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<th>Revision</th>
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<td>0</td>
<td>First issue</td>
</tr>
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<td>2.</td>
<td>October 2003</td>
<td>1</td>
<td>Clause no. 4.5 for Event recorder modified</td>
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<td>3.</td>
<td>August 2004</td>
<td>2</td>
<td>Clause 4.5 for Event recorder modified, clause no 15.0 Fuel consumption measuring and recording, removed, clause no 29.0 Packaging added</td>
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<td>November 2005</td>
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<td>5.</td>
<td>May 2007</td>
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<td>Clause 4.4 Data/ Fault Logging, Diagnostics and Display, Clause 4.6 Multi-Resetting Vigilance Control, Clause 16.0 User Programmable Variables, clause 30.0 List of enclosures. Removal of clause 11.0 Master Controller (Optional), clause 22.1 Special tools required for installation. Addition of clause 28 After sale service</td>
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<td>7.</td>
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<td>8.</td>
<td>February 2018</td>
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<td>1. Incorporation of Corrigendum of Rev.6 issued vide RDSO letter no. SD.DEV.MCS dt. 18.06.10</td>
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| 9.    | July 2020      | 8        | • Review of Clause 4(Optional item) and updated with latest standard.  
• Environment standards are updated at Clause 5.42.  
• Test Protocol format for prototype test and routine test are incorporated as Annexure-1 of the specification.  
• Clause no. 6, reference of ISO document no. updated.  
• Clause 7 & 8 for IPR and Confidentiality has been incorporated.  
• ‘Make in India Policy’ has been incorporated at Clause no. 9.  
• Addition of Document no.MP-M-8.1-1(latest) at Clause 5.43 |
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1 Introduction

This specification is for Microprocessor based AC-DC Locomotive Control System for ALCO type Diesel Electric Locomotives/retro fitment of locomotive with “E” type controls. As far as possible required details have been provided however vendor may deputise engineer to RDSO for obtaining further information. The development of MBCS shall be as per latest RDSO guidelines No. MP.GD.12.

The details of some of the type of locomotives are as under:

<table>
<thead>
<tr>
<th>Loco type</th>
<th>WDM3F(GE)</th>
<th>WDM3D</th>
<th>WDG3A</th>
<th>WDM3A</th>
<th>WDS6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross HP under UIC condition</td>
<td>3600</td>
<td>3300</td>
<td>3100</td>
<td>3100</td>
<td>1400</td>
</tr>
<tr>
<td>Traction Alternator / Generator</td>
<td>GTA24H / GTA11H</td>
<td>TA10102</td>
<td>TA10102</td>
<td>TA10102</td>
<td>TA 10106</td>
</tr>
<tr>
<td>Traction Motor</td>
<td>TM752AH</td>
<td>TM4907</td>
<td>TM4907</td>
<td>TM4907</td>
<td>TM165</td>
</tr>
<tr>
<td>Exciter</td>
<td>5GY27M2</td>
<td>AG3101</td>
<td>AG3101</td>
<td>AG3101</td>
<td>AG2210</td>
</tr>
<tr>
<td>Aux Gen</td>
<td>5GY27L2</td>
<td>AG3101AY</td>
<td>AG3101AY</td>
<td>AG3101</td>
<td>AG2513</td>
</tr>
<tr>
<td>Transition</td>
<td>Alternator transition</td>
<td>2S3PFF-2S3PFS, 6PFF</td>
<td>2S3PFF - 2S3PFS</td>
<td>2S3PFF-2S3PFS</td>
<td>2S3PFF</td>
</tr>
<tr>
<td>Gear Ratio</td>
<td>18.65</td>
<td>18.65</td>
<td>18.74</td>
<td>18.65</td>
<td>18.65</td>
</tr>
<tr>
<td>Max Speed, Kph</td>
<td>120</td>
<td>120</td>
<td>100</td>
<td>100</td>
<td>71</td>
</tr>
</tbody>
</table>

2 Performance & other requirement

2.1. The system hardware and software shall be of proven design having trouble free service performance on diesel electric locomotives on established Railway systems. The vendor shall furnish a list of the offered equipment supplied by them to other Railways, giving relevant details and evidence of its satisfactory performance.

2.2. The prototype system shall require only minimal changes in the physical layout and operating function of existing equipment in the driver’s cab, controls, switches, indication lamps, and such changes shall be made by mutual agreement. Internally, however all such equipment shall be interfaced directly with the microprocessor system, circuits for E-Type excitation System, previously used with Alco Loco being discarded completely, except for lighting circuits, to enable all control actions to be routed through the microprocessor control system.

2.3. All issues of system integration and interfacing with third party system shall be the responsibility of approved vendor of this system. The vendor will provide complete details.

2.4. Change in performance, functionality and deviation for scope if any with the proposed system, shall be brought out by the vendor and approval of RDSO should be obtained.

3 Scope of supply

3.1. The complete microprocessor control system as per this specification.
3.2. The complete control panel fully wired and equipped with control gears (integrated with power and control items) as per vendor requirement (Optional).

3.3. Suitable sensors for engine & Traction Motor speed including speed sensing gear kit (not applicable for DLW), pressure sensors for Water Pump, lube oil, MR, BP, BC & atmospheric, temperature sensors for engine water, lube oil, Ambient, voltage/current sensors etc. required to cover the specification's functional requirements. All the sensors to be supplied with mounting brackets/ fittings/ weld nuts with suitable inside threading for sensor fixation to outer diameter as per hose size decided by IR along with suitable mounting lead and the protective flexible (PVC coated) conduits as per requirement. The temperature/pressure sensors to have ¼” NPT threading (piping interface). All the units shall be metric standard.

4 Optional features
Interfacing/Provision for these features if required at a later date should be provided without any additional cost for interfacing with their system and update of software. However, additional equipment required shall be provided by Railways as per the details/or may be part of the system under scope of supply, if specifically mentioned by the purchaser.

<table>
<thead>
<tr>
<th>Feature(s)</th>
<th>Applicable for New/Rebuilt Locos</th>
<th>Applicable for zonal Railways</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distributed power Control</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Fire alerters</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Auto Creep Control</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>DIALS (TFT display)</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>CCB with Blended Brake</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>ACES (Auto Control of Engine Stop)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>EOTT</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>High-speed cruise control</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Micro driven Speed indicator-</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Extended Range Dynamic Braking feature</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Remote Monitoring &amp; Management of</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>DIGITAL AIR FLOW Meter</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Fuel Oil Level measurement</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

If there is any requirement of sensor(s) for above optional features over and above those already provided for the main microprocessor system, the same shall be spelt out clearly by vendor.

5 Functional requirements:

The microprocessor control system shall have following features:

5.1 Alternator excitation control during traction and braking
The system shall control the exciter field strength to obtain required GHP and ensure Volt and current limit of alternator. Correction factor for GHP shall be as per RDSO publication no. MP.MI.10 (latest). Unused auxiliary power, whenever unloaded or partially loaded shall be utilized for traction such that the GHP does not exceed the max. value.

Restricts excitation in the event various parameters water temp, grid current, power ground, TM Temp (based on thermal modeling) going beyond limit.
5.2 Tractive limit to 30.5 tonne (user settable)
Through A switch / input through display unit.

5.3 Wheel slip control during motoring and dynamic braking & Adhesion improvement
System shall have wheel creep – based slip and slide control and automatic sanding to maximize adhesion in all weather conditions. In case of failure/malfunction of TM speed sensors, system shall employ with TM current/voltage dependent algorithm. The system shall have automatic wheel wear diameter compensation.
Minimum improvement of adhesion over the conventional loco by 10% and 15% on dry rail with sanding, in unsanded and 3% in wet condition (starting, running, braking) to be validated during trial.
TE shall be reduced in steps with the experience of wheel slip and slide beyond the regular creep range for minimum time and shall have adequate protection for locked axle/excessive slipping/ Pinion Slip/TM Over speed.
Manual sanding for front and rear sanders shall be provided.

5.4 Fail safe feature & protection to the equipment
The equipment shall have failsafe feature where, in case of a system failure the system goes to SAFE MODE so as not to cause any damage to any equipment controlled by it. Protective actions shall include automatic action to isolate defective assembly, request to driver for manual corrective action, shutting down or idling engine in emergency situations. The system shall have fault tolerance feature to keep locomotive in operation or downgraded till it completes trip safely.

5.5 Loco Over Speed Alarm & Protection
System shall be able to give audio-visual warning at pre-desired maximum permitted speed & protection

5.6 Aux gen excitation control
A 64 V battery is available for meeting the power requirement of the system. During cranking, the battery voltage may drop to around 22V for about 0.8 sec. Shall regulate the AG voltage within 72+1V, 160 Amp (user settable) Shall monitor battery charging and protection be provided against deep discharge and over voltage of battery.

5.7 Propulsion control
Operate the locomotive i.e. starting, stopping, traction, braking, field weakening and motor transition etc. including implementation of safety features and protection of all traction equipment.

5.8 Engine control
The Engine RPM and load control shall be through MCBG to RDSO specification no. MP.0.17.00.01. The notch, LCP, engine rpm, Lube oil, fuel oil and booster air pressure signals signal shall also be communicated through RS 485 port with MCBG. RDSO shall facilitate in exchange of data between two systems. However, Lube oil pressure sensing shall be at both ends to have redundancy.
If required 72V notch and LCP signal reference signals for Woodward PGEV-8 governor and shall be made available in conventional manner.

5.9 Power setter (MU operation)
In this mode, when selected by the driver, all rear locomotives shall run in idle. Dynamic brake shall work normally in both the locos at all times.

5.10 Extended range dynamic braking i.e. Higher breaking effort at lower speed system
The system shall have software and input/output capability to implement this feature if the locomotive is equipped requisite additional contactors as RDSO modification sheet no. MP.MOD.EC.05.26.09.
5.11 Low idling feature on locomotives fitted with MCBG

The system shall bring the engine to 350 rpm, if engine is running at idle at 400 rpm continuously for 5 minutes and Lube Oil Pressure is more than 1.7 kg/cm². If LOP reduces below 1.2 kg/cm² RPM shall revert to normal 400 rpm. Refer RDSO Instruction Bulletin No. MP.IB.EN.08.43.08

5.12 Control of auxiliaries

1. System shall control Unloading/ loading of Air Compressor when MR Pressure is 10/8- kg/cm².
2. System control Radiator Fan based on temp of cooling water by means energizing R1 & R2 Contactors. RPM measuring may be displayed for radiator fan speed (control system to have direct feedback of radiator fan speed). However this feature is not mandatory.

5.13 Pre and post lubrication:

System would control same 72V-1.5 hp lube pump (if provided) Carry out pre-lubrication for 60 second If the locomotive is started after half an hour from the last shut down. A counter shall display the time left for completion of pre lubrication before cranking. Post lubrication shall be done after every shut down for 5 minutes and Display of message showing post lubrication is in process.

5.14 Automatic emergency brake system

System should automatically operate to apply the brake at a pre-determined speed through user variable parameter option.
Provision for manual switch with resetting of the system from the lead locomotive shall be kept.
Norms for AEB Penalty Brake Application confirm to RDSO Instruction bulletin no. MP.IB.EC.01.02.08.

5.15 Multi-resetting vigilance control

The system shall have Vigilance Control feature, functionally conforming to RDSO latest spec. no. MP.0.3400.04. Pressure sensor for Brake Cylinder pressure sensing will be taken from delivery pipeline of brake cylinder charging C2W relay valve.
However, VCD shall not be active during cranking, speed is ≤ 3 Kph, BC ≥ 1.3 kg/cm². If locomotive is provided with CCB, system shall give a command to CCB for penalty brakes application during VCD & AEB operation.

5.16 Flasher light control

Flasher Light shall be driven by the system directly and replace the existing control unit may be considered as deleted. (Ref: Corrigendum of Rev.6 issued vide RDSO letter no. SD.DEV.MCS dt. 18.06.10)

5.17 Automatic flasher light control

Flasher light shall glow automatically even if flasher light switch is in OFF position along with audio visual indication to the drive whenever, BP is less than < 4.4 kg/cm² (reset at 4.7) and A-9 pilot air pressure > 4.8 kg/cm² (this condition shall only be effective for 60 sec after that only first condition is valid) however, audio signal can be reset by a separate switch.

5.18 Display screen and facility of fault data analysis through display

All the message and information to the drivers and maintainers shall be given through a suitable alphanumeric display of minimum 4 lines and 40 characters, preferably 256X64 pixels graphical display. Display Screen shall be configurable.

System shall have provision to see the logged fault history on Display Unit. This fault history shall have all faults with frequency (code wise), Faults since date and all faults in chronologically recorded with the real date and time of the occurrence.
Display shall have provision for customising the display screens with selectable parameters as User programmable display screens. Display of various parameter on DID including messages, User Inputs. LED indication and audio buzzer.
5.19 User settable parameters
The system shall have user settable parameters with password protection. It shall be possible to enable / disable the user programmable feature based on type of loco and its configuration. Parameters shall be as per RDSO Mod sheet No.MP.MOD.EC.05.27.10.

5.20 Data logging, fault management & diagnostics
The system shall have built in data logging, diagnostics features and trouble shooting, including indication of fault status, information pack, analysis of the fault data, Classification of faults, fault data pack and provision of necessary information to drivers/maintainers shall be as per Mod sheet No.MP.MOD.EC.05.27.10. However, supplier may propose alternatives for approval of RDSO.

Two USB ports shall be provided for downloading through laptop/ Pen drive. The contractor vendor shall supply software for configuring Microprocessor based control system, downloading, and analysis of data. It should be possible to on line monitor and record the various excitation and propulsion parameters through a lap top computer. Analysis software should also support the graphical analysis.

5.21 Event recorder
Industrial rugged design separate (take out type) Flash EEPROM based Memory Card under lock and key shall be provided. To download the data the portable memory card shall be removed from the locked cassette compartment of the control unit connected to USB port of IBM compatible PC, equipped with required software for downloading short and long term to be supplied by the vendor. Short term memory shall be one sec interval for the last 72 hours. Long Term Memory data for 90 days with resolution of 20 secs.

5.22 Memory freeze of the Event recorder
A switch for freezing the data under a sealed glass cover shall be provided. A LED freeze indication shall also be provided. The glass shall be broken, when required, for operating the switch.

5.23 Self-test
The system shall be able to run a self-test at user request to verify satisfactory functioning of all component system including Input/ output.

5.24 Analog meters interface
System shall be provided with analog output interface for Load Ammeter (FSD 90 mV) and Speed indicator with calibration facility.

5.25 Test Modes
System shall be able to test following (through DID): Radiator Fan, Load meter, speedometer, motor transition, Auto Emergency Braking, Relays, PWM drive, etc.

System in password protected test mode and locomotive in standstill and reverser in neutral position shall be able to test engine GHP and control system by connections of alternator output at rectifier terminals with external load box as well as self-load test with dynamic braking grids (up to the grid current limit).

5.26 Fuel oil level recording and display (Optional)
System shall have provision for acquiring fuel Tank level data on Locomotive fitted with fuel oil level sensor to RDSO specification No.MP.0.24.00.63 latest. Calculation of sfc/consumption would done by the system. Calibration of Fuel Tank shall be done through pre-defined function from micro display Unit/ lap top.

5.27 Auto control of engine stop (ACES) (Optional)
The functionality shall be in accordance with RDSO specification no. MP.0.2400.61 (Latest). However, the system shall be finalized by successful vendor in consultation with RDSO. Limits of the parameters shall be set through user settable parameters.
5.28 Distributed power (Optional)
The functionality shall be in accordance with RDSO specification no. MP.0.400.02 (Latest).

5.29 High-speed cruise control (Optional)
System shall have capability to run the train at predetermined speed entered though DID. However system can be automatically interrupted by the loco pilot.

5.30 Integration with digital air flow meter (Optional)
The system shall be suitable for interfaced with Digital airflow gauge to RDSO Specification No. MP.0.01.00.18. Digital flow sensor can be offered and it may be suitably integrated with the Microprocessor Controlled air brake system.

5.31 Integration with Fire Alerter (Optional)
Fire Alert alarm shall be Interfacing (relay output) with the system to Shutdown the Engine of locomotive with suitable message on Display unit
a. Apply Penalty Brake through VCD Magnet valve
Train line 11 shall be energised for MU operation. The system shall interface with Fire sensor through Digital input from Fire sensor (Where provided).The system shall provide the digital output for the same.

5.32 Integration with REMMLOT (Optional)
System shall be interfaced with REMMLOT. Remote Monitoring & Management of Locomotives and Trains (REMMLOT) shall be as per RDSO specification no. MP.0.04.02.04. (latest)

5.33 DIALS TFT display (Optional)
Analog dials and LED indications on the control stand shall be replaced by a pre-configured TFT LCD display screen/s and interfaced with the system for displaying important parameters required for driver. Display screen shall conform to RDSO latest specification no. MP.0.04.00.10.

5.34 Microprocessor controlled Air Brake System with versatile software (Optional)
System shall be integrated with Microprocessor controlled Air Brake System with versatile software (Specification No. MP.0.01.00.23 Rev 0 or latest)

5.35 END -OF - TRAIN TELEMETRY (Optional)
System shall be integrated with END - OF - TRAIN TELEMETRY confirming to RDSO functional requirement specification no.-RDSO/2019/EL/FRS/0025 Rev.0 dated 25.06.2019 or latest.

5.36 Auto Creep Control (optional)
System shall have capability to run the train at predetermined low speed entered though DID. However system can be automatically interrupted by the loco pilot.

5.37 Speed Indicator (Optional)
System shall be integrated with speed indicator conforming to EMD Part no. 40087769 /40071195. Alternatively, digital speed indicator may also be integrated with MBCS as per Instruction Bulletin no.MP.IB.EC.01.01.20, Rev.0 or Latest.

5.38 Multiple Unit operation
The system shall be capable of multiple unit operation in consist of up to four diesel electric locomotives fitted with either the conventional "E" type excitation and control system or the microprocessor system.
5.39 Meggering
It shall be possible to megger by opening two or three connectors only.

5.40 Design of the system
The vendor shall associate Indian Railway in System engineering, Control Cubicle including cooling arrangement, wiring diagram / wire cutting charts of the locomotive fitted with their system. Prior approval of the RDSO shall take drawings & electrical schematic diagram and of the system. The design shall be far as common with existing systems.

5.41 Identification Plate
ID plate Name of Component, Make, Sl. No, Date of Manufacture, Ratings shall be provided on All assemblies / sub assemblies.

5.42 Climatic, Environmental Condition & Testing
One no. complete prototype system shall be tested to ensure compliances for climatic and environmental condition as per latest edition of IEC 60571 (Railway applications - Electronic equipment used on rolling stock). Verified Test certificates and reports submitted from internationally accredited/NABL accredited lab for environmental test compliances may be accepted. The Test Plan for prototype is attached as Annexure-1.

5.43 Field trials
After successful prototype test and validation on locomotive, the Systems shall be subjected to field trials before clearance is given for bulk supply. The Qualifying period and Qualifying Quantity for field trials is governed by RDSO Doc.no.MP-M-8.1-1 (Latest).

Performance shall be closely monitored and evaluated by Vendor controlling authority for:

- Reliability under actual operating conditions
- Advantages for locomotive operation and maintenance
- Maintainability of the system

Notwithstanding anything that may be specified in this specification, the final responsibility for the suitability of the design shall lie with the vendor and shall carry out all modifications for satisfactory functioning during the period of field trials. Any safety related modifications issued by IR are to be carried out by the vendor.

5.44 Warranty, Support for Preventive & Breakdown Maintenance
The vendor shall guarantee the equipment against design and manufacturing defects for a period of two years from the date of commissioning. The reliability locomotives fitted with the microprocessor equipment should be available for a minimum of 95%. The proposal shall be given for service support to be provided to diesel shed at the shortest notice. IR Staff shall also be associated with the supplier’s engineer for maintenance and operation. If the tenderer vendor does not have adequate service support, his offer will be liable for rejection. AMC beyond warranty period shall be as per DLW’s Spec no. DLW/ALCo/AMC(micro)/01.

5.45 System integration
The vendor shall be primarily responsible for the system integration of the system offered by them with the other systems on the prototype locomotives. The tenderer vendor on the prototype (at least two different types of locomotives) shall demonstrate the system integration.

5.46 Training
The vendor shall arrange, free of cost training to the personnel of IR in India or abroad to make them proficient in operation and maintenance of the system and associated equipment. The to and fro fare and living expenses shall be borne by Indian Railways. Details of the training requirements shall be indicated by the tenderer vendor in its offer.
5.47 Documentation

1. Documents to be furnished with their offer

   • Schedule of supply with part number, Outline and general arrangement drawings, Printed product catalogue and standard data sheet of offered system.

2. Data and documents to be furnished before type testing

   • Detailed specifications (technical catalogue and data sheet) for the equipment offered.
   • Maintenance schedules for the major equipment
   • Maintenance manual, Loco operational manuals and List of spares for maintenance.
   • Commissioning test procedure for the locos.
   • Driver's operating instructions and trouble shooting handbook.
   • Schematics for the control and power circuit of the locomotive. Locomotive Circuit descriptions and sequence of operation where necessary
   • Detailed trouble shooting directory.
   • Such design data as may be required by RDSO to establish the adequacy of the design.

5.48 Annexures

   • Locomotive and E-Type Control Description.
   • Typical power circuit for WDG3A and WDM3D class of locomotives
   • Characteristic curves for traction alternators, traction motors, exciters, auxiliary generators
   • Performance curve of the locomotives during Powering and Braking
   • List of high priority faults
   • Schematic of Vigilance Control system
   • Event recorder
   • Graphical (expanded) data of speedometer
   • User settable parameters
   • Type test and Routine test Plan

6 Vendor changes in Approved status

All the provisions contained in RDSO's ISO procedures laid down in document no. QO-D-8.1-11, dated 01.07.2020 (Titled “Vendor - changes in approved status) and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/vendors in the contracts floated by Railways to maintain quality of products supplied to Railways.

7 Undertaking by equipment manufacturer

Vendor shall provide a signed copy of the undertaking on “INFRINGEMENT OF PATENT RIGHTS”. The undertaking shall be as under

Indian Railways shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, use of similar components in the design & development of this item and any other factor not mentioned herein which may cause such a dispute. The entire responsibility to settle any such disputes/matters lies with the manufacturer/ supplier.

Details / design/documents given by them are not infringing any IPR and they are responsible in absolute and full measure instead of railways for any such violations. Data, specifications and other IP as generated out of interaction with railways shall not be unilaterally used without the consent of RDSO and right of Railways / RDSO on such IP is acceptable to them.

8 Declaration of confidentiality of submitted documents by manufacturers

While submitting a new proposal/design, manufacturer must classify their documents confidentiality declaration, such as
9 Preference to Make in India

The Government of India policy on “Make in India” shall apply.