Chapter 3 – Signal and Telecommunication

The Signalling Department is responsible for Safe Train operations and maximizing the utilization of fixed and moving assets such as train rakes, locos and tracks etc. The Telecommunication Department caters for safety related and operational communication needs of the Indian Railway network.

The Signal and Telecommunication Organization is headed by Member-Electrical and is assisted by Additional Member (Signal) and Additional Member (Telecommunication). At Zonal level the organization is headed by Chief Signal & Telecommunication Engineer (CSTE) who is assisted by Chief Signal Engineer, Chief Communication Engineer, CSTE (Planning), CSTE (Projects) and CSTE (Construction).

Maintaining signalling assets is the primarily the responsibility of the Signalling Department. A thematic study on 'Performance efficiency of Signalling assets – Indian Railways' was conducted by audit covering a period of four years from 2008-09 to 2011-12. The study examined the implementation of the targets laid down in the Corporate Safety Plan (2003-13) which special focus on monitoring of signal failures and performance efficiency of signal assets. The audit methodology included scrutiny of documents, analysis of data at the S&T branch of Zonal Headquarters (except Metro Railway) and Divisional Headquarters. The related records of 179 Railway stations were test checked for assessing age profile and maintenance schedules of S & T equipments.

This chapter contains the audit findings of the above thematic study.

Performance efficiency of Signalling assets – Indian Railways

Executive Summary

Modern signalling systems play a key role in enhancing safe and reliable train operations. Indian Railway have initiated action under the Corporate Safety Plan (2003-13) to upgrade and modernize their signalling systems. Proper and timely upgradation, inspection and maintenance of signalling assets are essential to enhance their performance efficiency and ensure optimum use of existing line capacity. Audit conducted the present study during 2012-13 to evaluate the overall performance efficiency of signalling assets with special reference to efficacy of monitoring systems, preventive maintenance of signal equipment and replacement of aged assets. Some of the key findings were:

- Signal incidence per thousand ZISTU is a key performance indicator to monitor signal incidences. The indicator was within the tolerance limit only in six out of sixteen Zonal Railways. However, the basic units assigned to Signal and Telecom (S&T) equipment for calculation of ZISTU had not been revised for four decades. As ZISTU was not assessed uniformly across Zonal Railways the same cannot be considered as a fair indicator of signal incidents.
- The data collected for different signalling equipment indicating Mean Time Between Failures (MTBF) and Mean Time To Repair (MTTR) showed wide variations across Zonal Railways and the same brand/make. No standard norms for monitoring down time and response time were prescribed for assessing the performance of the equipment.
- Dissimilar signalling systems existed on 26 sections with more than 100 per cent line capacity utilization, resulting in slower signal communications and movement of traffic.
- While the overall progress in upgrading systems vis-à-vis targets under the Corporate Safety Plan was satisfactory, in some Zonal Railways, more than one – third of the targets as on 31 March, 2012 were yet to be achieved.
- In 32 'A' route stations, 64 signalling equipments out of 93 were dated and overdue for replacement.
- There was substantial shortfall in adhering to the maintenance schedules in test checked stations.

3.1 Introduction

Modern signalling systems play a key role in enhancing safe and reliable train operations. Indian Railway (IR) have initiated action under the Corporate Safety Plan (CSP) - (2003-13) to upgrade and modernize their signalling systems. The XI Plan recognized that a commitment had been made to the Parliament that replacement of over-aged assets would be sanctioned on concurrent basis so that arrears were not accumulated. Further, it was envisaged that efforts would be made to expedite the remaining safety related works planned in the CSP.

3.2 Audit objectives and scope of study

An earlier performance audit on "Signalling and Telecommunication" forming part of Comptroller Auditor General of India's Report No.PA 26 of 2008-09 Union Government (Railways) highlighted progress made in implementation of various targets laid down in the CSP. The present study was conducted during June-July 2012 to evaluate the follow-up action taken by the Ministry, with special focus on:-

- Monitoring of signal failures;
- Performance efficiency of signal assets;
- Efficiency in preventive maintenance including replacement of over-aged assets.

The study covered a period of four years from 2008-09 to 2011-12.

3.3 Audit criteria and methodology

Provisions included in the Signal Engineering Manual (SEM) and the recommendations of the CSP accepted by the Ministry were the sources for the criteria adopted in aduit. Report of the Working Group on Railway Programmes for the XI Five Year Plan (2007-12) and guidelines and instructions issued by the Railway Board (RB) from time to time were also considered.

The audit methodology included scrutiny of documents, analysis of data at the S&T branch of Zonal Headquarters (except Metro Railway) and Divisional Headquarters. Field units were test checked as shown below for assessing age profile and maintenance schedules of S&T equipment.

Category of Route	No. of stations test checked
A	53
B	42
C	21
D & D Spl.	30
E & E Spl.	33
Total	179

3.4 Audit findings

3.4.1 Effectiveness in monitoring signal failures

3.4.1.1 Adherence to the tolerance limit of signal failures

Signal failures in IR are being monitored through an index called Signal failures per 1000 Zonal Integrated Signal and Telecom Units (ZISTUs). The work load of S & T department in a Zonal Railway is measured in terms of Zonal Integrated Signal and Telecom Units (ZISTUs) which comprises of

(i) equated workload for maintenance of signalling equipment (ZESU);

(ii) Equated workload for maintenance of telecom equipment (ZETU) and

(iii) Equated workload for management of S&T workshop (ZEW) on that Zone.

For the purpose of quantifying the work to be performed, basic units were evolved (1969) for each Signal &Telecom equipment. ZISTU is also used in IR as a Key Performance Indicator of signal failures and expressed as signal failures per 1000 ZISTUs as explained below:

$$\textit{Signal failures per 1000 ZISTU} = \frac{\textit{Total signal incidence X 1000}}{\textit{ZISTU}}$$

CSP (2003-2013) envisaged a consolidated target whereby all types of signal defects would reduce from the level of 13.19 incidences per 1000 ZISTUs at the end of March 2003 to 7.91 by the end of March 2008 and further to 5.28 by March 2013. As against this, the level achieved by IR was 5.30 incidences per thousand workload of ZISTU at the end of March 2012 as detailed below:

Zone	Total signal incidences	ZISTU	Signal Incidences per thousand work load of ZISTUs
CR	15292	3183.21	4.80
ECOR	4099	721.72	5.68
ECR	11898	1496.60	7.95
ER	20160	2898.00	6.96
NCR	9967	2949.46	3.38
NER	2886	2203.05	1.31
NFR	6922	666.86	10.38
NR	18348	2549.80	7.20
NWR	9068	674.03	13.45
SCR	10905	1551.21	7.03
SECR	6463	848.46	7.62
SER	6995	1444.37	4.84
SR	5514	3802.76	1.45
SWR	3626	720.87	5.03
WCR	9544	1356.00	7.04
WR	10892	1727.30	6.31
Total	**152579**	**28793.70**	**5.30**

Audit analysis revealed that six zones (CR, NCR, NER, SER, SR and SWR) achieved the target envisaged in the CSP in March 2012 itself. In other zones, the signal incidences ranged between 5.68 (ECoR) and 13.45 (NWR) ZISTUs at the end of 2011-12.

Audit observed that while the signal incidences per 1000 ZITSU had declined during 2011-12 as compared to 2008-09 and were closer to the tolerance limit prescribed (5.28), audit considers this to be mainly due to non-revision of weights for various S&T equipment and yardsticks as discussed in the succeeding paragraph.

The overall signal failures per 1000 ZISTU (5.30) in IR show a decreasing trend. However, the signal failures were within the tolerance limit only in six Zonal Railways.

3.4.1.2 Adoption of Basic Unit

The basic units assigned for ZISTU during 1969 were not updated to cover modern signalling equipment like digital electronic exchanges, Solid State Interlocking (SSI) system, data communication equipment for Passenger Reservation System, auxiliary warning system, data loggers and Block Proving by Axle Counters (BPAC). As a result, Zonal Railways adopted different units for the same equipment. For example, basic unit adopted for different equipment varied as under:

- Basic units for BPAC ranged from four to 100 units across Zones.
- For electronic interlocking, basic unit was not assigned in eight Zones (SER, SR, SWR, SECR, CR, ER, NER and NR). Two Zones (ECR & WR) adopted two units. For other Zones details were not available.
- For data loggers, different units were assigned by Zonal Railways depending upon the number of ports. The basic units for data loggers ranged from five to 20 across 10 Zones. Of these, there was no differentiation based on the number of ports in ECR & NER. SWR has not assigned any unit to data loggers.

Thus, the ZISTU calculated by the Zones were not comparable due to the adoption of different basic units by them.

3.4.1.3 Impact of inclusion of ZEW

One of the components of ZISTU included equated workload for management of S&T workshop (ZEW) on that Zone. Adoption of this index across all Zones is not equitable resulting in non-comparable data. In a test check carried out by audit over four Zones, the following was observed:-

(For the year 2011-12)

Sl. No	Particulars	CR	SR	ER	WCR
1	ZESU	1560198.10	348187.00	1767810.00	561786.10
2	ZETU	934515.00	519038.00	538941.00	794173.16
3	ZEW	688500.00	2937600.00	591462.00	0.00
4	ZISTU (1+2+3)	3183213.10	3804825.00	2898213.00	1355959.26
5	Total Signal incidences	15292	5514	20160	9544
6	Signal incidences per 1000 ZESU (5/1)	9.8	15.84	11.40	16.99
7	Signal incidences per 1000 ZESU+ZETU (5/(1+2))	6.12	6.36	8.74	7.04
8	Signal incidences per 1000 ZISTU (5/4)	4.80	1.45	6.96	7.04
9	Value of materials manufactured, overhauled and repaired in workshop	15.30 crore	65.28 crore	13.14 crore	0

- Out of the four Zones, WCR does not have a workshop and hence ZEW is not computed. Hence, signal incidences per 1000 ZISTU is found to be the highest in WCR.
- As only seven out of the 16 Zones have workshops, ZEW is calculated only for these Zones and this gives them a tremendous comparative advantage over other Zones as signal incidences per 1000 ZISTU will be lower in these Zones due to inclusion of an additional parameter, namely ZEW.
- ZEW is calculated by considering the value of materials manufactured, overhauled or repaired in the workshop. Hence, a Zone handling high value materials gets a tremendous edge over other Zones. A case in point is SR which handled materials worth ₹ 65.28 crore as against ₹ 15.30 crore and ₹ 13.14 crore of CR and ER respectively and hence its signal incidences per 1000 ZISTU is 1.45 as against 6.36 signal incidences per 1000 ZESU+ZETU.

Audit is of the view that the present system of computation of signal incidence per 1000 ZISTU does not give a true picture of signalling defects in IR as it gives an unfair edge to Zones having signalling workshops and handling large value materials in the workshop. Further, due to non-revision of basic units for more than four decades and adoption of widely varying units by different Zones for new equipment, measuring of signal failures per 1000 ZISTUs in its present form did not represent a true and fair trend of signal incidences.

The basic units and yardsticks for S&T equipment have not been revised for four decades. This has led to adoption of different equated S&T units and yard sticks by Zonal Railways in respect of newly introduced modern signalling and telecommunication equipment. As ZISTU was not assessed uniformly across Railway Zones, the work load was not brought on comparable terms and on realistic basis. Thus, the achievement of incidences per thousand ZISTU was not only deceptive but rendered the monitoring of signal failures ineffective. Thus it cannot be stated with certainty that the targets fixed in Corporate Safety Plan (2003-13) have been achieved.

3.4.2 Performance of signalling equipment

3.4.2.1 Analysis of MTBF and MTTR

Efficiency in monitoring performance of signalling equipment and its maintenance is determined by a normative measure to be prescribed, i.e. Mean Time Between Failures (MTBF) and Mean Time to Repair (MTTR). In the Comptroller and Auditor General of India's Union Government (Railways) Report quoted in Para-2 ibid, audit had recommended that benchmark for MTBF and MTTR should be fixed to enhance the quality of monitoring the efficiency of modern signalling equipment. Ministry of Railways, in its Action Taken Note (February 2011), stated that norms for MTTR would be issued. Audit observed that these norms had not yet been issued by Ministry of Railways.

Further, analysis of actual down time of signalling equipment across various Zones during 2008-09 to 2011-12 revealed large variations in MTBF and MTTR of Integrated Power Supply System (IPS), Data Loggers, BPAC and SSI as detailed below:

Equipment	Brand	No failure reported since installation	MTBF (in hours)		MTTR (in hours)	
			Lowest	Highest	Lowest	Highest
Integrated Supply System (ISS)	Amarraja Batteries	ECOR	3957.35 (NER)	650758.00NFR	0.82 (NWR)	744 (NFR)
	HBL NIFE	NFR	13521.23 (ER)	1086888.80 (SER)	0.75(NR)	1440.00 (NCR)
	STATCON	NFR, Metro	26632.82 (SER)	410496.00 (NWR)	0.43 (SR)	2590.43 (SCR)
Data Loggers (DL)	EFFT Tronics	Metro	8952.96 (SER)	765928.00 (NR)	5.50 (NWR)	914.04 (WR)
	HBL NIFE	SWR, WR	1027.89 (SCR)	391848.00 (NR)	2.57 (NWR)	198248.00 (NR)
	Crompton	ECoR, NWR, WCR & WR	352.98 (SCR)	94224 (ECR)	1.07 (SCR)	1414.29 (SR)
Solid State Interlocking (SSI)	US & S	NR	5584.94 (SECR)	106911.47 (SR)	0.89 (ECoR)	12.87 (NCR)
	Ansoldo	…	2291.48 (SR)	208284 (NWR)	0.08 (SR)	14.43 (ECR)
BPAC	CEL	…	845.07 (ER)	45933.00 (WR)	0.46 (EcoR)	744 (NFR)
BPAC	Blydne	…	3488.14 (SCR)	13054.10 (WCR)	0.87 (SCR)	193.05 (WCR)

It could be seen from the above that

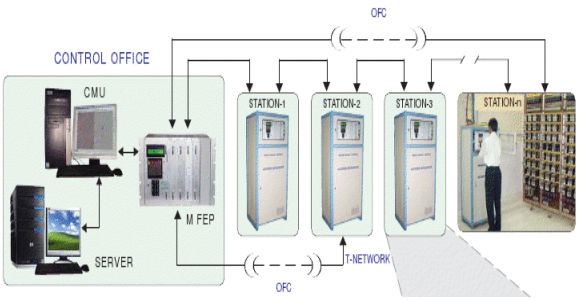
- no failures were recorded since installation by many Zonal Railways, which seems highly improbable;
- MTBF in the case of ISS reported by Zones was very high in respect of HBL NIFE (1086888 - SER) and Amarraja Batteries (650758 hours – NFR) make. Similarly, wide variations were also noticed in respect of other equipment. In respect of DL and SSI, the MTBF was very high. (765928.00- 208284)

These large variations, in the absence of a standard norm did not lend themselves to reasonable conclusions, besides raising issues of data reliability. Standard norms for monitoring downtime and response time for equipment maintenance need to be therefore put in place.

MTBF and MTTR of modern signalling equipment varied widely across Railway Zones and brands. Standard norms for monitoring downtime and response time have not been prescribed.

3.4.2.2 Utilization of Data loggers

A Data Logger (DL) is a device that monitors real time events and records the functions of track circuits, points, signals, Axle counter signals etc. It has the capability to perform statistical analysis, predict faults and generate failure reports.



Data loggers in net work

Railway Board had expressed concern (July 2010) that the devices were not being properly utilized on account of lack of involvement of staff, improper upkeep of the device, absence of Annual Maintenance Contract (AMC) with Original Equipment Manufacturers (OEMs), poor follow up in case of failures, etc, and reiterated instructions to all Zonal Railways to ensure correct configuration of the wiring of the devices with the approval of Chief Signalling Engineer, training in correct and proper use of the DL being imparted to the technical staff and in the extraction and print-out of the reports. They play an important role in analyzing the causes of an accident, if any.

Audit assessed the performance and utilization of data loggers, Zonal Railway wise and observed the following:

- Networking of DLs was complete in only five Zones (SR, WR, SCR, ECoR and NWR) out of 16 Zones (except Metro Railway).
- All relays were required to be proved through DL for effective monitoring of relays as per the directives of Railway Board (June 2011). Audit, however, observed that, all relays were connected to DLs in only three (NER, CR, ECoR) Zones. In six Zones (ECR, SER, NCR, SWR, NR and ER) only vital relays were proved through DL. In Seven Zones (WR, SECR, SCR, WCR, NWR, NFR and SR) connection to DL was partial. Audit observed that not connecting all the relays to DL impaired its usefulness as failure occurring in these relays could not be effectively monitored.
- Exception reports from Data Loggers were required to be analysed through print-outs on a daily basis. Audit observed that the provision of printers was complete only in five Zones (WR, CR, SWR, SCR and ECoR).In the remaining 11 Zones, adequate printers to DLs were yet to be provided, which impaired proper analysis of the functioning of the assets. This defeated timely preventive maintenance.
- Only in three Zones (SECR, CR and WR) all data loggers were covered under AMC. In five Zones (ECR, SER, SR, NFR, NWR) the coverage was partial, ranging from 35 to 96 per cent. In seven Zones, details were not furnished and AMC is under implementation in one Zone.
- The terms of AMC stipulated that the failure had to be rectified and the system was to be restored within a period ranging from 24 to 90 hours in six Zones (SR, WR, ER, ECR, WCR and NWR). However, the maximum duration of MTTR was 1414.29 (Crompton), 914.04 (EFFT Tronics) and 198248 (HBL NIFE) hours as against the period prescribed in the AMC.
- During the period 2008-09 to 2011-12, there were 33 accidents involving collision over 11 Zones. Out of 33 collisions, DL was used in only seven locations. (SECR-1, SCR-2, ECoR-1, NR-2 and WR-1). DL was not available/ commissioned at eight locations where accidents occurred (ECR-1, SER-6 and WCR-1).

The installation of data loggers was not accompanied by proper networking resulting in non-proving of relays, inadequate maintenance and upkeep.

3.4.2.3 Provision of BPAC

Provision of Block Proving by Axle Counter (BPAC) reduces dependence on human element in train operation through a system of automatic counting of axles of a moving train over a section and enhances safety. Railway Board reiterated (November 2009) their earlier instructions of July 2002 and October 2003 that Zonal Railways must provide BPAC in all A and B routes in a contiguous manner. Audit observed that though priority was to be accorded for all A and B routes, 830 stations in A and B routes were without

BPAC/Absolute Block System (ABS), whereas 1103 stations in D, D Special and E routes were provided with BPAC/ABS.

3.4.2.4 Non-provision of Integrated Power Supply system

For a robust Signalling system installation, reliable power supply system is vital. Railway Board issued (September 2009) instructions to all Zonal Railways to ensure availability of adequate power supply for signals at all stations including block huts in both electrified and non-electrified routes. Railway Board again reiterated (July 2010) that work for provision of adequate power supply was to be completed on A, B & C routes by March 2011, D special and E special routes by September 2011 and D & E routes by December 2011. Further during a meeting of Chief Safety Officers held in September 2010, it was decided to provide Integrated Power Supply (IPS) with battery back up in order to avoid signal blanking. Audit reviewed the action taken by Zonal Railways and observed the following:

- In nine Zones (WR, NER, SECR, CR, SCR, ECR, ECoR, WCR and ER), IPS system had been provided to the extent of 73 to 91 per cent.
- In SR, the Administration prioritized (Feb 2011) the reliability improvement works by providing IPS system, maintenance free earths, lightning dischargers and replacement of batteries and improved maintenance of DG sets. However, IPS was provided to the extent of 26 per cent.
- IPS system had been provided to the extent of 55 per cent in two divisions test checked (Kharagpur and Adra) in SER and 61 per cent in SWR.

In view of the above findings, Audit is of the opinion that Railway Board's instructions to ensure provision of IPS in all routes remained unfulfilled by March 2012.

3.5 Analysis of signal failures

There is a significant correlation between safety and reliability of assets. As reliability of asset improves, dependence on human judgment decreases and safety is enhanced. Details of causes of signal failures during 2008-09 to 2011-12 are tabulated below:

Sl. No.	Causes of failure on S&T Account	2008-09	2009-10	2010-11	2011-12
1	Equipment failure	12290	12541	7298	6860
2	Lamp fusing	3797	3285	3854	4015
	Out of the above, failure of LED/HMU/CR due to power surge	Not available		2280	2766
3	Cable	4638	4141	5498	5890
	Out of the above, failure of cable terminator due to vibration	Not available		338	317

4	Relay failure	5290	5812	6504	6319
	Out of the above, failure due to high resistance in metal to carbon contacts	Not available		6062	5719
5	Point machine	1200	1357	1365	1551
6	Fuse blown off	3792	4171	4545	4043
7	Power equipment	3326	3248	3406	2978
8	Bad maintenance	2732	2463	4205	4307
9	Track Circuit Failure	Not available		5905	6263
10	Block Instrument failure			10132	11555

Our analysis revealed the following:

- Equipment failure had been declining during the period (except in 2009-10) in IR. However, it showed an increasing trend in CR.
- Failure due to lamp fusing generally showed an increasing trend (except in 2009-10) despite replacement of filament lamps in signals by LEDs (Light Emitting Diodes).
- Cable failure was on an increasing trend in NCR, SR, and WCR. The total cable failure in IR increased from 4638 (2008-09) to 5890 (2011-12).
- Majority of relay failures (6062 out of 6504) during 2010-11 and 2011-12 (5719 out of 6319) were on account of high resistance in metal to carbon contacts in relays (excluding CR, ECR, SER, SWR, WR).
- Failures on account of bad maintenance of equipment were much higher in 2010-11 and 2011-12 compared to earlier years.
- Block Instrument failure was the single largest cause of signal failure.

Block instrument

3.5.1 Availability of dissimilar signalling equipment on same route

Signalling infrastructure of the same standard in all sections of a particular route is important to ensure maximum utilization of the existing railway lines. It was highlighted inter- alia in Comptroller and Auditor General of India's Report quoted in para-2 ibid that similar standard of signalling had been provided in only one Zonal Railway (SWR). The Ministry (February 2009) replied that modern signalling on

Semaphore signal at Malda Town (ER)

all Broad Gauge sections would be approved by the year 2020.

Audit reviewed the progress and observed that 26 sections across the Zonal Railways where utilization was more than 100 per cent of line capacity across the Zonal Railways did not have signalling equipment of similar standard. Existence of equipment with dissimilar standard has safety implications.

3.5.1.1 Replacement of dated signal equipment

Replacement of old and ageing assets through upgraded modern signalling system is an essential step towards achieving Indian Railway's goal of a collision free system.

The Comptroller and Auditor General of India's Report quoted in para -2 ibid had inter-alia highlighted shortfall in provision of modern signalling equipment vis-a- vis targets in the CSP (2003-2013). In reply, the Ministry had stated that not only fund availability, but also manpower and resource capabilities needed to be strengthened (February 2011).

3.5.1.2 Age profile of signalling asset

Audit test checked age profile of assets like signalling equipment/machines, point machines, relays, battery chargers, signal transformers and cables available at 98 selected stations across Indian Railways and observed the following:

- Out of 93 signalling equipments[22] available in 32 stations on 'A' category routes, 64 items (69 per cent) had outlived their prescribed life. However, there are yet to be replaced. These assets had exceeded their prescribed life as below.

Period in excess of prescribed life	No. of equipment
Up to 1 year	5
Above 1 year and up to 5 years	13
Above 5 years and up to 10 years	13
Above 10 years	33

The reasons attributed by Railway Administration for non-replacement of aged signalling assets were:–

- satisfactory performance of the assets (though they were over aged);
- continued use of over-aged assets by overhauling;
- delay in sanction of new assets;
- want of material, stores, equipment, and
- proposed upgrading of signalling system to Panel Interlocking (PI), Route Relay Interlocking(RRI).

[22] Point Machines, RRI, Lever Frame, Electronic Signalling System like SSI, Axle Counter, AFTC, IPS etc., Battery Charger, DG Sets ,Inverters

3.5.1.3 Instances of assets aged more than 50 years

The Jeumont Track Circuit at Chennai Central was installed during the early 1960s (exact date of installation not available on record). This track circuit was installed at berthing track of all 11 platforms in Chennai Central Station to indicate whether a platform is occupied or not. Trains can be received only when the platform is unoccupied. In the event of failure the loco pilot should depend only on the "calling on signal" and proceed with speed of 15 kms per hour. The relays used in the Track circuit were imported from Japan during 1947 and spares are not available. The old circuit is yet to be replaced with modern track circuits. Though the Track circuit is in working condition, yet there is an element of inherent risk of failure due to use of over aged equipment.

3.5.2 Provision of modern signal equipment

Audit reviewed the progress of provision of modern signalling equipment in 16 Zones (except Metro) vis-à-vis targets laid down under the Corporate Safety Plan (2003-2013) as tabulated below:-

Name of the signalling asset	Provided as on 31st March 2012 (stations)	Balance to be provided vis-à-vis targets under CSP	Percentage to be provided
Electronic Interlocking (EI)	4897	643	11.64
Route Relay Interlocking (RRI)/Panel Interlocking (PI)			
Block Proving Axle Counter (BPAC)	3264.5	1481.5	31.22
Data loggers (DL)	5000	645	11.43
Light Emitting Diode (LED)	4672	769	14.13
Multiple Aspect Colour Light Signalling (MACLS)	5089	337	6.21
Track Circuiting – FM to FM	5230	133	2.48
Complete Track Circuiting in station section	6056	497	7.58
Integrated Power supply (IPS)	3951	885	18.30

From the above table audit it is seen that there were substantial shortfalls in achieving target of provision of modern signalling equipments vis. BPAC and Integrated Power Supply as on 31st March 2012.

3.5.3 Operation and maintenance

3.5.3.1 Preventive Maintenance

Corporate Safety Plan laid stress on preventive maintenance as opposed to corrective maintenance for preserving the longevity of the equipment to fulfill the functions for which it is designed. In the C&AG's Report quoted in para-2 ibid there were instances of non adherence/delay in adherence to the

maintenance schedule attributed to shortage of manpower. In their Action Taken Note, the Ministry had stated that the maintenance organization had been strengthened by issuing new norms for maintenance of new signalling assets. Audit observed that the shortage of staff for maintenance persisted at various levels during test check of compliance of maintenance schedules at selected stations for the year 2011-12 for various signalling equipment as prescribed in the Indian Railway Signal Engineering Manual Part-II (September 2001 edition).

Audit noticed shortfalls as below:-

- Out of 179 stations test checked, there was shortfall in adherence to maintenance schedules in 109 stations (61 per cent).
- There was shortfall in conducting maintenance schedules at all levels viz. Mechanical Signal Maintainer, Senior Section Engineer, Junior Engineer.
- There was shortfall in maintenance in 22 stations of 'A' category routes over seven Zonal Railways (CR-3, ECR-5, NCR-3, SR-1, SER-4, SECR-4 and WR-2).

The Zonal Railways attributed shortfall in the maintenance schedules to shortage of manpower.

3.6 Efficient utilization of training facility by S&T personnel

The CSP had recommended a broad-based strategy on human resource development which included imparting of training to various categories of staff for skill up-gradation. The Ministry, in their Action Taken Note to C&AG's Report No.26 of 2008-09 quoted in para-2 ibid had stated that the shortfalls in maintenance schedule primarily arose on account of shortage of trained manpower and intensive training was required for proper maintenance of the new technological signalling devices. Audit analyzed the data on training course conducted by the Indian Railway Institute for Signal Engineering and Telecommunication (IRISET) at Secunderabad and the ten Zonal Training Centers vis-à-vis slots actually utilized and observed the following:

- All training slots were utilized by NFR in respect of NGOs during the four years period of 2008-09 to 2011-12.
- In respect of other fifteen Zones[23], 13009 out of 48061 slots offered to the NGOs were not utilized during the four years period of 2008-09 to 2011-12. Thus only 73 per cent of the training slots were utilized as against the RB's instructions (1999) to ensure capacity utilization of more than 90 per cent.
- There was under utilization of slots in all the training centers, except in SCR and WR during 2009-10.

The under- utilization of training slots was attributed by Zonal Railways to:-

- Non-fulfillment of quota for training slots by Divisions (NER);
- Sickness, long absence and shortage of staff (SECR, WCR,WR);

[23] CR,ECoR,ECR,ER,NCR,NER,NR,NWR,SCR,SECR,SER,SR,SWR,WCR and WR

- Non-availability of full strength of instructors, dearth of vital modern training equipment and non-updating of the Training Centre's modules. (SER).

3.7 Accidents due to collision

CSP (2003-2013) envisaged that the Indian Railways should attain a Collision-free status by ensuring completion of all safety related works by upgrading

Accident involving Gyaneswary Express in 2010-11 (SER)

Collision accident in 2011-12 (SR)

signalling technology and equipment and efficiency in maintenance. Audit observed that as a result of the various safety works executed under SRSF, the average number of collisions per annum had come down from 22.5 during 1998-99 to 2001-02 to 8.25 during 2008-09 to 2011-12. However, during 2008-09 to 2011-12, out of 587 consequential accidents, 33 were due to collision. Analysis of the inquiry reports in 27 cases revealed that human error of judgment and non-observance of the rules was cited as the major cause.

It was thus evident that in order to realize a collision-free system, the Indian Railways would have to expedite completion of up-gradation of signalling technology that would significantly reduce human intervention, upgrade preventive maintenance and human resource skills.

3.8 Conclusion

The performance efficiency of signalling assets measured by existing norms provided an optimistic outlook in regard to signal incidences. However, the basic units and yardsticks for monitoring signal failure have not been revised for decades. They were not reliable in presenting a fair view of actual progress achieved in signal incidences. The Indian Railways need to revisit the basis of measurement of signal failures in view of the ongoing modernization of the signalling systems for ensuring effective performance monitoring, targeted implementation of the up-gradation of signalling assets and address manpower and training issues for ensuring better preventive maintenance and achieving a collision – free environment.