ELECTRICAL

RESEARCH DESIGNS & DEVELOPMENT

Implementation of Real-time Train Information System (RTIS) on Electric Locos

Indian Railways has decided for automatic acquisition of train operation data for improving operational efficiency and quality of passenger information. Provision has been made for providing Real Time Train Information System (RTIS) in all locomotives of Indian Railways. RTIS monitors and send continuous information of geographical location of locomotive to a central server through GSAT-6 satellite. RTIS is under implementation by M/s CRIS in association with M/s Bharat Electronics Ltd.(M/s BEL). Indian Railways have about 5500 electric locomotives, 6500 diesel locomotives and 3000 EMU/MEMU/DMUs. Implementation of RTIS in locomotives will be in two phases. In first phase RTIS is to be provided in 2700 electric locomotives. After this, Control Office Application (COA) will enable automatic charting and passengers will get accurate & real time information. RTIS will assist better utilization of resources and in emergency condition messaging between Loco driver and control office can be made. Interfacing of RTIS and control unit of locomotive will be feasible in future by which health of the equipment of locomotives will be available in real time and accordingly respective sheds can plan its maintenance activities.

MAIN EQUIPMENT OF RTIS

Mobile Satellite Service Hub (MSS Hub)

Mobile Satellite Service hub works on GSAT-6 and located at Data Centre of CRIS. MSS Hub receives data from GSAT-6 on C-band.

![Diagram of RTIS System](image)

Fig 1 : Working System of RTIS
L-Band

This communication band works from 1 to 2 GHz. Communication between locomotive & GPS/GGN/IRNSS took place on this band.

S-Band

This communication band works from 2 to 4 GHz. Communication between locomotive & GSAT-6 took place on this band.

C-Band

This communication band works from 4 to 8 GHz. Communication among locomotive, GSAT-6 and MSS Hub took place on this band.

Central Location Server (CLS)

Central Location Server is located at CRIS Data Centre. CLS and MSS Hub communicate each other.

RTIS Device has two parts. First part is called Indian rail Navigator (IRN) which comprises display, integrated communication model & power management unit and it is installed at locomotive cab. 2nd part is called Rail Mobile Satellite System (RMT) which is outdoor and is installed on roof of the locomotive.

Benefits of RTIS

- Automatic capture of train running Information & automatic plotting of Control Charts in COA
- Stress free work conditions for train controllers
- Optimum utilization of resources
- Accurate train running information to passengers
- Improved Customer Services
- Richer MIS for management
- Improvement in operational efficiency

The fitment location & scheme for RTIS in various class of locomotives have been finalized jointly with CRIS & M/s Bharat Electronics Limited (BEL). The installation & commissioning of RTIS in electric locos as per fitment scheme is in progress.

Development of End of Train Telemetry (EoTT)

End to Train Telemetry (EoTT) is a device which could work as an alternative of freight running trains without guard. EoTT system consists of two units:

- **End of Train (EoT) Unit**

  This unit is installed on the Last Vehicle of the train. It comprises of SBU, Radio transmitter & Receiver, battery, Air turbine for battery charging, GPS device etc. It transmits and receives information to/from HoT device fitted in the locomotive. It is shown below:
Both the EoT & HoT units are fitted with radio transmitter which communicates with each other. EoT senses the brake pipe pressure of Last Vehicle and transmit to HoT unit where it can be seen on display unit of HoT. In case of a train parting, the system is designed to indicate to the driver the parting of the train and to apply brakes to the rear unit, thus averting the collision of the rear portion with the front portion of the train.

Presently, End of Train Telemetry (EoTT) system is in working in some of the countries which are based on AAR-S-9152 and TFR, the international standards. RDSO has done detailed study as well as based on the meeting with EoTT manufacturers, RDSO has prepared & issued Functional Requirement Specification (FRS) No. RDSO/2019/EL/FRS/0025, Rev’0’ for the development of End of Train Telemetry (EoTT). Railway Board has sanctioned development of EoTT system on five trains each in SER & ECoR.

**Head of Train (HoT) Unit**

This unit is fitted on the Cab of locomotive. Display unit is part of HoT device fitted in the locomotive. One display unit will be provided in each cab of the locomotive. Total two display units will be provided as part of HoT. It is shown below:

Some of the main features of EoTT system are as under:

- EoTT system is based on AAR-S-9152 & TFR international standards.
- Two way Telemetry system has been adopted in this specification.
- EoT senses the brake pipe pressure of Last Vehicle and transmit to HoT unit where it can be seen on display unit of HoT by the Loco Pilot.
The system is designed to indicate to the driver the parting of the train and to apply brakes to the rear unit.

There is a provision of High Visibility Marker Light (HVML) and Disable Train Warning Light (DTWL) in the Last Vehicle of the train.

**Up-gradation of Speed of WAP7 Locos from 140kmph to 160kmph**

The WAP7 is a three phase AC electric passenger locomotive. It is a passenger variant of the freight locomotive WAG 9 (Gear Ratio 5.133) with a modified gear ratio (3.6) to pull lighter loads at higher speeds. It is capable of hauling 24 coach trains at speeds up to 140 km/h. The existing speed of WAP7 loco has to be upgraded to 160 kmph by changing the gear ratio from 3.6 to 3.18 & reducing the weight by 14.5t approx. Upgraded WAP7 loco (designated as WAP7HS) can haul 24 coach train at 160 kmph. This will reduce the journey time will improve line capacity. Prototype unit of WAP-7HS locomotive has been manufactured by CLW. Oscillation trials will be under taken in BE-MB-SRE section of NR at 115 kmph and at 180 kmph in NAD-KOTA-SWM section of WCR. This will be the first indigenously developed high speed & high horse power electric locomotive under ‘Make in India’ ideology.

**Provision of LED Type Light for exchanging signals with train passing staff**

To avoid the frequent opening of windows of air conditioned cab for exchanging the signals, a LED based signal exchange lamp is required to be provided outside the cabs with control push button at the ALP/LP desk for exchange of signals. If cab doors/windows are opened frequently, this activity reduces the effectiveness of Cab AC. Therefore, provision of exchanging of signals is considered through LED light. These lamps shall be operated by push buttons as shown in Figure 8. The lamps with push button shall be connected in series with a feedback light as repeater for ensuring the glowing of respective lamp when ever push button is pressed.

![Location of LED lamps for signal exchange](image)

**Fig 8: Location of LED lamps for signal exchange**

**Legends:**
- LG: LED Light Green lamp
- LR: LED Light Red lamp
- PB: Push Button

The scheme has been advised to Railways vide Modification sheet No.RDSO/2018/EL/MS/0470 dated 18.06.2018 for implementation.
Indigenous Development of Radio Equipment for Distributed Power Wireless Control System (DPWCS)

The requirement of the interoperability feature is desirable for flexibility in operation of locomotives fitted with Distributed Power Wireless Control System (DPWCS). OEMs of DPWCS are using different sets of Radio Equipment leading to problem in Interoperability among different makes of DPWCS. This is because different Radio Equipment does not have common communication protocol for ensuring interoperability. Common RF devices in DPWCS will help in achieving following objectives:

- Interoperability among various make of DPWCS.
- Common communication protocol is feasible.
- Simplifying the requirements for obtaining an operator’s license for radios from Wireless Planning & Co-ordination (WPC) wing of Telecommunication Department. As each radio modem needs to be approved by WPC. Proliferation of different modems will increase the license processing time.
- Cost reduction of DPWCS provided with indigenous Radio equipment

Under ‘Make in India’ ideology, Data Radio for Distributed Power Wireless Control System (DPWCS) for Indian Railways has been developed indigenously with M/s Bharat Electronics Limited (BEL)/Panchkula. The radio has been developed to provide interoperability among various make of DPWCS, is cost effective and an import substitution.

Development of EP Assisted Brake System

In the present brake system the Brake Pressure (BP) is depleted in the locomotive to apply brake in the train. The brake is applied in the engine as well as in the train. To release brake, the Brake Pressure (BP) is charged in the train through engine resulting in release of brake in the complete train.

Application and release of brake from engine is not simultaneous in complete rake, rather it reaches to last coach with some time delay. EP assisted brake system is required to apply/release brake in the complete rake simultaneously. RDSO has developed specification No. RDSO/EL/SPEC/2018/038, Rev’0’ to implement EP assisted brake system in the existing brake system (E-70/CCB) on Indian Railways. In EP assisted brake system each coach is provided with Brake application & Release solenoid valve operated with electric supply.

Advantages of EP Assisted Brake System

- EP assisted brake system may be fitted with existing brake system on IR.
- In case of failure of EP assisted brake system, train operation is continued with existing air brake system.
Brake application & its release are simultaneous in the whole train, Therefore, no jerk during application of brake/release which improves the passenger comfort.

Braking distance is reduced by approx. 15% with the use of EP assisted brake system.

Reduction in journey time by use of EP assisted brake system.

IMPROVING THE RELIABILITY & MAINTAINABILITY OF ELECTRIC LOCOMOTIVES

Development of 2x130kVA Static Inverter (SIV)

2x130kVA Static Inverter (SIV) has been developed by RDSO. This is the new design with 100% redundancy which will improve the reliability of locomotives. New design of SIV (2X130 kVA) was provided in one WAP4 loco No. 22714 (ELS/LGD) on 17.05.2018. After successful trial, Railway Board has directed Zonal Railways for procurement of SIVs as per new RDSO specification.

Interchangeability & Maintainability of Hall Effect Speed Sensors in IGBT Based 3-phase Locomotive

Technical Circular No. 0145 issued to make the speed sensors interchangeable among different make IGBT based traction converters and suggest maintenance practices to improve the reliability of speed sensors.

Jig for Checking Position of the Boss of Gear Case of Hitachi Traction Motor in Electric Locomotive

Post rehabilitation/overhauling of gear case of Hitachi traction motor in the sheds/workshops, many a times it is found that gear box Boss and bolt of traction motor do not match with each other. This results in difficulty in fitment and undue stress on the gear case/traction motor lug. Sometimes it has been noticed that minor misalignment of boss holes remains after repair because it was not been located properly during repair or disturbed during repair. This happens because there is no standard means to check the position of Boss after repair of gear case. Technical circular No. 0146 issued which defines the standard design of jig to be followed to overcome the problem.

Fig 10: Jig for Hitachi TM gear case

Testing of Carbon Brush

Technical Circular No. 0147 issued for testing of carbon brush block properties from finished carbon brush of Hitachi HS 15250A Traction Motors.

Guidelines for Refurbishment/Rehabilitation of Printed Circuit Boards of E70 Brake System for 3-Phase Electric Locomotives Type WAP5, WAG9 & WAP7.

Refurbishment of electronic cards is required to prevent failure of cards due to aging of components on line and for enhancement of service reliability and safety of the brake equipment. Accordingly, Guidelines in form of Technical Circular No. 0148 issued.