1.0 Pre-Qualification Criteria

1.1 The bidder should be a manufacturer/supplier of the product for Rolling stock application of Railways for 3 phase IGBT based Train sets/RRTS/Semi high speed trains/AC EMU/MEMU/Metros in India or any railway systems in the world.

1.2 For supplies made in India, bidder should be approved vendor of Indian Railways /Metro/RRTS.

OR

For supplies made to any railway systems in the world, bidder shall provide approval, authenticated by country's recognized railway organization. Acceptance of such approvals will be at BHEL's discretion.

1.3 The product should have valid type test certificates complying to relevant latest IEC and other standards mentioned in the Reference Technical Specification for rolling stock application on the date of submission of the tender. The bidder shall fully comply with the type and routine test & inspection clause of the technical specification. The bidder shall conduct/repeat type tests either partially or fully **for the offered product** without any price implication to BHEL. Decision to conduct type test shall be at BHEL's discretion.

OR

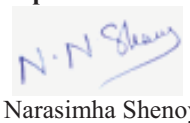
The bidder shall provide valid type test certificate/reports complying to relevant latest IEC and other standards for similar product supplied as per clause 1.1. Acceptance of such type test certificate/reports will be at BHEL's discretion. In such case, bidder will be considered for technical evaluation. The bidder shall conduct type tests fully **for the offered product**, without any price implication to BHEL.

1.4 Those bidder(s) who are registered with BHEL/ BHEL's customer (as the case may be) shall be considered for technical evaluation, subject to meeting above PQC clauses.

Bidders who are not registered with BHEL/BHEL's customer (as the case may be) can also quote in the tender. However, their credentials will be assessed for consideration in the tender, before price bid opening, subject to meeting above PQC clauses.

2.0 Documents to be submitted

All the relevant documents proof for points referred in 1.0 shall be submitted along with the tender.

		Approved: Anjul 		
Rev. 00		**Prepared**  Narasimha Shenoy	**Checked**  C David	**Date:** 19.01.2024

Bill of Material for Fire Detection system(Vande Bharat - 80 Train Sets)					
Sl. No.	**Material Code**	**Item Description**	**Qty per Rake (set)**	**Total qty. required for 32 Rakes (Set)**	**Remarks**
1	PR2900000165	Automatic Fire Detection with Alarm and Suppression System	1	32	
2	-	35 years maintenance for the equipment	1	32	
3	-	Erection/Supervision of Erection charges	1	32	
4	-	Commissioning/Supervision of Commissioning charges	1	32	
5		Training		16 mandays	
Note -					
All vendor must quote as per the quantities mentioned in this table and the quantities mentioned in the specification are for reference purpose only					

CUSTOMER/ USER	BHEL/INDIAN RAILWAYS
PROJECT	Manufacturing cum Maintenance of Vande Bharat Trainsets

TECHNICAL SPECIFICATION

Automatic Fire Detection with Alarm and Suppression System

Rev No.	Date	Altered	Checked	Approved	Revision Details

Issued by:
Traction Engg. Dept.,
BHEL-EDN

APPROVED
S P Singh

PREPARED	CHECKED	DATE
V Sunil Kumar	Prafful K Lakra	29.12.2023

Table of Contents:

ABBREVIATIONS

Abbreviation	Description
CCMS	Centralized Coach Monitoring System
EN	Europäische Norm (European Norm)
FDS	Automatic Fire / Smoke detection system
FDCU	Fire Detection Control Unit
IEC	International Electrotechnical Commission
IR	Indian Railways
ISA	Independent Safety Assessment
LHD	Linear Heat Detector
NFPA	National Fire Protection Association
RDSO	Research Designs & Standards Organization
SDTv2	Safe Data Transmission version 2
SIL	Safety Integrity Level
TCMS	Train Control & Monitoring System
TRDP	Train Real-Time Data Protocol

SECTION – 1
SCOPE, QUANTITIES & ELIGIBILITY

1.1 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of complete "Automatic Fire Detection (Point Type Detection Technology) with Alarm and Suppression system" as integrated package. The said system is hereafter referred as "FDS".

The equipment is required for the following project.

Name of the customer : BHEL / INDIAN RAILWAYS
Name of the Project : Manufacturing cum Maintenance of Vande Bharat Trainsets

The scope shall also include the followings:

- The supply of complete documentation for approval of design, relevant drawings and calculations to the satisfaction of purchaser, RDSO and support documentation associated with the operation and maintenance of the equipment supplied.
- The design of the equipment as offered shall be finally approved by RDSO/ICF/IR/Nominated Agency.
- The supplier shall submit list of equipment and facilities required for maintenance and overhaul of equipment offered.
- Supervision of installation of complete system of Automatic Smoke / Fire Detection with Alarm & Suppression System for the first 2 nos. prototype rakes shall be in scope of supplier.
- Commissioning and interfacing (hardware and software) of complete system shall be in scope of supplier. Supplier to depute team of skilled staff for Commissioning and interfacing at ICF and User Railways.
- Certification of designed & installed system for SIL2 compliant by ISA and submission of certificate and report.

Testing and commissioning support shall be required.

1.2 BILL OF MATERIAL:

S. No.	Description	Quantity (per rake)	Remarks
1.	Automatic Fire Detection (Point Type Detection Technology) with Alarm and Suppression System *[includes FDCU, Point type Detectors, DC-DC Converters, LHD Interfacing box, Passenger & Cab Alarm system, Aerosols etc.]*	**01 Set**	As per finalized design architecture
2.	Other accessories required for mounting, termination, Suitable power & Communication mating / interfacing connectors with associated pins & all cables required for the FDS package.	As reqd.	All mounting hardware shall be Stainless steel material

1.3 ELIGIBILITY CRITERIA

The Bidder should be a regular supplier to Indian Railway Projects, should have supplied & executed Point detection based Automatic Fire Detection with alarm system that is SIL2 proven & ISA certified FDS to Indian Railways projects of 3 phase IGBT Based AC EMU / Metros / Trainsets operating in India.

Alternately, bidder may offer the Point detection based Automatic Fire Detection with alarm system that is supplied, installed and is SIL2 proven & certified by reputed ISA (Independent Safety Assessment) body and under successful operation in any of the passenger trains like metros / semi-high speed / high speed / other Multiple Unit Trains operating globally.

1.4 CLAUSE BY CLAUSE COMPLIANCE

Vendor to submit clause by clause compliance to complete technical specification with seal and signature of competent authority along with the technical bid.

1.5 REFERENCE SPECIFICATIONS

This purchase specification has the reference of Railway Specification No. ICF MD SPEC-398 Rev-01 dated: 05/11/2022.

SECTION – 2
TECHNICAL SPECIFICATION

2.1 GENRAL TECHNICAL INFORMATION / REQUIREMENTS

a) Rake configuration consist of multiple of 04 basic units (each basic unit with 4 car / coach). One 16 car train Set (Sleeper) formation is as follows:

DTC-MC-TC-MC-MC-TC-MC-NDTC-NDTC-MC-TC-MC-MC-TC-MC-DTC

Where DTC: Driving Trailer Coach, MC: Motor Coach, NDTC: Non-Driving Trailer Coach and TC: Trailer Coach

b) The rake formation shown above shall consist of AC 3 Tier, AC 2 Tier & First Class AC coaches. The Qty. of the same are shown below:

S.No.	Type of Coach	No. of coaches per 16 car train
1.	AC 3 Tier	11
2.	AC 2 Tier	4
3.	First Class AC	1

c) Train (Rake) formation in Train set is dynamic and is possible with minimum of 4 basic units and maximum of 6 basic units. Thereby Train set rakes have 16/20/24 coaches. The design of Automatic Fire Detection with Alarm System shall take into consideration of these rake formations.

d) Every coach will have a Sub-Pantry housing pantry equipment like bottle cooler cum freezer, water boiler, hot cases, trolleys, waste disposal arrangement etc. which is a closed area to be covered for fire detection.

e) There shall be 07 partitions in passenger area for privacy in AC 2 Tier & 9 partitions in AC 3 Tier coaches except in DTC where 05 partitions are present. In First Class AC coach there are 03 nos. Cabins & 07 nos. Coupes with enclosure.

f) In 2 variants of coaches only, there are 2 nos. Passenger toilet areas each. The rest of other coaches shall be having 3 nos. passenger toilet areas each which are to be covered for fire detection.

g) FDS shall cover all the onboard cabinets housing electrical switchgears/equipment i.e. the TCMS cabinets also. In addition to above, corridors & staff areas shall also be covered.

h) Aerosol based Fire suppression shall also be part of the supply package covering all electrical cubicles i.e. TCMS cabinets, traction and auxiliary converter.

i) Design and manufacturing of Automatic Smoke / Fire Detection with Alarm & Suppression System shall be in accordance with EN45545.

j) An automatic alarm system as per EN45545-6 (local & remote) in case of fire shall be a part of this proposal.

k) The FDS shall be interfaced with train TCMS for safe exchange of coach information, sensor status, fire zone location, sensor maintenance status, aerosol status and diagnostic data etc.

l) All the communication and control cables associated with FDS shall be conforming to international standards for fire survival characteristics complying to EN50200 minimum PH30 Class.

m) A total of 2 Nos. Train lines will be dedicated in the inter vehicular couplers for Fire Detection Status. Additionally, a provision of **2 nos. - 4CX0.75 Sq.mm Twisted Pair Shielded cable (Fire Survival)** is also available in the couplers for Communication & Control purpose of FDS.

2.2 TECHNICAL SPECIFICATION OF FDS

a) Train shall have Automatic Fire / Smoke detection system complying to ARGE Guideline – Part 1 'Fire Detection in Rolling Stock'. In the event of detection of a fire, the system shall have different levels of response (for information to driver / guard and passenger for safe evacuation) and minimize the spread of fire as per standardized global practice.

b) Point type detection sensor based fire detection technology which is proven & established technology shall be deployed.

c) **Fire Detection System shall be SIL2 compliant** but not limited to the hardware, software and control functions. **The system should generally be SIL2 compliant at system level.** Reference of SIL2 point detection based projects executed globally to be submitted with the technical bid.

d) The fire detection system shall be able to detect any fire originating inside the cars, and also detect smoke coming inside cars emanating from outside. **The focus is on protection of passengers and staff in rolling stock as well as electrical equipment.**

e) A fire event shall be detected early during the development phase, the affected area of the car shall be located exactly by identifying which sensor(s) in the zone is actuated and further system's actions shall be activated without any delay.

f) The objective shall be to detect incipient fires in an early stage in order to warn Train Operator.

g) Materials used in the manufacture of FDS shall be selected to reduce the heat load, rate of heat release, propensity to ignite, rate of flame spread, smoke emission, toxicity of combustion gases and shall comply with EN 45545-2 with hazard level **HL3**.

h) Train battery supply of 110VDC shall be made available to the FDS. The system shall be compatible for working on 110VDC (77 VDC ~137.5 VDC). Voltage regulators / converters required as per design requirement shall be in the scope of the supplier.

i) All the major events (alarms, faults etc.) shall be recorded in TCMS and shall be retrievable on maintenance terminal for analyzing any issue. Health status of all equipment shall be available on TCMS. Interfacing for same shall be provided by supplier.

j) The bidder shall consider a dynamic two detector dependency (smoke and heat) or a multi-criteria detector in the passenger areas, corridors & staff areas along with provision of drift compensation in order to decrease the risk of false, or unwanted alarm.

k) In general, the following areas are to be covered inside the train with suitable point type detector:

i. Multi criteria smoke & temperature detectors mounted on central ceiling (Flush mounted) in passenger areas (including doorway, staff areas) & toilets. Quantity as per bidder system design.
ii. Heat / Multi criteria smoke & heat detector for each TCMS cabinet. The quantity of cabinets are detailed in subsequent clauses.
iii. Heat / Multi criteria smoke & heat detector in Pantry area.
iv. Multi criteria Smoke & Temperature detector with buzzer module installed in each driver cab area.
v. In addition to the areas specified above, following Underframe equipment shall be covered for fire detection:
   a) TRaction Converter [TRC] – 01 no. (located in Motor Coaches)
   b) AUXiliary Converters [AUX] – 02 nos. (located in Trailer Coaches)
   c) Battery Box with BMS – 04 nos. (located in DTC / NDTC Coaches)

Note: *The TRC, AUX & Battery box equipment shall be pre-installed with LHD cable (In BHEL Scope) of suitable temperature which are to be taken to FDS with suitable interface / LHD boxes for monitoring. Only LHD interfacing box in MC coach, TC coach to be considered in the proposal under supplier scope.*

l) The tentative quantity of Point type sensors as foreseen from our end is indicated in the table below:

Location & Qty in Nos. / Coach Type	Passenger Area (Sleeping)	TCMS Cabinet	Doorway Area	Toilets	Pantry	Other locations (Cab / staff Area / Corridor)	Qty. of coach types / 16 car	Total Qty. of Sensors / 16 car
DTC	3	4	2	2	1	2	2	28
MC - Variant 1	6	5	2	3	1	0	4	68
TC	6	5	2	3	1	0	4	68
NDTC - Varient 1	6	5	2	3	1	0	1	17
MC - Variant 2	6	5	2	3	1	0	4	68
MC / NDTC - Variant 3	10	5	2	2	1	3	1	23
								272

Note: *The above quantities are indicative only. For bidder to design / estimate properly, dimension of the areas to be covered are given in annexure to this technical specification.*

m) The RAL color shade for the detectors shall match will the interior saloon color. The color shade shall be mutually agreed during design stage.

n) There shall be an automatic alarm status and automatic alarm on activation of a detector. The alarm shall be local and/or remote as specified below:

i. A local alarm shall be provided in train at a suitable location in the vicinity of the activated detector in Passenger areas and sleeper compartments. The alarm sounders / beacons shall be audible and may be visible

depending on its location, in all modes of service. Alarms in sleeper compartments shall be able to wake a sleeping occupant.

ii. All detections shall also give a remote alarm. The alarm shall be given to the driver. The alarm shall be audible and/or visible depending on its type and location in all modes of service.

o) As per NFPA 72, Low frequency 520 Hz alarm is more effective for those in high-risk categories, such as children, elderly, those with hearing impairments etc. Design of Alarm sounder shall take this into consideration of this aspect. The bidder's technical proposal shall include the type and quantity considered.

p) **Fire Suppression:**

i. For all electrical cubicles i.e. TCMS cabinets, Traction Converter and Auxiliary converter, aerosol based fire suppression system shall be provided broadly in line with technical parameters as per RDSO specification no. RDSO/PE/SPEC/AC/0192-2018 (Rev.1) so that 100gms of aerosol fire suppressant is provided for every meter cube space of the enclosed panel. The requirement of aerosol based fire suppression system for all electrical cubicles and traction and auxiliary converter is over and above the requirements of EN 45545.

ii. The tentative quantity of Aerosol Generators as foreseen from our end is indicated in the table below:

Location & Qty in Nos. / Coach Type	Underframe	TCMS Cabinet	Qty. of coach types / 16 car	Total Qty. of Aerosols / 16 car
DTC	1	4	2	10
MC - Variant 1	1	5	4	24
TC	2	5	4	28
NDTC - Variant 1	1	5	1	6
MC - Variant 2	1	5	4	24
MC / NDTC - Variant 3	1	5	1	6
				98

Note: *The above minimum quantities are indicative only. For bidder to design the quantity & volume of aerosol generator, dimension of the technical cubicles is given in annexure to this technical specification*

iii. Bidder to submit the calculation for the design concentration, design extinguishing mass and the number of generators.

iv. All onboard TCMS cabinets shall be IP54 & Underslung technical cabinets shall be IP66 both with Internal circulating fans. Accordingly, suitable Coefficient of non-tightness of the protected volume to be selected.

v. The aerosol generators shall be Thermal activation type for all the technical areas on board, electrically activated type for all underslung technical areas and suitable for extinguishing fires arising out of electrical abnormalities (Electrical Fires - Class E)

vi. Important features: Automatic Triggering / Triggering based on detector and must not have interactions with the environment with zero depletion potential (ODP), Non corrosive & non toxic, zero global warming potential (GWP) and

Zero Atmospheric Life time (ALT) also zero maintenance. The residues after discharges shall be negligible.

vii. The aerosol generator should be UL-2775 or ISO 15779 certified and certificate from 3rd party to be furnished by the supplier at the time of inspection by IR authorities.

viii. Action temperature of device should be 94-104 degree Celsius.

ix. The aerosol technology should meet the requirement of National Fire Protection Association - **NFPA 2010**, Standard for Fixed Aerosol Fire Extinguishing Systems. 3rd party certification to be furnished by the supplier at the time of design & same to be produced during inspection by IR authorities.

x. The expected lifetime of the Aerosol generator should be minimum 10 years.

xi. The mounting arrangement / Fixing clamp shall be a proven design suitable for installation in Electricals cabinets installed on Railways coach.

q) In the event of detection of a smoke/fire, the air conditioning system shall be controlled to minimize the spread of fire to close the air conditioning system fresh air intake dampers. For this purpose, critical signals like fire etc. to be transmitted through SDTv2 over TCMS communication between FDCU & TCMS.

r) All cables used for interconnecting the FDS like Power Supply, Communication within FDS (with detectors, LHD box etc.), Strobe light, Hooter etc. shall be in the scope of FDS supplier. Fire survival cables conforming to international standards for fire survival characteristics complying to EN50200 for the continued functioning to the extent possible in the event of fire shall be used. Survival duration classification of PH30 (30 minutes) or higher shall be used.

s) The battery supply shall be made available to FDS in every car. Required DC-DC converters for voltage requirements as per FDS shall be in the scope of supplier.

t) FDS being vital and monitoring functions in the train, the control functions for FDS shall meet the requirements of EN 50126 and EN 50128 shall be applied. The system (Fire Detection) shall be designed to meet minimum SIL2 level according to EN 50129 at system level.

u) Independent safety audit (ISA) or safety assessment by an accredited agency shall be done for FDS system for functionalities implemented for validation and certification of SIL levels according to prevailing EN standards and international practices by the supplier for the project. The assessment report / project documentation required for certification of SIL2 level shall be submitted by supplier during contract execution & maintenance phase to the purchaser as per agreed timeline with ISA.

v) The supplier responsibility for this proposal is deemed to be complete on meeting 02 Years of RAMS criteria to meet SIL2 compliance & submission of project specific SIL certificate, Safety Case & Assessment Report including warranty & guarantee period for this Vande Bharat Project.

w) As per RDSO, Safety Systems like FDS shall have adequate redundancy to avoid any single point of failure in the system design. Bidder shall submit architecture of

FDS system for trainset considering the redundancy concept and single point failure, high reliability and availability in view.

x) As per NFPA 72 Circuits & Pathways, Class A type of wiring shall be ensured between FDCU & detectors forming a loop.

y) For the proposed FDS, if the bidder is not the OEM of the system, necessary authorization for submission of bid to be submitted along with the bid.

z) The bidder shall submit the detailed Preventive & Corrective Maintenance procedures for the proposed FDS system including the minimum cleaning interval of the sensors (Minimum frequency should be 6/12 months), testing, consumables, manpower, sequence of activities, timeline, tools & plants required etc. Supplier to consider a Multi-stimulus detector tester 3 nos. minimum as one of the required tool in the proposal.

aa) The bidder shall impart training to IR / Shed Personnel for maintenance of the FDS. Refer Clause 5.7 for more information.

bb) Bidder / supplier shall select the quantity of detectors required in passenger areas (covering toilets, doorway, pantry also) for detection of fire / smoke to ensure ARGE compliance and the entire responsibility lies with bidder / supplier to comply ARGE. In case, an addition of sensors is required during testing, the same shall be in the bidder / supplier scope with no additional cost to the purchaser.

cc) ARGE test should have to be mandatorily performed on the interconnected system with TCMS on each type of coach type & AC tier variant (DTC, MC, TC, NDTC) to verify the response time of < 60 seconds.

Note:

1) *Every variation of coach type will necessitate performing ARGE to find the exact positioning of the detectors to meet the response time.*
2) *Also, ARGE to be performed from far end coach / Basic Unit from the cab to check the response time. The far end coach will be decided by BHEL during commissioning / testing of the FDS.*

dd) FDCU selection by bidder per Car / Basic Unit should take into consideration the limitation of number of detectors driven by the FDCU & the ARGE response time, cable routing length in each car [Each car length is ~24 meters, routing length may be >24Mtrs]. Also, the train configuration is very important parameter for positioning of components like power supply, FDCU etc. because interchangeability of the car / basic unit should not alter the architecture / configuration of the devices.

ee) Proposed components should have been service proven on a SIL2 project. Supporting documents to be submitted by the bidder.

ff) Previous project SIL certificate, SIL assessment report, SIL safety case shall be submitted along with technical bid supporting eligibility criteria.

gg) The SIL boundary shall include the entire Fire Detection System including safe communication with TCMS via SDTv2 over TRDP. Proposed architecture for this project shall consider the same into account.

hh) The detectors shall preferably have soft addressing (i.e. addressing of the sensors should be possible from single point through software) considering the volume of sensors used in the entire train and time required during commissioning of the system.

ii) **Interface with TCMS:**

i) FDS shall be interfaced to the on-board train TCMS using Ethernet protocol (TRDP + SDTv2 – Safe Data Transmission) providing safe data, fault & diagnostic data. Vital data packet containing signals such a fire, fault, reset & Bypass function if any shall be over SDTv2. Sufficient Relay Contacts for interlocking of Fault conditions. It shall be connected to ECN-ETB network of train as per IEC 61375-3-4 & IEC 61375-2-5 standards. The pinout of the communication interface shall also be according to the relevant part of IEC 61375.

ii) Normal Data packets containing sensor healthiness information, locations / zone details, Smoke detector Address, status i.e. availability, smoke level in real time, Status of LHD etc. shall be sent to TCMS for displaying in DDU & CCMS.

iii) The smoke level trending analysis to compare smoke levels across the system in real time shall be required.

iv) FDCU shall be interfaced with TCMS controller / network in Dual homing scheme with active passive mode preferably as FDS is one of the critical systems on the train.

v) Interface Control Document (ICD) of FDS with TCMS will be finalized during detailed design stage.

jj) Bidder shall submit complete Type test report of all components (Power supply, detectors, FDCU, LHD interface device etc.) tested as per EN50155 / IEC 60571 along with the technical bid for evaluation.

kk) The supplier shall consider necessary diagnostic tools (softwares, hardwares etc.)

ll) The proposed FDS shall be of proven design in railway applications and sensitivity of proposed detectors shall comply relevant provisions of EN 54 standard.

mm) The detection system shall be designed to give a fast and accurate response with minimized nuisance activation.

nn) The detailed design shall be submitted to RDSO / IR for scrutiny and approval of the design features before commencing of the manufacturing. The suppliers shall, however, be responsible for performance of complete system.

oo) Applicable standards:

[1] EN 50126-1:2017 Railway Applications - The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) - Part 1: Generic RAMS Process
[2] EN 50126-2:2017 Railway Applications - The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) - Part 2: Systems Approach to Safety
[3] EN 50128:2011+A2:2020 (OR) EN 50716:2023 Railway applications - Communication, signalling and processing systems - Software for railway control and protection systems (OR) Requirements of Software development
[4] EN 50657:2017 (OR) EN 50716:2023 Railways Applications - Rolling stock applications - Software on Board Rolling Stock (OR) Requirements of Software development

[5] EN 50129:2018 Railway applications - Communication, signalling and processing systems - Safety related electronic systems for signalling
[6] EN50159:2010+A1:2020 Railway applications - Communication, signalling and processing systems - Safety-related communication in transmission systems
[7] ARGE Directive : Guidelines for fire detection systems in rolling stock applications
[8] EN 54-7:2018 Fire detection and fire alarm systems - Part 7: Smoke detectors - Point smoke detectors that operate using scattered light, transmitted light or ionization
[9] EN 54-5:2017+A1:2018 Fire detection and fire alarm systems - Part 5: Heat detectors - Point heat detectors
[10] EN 54-4:1997 Fire detection and fire alarm system - Part 4: Power Supply equipment
[11] EN45545: Part 1 to 7 (latest) Railway applications: Fire protection on Railway vehicles
[12] EN 50155:2017 OR LATEST Railway applications - Rolling stock - Electronic equipment
[13] NI ISO 15779 "Condensed aerosol fire extinguishing systems - Requirements and test methods for components and system design, installation and maintenance - General requirements"
[14] UNI EN 15276 "Fixed firefighting systems - Condensed aerosol extinguishing systems. Part 1 - Requirements and test methods for components."
[15] UNI EN 15276 "Fixed firefighting systems - Condensed aerosol extinguishing systems. Part 2 - Design, Installation and Maintenance."
[16] BS EN 50200:2015 (Classification PH30) Method of test for resistance to fire of unprotected small cables for use in emergency circuits

In addition to the above, the offered equipment must comply to other relevant IECs / other applicable standards.

2.3 ASSEMBLY, MOUNTING, INSTALLATION OF FDS

The mounting & installation of FDS shall be in the scope of purchaser.

The supplier to furnish detailed description / procedure of mounting and installation of the FDS. The supplier shall also furnish supporting circuit / block / connections diagram & cable harness chart for installing the FDS on the Train.

The supplier shall find the most optimum location of sensor installation on the Saloon area on the mock-up model of each coach variant facilitated by the purchaser by conducting a pre-smoke test. The final location & quantity of sensors shall be mutually agreed based on ARGE test on the complete train.

The details of mounting & Installation of FDS will be decided and finalized with supplier during design phase. The supervision of mounting & Installation of complete FDS shall be in the scope of Supplier for first 2 nos. proto type rakes.

2.4 COMMISSIONING OF FDS

The Commissioning of the complete Fire Detection System shall be in the scope of the supplier. During this commissioning phase, following activities are envisaged:

- ARGE test shall be conducted at coach manufacturing location on the complete 16 car rake for finalizing the quantity & location of the sensors.
- Addressing of the detectors.
- Downloading the necessary configuration file.
- Establishing communication with train TCMS and checking of signals etc. by simulation or real time activation shall be verified.
- Joint checking & witnessing along with supplier, IR / RDSO personnel to prove the system as per the approved test procedure / protocol.
- Demonstration & testing of the system as per ISA for necessary SIL2 certification.

Any other activities deemed necessary during the commissioning phase shall be considered in supplier scope.

2.5 EQUIPMENT TESTING

a) Valid Type test report is to be submitted for the equipment along with offer, if the equipment is already type tested. In case, ultimate customer insists to repeat the type tests due to any reason, the type test shall be conducted again by the supplier, for which test procedure shall also be submitted by the supplier for approval before conducting the type test. In case ultimate customer desires to witness the type tests, the supplier shall have no objection. The supplier is required to quote for the type test charges if any, separately in commercial offer. These charges will be loaded in the equipment price at the time of final evaluation. If Type Test charges are not quoted separately in the commercial offer, then it will be presumed that offer is inclusive of type test charges and no extra payment will be done in case of type test conducted due to any reason.

b) Supplier to submit Routine test certificates and inspection certificate of equipment as per QAP along with equipment.

c) Type and routine test will also confirm to clause 3.13 of section 3 of technical specification.

2.6 DESIGN REQUIREMENTS TO BE PROVIDED BY SUPPLIER / BIDDER:

• Write-up/ description of each equipment	To be provided by Bidder.
• Datasheet of equipment	To be provided by Bidder.
• Circuit diagram, connection & wiring diagram, equipment drawing with mounting details, weights, center of gravity, etc. and any other relevant drawings.	To be provided by Bidder for both Electricals & Mechanical interfaces.
• Type test protocol & procedure/ Type test reports	Bidder to submit the complete reports of type test already conducted on the

	proposed/offered equipment. In case type test is required to be done as per RDSO / IR, Bidder to submit the detailed test procedures for approval.
• Routine test protocol & procedure/ Routine test reports and functional tests	Bidder to submit Routine test & functional test certificates / report and inspection certificate / report of equipment as per QAP along with equipment.
• Details of proven design	To be provided by Bidder.
• Performance statement	To be provided by Bidder in the attached format.
• Performance certificate	To be provided by Bidder in the attached format.
• Project specific AUTO CAD drawing-2D and 3D model	To be provided by Supplier after order placement
• Project Specific Drawings in A3 size	To be provided by Supplier along with bid.
• Installation, Operational and Maintenance Manual	To be provided by Supplier.
• MTBF/MDBF Values along with the method of calculation.	To be provided by Supplier after order placement
• Quality assurance plan (QAP)	To be provided by Bidder.
• Software Quality Assurance plan (SQAP)	To be provided by Supplier.
• RAMS Documentation	To be provided by Supplier after order placement
• Diagnostic tool programming manual	To be provided by Supplier after order placement
• Bill of Material (BOM)	To be provided by Bidder.
• SIL documentation - SIL2 Certificate, Safety Assessment Report	To be provided by Supplier on project completion

SECTION – 3
PROJECT DETAILS AND GENERAL SPECIFICATIONS

3.1 GENERAL

This section stipulates the General Technical Requirements under the contract and forms an integral part of the Technical Specification. The provisions under this section are intended to supplement general requirements for the materials, equipment and services covered under other sections and are not exclusive.

However, in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

The Train shall be Distributed Power type which shall have Driving Cabs on its both ends and shall be capable of running in either direction without the requirement for any change in its composition. Configuration of 16-car rake shall be two End Basic Units and two Middle Basic Units.

The configuration of Vande Bharat express (Trainsets) is as under (for reference):

DTC-MC-TC-MC-MC-TC-MC-NDTC-NDTC-MC-TC-MC-MC-TC-MC-DTC
Where,
DTC: Driving Trailer Coach
MC: Motor Coach
NDTC: Non-Driving Trailer Coach
TC: Trailer Coach

3.2 INSTRUCTION TO BIDDERS

The bidders shall submit the technical requirements, data and information as per the technical specification, provided in Section-2.

The bidders shall furnish catalogues, engineering data, technical information, design documents, drawings etc. in English language, fully in conformity with the technical specification.

Whenever required, the bidder shall depute his technical experts to RDSO / nominated agency for design discussions and approval.

3.3 GENERAL DESIGN REQUIREMENTS

i) The stock fitted with the supplied equipment shall meet the operating, service conditions and performance requirements of this specification and shall be suitable for operating conditions on IR.

ii) All equipment shall be vandal proof and incorporate necessary anti-pilferage features without compromising aesthetics / maintainability.

iii) Notwithstanding the contents of this specification, the Supplier shall ensure that the equipment supplied by them is complete in all respect so as to achieve the efficient operation & optimum performance of the Train set.

iv) The equipment design shall incorporate all essential features necessary to yield high traffic use, low maintenance requirements, easy maintainability, high regeneration, high efficiency, light in weight, user & environment friendly and high reliability in train operation. The design shall also facilitate easy erection, inspection, maintenance and replacement of the sub-units/ assemblies of all the equipment.

v) The entire equipment shall be designed to ensure satisfactory and safe operation under the running conditions mentioned in this specification duly taking care of sudden variations in load, voltage etc. under abnormal working conditions due to faulty operation, short circuits & earth faults etc.

vi) Wherever applicable: Airflow inlet/ arrangement for forced cooled equipment shall be designed in such a way that cloth, polythene, papers etc., which may get sucked, either do not block the airflow or get removed during halts. Moreover, filter should be easily cleanable.

vii) All working parts of the control and auxiliary circuit specifically electronics and PCBs, shall be suitably covered to keep them free from moisture, mold growth and dust. The protection level shall be furnished by the Supplier during design approval.

viii) All the electrical equipment shall comply with the latest edition of governing IEC specifications unless otherwise specified. The temperature rise shall be measured according to the procedure stipulated by IEC and shall comply with the limits specified and the ambient conditions defined in the Specification.

ix) All equipment shall be adequately earthed, insulated, screened or enclosed. They shall be provided with essential interlocks & keys as may be adequate to ensure the protection of the equipment and the safety of those concerned with its operation and maintenance.

x) Wherever applicable: Supplier shall to the extent feasible employ the currently available lubricants/cooling oils in India. Full lubrication scheme and schedule for the equipment shall be submitted. If use of imported lubricants or cooling oil is inevitable, supplier shall furnish details of equivalent Indian lubricants/oil.

xi) Supplier shall submit 3D models of offered equipment including associated sub-assemblies, etc. in .stp formats.

xii) The design of the equipment shall be based on sound, proven and reliable engineering practices. The equipment used in different sub systems shall be of proven technology and design. The supplier shall submit the supportive document for each of the assembly/sub-assembly for its proven performance under the environmental conditions prevalent in India.

xiii) The supplier shall design the mounting arrangements suitable for coaches. The accessories for mounting the equipment shall be part of the scope of supply. The hardware for mounting, safety links for underslung equipment, the termination hardware also will be in the scope of supply for all equipment.

xiv) SOFTWARE (WHEREVER APPLICABLE)

a. Software shall be written in a structured manner and fully documented during all stages of its design and development. This shall meet the requirements of EN 50126-2: The specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) - Part 2, EN 50128: Railway Applications: Software for Railway Control and Protection Systems, and EN 50129: Safety-related Electronic Railway Control and Protection Systems.

b. The Supplier shall submit the values of parameters, list of fault messages, their environmental data, hierarchy of fault display, fault categorization, trouble shooting of each fault by way of Changes in parameters shall be demonstrated with their effect on the results.

c. Parametric changes shall be possible in the software in order to meet the future requirements. While listing out the values of various parameters, the Supplier must provide a range within which any change can be made without jeopardizing the functionality of the system. Supplier shall submit the licensed software to the purchaser.

d. Software shall be fine-tuned through simulations & real life working conditions based on the extensive trials, associating BHEL / user Railways before putting the rake in commercial services. As it requires, instrumentation and expertise of Software Design Professionals, software expert(s) of Supplier shall be based at the work place along with commissioning engineers so that all software related issues are expeditiously resolved before putting the rake into commercial service.

e. Quality and efficacy of trouble shooting manual, software tools and software documentation shall be validated during extensive field trials. Final version of these documents shall include the changes required based on the service trials, commercial service operation, experience of operating Railways.

f. All the changes, thereafter, in software shall be approved by RDSO / nominated agency in consultation with user Railways before actual implementation and the Supplier must give software release, which shall include brief description of the problem, earlier as well as modified logic, explanation, parametric changes etc. to the satisfaction of RDSO / nominated agency.

g. The Supplier shall submit Software Quality Plan for review before work commences on software design. The software quality plan shall clearly state

the controls and practices used in the software life cycle from specification through to in-service operation.

h. Internal independent review, verification & testing, using real & synthetic data, shall be performed at the software module and system level. RDSO/ nominated agency / BHEL / user Railway may audit the Supplier against the **Software Quality Plan** at any stage during the Contract. The Supplier shall ensure that all software is fully de- bugged prior to the final review by RDSO/user Railway.

i. Sufficient software documentation shall be provided to give the full understanding of the software function, logics, parameters and operation. Documentation shall be complete, clear and concise, and include all modifications up to the final acceptance. Documentation shall clearly explain the software logics, associated parameters, include software block diagram showing signal flow, logic and hardware interfaces etc. A top level flow diagram and description of detailed operation shall be provided.

xv) Notwithstanding the contents of this specification, the supplier shall ensure that the equipment supplied by them is complete in all respect so as to enable the desired operation of the Train fitted with their equipment.

xvi) Supplier shall deliver the executable files of all developed software along with necessity tools to upload / download and carry out fault analysis.

3.4 INGRESS PROTECTION

i) All equipment shall be suitably protected from dust and water. As a minimum, equipment shall be sealed to the standards stated below:

Under frame & externally mounted equipment (other than traction/ auxiliary converter/Traction Motor)	IP65
Battery Box and Brake Chopper	IP20
Equipment mounted inside the Car body	IP54

ii) It may be necessary to protect some equipment to IP67 in order to meet the requirements of Clause 3.4 of this Specification.

3.5 AMBIENT CONDITIONS / OPERATING CONDITIONS

The equipment shall be designed to work satisfactorily under following environmental conditions: -

Atmospheric temperature	Maximum temperature: 50 degrees Celsius Maximum touch temperature of metallic surface under the Sun: 75 degrees Celsius and in shade: 55 degrees Celsius Minimum temperature: (-)10 degree Celsius
Humidity	100% saturation during rainy season

Solar radiation	1 kW/m^2
Altitude	1000 meter above mean sea level
Rain fall	Very heavy and continuous rainfall in certain areas (up to 2500 mm during rainy season)
Atmospheric conditions	Extremely dusty and desert terrain in certain areas. The dust concentration in air may reach a high value of 1.6 mg/m^3. In many iron ore and coal mine areas, the dust concentration is very high affecting the filter and air ventilation system
Coastal area	Humid and salt laden atmosphere. The equipment shall function in accordance with this Specification when subjected continuously to a humid and salt laden atmosphere with maximum pH value as per IEC 60571, sulphate content of 7 mg per litre, maximum concentration of chlorine 6 mg per litres and maximum conductivity of 130 micro Siemens / cm.
Vibration	The vibration and shock levels recorded on various Sub-systems in existing Trains of IR are generally more than the limits given in IEC 61373 particularly at axle box, and traction motor. Accelerations over 50g have been recorded at axle box levels during run. Vibrations during wheel slips are of even higher magnitude. High level of vibrations above 30g have been measured at traction motor on IR's Trains, which increase up to 50g with worn gear- pinion.
Wind speed	High wind speed in certain areas, with wind pressure reaching 216 kg/m^2 as per IS:875 Part 3(2015)
Flood level	The Train shall function in accordance with these Specifications and Standards in the event of flooding up to 203 mm above Rail Level as follows: • In the event of flooding at any level below Rail Level, the Train shall operate in full compliance with these Specifications and Standards. • In the event of flooding at a height between Rail Level and 203 mm above Rail Level, the Train shall operate in full compliance with these Specifications and Standards with the exception that it is permissible to restrict the operation of the Train to a maximum of 8 km/h. Allowance is to be made in addition for increase in the height of water level due to the "bow wave" effect of the Train passing through the water.

Flood Proofing of the under slung Equipment	Waterproofing test will be conducted on Traction and Auxiliary Converter by dipping them up to a height equivalent to 650 mm from rail level (under fully wheel worn condition) in stationary water for 12 hours. There should be no water ingress and Converters shall function normal after the test. Traction Motor with gearbox shall be tested for waterproofing as defined in clause 3.4.6.10.1 of specification ICF MD SPEC-398, issue status-01, rev 01. Other underslung equipment shall have IP protection as mentioned in clause 3.4. However, even in case of flood levels more than the mentioned above, the equipment shall not get damaged and it should be possible to rejuvenate the equipment with minor attention without any adverse effect on their performance. Axle box shall be adequately flood proof.

3.6 STANDARDS

(a) The standards applicable and relevant to the complete Train and to the various Sub-systems and systems shall be:

(i) IEC publications;
(ii) EN;
(iii) UIC;
(iv) AAR;
(v) IEEE;
(vi) BS;
(vii) RDSO specifications;
(viii) ICF/RCF specifications;
(ix) NF-F;
(x) ORE;
(xi) VDE;
(xii) UL;
(xiii) JIS
(xiv) IS; and
(xv) Any other standards referred to in this Schedule.

(b) In the event of any contradiction in the aforesaid standards, the following standards shall have priority in the order listed:

(i) Standards mentioned in these Specifications and Standards set forth herein;
(ii) EN/IEC/UIC/AAR and
(iii) IS.

(c) For avoidance of any doubt, in case of any conflict between the requirements of these standards, the stipulations of Specifications and Standards in this Schedule shall have precedence.

(d) The temperature rise shall be measured according to the procedure stipulated by IEC and shall comply with the limits specified and the ambient conditions defined in the Specification. Specified temperature rise of equipment shall be calculated after taking into account at least 25% choking of air filters and radiator fins etc.

3.7 ENGINEERING DATA

(a) The contactor shall necessarily submit all the drawings/ documents unless anything is waived. The contactor shall submit drawings/ design documents/ data/ test reports as may be required for the approval of the purchaser. All drawings submitted by the Manufacturer including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required, dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required for installation and interconnections between various portions of equipment and any other information specifically requested in the specifications.

(b) Each drawing submitted by the Manufacturer shall be clearly marked with the name of the Customer and Project, the unit designation, the specifications title, the specification number, date of revision (if any), duly signed by the concerned technical person. If standard catalogue pages are submitted, the applicable items shall be indicated therein and should be made project specific. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

(c) The title block of drawings shall contain the following information incorporated in all contract drawings:

1. Customer : BHEL /Indian Railways
2. Project: Manufacturing cum Maintenance of Vande Bharat Trainsets
3.Contract No./LOA No./ Ref no.: 2022/RS(WTA)-527/Vande Bharat Trains/874/1 dated 14/06/23
4. Main Contractor : Bharat Heavy Electricals Limited

3.7.1 SIZE OF DRAWINGS

The drawings of the following parts shall be to the sizes indicated below

I. Equipment details – full size or half size

II. Motor Assemblies – 1:5

III. General Assemblies- 1:10

Further, the scaling of drawings should be as per applicable standards.

3.7.2 METHOD OF FILING OF DRAWINGS

To facilitate filing of drawings, it is essential that each drawing submitted for approval is marked so that it can be identified. The supplier is, therefore, required to ensure that all prints are marked legibly at the right hand bottom corner. The following information is required in respect of each drawing:

I. Supplier's drawing number.
II. Supplier's name and date of submission.
III. Contract no. given by the purchaser.
IV. Description of drawings.
V. Relevant Specifications

3.8 MARKING OF EQUIPMENT & RATING PLATE

(a) All main assemblies of the equipment shall bear serial number, year of manufacture and symbol/ identification of the purchaser. Where the sub-assemblies/components of the main assemblies are not inter-changeable, the sub-assemblies shall also be marked with the serial nos. of the main assembly of which they form a part.

(b) All equipment/cubicles shall contain non-detachable rating plates of anodized aluminium with embossed letters and fitted in a visible position. The rating plate will give detailed rating specification and identification of equipment.

3.9 INFRINGEMENT OF PATENT RIGHTS

BHEL and Indian Railway shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, components used in design, development and manufacturing of propulsion system & other equipment and any other factor which may be a cause such dispute. The responsibility to settle any issue lies with the manufacturer.

3.10 DOCUMENT SUBMISSIONS

The scheduled dates for the submission of these as well as for, any data/information to be furnished by the Purchaser would be discussed and finalized at the time of award. The following schedule shall be followed generally for approval:

Sl.no.	No. of copies	Schedule
i)	Initial Submission Drawings, Data sheets, Type test Reports	At the time of submission of offer.
ii)	Furnishing of drawings in hard / soft copy format	Approx. 2 to 3 weeks from the date of award of contract.
iii)	Furnishing of type test reports in hard / soft copy format	Hard / soft copy to be submitted immediately after the completion of the test.

iv)	Furnishing of routine test reports	Hard / soft copy to be submitted immediately after the completion of the test.
v)	All documents including installation, operation & maintenance manuals.	Approx. 2 to 3 weeks from the date of award of contract.

3.11 QUALITY ASSURANCE PROGRAMME

(a) To ensure that the equipment and services under the scope of this Contract, whether manufactured or performed within the Manufacturer's Works or at his Sub-manufacturer's premises or at the Purchaser's site or at any other place of Work, are in accordance with the specifications, the Manufacturer shall adopt a suitable quality assurance program to control such activities at all points, as necessary. Such program shall be outlined by the Manufacturer and shall be finally accepted by the Purchaser

(b) A quality assurance program of the manufacturer shall generally cover the following:

I. Manufacturer's organization structure for the management and implementation of the proposed quality assurance program:
II. Documentation control system;
III. Qualification data of bidder's key personnel;
IV. The procedure for purchases of materials, parts components and selection of sub-Manufacturer's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
V. System for shop manufacturing and site erection controls including process controls and fabrication and assembly control;
VI. Control of non-conforming items and system for corrective actions;
VII. Inspection and test procedure both for manufacture and field activities;
VIII. Control of calibration and testing of measuring instruments and field activities;
IX. System for indication and appraisal of inspection status;
X. System for quality audits;
XI. System for authorizing release of manufactured product to the Purchaser
XII. System for maintenance of records;
XIII. System for handling storage and delivery; and
XIV. A quality plan detailing out the specific quality control measures and Procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.

(c) The Purchaser or his duly authorized representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Manufacturer / his vendor's quality management and control activities.

3.12 QUALITY ASSURANCE DOCUMENTS

The Manufacturer shall be required to submit the Quality Assurance Documents as stipulated in the quality plan at the time of purchaser's inspection of equipment/ material.

3.13 TYPE AND ROUTINE TESTING & INSPECTION

i) The individual prototype equipment, systems and sub- systems shall be type and routine tested in accordance with the relevant IEC/UIC/EN publications inclusive of the mandatory and optional tests along with the special tests as specified.

ii) All type tests shall be conducted by Supplier or such other agency or person agreed by RDSO / Nominated Agency at the Supplier's cost where ever performed in presence of and to the satisfaction of RDSO/ Nominated Agency, who reserves the right to witness any or all of the tests. All tests set forth in this specification shall be conducted by the Supplier or other agency or competent person as agreed by the purchaser/ RDSO/ Nominated Agency.

iii) RDSO / Nominated Agency may waive some of these tests in case of equipment/ sub-assemblies where the manufacturer can establish to the satisfaction of RDSO that such tests have already been carried out earlier. In such a case, manufacturer shall submit complete test reports along with necessary certification.

iv) Wherever any equipment, system, sub system is not specifically covered by an international recognized specification or test procedure, the tests which are acceptable to both to Supplier and to the IR's representative shall be devised.

v) Without prejudice to any provisions of the contract, the purchaser reserves the right to witness any or all of the type tests and to require submission of any or all test specification and reports.

vi) In case any bidder indicates that he shall not carry out a particular test, his offer shall be considered incomplete and shall be liable to be rejected.

vii) The Purchaser, his duly authorized representative and/or outside inspection agency acting on behalf of the Purchaser shall have at all reasonable times free access to the Contractors premises or Works and shall have the power, at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection if part of the Works is being manufactured or assembled at other premises or works, the Manufacturer shall obtain for the Engineer and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on the Manufacturer's own premises or works. Inspection may be made at any stage of manufacture, dispatch or at site as the option of the Purchaser and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

viii) Supplier to depute qualified person for supervision of installation and commissioning of the equipment in the prototype rake. During the prototype tests/trials of train, if a technical problem arises with the equipment, qualified supplier representative should be deputed to attend the same.

ix) During the prototype tests/trials or service of train, if any problems arise or feedback information is obtained, which warrants a re-check of the design/manufacture/quality of the equipment and components, action will be taken as may be necessary by the Supplier to carry out the required investigations and to incorporate the improvements considered most appropriate to reach compliance with the specification without any extra costs to the Purchaser and in a manner approved by the RDSO/Nominated Agency on equipment/components already supplied as well as those to be supplied later.

x) The prototype rakes fitted with the supplied equipment, shall be subjected to pre-revenue service trials. Service trials are intended to prove the satisfactory running performance of the supplied Train set equipment and evaluate their reliability in service, ease of maintenance and operations. The performance of the equipment shall be assessed based on the experience gained during the service trials. Necessary modification as required and also as desired by the RDSO/ Nominated Agency / Indian Railway shall be implemented in the series production without any extra costs to the Purchaser.

xi) **Type tests on electronic equipment and control electronics**

The electronic equipment and Control Electronics shall be tested as per IEC 60571 / EN50155, IEC 60068, EN 50121, IEC 60721-2-5 and IEC 61373 including **both compulsory and optional tests**. Dry heat test, as specified in IEC 60571, shall be conducted for testing power and control electronic equipment at 80 degrees Celsius. LCD display units shall be tested at 70 degrees Celsius.

3.14 MATERIALS AND WORKMANSHIP

Equipment materials and components shall be new, of high grade and good quality and be to the latest engineering practice. The material and workmanship throughout shall be in accordance with the purpose for which they are intended. Each component shall be designed to be consistent with its duty.

3.15 PACKING, STORAGE AND HANDLING INSTRUCTIONS

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. The manufacturer shall also submit packing details/ associated drawing for any equipment/ material before equipment dispatch.

All coated surfaces shall be protected against abrasions, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device.

Storage requirements shall be clearly defined by the supplier. Packing shall be such that if required, long time storage at site should not deteriorate the performance of the equipment.

3.16 FIRE PREVENTION

i) The design of equipment shall incorporate all measures to prevent fire, and will be such that should any fire take place, the effects shall be minimized and no spread of fire should take place. Materials that are not fire retardant shall not be used.

ii) Materials used in the manufacture of equipment shall be selected to reduce the heat load, rate of heat release, propensity to ignite, rate of flame spread, smoke emission and toxicity of combustion gases.

iii) The fire protection on Train shall be designed and constructed in accordance with EN 45545.The applicable Hazard level will be HL3.

iv) Contractor shall furnish the relevant data, fire load calculations, certifications etc. of the items considered in fire load calculations separately for Above & Below the floor level. The calculations and validation shall conform to the standard adopted by the contractor for fire strategy.

v) Relevant provisions stipulated in Central Electricity Authority (Measures related to Safety and Electric Supply) Regulations, 2010, shall be followed in the interest of safety of passenger/staff as well as for equipment / instruments provided in the coaches.

SECTION – 4

RELIABILITY, AVAILABILITY, MAINTAINABILITY AND SAFETY (RAMS)

4.1 KEY PERFORMANCE INDICATORS

Performance indicators comprises of Availability, Reliability and upkeep of Cars. The bidder must ensure RAMS parameters for the offered equipment and its sub-assemblies supplied to at least maintain the overall fleet availability and reliability targets given below. In case, fleet reliability drops on account of poor reliability of subassemblies supplied, the supplier will be required to improve the quality of subassemblies to match the availability & reliability targets.

a) Availability

Sum of Available Hours as a proportion of the total hours (Available Hours + Non-Available Hours) in the Fleet in any Accounting Year, shall be considered as “Availability”. Guaranteed Availability in every Accounting Year shall be at least 95%.

b) Reliability

Average Mean distance travelled between two Failures for the fleet in any Accounting Year shall be considered as “Reliability”. Guaranteed Reliability shall not be less than 200,000 km.

c) Upkeep

For the offered equipment, there shall be no such conditions during the operation of trains that affects the reliability, safety and passenger amenities. Any maintenance shall be conterminous with the train maintenance schedules as given in Cl 4.5 of this section.

List of Conditions affecting Upkeep (As applicable) is enclosed as Annexure-A of this section.

4.2 RELIABILITY AVAILABILITY MAINTAINABILITY AND SAFETY (RAMS)

a) The supplier shall ensure that, Guaranteed Reliability, Guaranteed Availability and High Degree of Safety in order to provide a dependable service, forms an integral element of the offered products.

b) The plan for Reliability, Availability, Maintainability and Safety shall conform to EN 50126/ IEC 61709/ IEC 62278. Reliability of electronic components shall conform to IEC 61709.

c) The supplier shall develop and provide RAMS targets (MTBF/MDBF/MTBSF) for the offered equipment both for the complete system and for the major Sub-systems at ambient temperature up to 50°C.

d) After rectification of any failure / fault, the concerned equipment / system should resume its original performance / function.

e) Components critical for safety shall fall into safe operating mode in case of malfunctioning. The system safety plan shall identify and list safety critical components and this list shall be updated periodically and intimate to the purchaser.

f) Supplier shall submit the basic maintenance schedules of the proposed equipment. Minimum interval between two maintenance schedules in the depot for the equipment supplied should not be less than 90 days except for activities which can be done outside the base depot (such as cleaning of filters mounted in the under-frame, for which the periodicity shall not be less than 15 days) and 3 years for major works in workshop/major depot. Average running distance of a rake may be considered as 2000 kilometer per day. Please refer Cl 4.5 below in respective planning of maintenance schedule for the supplied equipment.

g) All systems, components and structural areas serviced as part of inspection or periodic preventive maintenance shall be conveniently accessible for service and inspection.

4.3 RAMS DOCUMENTATION

Vendor shall agree to submit following documents pertaining to RAMS analysis:

- Functional breakdown + inherent failure analysis
- Mission critical failures Analysis (Fault Tree Analysis)
- FMECA (Failure Mode Effects and Criticality Analysis)
- System/Sub-Systems Hazard Analysis
- Hazard Log + SIL data (if applicable)
- List of critical components
- Preventive Maintenance Analysis
- Corrective Maintenance Analysis

4.4 SERVICE LIFE OF EQUIPMENT/SYSTEM

Vendor shall specify the service life of the offered equipment / system based on life cycle calculations after which the equipment / system shall call for complete replacement to maintain the required reliability & availability of fleet.

4.5 TRAIN MAINTENANCE SCHEDULE (TENTATIVE)

Sl. No.	Schedule	Place of maintenance	Permissible time per schedule	Periodicity
1	Minor maintenance	Light maintenance at Depot	8 hours	3 months
2	AOH	Light maintenance at Depot	7 days	18 months
3	IOH	Heavy maintenance at Depot	10 days	36 months
4	POH	Heavy maintenance at Depot	20 days	72 months

Annexure-A

List of Conditions affecting Upkeep of Trains.

S.No.	System Name	Condition
1	Windscreen Wiper and Washer System	▪ Rainy weather, defective wiper in any cab.
2	Couplers (any type)	▪ Any mechanical/electrical/pneumatic fault and/or any dimensional misalignment and/or any damage to any part which does not allow the coupler to guarantee the fulfilment to its assigned mission, in accordance to the technical requirements, performance and safety set out in this specification.
3	Suspension	▪ Any defect in primary / secondary suspension resulting in passenger safety, comfort or performance.
4	Wheel	▪ If wheel flat is > 40 mm or as finalised in design. ▪ Any abnormal hammering as reported by the TO.C9
5	Pantograph	▪ Isolation of any pantograph
6	Transformer	▪ Isolation of any one main transformer
7	Battery charger	▪ Battery Charger of one unit isolated
8	Mechanical drive system	▪ Any defect resulting in high temperature / isolation
9	Traction Motors	▪ Isolation of more than 25%motors.
10	Traction converters	▪ As per the consequential effect as defined in Item 10 above.
11	Main compressor unit	▪ Isolation of any main Compressor unit
12	Auxiliary converter-inverter	▪ Isolation of any Auxiliary Converter-Inverter unit.
13	Brake system (mechanical)	▪ If isolation of an additional bogie (mechanical) leads to speed restriction.
14	Exterior lights	▪ Failure of any head light / marker/tail light.
15	Driver's desk	▪ If master controller prevents the train from moving. ▪ Any defect in master controller even if no delays are reported. ▪ Any defective cab switch leading to unsafe operation.
16	TCMS & Vehicle circuits	▪ If HMI display fails & functionality is not transferred to redundant HMI. ▪ Any failure in TCMS component / equipment /circuit element / software/communication system etc. resulting in loss of intended function. ▪ Further cases will be included based on TCMS redundancy and configuration.

S.No.	System Name	Condition
17	PIS & CCTV	▪ If both automatic and manual announcements fail ▪ If announcements in Car is not audible ▪ if ≥ 1 unit exterior side view CCTV not working ▪ If >1 PEA in any car is defective ▪ One saloon CCTV, including its backup if any, is isolated. ▪ If ≥ 1 unit for rear cab and front cab camera, cameras on the roof
18	Passenger doors	▪ If ≥ 1 (one) door per train side is isolated.
19	HVAC (passenger area)	▪ Failure of any one HVAC in any car leading to increase in inside temperature ≥280C - Failure of two HVAC's in one car. - Noisy Air Conditioner: Interior Noise >+2dB than the one recorded and validated during the type test at standstill)
20	Ground fault in DC Circuit	▪ Train to be withdrawn in case of single ground fault if it leads to unsafe operation as per the design.
21	A failure or symptom which may endanger safe and/or normal operation of train	▪ Failure in safety interlock or protection circuit such as door loop ▪ Abnormal noise in underframe ▪ Wheel flat ▪ Arcing in pantograph ▪ Failure of emergency equipment ▪ Failure which may disable train's push out duty. ▪ Train which that requires more than 2 instances of reset within 30 minutes ▪ Jerky movement (The details shall be finalized in design stage). ▪ Others to be decided during design stage

Note: *The above list shall be further reviewed and updated during design stage.*

SECTION -5
SPARES AND CONSUMABLES FOR MAINTENANCE

5.1 SPARES AND CONSUMABLES

i) Supplier shall provide complete list of items/materials which get consumed during normal course of operation of the Train as applicable for the equipment/system (the **"Consumables"**).

ii) Supplier shall provide complete list of parts or equipment/system ensuring fleet availability of 95% or better, which would be necessary for efficient operation and maintenance of the (the **"Spares")**.

iii) Supplier shall provide detailed spare parts catalogue / data-sheet listing all components manufactured or purchased by the supplier along with their rating, source, type / model no., schematic, position, etc.

iv) Price for above spares and consumables to be shared separately as part of commercial offer.

5.2 SCHEDULED MAINTENANCE

a) Scheduled (Preventive) maintenance consists of operations to maintain an assembly/subassembly or components in its specific operating conditions by performing:

i) periodical inspection and diagnostic tests for prevention of malfunctioning.
ii) scheduled replacement of components.
iii) checks to be performed at specified time intervals, whose outcome determines whether or not replacements will be required.
iv) routine operations, such as filling, topping up, change oil, greasing, adjustments, etc.
v) general overhaul of systems and subsystems.

b) The preventive maintenance schedules required to keep the supplied system in good fettle with requisite reliability and availability would be coterminous with the train maintenance schedules and it should be possible to comfortably complete such maintenance during the time provided for respective train maintenance schedule and in the facility provided (refer Chapter Reliability, Availability, Maintainability and Safety).

c) Details of Schedule of Periodic / preventive maintenance (the **"Scheduled maintenance")** shall be submitted in following sample format:

Nature of inspection / maintenance	Periodicity / Interval	Items to be replaced

d) Scheduled Maintenance shall ordinarily not be required before a travel of 40,000 km (forty thousand kilometres).
e) Supplier shall provide plan / activities for periodical inspection and diagnostic test for prevention of malfunctioning
f) List of facilities including tools & tackles required for carrying out all scheduled maintenance activities to be provided by vendor.
g) All systems, components and structural areas serviced as part of inspection or periodic preventive maintenance shall be conveniently accessible for service and inspection.

5.3 UNSCHEDULED MAINTENANCE

Unscheduled (Corrective) maintenance consists of maintenance operation which is not scheduled (part of preventive maintenance) as a result of an in-service failure.

The supplier shall be required to provide repair & maintenance instructions to put back the equipment / system back in service.

List of facilities including tools & tackles required for carrying out all unscheduled maintenance activities to be provided by vendor.

5.4 EPIDEMIC DEFECT WARRANTY

(a) If any identical defect or deficiency affecting Safety, Reliability and Availability of the trains on more than 20% (twenty per cent) of equipment or parts in any rolling period of 36 (thirty-six) months commencing from the second Year of the Supply Period, such defect or deficiency shall be deemed to be an epidemic defect (the "Epidemic Defect") and the supplier shall cover such Epidemic Defect under an epidemic defect warranty.

(b) In case, the Government (Railways) notifies an Epidemic Defect on account of the supplied assembly, the supplier shall remedy such Epidemic Defect on all such Trains where equipment or parts of that particular design or lot are provided, subject to limitation of period elapsed since commissioning as mentioned above in this para.

5.5 OPERATION AND MAINTENANCE MANUAL

i) Supplier shall provide an operation manual (the "Operation Manual") for the offered equipment / system in soft copy format in English and Hindi language. The Operation Manual shall include (but not limited to):
   a) Instructions for troubleshooting;
   b) Rating and layout of equipment;
   c) Operating limits of installed systems;
   d) Control and safety features of the Equipment/System;
   e) Instructions to Loco Pilots for operation of the Train (if applicable);
   f) Do's and don'ts for Loco Pilots (if applicable);

g) Safety precautions to be taken by the Loco Pilots (if applicable);

ii) The Maintenance Manual to be provided by supplier shall include:

(a) All maintenance activities and their periodicities that are required to keep the Train safe and ensure that the prescribed tolerances of systems and components are not exceeded at any time, including any systems relevant to the maximum moving dimensions;
(b) The inspection program for regularly checking that the Train is safe to continuing in service;
(c) Assembly & disassembly sequences for the supplies with pictorial playbook guide
(d) The engineering facilities (such as pit facilities, special tools etc.) necessary for the mandated maintenance;
(e) Minimum competencies required by staff for the maintenance activities.

iii) The Maintenance Manual shall ensure that safety critical systems and components on the Train are identified specifically and the minimum testing requirements that must be invoked in the event of their disturbance at examination or repair are defined.

iv) Preparation of the Maintenance Manual shall give consideration to inspections, tests and maintenance of the following that have a bearing on safety:

(a) inter-vehicular couplers.
(b) fire prevention system including safe working of pantry/ sub pantry equipment.
(c) Auxiliary electrical machines: Integrity and security, earthing condition and integrity, condition of safety labelling.
(d) Passenger Information System
(e) Cleaning: Ventilation ducts, filters, bogies and underframe equipment
(f) Power systems (including protection systems): Integrity and security earthing condition and integrity, condition of safety labelling.
(g) Pantographs: Integrity and security - dimensions and condition of pantograph head, over-height protection, earthing condition and integrity, condition of safety labelling.
(h) Train structures and underframes: Integrity and condition of all load bearing members or panels, integrity, operation and security of doors, openable and removable panels, integrity and security of all body mounted equipment, alignment, gangway.
(i) Safety systems (e.g. Vigilance control device): Functional tests;
(j) Hydraulic and pneumatic systems: Condition and integrity of hoses, pipework, valves, etc.
(k) Fire protection systems: Integrity and condition.
(l) Lighting Systems & Visibility: Headlight, flasher and marker lights, adjustment, intensity

(m) Speedometers; headlights and marker lights; horn; doors; cattle guard; and bio-vacuum toilets

(v) The instructions within the Maintenance Manuals shall be such as to protect staff working on the Trains, with particular reference to safety precautions and implementing a specified safety condition of the Train prior to starting work.

5.6 OBSOLESCENCE MANAGEMENT

Supplier is required to manage obsolescence of all equipment, spares and consumables to enable the trains to continue in service for 35 years. This obsolescence management service must include:

i) Timely identification of any obsolete items of equipment;

ii)Development of mitigation strategies to minimize the impact of the imminent obsolescence of any item within the offered equipment / system including:

- Establishing alternative supply paths
- Provision of equivalent or interchange parts or equipment
- Development of replacement products or design modifications to accept market available alternatives.

5.7 TRAINING ON MAINTENACE ASPECTS

Suppler to provide training to undertake scheduled and unscheduled maintenance to purchaser and its designated persons to handle the maintenance of train for 35 years. The duration of training shall be 12 man days.

PERFORMA FOR PERFORMANCE CERTIFICATE

Name of firm: .....

TO WHOMSOEVER IT MAY CONCERN

Sub : Confirmation letter for service performance

Dear Sir,

We hereby confirm that We ..... have manufactured _____ number of sets of .....(Name of Equipment with Model No.) for 3 Phase IGBT based EMUs/MEMUs/Metros/trainsets/LOCOs.
We further confirm that …… number of sets of .....(Name of Equipment with Model No.) for 3 Phase IGBT based EMUs/ MEMUs/Metros/trainsets/Locos are in satisfactory operation for railway rolling stock application.
Proforma for performance statement confirming above is also attached.

Yours faithfully

For (Name of Firm)

PERFORMA FOR PERFORMANCE STATEMENT

IGBT BASED 3-PHASE DRIVE TRAINSETS
PROFORMA FOR PERFORMANCE STATEMENT

Name of the Equipment:
Name of Firm :

S. No.	Order placed by (full address of Purchaser)	Order No. and Date	Description of Quantity of ordered equipment	Details of System for which equipment was supplied at Sr. No. 4 above to be given as follows			Value of Order	Date of Completion of Delivery		Remarks indicating Reasons for late Delivery, if any	Qty. in Satisfactory Service on 3 Phase IGBT based EMU's/MEMUs/ Locos/Trainsets /Metros
				Supply System	Unit Formation	Speed Potential		As per Contract	Actual		
(1)	(2)	(3)	(4)	(5)			(6)	(7)	(8)	(9)	(10)

REVISION HISTORY

Rev No.	Date	Description/Update

ANNEXURE

❖ **Dimensions of Underslung Cabinets:**

	L in mm	B in mm	H in mm
Traction Converter	2150	1200	700
Auxiliary Converter	1550	1300	600

❖ **Dimensions of On-board TCMS Cabinets:**

	L in mm	B in mm	H in mm
End Wall Panels (all coaches)	850	300	1800
End Wall Panels (DTC only -1 No.)	800	1100	1800
ECC Cabinets (Other than DTC)	850	1100	1800
ECC Cabinet (DTC only)	2000	1100	1800

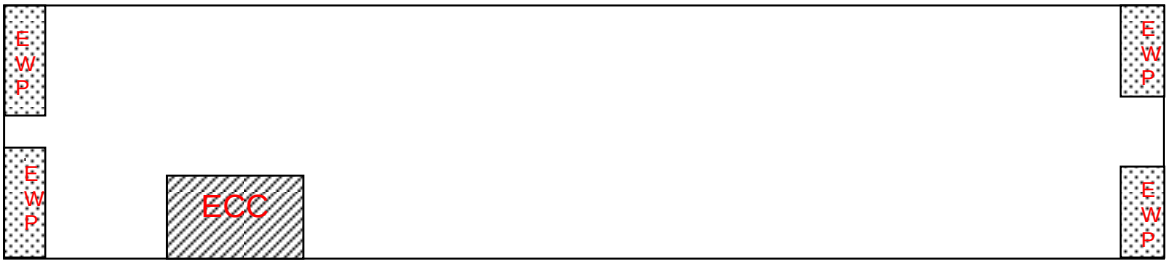


Figure 1: Overview of Onboard TCMS Cabinets in all coaches types except DTC

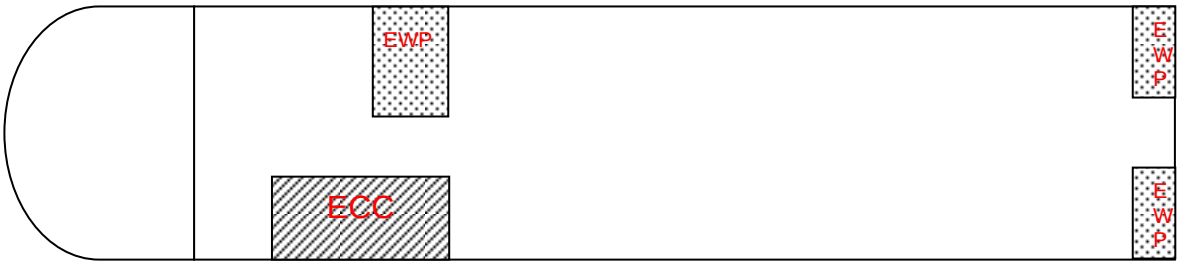


Figure 2: Overview of Onboard TCMS cabinets in DTC coach type only

❖ **Dimensions of Toilet area:**

We have a total of 4 nos. variants of toilets on the train. Dimension as below:

	L in mm	B in mm	H in mm
Western Toilets	1200	900	2000
Indian Toilet	900	1200	2000
Toilet for PHC	2000	1700	2000
Toilet with Shower	2000	1700	2000

❖ **Dimensions of Pantry area:**

	L in mm	B in mm	H in mm
Pantry area	1500	2500	2000

	BHARAT HEAVY ELECTRICALS LIMITED ELECTRONICS DIVISION Mysore Road, Bangalore	Doc. No : PS4452951 Rev. No : 00 Page : 1 of 3

	CUSTOMER/ USER	BHEL/INDIAN RAILWAYS
	PROJECT	MANUFACTURING CUM MAINTENANCE OF VANDE BHARAT TRAINSETS

Purchase Specification For -Automatic Fire Detection with Alarm and Suppression System

Rev No.	Date	Altered	Checked	Approved	Revision Details

Approved

Anjul

Issued by:	Prepared	Checked	Date
Traction Engg. Dept., BHEL-EDN	Narasimha Shenoy	David J	30.12.2023

1.1 Technical Specification

1.1.1 For the technical requirement, bidder to refer to **PS4452951** - Part A

2.1 Bill of Quantities

2.1.1 Bill of Materials in the technical specification (Part A) is for information only. Bidder to consider & quote for the items as per the quantity mentioned in the RFQ

3.1 Packing Instructions

3.1.1 Successful bidder to mandatorily follow the packing instructions given in Part A

3.1.2 Stack-ability of the packaged boxes & storage worthiness/durability to be ensured

3.1.3 Successful bidder shall ensure that set-wise Packing List be pasted on each Box (Typical format enclosed with this document)

Set wise Packing List to be pasted on each Box

Supplier shall furnish the packing list as per the format given below:

BHEL PO No.	
BHEL Material Code	
Material Description	
Quantity (Set)	
Box No (per set)	

Bill of Materials (Supplier shall list down all the items including loose items and respective quantities):

Main Item:

Sl. No.	Item description	Quantity per Set	Total Sets packed in the Box (applicable in case of multiple sets in one Box)

Loose Items (if any):

Sl. No.	Item description	Quantity per Set	Total Sets packed in the Box (applicable in case of multiple sets in one Box)

Supplier details:

Notes for suppliers:

1) Suppliers shall pack items, set wise in one box. In case of multiple boxes for one set, supplier shall identify box numbers (Set 1/ Box1, Set 1/ Box2 etc.)
2) Packing list shall be pasted on each box, as per actual contents inside the box. This list will be in addition to the supplier's standard packing list.
3) Box wise Packing list shall be shared with BHEL MM and same will be mandatory for dispatch clearance.

	Vande Bharat Project
	RAMS TEMPLATES
	CONTENTS
1	**Breakdown + Inherent Failure Reliability Prediction**
2	**Critical failures analysis**
3	**Failure Mode Effects and Criticality Analysis (FMECA)**
4	**System/Sub-Systems Hazard Analysis (SHA)**
5	**Hazard Log + SIL**
	Note All table are in accordance to the EN 50126-1-2-3 used as guideline. Refer to above standard for definition and meaning of contents. Minor differences may exist due to application of specific requirement from Railway Administration or final User

Breakdown + Inherent Failure Reliability Prediction

Project:															**Document No/Rev:**		
System:										**System Supplier:**					**Issue date:**		
Sub-System:																	
Drawing no:																	

RAMS code				Equipment /System Breakdown	Part number	Data Input	DTC	MC	TC	NDTC		λ unit. BASIC (FPMH)	Duty Cycle %	λ Effett. BASIC (FPMH)	λ Train Level (FPMH)	λ Train Level LEVEL 1 (FPMH) (16 CarTrain)	λ Train Level LEVEL 2 (FPMH) (Sub System)
				Equipment /System												Sum of Subsytems	
1	**1**			**Sub System 1**													**0.00**
1	**1**	1		Item 1													
1	**1**	2		Item 2													
1	**1**	3		Item (n)													
1	**2**			**Sub System 2**													**0.00**
1	**2**	1		Item 1													
1	**2**	2		Item 2													
1	**2**	3		Item (n)													
1	**3**			**Sub System (n)**													**0.00**
1	**3**	1		Item 1													
1	**3**	2		Item 2													
1	**3**	3		Item (n)													
				66													

Critical Failures Analysis

Project:			**Document No/Rev:**
System:		**System Supplier:**	**Issue date:**
Sub-System:			
Drawing no:			

TOP EVENT description:

Pos. No	Event Id. Number	Part/LRU Code	Description	Part Number	Coach type	Failure mode	Failure rate [1/(E-6 hrs)	FPMK	MTTR (h)	Failure rate source	Ref. to FMECA	Remarks	Action required

Failure Mode Effects and Criticality Analysis (FMECA)

Project:			**Document No/Rev:**
System:	**System Supplier:**		**Issue date:**
Sub-System:			
Drawing no:			

Position No	Part/LRU Code	Description	P/N	Coach type	Function	Phase	Failure mode		Cause of Failure Mode	Failure rate (FPMH)	Failure effect			Criticality		Failure identification /detection	Preventive and compensating measures	Remarks
							Fail. Mode index	Failure Mode			Local	System	Train	Service	Safety			

System/Sub-Systems Hazard Analysis (SHA)

:		Document No/Rev:
:	System Supplier:	Issue date:
stem:		
g no:		

Main System ID	Hazard Category	Hazard description (general)	Hazard Identification (detailed)	Hazard description (detailed)	Sequential Numbering	Phase / Operation mode	System / Sub-Sytem / Component	Causes	Consequence Potential accident/ damage	Severity Level	Probability	Risk Category	Preventive/compensating actions (Design, Maintenance, Operational Safeguards)	Target risk category	Remarks / Documents reference	Comments
Code that univocally identifies the system object of SHA	*Numbering for each hazard of the correspondin g "hazard type category"*	*Hazard category in accoding with Hazard List*	*Numbering for each hazard of the corresponding "hazard type"*	*Specific description of the generic hazard*	*Progressive number associated to previous column*	*- Running / Normal operation - Running / Degraded operation - Running / Multiple operation - Running / Emergency operation - Standstill / Parking - Standstill / Stabling - Standstill /Driver cab change - Depot / Manoeuvre - Depot / Maintenance*	*System/ subsystem /component from which the hazard originates*	*Description of the cause that originate the correspondin g hazard*	*Description of the consequences that could occour in case of the corresponding hazard. The subject of the consequences shall be identified.*	*Severity level category*	*Estimed Frequency of Hazard*	*Risk category and acceptance criteria*	*The preventive and mitigation measures identified in order to reach the Target risk Objective.All the useful Design, Maintenance, Operational safeguards shall be taken into account, and where available, a reference to applicable standards or regulation shall be reported.*	*Desired risk category and acceptance criteria*	*Reference to drawings or specification or documents*	*Any useful comments for a better understanding. For example it shall be highlighted If an hazard needs to be exported to the vehicle builder / train operator*

Hazard Log + SIL

Project:										Document No/Rev:			
System:							System Supplier:			Issue date:			
Sub-System:													
Drawing no:													

No.	Main Sys. Id.	Hazard Type	Hazard category	Hazard ID	Hazard Description	System / Sub-system/ Component	Cause	Exposed to the Hazard				Effects	Phase / Operation mode	Initial Risk Evaluation			Safety Function Code [A]	Description of Safety Function [B]	SIL [C]	Software (Safety Function) [D]	Preventive and mitigative measures	Final Risk Evaluation			STATUS	Responsibility				Remarks
								Driver	Crew	Passenger	Maintainer			Severity	Frequency	Risk						Severity	Frequency	Residual Risk		Car builder	Supplier	Maintainer	Operator	
1																													
2																													
3																													
4																													
5																													
.																													
.																													
.																													

Corrective Maintenance Analysis

Doc. No		**Rev No.**	**00**
Date:			
Project	**Vande Bharat Project**		
Equipment:			
Supplier:			
Compiled by:			

			REMARKS
Manpower cost		**Rs/hrs**	
Yearly distance run	**3,50,000**	**km**	
LCC period	**35**	**Years**	
Fleet (nr. of trains)	**80**	**Trains**	

Name of project	Corrective Maintenance results	TOTAL COST	35	Maint. hours per 1000 km
System:	Name of system	Period:	years	
Material cost [Rs/1000km]	Manpower cost [Rs/1000km]	Total cost [Rs/1000km]	Train/year	
			Train/period	
MTTR [h]	Total failure rate [f/10^6 h]		Fleet/Period	

Maintenance time [h]	FLEET level maintenance hours sum
Global Manhours [h]	FLEET level manhours sum
For AVAILABILITY index calculation	

COSTs		
Material [Rs/years]	Manpower [Rs/years]	Total [Rs/years]

RAMS code	Description	P/N	Failure mode	Failure rate [f/10^6 h]	MTBF [h]	Duty Cycle [%]	Applicable Failure Rate [f/10^6 h]	Vehicle DTC	Vehicle MC	Vehicle TC	Vehicle NDTC	Train Total Q.ty	Maintenance level
1	**Equipment / System**												
	(Sub-Assembly A)												
	Item 1		Description										
	(Sub-Assembly A)												
	Item 2												
	Sub-Item 1		Description										
	Sub-Item 2		Description										
	Sub-Item 3		Description										

Description	Maintenance task	Standard Tool	Special Tool	People Level	People N°	Failure diagnosis [min]	Integrator accesibility [min]	Supplier accesibility [min]	Change/ Repair/ Functional check	Other activity [min]	Nr. of persons OFF train	Off train activity [min]	Global Operation Time [h]	Global Man Time [h/man]	Percentage of global MTTR	Material Price [Rs]	Remark / Note
Equipment / System																	
(Sub-Assembly A)																	
Item 1																	
(Sub-Assembly A)																	
Item 2																	-
Sub-Item 1																	-
Sub-Item 2																	-
Sub-Item 3																	-
																	-

Description	Single item Partial Failure Rate [f/10^6 h]	Single item MTBF [h]	Single item MDBF [km]	Single item Material cost [Rs/1000km]	Single item Manpower cost [Rs/1000km]	Single item Total cost [Rs/1000km]	Interval/Years 35.0 Failure number	Interval/Years 35.0 % Failure per fleet	Interval/Years 35.0 Material [Rs]	Interval/Years 35.0 Manpower [Rs]	Interval/Years 35.0 Total [Rs]	COSTs Interval/Years 35.0 Material FLEET [Rs]	COSTs Interval/Years 35.0 Manpower FLEET [Rs]	COSTs Interval/Years 35.0 Total FLEET [Rs]
Equipment / System														
(Sub-Assembly A)														
Item 1														
(Sub-Assembly A)														
Item 2														
Sub-Item 1														
Sub-Item 2														
Sub-Item 3														

Preventive Maintenance Analysis

Doc. No		**Rev No.**	
Date:			
Project	**Vande Bharat Project**		
Equipment:			
Supplier:			
Compiled by:			

			REMARKS
Conversion speed		**km/hrs**	
Manpower cost		**Rs/hrs**	
Yearly distance run	**3,50,000**	**km**	
Running days per year		**days**	
LCC considered period	**35**	**years**	
Basic maintenance frequency		**km**	
Distance covered in the considered period	**1,22,50,000**	**km**	
Train-sets number in the fleet	**80**	**Trains**	

Name of project	Preventive Maintenance results	
System:	name of system	
Material cost [Rs/1000km]	Manpower cost [Rs/1000km]	Total cost [RS/1000km]

35 [YEARS] Maintenance

			Material	ManPower	Total
Maintenance time [h]	Train-set level maintenance hours sum	Train / Year			
Global Manhours [h]	Train-set level manhours sum	Train / Period			
		Fleet / Period			

RAMS LRU code		Description	Part Number P/N	Vehicle DTC	MC	TC	NDTC	TRAIN Total Q.ty	Step N°	Maintenance Level
1		**Equipment / System**								
		(Sub-Assembly A)								
		Item 1								
		Item 2								
		(Sub-Assembly B)								
		Item 3								
		Sub-Item 1								
		Sub-Item 2								
		Sub-Item 3								
		Sub-Item 4								
		Sub-Item 5								
		Sub-Item 6								

Description	Maintenance task	Standard Tool	Special Tool	Material	Frequency unit	Multiple	Cancellation per year	Cancellation at life end	Frequency [km]	People Level	Nr	Failure diagnosis [min]	Integrator accesibility [min]	Supplier accesibility [min]
Equipment / System														
(Sub-Assembly A)														
Item 1														
Item 2														
(Sub-Assembly B)														
Item 3														
Sub-Item 1														
Sub-Item 2														
Sub-Item 3														
Sub-Item 4														
Sub-Item 5														
Sub-Item 6														

Description	Change/ Repair/ Functional check [min]	Other activity [min]	n. people OFF train	Off train activity Time [min]	Global Operation Time [h]	Global Man Time [h/man]	Material cost [Rs]	Remark / Note	35 Years Nr of interventions	Per Type of Item Material cost [€ / 1000 km]	Per Type of Item Manpower cost [€ / 1000 km]	Per Type of Item Total cost [€ / 1000 km]
Equipment / System												
(Sub-Assembly A)												
Item 1												
Item 2												
(Sub-Assembly B)												
Item 3												
Sub-Item 1												
Sub-Item 2												
Sub-Item 3												
Sub-Item 4												
Sub-Item 5												
Sub-Item 6												

Checklist - Documents to be submitted by Bidder					
Sl. No.	**Particulars**	**Acceptable documentation**	**Submitted with Tender**	**Document/s submitted by bidder**	**Remarks by Bidder**
1	PQC qualification documentation	• RDSO/Indian Railways approval for Indian bidders • Relevant PO copies • Performance statements/certificate	YES / NO		
2	Type test reports & protocol	• Recent type test reports from NABL-accredited laboratory and/or protocol for Indian bidders • Recent type test reports from international accreditition agencies for international bidders and/or protocol	YES / NO		
3	Routine test protocol	• Routine test protocol	YES / NO		
4	QAP [Quality Action Plan]	• QAP [Quality Action Plan]	YES / NO		
5	Clause-by-clause compliance - duly signed & stamped	• Signed & stamped copy of complete specification • Bidder's document tabling each specification clause and indicating the compliance against each clause	YES / NO		
6	No deviation format - duly signed & stamped	• No deviation format, duly filled-in & signed/stamped	YES / NO		
7	Drawings & datasheets if applicable	• Drawing with all required data & BoM • Datasheet with all required parameters mentioned & BoM • Catalogue for standard product with all technical & dimensional details mentioned	YES / NO		
8	HL3 compliance	• Certificate from NABL approved lab or any International accredition agency	YES / NO		
9	Bill of Materials	• Unpriced copy of price format indicating "Quoted" against each line item	YES / NO		
10	Spares for 35 years' maintenance requirement	• Preventive & Corrective Maintenance Schedule with list of spares, in line with Chapter-5 of Technical Specification. • Unpriced list of above spares with yearly consumption including replacements.	YES / NO		
11	Checklist	• This checklist duly filled-in	YES / NO		
12	Contact details for correspondence	• Email & contact details of representative to contact for technical & commercial queries	YES / NO		
13	Authorization for bid signing	• Notarized/suitable valued bond paper stating authorization for bid signing	YES / NO		
14	Formats in tech spec	• All formats to be filled which ar part of the technical documentation .	YES / NO		
15	RAMS Documentation	• Sample documents on RAMS compliance (as applicable) as per Chapter-4 of Technical Specification.	YES / NO		

Note to bidder -	
1	Bidder shall necessarily fill this checklist and upload it as a part of the documentation towards this tender. Incomplete documentation may make your offer liable for rejection
2	Bidder shall upload the documents in a logical sequence & include a table of content clearly indicating the page numbers
3	This list is not exhaustive & BHEL may ask for additional documentation from bidders in the course of evaluation of the offers