INDIAN RAILWAYS

SCHEDULE OF TECHNICAL REQUIREMENTS FOR SUPPLY, INSTALLATION AND COMMISSIONING & MAINTENANCE OF “AUTOMATIC FIRE DETECTION CUM MANUAL SUPPRESSION SYSTEM” FOR PANTRY CAR & GENERATOR CUM BRAKE VAN OF INDIAN RAILWAYS COACHES (ICF AND LHB DESIGN)

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<th>S. No.</th>
<th>Month/Year of issue</th>
<th>Revision / Amendment</th>
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<td>First issue</td>
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1. **Introduction:**

Generator-cum-Brake Van and Pantry Car of IR Coaches (AC and Non-AC) of both ICF & LHB Design shall be equipped with a fire extinguishing system. The fire extinguishing equipment for the Generator-cum-Brake Van and Pantry Cars shall be based on use of water mist to fight fire. In case of a fire the extinguishing equipment shall be manually operated. This fire extinguishing equipment shall be provided to fulfill the stipulations of Para 4.5 of UIC 564-2 OR and system shall be designed to protect the Generator-cum-Brake Van and Pantry Cars.

The installed fire extinguishing system shall be a high pressure water mist system. The fire suppression effect of water mist shall be due to the large total surface area of the droplets and the high rate of speed at which they shall turn to water mist, thus absorbing the energy of fire. The average droplet of the system, yield a total surface area at least 100 times greater than conventional sprinkler droplets for the same volume of water. Therefore much smaller amount of water shall be required by fog system to absorb the equivalent amount of energy from the fire. The water shall have to be forced at high velocity through specially developed nozzles arranged on spray heads. This may be achieved by using a high storage pressure.

2. **Scope:**

This specification covers the general and technical requirements of interior high pressure water mist type fire extinguishing arrangement and mountings in Generator-cum-Brake Van and Pantry Cars. The general arrangement mountings and scope of supply shall be as per the latest alterations of the drawings of Generator-cum-Brake Van and Pantry Cars and shall also include its installation in IR coaches.

The supplier may ensure that the supplied system fully meets with the system components, system description and functional requirements indicated in following paragraphs.

2.1 All the provisions contained in RDSO’s ISO procedures 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 contract floated by Railways to maintain quality of products supplied to Railways.

2.2 IR/Purchaser will have prerogative to purchase the complete system or only Fire suppression system. The firm will submit their offer with and without “Automatic Fire detection system”.

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3 **Functional Requirements:**
The system supplied should work satisfactorily under the following operating conditions of IR coaches:

3.1 **Coach Dynamics:**
Equipment shall withstand satisfactorily the vibrations and shocks normally encountered in service as indicated below:

i) Maximum vertical acceleration 1.0g  
ii) Maximum longitudinal acceleration 3.0g  
iii) Maximum transverse acceleration 2.0g

The vibrations are of sine wave form and the frequency vibration is between 1 Hz to 50 Hz.

The amplitude ‘a’ expressed in millimeters is given as a function of f, by equations

\[ a = \frac{25}{f} \text{ for values from } 1 \text{ Hz to } 10 \text{ Hz.} \]
\[ a = \frac{250}{f^2} \text{ for values exceeding } 10 \text{Hz and up to } 50 \text{ Hz.} \]

3.2 In the direction corresponding to the longitudinal movement of the vehicle, the equipment is subjected for 2 min. to 50 Hz. Vibrations of such a value that the maximum acceleration is equal to 3g.

3.3 **Coach-body displacement encountered under dynamic conditions:**

i) Vertically- ±100 mm  
ii) Laterally - ±55 mm  
iii) Longitudinally- ±10 mm  
iv) Bogie rotation about center pivot- ±4°

3.4 **Ambient Conditions:**

(i) Ambient temperature : 1°C to 50°C  
Altitude : Sea level to 2500m  
Max. temperature under Sun : 70°C  
Relative humidity : 40% to 95%

(ii) The rainfall is fairly heavy.  
(iii) During dry weather, the atmosphere is likely to be dusty.  
(iv) Temperature variations can be quite high in the same journey or short period of time.
Coaches operate in coastal areas with continued exposure to salt laden air.

3.5 Coach Inside Condition:

Inside condition of the coach may be considered as under:

i) The ambient conditions may be similar as mentioned under para 3.4 above, as there is no control in temperature for non-AC Pantry Cars/Generator-cum-Brake Van. However in summers the value of upper range of the temperature may go up to 70°C near the roof ceiling above the cooking Hobs in Pantry Cars. There may be remarkable variation in temperature inside of the coach from floor to roof level in both these types of coaches.

ii) Wind flow speed nearby the window portion may be considered more than the specified speed of the non-AC Pantry Cars/Generator-cum-Brake Van, as windows may remain opened. The specified speed of the non-AC Pantry Car/Generator-cum-Brake Van is 110 kmph and 130 kmph in AC EOG.

iii) Both non-AC and AC Pantry Cars/Generator-cum-Brake Van have cooking and escorting staff area, the meals and snacks are prepared on electrical heaters/LPG Hobs and escorting staff in Generator-cum-Brake Van.

iv) The coach length over coupler is approximately 24 meter for LHB coaches and 22.96 meters in ICF type coaches.

v) Area to be covered by the system for fire suppression is cooking area in pantry car & DG set area in Generator Car which are having approx. dimensions tabulated as under:

<table>
<thead>
<tr>
<th>Coach Type</th>
<th>ICF Design</th>
<th>LHB Design</th>
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<tr>
<td></td>
<td>Length</td>
<td>Width</td>
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<tr>
<td>Pantry Car</td>
<td>8034</td>
<td>3045</td>
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<tr>
<td>Generator cum Brake Van</td>
<td>7440</td>
<td>3045</td>
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Necessary detailed layout drawing indicating the areas to be covered are enclosed at Annexure -I.

3.6 Power, Supply:

110±30% Volt DC supply with 15% ripple content is available from the coach circuits. For main source of supply to The System the vendor/supplier shall convert the voltage from coach circuit as per their requirements. For standby source of supply, battery and battery charger or other means of standby source
of supply to The System shall be used. The standby source of supply to the System shall comply with the EN 54-4 “Fire detection and alarm systems power supply equipment.”

4.0 DESIGN REQUIREMENTS:

4.1 The System designed shall be a proven and established technology/system on National/International Railway systems. Documentary evidence along with proof of supply and satisfactory performance certificate from user Railway(s)/Rolling Stock manufacturer shall be provided by the firm/collaborator.

4.2 All The System equipment(/s) designed, shall be tested, and comply according to the following Standards/Guidelines:

<table>
<thead>
<tr>
<th>Standard</th>
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<tr>
<td>ARGE Directive “Fire Fighting in Railway Vehicles”, Version 3.0</td>
<td>Evaluation of fire suppression systems</td>
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<tr>
<td>ARGE Directive Guideline “Fire Detection in Rolling Stock”, Version 4.0</td>
<td>Evaluation of fire detection system</td>
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<tr>
<td>EN 12 663</td>
<td>Railway applications - Structural requirements of railway vehicle bodies</td>
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<td>EN 50 121-3-2 2007</td>
<td>Railway applications – Electromagnetic compatibility – Rolling stock – Apparatus</td>
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<td>EN 50 125-1 2000</td>
<td>Railway applications – Environmental conditions for equipment – Equipment on board rolling stock</td>
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<tr>
<td>EN 50 126 2000</td>
<td>Railway applications – The specification and demonstration of reliability, availability, maintainability and safety (RAMS);</td>
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<tr>
<td>EN 50 128 2001</td>
<td>Railway applications – Communications, signaling and processing systems – Software for railway control and protection systems;</td>
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<td>EN 50 129 2003</td>
<td>Railway applications – Communications, signaling and processing systems – Safety related electronic systems for signaling;</td>
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<tr>
<td>EN 50 153 1996</td>
<td>Railway applications - Rolling stock – Protective provisions relating to electrical hazards</td>
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<td>Dy. Dir/SS/Carriage</td>
<td>Director/SS/Carriage</td>
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EN 50 155 2004  Railway applications - Electronic equipment used on rolling stock
EN 50159-1 2001  Railway applications - Communication, signalling and processing systems - Part 1: Safety-related communication in closed transmission systems;
BS EN 45545-6:2013  Railway applications - Fire protection on railway vehicles – Part 6: Fire control and management systems
NFPA 750  Standard on Water Mist Fire Protection Systems

The equipment supplier/collaborator should be a member of ARGE/NFPA and preferably should have IRIS certification and have IBS/IFAB/Vds/TUV approvals.

4.3 The System shall be designed for very early suppression of fire incidence. The design should incorporate any suitable principle for higher sensitivity to detect all possible size of smoke particles and/or elevated heat and very early suppression of fire incidence.

4.4 The System shall be designed to very early suppression of all type of fires and shall be capable to protect Kitchen area in pantry car and Generator Room area of Generator-cum-Brake Van. The system shall be compact, lightweight and highly reliable & robust in design.

The main functions of the fire extinguishing system shall be as per para 4.5.2 of the UIC 564-2 OR, “Fire Protection Regulations and Fire Fighting for International Passenger Cars or Coaches” which is reproduced below:

“Rooms with combustion engines are to be provided with fire extinguishing system allowing a manual remote control”.

The functioning of the fire extinguishing equipment shall be as follows:

4.4.1 The water shall be stored in the extinguishing agent reservoirs under a pressure of 200 bars (in case pressure is different from the specified value, the supplier have to demonstrate the efficacy of the system) and therefore, the reservoirs shall be filled not only with water but also with nitrogen to generate the requisite pressure. Water fog as fire-fighting agent shall be insensitive enough against the influences of air coming into the Pantry Cars/Generator-cum-Brake Van through the windows/doors. Alternatively, the system may also have two cylinders one filled with water & other one with Nitrogen, so just one pressurized cylinder needs to be fitted in the car.

4.4.2 The fire extinguishing equipment shall be manually released by applying the lever valves fixed to the reservoirs. The pressure on the reservoir shall push the water
from the reservoirs through the hoses, the manifold and the fire extinguishing pipes to the nozzles. The nozzles shall produce fine water fog of 0.01 mm to 0.1mm diameter. The arrangement should ensure that the droplets of fog have a huge reaction surface compared to the volume of water (approx. 200 m²/litre of water) and absorb large amounts of energy from the fire which shall lead to an immediate drop in temperature in the surroundings. Due to the rapid transformation of the droplets into stream, large quantities of energy should be additionally absorbed. The volume of the water should increase by evaporation 1640-fold and reduce the amount of oxygen at the source of the fire.

4.4.3 For monitoring of the readiness for working, the reservoirs shall be provided with the pressure gauges.

4.4.4 For the detection of a fire in the Pantry Cars/Generator-cum-Brake Van, the detectors for smoke and heat should be provided.

4.4.5 In case of response of one of these sensors, an acoustic signal shall be generated by a buzzer located on the appropriate position such as managers room/escorting staff cabin. The staff in the manager’s room/cabin will then check whether there is a fire in the Pantry Car/Generator-cum-Brake Van.

4.4.6 If there is a fire in the Pantry Car/Generator-cum-Brake Van, then, at first, the DG sets & Electrical supply shall be switched off by applying emergency stop on DG electrical panel. After that, the fire extinguishing equipment shall be released by applying the lever valves by its manual remote control, alternatively by pressing manual activation switch provided on control panel box.

4.4.7 The capacity of fire extinguishing system in the Pantry Car/Generator-cum-Brake Van should be such that the fire occurring in these coaches can be extinguished. The discharge time calculation should be tested and proven according to ARGE Guidelines. The fire load should be minimum 1.8 MW. The firms who wish to supply against the specification will be required to prove the efficacy of their system according to ARGE Guidelines during prototype approval.

4.4.8 It may be noted that apart from other reasons, fire may occur in the Pantry Car/Generator-cum-Brake Van on account of following:

- Combustion engines due to combustible liquids (Diesel, motor oil etc.)
- Electrical components,
- Cables& cable ducts,
- Control cabinets&
- Batteries in plastic casings

4.4.9 The fire extinguishing system shall be suitable for the use in railway vehicles, i.e. a safe functioning should be ensured for all operating conditions. It shall be ensured that the operating/running conditions of railway coaches do not result in

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unintentional release of the fire extinguishing system i.e. system shall be operative only on pressing the lever.

4.4.10 The refilling of used extinguishing agent shall be easy and simple. Sources and method of filling should be clearly indicated. The water cylinders should have special plastic lining/coating from inside the cylinder to avoiding corrosion.

4.4.11 The fire extinguishing system shall have an easy manual control and release. The operating mechanism shall be easily accessible. Operating instructions given by the supplier in the form of information boards or inscriptions shall be easily understandable to everyone. These information boards or inscriptions shall be made in the form of pictographs. Written instructions shall be provided by the supplier in a bilingual version, i.e. Hindi and English.

4.4.12 The operating mechanism shall be provided with suitable sealing in order to protect the fire extinguishing system against unauthorized use and to ensure proper level control of the extinguishing agent.

4.4.13 The weight of the fire extinguishing system to be supplied should be as low as possible.

5.0 Interface with the Car-body:

5.1 The approved vendor will be required to submit the general layout drawing including the fixing dimensions, tolerances and mounting arrangement of fire extinguishers

6.0 System Description:

6.1 The 50-100 litre cylinders shall be filled with 33-66 litres of water (drinking water quality) and adequately pressurized with Nitrogen. Alternatively, the system may also have two cylinders one filled with water & other one with Nitrogen, so just one pressurized cylinder needs to be fitted in the car.

The release of the extinguishing system shall be purely manual. Both cylinders shall be equipped with a valve with manual release lever. Pressure switches at the manifold shall initiate an electric alarm.

The distribution pipe system shall be made of stainless steel pipes to DIN-2462 of 12 OD x 1.5 mm thick. The pipes shall be fixed to the roof construction.

The nozzle should be made of Stainless Steel AISI 316 or better grade.

The firm shall provide a droplet spectrum for the selected nozzle verify that it confirm to NFPA 750 for high pressure water mist system.

6.2 The firm shall submit the scope of supply for system along with detailed calculation for the size of pressuring cylinder, water cylinder and no. of nozzles.
7.0 Mechanical strength requirements:
   i) Fire extinguishers shall meet the mechanical strength requirements as the
      Pantry Cars/Generator-cum-Brake Van running on Indian Railways are
      designed for a service life of 30 years. The fire extinguishers are to be
      developed and assembled accordingly.

   ii) Resistance to vermin:
       Selection of the materials (insulation, sealant, rubber, etc.) should be done
       with due consideration to their resistance to vermin (e.g. termites).

   iii) Climatic conditions:
       During normal operation, the generator room is forced-ventilated so the
       temperature reaches >65°C. However, temperatures up to >90°C may
       temporarily occur in the generator room when the vehicle stops because
       of compressive heat. Furthermore, temperatures of >90°C may occur at
       unfavourable places (especially due to closing of the exhaust system of
       the diesel engine).

       During normal operation, the kitchen area is used for cooking food etc. so
       the temperature reaches >70°C.

8.0 Warranty:

   Fire extinguishing system shall be of proven design and the supplier shall give
   warranty for the complete or part of fire extinguisher, for failing or proving
   unsatisfactory in service due to defective design, material or workmanship within
   36 months from the date of regular supply or 30 months from the date of
   installation whichever is earlier and shall replace the same at his own cost and
   risk. The supplier shall fix metallic stickers on each fire extinguisher mentioning
   name of the supplier and month of supply of fire extinguishers to Indian Railways.

9.0 Documents to be submitted by Supplier for Prototype Approval with each
   supply:

   The following documentation for the assembly of the fire extinguishers is to be
   prepared by the supplier for submission along with the prototype assembly:

   i) A set of drawings consisting of drawings and parts lists.

   ii) Clearly organized instructions for mounting and adjusting the fire
       extinguishers, changing the fire extinguisher and wearing parts

   iii) Maintenance and repair instructions

   iv) Technical description of the fire extinguisher

   v) Commissioning instructions

   vi) One set of information board/inscription (for each set)
10.0 Testing of Prototype & Regular Production Assemblies:

The supplier shall supply one set of system components of fire extinguishers along with the documents indicated above for approval before commencing bulk supply. The prototypes and drawings shall be examined and tested from all viewpoints and these shall be fitted on the coach for checking the proper fitment/functioning of the fire extinguishers for which one time full working of the system be demonstrated in order to ascertain the functioning & adequacy of the system. Supplier shall incorporate changes suggested by RCF in the prototype as well as bulk supply. The bulk manufacturing shall be undertaken only after the approval of prototype.

This clause is applicable for first supply of a supplier. However, RDSO/Indian Railways shall have the right to repeat prototype approval process in subsequent order also. In this regard RDSO decision shall be final.

11.0 Up-gradation of Design:

Supplier may offer alternate design of Fire Suppression System for all the above or any of the above clauses with a view to upgrade the design. Clause wise justification shall be given by the supplier in such case. Fire Suppression System having lower weight shall be preferred. Specification details may be deviated from those specified above, if sufficient technical justification is available. However, RDSO decision on all such matters shall be final.