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डीजल इलेक्ट्रिक लोकोमोटिव एवं माल गाड़ी में प्रयोग हेतु माइक्रोप्रोसेसर
आधारित कण्ट्रोल के साथ “एण्ड ऑफ ट्रेन टेलीमेट्री इक्विपमेंट” के लिए
विशिष्टि

**Specification for End of Train Telemetry Equipment Integrated with
microprocessor based control for use on Freight train with Diesel
electric locomotive**

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1.0 PREAMBLE

WDG3A and WDM3D locomotives on Indian Railways are being fitted with Microprocessor based control system during manufacturing at DLW, which can control the various equipments on the locomotive and provide fault data packs along with fault diagnostics. Microprocessor based control systems are also being installed on WDM3A locomotives rebuilt at DMW and further fitment of this system in POH shops and sheds has been taken up fitment of this system in POH shops and sheds under RSP program.

RDSO had earlier issued Specification No. WD-16-ABR-2003, July'2003 for End of Train Telemetry (EOTT) device for use on Freight stock of Indian Railways. This system envisages a standalone EOTT comprising a Communication Display Unit (CDU) (locomotive unit / front unit) and Sense and Brake Unit (SBU) (rear unit). Installation of CDU on the locomotive control desk requires additional space on already congested control desk. Further, CDU unit includes pressure sensors for sensing Brake Pipe pressure on the locomotive, which is already sensed in Microprocessor system.

With the fitment of Microprocessor based control system, certain modules of EOTT device on locomotive like Brake Pipe pressure monitoring, display unit, power supply etc can be made common to both CDU and Microprocessor system by integrating the CDU part of the End of Telemetry systems with Microprocessor system and, thereby, achieving substantial cost saving. With this view, this specification has been prepared.

2.0 DEFINITION OF TERMS

The following terms and abbreviations are used throughout the Specification.

- EOT** End of Train refers to an End - Of -Train telemetry system comprising of acab unit mounted in the locomotive and End Unit mounted on the rear of the last vehicle of the train.
- SBU** Sense and Brake Unit- A two-way End of Train end unit capable of Remote 'Emergency / service 'Brake Application.
- LU** Locomotive Unit – Locomotive Cab unit that communicates with SBU and displays the SBU status in the locomotive cab. This is to be integrated with the existing Microprocessor based Locomotive Control System.
- CDU** Communication Display Unit - Any generic two way End of Train Cab Unit.

HVM High visible marking device - The marker light portion of the SBU: Flashing light used as working device to mark the End of Train.

KPA Kilo Pascal (1KPA= 0.145 psig, 1 psig= 0.0704 Kg/cm²).

BP Brake pipe pressure.

FP Feed pipe pressure.

IR Indian Railways.

RDSO Research Designs and Standards Organisation.

3.0 SCOPE

This specification covers the technical requirements for End-Of-Train Telemetry device with respect to its performance, operations and testing on Freight Stock and locomotive unit integrated with microprocessor based control system. It is the responsibility of the manufacturer/supplier to develop detailed design to meet the requirements of this specification.

The Scope of supply shall include the following:

- 3.1 Front Unit (Locomotive Unit) integrated with the Microprocessor Control System (specification **MP.0.24.00.26 Rev. 05**) with Antenna for communication with SBU
- 3.2 Sensor Brake Unit (SBU) including antenna for communication with Front Unit
- 3.3 Battery charger with 220V main power supply
- 3.4 Batteries including spare requirements for charging etc
- 3.5 Operation & Maintenance Manuals
- 3.6 Spare parts catalogue.

4.0 ENVIRONMENTAL CONDITIONS

The front and rear unit shall be designed to meet the performance requirements under the following operating conditions:

Maximum temperature (Atmospheric)	(i) 70 °C (under sun) (ii) 50 °C (in shade)
Minimum temperature (Atmospheric)	-5 °C
Humidity	100 % saturation during rainy season
Altitude	Max. 1200 meter above mean sea level.
Reference site conditions	(i) Ambient temp. 47 °C (ii) Humidity 60%

	(iii) Altitude 160 m.
Annual rainfall	Very heavy in certain areas The locomotive shall be designed to permit its running at 10 km/h in a flood water level of 102 mm above rail level.
Dust	Extremely dusty and desert terrain in certain areas. The dust content in air may reach as high value as 1.6 mg / m ³ .
Atmospheric conditions in coastal areas in humid, salt laden and corrosive atmosphere	All the equipment shall be designed to work in coastal areas in humid, salt laden and corrosive atmosphere. (a) Maximum PH value: 8.5 (b) Sulphate: 7 mg / l. (c) Max. concentration of chlorine: 6 mg / l (d) Maximum conductivity: 130 micro siemens /cm.

Complete system shall be suitable for rugged service normally experienced in traction service.

5.0 DESIGN STANDARDS FOR TWO WAY END - OF - TRAIN TELEMTRY DEVICE

5.1 General: A two-way end-of-train device shall comprise of a rear-of-train unit (SBU) located on the last vehicle of a train and a front-of-train unit (LU) located in the cab of the locomotive controlling the train.

5.1.1 Rear unit: The rear unit shall be capable of determining the brake pipe pressure on the rear vehicle and transmitting that information to the front unit for display to the locomotive driver. The rear unit shall be

- i. Capable of measuring the brake pipe pressure on the rear vehicle with an accuracy of ± 0.2113 Kg/cm² and variations in brake pipe pressure up to ± 0.0704 Kg/cm².
- ii. Equipped with a "bleeder valve" that permits the release of any air under pressure from the rear of train unit or the associated air hoses prior to detaching the rear unit from the brake pipe.
- iii. Designed so that an internal failure will not cause an undesired brake application.
- iv. Equipped with either an air pressure gauge or any other provision for visual display of brake pipe pressure of the rear unit; and
- v. Equipped with a "relief valve" to prevent explosion from any high-pressure air leak inside the rear unit.

5.1.2 Reporting rate: Multiple data transmission from the rear unit shall start immediately after sensing pressure variation of ± 0.14085 Kg/cm² in the rear vehicle brake pipe pressure at intervals not greater than 70 seconds or when the

variation in the rear vehicle brake pipe pressure for more than 70 second interval is less than $\pm 0.14085 \text{ Kg/cm}^2$.

5.1.3 **Unique code:** Each rear unit shall have a unique and permanent identification code that is transmitted along with the pressure message to the front train unit. A code allotted by IR shall be deemed to be a unique code for purposes of this Specification.

5.1.4 It shall be designed to withstand vibrations and shocks as specified in IEC-61373.

5.2 Front unit

5.2.1 The front unit (Locomotive Unit) shall be integrated with Microprocessor based Locomotive Control System, so as to share power supply, display unit etc. and receive pressure sensor information. All data entry requirements of the Front Unit shall be done through the Microprocessor display unit.

5.2.2 The front unit shall be so designed to receive data messages from the rear unit and shall be capable of displaying the rear vehicle brake pipe pressure in increments not to exceed 0.0704 kg/cm^2 .

5.2.3 One Emergency brake switch to be fitted on the driver's desk shall be supplied along with Front unit. This switch will be used by the driver for activating emergency braking from the EOT device.

5.2.4 The front device shall have provision for entry of the unique identification code of the rear unit being used. The front unit shall be so designed that it will display a message from the rear unit with the same code as entered into the front unit.

5.2.5 It shall be designed to withstand vibrations and shocks as specified in IEC-61373.

5.2.6 Radio equipment

.1 The radio transmitter in the rear unit and the radio receiver in the front unit shall comply with the applicable regulatory requirements of the country and shall use a transmission format acceptable to the IR.

.2 If the power is supplied by one or more batteries, the operating life shall be a minimum of 96 hours at 0 deg. C.

5.3 An emergency brake application command from the front unit of the device (through emergency switch to be fitted on the control stand) shall activate the emergency air valve at the rear of the train within one second.

5.4 The rear unit of the device shall send an acknowledgment message to the front unit immediately upon receipt of an emergency brake application command. The front unit shall listen for this acknowledgment and repeat the brake application command if the acknowledgment is not correctly received.

5.4.1 The rear unit, on receipt of a properly coded command, shall open a valve in the brake line and hold it open for a minimum of 15 seconds. This opening of the valve shall cause the brake line to vent the exterior.

5.4.2 The valve opening shall have a minimum diameter of 19.05 mm and the internal diameter of the hose shall be 15.875 mm to effect an emergency brake application.

5.4.3 The front unit shall have a manually operated switch which, when activated, shall initiate an emergency brake transmission command to the rear unit or the locomotive shall be equipped with a manually operated switch on the Driver control stand designed to perform the equivalent function. The switch shall be labeled "Emergency" and shall be protected so that there may not be any possibility of accidental activation.

5.4.4 (1) Rear Unit- Radio Transmitter:

SN	Parameter	Min.	Typical	Max.	Unit
1.	Frequency Range-UHF	450	-	480	MHz
2.	Power Output	-	2	-	Watts
3.	Frequency Stability (-40°C to 70° C)	-	-	5	ppm
4.	Emission	-	16K0F2D	-	-
5.	Deviation	-	3.3	-	KHz

(2) Rear Unit- Radio Receiver:

SN	Parameter	Min.	Typical	Max.	Unit
1.	Frequency Range-UHF	450	-	480	MHz
2.	Sensitivity-input required for -12ds SINAD	-	0.25	0.4	µv
3.	Frequency Stability (-40°C to 70° C)	-	-	10	ppm
4.	Selectivity (± 25KHz.)	60	-	-	dB
5.	Intermodulation Immunity	60	-	-	dB
6.	Spurious Rejection	55	-	-	dB
7.	Image Rejection	50	-	-	dB

5.4.5 (1) Front Unit- Radio Transceiver:

SN	Parameter	Min.	Typical	Max.	Unit
1.	Transmit Frequency	450	-	475	MHz
2.	Transmit Power	-	2 Configurable	4	Watts
3.	Transmit Frequency Stability	-	5	-	ppm
4.	Emission	-	16K0F2D	-	-
5.	Deviation (1200 Hz)	-	3.3	-	KHz
6.	Receive Frequency	450	-	470	MHz
7.	Receive Frequency Sensitivity (-12ds SINAD)	-	-	0.45	μ v
8.	Receive Frequency stability	-	-	10	ppm
9.	Selectivity	60	-	-	dB
10.	Intermodulation Immunity	60	-	-	dB
11.	Spurious Rejection	55	-	-	dB
12.	Image Rejection	50	-	-	dB
13.	Max. CDU current	-	0.35	1.5	Amp

(2) Data logger Interface-

- i) Asynchronous Serial data rate - 300 to 9600 Baud or higher
- ii) Voltage level - EIA.RS-232C
- iii) Data Format - Configurable parity Stop Bits

(3) PC Diagnostic Interface (Industry Standard)

- i) Asynchronous Serial data rate -9600 Baud or higher
- ii) Voltage level - EIA.RS-232C

5.4.5 The availability of the front-to-rear communication link shall be checked automatically at frequent intervals.

5.4.6 There should be provision to confirm the availability and proper functioning of the emergency valve.

5.4.7 Means shall be provided to arm the front and rear units to ensure the rear unit responds to an emergency command only from a properly associated front unit.

6.0 OTHER REQUIREMENTS

6.1 In addition to emergency brake application the EOT should also be able to apply service brakes from rear end.

6.2 EOTT should have functional capabilities for the following status indications:

- Distance measurement in reference with loco.
 - Last Vehicle BP & FP pressure monitoring.
 - Last Vehicle low pressure Alarm.
 - Motion status (Moving or stopped).
 - Marker light status (ON/OFF).
 - Battery status.
 - Loss of communication alarm.
 - Automatic and manual communication test.
 - Rear at train emergency braking.
- 6.3 This specification is for specific requirements of IR. The tenderer can offer a system with some deviations from the specified parameters with a view to bring further improvement. However, each of such deviation/improved feature offered shall be supported by detailed justification and supported by documents/test results.
- 6.4 It should be possible to easily remove and fit the antenna of EOTT from one locomotive to another only by authorised personnel on Diesel electric locomotives.
- 6.5 **The Rear Unit (SBU) unit** mounting/clamping should be sturdy with proper protection against theft and suitable for Indian conditions.
- 6.6 The rear Unit will be provided on Non-transition AAR E/F Center Buffer Coupler. A copy of its drg. No. WD-81010-S-03 is enclosed.
- 6.7 The EOTT shall be supplied with all mounting, clamping and securing arrangement.
- 6.8 The equipment should be lightweight, small and easy to mount, secure and easy to handle. The equipment shall be portable and it should be possible to remove and mount on the locomotive and rear vehicle by authorized personnel only.
- 6.9 EOTT brake interface module shall be capable of working with air brake system of diesel electric locomotive and shall not interface with the braking initiated by driver.
- 6.10 EOTT brake interface shall not adversely affect the brake application and release timings.
- 6.11 Brake application and release characteristics in each mode of operation of EOTT with standard parameters, details of testing and reliability of brake equipment should be submitted to RDSO for verification and validation. Final clearance from RDSO would be essential for fitment of braking unit on loco.
- 6.12 System of EOTT should work on curves and in tunnels.

- 6.13 **System integration:** The tenderer shall be responsible for the complete system integration of the EOTT system with microprocessor based control system.
- 6.14 The equipment shall be protected from dusty environment by providing well-sealed enclosures. Necessary precaution should be taken against high degree of electromagnetic pollution anticipated in the locomotive.
- 6.15 The EOTT shall work satisfactorily on Diesel electric locomotive, which have electrical and electronic equipments complied with the following specifications:
- IS: 616 - Safety requirements for mains operated Electronics or related apparatus for household and similar general use.
- IEC: 60571- Rules for Electronic Equipment used on Rail Vehicles.
- ELRS/SPEC/SE/0015-Reliability of Electronics used on Rolling Stock application.
- 6.16 A list of tests to be carried out during type testing is given below. Prototype test shall be conducted on the basis of the approved type test scheme in the presence of the RDSO's representative.

SN	Clause No.	Details of test
1.	10.2.1 of IEC 60571	Visual inspection
2.	10.2.2 of IEC 60571	Performance test, reverse polarity test, Effect of voltage variation test
3.	10.2.3 of IEC 60571	Cooling test
4.	10.2.4 of IEC 60571	Dry heat test
5.	10.2.5 of IEC 60571	Damp heat test
6.	10.2.6 of IEC 60571	Supply over voltage, surge and Electro static discharge test
7.	10.2.7 of IEC 60571	Transient Burst Susceptibility test
8.	10.2.8 of IEC 60571	Radio Interference test
9.	10.2.9 of IEC 60571	Insulation test
10.	10.2.10 of IEC 60571	Salt Mist test
11.	10.2.11 of IEC 60571	Vibration and shock test
12.	10.2.12 of IEC 60571	Water tightness test

Routine test shall be conducted on the basis of the approved routine test scheme in the presence of IR representative and the test results shall be submitted to RDSO for scrutiny and approval.

- .1 The above testing requirement can be waived off only in case of reputed suppliers with ample experience of development of similar microprocessor systems for Railway applications. However, a copy of the type and routine test

reports conducted earlier by the supplier shall be submitted for scrutiny and approval.

- .2 The inspection and acceptance norm shall be finalised mutually depending upon the type and routine test requirement frozen. The acceptance norm proposed shall, however, be submitted along with the offer by the supplier.
- .3 The supplier shall be required to provide WTC of OEM of all-important equipment/components used in the EOTT system.

- .4 EMI/EMC tests to be conducted on Electronic equipments are given below:

The electronic equipments shall be tested for the immunity to Radiated electromagnetic energy when subjected to radio frequency electromagnetic fields.

The acceptable test level shall be 2 as specified in clause 5 of IEC 1000-4 (BS EN 61000-4-3: 1997 Amendment No. 1). There shall be no degradation or loss of function, which is not recoverable due to damage of equipment (components) or software during or after the test.

The electronic equipments shall be tested for the immunity to types of transient disturbances such as those originating from switching transients (interruption of inductive loads, relay contact bounce, etc.).

The acceptable test level shall be 2 as specified in clause 5 of IEC 1000-4-4: 1995. There shall be no degradation of performance allowed during or after the test.

The electronic equipments shall be tested for the immunity to electromagnetic disturbances coming from intended radio frequency (RF) transmitters in the frequency range 9 kHz to 80 MHz.

The acceptable test level shall be 2 as specified in clause 5 of IEC 1000-4-6: 1996. There shall be no degradation or loss of function, which is not recoverable due to damage of equipment (components) or software during or after the test.

- .5 The EOTT will be used on Diesel Electric Locomotives on electrified and non-electrified sections. Therefore, EOTT shall be capable of working in 25 KVA Electric Traction and non-electrified System of IR.

7.0 4 (Four) sets of operation and maintenance manuals on soft & hard media shall be supplied with each equipment.

8.0 Spares: The supplier shall specify requirements of spares for operation and maintenance for five years. The supplier shall supply spares, provide repairs and maintenance of the equipment after warranty period on payment basis.

9.0 Training: The supplier shall arrange for demonstration of equipment and training to Railway officials. The tenderer shall arrange free of cost training to the personnel of Indian Railways, to make them proficient in the operation and maintenance of the system and associated equipment, providing adequate guidance to enable them to train their subordinate staff in these functions. Details of the training requirements shall be indicated by the tenderer in its offer.

10.0 WARRANTY AND SERVICE SUPPORT

- 10.1 The equipment shall have warranty of 24 months of service or 30 months from date of receipt of material, whichever is later. The equipment shall be repaired / replaced by the supplier within the warranty period free of cost.
- 10.2 The contractor shall guarantee the equipment against design and manufacturing defects for a period of one year from the date of commissioning. Notwithstanding anything that may be specified in this specification, the final responsibility for the suitability of the design shall lie with the contractor, who shall undertake to carry out all modifications and alterations to equipment supplied by them for satisfactory functioning in accordance with this specification, as may be necessary during the period of one year.

When the equipment is taken in hand for installation at a nominated shed/workshop/production unit, the contractor shall be responsible for providing all necessary service support and guidance for satisfactory installation and commissioning.

11.0 QUALIFYING CRITERIA

Only those offers will be considered for technical evaluation, which qualify the following criteria:

Offers from existing Microprocessor system suppliers qualify to supply the EOTT equipment as per this specification. If the existing Microprocessor system supplier does not possess this product or technology, it can have a tie up with EOTT supplier so as to integrate EOTT front unit into the Microprocessor system and supply the complete system.

On the other hand, an EOTT supplier can also qualify if he quotes in association with an existing microprocessor supplier.

Following information must be furnished along with the tender-

- i) Name of EOTT manufacturer,
- ii) Details of approval from Railroad and concerned regulatory authorities,
- iii) Test, trial or performance report from concerned Railroad authorities,
- iv) Details of different models of EOTT in service and approximate period in service-

EOTT Model No.	Name of Railroad using EOTT	Total EOTT in service	Approximate period in service
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12.0 FIELD TRIALS

One or two prototypes of the equipment ,as decided by IR shall be subjected to field trials for one year before clearance is given for bulk supply. During this period, the performance of the equipment shall be closely monitored and evaluated by RDSO. These trials are intended to prove

- Reliability under rigorous environmental and operating conditions
- Advantages for locomotive operation and maintenance
- Maintainability of the equipment.

Modifications if found necessary, as a result of these tests shall be implemented by the supplier. The supplier at his own cost shall carry out trials after the relevant modifications have been approved by RDSO.

13.0 SAFETY RELATED MODIFICATION

During implementation of the system any safety related modifications (if any) issued by IR are to be carried out by the tenderer.

14.0 AFTER-SALE SERVICE

- 14.1 The proposal should include the following with regard to the maintenance of equipment: Detailed service support to diesel shed for repairs and maintenance, troubleshooting and repairs to the equipment.
- 14.2 Service support should be provided to diesel sheds where such equipment is installed at the shortest notice. It shall be the responsibility of the supplier for satisfactory operation of the equipment. Indian Railway maintenance staff shall be associated with the supplier's engineer for maintenance and operation.
- 14.3 If the tenderer does not have adequate service support, his offer will be liable for rejection.

15.0 IDENTIFICATION MARK

The following particulars shall be clearly and indelibly marked on the appropriate location of the equipment:

- .1 Manufacturer's/supplier's identification or trade mark
- .2 Manufacturer's / supplier's designation (type, symbol or code etc.).
- .3 Manufacturer's serial no./batch number and year of manufacture.

16.0 SOFTWARE

Software shall preferably be in a higher-level language. Computer models shall be developed to simulate the operation of EOTT. These models shall be used to test in interactive mode for the satisfactory functioning of individual modules and finally the complete web application software, on a PC

Software interface to the user (Uploading, Calibration, Configuring, Data pack, Downloading, Decoding etc.) should be menu driven and user friendly.

17.0 DOCUMENTATION

17.1 Documents to be furnished with tender documents

- Block diagram and the flow charts of the hardware and software
- Schedule of supply, listing all equipment with part numbers
- Outline and general arrangement drawings
- Printed product catalogue and standard data sheet of offered system.

17.2 Data and documents to be furnished before type testing

- Detailed specifications (technical catalogue and data sheet) for the equipment offered.
- Maintenance schedules for the equipment offered.
- Maintenance manual with full description of maintenance and repair procedures.
- List of maintenance spares required for normal maintenance and emergency repairs.
- Driver's operating instructions and trouble shooting handbook.
- Interfacing Circuit with descriptions for the equipment offered.
- Sequence of operation where necessary
- Such design data as may be required by RDSO to establish the adequacy of the design.
- Detailed trouble shooting directory.

18.0 EQUIPMENT FOR TROUBLESHOOTING, MAINTENANCE AND TESTING

Shed based equipment required for storage transfer; storage and analysis of data recorded by the system shall also be provided, along with any software required for this purpose.

The tenderer shall therefore, always quote for the complete set of equipment with individual breakup to enable the Indenter to procure the same as per requirement. IR shall indicate the requirement.

During the course of the field testing it may be necessary to capture a lot of data in the course of its normal operation, for the purpose of debugging and refining the software.

The contractor can take the equipment back after completion of field trials and finalisation of software.

19.0 PACKAGING

The component packing must be in assembled form of all the sub-assemblies. The packing list must totally match the complete BOM to be given by the supplier and this match shall be clearly indicated in the documents accompanying the supply.

It shall be suitably packed to prevent any transit damage. It shall be in line with the standard Indian Railways packing instruction.
