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GOVERNMENT OF INDIA / BHARAT SARKAR  
MINISTRY OF RAILWAYS / RAIL MANTRALAYA  
(RAILWAY BOARD)

No.2013/Sig./Specifications

New Delhi 14.11.2017

DG	to
DG	to
SIGNED	to
DATE	to

PCSTEs  
All Indian Railways

Sub: Provision of Fire Suppression System.

The draft specifications for Automatic Fire Suppression system for signalling installations was prepared by RDSO and deliberated during 85<sup>th</sup> SSC held at Udaipur on 18-19.08.2017.

2. After deliberations, SSC has recommended as under:
  - (i) The specifications shall remain as draft till such time trials are conducted. The draft specifications shall be circulated to all Zonal Railways.
  - (ii) Initial trials shall be conducted at Juhi (NCR), Kharagpur (SER), Kurla (CR) and Vijayawada (SCR).
3. DG (S&T), Railway Board has further directed that besides the four stations mentioned above, PCSTEs should identify vulnerable RRIs and the fire suppression system may be provided there also. This should be done in coordination with RDSO and as per RDSO's draft specifications.
4. PCSTEs are requested to take necessary action as per the above directives.

21-11-17  
(Arvind Mital)

Principal Executive Director (Signal)

✓ Copy to ED (Coordination) Signal, RDSO in reference to letter No. STS/E/AFSS Vol-II dated 06.10.2017.

note need to circulate  
draft instructions  
22/11/17

संकेत निदेशालय

दिनांक: 21/11/17  
कार्य. निदेशक (संकेत):  
कार्य. निदेशक:  
निर्देशक/सं. निदेशक: 5  
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ADG/Sig(U)(C)  
JRE (Five)  
22/11/17

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सत्यमेव जयते

# **FINAL DRAFT SPECIFICATION FOR AUTOMATIC FIRE SUPPRESSION SYSTEM FOR SIGNALLING INSTALLATIONS**

**SPECIFICATION No.: RDSO/SPN/218/2016  
Version 1.0- d2**

Number of Pages: 36

**Issued by**

**SIGNAL DIRECTORATE  
RESEARCH, DESIGNS & STANDARDS ORGANISATION  
MINISTRY OF RAILWAYS  
MANAK NAGAR  
LUCKNOW – 226 011**

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## Document Control Sheet

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## AMENDMENTS

Number	Chapter/ Annexure	Amendments	Date
RDSO/SPN/218/2016	---	Draft	DD.MM.YYYY

FINAL DRAFT

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## SPECIFICATION FOR AUTOMATIC FIRE SUPPRESSION SYSTEM FOR SIGNALLING INSTALLATIONS

### 0.0 FOREWORD

- 0.1 This specification is issued with 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 is intended chiefly to cover the technical provisions and does not include the necessary provisions of a contract.
- 0.3 The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.

(A) National Fire Protection Association (NFPA) standards:

NFPA 2001	Standard on Clean Agent Fire Extinguishing Systems
NFPA 70	National Electrical Code (NEC)
NFPA 72	National Fire Alarm and Signalling Code
NFPA 76	Standard for the Fire Protection of Telecommunications Facilities

(B) BSI standards:

BS EN54-2	Control and Indicating Equipment
BS EN54-4	Power Supply Equipment
BS EN54-11	Manual Call Points
BS EN54-18	Input/ output Devices
BS EN 15004	Fixed fire fighting systems. Gas extinguishing systems. Design, installation and maintenance

(C) Indian Standards:

IS: 15493	Gaseous fire extinguishing systems
IS: 15496	Inspection & maintenance of gaseous fire extinguishing systems- Code of practice
IS: 2189	Selection, Installation And Maintenance Of Automatic Fire Detection And Alarm System-Code Of Practice
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: 7285	Refillable Seamless Steel Gas Cylinders — Specification
IS: 15683	Portable Fire Extinguishers – Performance and Construction – Specification
IS: 10245 (Part-IV)	Escape Breathing Apparatus (Short Duration Self-contained type)
IS: 3624	Specification For Pressure And Vacuum Gauges
SP 30	National Electrical Code

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(D) IEC Standards:

IEC 61000-4-4	Electromagnetic Compatibility – Testing and Measurement Techniques – Electrical Fast Transient/Burst Immunity Test
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(E) ISO Standards:

ISO 14520	International Standard for Gaseous Fire-Extinguishing Systems
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(F) ANSI Standards:

ANSI C2	National Electrical Safety Code
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(G) ASTM Standards:

ASME B31.1	Code for Pressure Piping, Power piping
ASTM A 106	Grade B (Minimum required)
ASTM A53/53M -12	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
ASME B31.3-2002	Process Piping Guide

(H) RDSO/IRS standards:

IRS: S 23	Electrical and Electronic based signalling and interlocking equipment
IRS:S 93/96(A)	Valve Regulated Lead Acid Sealed Maintenance Free Stationary Battery
RDSO/SPN/144/2006	Safety and Reliability requirement of electronic signalling equipment
RDSO/SPN/217/2016	Automatic Fire Detection & Alarm System for Signalling Installations
IRS: S 99/2006	Data Logger System

0.4 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.

## 1.0 SCOPE

1.1 This document sets forth general, operational, technical and performance requirements of Automatic Fire suppression System (AFSS) for Signalling Installations.

1.2 The Automatic Fire suppression System (AFSS) as per this specification shall be of two types, described as follows:

1.2.1 Total Flooding Automatic Fire Suppression System (TFAFSS): The TFAFSS shall be an engineered system consists of an agent supply and distribution network designed to achieve a total flooding condition in a hazard volume.

1.2.2 In-Cabinet Automatic Fire Suppression System (ICAFSS): The ICAFSS shall be a pre-engineered system designed to self-detect, actuate & suppress

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fire/fire like situation within electrical/electronic equipment cabinet before fire could cause damage to any of the above equipment.

1.3 The clauses in this specification referring AFSS shall be complied by both TFAFSS and ICAFSS.

1.4 The TFAFSS shall be provided in only Relay/EI room. ICAFSS shall be provided for cabinets such as IPS, Data Logger, EI etc.

## 2.0 ABBREVIATIONS USED

Abbreviation used	Description
AU	Alarm Unit
AFSS	Automatic Fire Suppression System for Signalling Installations
AFSSCP	Automatic Fire Suppression System Control Panel
AMDC	Adjusted Minimum Design Concentration
AMDQ	Adjusted Minimum Design Quantity
ANSI	American National Standard Institute
ASME	American Society Of Mechanical Engineers
ASTM	American Society for Testing of Materials
ASM	Assistant Station Master
ATC	Annealed Tinned Copper
BSI	British Standard Institutions
CSTE	Chief Signal & Telecom Engineer
DF	Design Factor
EI	Electronic Interlocking
EPA	Environmental Protection Agency
FDC	Final Design Concentration
FDQ	Final Design Quantity
ICAFSS	In-Cabinet Automatic Fire Suppression System
ICMP	In-Cabinet Automatic Fire Suppression System Monitoring Panel
IEC	International Electro Technical Commission
ILAC	International Laboratory Accreditation Co-Operation
IMO	International Maritime Organization
IPS	Integrated Power Supply
IS	Indian Standards
ISO	International Organization For Standardization
LOAEL	Lowest Observable Adverse Effect Level
LPCB	Loss Prevention Certification Board
MDQ	Minimum Design Quantity
NABL	National Accredited Board For Testing And Calibration Laboratories
NFPA	National Fire Protection Association
NOAEL	No Observed Adverse Effect Level
PESO	Petroleum and Explosives Safety Organization
PI	Panel Interlocking

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Abbreviation used	Description
PLC	Programmable Logic Controller
RRI	Route Relay Interlocking
SF	Safety Factor
TFAFSS	Total Flooding Automatic Fire Suppression System
UL	Underwriter's Laboratories

### 3.0 TERMINOLOGY

3.1 The terminology used in this specification is covered by the definitions given in NFPA 2001, IS: 15493&IRS: S 23.

3.1.1 Approved: Acceptable to the individual responsible for approving installation.

3.1.2 Class A Fires: Fire in ordinary combustible materials, such as wood, cloth, paper, rubber, many plastics, electrical and electronic hazards without any flammable liquid or gas.

3.1.3 Class B Fires: Fire in flammable materials like diesel & other petroleum products etc.

3.1.4 Class C Fires: A fire that involves energized electrical equipment.

3.1.5 Clean Agent: Electrically non-conducting, vaporizing or gaseous that does not leave any residue after evaporation.

3.1.6 Clearance: The air distance between clean agent equipment, including piping and nozzles and unenclosed or uninsulated live electrical components at other than ground potential.

3.1.7 Containers: A Cylinder or other vessels used to store the clean agent.

3.1.8 Container Discharge Valve: A valve directly connected to a container which when actuated releases the clean agent into the distribution piping.

3.1.9 Automatic Fire Suppression System Control Panel: A device to control the sequence of events leading to the release of clean agent.

3.1.10 Design Concentration: The concentration (including safety factor) of the clean agent necessary to extinguish a fire of a particular fuel (in this specification fires can be generated by electrical hazards or diesel oil).

3.1.11 Extinguishing Concentration: The concentration (without safety factor) of the agent necessary to extinguish the flame of a particular fuel at atmospheric pressure.

3.1.12 Hazardous Concentration: The concentration that exceeds the LOAEL for the agent used.

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- 3.1.13 **Injected Concentration:** The concentration of the agent necessary to develop under free efflux conditions to the required design concentration.
- 3.1.14 **Maximum Concentration:** The concentration achieved from the actual clean agent quantity at the maximum ambient temperature.
- 3.1.15 **Pre-Engineered System:** A system having predetermined flow rates, nozzle pressures, and quantities of agent. These systems have the specific pipe size, maximum and minimum pipe lengths, flexible hose specifications, number of fittings, and number and types of nozzles prescribed by a testing laboratory. The hazards protected by these systems are specifically limited as to type and size by a testing laboratory based upon actual fire tests. Limitations on hazards that can be protected by these systems are contained in the manufacturer's installation manual, which is referenced as part of the listing.
- 3.1.16 **Residual Oxygen Concentration:** The resulting concentration of oxygen achieved within a protected area after the discharge of agent into the area.
- 3.1.17 **Discharge Inhibit (Abort) Switch:** A manually operated switch that prevents the automatic discharge of the clean agent.
- 3.1.18 **Distribution Systems:** All the pipe work and fittings downstream of any container discharge valve.
- 3.1.19 **Engineered System:** A system requiring individual calculation and design to determine the flow rates, nozzle pressures, pipe size, area or volume protected by each nozzle, quantity of agent, and the number and types of nozzles and their placement in a specific system.
- 3.1.20 **Fill Density:** The mass of gaseous agent per unit volume of the container (Kg/m<sup>3</sup>).
- 3.1.21 **Flooding quantity:** Mass or volume of clean agent required to achieve the design concentration within the protected volume within the specified discharge time.
- 3.1.22 **Gross Volume:** The volume enclosed by the building elements around the protected enclosure, less the volume of any permanent impermeable building elements within the enclosure.
- 3.1.23 **Holding Time:** Period of time during which a concentration of clean agent greater than the fire extinguishing concentration surrounds the hazard.
- 3.1.24 **In-Cabinet Automatic Fire Suppression System Monitoring Panel:** A device to monitor the functioning of ICAFSS.

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- 3.1.25 Lock off Valve: A mechanically operated device which prevents a clean agent from being discharged through distribution pipe work to the protected area.
- 3.1.26 Lowest Observable Adverse Effect Level (LOAEL): The lowest concentration of clean agent at which an adverse toxicological or physiological effect has been observed.
- 3.1.27 Maximum Working Pressure: Equilibrium pressure within a container at the maximum working temperature.
- 3.1.28 Monitoring: The supervision of the operating integrity of an electrical, mechanical, pneumatic or hydraulic control feature of a system.
- 3.1.29 No Observed Adverse Effect Level (NOAEL) :— The highest concentration of a clean agent at which no adverse toxicological or physiological effect has been observed.
- 3.1.30 Normally Occupied Area: An area where, under normal circumstances, humans are present.
- 3.1.31 Normally Unoccupied Area: Area not occupied by people but may be occasionally entered for brief periods.
- 3.1.32 Retrofitability: To modify a equipment that is already in service using parts developed after the time of original manufacture.
- 3.1.33 Total Flooding: The act and manner of discharging an agent for the purpose of achieving a specified minimum agent concentration throughout a hazard volume.

#### 4.0 GENERAL REQUIREMENTS

- 4.1 Automatic Fire suppression System for Signalling Installation (AFSS) shall consist of the followings:
- 4.1.1 Total Flooding Automatic Fire Suppression System (TFAFSS):
- 4.1.1.1 Clean Agent Filled Containers as per IS: 7285;
- 4.1.1.2 Pressure gauge with low pressure switch;
- 4.1.1.3 Distribution System;
- 4.1.1.4 Automatic Fire Suppression System Control Panel (AFSSCP);
- 4.1.1.5 Alarm Unit;
- 4.1.1.6 Cables & Relays;
- 4.1.1.7 Heavy duty weighing scale with digital indicator for monitoring the weight of the container. (Optional).
- 4.1.2 In-Cabinet Automatic Fire Suppression System (ICAFSS):
- 4.1.2.1 In-Cabinet Automatic Fire Suppression System Monitoring Panel (ICMP);
- 4.1.2.2 Clean agent filled Container as per IS: 7825/ IS: 15683;
- 4.1.2.3 Pressure Gauge with low pressure switch;

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- 4.1.2.4 Valve;
- 4.1.2.5 Heat sensing element;
- 4.1.2.6 Alarm Unit;
- 4.1.2.7 Cables & Relays.
- 4.2 The TFAFSS shall be initiated both automatically as well as manually.
- 4.3 The ICAFSS shall be suitable to suppress fire/ fire like situation inside electrical cabinets, transformers, invertors, cable trays and electronic equipment. The TFAFSS shall be suitable for installation in power equipment rooms, relay rooms, battery rooms, IPS rooms, DG rooms and any other rooms concerned to signalling installations.
- 4.4 The TFAFSS shall be suitable to suppress fire/ fire like situation in relay room, power equipment room, electronic equipment, electrical wiring etc. & shall be able to extinguish fire before it causes damage to any of the above equipment.
- 4.5 The AFSS shall not degrade the performance of relays, power equipment, wiring, cables etc. when subjected to fire suppression/extinguishing process.
- 4.6 The AFSS shall work satisfactorily & reliably over the entire range of following environmental parameters:
  - 4.6.1 Temperature range:-10°C to + 55°C (NFPA 2001 Para 4.1.4.3)
  - 4.6.2 Humidity: 0 to 95 %
  - 4.6.3 External heating or cooling arrangements shall be used to keep the temperature of the storage container within the desired limits (NFPA 2001 Para 4.1.4.6). These external heating or cooling arrangements shall be provided by the purchaser for TFAFSS as per guidelines of manufacturer.
- 4.7 The TFAFSS shall be possible to be interfaced with the existing Fire Alarm System wherever available or to be provided with Automatic Fire Detection and Alarm System as per RDSO/SPN/217/2016 Ver. 1.0 or latest.
- 4.8 The TFAFSS shall have manual override to initiate TFAFSS or to disable the system.
- 4.9 The working of the AFSS shall not cause interference to other electrical/electronic circuits/systems and shall not damage relays, wiring, power equipment etc.
- 4.10 The AFSS shall be provided with all precautions regarding earthing & preventing hazard as per requisite clauses of IS 15493: 2004.The system shall be bonded & earthed as per SP 30: 2011.
- 4.11 The TFAFSS shall fulfil all the quality requirement & storage shall be as per clause no 8.1(except for lower limit of temperature for agent storage) of IS 15493-2004.

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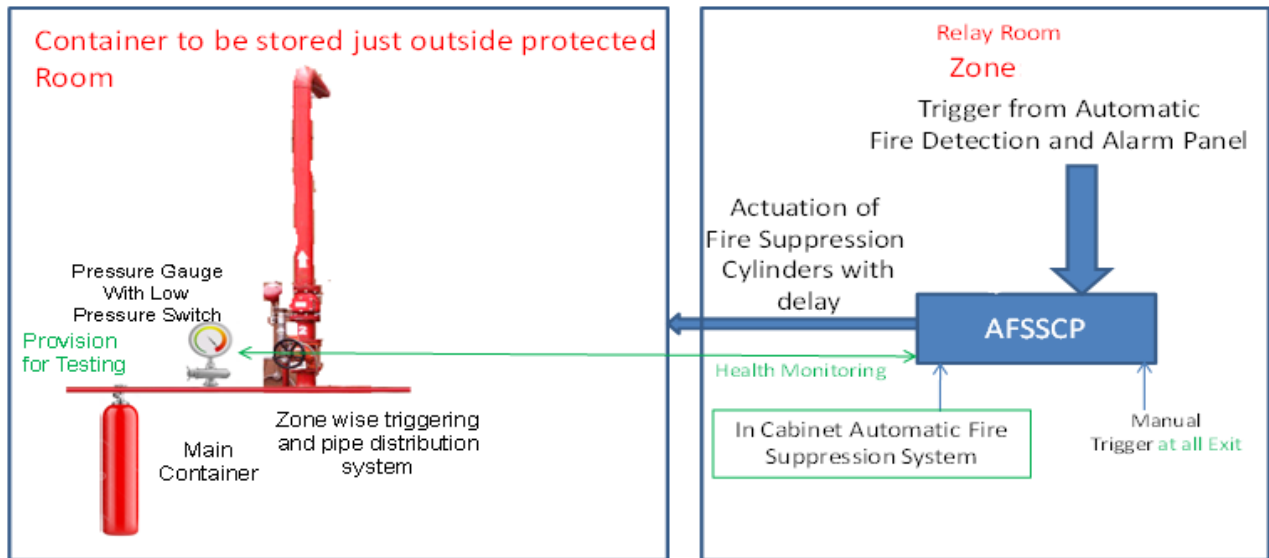
- 4.12 The TFAFSS shall incorporate a pre discharge alarm with a time delay sufficient to allow personnel evacuation prior to discharge.
- 4.13 The TFAFSS shall consist of a time delay device, which shall be used only for personnel evacuation or to prepare the hazard area for discharge.
- 4.14 Automatic/manual switch shall be provided in the AFSSCP to the protected area where required.
- 4.15 A Lock off Valve shall be provided in the discharge pipe between the nozzle and agent supply. This shall be used to prevent discharge of clean agent through distribution pipe work to the protected area during maintenance. The status of Lock off Valve shall be monitored by AFSSCP.
- 4.16 The TFAFSS shall be provided with occupancy sensor/s. The occupancy sensor shall prevent the triggering of TFAFSS in case of the hazard area is occupied by humans.
- 4.17 The room integrity shall be ensured by purchaser and manufacturer before installing TFAFSS.
- 4.18 Pressure relief device/s such as Baffle/s shall be provided in the installation for relieving of pressure arises due to total flooding condition for protection of signalling installation without compromising fire safety.
- 4.19 GENERAL PRINCIPLES OF AFSS:
- 4.19.1 The extinguishing Clean Agent and / or its by-products shall not leave any residue and shall not be harmful to living beings, environment, electrical equipment, electronic equipment, power equipment, signalling equipment, relays and shall not cause interference to working of electrical/electronic/signalling circuits/systems and shall not damage relays, wiring, power equipment etc.
- 4.19.2 During the course of fire extinguishing process & after that, it shall not provide any conductance or any insulation between relay contacts, terminals & exposed wires.
- 4.19.3 It shall be friendly to the ozone layer. While discharge, it shall not deplete the oxygen content beyond the NOAEL.
- 4.19.4 The containers used for TFAFSS shall be Seamless Steel containers manufactured to IS: 7285 and shall be PESO approved.

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- 4.19.5 The containers used for ICAFSS shall be Steel containers manufactured to IS: 7285/IS: 15683 and shall be type approved as per the relevant IS Specification.
- 4.19.6 There shall be an arrangement of refilling once the fire extinguishing system is operated. Refilling shall be done at PESO Authorized Filling Stations. The refilling, transportation of empty and filled containers shall be the responsibility of the manufacturer. Thereafter this activity shall be carried out by the manufacturer as per the terms and conditions agreed between purchaser and manufacturer.
- 4.19.7 The manufacturer shall provide a guarantee certificate to provide filled containers before taking away the empty containers as per the request of the purchaser.
- 4.19.8 The general arrangement of AFSS for control flow shall be as per Annexure-C.
- 4.20 The TFAFSS shall be installed along with the fire preventive measures described as follows: (This clause is optional for ICAFSS manufacturer)
- 4.20.1 Insulated cover for Lugs of battery terminals.
- 4.20.2 Air Conditioner Fire detection and suppression device that also helps in preventing the spread of fire.
- 4.20.3 Fire preventive provision for the conduits from where cables enter.
- 4.20.4 Fire Granules for prevention in cable trays.
- 4.20.5 Self-Contained Breathing Apparatus as per IS 10245-Part-IV and Protective dress at least two sets for each signalling installation provided with AFSS.
- 4.20.6 Any rearrangement of electrical gadgets required for installation of AFSS shall be done by the purchaser.
- 4.20.7 Exit routes shall be kept clear at all times and provision of emergency lighting and adequate direction signs to minimize travel distances shall be provided.
- 4.20.8 All the doors shall have facility to open from inside even though they are locked from outside to allow any person to come out of the hazard area. This arrangement is to be done by the purchaser.
- 4.20.9 Radio frequency /electromagnetic interference and electromagnetic compatibility must be available. The limits for EMI shall be 2KV ( $\pm 10\%$ ), 5 KHz ( $\pm 20\%$ ) for Power supply ports and 1KV ( $\pm 10\%$ ), 5 KHz ( $\pm 20\%$ ) for input/output signal, data and control ports (IEC 61000 4-4).
- 4.20.10 **GENERAL ARRANGEMENT OF AUTOMATIC SUPPRESSION SYSTEM FOR SIGNALLING INSTALLATION (AFSS):**

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## 5.0 TECHNICAL REQUIREMENTS

### 5.1 CLEAN AGENT:

- 5.1.1 The clean agent shall be halocarbon based and shall be approved by UL/FM/Vds/LPCB.
- 5.1.2 The clean agent shall extinguish a fire by removing the free radicals or heat elements from the fire tetrahedron. (Oxygen, Heat, Fuel& Chemical Reaction).
- 5.1.3 The following parameters of the clean agent proposed for TFAFSS or ICAFSS or both shall be submitted separately, duly certified by an international recognized laboratory and by the manufacturer:
- 5.1.3.1 Product chemical formula:
  - 5.1.3.2 Molecular weight:
  - 5.1.3.3 Standard Followed in Design:
  - 5.1.3.4 Design Concentration for fires originated by Electrical apparatus:
  - 5.1.3.5 Design Concentration for fires originated by Diesel Oil:
  - 5.1.3.6 Boiling Point:
  - 5.1.3.7 Freezing Point:
  - 5.1.3.8 Toxicity Levels: (NOAEL/LOAEL)
  - 5.1.3.9 Container pressure at 21°C:
  - 5.1.3.10 Container pressure at 55 °C:
  - 5.1.3.11 Minimum Piping Design pressure at 21°C:
  - 5.1.3.12 Global Warming Potential
  - 5.1.3.13 Ozone depletion potential
  - 5.1.3.14 Extinguishing Concentration
  - 5.1.3.15 Atmospheric Life time
  - 5.1.3.16 Decrease in quantity of oxygen present in the chamber due to action of clean agent.
  - 5.1.3.17 Maximum Fill Density
  - 5.1.3.18 Flooding Factor
  - 5.1.3.19 Safety Factor
  - 5.1.3.20 Design Concentration
  - 5.1.3.21 The manufacturer shall submit the chromatography certificate for the purity of the clean agent used from a laboratory approved by UL/FM/Vds/LPCB.
- 5.1.4 The quality of the clean agent used shall be as per Clause 4.1.2 of NFPA 2001.
- 5.1.5 The Clean agent shall be certified non-conductive up to and at least 25KV (AC/DC).

### 5.2 TECHNICAL REQUIREMENTS FOR TFAFSS:

#### 5.2.1 TFAFSS SYSTEM DESIGN ENGINEERING:

- 5.2.1.1 The purchaser shall give the details of installation for TFAFSS as per Annexure-A. Based on these inputs, the manufacturer shall carry out the

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pipings Isometric design and validate the same with a hydraulic flow calculation generated by using the UL/FM/Vds/LPCB approved software. The appropriate fill density shall be arrived at based on the same.

5.2.1.2 The design & calculation of clean agent shall be checked & certified by trained design engineer of the clean agent and inspecting official jointly.

5.2.1.3 The minimum design quantity of clean agent shall be as per NFPA 2001(latest edition).

5.2.1.4 The maximum permitted time to extinguish a fire with a halocarbon agent shall not exceed 10 seconds as per clause no. 5.7.1 of NFPA 2001.

5.2.1.5 Plans, design of the system, agent requirement shall be as per NFPA 2001(latest edition). The calculations for piping and nozzle orifice shall be got done by a licensed software approved from FM/UL/Vds/LPCB.

5.2.1.6 For safety reasons, the clean agent AFSS container-valve, discharge hose, nozzles, Electric actuators/Solenoid Valve, Check Valve, Pressure Release Valve, Interconnected hose, non-return valve, manual release station, supervisory switch for container pressure, pressure switch and pressure gauge must be provided from the same manufacturer to ensure proper performance as a system with UL/FM/Vds/LPCB approvals, thereby giving a confidence that a third party has tested the performance of the whole unit as a system.

5.2.1.7 Container for TFAFSS shall be seamless steel type manufactured and tested in accordance with IS: 7285 standard approved by PESO. The sizes of the containers shall be UL/FM/Vds/LPCB approved.

5.2.1.8 Container shall be actuated by resettable electric actuator as well as manual actuator.

5.2.1.9 Each Container shall have a pressure gauge and low pressure switch to provide visual and electrical supervision of the container pressure.

5.2.1.10 The low-pressure switch shall be wired to the AFSSCP to provide audible and visual "Trouble" alarms in the event the container pressure drops below the value, which is to be specified by Manufacturer of TFAFSS .

5.2.1.11 The pressure gauge shall be colour coded to provide an easy, visual indication of container pressure.

5.2.1.12 Each pressure gauge shall be UL/FM/Vds/LPCB approved and calibrated for its 'accuracy' & 'precision in reading' from a reputed calibrating agency as per IS 3624. The calibration of pressure gauges shall be done by the calibrating agency, which shall issue a certificate of calibration & fix a non-erasable and non-peelable sticker bearing validity of calibration at the time of supply.

## 5.2.2 TFAFSS DISTRIBUTION SYSTEM DESIGN:

5.2.2.1 The pipes used in the pipe network shall be made of Stainless/carbon Steel(ASTM A53/53M-12/106)including their assemblies such as couplings, unions, elbows, tees, end caps, capillary tubes, sampling ports and mounting brackets. They shall be in accordance with ASME B31.3 -2002& NFPA 2001.In exceptional circumstances, at some isolated location, if it is not feasible to provide CS/SS pipes due to constraints, flexible pipe, flexible non-metallic pipe, tubing or hoses, including interconnections shall be used with the approval of

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the purchaser for the materials and pressure ratings during installation. All distribution piping shall be installed by qualified individuals using accepted practices and quality procedures. The pipe network shall be free of particulate matter and oil residue before installation of nozzles and discharge devices.

5.2.2.2 The internal pressure used for these calculations shall not be less than the greater of the following values:

5.2.2.3 The normal charging pressure in the agent container shall be at 21°C.

5.2.2.4 The eighty percent of the maximum pressure in the agent container at a maximum storage temperature of not less than 55°C, using the equipment manufacturer's maximum allowable fill density.

5.2.2.5 All piping shall be adequately supported and anchored at all directional changes and nozzle locations.

5.2.2.6 All piping shall be reamed, blown clear and swabbed with suitable solvents to remove burrs, mill varnish and cutting oils before assembly.

5.2.2.7 Provision shall be kept in the system for testing the suppression system efficacy to observe blockage/leakage in pipes and nozzles.

5.2.2.8 All pipe threads shall be sealed with Teflon tape pipe sealant applied to the male thread only. Alternatively pipe fittings are to be welded to the pipe as required.

#### 5.2.3 STORAGE CONTAINER ARRANGEMENT FOR TFAFSS:

5.2.3.1 The storage container and its accessories shall be compatible to the clean agent used and shall be designed for the anticipated pressures.

5.2.3.2 Each container shall be equipped with pressure relief device to protect against excessive pressure situations (NFPA 70 A.4.1.4.1).

5.2.3.3 The maximum fill density limit specified for each liquefied clean agent shall not be exceeded.

5.2.3.4 The storage container shall be suitable to work up to a maximum temperature of 55°C.

#### 5.2.3.5 NOZZLES FOR TFAFSS:

5.2.3.6 To avoid clogging of external foreign materials, the discharge nozzles shall be provided with flange discs, blow off caps or other suitable devices.

5.2.3.7 Engineered discharge nozzles shall be provided within the clean agent manufacturer's guidelines to distribute the clean agent throughout the protected spaces.

5.2.3.8 The nozzles shall be designed to provide proper agent quantity and distribution.

5.2.3.9 Nozzles shall be available in 1/2 in. to 2 in. pipe sizes. Each size shall be available in 180° and 360° distribution patterns.

#### 5.2.4 VALVE FOR TFAFSS:

5.2.4.1 All valve components shall be compatible with the agent used in the suppression system.

#### 5.2.5 ELECTRIC ACTUATOR FOR TFAFSS:

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5.2.5.1 Electric actuator (solenoid or equivalent) valve shall be used for opening the container or at zone selection point for discharge. It shall be driven by the AFSSCP and shall work on 24VDC.

5.2.6 TIME DELAY:

5.2.6.1 Time delay shall be used only for personnel evacuation and preparing hazard area for discharge of TFAFSS.

5.2.6.2 No time delay shall be required for ICAFSS.

5.2.6.3 The time delay shall range from 60 seconds to 120 seconds from the reception of alarm signal from detection system depending on the time required for the last person to come out of the Fire Hazard area.

5.2.7 DISCHARGE TIME:

5.2.7.1 The discharge time required to achieve 95% of the minimum design concentration with at least 20% safety factor for the fire suppression shall not exceed 10 seconds.

5.2.8 MANUAL ACTUATOR FOR TFAFSS:

5.2.8.1 The manual actuator device shall be used for opening the container at zone selection point for discharge manually.

5.2.8.2 The system shall also be capable of being actuated by manual discharge devices located at each hazard entrance/exit.

5.2.8.3 Operation of a manual device shall duplicate the sequence description above except the time delays and abort functions be bypassed.

5.2.8.4 The manual discharge actuator shall be of the electrical/pneumatic actuation type and shall be supervised at the AFSSCP.

5.2.8.5 The Abort switch shall have IP 31 protection.

5.2.9 ABORT SWITCH FOR TFAFSS:

5.2.9.1 To avoid unwanted discharge of clean agent system, an Abort switch shall be provided. The Abort switch shall be located within the protected area near the exit.

5.2.9.2 The Abort switch shall interrupt the releasing circuit to the suppression system.

5.2.9.3 The Abort switch shall be of such type that requires constant pressure to inhibit the discharge.

5.2.9.4 The operation of Abort switch shall cause distinct audio and visual alarm.

5.2.9.5 The Abort switch operation shall override all the other systems except the ICAFSS. If the abort switch is initiated before the automatic discharge delay expiry, the system shall prevent agent release and the automatic delay timer shall stop. When the abort switch is restored, the automatic delay timer shall resume from the stop point and agent release shall occur with the expiry of the timer.

5.2.9.6 Software based Abort switch shall not be permitted.

5.2.9.7 A telephone is required to be provided near Abort switch. The telephone shall be provided by the purchaser.

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5.2.9.8 The Abort switch shall have IP 31 protection.

#### 5.2.10 DETECTION ARRANGEMENT FOR TFAFSS:

5.2.10.1 The detectors for detection of fire/fire like situation for triggering AFSSCP shall be provided as per RDSO/SPN/217/2016 or latest by the purchaser.

#### 5.2.11 AUTOMATIC FIRE SUPPRESSION SYSTEM CONTROL PANEL (AFSSCP): (To be supplied by TFAFSS manufacturer)

5.2.11.1 The AFSSCP shall be of PLC/microcontroller based with monitoring for AC power ON, System ON, system discharge, electrical actuator status, pressure healthy, position of Lock off valve, removal of clean agent container and battery low by LED indicators and system operation by LED strobe light and buzzer.

5.2.11.2 Necessary inputs for discharge, pressure switch, Trigger from AFDAS and ICMP shall be provided by means of Potential Free Contact. Zone wise discharge facility shall be available. All the outputs shall have potential free relay contact (NO/NC).

5.2.11.3 The AFSSCP shall be provided with 50 dB piezoelectric buzzer output.

5.2.11.4 The AFSSCP shall be fitted in an IP 31- enclosure.

5.2.11.5 The AFSSCP shall be designed to work on power supply of 24 V DC  $\pm 20\%$  as well as 110VAC/230 V AC  $\pm 20\%$ . The AFSSCP shall have in-built charging facility to have 24V DC battery backup (VRLA as per IRS: S-93/96(A) or latest) for at least 24 hours.

5.2.11.6 The AFSSCP shall be self-checking & diagnostic type. The data regarding health & event shall be logged in the system with date & time stamp, which could be downloaded to a PC/ Laptop at later stage. The system shall have capacity to store data for up to a minimum of 1000 fire events and 1000 other events. The AFSSCP shall be networkable to the Zonal/Divisional Railway headquarters preferably over TCP/IP and shall have clock synchronization facility.

5.2.11.7 It shall be possible to download data from Control unit through suitable ports like RS232/ USB into a PC/Laptop operating on Windows platform. The software for downloading and analysing fault data shall be provided & shall be compatible with windows operating system.

5.2.11.8 Operating devices such as system isolate switches and ancillary equipment; including shutdown equipment; dampers and door closures, required for successful system performance shall be considered integral parts of the system. All ancillaries should incorporate manual reset facilities.

5.2.11.9 GSM Module (optional):The AFSSCP should have a GSM module and the system(s) shall send SMSs on GSM network to not less than 5 preselected GSM mobile numbers as desired by the user . The mobile numbers shall be configurable. SMS shall be generated within 30 seconds of the AFSSCP 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

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MHz. It shall support GPRS class 10 and shall work on power supply of the AFSS with suitable power supply adapter. It shall be able to withstand operating temperature -10 ° C to 70° C and humidity up to 95%. This shall be an optional item and shall be supplied as per the request of purchaser.

#### 5.2.12 OCCUPANCY SENSOR:

- 5.2.12.1 Suitable occupancy sensor/s shall be provided for preventing the total flooding condition unless the hazard area is cleared by human.
- 5.2.12.2 The occupancy sensor shall be interfaced with AFSSCP.
- 5.2.12.3 The presence of occupancy sensors/s shall be indicated by AFSSCP.
- 5.2.12.4 The method of occupancy shall be advised in detail at the time of type approval.

#### 5.3 TECHNICAL REQUIREMENTS FOR IN-CABINET AUTOMATIC FIRE SUPPRESSION SYSTEM(ICAFSS):

- 5.3.1 The ICAFSS shall be so designed that it shall self-detect, actuate & suppress fire/fire like situation within electrical/electronic equipment cabinet before fire could cause damage to any of the above equipment.

#### 5.3.2 STORAGE CONTAINER FOR ICAFSS:

- 5.3.2.1 The storage container and its accessories shall be compatible to the clean agent used and shall be designed for the anticipated pressures.
- 5.3.2.2 The maximum fill density limit specified for each liquefied clean agent shall not be exceeded.
- 5.3.2.3 The storage container shall be suitable to work up to a maximum temperature of 55°C.
- 5.3.2.4 Each Container shall have a pressure gauge and low pressure switch to provide visual and electrical supervision of the container pressure.
- 5.3.2.5 The low-pressure switch shall be wired to the ICMP to provide audible and visual "Trouble" alarms in the event the container pressure drops below the value, which is to be specified by Manufacturer of ICAFSS .
- 5.3.2.6 The pressure gauge shall be colour coded to provide an easy, visual indication of container pressure.
- 5.3.2.7 Each pressure gauge shall be UL/FM/Vds/LPCB approved and calibrated for its 'accuracy' & 'precision in reading' from a reputed calibrating agency as per IS 3624. The calibration of pressure gauges shall be done by the calibrating agency, which shall issue a certificate of calibration & fix a non-erasable and non-peelable sticker bearing validity of calibration at the time of supply.

#### 5.3.3 DETECTION ARRANGEMENTFOR ICAFSS:

- 5.3.3.1 The ICAFSS shall be equipped with detection arrangements in the area under its influence (in cabinet).
- 5.3.3.2 The heat sensing element used for ICAFSS shall be such that it detects fire or fire like situation in each partition of the cabinet.

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#### 5.3.4 IN CABINET AUTOMATIC FIRE SUPPRESSION SYSTEM MONITORING PANEL (ICMP):

- 5.3.4.1 The ICMP shall have the facility to trigger the TFAFSS (if provided).
- 5.3.4.2 The ICMP shall be provided with 50 dB piezoelectric buzzer output.
- 5.3.4.3 The ICMP shall have potential free relay contact (NO and NC) at least 4 Nos.
- 5.3.4.4 The ICMP shall be self-checking & diagnostic type.
- 5.3.4.5 The data regarding health & event shall be logged in the ICMP with date & time stamp, which could be downloaded to a PC/ Laptop at later stage.
- 5.3.4.6 The system shall have capacity to store data for up to a minimum of 1000 fire events and 1000 other events. The ICMP shall be networkable to the Zonal/Divisional Railway headquarters preferably over TCP/IP and shall have clock synchronization facility.
- 5.3.4.7 The ICMP shall be provided with 50 dB piezoelectric buzzer output.
- 5.3.4.8 The ICMP shall have the facility to monitor the health of containers and trigger to the AFSSCP to trigger the TFAFSS by means of potential free contact. The ICMP shall be fitted in an IP 31- enclosure.
- 5.3.4.9 The ICMPs shall be powered from the SMPS Based IPS available at station with 24V-32V DC-DC converters in 1+1 configuration.
- 5.3.5 The purchaser shall give the details of installation for ICAFSS as per Annexure-B.

#### 5.4 ALARM UNIT (AU):

- 5.4.1 The Alarm Unit shall be as follows:
  - 5.4.1.1 The AU shall be provided for warning of hazardous condition. It shall provide distinct audio & visual warning alarm for personnel evacuation prior to discharge for TFAFSS only. The audio & visual alarm for AFSS shall be activated during discharge.
  - 5.4.1.2 The AU shall be such that a hazardous condition is indicated through audio and visual warning prior to discharge of the agent.
  - 5.4.1.3 The AU shall be complied relevant clauses of RDSO/SPN/144/2006 or latest.
  - 5.4.1.4 The AU shall have IP 31 protection.

#### 5.5 REFILLING OF STORAGE CONTAINERS:

- 5.5.1 The Refilling of Storage Containers shall be done as follows:
  - 5.5.1.1 Before the system containers are moved, the container outlets shall be connected with anti-recoil devices, caps or both when the container outlet is connected to the system pipe inlet. Actuators shall be disabled before the containers are removed from the retaining bracketing. Safe handling procedures are to be followed while transporting the system containers. Equipment designed for transporting containers shall only be used. The Manufacturer shall be completely responsible for refilling the empty container from authorized filling stations and transportation of filled containers to the protected area. The purchaser shall ensure that the contract is in place with the Manufacturer for such refilling and transportation.

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## 5.6 FIRE SURVIVAL CABLES:

5.6.1 The cables shall be of Fire Survival type and shall be as follows:

5.6.1.1 Armoured copper cables of minimum 2C x 1.5 sq.mm having cross linkable Low smoke halogen free insulation, inner & outer sheath, 1000V rated, twisted shall be used when the entire circuit is not within the same building.

5.6.1.2 Unarmoured copper cables of minimum 2C x 1.5 sq.mm having cross linkable Low smoke halogen free insulation and sheath, 500V rated, twisted with ATC un-insulated circuit protective conductor of 1.5 sq.mm, aluminium tape screening shall be used when the entire circuit is within the same building.

5.6.1.3 Armoured and unarmoured shall have anti-rodent outer sheath with Low Smoke Properties.

5.6.1.4 Armoured & unarmoured cables shall meet fire performance test under simultaneous action of Flame, water stress and impacts on single sample at 950°C for minimum 2 hours.

5.6.1.5 The cable manufacturer shall provide test certificate related to the manufacturing of fire resistant wires & cables from UL/FM/Vds/LPCB/ BRE Global or any recognized lab by Government of India. The manufacturer shall also give self-certification in this regard.

## 5.7 ELECTRICAL CLEARANCES:

5.7.1 All of the AFSS components shall be located to maintain no less than the minimum horizontal and vertical clearance of at least 50mm(as per Clause 7.4.4.3 of SP 30:2011) from the energized electrical parts.

## 6.0 **REQUIREMENTS TO BE FULFILLED BY MANUFACTURER BEFORE APPROVAL**

### 6.1 CERTIFICATES / APPROVALS / EXPERIENCE OF THE PRODUCT / MANUFACTURER TO BE SUBMITTED:

6.1.1 The manufacturer must be certified with ISO 9001:2000 (the scope of the ISO Certification has to specifically refer to the manufacturing of the products as described below).

6.1.2 The manufacturer shall be approved for TFAFSS or ICAFSS or for both.

6.1.3 The manufacturer seeking approval for TFAFSS shall be a firm whose system shall be UL/FM/Vds/LPCB listed/approved.

6.1.4 The manufacturer seeking approval for ICAFSS shall be a firm which possesses listing/approval of UL/FM/Vds/LPCB for complete system or the entire component individually..

6.1.5 The manufacturer seeking approval for both TFAFSS and ICAFSS shall comply the requirements mentioned in the both the clauses above.

6.1.6 The Manufacturer shall submit test report and certificate with full analysis report from NABL/ILAC/UL/FM/Vds/LPCB/BRE Global/PESO or any accredited lab in reference to AFSS for the followings:

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- 6.1.6.1 During the course of Fire Suppression process & after that, it shall not provide any conductance or any insulation between relay contacts, terminals & exposed wires.
- 6.1.6.2 The containers for TFAFSS shall be marked to IS: 7285 and shall be PESO approved. The containers for in cabinet system shall be as per IS: 7285/ IS: 15683. The type approval certificates of containers shall be submitted.
- 6.1.6.3 The clean agent shall react with the free radicals of fire.
- 6.1.6.4 The system shall work in the entire range of environmental parameters mentioned in relevant clause(s).
- 6.1.6.5 Product Certification / Listing of TFAFSS shall be from UL/FM/Vds/LPCB which certify / list all models and all mechanical components according to the existing standards on Clean Agent fire protection systems. The certified accessories along with manufacturer Name, certifications and data sheet shall be as follows:

S. No.	Description of the accessory	Make and Model No	Certified by
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- 6.1.7 The Certification from any of the above labs for all the parameters of the Clean Agent specified in above concerned clauses shall be submitted. The Clearance letter from Ministry of Environment, Forest and Climate Change for the Clean Agent proposed to be used for AFSS by manufacturer shall be submitted.
- 6.1.8 The AFSS manufacturer shall submit the list of Authorized Clean Agent storage and filling Stations duly certified by PESO for the clean agent.
- 6.1.9 The TFAFSS. manufacturer shall submit the list of Equipment being supplied for fire preventive measures along with manufacturer Name, certifications and data sheet as follows:

S. No.	Description of the Equipment	Make and Model No	Certified by
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This clause is optional for ICAFSS manufacturer.

- 6.1.10 The manufacturer shall submit the certified lab report of Fire survival Cable from "UL/FM/EN/Vds/LPCB/ BRE Global/NABL or any recognized lab by Government of India.
- 6.1.11 The manufacturer shall submit the make of VRLA Battery as per IRS/S-93/96(A) or latest.
- 6.1.12 The Manufacturer shall guarantee for supply of spares during life of the equipment & extend maintenance support, if required by the Railway/purchaser.
- 6.1.13 The manufacturer shall supply detailed instructions for proper installation of the system. The manufacturer shall depute his expert/trained engineers/supervisors to purchaser's site during installation of the equipment.
- 6.1.14 The Manufacturer shall associate themselves during commissioning, testing and field trials of the system.
- 6.1.15 The manufacturer shall install & commission the system at the locations identified for field trials. The detailed field trials to ascertain the suitability of the

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system shall be carried out by purchaser before considering the manufacturer for approval.

- 6.1.16 The manufacturer shall also offer special tools and instruments separately, which may be required for maintenance.
- 6.1.17 The Manufacturer shall submit recommended list of spares required for satisfactory maintenance and operation of the AFSS.
- 6.1.18 The Manufacturer shall submit design manual for the system containing detail functioning of each item and its sub-assembly giving following details about:
  - 6.1.18.1 Testing procedure;
  - 6.1.18.2 Diagram & layout;
  - 6.1.18.3 Write up on the working of Automatic fire Suppression system;
  - 6.1.18.4 Machinery and Plant required for manufacturing/assembling;
  - 6.1.18.5 The Manufacturer shall supply the user's manual for maintenance and troubleshooting.
- 6.1.19 The manufacturer shall be responsible for carrying out improvements and modifications at his own expense on all the equipment 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. A certificate to this affect shall be submitted by the Manufacturer.
- 6.1.20 Pre-installation checklist, Pre-commissioning checklist and Maintenance checklist shall be submitted to RDSO by the manufacturer or approval.
- 6.1.21 For the purpose of technical decisions on improvements/ modifications etc. on equipment, the final authority from the purchaser's side will be RDSO.

## **7.0 INSPECTION AND TESTING:**

### **7.1 GENERAL:**

- 7.1.1 Type, Acceptance and Routine tests on AFSS and its sub-units, including outsourced items; as and when required, shall be conducted by concerned agencies as mentioned in the subsequent clauses.
- 7.1.2 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 a supply lot. Routine Test for the complete/sub system shall be carried out by manufacturer.
- 7.1.3 The routine test shall be carried out by the manufacturer on each unit and the proper record to be maintained by the manufacturer.
- 7.1.4 Acceptance test shall be carried out by inspecting agencies nominated to accept supply lot.

### **7.2 TFAFSS:**

#### **7.2.1 TYPE TEST:**

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7.2.1.1 For type test, one prototype sample of TFAFSS shall be subjected to following tests as applicable:

7.2.1.1.1 Visual check;

7.2.1.1.2 Applied High Voltage Test;

7.2.1.1.3 Insulation Resistance test;

7.2.1.1.4 Radio frequency/electromagnetic interference and electromagnetic compatibility test;

7.2.1.1.5 Performance test;

7.2.1.1.6 System level functional test;

7.2.1.1.7 Chromatography test;

7.2.1.1.8 Container test;

7.2.1.1.9 Software design calculation test;

7.2.1.1.10 Endurance test;

7.2.1.1.11 Environmental test.

7.2.1.1.12 Leak Detection Test.

7.2.1.2 The prototype sample of TFAFSS shall include all subsystems or components suitable to suppress Class B (diesel originated) and Class C fires in 1000ft<sup>3</sup>.

7.2.1.3 The system shall successfully pass all the type tests for proving conformity with this specification. If any one of the equipment fails in any of the type tests, the purchaser or his nominee at his discretion, may call for another sample and subject it to all tests. No failure shall be permitted in the repeat test(s).

## 7.2.2 ACCEPTANCE TEST:

7.2.2.1 Acceptance test shall be carried out on 20% of the lot offered subject to minimum of one number:

7.2.2.1.1 Visual check;

7.2.2.1.2 Applied High Voltage Test;

7.2.2.1.3 Insulation Resistance test;

7.2.2.1.4 Radio frequency/electromagnetic interference and electromagnetic compatibility test;

7.2.2.1.5 Performance test;

7.2.2.1.6 System level functional test;

7.2.2.1.7 Chromatography test;

7.2.2.1.8 Container test;

7.2.2.1.9 Software design calculation test.

7.2.2.1.10 Leak Detection Test.

## 7.2.3 ROUTINE TEST:

7.2.3.1 For Routine test, complete system shall be subjected to following tests by manufacturer

7.2.3.1.1 Visual check;

7.2.3.1.2 Applied High Voltage Test;

7.2.3.1.3 Insulation Resistance test;

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- 7.2.3.1.4 Radio frequency/electromagnetic interference and electromagnetic compatibility test;
- 7.2.3.1.5 Performance test;
- 7.2.3.1.6 System level functional test;
- 7.2.3.1.7 Chromatography test;
- 7.2.3.1.8 Container test;
- 7.2.3.1.9 Software design calculation test.
- 7.2.3.1.10 Leak Detection Test.

### 7.3 ICAFSS:

#### 7.3.1 TYPE TEST:

- 7.3.1.1 For type test, one prototype sample of ICAFSS shall be subjected to following tests as applicable:
  - 7.3.1.1.1 Visual check;
  - 7.3.1.1.2 Applied High Voltage Test;
  - 7.3.1.1.3 Insulation Resistance test;
  - 7.3.1.1.4 Radio frequency/electromagnetic interference and electromagnetic compatibility test;
  - 7.3.1.1.5 Performance test;
  - 7.3.1.1.6 System level functional test;
  - 7.3.1.1.7 Chromatography test;
  - 7.3.1.1.8 Container test;
  - 7.3.1.1.9 Endurance test;
  - 7.3.1.1.10 Environmental test,
  - 7.3.1.1.11 Leak Detection Test.
- 7.3.1.2 The prototype sample of ICAFSS shall include all subsystem or component suitable to suppress fire in a cabinet of 6ft (height) x 3ft (width) x 3ft (depth) with 4 Nos. of equal partition housed with electrical equipment.
- 7.3.1.3 The system shall successfully pass all the type tests for proving conformity with this specification. If any one of the equipment fails in any of the type tests, the purchaser or his nominee at his discretion, may call for another sample and subject it to all tests. No failure shall be permitted in the repeat test(s).

#### 7.3.2 ACCEPTANCE TEST:

- 7.3.2.1 Acceptance test shall be carried out on 20% of the lot offered subject to minimum of one number:
  - 7.3.2.1.1 Visual check;
  - 7.3.2.1.2 Applied High Voltage Test;
  - 7.3.2.1.3 Insulation Resistance test;
  - 7.3.2.1.4 Radio frequency/electromagnetic interference and electromagnetic compatibility test;
  - 7.3.2.1.5 Performance test;
  - 7.3.2.1.6 System level functional test;

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- 7.3.2.1.7 Chromatography test;
- 7.3.2.1.8 Container test.
- 7.3.2.1.9 Leak Detection Test.

### 7.3.3 ROUTINE TEST:

- 7.3.3.1 For Routine test, complete system shall be subjected to following tests by manufacturer
  - 7.3.3.1.1 Visual check;
  - 7.3.3.1.2 Applied High Voltage Test;
  - 7.3.3.1.3 Insulation Resistance test;
  - 7.3.3.1.4 Radio frequency/electromagnetic interference and electromagnetic compatibility test;
  - 7.3.3.1.5 Performance test;
  - 7.3.3.1.6 System level functional test;
  - 7.3.3.1.7 Chromatography test;
  - 7.3.3.1.8 Container test.
  - 7.3.3.1.9 Leak Detection Test.

## 8.0 **TEST PROCEDURE:**

### 8.1 VISUAL CHECK:

- 8.1.1 The AFSS shall be checked for proper manufacturing, proper fitment in its enclosure, connection and dimensions as agreed between manufacturer and purchaser.
- 8.1.2 Each unit of the AFSS shall be visually inspected to ensure compliance with the requirement of clauses of this specification. The visual inspection shall broadly include:
  - 8.1.2.1 Constructional details;
  - 8.1.2.2 Dimensional check;
  - 8.1.2.3 General workmanship;
  - 8.1.2.4 Configuration;
  - 8.1.2.5 Indications and displays;
  - 8.1.2.6 Mounting and clamping of connectors;
  - 8.1.2.7 Markings.

### 8.2 APPLIED HIGH VOLTAGE TEST:

- 8.2.1 The Applied High Voltage Test shall be carried out as per clause 9.6 of RDSO/SPN/144/2006 Rev. 2.0 to the AFSSCP, Abort Switch, Electrical Actuator, low pressure switch, Manual Actuator and other electrical systems for TFAFSS.
- 8.2.2 The Applied High Voltage Test shall be carried out as per clause 9.6 of RDSO/SPN/144/2006 Rev. 2.0 to the ICMP and other electrical systems for ICAFSS.

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### 8.3 INSULATION RESISTANCE TEST:

- 8.3.1 The Insulation Resistance Test shall be carried out as per clause 9.5 of RDSO/SPN/144/2006 Rev. 2.0 to the AFSSCP, Abort Switch, Electrical Actuator, low pressure switch, Manual Actuator and other electrical systems for TFAFSS.
- 8.3.2 The Insulation Resistance Test shall be carried out as per clause 9.5 of RDSO/SPN/144/2006 Rev. 2.0 to the ICMP and other electrical systems for ICAFSS.

### 8.4 RADIO FREQUENCY / ELECTROMAGNETIC INTERFERENCE AND ELECTROMAGNETIC COMPATIBILITY TEST:

- 8.4.1 The Radio frequency/electromagnetic interference and electromagnetic compatibility test for AFSS shall be conducted in accordance with IEC 61000-4-4.

### 8.5 PERFORMANCE TEST:

- 8.5.1 The performance test for TFAFSS shall be conducted on AFSSCP, Abort Switch, Electrical Actuator, low pressure switch, Manual Actuator and other electrical systems to test for the conformity to this specification.
- 8.5.2 The performance test for ICAFSS shall be conducted on ICMP, low pressure switch and other electrical systems to test for the conformity to this specification.

### 8.6 SYSTEM LEVEL FUNCTIONAL TEST:

- 8.6.1 The functionality and various parameters of AFSS as a complete shall be tested as per this specification.

### 8.7 CHROMATOGRAPHY TEST:

- 8.7.1 The clean agent used in AFFS shall be tested for Chromatography test for purity of the clean agent.

### 8.8 CONTAINER TEST BEFORE REFILLING:

- 8.8.1 All the pressurized containers for TFAFSS shall be retested as per IS: 7285 before each refilling.
- 8.8.2 All the pressurized containers for ICAFSS shall be retested as per IS: 15683/IS: 7285 (as applicable) before each refilling.

### 8.9 SOFTWARE DESIGN CALCULATION TEST:

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8.9.1 The Software design calculation test for TFAFSS on manufacturer's UL/FM/Vds/LPCB approved software shall be conducted to check as per NFPA 2001 latest edition. The manufacturer shall run the software before the inspecting official for the tendered quantity for design verification.

#### 8.10 ENDURANCE TEST:

##### 8.10.1 TFAFSS:

8.10.1.1 The endurance test on TFAFSS shall be done to ensure its endurance against repeated use.

8.10.1.2 The complete prototype TFAFSS system filled with air shall be subjected to 1,000 discharge cycles. At the end of this test the TFAFSS shall be completely functional.

8.10.1.3 The standalone electrical actuators (solenoid or equivalent) along with low pressure switch shall be subjected to 10,000 cycle of operation by extending the supply of 24VDC through make & break of contacts at specified time interval. At the end of this test the electrical actuators (solenoid or equivalent) shall be completely functional.

##### 8.10.2 ICAFSS:

8.10.2.1 The endurance test on ICAFSS shall be done to ensure its endurance against repeated use.

8.10.2.2 The complete prototype ICAFSS system filled with air shall be subjected to 1,000 discharge cycles. At the end of this test the ICAFSS shall be completely functional.

8.10.2.3 The standalone valve along with low pressure switch shall be subjected to 10,000 cycle of operation by extending the supply of 24VDC through make & break of contacts at specified time interval. At the end of this test the electrical actuators (solenoid or equivalent) shall be completely functional.

#### 8.11 ENVIRONMENTAL TEST:

8.11.1 The complete prototype TFAFSS shall be tested as per SI. No. 1 (temp range - 10°C to 55°C), 2 (55°C), 3 (-10°C), 4 (humidity 95%), 5 (humidity 95%), 6 (humidity 95%), 7, 11 & 12 of Clause No. 9.3. The Insulation Resistance test as per clause 9.5, High Voltage test as per clause no. 9.6 of Specification RDSO/SPN/144/2006 Rev. 2.0 on AFSSCP, Abort Switch, Electrical Actuator, low pressure switch, Manual Actuator and other electrical systems shall be conducted before and after each climatic test.

8.11.2 The complete prototype ICAFSS shall be tested as per SI. No. 1 (temp range - 10°C to 55°C), 2 (55°C), 3 (-10°C), 4 (humidity 95%), 5 (humidity 95%), 6 (humidity 95%), 7, 11 & 12 of Clause No. 9.3. The Insulation Resistance test as per clause 9.5, High Voltage test as per clause no. 9.6 of Specification RDSO/SPN/144/2006 Rev. 2.0 on ICMP and other electrical systems shall be conducted before and after each climatic test.

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## 8.12 LEAK DETECTION TEST:

- 8.12.1 Leak detection test of container equipped with clean agent, valve, pressure gauge before and after environmental test. The leak detection shall be carried out by a pre-checked leak detector for minimum sensitivity of  $1 \times 10^{-6}$  cm<sup>3</sup>/second at all potential leak areas such as valve to cylinder thread, gauge port threads, top of valve etc.

## 9.0 **MARKING**

- 9.1 The following information shall be clearly marked on a permanent name plate at a suitable place on each item of AFSS:
- 9.1.1 Name, trademark and Address of the manufacturer;
- 9.1.2 Month and Year of the manufacture;
- 9.1.3 Serial number of Equipment;
- 9.1.4 Version number;
- 9.1.5 RDSO Specification number;
- 9.1.6 Identification regarding recognized LAB certification;
- 9.2 A connection diagram for TFAFSS shall be provided on the AFSSCP.
- 9.3 A connection diagram for ICAFSS shall be provided on the AFSSCP.
- 9.4 In addition to above the containers used shall be marked as follows:
- 9.4.1 The agent used;
- 9.4.2 Tare and gross weight of the container;
- 9.4.3 The super-pressurization level;
- 9.4.4 Test pressure and date of the hydrostatic stretch test.
- 9.5 The marking shall be as per Clauses 12.1 and 12.2 of specification RDSO/SPN/144/2006 Rev. 2.0.
- 9.6 The words 'INDIAN RAILWAY PROPERTY' shall be engraved /embossed on every unit in letters of at least 10 mm size at a conspicuous place.

## 10.0 **INSTALLATION & MAINTENANCE**

### 10.1 INSTALLATION:

#### 10.1.1 TFAFSS:

- 10.1.1.1 Installation and commissioning of TFAFSS shall be done by Manufacturer as specified by the purchaser. Manufacturer shall issue a certificate of fitness of installation before commissioning with the approval of CSTE of Zonal Railways. For this, Zonal Railways and manufacturer shall ensure the compliance to Pre-commissioning checklist.
- 10.1.1.2 The manufacturer shall perform Enclosure Evaluation test for each location before installation as per Annex-D of NFPA 2001. In some circumstances it is necessary to gain the approval of the CSTE of Zonal Railways to waive the

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quantitative results of a standard door fan test and instead conduct a detailed witnessed leak inspection. This alternate testing process is described in NFPA 2001 Annex C.1.2.2 (5) in a section titled *Technical Judgment*. The purchaser shall comply the observations of room integrity test.

#### 10.1.2 ICAFSS:

10.1.2.1 Installation and commissioning of ICAFSS shall be done by Manufacturer as specified by the purchaser. Manufacturer shall issue a certificate of fitness of installation before commissioning with the approval of CSTE of Zonal Railways. For this, Zonal Railways and manufacturer shall ensure the compliance to Pre-commissioning checklist.

#### 10.2 MAINTENANCE:

10.2.1 The maintenance schedule along with necessary check list shall be issued by manufacturer with the approval of RDSO.

### 11.0 **TRAINING**

11.1 The manufacturer shall impart adequate and suitable training to the satisfaction of the purchaser for each installation, in operation, maintenance, inspection, testing of the AFSS including Fire prevention measures.

### 12.0 **DOCUMENTATION**

12.1 Following documents shall be supplied with each set of AFSS installation:

12.1.1 Two copies of Installation and maintenance manual. This should also include following information:

- (i) Guaranteed performance data, technical and other particulars.
- (ii) Schematic block diagram showing mounting arrangement of various components & details of each type of assemblies such as containers, valve, hose, piping arrangement, nozzles, control wiring, location of fail safety device, location of manual discharge switches, location & description of warning signs etc.
- (iii) Mechanical drawings of every unit & complete installation of AFSS.
- (iv) Part no. and manufacturer's data sheet of each component used.
- (v) Trouble shooting procedure.
- (vi) Dos & Don'ts
- (vii) Pre-installation checklist, Pre-commissioning checklist and Maintenance checklist.

### 13.0 **PACKING**

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13.1 The equipment and its sub-assemblies shall be packed suitably and the empty spaces shall be filled with suitable filling material. Before keeping in the 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.

13.2 Every box shall be marked with code numbers, contents and name of manufacturer. The upside shall be indicated with an arrow. Boxes should have standard signage to indicate the correct position and precaution "Handle with Care" with necessary instructions.

13.3 The units and their sub-assemblies shall be so packed as to permit convenient handling and to protect against loss or damage during transit and storage.

#### 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 & installation of AFSS and any other factor which may cause such dispute

#### 15.0 VENDOR –CHANGES IN APPROVED STATUS

15.1 All the provisions contained in RDSO's ISO procedure laid down in Document No. QO-D-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.

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### Annexure-A Design Calculations for TFAFSS

<b>Offer No :</b>														<b>Date:</b>					
DESIGN SHEET FOR TOTAL FLOODING SYSTEM FOR SIGNALLING INSTALLATIONS																			
<b>ZONAL RAILWAYS:</b>												<b>TYPE OF HAZARD</b>			Class		C & B*		
<b>DIVISION:</b>												<b>DESIGN CONCENTRATION</b>			% V / V				
<b>STATION:</b>												<b>DESIGN TEMPERATURE</b>			Deg.° C		21		
<b>PROJECT NAME:</b>												<b>FLOODING FACTOR</b>							
<b>LEGEND :</b>		CV - Ceiling Void / RV - Room Void / FV - Floor Void										<b>DESIGN PRESSURE</b>			Bar				
<b>S.No.</b>	<b>Room Description</b>	To be filled by Purchaser										To be filled by the Manufacturer							
		Dimension Details										Nozzles Qty				Gas Qty = Vol * Flooding factor Kgs.	Cyl. Cap. Ltrs.	Cyl. Qty= Round up[Gas Qty/(Maximum Cyl.Cap)]	Fill Density Kg/Ltr. =Gas Qty/( Cyl.Cap *Cyl.Qty)
		Length in M.	Width in M./ Area Sq.m.	Height in M.			Volume in M <sup>3</sup>				CV	RV	FV	Total					
CV	RV			FV	CV	RV	FV	Total											
1	Relay/EI Room																		
	<b>Total</b>																<b>0</b>		

The system shall be considered and designed for individual rooms.

\* Type of Hazard i.e. Class B shall be used for diesel oil storage room for diesel originated fire.

\* Type of Hazard i.e. Class C shall be used for all other room for energized electrical equipment originated fire.

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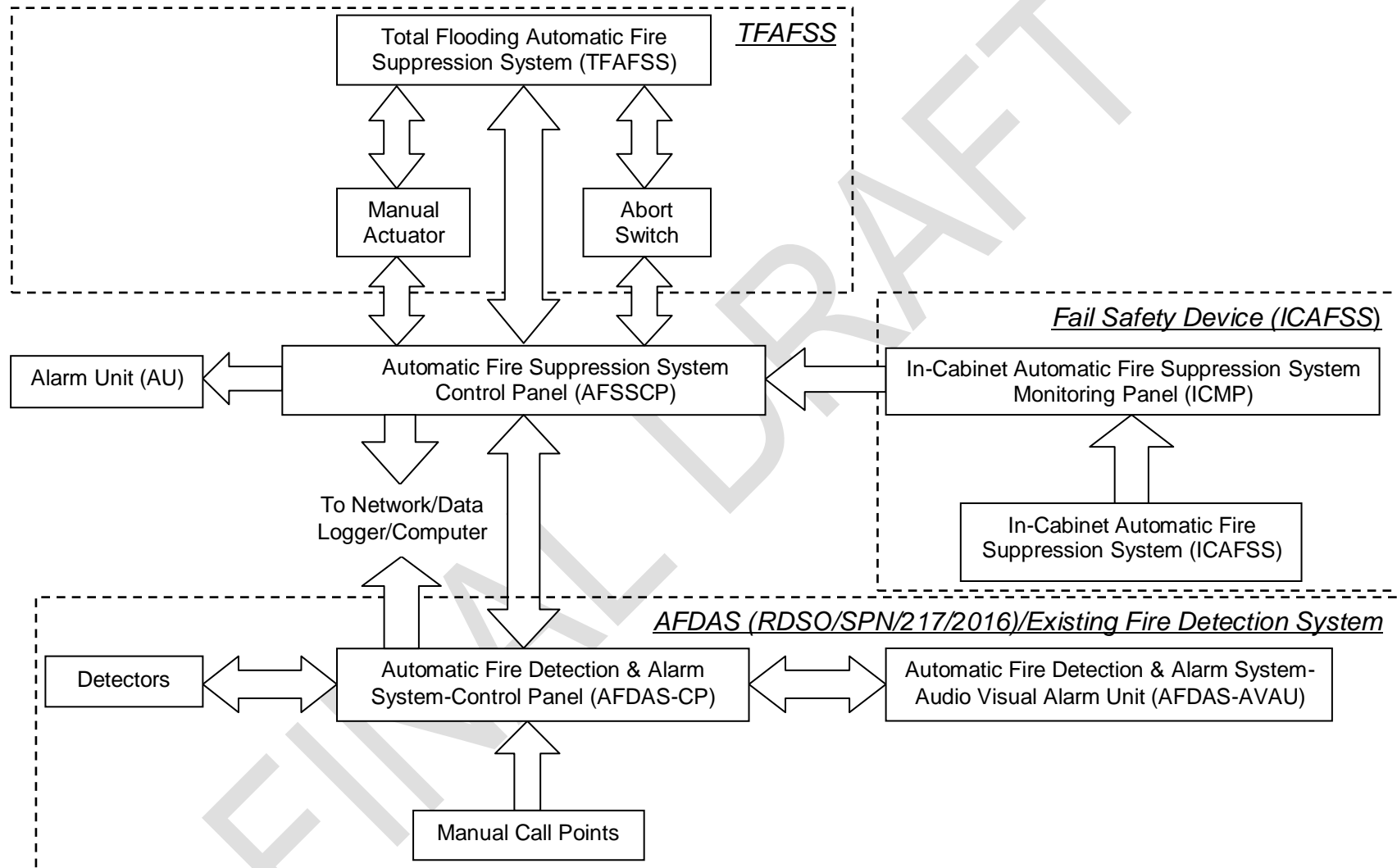
## Annexure- B Design Calculations for ICAFSS

<b>Offer No :</b>										<b>Date:</b>	
DESIGN SHEET FOR ICAFSS											
<b>ZONAL RAILWAYS:</b>								<b>TYPE OF HAZARD</b>		Class	C
<b>DIVISION:</b>								<b>DESIGN CONCENTRATION</b>		% V / V	
<b>STATION:</b>								<b>DESIGN TEMPERATURE</b>		Deg.° C	21
<b>PROJECT NAME:</b>								<b>FLOODING FACTOR</b>			
<b>LEGEND :</b>				L- Length, W- Width, H- Height, PV- Partition Volume				<b>DESIGN PRESSURE</b>		Bar	
.No.	Description of Cabinet.	To be filled by Purchaser						To be filled by the Manufacturer			
		Dimension Details						Length of Detection Element in meter	Gas Quantity	No. of Containers	No. of Monitoring Panel
		Room / Location	No. of Partitions	Dimension in meter			Volume in M <sup>3</sup> PV				
				L	W	H					
1											
2											
3											
4											
5											
6											
7											
	<b>Total</b>										

The system shall be considered and designed for individual cabinets.

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### **Annexure-C**



**General arrangement for Control Flow of AFSS**

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