रेल डिब्बा कारखाना, कपूरथला-144602, पंजाब, भारत

RAIL COACH FACTORY, KAPURTHALA-144602, PUNJAB, INDIA

पत्र संख्या- **MD35131** जारी करने की तिथि - **January 15, 2024**

विषय: विशिष्टता प्रकाशन संख्या RCF-MD-PS-2024-1 Rev 00.

आपको सूचित किया जाता है विनिर्देश दस्तावेज़ आधिकारिक तौर पर जारी कर दिया गया है।
कृपया जानकारी और अन्य आवश्यक कार्रवाई के लिए निम्नलिखित विशिष्टताओं की संलग्न प्रति प्राप्त करें

S. No	Description	Specification No.
1.	TECHNICAL SPECIFICATION OF THREE PHASE PROPULSION EQUIPMENTAND CONTROL SYSTEM FOR BG HIGH SPEED HYBRID SELF-PROPELLED ACCIDENT RELIEF TRAIN (SPART)	**RCF-MD-PS-2024-1 Rev 00**

JUGAL KISHOR
Digitally signed by JUGAL KISHOR
Date: 2024.01.15 18:49:05 +05'30'
डिप्टी सीएमई/डी-**II**

CQM-I,II CPLE CWE/Fur CMM/ HSQ CMM/TKJ CWE/Shell

Dy.CMM/LHB/HSQ Dy.CMM/G CMT Dy. CPLE-I,II Dy.CMM/Fur

SSE/Filing Section

SSE/Library, Mech. Design

SSE Record (Original copy)

SSE/Dev.

Copy for kind information to:

CDE

Dy.CME/DP & S&B

भारतसरकार

रेलमंत्रालय

रेलडिब्बाकारखाना

कपूरथला

पंजाब-144602

स्थापित: 1986

Government of India

Ministry of Railways

Rail Coach Factory
Kapurthala

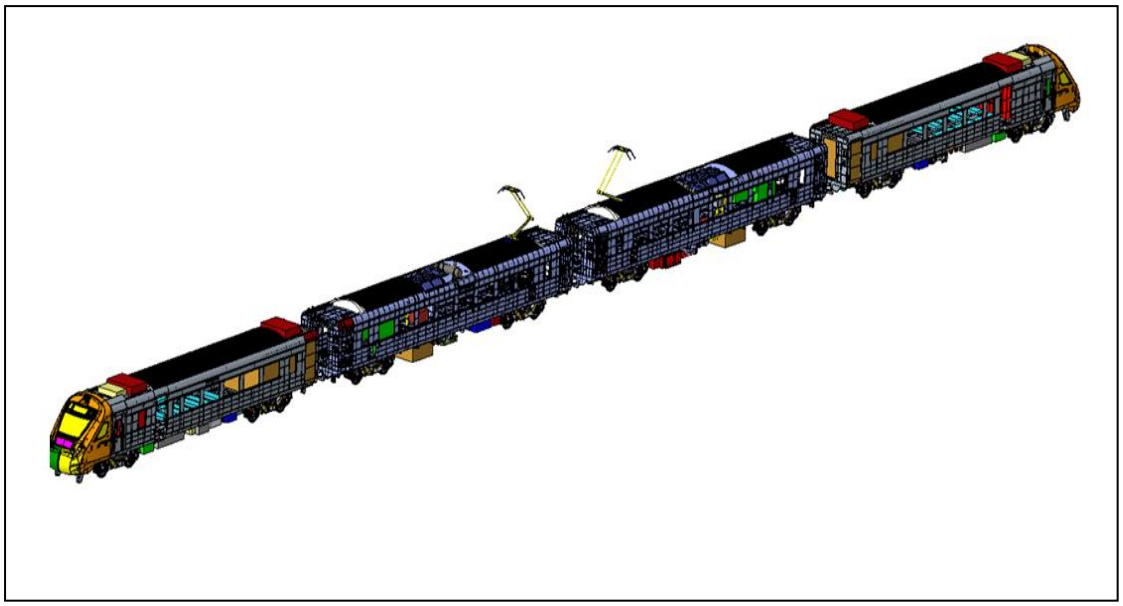
Punjab-144602

ESTT: 1986

RCF

KAPURTHALA

TECHNICAL SPECIFICATION OF THREE PHASE PROPULSION EQUIPMENTAND CONTROL SYSTEM FOR BG HIGH SPEED HYBRID SELF-PROPELLED ACCIDENT RELIEF TRAIN (SPART)



Specification Number	RCF-MD-PS-2024-1		
RevisionNumber	**0**	**Date of Issue**	**10.01.2024**

The purpose of this specification is to establish a clear objective for three phase propulsion equipment and control system for High-Speed Self Propelled Accident Relief Train for IR.

Brief Description

FOREWORD:

The purpose of this specification is to establish a clear objective for three phase propulsion equipment and control system for High-Speed Self Propelled Accident Relief Train for Indian Railways.

DISCLAIMER:

This specification is based on the studies, trials & experience by RCF/KXH. Although every care is taken in specifying details adequately and unambiguously, RCF/KXH shall not be liable for any kind of damages / losses incurred by any and all due to errors or omissions in this document. When using the information described herein, the user is ultimately responsible for their own actions, as well as the actions of subordinates and assistants, and the consequences arising therefrom.

This document may mention numerous commercial and proprietary trade names, registered trademarks and the like (not necessarily marked as such), patents, production and manufacturing procedures, registered designs, and designations. RCF wishes to state clearly that the present legal situation in respect of these names or designations or trademarks must be carefully examined before making any commercial use of the same.

Names of industrially produced apparatus and equipment may be included to a necessarily restricted extent only and any exclusion of products not mentioned in this document does not imply that any such exclusion has been based on quality criteria or any other qualifying consideration.

COPYRIGHT:

ADDRESS FOR COMMUNICATION:

Public Relations Officer
Government of India - Ministry of Railways, Rail Coach Factory
Kapurthala Punjab India
Pin: 144602
Website: www.rcf.indianrailways.gov.in

DOCUMENT CONTROL:

Name	Designation	Signature	Reason
Sh. Kapil Choudhary	SSE/ Electrical Design		Prepared
Sh. Arvind Kumar	SSE/ Mechanical Design	ARVIND KUMAR Digitally signed by ARVIND KUMAR Date: 2024.01.10 18:12:21 +05'30'	
Sh. Kulwinder Singh	Dy. CEE/D/Project	KULWINDER SINGH CHANA Digitally signed by KULWINDER SINGH CHANA Date: 2024.01.10 18:06:24 +05'30'	Agreed
Sh. Jugal Kishor	Dy. CME/D-2	JUGAL KISHOR Digitally signed by JUGAL KISHOR Date: 2024.01.10 18:13:16 +05'30'	
Sh. Mahendra Singh	CEDE	MAHENDRA BISHAN SINGH Digitally signed by MAHENDRA BISHAN SINGH Date: 2024.01.13 11:59:14 +05'30'	Approved
Sh. Akhilesh Misra	CDE	 AKHILESH MISRA 2024.01.15 13:17:18 +05'30'	

LIST OF AMENDMENTS:

S.No.	AmendmentDate	Revision	Details
	10.01.2024	Nil	First Issue

Chapter 1: General

1.1 Purpose

1.1.1 The purpose of this specification is to establish a clear objective for design, development, manufacture, supply, installation/integration, testing and commissioning of dual mode IGBT based three-phase propulsion, control and other equipment for High-Speed Self Propelled Accident Relief Train(HS-SPART) suitable for operation on (1) 25kV AC OHE system and (2) Diesel-Electrical system. `

1.2 Foreword and Scope

1.2.1 To achieve faster initial response and for providing quickest possible medical attention and restoration, it is planned to induct HSSPART capable of running in dual mode.

i.) Maximum operational Speed of 160 KMPH on Electric (OHE) mode

ii.) Maximum operational Speed of 140 KMPH on Diesel-Electric mode

1.2.2 The equipment and control systems in the scope of supply are listed (not exhaustive) in Chapter 5 of this specification. It shall also include variousservices and control packages required to build the complete Train.

1.2.3 Propulsion equipment such as Diesel Engine, transformers, 3-phase induction motors, gearbox assembly, IGBT based traction converter, auxiliary converter, Main compressor, battery charger, battery etc. will be underslung mounted, whereas, other sub-systems such as Train Control and Management System, Brake Interface Unit, PA/PIS, CCTV etc. will be mounted on-board.

1.2.4 The propulsion system shall meet the operating, service conditions and performance requirements of this specification and shall be suitable for operating conditions on IR.

1.2.5 Vehicle Configuration

1.2.5.1 The Vehicle Configuration of HSSPART consists of two basic units, First basic unit consists of Supervisor Van +Tool Van, Second basic unit consists of Medical Van + Tool Van. The rake formation is as follows:

(Supervisor Van + Tool Van) + (Tool Van + Medical Van)
(Basic Unit 1) + (Basic Unit 2)

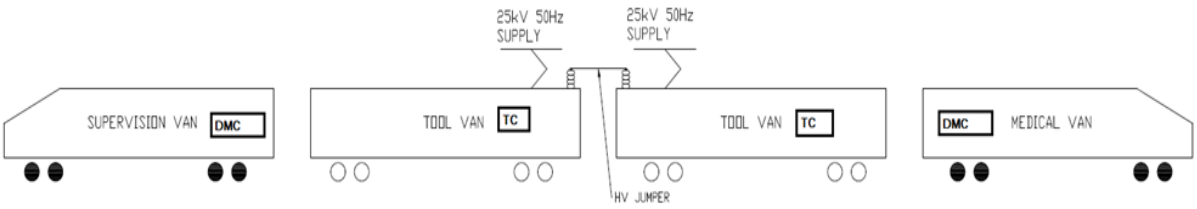


Figure 1: Vehicle configuration

1.2.6 One Supervisor Van / Medical Van along with one tool van makes one basic unit. Supervisor van and Medicalvan are the motor coaches with driver cabin called DMC whereas the Tool van is Trailer coach (TC). Supervisor van and Medical van have air conditioning system (HVAC).

1.2.7 Supervisor Van and Medical Van are driving motor cars(DMC) and the following equipment are to be considered for the DMC.

i.) Traction Motors
ii.) Line and Traction Converters
iii.) Auxiliary Converter
iv.) Main air Compressor
v.) Air Reservoirs
vi.) HVAC
vii.) Drivers Desk and Panels
viii.) Battery and Battery charger

1.2.8 The Tool Vans are Trailer Coaches (TC) with no passenger on board considered and hence no air conditioning required. The following are installed in the TC.

i.) Diesel Electric Power Pack
ii.) Traction Rectifier
iii.) Traction Transformer
iv.) Fuel Tank
v.) Charge Air Cooler
vi.) Roof Mounted Radiator
vii.) Pantograph and VCB

1.2.9 HSSPART will operate with following major items depending on type of car:

1.2.9.1 Tool Van

i.) Set of Hydraulic Rescue Device (HRD)
ii.) Set of Hydraulic Re-Railing Equipment (HRE)
iii.) Other cutting tools & lighting provisions
iv.) EOT crane

1.2.9.2 Medical Van

i.) Medical Equipment and Supplies
ii.) Operation Theatre and ward for injured passengers

1.2.9.3 Supervisor Van

i.) Kitchen
ii.) Berths for Supervisors

1.3 Applicable standard

1.3.1 The following standards are applicable wherever referred.

Table 1: Standard and specification

S. No.	Standard	Title
1.	IEC –60571 (1998-02)	General requirements and tests for electronic equipment used on rail vehicles.
2.	IEC–61287–1	Railway applications–Power converters installed on rolling stock.
3.	IEC–60310	Rules for traction transformer and reactor.
4.	IEC–60077 –1	Railway applications –Electric equipment for rolling stock –part 1: General service conditions and general rules.
5.	IEC–61373	Railway applications –rolling stock equipment –shock and vibration tests.
6.	EN–50121 –3 –2 (CENELEC)	Railway applications –Electromagnetic compatibility part 3 –2: Rolling stock apparatus.
7.	EN–50121 –2 (CENELEC)	Railway applications –Electromagnetic compatibility part 2: Emission of the whole Railway system to the outside world
8.	EN–50153	Railway applications –Rolling stock –Proactive actions against electrical hazards.
9.	IEC –60529	Degree of protection provided by enclosures (IP code)
10.	EN–50126 / IEC 62278	Railway applications –Specification and demonstration of reliability, availability, maintainability and safety (RAMS).
11.	EN–50238	Railway applications –Compatibility between rolling stock and train detection systems.
12.	EN–50264	Railway applications –Railway rolling stock power and control cables having special fire performance.

13.	IEC- 60349	Electric Traction Rotating Electrical Machines for Rail and Road Vehicles - Edition 2.0
14.	IEC-60411	1Single-Phase Traction Power Convertors
15.	IEC 62279/EN 50128	Railways applications - Communications, signalling and processing systems - software for railway control and protection system
16.	IEC 62425 /EN 50129	Railways applications - Communications, signalling and processing systems - Safety related electronic systems for signalling
17.	IEC 62280 /EN 50159	Railways applications - Communications, signalling and processing systems - Safety related communication (part 1&2)
18.	IEC 61131 part 1 to 9	Programming controllers languages
19.	IEC-61375	Train communication network
20.	IEC 61375 -1	General Architecture
21.	IEC 61375 -2-5	Ethernet Train Backbone
22.	IEC 61375 -3-3	CAN open as vehicle bus
23.	IEC 61375 - 2-1/2-2	Wire Train Bus
24.	IEC 61375 - 2-6	Board to ground communication
25.	IEC 61375 - 2-3	Communication profile
26.	IEC 61375 - 3 -4	Ethernet consist network
27.	IECTR 61375 -2-8 New	TCN conformance test
28.	IEC 61375 -2-4	Application profile
29.	IEC 60349-1,2	Traction Motor
30.	IEC - 60411,	Power Rectifier
31.	IEC - 60337, 60157, 60158, 77	Relays & Contactors
32.	IEC - 68-2-14	Control cubicle
33.	IEC - 60349 (Pt - 1)	Traction Alternator

1.4 Abbreviation / Terminology

Table 2: Abbrevaiation

S.No.	Abbreviation /Terminology	Expansion/Explanation
1.	AC	Alternating current
2.	DC	Direct current

3.	RPM	Revolutions per minute
4.	HP	Horsepower
5.	AH	Ampere hour
6.	IGBT	Insulated Gate Bipolar Transistor
7.	IEC	International Electro technical Commission
8.	IR	Indian Railways
9.	IS	Indian Standard
10.	SPART	Self-Propelled Accident Relief Train
11.	HPI	High pressure Injection
12.	VVVF	Variable Voltage variable frequency
13.	HV	High Voltage
14.	TM	Traction Motor
15.	TCMS	Train control and Management system
16.	TCN	Train control network
17.	Aux.	Auxiliary
18.	DE	Diesel-Electric
19.	DA	Diesel Alternating set
20.	ACU	Auxiliary Converter unit
21.	TCU	Traction converter unit
22.	OHE	Over-head electric
23.	TA	Traction alternator
24.	LTC	Line and traction converter unit
25.	RDSO	Research Designs & Standards Organisation
26.	RCF	Rail Coach Factory, Kapurthala
27.	DMC	Driving motor coach
28.	TC	Trailer Coach
29.	SV	Supervisor Van
30.	MV	Medical Van
31.	TV	Tool Van
32.	TSD	Trouble shooting directory
33.	SIL	Safety Integrity level
34.	VRLA	Valve regulated Lead-acid

1.5 Definitions & Interpretations

Table 3: Definitions

S.No.	Abbreviation /Terminology	Expansion/Explanation

1.	Train/Train set	Train/Train set means Self-propelled accident relief train (SPART),consists of 4-car rake formation
2.	Rake	Rake means combination of two basic units, consists of 4 cars
3.	Basic unit	Supervisor van plus Tool Van or Medical van plus Tool Van

Chapter 2 :General Requirements and Supplier's Responsibilities

2.0 General requirements

RDSO specification RDSO/PE/SPEC/EMU/0196-2019 (Rev.0) for "3 Phase Propulsion Equipments and Control system for Electric Trainsets" shall be referred with suitable modifications in relevant clauses applicable in this specification. The modifications in the relevant clauses/Annexures of above RDSO specifications are as under:

Approval by "RDSO" is replaced with "RCF/RDSO or its authorized agency" wherever applicable.

Existing Clause of RDSO spec RDSO/PE/SPEC/EMU/0196-2019 (Rev.0)	Modified Clause
Clause 1.8.2 Installation of supplied equipment and control system is generally not in the scope of Supplier. The Supplier shall therefore make available the detailed instructions, drawings and relevant specifications for proper installation of the equipment and system in coaches to Purchaser and RDSO or any other authorised agency nominated by Purchaser. Supplier shall depute engineers to Purchaser or any other manufacturer's premises authorised by Purchaser for supervision of installation of the equipment on coaches of all the rakes.	**Installation of supplied equipment and control system is in the scope of Supplier.** The Supplier shall therefore make available the detailed instructions, drawings and relevant specifications for proper installation of the equipment and system in coaches to RCF and RDSO. Supplier shall depute engineers and skilled manpower to RCF or any other manufacturer's premises authorised by RCF for installation of the equipments on coaches of all the rakes.
1.8.12 Save otherwise exempted under this specification, two prototype rakes, fitted with the supplied equipment after the successful completion of all tests and trials and RDSO clearance shall undergo service trials for six months or one lakh km whichever is earlier. Clearance for supply of equipment for series rakes shall be given by RCF after successful service	Save otherwise exempted under this specification, one prototype rakes, fitted with the supplied equipment after the successful completion of all tests and trials and RCF clearance shall undergo service trials for three months or Fifty Thousand km (25000 km in each OH and DE mode) whichever is earlier. Clearance for supply of equipment for series rakes shall be given by RCF after successful service trials for three months or Fifty Thousand km as stated

trials for three months or one lakh km as stated above for prototype rake. The supply of equipment for the "work in progress" for the period of service trials can commence as agreed by the supplier and purchaser so that the continuity of the production is not affected. During the prototype tests/service trials, if any problem arise or feedback 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 modification considered most appropriate to reach compliance with the specification without any extra costs to the Purchaser and in a manner approved by the RCF on equipment/components already supplied as well as those to be supplied later.	above for prototype rake. The supply of equipment for the "work in progress" for the period of service trials can commence as agreed by the supplier and purchaser so that the continuity of the production is not affected. During the prototype tests/service trials, if any problem arise or feedback 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 modification considered most appropriate to reach compliance with the specification without any extra costs to the Purchaser and in a manner approved by the RCF on equipment/components already supplied as well as those to be supplied later.
Clause 1.11.12 Supplier shall submit the 3D models (for interface purposes) in SolidWorks and 2D drawings in "AUTOCAD". To ensure tool independent exchange of models, step-files shall also be submitted. The complete documentation shall be provided on digital storage media along with relevant software and complete arrangement to read, edit and to take prints in colour. In case the drawing format is not compatible with AUTOCAD, necessary customized hardware and software shall also be submitted	Supplier shall submit the 3D models (for interface purposes) and 2D drawing in "Siemens NX". To ensure tool independent exchange of models, step-files shall also be submitted. The complete documentation shall be provided on digital storage media along with relevant software and complete arrangement to read, edit and to take prints in colour. In case the drawing format is not compatible with Siemens NX, necessary customized hardware and software shall also be submitted

Chapter 3: Operating and Service Conditions: Design Constraints

Existing Clause of RDSO spec RDSO/PE/SPEC/EMU/0196-2019 (Rev.0)	Modified Clause
Clause 2.1 Leading particulars For leading particulars of the Chair Cars, on which supplied equipment are to be fitted, following ICF Car layout OGA drawings may be referred: (Annexure: X) (i) TRAIN 18/DTC/AC-9-0-001 (ii) TRAIN 18/MC/AC-9-0-001 (iii) TRAIN 18/TC/AC-9-0-001 (iv) TRAIN 18/NDTC/AC-9-0-001	Leading particulars For leading particulars of the HS-SPART, on which supplied equipment are to be fitted, following RCF layout drawings (latest revisions) shall be referred: i) RT90022 ii) RT90023 iii) RT90024 iv) RT90025
Clause 2.1.1 The layouts for sleeper coaches are under finalization and will be madeavailable at appropriate stage.	Deleted
Clause 2.2 Payload and weight particulars	Maximum weight of Propulsion Electrics under the scope of the firm shall not exceed 68.5 T.
Clause 2.5 (i) Max. service speed **:**160 KMPH (ii) Max. test speed :180 KMPH	**Maximum service speed :**160 KMPH in OHE mode and 140 KMPH in Diesel-Electric mode **Maximum test speed :**180 KMPH in OHE mode and 154 KMPH in Diesel-Electric mode
Clause 2.6.2 The guaranteed performance shall be available from 22.5 kV to 27.5 kV for gross train weight of 550 ton plus weight of equipment covered under this specification to be supplied by Supplier. The maximum current drawn by a 16-car loaded Train to meet the performance requirements of this specification at 22.5 kV shall not exceed 540 Amp. Regenerative braking system shall continueto operate when the supply voltage is in the range from 17kV to 30kV. Train operation shall be	The guaranteed performance shall be available from 22.5 kV to 27.5 kV for gross train weight of **272** Ton including weight of equipment covered under this specification to be supplied by Supplier. The maximum current drawn by a **4-car** loaded train to meet the performance requirements of this specification at 22.5 kV shall not exceed **125** Amp. Regenerative braking system shall continueto operate when the supply voltage is in the range from 17kV to 30kV. Train operation shall be feasible at OHE voltage of 17 kV, may be with restrictedpower.

feasible at OHE voltage of 17 kV, may be with restricted power. It should be possible to run the Train up to 24-car formation with suitable parametric changes to take care of OHE limitations.	
Clause 2.13 Reliability, Availability, Maintainability and Safety (RAMS)	New clause 2.13.13 added: **Diesel Electric Power Pack** The tenderer shall clearly specify the minimum guaranteed reliability of the equipment in terms of km/failure. The equipment shall incorporate features to ensure high availability, low maintenance requirements, high reliability in operation and excellent overall efficiency.

Chapter 4: Performance Requirements

Existing Clause of RDSO spec RDSO/PE/SPEC/EMU/0196 -2019 (Rev.0)	**Modified Clause**
Clause 3.1.1 (i) The capacity of the traction motor and the other equipment shall be adequate to permit continuous operation of 16-car train comprising 4 basic units of total weight 550 ton and items covered under scope of supply of this specification (all items mentioned in clause (to be considered) to be supplied by Supplier so as to meet the performance requirements specified herein. The design shall permit the operation of Train up to 24 cars under loaded conditions with the unit weight as above with suitable parametric changes to take care of OHE limitations. All performance calculations/ evaluations shall be with respect to 16-Car train having four basic units unless stated otherwise.	The capacity of the traction motor and the other equipment shall be adequate to permit continuous operation of 4-car train comprising 2 basic units of total weight 272 ton and items covered under scope of supply of this specification (all items mentioned in clause 5.1 of this specification to be considered) to be supplied by Supplier so as to meet the performance requirements specified herein. The design shall permit the operation of Train up to 4 cars under loaded conditions with the unit weight as above with suitable parametric changes to take care of OHE limitations. All performance calculations/ evaluations shall be with respect to 4-Car train having two basic units unless stated otherwise
Clause 3.1.3 Supplier shall submit the RMS current values of traction motor and temperature rise of propulsion equipment for a 16 Car rake operation for repeated all-out cycles of 10 km with a dwell time of 30 seconds up to stabilization	Supplier shall submit the RMS current values of traction motor and temperature rise of propulsion equipment for a 4 Car rake operation for repeated all-out cycles of 10 km with a dwell time of 30 seconds up to stabilization of temperatures of all propulsion equipment. The R.M.S. (root mean square) loading of the traction motor with regenerative braking in use for all out running as mentioned herein shall not exceed the continuous rating of the traction motor.

<table>
<tr><td>of temperatures of all propulsion equipment. The R.M.S. (root mean square) loading of the traction motor with regenerative braking in use for all out running as mentioned herein shall not exceed the continuous rating of the traction motor.</td><td></td></tr>
<tr><td>Clause 3.2.1

The Traction performance shall be achieved for maximum gross weight of 550 ton plus weight of items in the scope of this specification (all items mentioned in Clause 4.1 to be considered) to be supplied by Supplier for 16-car train.</td><td>The Traction performance shall be achieved for maximum gross weight of 272 ton including weight of items in the scope of this specification (all items mentioned in Clause 5.1 of this specification to be considered) to be supplied by Supplier for 4-car train.</td></tr>
<tr><td>Clause 3.2.4</td><td>To be read as:
<table>
<tr><th>SN</th><th>Parameter</th><th>OHE (*)</th><th>DE (with 50 kW auxiliary load) (*)</th></tr>
<tr><td>1.</td><td>Starting acceleration at FL up to 40 kmph</td><td>0.7 m/s^2</td><td>0.6 m/s^2</td></tr>
<tr><td>2.</td><td>Acceleration residual at max permissible speed (160 kmph for OHE and 140kmph for DE)</td><td>0.1 m/s^2</td><td>0.04m/s^2</td></tr>
<tr><td>3.</td><td>Deceleration (during full service braking)</td><td>0.8 m/s^2</td><td>0.8m/s^2</td></tr>
</table>
(*) subject to the requirements with respect to jerk rate specified in Clause 3.4 of RDSO Specification RDSO/PE/SPEC/EMU/0196-2019 (Rev.0).</td></tr>
</table>

Clause 3.3.1 All requirements specified in this clause shall be achieved when the Train load is as given in clause 2.2.	All requirements specified in this clause shall be achieved for the gross load condition for the whole rake of 4 coaches.
Clause 3.3.4 Train shall be fitted with an emergency brake, which can bring the Train to standstill in less than 1250 mwhen the Train is travelling at 160 km/h.	Train shall be fitted with an emergency brake, which can bring the train-set to standstill in less than 1100 m when the Train is travelling at 160 km/h.
Clause 3.5.6 The fully loaded 16-car rake with one basic unit isolated and already running continuously at sectional speed shall be capable of starting on a gradient of 1 in 37 and clear the section of 10 km with speed up to 60 kmph. The temperature rise of the traction motor and other propulsion equipment shall be within thermal rating of the respective equipment as specified in chapter 4. The one-hour rating of the Traction Motor shall be submitted. Average line voltage during the period shall be taken as 22.5kV AC under traction. The time in which the section will be cleared and the maximum speed attainable shall be furnished by the Supplier. Supplier shall submit simulation results for the propulsion equipment temperature rise under the above conditions as per annexure-II.	The fully loaded 4-car rake with one basic unit isolated and already running continuously at sectional speed shall be capable of starting on a gradient of 1 in 37 and clear the section of 10 km with speed up to 60 kmph. The temperature rise of the traction motor and other propulsion equipment shall be within thermal rating of the respective equipment as specified in chapter 4 of RDSO Spec RDSO/PE/SPEC/EMU/0196-2019 (Rev.0). The one-hour rating of the Traction Motor shall be submitted. Average line voltage during the period shall be taken as 22.5kV AC under traction. The time in which the section will be cleared and the maximum speed attainable shall be furnished by the Supplier. Supplier shall submit simulation results for the propulsion equipment temperature rise under the above conditions as per annexure-II of this specification.

Clause 3.5.12.2 Supplier shall submit the balancing speed for the fully loaded 16-Car train in normal and one basic unit isolated condition.	Supplier shall submit the balancing speed for the fully loaded 4-Car train in normal and one basic unit isolated condition.
Clause 3.10 **Minimum Clearance from Rail Level** Under fully worn wheels and fully loaded condition of the coach, the minimum clearance of bogie-mounted equipment from rail level shall be more than prescribed in (IRSOD ACS 27 of July 2019) under worst conditions. The minimum clearance for the body mounted under slung equipment shall be 215 mm under tare condition with fully worn wheels.	**Minimum Clearance from Rail Level** Under fully worn wheels and fully loaded condition of the coach, the minimum clearance of bogie-mounted equipment from rail level shall be more than prescribed in (IRSOD 2022) under worst conditions. The minimum clearance for the body mounted under slung equipment shall be 215 mm under tare condition with fully worn wheels.

Chapter 5: Scope of Supply and Technical Specifications

5.1 Scope of Supply

5.1.1 For the design, development including simulation studies, manufacture, supply and commissioning of complete set of 3-phase drive equipment on OHE mode and DE mode, the scope of supply is as under unless stated otherwise in the bid document/ purchase order (in the event of non-inclusion of any item indicated hereunder, the accountal of respective weight shall continue as though in the scope of Supplier):

i.) Traction transformer with required number of secondary traction windings along with protection equipment.Gapless lightning arrestors, Current transformer and Potential transformer for 25kV AC.

ii.) IGBT based PWM Traction Converter set including DC link with 100 HZ resonance filter (optional) and/or any other equipment necessary to reduce the effect of other harmonics on S&T equipment.

iii.) Three-phase induction motors compatible with IGBT based traction converter power supply, with coupling, gear box assembly, sensors and associated equipment.

iv.) Microprocessor based Train Control and Management System (TCMS) including fault diagnosis and display system in the driving cab.

v.) Train Control & Management System, multiplexing system for relevant control & other signals and any other equipment, cables, inter-vehicular couplers & terminal equipment. Inter-vehicular couplers shall be supplied in assembled form.

vi.) Event Recorder

vii.) Voice communication system, Passenger information system including coach displays, audio communication system, emergency talk back system and interface with the Train Monitoring System (TMS) and any equipment required for interfacing PIS with the Receiver-equipment of TMS.

viii.) Emergency Talk Back Unit (ETB)

ix.) Cab recording equipment

x.) Integration with TCMS of Brake system, Bogies and Automatic door closure system

xi.) Master cum Brake controller

xii.) Complete pre-fabricated driver desk housing all the necessary equipment and driver/ guard seat. Cab radio may be provided by IR for sections with GSM-R.

xiii.) Automatic smoke/fire detection and alarm system

xiv.) Speed Indicating cum recording equipment, Control Equipment such as relays, contactors, circuit breakers and related switchgears etc. for propulsion system, controls, auxiliaries in the assembled form viz. cubicle or cabinet.

xv.) Passenger alarm system

xvi.) Control Equipment such as relays, contactors, circuit breakers and related switchgears etc. for propulsion system, controls, auxiliaries in the assembled form viz. cubicle or cabinet.

xvii.) Brake Interface Unit fulfilling the brake blending requirements. (Envisaged as a constituent of TCMS and not to be treated as a separate item for the purpose of SOR items)Wheel slip/ slide control

xviii.) Wheel slip/ slide control (Envisaged as part of propulsion control of motor coach not to be treated as a separate item for the purpose of SOR items).

xix.) Load weighing system including redundant weight sensors at bogie level. The scope of supply of pressure transducers shall be with Supplier

xx.) High Voltage cable including isolation & protection system for feeding adjacent units

xxi.) Auxiliary system including IGBT/ SiC power module based Auxiliary converter for auxiliary supplies,

xxii.) Battery and battery charging system along with Battery Box.

xxiii.) Auxiliary machines such as oil pump, oil cooling blowers for traction transformer, blowers for traction converter, auxiliary converter etc.

xxiv.) Light system including coach lights, Headlight, Tail-light, Marker lights and Flasher lightsand Disaster Management Light etc. including control switchgear thereof.

xxv.) Pneumatic system comprising of main air compressor, air dryer, filters and auxiliary compressor

xxvi.) Complete air-conditioning system with necessary equipment such as Roof Mounted Package Unit (RMPU), Cab AC units, control panel, micro-controller etc.

xxvii.) Power & control cables including termination equipmentand cable ducts/ conduits/ trays.

xxviii.) Inter-vehicular couplers

xxix.) Data / communication cables, fire survival cables as mentioned in relevant clauses.

xxx.) EPDM & EMC type cable glands for sealing & shielding

xxxi.) Pantograph & Earthing Switches - Single pantograph suitable for 25kV AC supply shall be used on each basic unit.

xxxii.) Independent VCBs (One with earthing switch for Traction Circuit protection and one without earthing switch for HT cable protection)

xxxiii.) Centralized Coach Monitoring System (CCMS)

xxxiv.) APC receiver compatible with existing track magnets

xxxv.) Any other equipment required for power isolation, interlocking & proper functioning of the traction equipment etc.

xxxvi.) Instrumentation required for commissioning and field-testing of the equipment. (May be taken back by the Supplier after completion of the commissioning and field testing activities)

xxxvii.) 3-phase to single phase underslung transformer of adequate capacity for auxiliary loads (not less than 20 kVA rating) generally conforming but not limited to ICF specification no. ICF/Elec/160 Rev 0 or latest.

xxxviii.) Underslung mounted Horizontal Diesel engine of minimum 750 HP with mounting system, roof mounted radiator, 24 V Starter battery andCharger and all standard accessories.

xxxix.) Traction Alternator to be directly coupled to Diesel engine.

xl.) Traction Rectifier with suitable DC Link interface

Existing Clause of RDSO spec RDSO/PE/SPEC/EMU/0196-2019 (Rev.0)	**Modified Clause**
Clause 4.7	Deleted
Clause 4.9.10 The electronic cards and couplers/ connectors shall be polarized or suitably designed to ensure that insertion in wrong position is not possible. The TCMS system shall be modular in design and shall cater for at least 10% capacity with necessary input & outputs for expansion & future use over & above essential requirement for 24-Car Train.	The electronic cards and couplers/ connectors shall be polarized or suitably designed to ensure that insertion in wrong position is not possible. The TCMS system shall be modular in design and shall cater for at least 10% capacity with necessary input & outputs for expansion & future use over & above essential requirement for 4-Car Train.
Clause 4.11.1, 4.11.4, 4.11.6, 4.11.7, 4.11.8, 4.11.9, 4.11.10, 4.11.11, 4.11.13	Deleted
--	New Clause 4.11.14 added: **Headcode:** One Destination indicator (Head Code) shall be provided on the Driving coach face (nose cone). The head code shall be in a separate box above the lookout glass. A modern high resolution LED display in both English and Hindi in amber colour shall be provided which should be visible clearly from the platform from the distance of 50 meters minimum (in day light). Full details of the data to be incorporated will be furnished to the Supplier at the design stage. Data input shall be from the driver's console as a part of setting up procedure. There shall be provision of manual over ride

	feature for setting the Head Code display in the event of failure of electronics. The viewing angle for the destination indicators shall be 60 degree (+/-30 degree from the centre line).This shall use GPS to determine the Train location.
Clause 4.12	Deleted
Clause 4.13	Deleted
Clause 4.29.2	To be read as: 120 Ah VRLA batteries shall be provided on each Basic Unit to feed the emergency 110V DC load for at least 2 hours in the event OHE supply is not available. Nominal voltage of the battery shall be 110 V.
Clause 4.29.3.1	To be read as: The batteries shall be maintained at an adequate level of charge to satisfy the requirements of following Emergency Loads for a duration of 2 hours after the loss of OHE power: (i)Head light and Emergency light including Flasher lights. (ii) 50% Coach lighting. (iii) Train controls (full load). (iv) Fire detection system.

New Clause 5.45 – Added:

5.45 Diesel-Electric mode

(i) Dual mode SPART shall be capable to works on either of the modes, OHE mode or Diesel - Electric mode

(ii) In diesel-Electric mode the DE power pack shall be capable to generate 3 phase, 1335 V (Alternating Voltage) or as per OEM's design at 1800 RPM. Traction rectifier unit shall be used to convert 3 ϕ alternating output of DE set to 1800 V Direct Voltage. The output of the Traction rectifier shall be directly fed to the DC link of the Line and traction converter (LTC).

(iii) Suitable Power switching along with interlocking arrangement shall be provided to ensure that only one source of power is connected to the LTC at any point of time.

(iv) The Diesel-Electric Power pack to have following general features.

Diesel Engine		
S. No.	**Parameter**	**Remark**
1.	Engine Type (Mechanical /Electronic)	Electronic
2.	Diesel engine orientation	Horizontal engine
3.	Rated output of the engine at NTC condition	750 HP @1800 RPM (Intermittent rating)
4.	Rated engine Speed	1800 RPM
5.	Fuel system	Electronic fuel Injection
6.	Aspiration	Turbocharged and charged air cooled
7.	Cooling system and Radiator mounting	Water cooled, Roof mounted radiator (Electrically driven fan motor)
8.	Engine starting system (Electric starter)	Suitable for 24 V DC battery system
9.	Engine and traction alternator mounting	The engine and traction alternator shall be resiliently mounted to the subframe and the subframe resiliently mounted to underframe. Suitable anti vibration mounting pads shall be required.
10.	The diesel engine along with accessories shall be subjected to the fitment within the following maximum limiting dimensions (Envelope).	(Lx W x H) 1900 mm x 2200 mm x 850 mm
11.	The Diesel-Alternator set shall be subjected to the fitment within the following maximum limiting dimensions (Envelope).	(Lx W x H) 2900 mm x 2200 mm x 850 mm
12.	Approximate weight of the engine	Maximum 2.2 tons
Traction Alternator		
1.	Alternator Power rating	550 kW
2.	Rated Voltage	1350 V or as per OEM's design,3 Phase AC(Suitably selected to meet DC link Voltage)

3.	Rated RPM	1800
4.	No.of Poles	6/4
5.	No.of phases	3 phase, Synchronous
6.	Insulation Class	H
7.	IP rating	IP23
8.	Alternator efficiency	94 %
9.	Alternator mounting	Underslung mounted along with Diesel Engine
10.	Approximate weight	2 tons

(iii) The diesel engine along with accessories shall be subjected to the fitment within the 1900 mm(length) x 2200 mm (width) x 850 mm (height) maximum limiting dimensions (Envelope).

(iv) All traction power diesel engines shall be of a service-proven design. They shall be identical and fully interchangeable with one another. The diesel engine shall deliver sufficient power to meet the performance requirements of design criteria.

(v) The OEM shall submit the details of power absorbed by the individual accessories essential for the working of the engine.

(vi) The diesel engine shall work satisfactorily with fuel oil to Indian Standard Specification No. 1460 (2005).

(vii) Filters for engine air intake shall be provided with restriction indicator to ensure satisfactory performance under dusty environment.

(viii) The engine shall be provided with a flexible coupling to suit traction alternator. The couplingshall be of adequate capacity to withstand high deflection and torque (at starting, stopping anddue to any misfiring of the cylinders) so that no damage is caused to transmission and enginecomponents in service.

(ix) Suitable provision for lube oil drain arrangement from engine sump easily shall be provided toavoid oil spillage.

(x) The supplier shall time to time inform Railways about the modification to be carried out on theengine.

(xi) The supplier shall co-ordinate with Railway administration for carry out any modificationsuggested by RCF/RDSO or authorised agency.

(xii) The diesel engines shall have the following basic design features:

i.) Water cooled
ii.) Turbocharged
iii.) Electronic fuel injection
iv.) Self-protection
v.) Low temperature starting capability

(xiii) Contractor will provide detailed engine performance curves which are required for traction performance in comparison with a stated maximum adhesion coefficient.

(xiv) Each diesel engine and associated traction power equipment shall be either directly mounted under the car frame or a sub frame for modular removal from the car. The engine shall be resiliently mounted. The mounting system shall meet the shock and vibration criteria stated in this specification while minimizing noise and vibration transmitted into the occupant areas.

(xv) Engine compartment access shall be provided through removable access panels. Test ports shall allow service personnel to collect samples of engine oil and coolant easily. Filling, draining, and checking all polluting components such as oil, grease, and coolant shall be done from the outside of the car passenger area. At a minimum, the following items shall be easily serviced through side access doors:

1. All fuel, engine oil, and associated filter elements;
2. Engine oil level dip stick or sight glasses, oil fill port, and drain ports;
3. Engine start panel;
4. Water and lubricating oil pumps;
5. All visual indicators, gauges, protective devices and test connection points for engine coolant, lubricating oil, fuel oil, and combustion air.

(xvi) **SFC and Lube oil Consumption:** OEM shall indicate the specific fuel consumption & lube oil consumption at maximum rated output & load.

(xvii) **Engine Starting System:**24 V, 450/500 Ah, low maintenance Lead Acid storage batteries (5 hrs. discharge rate) conforming toRDSO/PE/SPEC/TL/0001-1998 (Rev-0) and approved make shall be provided. Adequate fuseprotection is given in positive and negative battery circuit. The battery shall cater to 3 cranking ofengine at 10 seconds' interval.

(xviii) **Engine Cooling System**

1. Each engine shall have its own cooling system. The cooling system shall consist of the radiators, expansion tank, temperature sensors, controllable valves, and fans to

regulate the cooling air volume. The cooling controls shall keep the engine temperature in the specified optimum operating range under all operating conditions. The radiators shall be mounted on the roof for maximum access to clean, ambient air.

2. The cooling equipment for diesel engine shall be required to work efficiently under specified climatic conditions specified. Apart from meeting the cooling requirement of diesel engine including after cooler, the cooling equipment shall be required to dissipate heat of Lubricating oil, with **30%** chocked condition of radiator. Airflow required for the radiator fan shall be at least 15% more than actually required to make up for any reduction in air flow due to train movement.

3. Expansion tank shall be provided at a suitable location for ease of maintainability. It shall be provided with glow type sight glass marked with high & low level. Water level indicator shall be provided on radiator top tank and it should be easily visible and readable. Also, the capacity in liters may be indicated on tank itself. Its filling point shall be provided with pressurized cap and pressure relief valve.

4. The radiators shall be of service proven design, made of either copper/redbrass or aluminum compatible to the corrosion inhibitor/coolant used in engine cooling system. Connections shall be provided with couplings to facilitate easy removal and replacement.

5. The Contractor shall submit following details and calculations for the offered cooling system:

   i.) Cooling requirement for all sources of heat (with break up)
   ii.) Heat dissipation characteristics of the radiator and its resistance characteristics.
   iii.) Radiator fan characteristics curve showing the air flow Vs total heat at different speeds and power consumption.
   iv.) Cooling system-matching calculations and heat balance sheet at maximum output.
   v.) Schematic cooling circuit diagram showing water, oil and airflow.
   vi.) Installation drawing of radiator, fan assembly for cooling arrangement.

(xix) **Fuel tank system:** The fuel tank and refilling system shall be provided of:

1. One fuel stop Electro-Valve to avoid overfilling.
2. Two air venting valves but holding the fuel to avoid overpressure

(xx) **Engine Control System**

Engine operation shall be controlled by an electronic control unit (ECU). The control unit shall have a connector for a portable test unit (PTU) to permit static testing, access to diagnostics, and monitoring of the traction system during car operations. All major operating parameters, such as engine temperature, speed, and fault conditions, shall be reported to the car monitoring and diagnostic system.

(xxi) **Traction Alternator**

1. The traction power diesel engine shall be coupled to a matching alternator. The alternator shall provide electric power to traction rectifier and potentially an auxiliary inverter. The traction inverters shall provide a variable-voltage, variable-frequency (VVVF) output to drive the traction motors. Each VVVF output may drive one or more traction motors in one bogie.
2. The alternator unit shall consist of the excitation circuit, output rectifier, protection circuits, and the corresponding controls. The excitation shall be provided by a car battery, at 24VDC nominal, and shall be functional over the full battery voltage range but not less than +25% /-30%.
3. The alternator controls shall be part of the car controls to allow an optimum control of the power generation, as needed by the traction and auxiliary inverters.
4. Any fault conditions or irregularities shall be reported to the train controls and management system.
5. Asynchronous generator may be proposed.
6. If the alternator is not close-coupled to the traction engine, then it shall be resiliently mounted to a sub frame and the sub frame resiliently mounted to the car in a similar manner as the engine. The mounting system shall meet the shock and vibration criteria stated in this specification while minimizing noise and vibration transmitted into the passenger areas

(xxii) **Traction rectifier:** The Traction rectifiers for conversion of controlled AC supply of traction alternator to DC supply suitable to traction motor and other equipment shall be a full wave three phase silicon diode bridge power rectifier.

(xxiii) **Interlock panel for changeover between OHE to DE mode**

1. Ordinarily, the SPART shall run in OHE mode. If OHE is not available, an interlock panel shall be provided to ensure that only one power source, either OHE or DE, shall be connected to the traction system at any point of time. The interlock panel will allow the traction drive system of SPART to run on both electrified and non-electrified tracks along with auxiliary power supply. The interlock panel should smoothly switch the mode of power source to run the traction system on either OHE or DE mode.

2. Changeover from Overhead electric (OHE) mode to Diesel-Electric mode should be achievable within 4 minutes without stopping the train and shall ordinarily follow following sequence:

    a) Bring master controller to neutral position
    b) Open the VCB and lower the Pantograph.
    c) Select the Diesel-Electric mode by using selector switch
    d) Switch ON the Diesel engines as required.
    e) Run the engine at 1500 RPM and transfer the auxiliary loads.
    f) Increase the engine RPM to rated speed.
    g) Increase the traction load gradually with the help of master controller as required.

3. Changeover from Diesel-Electric mode to overhead electric (OHE) mode shall ordinarily follow following sequence:

    a) Bring master controller to neutral position
    b) Select the OHE electric mode by selector switch.
    c) Raise the Pantograph and close the VCB
    d) The Line Converter shall get Power for Control electronics after selecting OHE mode.
    e) Increase the traction load gradually with the help of master controller as required.

4. When the OHE mode is selected, the Alternator excitation shall be disabled and the engine shall execute the cooling cycle and shut down automatically.

New Clause 6.0 Added:

6.0 (a) Auxiliary Power Supply

i. The SPART train set shall be provided with two Auxiliary Converters of approx. 200 kVA capacity each. Both the Converters will be required to work at accident site and the controls shall be accordingly provided so that these can be worked as single or a combined unit.

ii. The following electrical loads will be catered by the auxiliary Converter.

S.No.	Load Description	Load (kW)/unit
1.	WRA pump – 2 Nos.	0.746
2.	Fans – 0.84 kW per coach (earlier fans in 3 coaches, now AC added in 2 coaches & fans in 2 coaches)	1.68
3.	Lights – 1.2 kW per coach	2.4
4.	Boyles Apparatus	0.25
5.	Suction Apparatus	0.3

6.	Electric Cautery	1.0
7.	Pulse Oximeter	0.2
8.	Autoclave	2.0
9.	Water sterilizer	1.8
10.	Refrigerator	0.746
11.	Kitchen load	6.0
12.	Headlight – 2 Nos., Marker light, Tail light, Flasher light	0.50
13.	110V Battery Charger (for battery capacity 120 Ah)	1.5
14.	Air compressor electric motor driven (considering 1 no. compressor in each basic unit)	13.5
15.	Traction Engine cooling fan load @ 12 kW per powerpack	12
16.	Motorized Sliding Ladder	0.746
17.	Electrically Operated wiper (Rated voltage = 110V DC) High speed - 0.7A=0.077 kW Low speed - 0.4A=0.044 kW	0.077
18.	Traction Engine Charge Air cooler Fan	5
19.	Traction Converter cooling Fan	4
20.	Transformer oil cooling fan	1.35
21.	APS Ventilation	1.9
22.	Toilet Loads	1
23.	Transformer oil pump	1.8
24.	Input Power RMPU (17 kVA *2)	27.2
25.	Driver HVAC	3.2

iii. Contractor shall submit calculations showing assessment of power rating of Auxiliary Converter at the time of design finalisation.

b. Battery

i. The 24 V, starter battery that comply with the applicable requirements.

ii. The 110 V, 120 AH VRLA battery for emergency lighting and controls. It will provide backup low voltage power in the event of LVPS failure. Emergency low voltage power shall be provided by the batteries. The batteries shall have the capacity to supply all emergency loads.

Chapter 6: Tests and Trials

Existing Clause of RDSO spec RDSO/PE/SPEC/EMU/0196-2019 (Rev.0)	**Modified Clause**
Clause 5.2.3 **Braking Distance trial (on prototype rake)** After the completion of satisfactory oscillation trial, the braking distance trials shall be conducted by IR for the rake formation of 16/20/24 Car rake. The rake formation shall be finally decided during design stage. The supplier shall be associated with this test in respect of the items related to regenerative braking, brake blending and connected microprocessor controls.	After the completion of satisfactory oscillation trial, the braking distance trials shall be conducted by IR for the rake formation of 4-Car rake. The rakeformation shall be finally decided during design stage. The supplier shall beassociated with this test in respect of the items related to regenerative braking,brake blending and connected microprocessor controls.
Clause 5.11.1 (iv) During the tests acceleration, deceleration, speed on straight level track and the energy consumption for a round trip shall be measured. In all cases, 16-Car fully loaded train shall be tested. However, certain tests viz. TCMS, braking, interference etc. shall be carried out on higher configuration also up to 24-cars.	During the tests acceleration, deceleration, speed on straight level track, TCMS, braking, interference and the energy consumption for a round trip shall be measured. In all cases, 4-Car fully loaded train shall be tested.
Clause 5.12 The supplier shall measure the required values of energy saving for a 16-car, fully loaded rake as per Clause no. 3.5.10; operation on the nominated section…….	The supplier shall measure the required values of energy saving for a 4-car, fully loaded rake as per Clause no. 3.5.10; operation on the nominated section…….
Clause 5.13 **Installation of Equipment at Purchaser premises:** Supplier shall maintain sufficient staff at Purchaser's works for supervision of installation and commissioning of three-phase propulsion, control and other system and also provide all the necessary support in carrying out these activities. Installation will generally be in the scope of Purchaser, however, is so desired Purchase may entrust this activity to the Supplier. Supplier shall also furnish the installation procedure of all the equipment of three-phase propulsion, control and other	**Installation of Equipment at Purchaser premises:** Supplier shall maintain sufficient staff at Purchaser's works for installation and commissioning of three-phase propulsion, control and other system. Supplier shall also furnish the installation procedure of all the equipment of three-phase propulsion, control and other system. Supplier shall list the tests to be carried out on the supplied equipment after it has been mounted on the Train at Purchaser's works or at maintenance depot/workshop of IR or at any other

system. Supplier shall list the tests to be carried out on the supplied equipment after it has been mounted on the Train at Purchaser's works or at maintenance depot/workshop of IR or at any other manufacturer's premises. The test procedure, instrumentation and tolerance shall be furnished. The Supplier shall conduct these tests on two prototypes and all series production of Train sets and also train staff of Purchaser, maintenance shed/workshop/any other manufacturer's works where the propulsion supplied as per this specification shall be equipped in Train set coaches in carrying out the tests.	manufacturer's premises. The test procedure, instrumentation and tolerance shall be furnished. The Supplier shall conduct these tests on one prototype rake and all series production of Train sets and also train staff of Purchaser, maintenance shed/workshop/any other manufacturer's works where the propulsion supplied as per this specification shall be equipped in Train set coaches in carrying out the tests.
Clause 5.14 **Commissioning of Trains at Purchaser's works and Maintenance depot:** Each rake shall be commissioned at Purchaser's works and maintenance depot / workshop of IR by the Supplier's staff before putting into commercial service. The Supplier shall be responsible for commissioning of two prototype rakes and all the series production of Train sets. The supplier shall furnish a Commissioning Schedule for the supplied equipment and the system which shall inter-alia include the following:- (i) Confirming satisfactory functioning of the all system. (ii) Test run to confirm specified operating parameters such as acceleration, deceleration, brake blending and energy consumption etc. (iii) Rectification / replacement of any malfunctioning equipment. (iv) Check of all the safety related items.	**Commissioning of Trains at Purchaser's works and Maintenance depot:** Each rake shall be commissioned at Purchaser's works and maintenance depot / workshop of IR by the Supplier's staff before putting into commercial service. The Supplier shall be responsible for commissioning of one prototype rake and all the series production of Train sets. The supplier shall furnish a Commissioning Schedule for the supplied equipment and the system which shall inter-alia include the following:- (i) Confirming satisfactory functioning of the all system. (ii) Test run to confirm specified operating parameters such as acceleration, deceleration, brake blending and energy consumption etc. (iii) Rectification / replacement of any malfunctioning equipment. (iv) Check of all the safety related items.

New Clause 5.16 Added:

5.16 Diesel-Alternator Set: The tenderer shall furnish a copy of 100 hours Type Testing report of the engine conforming to UIC 623-2 OR in support of their claim regarding performance, reliability & specific fuel consumption. In case, the offered engine is to be used first time in Indian Railways, the 100 hours type testing shall have to be carried out in accordance with UIC 623-2-OR in the presence

of RCF/RDSO or any authorized representative and the scheme for type testing shall be finalised by RCF & supplier jointly

For all the remaining engines, other than the first engine offered for 100 hours type test, the Routine test report shall be required to be submitted along with respective engines at the time of supply.

Annexure-I (of RDSO spec RDSO/PE/SPEC/EMU/0196-2019, Rev.0)

Design Data, Calculations and Drawings to be Submitted by the Supplier

Existing Clause of RDSO spec RDSO/PE/SPEC/EMU/0196-2019 (Rev.0)	Modified Clause
A)	26. Added as follows: Design data of Diesel-Electric mode equipments as per D) below.
B)	Design calculations should include: 21. Added as follows: Diesel-Electric mode calculations.
C)	Following Drawings to be submitted as part of Design document including dimensions and material specifications: 18. Added as follows: Drawings of Diesel Engine and Alternator. 1. OGA of DA set, Silencer with mounting frame indicating interface requirements. 2. OGA of CAC, Radiator, Traction Rectifier, Fuel pipeline, Fresh air intake filters. 3. Complete wiring/Harness arrangement drawing.

D) Following design details of Diesel-Electric equipments to be submitted as part of Design documents:

Diesel Engine	
S. No.	**Parameter**
1.	Engine Model
2.	Engine Type (Mechanical /Electronic)
3.	Diesel engine orientation
4.	Rated output of the engine at NTC condition
5.	Rated engine Speed
6.	Fuel system
7.	Aspiration
8.	Cooling system and Radiator mounting
9.	Engine starting system (Electric starter)
10.	Engine and traction alternator mounting

11.	The diesel engine along with accessories shall be subjected to the fitment within the following maximum limiting dimensions (Envelope).
12.	The Diesel-Alternator set shall be subjected to the fitment within the following maximum limiting dimensions (Envelope).
13.	Approximate weight of the engine
Traction Alternator	
1.	Alternator Power rating
2.	Rated Voltage
3.	Rated RPM
4.	No.of Poles
5.	No.of phases
6.	Insulation Class
7.	IP rating
8.	Alternator efficiency
9.	Alternator mounting
10.	Approximate weight

Annexure-II (of RDSO spec RDSO/PE/SPEC/EMU/0196-2019, Rev.0)

1. Performance simulations to be submitted by the supplier as applicable to 4-car HS-SPART Rake as mentioned in a.) to h.)
2. In addition to above, Performance simulations to be submitted by the supplier as applicable to 4-car HS-SPART Rakein Diesel-Electric mode.

Annexure-III (of RDSO spec RDSO/PE/SPEC/EMU/0196-2019, Rev.0)

List of standards for testing of equipments

For Diesel Alternator setRDSO specification RDSO/PE/SPEC/AC/0103 (latest) shall be referred in addition to standards mentioned in Annexure-III.

Annexure IV to Annexure-X

Existing Annexure of RDSO spec RDSO/PE/SPEC/EMU/0196-2019, Rev.0)	**Revised/Remarks**
Annexure-IV	No Change
Annexure-V	No Change
Annexure-VI	No Change
Annexure-VII	No Change
Annexure-VIII	No Change
Annexure-IX	S.No. 25 – "Diesel-Electric equipments" - Added
Annexure-X	Following RCF layouts to be followed: 1. RT90022 (latest) 2. RT90023(latest) 3. RT90024(latest) 4. RT90025(latest)