

## Safety

There were 131\* consequential train accidents in 2014-15 as compared to 117\* in 2013-14. Train accidents per million train kilometers, an important index of safety, is 0.10 in 2013-14 and 0.11 in 2014-15.

Category-wise and Cause-wise analysis of consequential train accidents during the last two years is as under:

Categories	No. of accidents	
	2013-14	2014-15
Collisions	4	5
Derailments	52	60
Accidents at level crossings	51	56
Fire in trains	7	6
Miscellaneous	3	4
<b>Total</b>	117*	131*
<b>Causes of train accidents</b>		
Human failures:		
(a) Failure of railway staff	50	58
(b) Failure of persons other than railway staff	57	57
Equipment failures:		
(a) Rolling Stock	3	3
(b) Track	-	-
(c) Electrical	-	-
(d) S&T	-	-
(e) Rolling Stock + Track	3	2
Sabotage:		
Combination of factors	-	-
Incidental	4	8
Cause not established/non-held	-	2
Under investigation	-	1
<b>Total</b>	117*	131*
<b>Casualties:</b>		
Passengers		
Killed	42	118
Injured	94	324
Railway Employees:		
Killed	7	6
Injured	24	10
Others:		
Killed	103	168
Injured	116	107

\* Excludes Konkan Railway.

## Compensation

A sum of ₹127 lakh (approximately) was paid as compensation under section 124 of Indian Railways Act, 1989 for death/injury in train accidents to the victims during 2014-15 as compared to ₹149 lakh (approximately) in 2013-14. The compensation paid during a year relates to cases settled and not necessarily to the number of accidents/casualties during that year.

## Damage to Railway Property

The cost of damage to railway property and duration of interruption to through communication caused by consequential train accidents during 2013-14 and 2014-15 were as under:

Year	Cost of damage		Interruption to through communication (Hours)
	Rolling stock inclusive of engines (₹in lakhs)	Permanent Way (₹in lakhs)	
2013-14	2,003.29	1,798.61	745.38
<b>2014-15</b>	<b>6,313.06</b>	<b>894.45</b>	<b>946.27</b>

Note: The above figures exclude Konkan Railway.

## Measures to improve safety

- **Safety Action Plans-** were continually executed to reduce accidents caused by human errors. A multi-pronged approach with focus on introduction of newer technologies, mechanization of maintenance, early detection of flaws, etc. to reduce human dependence in the first place, alongwith upgrading the skills of the human resources were the prime drivers for accident prevention.
- **Periodical safety audits-** of different Divisions by multi-disciplinary teams of Zonal Railways as well as inter-railway safety audits were conducted on regular basis. During 2014-15, 81 internal safety audits and 31 inter-railway safety audits were carried out.
- **Training facilities-** for drivers, guards and staff connected with train operation have been upgraded. Disaster Management Modules have also been upgraded. During 2014-15, 90,524 safety category employees attended refresher training.

## Measures to avoid collisions

To increase Efficiency and to enhance Safety in train operations, Advanced Signaling System with Panel/Route Relay/Electronic Interlocking (PI/RRI/EI) along with Multi Aspect Colour Light Signals have been progressively provided at 5,317 stations i.e. about 85% of Broad Gauge stations of Indian Railways, replacing outdated Multi Cabin Mechanical Signaling system involving a large number of human interfaces. Route Relay Interlocking/Electronic Interlocking at 8 major stations namely Bardhaman, Firozpur, Jakhal, Tambaram, Nagda, Gomoh, Agra Cant & Chheoki have been provided during the year 2014-15.

Technological aids of Automatic Train Protection System to loco pilots to avoid collisions due to Signal Passing at Danger (SPAD) or over speeding have been put on trial on Indian Railways. These technological aids are briefly enumerated below:

## Train Protection and Warning System (TPWS)

- TPWS prevents train accidents caused by human error like Signal Passing at Danger (SPAD) and Over Speeding. Pilot project of

TPWS (ETCS Level-1) (European Train Control System) has been commissioned on 50 RKms. suburban section of Southern Railway. Commercial trials of pilot project on 200 Rkms. of Northern/North Central Railway have been conducted with 35 locomotives on nominated trains. During 2014-15, TPWS system has also been introduced in commercial service on all the rakes on Dum Dum-Kavi Subash section of Kolkata Metro (25 RKM).

### Train Collision Avoidance System (TCAS)

- TCAS has dual capability of preventing train accidents caused due to Signal Passing at Danger (SPAD) or non observance of speed restrictions by train drivers as well as preventing train collisions. Development of TCAS is being carried out as an indigenous, multi-vendor, interoperable cost-effective system by RDSO, subsequent to Proof of concept field trials of the prototype TCAS equipment developed by RDSO in association with an Indian Vendor. Extended field trials with multi-vendor, interoperability features are in progress by RDSO on Lingampalli-Vikarabad-Wadi-Bidar section, SCR (250 km). Initial field trials of TCAS on a limited section have established the functioning of various train protection scenarios including multi-supplier inter-operability. Extended field trials on 250Km section with 40 locomotives are planned during 2015-16.
- **Complete Track Circuiting** has been done upto 99.8% on A, B and C routes. Fouling Mark to Fouling Mark track circuiting on 'A', 'B', 'C', 'D Special' and 'E Special' routes, where permissible speed is more than 75 kilometres per hour has been completed.
- **Block Proving Axle Counter (BPAC)** To enhance safety, automatic verification of complete arrival of train is being provided at stations having centralized operation of points and signals. BPAC has been commissioned in 4,585 Block Sections upto 31.03.2015.
- **Automatic Block Signalling** For augmenting Line Capacity and reducing headway on existing High Density Routes on Indian Railways, Automatic Block Signalling provides a low cost option. As on 31.03.2015, Automatic Block Signalling has been provided on 2,715 Route Kms.
- **Train Management System (TMS)** TMS helps in real-time monitoring of trains in the control room. The arrival status of local trains is displayed on indicators installed on platforms in the form of a countdown (in minutes) to the train's arrival on the platform accompanied by automatic announcements on platforms.
- **Accidents at Level Crossings** have been a major area of concern. Indian Railways have provided interlocking with signals at more than 10,000 Level Crossing gates to enhance the safety at Level Crossings. Initiative has been taken to interlock Level Crossing gate with Train Vehicle Units of 20,000 and above.



Train Protection and Warning System (TPWS) installed in EMU/MEMU, SR



Road Mobile Accident Relief Van, SCR



CRS Inspection of Delang-Puri Double Line Section, ECoR

## Measures to Reduce Derailments

- **Upgradation of Track Structure** consisting of Pre-Stressed Concrete (PSC) sleepers, 52 kg/60 kg high strength (90 kg/mm<sup>2</sup> ultimate tensile strength) rails on concrete sleepers, fanshaped layout on PSC sleepers, Steel Channel Sleepers on girder bridges have been adopted on most of the routes.
- **Standardization of track structure with 60 Kg Rails and PSC Sleepers:** Track structure is being standardized with 60 kg rails and PSC sleepers on all the Broad Gauge routes, especially on high density routes to reduce fatigue of rails under higher axle-load traffic. New track construction and replacement of over-aged tracks is being done by PSC sleepers only.
- **Long Welded Rails:** To improve maintenance and reliability of assets, efforts to eliminate fish-plated joints by welding single rails into long welded rails were continued. During relaying/construction of new lines/ gauge conversion, long welded rails are laid on concrete sleepers. Long rail panels of 260 Meters/130 Meters length are being manufactured at the steel plants to minimize number of welded joints. Turnouts are also being improved systematically.
- **Flash Butt Welding:** There is progressive shifting to Flash Butt Welding which is superior in quality as compared to Alumino Thermic (AT) welding.
- **Ultrasonic Testing of Rails and Welds:** All rails and welds are ultrasonically tested as per laid down periodicity. To improve quality of testing, it is planned to replace existing analogue type USFD testing machines with digital type USFD testing machines which are capable of data logging, saving and transferring scan to computers.
- **Tie Tamping and Ballast Cleaning Machines:** There has been progressive use of Tie Tamping and ballast cleaning machines for track maintenance. Also, sophisticated Track Recording Cars, Oscillograph Cars and Portable Accelerometers are being used progressively.
- **Rail Grinding Machines:** Two Rail Grinding Machines are working on high density routes of Indian Railways for enhanced reliability of rails.
- **Electronic monitoring of track geometry** is carried out to detect defects and plan their maintenance.
- **Modern Bridge Inspection and Management System:** Modern bridge inspection and management system has been adopted, which includes non-destructive testing techniques, under water inspections, intelligent water level monitoring system, mapping unknown foundations and integrity testing, etc.



A view of performance of Mock Drill with NDRF Team, ECR.

- **Patrolling of Railway tracks:** During adverse weather conditions, patrolling of railway tracks including night patrolling is carried out at vulnerable locations regularly.
- **Centre Buffer Coupler:** Progressive fitment of tight lock Centre Buffer Coupler (CBC) in lieu of screw coupling on new manufacturing of ICF design coaches has been carried out with a view to prevent the coaches from climbing over each other in unfortunate event of an accident. So far, 2900 LHB coaches, 425 Hybrid Stainless Steel Coaches and 1340 Conventional ICF Design Coaches have been manufactured with Centre Buffer Couplers. Design of CBC has been upgraded to mitigate problem of jerks during acceleration/deceleration of trains.
- **Crashworthy features of Passenger Coaches:** To improve upon the standards of safety, a “crashworthy” ICF design, in conjunction with a Centre Buffer Coupler (CBC), was evolved. Such a design enables absorption of significant amount of energy during the impact/collision. About 530 such crashworthy ICF design coaches have been manufactured so far. LHB AC Double Decker coaches introduced first time on Indian Railways have also been provided with enhanced crashworthy features. On similar lines, principal design for a crashworthy LHB coach shell has been manufactured and crash test for design validation on this coach has been completed at RDSO. Enhancing crashworthiness of coaches, therefore, remains continuous endeavor of Indian Railways which minimizes injury/loss of life in the event of collision when compared with ICF designed conventional coaches.
- **Progressive use of Air springs:** For enhancing safety and reliability of passenger coaches, the suspension systems are being redesigned with air springs at secondary stage capable to maintain constant height at variable loads. Air springs have been developed and are being fitted on all the newly built EMU & DMU coaches for sub-urban trains. Air springs have now been developed for mainline coaches as well and have been fitted in a limited number of coaches.

### **Measures to curb accidents at unmanned Level Crossings:**

Various measures taken by Indian Railways to prevent accidents at level crossings, are as under:

- **Containing the proliferation of Level Crossings (LCs) at source-** A policy decision has been taken not to permit any new LC either on existing line or any new line/gauge conversion to be commissioned henceforth. However, in exceptional cases, retention of unmanned LCs on new line or gauge conversion can be permitted with the approval of Railway Board.
- **Progressively eliminate all unmanned Level Crossings:**
  - (i) **Closure:** Closing unmanned Level Crossings having nil/negligible Train Vehicle Unit (TVU).
  - (ii) **Merger:** Merger of unmanned Level Crossing gate to



*Street Play on Unmanned Level Crossing, NER*



Train Actuated Warning Device (TAWD) at UMLCs, SR

nearby manned or unmanned gates or subway or Road Under Bridge (RUB) or Road Over Bridge (ROB) by construction of diversion road.

(iii) **Provision of Subways/RUBS**

(iv) **Manning** : The unmanned level crossings which cannot be eliminated by above means, will be progressively manned based on rail- road traffic volume, visibility conditions.

(a) **Level Crossing**: Level crossings are meant to facilitate the smooth running of traffic in a regulated manner governed by specific rules & conditions. The status of Level Crossings on IR as on 01.04.2015 is as under:

Total Number of Level Crossings	:	29,487
Number of manned Level Crossings	:	19,047 (65%)
Number of unmanned Level Crossings	:	10,440 (35%)

Indian Railways has decided to progressively eliminate the Level Crossings for the safety of road-users and train passengers. During the year 2014-15, 1,148 Nos. of unmanned Level Crossings and 310 Nos. of manned Level Crossings have been eliminated.

During the year 2015-16 (upto October, 2015), 520 Nos. of unmanned Level Crossings and 164 Nos. of manned Level Crossings have been eliminated.

(b) **Road Over/Under Bridges**: To improve safety of train operation and reduce inconvenience to road users, Level Crossings are being replaced by Road Over/Under Bridges/Subways (ROBs/RUBs) in a phased manner based on the quantum of traffic.

There are 1,779 of sanctioned works of ROBs/RUBs appearing in Pink Book 2015-16 which contain 1,399 ROBs and 5,554 RUBs/Subways. These are at various stages of planning, estimation and execution.

During the year 2014-15, 185 ROBs and 923 RUBs/Subways have been constructed under cost sharing, railway cost/accommodation works, Deposit/BOT term and by NHAI over Indian Railway.

During the year 2015-16 (upto October, 2015), 69 ROBs and 292 RUBs/Subways have been constructed over Indian Railways.

**Major Achievements:**

- In the Budget 2015-16, 970 ROBs/RUBs and other Safety works have been sanctioned at a total cost of ₹10,754 crores. These works will result in elimination of 3,438 Level Crossings (LCs) including 3,026 unmanned LCs.
- With the proper monitoring and coordination, all unmanned Level Crossings in West Central Railway (WCR) have been eliminated. WCR has become first Zonal Railway with nil unmanned Level Crossings in August, 2015.

**Measures taken to prevent Fire in Trains**

Use of Fire Retardant Furnishing Material-Indian Railways have always endeavoured to enhance fire worthiness of coaches by using

fire retardant furnishing materials to mitigate the effect of fire such as fire retardant curtains, partition paneling, roof ceiling, flooring, seat and berths along with cushioning material and seat covers, windows and UIC Vestibules etc. Specifications for such furnishing materials have been periodically reviewed to incorporate fire retardant parameters in line with UIC and other international norms. All new manufacture of coaches/periodical overhauling of existing coaches is being carried out with fire retardant specifications of the furnishing materials wherever condition based replacements are warranted.

### **Introduction of Automatic Fire and Smoke Detection System**

A pilot project for field trial with Automatic Fire and Smoke Detection system has been taken up in one rake of New Delhi-Bhubaneswar Rajdhani Express. Besides, one LHB (Linke Hofmann Busch) rake in New Delhi – Jammu Tawi Rajdhani and one rake of LHB AC Double Decker coaches running between Kacheguda–Tirupati/Guntakal of South Central Railway have been provided with such a system. Extended field trials on representative population of coaches are planned to be conducted further with revised specification. In the revised specification, Air brake system has been interfaced with Fire and Smoke Detection System for stoppage of trains in emergent situation due to fire.

### **Provision of Fire Extinguishers**

Dry chemical powder type fire extinguishers are being provided in all mainline Trains. These are portable fire extinguishers and are easy to use by on board staff or passengers in case of emergency. Fire extinguishers are being provided in all air-conditioned coaches, second class–cum–guard and luggage van, pantry cars and train locomotives.

### **Inspection of Electrical & LPG Fittings in Pantry Cars**

Detailed instructions have been issued to zonal railways for observance of safe practices in handling of pantry cars and for ensuring periodical inspection of electrical and LPG fittings in the pantry cars.

### **Publicity Campaigns**

Intensive publicity campaigns to prevent the travelling public from carrying inflammable goods are regularly undertaken.

### **Administrative Measures:**

- Constant review of safety performance at Board’s apex level- Safety performance is invariably reviewed as a first item on agenda of Board Meeting at the apex level. All accidents are analyzed in detail so that remedial measures can be initiated.
- Safety review meetings with Zonal Railways-Chairman and Board Members have conducted Safety review meetings with General Managers and PHODs of Zonal railways during their visits.
- Intensive footplate night Inspections- Intensive footplate inspections including night inspections have been conducted at the level of SAG, Branch officers and supervisors in the field.
- Regular safety drives-Safety drives have been launched from time to time, covering the lessons learnt from recent train accidents so as to prevent similar accidents in future.



*“Gate Mithras” at all UMLs w.e.f. 1.8.2014, SCR for counseling road user*



*Monitoring of train movements round the clock at the Control Room during HudHud Cyclone, ECoR*