4.13.1  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.

4.13.2  A minimum of two UV&IR flame detectors shall be provided in the Diesel Oil storage rooms. The inter-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.
4.12.4.14.3 One number Smoke and heat multi sensor shall be provided on either side of each - one way 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. Each sensor shall be wired/addressed in different zones. If one detector only identifies fire like situation, then control panel shall provide only visual alarm. If both the adjacent detector provides the trigger for alarm, then the control panel shall treat as fire like situation.

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

4.13.15 CONVERSION TABLE OF OBSCURATION

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<td>1.45</td>
<td>1.5</td>
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</tr>
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</table>

4.14.16 SPARES

The following mandatory spares shall be supplied for each installation:

4.14.16.1 10% for modules, detectors, and loop cards, subject to minimum of one number for each installation.

4.14.16.2 For CPU card and Power Supply card minimum one number shall be provided for each installation.

5.0 FIRE SUPPRESSION

5.1 For fire suppression, railways shall provide one 4.5 kg capacity, IS 2878:2004, carbon dioxide extinguisher for every 100 m² of floor area or part thereof with minimum of two extinguishers so located as to be available within 10 m radius in addition to Automatic Fire Suppression System. (IS: 2190 - Annexure-B).

6.0 REQUIREMENTS TO BE FULFILLED BY MANUFACTURER BEFORE APPROVAL

6.1 Certificates/ Approvals/ Experience of the product / manufacturer

6.1.1 The manufacturer must be certified with ISO 9001:2008 (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 firms, but shall be responsible for the system integration. The outsourced firms shall be ISO
9001:2008 certified and the certification shall refer to the manufacturing of products being sourced.

6.1.2 The manufacturer shall provide certificates of all the projects executed by them for various applications of the same or similar systems during the last 5 years wherein they have used same/similar type of fire alarm and detection system.

6.2 The manufacturer shall guarantee for supply of spares including outsourced items during life of the equipment & 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 Alarm System

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 and modifications at his own expense on all the equipments supplied, provided such modifications / improvements are decided to be necessary for meeting the requirements of reliability, performance, and safety etc. jointly between manufacturer and purchaser.
6.11 For the purpose of technical decisions on improvements/ modifications etc. on equipment, 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 its sub-units, including outsourced items; as and when required, shall be conducted by concerned agencies as mentioned in the subsequent paras.

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 accept the 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 subjected to 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 sample as per guidelines of RDSO shall be tested for this purpose. The equipment shall successfully pass all the type tests for proving conformity with this specification. If the equipment fails in any of the type tests, the purchaser or his nominee at his discretion, may call for another equipment/card(s) of the same type and subject it to all tests or to the test(s) in which failure occurred. No failure shall be permitted in the repeat test(s).

7.4 Acceptance Test

7.4.1 Acceptance test shall be carried out on 20% of the lot offered (Minimum 2 of each 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 facilitate testing 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 to be adopted for various tests shall be decided taking into account the system design/configuration proposed by the manufacturer which shall be approved by RDSO.

9.2 Visual Inspection

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

9.2.2 Each equipment of the system shall be visually inspected to ensure compliance with the requirement of clauses of this specification. The visual inspection shall broadly 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.

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<thead>
<tr>
<th>Signature</th>
<th>Prepared By: Ranjeet Singh</th>
<th>Checked By: K. P. M. Singh</th>
<th>Issued By: U. Pavan Kumar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name &amp; Designation</td>
<td>BE (D) Signal</td>
<td>ACSR Signal 400</td>
<td>Electrical Signal - 40</td>
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DRAFT
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 55°C for Probe type bi-metallic heat detectors.

9.3.1.3 When the rate of temperature rise at the heat and smoke multi sensor exceeds 10°/C per 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 optical density of smoke exceeds 0.1dB/m (10 m visibility) at the heat and smoke multi sensor.

9.3.1.6 When LfHS cable senses temperature beyond 70°C.

9.3.1.7 When Aspirating (air sampling) Type Smoke Detector detects smoke with various levels of smoke for various stages, as follows:
   a) Stage 1 - 0.5 to 0.95% oce/m.
   b) Stage 2 - 1.0 to 1.45% oce/m.
   c) Stage 3 - 1.5 to 1.95% oce/m.
   d) Stage 4 - ≥ 2.0% oce/m.

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

9.3.1.11 All the above detectors shall be re-settable.

9.3.1.12 All the above detectors shall be addressable.

9.3.1.13 All the above detectors 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 200V DC for one minute in the correct polarity as well as in the reverse polarity. The unit shall be functional after applying 24V DC +10%, -15% 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, EN, FM, LPCB or UL, 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 specification on 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, 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, 11 & 12 of Clause No. 9.3 and Insulation Resistance test as per clause 9.5. High Voltage test as per clause no.9.6 of Specification RDSO/SPN/144/2006 or latest on single sample.

9.5.4 The triggering temperature of Probe type Bi metallic Heat Detector shall be set to value more than 100°C be subjected to 100°C for 16 hours. It shall be functioning properly during & after the test.

9.5.5 Other Items:

9.5.5.1 Fire survival Circuit Integrity Cable – Certified Lab report from UL/FM/EN/Vde/LPCB/UL or FM or Vds or LPCBor BRE Global or any recognized lab by Government of India.

9.5.5.2 VRLA Battery as per IRS/S-93/96(A) or latest.

9.5.5.3 Fasteners & Piping – Flame Proof - Certified Lab report from UL/EN/FMA/vde/LPCB-UL 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 out internally 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 each equipment:

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.

10.2 The equipment and its sub-assemblies shall be packed in thermo Cole boxes and the empty spaces shall be filled with suitable filling material. Before keeping in the thermo Cole box, the equipment shall be wrapped with bubble sheet. The equipment shall be finally packed in a wooden case of sufficient strength so that it 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:

<table>
<thead>
<tr>
<th>Signature</th>
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<th>Issued By</th>
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<tr>
<td>[Signature]</td>
<td>Harneet Singh JL (E) (Signal)</td>
<td>[Signature]</td>
<td>G. Praveen Kumar (E) (Signal)</td>
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</tbody>
</table>
11.1.1 Guaranteed performance data, technical and other particulars.
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, components, & details of each type of assembled PCB.
11.1.2.2 Details of Hardware e.g. schematic diagrams of the system circuits/components, details for each type of assembled PCB and part list
11.1.2.3 Mechanical drawings of every unit.
11.1.2.4 Part no. and manufacturer’s details of components used.
11.1.2.5 Trouble shooting procedure along with test voltages and waveforms at various test points in PCBs.
11.1.2.6 Details/procedure of trouble shooting of AFDAS.
11.1.2.7 Dos & Don’ts (Pocket size laminated cards)
11.1.2.8 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 for the equipment supplied under this specification.

13.0 TRAINING

13.1 The manufacturer shall impart suitable training in operation & maintenance/inspection & testing of the AFDAS.

14.0 INFRINGEMENT OF PATENT RIGHTS

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

5.0 VENDOR—CHANGES IN APPROVED STATUS

15.1 All the provisions contained in RDSO’s ISO procedure laid down in Document No. QOD-7.1-11 dated 19.07.2016 (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.