

Insight into TPWS Interoperability Trial

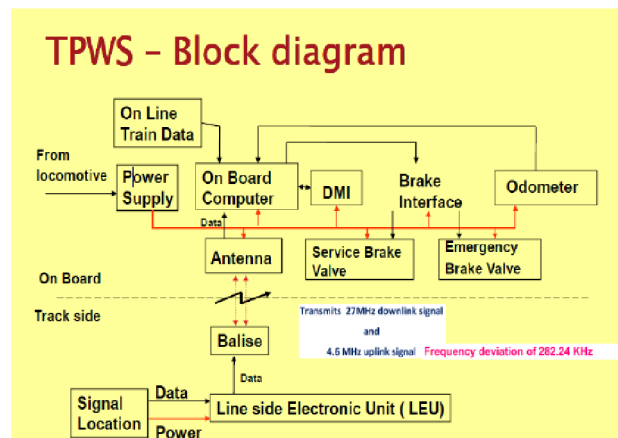
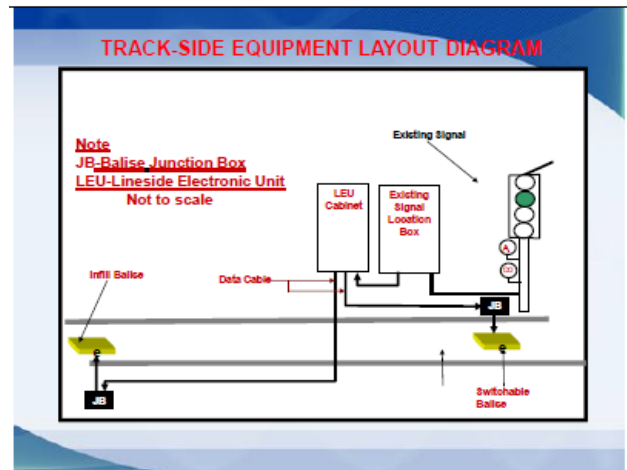
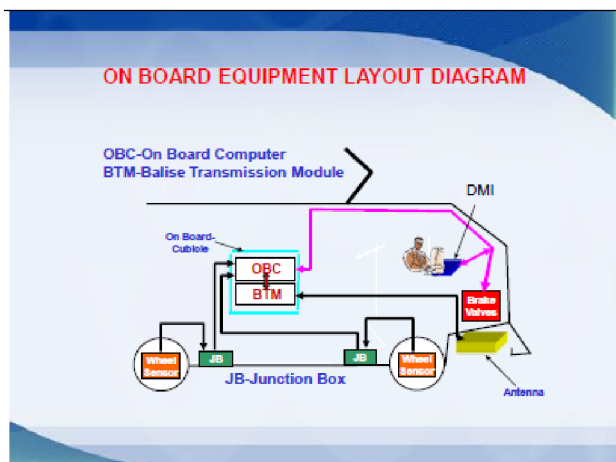
Shri. V.N.M Rao, Dy.CSTE/Proj/MS
Smt. M.Roopavathy, AXSTE/Proj/MS

Introduction:

The TPWS system was commissioned in Southern Railway on 2 May 2008 by installing TPWS Trackside equipment in Moore market Complex (MMC)- Chennai Beach(MSB) – Gummidipoondi (GPD) section of Southern Railway (48 Km) and also installing TPWS On-Board equipment in 82 EMUs/MEMUs in accordance with European Train Control System (ETCS) Level-1 principles conforming to RDSO specifications No. RDSO/SPN/183/2012Ver 2.3 or latest.

Features of TPWS:

- Supervising current speed to the Maximum Permitted Speed(MPS).
- Automatic Visual and Audio Warning during over speeds.
- Automatic Service Brake application, if current speed exceeds the MPS by 5 Kmph.
- Automatic Emergency Brake application, if current speed exceeds MPS by 10 Kmph.
- Roll away protection.
- TPWS system guides motorman during poor visibility of signal due to foggy weather/ obstruction of the signal.
- Since the location of Permanent speed restrictions and turn-outs are also fed in to the system, TPWS controls the speed of train ahead of such location also.



Provision of TPWS in BBQ - AJJ section:

During 2012-13, a new work was sanctioned for the provision of Track side equipment along with associated works for Train Protection & Warning System (TPWS) covering 68 RKM on Basin Bridge-Arakkonam (Slow line) section of Southern Railway at an estimate cost Rs.30,81,42,028/-and the contract has been awarded to M/s. Thales India Pvt. Ltd., in April 2014.

In this work, it is proposed to install M/s. Thales make TPWS Track side equipment on Basin Bridge-Arakkonam (Slow line) section covering over 169 Signals with 47 nos. of distributed type and 10 nos. of Centralized type LEU's comprising of 194-Switchable Balises, 90-Fixed Balises & 136-Infill Balises. The same has to be interfaced with the existing On-board System of M/s.

Ansaldo make.

Method statement for Design Deliverables:

• Method statement on Design Deliverables –

This sets out the details of the scope of work related to design inputs from Railways and design deliverable from the contractor

• Design Input from Railways:

- ✓ Approved P.Way Plan
- ✓ Latest Gradient Plan with accuracy.
- ✓ Approved signalling interlocking plan (SIP)
- ✓ Table of control
- ✓ Location box wiring diagrams details to identify ECR contacts
- ✓ Working Time Table(WTT) for Permanent Speed Restriction information (PSR)
- ✓ Relay Room Layout Plan and TPWS equipment for positioning of trackside equipment at centralised places (i.e at stations yards)
- ✓ LEU location box drawings

• Design Deliverable by Contractor

- ✓ Track side interface drawings showing
- ✓ LEU Line side cabinet layout
- ✓ Power and signal wiring and relay details.
- ✓ System Configuration – SIP showing TPWS equipment details
- ✓ TPWS equipment plan
- ✓ Base tables
- ✓ Telegram data
- ✓ Cable Route Plan and Cable core Plan.
- ✓ Safety case approval documents
- ✓ Any other documents as directed by the Railway Executive in-charge.

Insight of TPWS Interoperability Trials :

What is Interoperability?

Interoperability may be defined as “The capacity of the various national networks to interact, without interruption, with the adjoining networks, enabling a passenger or goods train to circulate without distinction on any section of the large trans-European railway network.”

Objective of Interoperability trials

- As per Para 9.7 of RDSO Specification No. RDSO/SPN/183/2012 Version 2.3 , the objective of the interoperability configuration is applied on situations where,
 - ◆ Interoperability of onboard system of one

manufacturer and Balise of another and vice-versa

- ◆ Interoperability of Balise of one manufacturer with LEU of another and vice-versa.

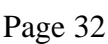
Need for interoperability trials

There are two different sections in Chennai Division namely MAS/MSB-GPD section and BBQ-AJJ(Slow line) section where TPWS system is installed .There are 82 EMU/MEMUs of Avadi car shed plying in these sections. Already TPWS system consisting of Track side subsystem and On Board Subsystem of M/s Ansaldo make is commissioned in MAS/MSB-GPD section. At present, the contract has been awarded to M/s Thales India Pvt. Ltd., for the provision of the TPWS track side system covering 68 RKM on Basin Bridge – Arakkonam (slow line) section during April-2014. Thus scope of BBQ-AJJ(Slow line) TPWS project involves only Trackside system installation as the motor coaches plying in this section are already installed with M/s Ansaldo make On Board System. As per the terms and conditions of the contract, vide. Clause 2.1 (c), the bidder shall demonstrate full interoperability of the Track Side equipment offered by them with the existing Onboard system complying SRS 2.2.2 before commencement of the supplies.

Thus M/s Thales has to demonstrate that their Track Side subsystem is compatible and fully interoperable with the M/s Ansaldo make On Board System.

Interoperability Trial Section – Action plan

- For the purpose of testing of Interoperability in the BBQ-AJJ Project, M/s. Thales India Pvt. Ltd. demonstrated the full interoperability of their Track side with the existing Onboard system by Ansaldo , in a trial section between Villivakkam-Ambattur of approx. 5 KM complying SRS 2.2.2 before commencement of the supplies.
- This includes both centralized as well as distributed LEU locations (i.e. within the station yard and Auto section).
- Interim approval have been communicated by SR for the Book of Rules, Interface drawings, and System configuration, cable route plan etc. submitted by M/s Thales India Pvt. Ltd. for preparation of telegrams and execution of



physical works at site.

- It is proposed for TPWS interoperability Trials in stages as follows:
 - ◆ A short trial to test Telegram transmission from Track Side System to On Board System of different makes.
 - ◆ Trials in the Automatic Signalling System covering 5 continuous signals in Up and Down directions. This involves distributed LEUs and Switchable/Infill/Fixed balises.
 - ◆ Trials covering full section of 5KM with centralized and distributed LEUs and all types of balises.

Testing of TPWS trackside system for interoperability involves the following testing:

- 1) Static testing of the TPWS installation
- 2) Dynamic Testing of the TPWS installation

Before conducting Dynamic test with empty rake, Static test has to be performed to ensure the correctness of the TPWS system installed.

Static testing of TPWS installation:

The following Balise Static tests will be carried out jointly by the contractor and Railway Representative:

1) Telegram verification using BEPT tool

Balise Equipment Programming tool (BEPT) and check whether the telegrams loaded at Balise is same as the telegrams submitted by the contractor. The following will be verified for the correctness with the help of BEPT tool:

- Check the availability of correct telegram per case
- Confirm the correct distance of the balises from the foot of the signal
- Check the telegrams generated for different Signal Aspects using Balise Equipment Programming Tool (BEPT)

2) Signal wiring verification using Bell testing

- 3) Data cable, power cable and signaling cable parameters verification using megger
 - i. To measure the Insulation resistance
 - ii. To conduct the loop test for measure conductivity

The sample of static report is shown below:

Signal name / LEU ID		Static test		Result	
Test No.	Test	3	12608	1	Updated
1	Default Telegram Balise	Balise 1 Balise 2	checked	checked	
2	Switched Telegram Balise	Balise 1 Balise 2	checked	checked	
3	Balise location (distance from the foot of the signal)	Balise 1 2 (L0-L1) Balise 2 2 (L0-L1)	checked	checked	
4	Signal inputs	1/7 2/8 3/9 4/10 5/11 6/12	checked	checked	
5	Checked aspects (M)	checked	checked	checked	
6	CAN-BUS Termination-Jumper (S)	checked	checked	checked	
7	CAN-BUS ID-Jumper (S)	checked	checked	checked	
Comments: Detailed telegram data attached.					
Date: 12-11-15 Tester Name: Sandesh Kumar					

Thales Representative

Name, Signature & Date
SANTOSH KUMAR

Railway Representative

Name, Signature & Date
G. K. Gopalakrishnan
13/01/2016

2) Dynamic Testing of the TPWS installation

The dynamic testing of TPWS trackside system will be carried out with the help of empty rake. All dynamic testing scenarios will be tested by doing 3-4 trips per day. The following dynamic test scenarios were tested for proving interoperability

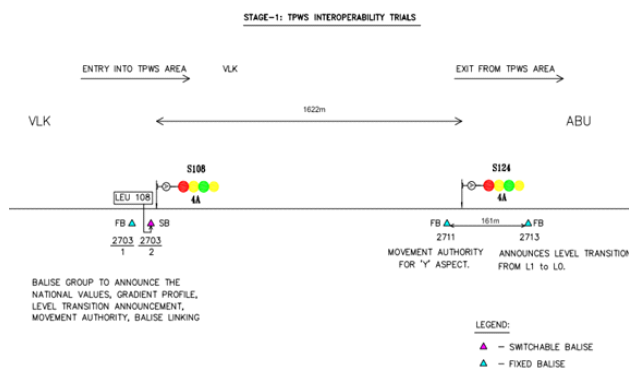
- ◆ Changing to Full Supervision Mode from Unfit mode once the motor coach enters the TPWS territory
- ◆ Changing to Unfitted mode once the motor coach exits out of TPWS territory
- ◆ Level Transition (L0 to L1 and Vice-Versa).
- ◆ Balise Linkage
- ◆ Design of Telegram with appropriate parameters.
- ◆ Compatibility of Telegram with respect to On Board and Trackside as per SRS 2.2.2.
- ◆ Transmission of correct telegrams corresponding to signal Aspects.
- ◆ Changing from Full Supervision (FS) mode to On Sight mode (OS) and from On Sight mode (OS) to Unfit mode (UN) .
- ◆ Testing of Big Metal Mass Balises - This will cut off the BTM Transmission power (27 MHz) of On Board system to balise to avoid reading of Balises over a predetermined distance. This is to bypass the service coaches for TPWS protection during trial period.
- ◆ Testing of Release speed-By keeping Signal at ON
- ◆ Testing for "No Reaction" of Onboard by disconnecting the cable connectivity between Infill Balise and LEU.
- ◆ Testing of Onboard reaction by disconnecting the cable connectivity between

Switchable Balise and LEU.

Stage-wise Interoperability trials

Stage I interoperability Trials

- A short trial covering two signals, (S108 and S124) near Villivakkam with one LEU and 4 balises (1 Switchable and 3 fixed Balises) was conducted with a 9 car motor coach and the following rudimentary tests were conducted successfully:



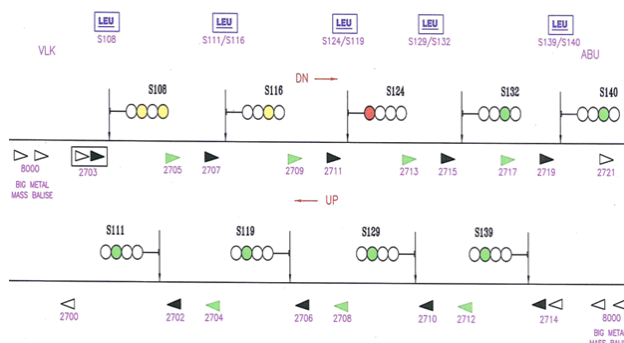
The following dynamic test scenarios were tested :

1. Changing to Full Supervision Mode once the motor coach enters the TPWS territory – S108.
2. Changing to Unfitted mode once the motor coach exits from TPWS territory Balise (2713)
3. Level Transition (L0 to L1 and Vice-Versa).
4. Balise Linkage
5. Compatibility of Telegram
6. Transmission of correct telegrams corresponding to signal Aspects

Stage II - Interoperability Trials

- The second stage of interoperability trials were conducted in the Automatic signalling section of Villivakkam-Ambattur section covering 5 continuous signals in Down direction (S108, S116, S124, S132 and S140) and 4 continuous signals in the Up directions (S139, S129, S119 and S111) involving distributed LEUs resided in the Location Boxes and Switchable/ Infill/fixed Balises. In this Stage 2 interoperability trial, 9 LEUs and 24 Balises (9 Switchable, 7 Infill Balises and 8 fixed Balises) have been installed and static and Dynamic tests were conducted.

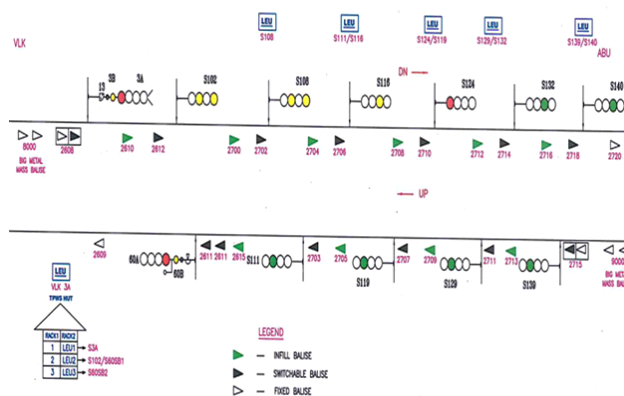
TPWS INTEROPERABILITY TRIAL RUN (STAGE-2)



Stage III – TPWS Interoperability Trials

- In continuation with the trials (Stage-2), M/s. Thales India Pvt Ltd have supplied and installed 12 LEUs and 31 Balises covering 5Km in Automatic Signalling section with 3 yard signals in Centralised system and 9 signals in Distributed System.
- The full trial (Stage-3) demonstrating the interoperability by M/s Thales India Pvt Ltd has been conducted for two days on 21st / 22nd May 2015 in the presence of Director/ Signal, RDSO/LKO.

TPWS INTEROPERABILITY TRIAL RUN (STAGE-3)



Interoperability Trials conclusion:

- Upon Successful completion of Interoperability Trials, RDSO has advised SR to go ahead with further installations in the remaining Section.
- The TPWS System was kept switched ON for a period of one month to observe the reliability of the System working after the issue of SOB to motormen.
- Failures and feedback from motor men were recorded and analyzed.

- Now the physical activities for the remaining section are in progress.
- Supply of TPWS equipment such as LEU, Balise, BEPT will be carried out shortly as the inspection at OEM premises is completed.



भारत सरकार - रेल विभाग
Government of India - Ministry of Railways
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Research Designs & Standards Organisation
पिन कोड: 226011
LUCKNOW - 226011

No. STS/E/TPWS/SR/Thales

Date: 27.05.2015

Chief Signal & Telecom Engineer,
Southern Railway, Park Town,
Chennai-3

Sub: TPWS interoperability Trials-reg.

Ref: (i) This office letter of even no. dt. 13.05.2015.

(ii) S. Railway letter no. SG/MS/TPWS/BBQ-AJJ/Vol. II dt. 25.05.2015.

(iii) Trial conducted between Villivakkam to Ambatur on dt. 21/22 May 2015.

Vide letter under ref. (i) above, compliance submitted by S. Railway with ref. (ii) and satisfactory performance observed during the trials on 21/22 May 2015, it is once again advised that S. Railway may go ahead for further installations of Track side (TPWS) equipment's in BBQ-AJJ section.

However, contractual obligations/compliance may be ensured at your end, please.


(Hari Om Kushwaha)
Director/Signal

Conclusion:

With this trial, the objective of testing the Interoperability between the existing On-Board system of M/s. Ansaldo and proposed Track side system of M/s. Thales make in the Automatic Signaling section (Villivakkam – Ambattur) is completed and found successful. This test was conducted by installing all the TPWS elements such as Infill Balise and Data cables in addition to Switchable/Fixed Balise and distributed LEU's.

During these trials, the designed telegrams were transmitted from trackside and displayed on DMI. Further TPWS system responded positively to the various modes of operation and reacted correctly for missing/defective Balises. The concept of Big Metal Mass telegram configuration could be successfully tested so as to limit the TPWS trials with empty rake and bypassing for other commuter EMU rakes as the system is yet to be commissioned for public use.