

Chapter 1 Assessment, Procurement and Utilization of Locomotives in Indian Railways

1.1 Introduction

Locomotives (locos) provide motive power for both passenger and freight train services. Timely availability of locos is critical to the operation of train services. As on 31 March 2018, Indian Railway had a fleet of 11,764 locos². Using this fleet of locos, Indian Railways runs 13,452 passenger and 9,141 goods trains daily over 68,442 Route Kilometres (RKM)³. The useful life⁴ of diesel and electric loco is 36 years and 35 years respectively.

Indian Railways has four loco production units (PUs), viz. Diesel Locomotive Works (DLW) at Varanasi, Chittaranjan Locomotive Works (CLW) at Chittaranjan, Diesel Modernisation Works (DMW) at Patiala and Electric Loco Assembly and Ancillary Unit (ELAAU) at Dankuni. DLW and DMW were diesel loco production units. However, DLW and DMW started manufacturing electric locos from 2016-17 and 2018-19 onwards respectively. Other two production units, CLW and ELAAU are manufacturing only electric locos. Two more PUs⁵ in PPP mode are supplying diesel and electric locos. Indian Railways are also procuring electric locos from Bharat Heavy Electricals Limited (BHEL).

Indian Railways spent ₹52,198.21 crore on production of locos during the past six years (2012-18) through its Production Units. Out of this, ₹ 44,254.92 crore (85 per cent) was met from Extra Budgetary Resources.

There are different types and versions of locos with reference to the kind of horsepower and utilisation for passenger and goods traffic in terms of capacity and other advantages. Prescribed periodical maintenances of locos are carried out in their designated workshops and loco sheds over Zonal Railways. There are six diesel loco workshops, six electrical loco workshops and 43 diesel loco sheds and 31 electric loco sheds over Indian Railways.

² Steam: 39 (26 MG & 13 NG); Diesel: 5,881 BG, 74 MG & 131 NG; Electric 5,639 BG

³ 63,558 RKM for BG; 3,200 RKM for MG and 1,684 RKM for NG

⁴ RB's letter no. 2002/ACII/1/10 dated 24.05.06 (RBA No. 25/2006)

⁵ One Diesel Loco Factory, (DLF) at Marhowra, Bihar and another Greenfield Electric Loco Factory (GELF) at Madhepura, Bihar

1.2 Organization Structure

At Railway Board level, Member Traction is responsible for loco procurement and Member Rolling Stock is responsible for loco maintenance. Production Units for production of locos are managed independently by General Managers reporting to the Railway Board.

At Zonal Railway level, the Principal Chief Electrical Engineer (PCEE) co-ordinates the assessment and procurement of locos required for the Zonal Railways and send indents to Railway Board. PCEE also looks after the maintenance of diesel and electric locos.

1.3 Audit Objectives

The Audit was undertaken with a view to assess:

- Whether assessment of requirement of locos over Zonal Railways was adequate;
- Whether acquisition of locos and allotment to Zonal Railways was commensurate with the assessed requirement;
- Whether the locos were utilized efficiently and optimally by Zonal Railways.

1.4 Audit Criteria

The following were the sources of Audit Criteria:

- (i) Indian Railway Code for the Mechanical Department (Workshop).
- (ii) Indian Railway Operating Manual.
- (iii) Indian Railway Maintenance Manuals of Diesel and Electric Locomotives.
- (iv) Instructions/ circulars issued by Railway Board/ Zonal Railway on assessment, procurement, utilization and maintenance of locos from time to time.
- (v) Annual Statistical Statements (ASS) of 2012-18.

1.5 Audit Scope, Methodology and Sample

Audit reviewed the assessment of requirement of locos, their procurement, and infrastructure for production of locos for 2012-19. Utilization of locos was reviewed for 2012-18. Maintenance of locos in workshops and loco sheds, and adequacy of infrastructure in loco sheds was reviewed for 2012-17. Uniformity in loco pilots sanctioned and their actual working among Zonal Railways as on 31 March 2017

was also reviewed. Records of Railway Board, Production Units, Zonal Railways in respect of assessment of requirement, production, procurement and utilization were examined. Records of 42 diesel and 30 electric loco sheds were examined for the adequacy of infrastructure therein. Audit also studied maintenance and utilization of locos in selected 32 Divisions, 6 diesel and 6 electric loco workshops and 16 diesel and 12 electric loco sheds. Details thereof are shown in **Annexure 1.1**.

Audit findings in this report are based on the observations noticed in all the production units, selected divisions, workshops and loco sheds. Similar deficiencies may be prevailing in other units of Indian Railways, which the Ministry of Railways may look into and take necessary measures.

Entry and Exit conferences were held in all Zonal Railways. Exit conference with Railway Board was held on 6 May 2019. Responses of Railway Board during exit conference and their reply to audit findings were included appropriately in the report.

1.6 Scope Limitation

Some of the Railway formations did not make available records/documents/information, as mentioned in the respective Annexure⁶. Audit observations have been framed assuming that they did not maintain records, though required to do so.

1.7 Acknowledgement

Audit acknowledges the co-operation extended by the Railway Board, Zonal Railways and Production Units during the conduct of this Audit.

Audit Findings

1.8 Assessment of requirement of locos and production planning

The assessment of requirement and planning for production of locos was centralised at Railway Board. Zonal Railways and Production Units were not involved in assessing the requirement. Railway Board prepared the production plan for a period of three year⁷ in advance. Various functional Directorates in Railway Board including Finance were involved in the assessment of requirement and production planning

⁶(i) New locos failed within 50 and 100 days of their commissioning by SECR & SER (Para 1.13); (ii) Detention of locos in exchange yard by ER, NWR & SR {Annexure 1.6 B (Para 1.17)}; (iii) Unscheduled repairs of Diesel Locos by CR, ECR, NR & NER {Annexure 1.7 A & B (Para 1.18 a)}; (iv) Loco failures within 180 days of POH by NWR & SR {Annexure 1.8 (Para 1.18 b)}.

⁷Indian Railway Code for the Mechanical Department (Workshops), 1991

process. The time taken for finalisation of production plan during 2012-19 at Railway Board was as follows:

Table 1.1 Details of locos initially proposed for production and locos approved for production, and delay in finalisation of production programme.

Year	Number of locos proposed initially		Number of locos approved for production programme		Date of finalisation of three year plan	Delay in months ⁸
	Diesel	Electric	Diesel	Electric		
2012-13	290	250	300	250	28.01.2011	00
2013-14	330	250	340	250	19.12.2014	24
2014-15	360	280	352	264	19.12.2014	12
2015-16	360	280	300	280	25.03.2015	03
2016-17	300	280	300	300	08.09.2016	08
2017-18	300	280	254	352*	27.01.2017	*Revised on 26.10.17
2018-19	350	375	107	1000*	25.10.2017	*Revised on 26.10.18

Audit observed that there were delays in finalization of plans for most of the years. The main reason for delay was absence of consensus regarding parameters/specific methodology amongst the various Directorates. Besides, lack of prescribed guidelines for assessing the requirement of locos has also added to the delays. Different Directorates adopted their own criteria, which were put forth on the basis of different data and parameters⁹. As such, the planning process was not a scientific and structured assessment. Railways did not make efforts to validate assumptions made by different members with actual empirical data collected from users of the locos (Zonal Railways).

Audit also noticed that production plan was not finalised in advance. As a result, Production Units continued production at their own pace during 2013-14, 2014-15 and 2016-17. It was seen that at the time of communication of finalised plan, significant/most part of the production was completed by the Production Units. Delayed production plan thus, could not realign production as per requirement.

Audit also noticed that Finance Directorate emphasized (March and June 2013) need to conduct a zero base review of requirement to arrive at a realistic projection on

⁸ Approved Production Programme should be issued by 15th December.

⁹ Growth of Traffic, Rake-Loco Ratio, Electrification of Routes etc.

rational basis. The same was to be supported by factual data linked to traffic requirements. No concerted efforts were taken by the Railway Board in this regard.

However, in planning the manufacturing of locomotives, Chairman Railway Board took a view (December 2014) on the issue. He opined that if enough locomotives were not produced, the staff in Production Units would have to be paid salary without any work and there would be industrial relations issues.

Thus, it was seen that locomotive requirement was decided not on the basis of actual requirement, but for utilising the production capacity. Further, the main criteria adopted by Railway Board for the assessment of requirement of locomotives and production planning were actual production of locomotives in previous years. Factors¹⁰, which should be an integral part of finalising locomotive requirements, were not wholly considered (**see Para 1.9**). More so, there is no structured methodology for assessing the requirement of locomotives based on specifically laid down parameters. This has led to more number of diesel locomotives in the system than required, as evident from the various efficiency indices of locomotive utilisation (**see Para 1.16**).

Railway Board decided to stop production of diesel locomotives in their manufacturing units from the year 2019-20 onwards. Review of the planning process showed that some of the parameters such as accelerated pace of railway electrification and requirement of right powering of passenger trains were considered for planning the production plan for the next three years. However, certain parameters such as traffic growth in the coming years, locomotive utilisation norms, rake-locomotive ratio as well as production by new units at Madhepura and Marhowra (diesel), (which was also flagged by Member (Traffic) while finalising the production plan for 2019-22) have not been taken into consideration.

It is, therefore, necessary that all factors are considered in the planning process for production of electric locomotives. There is a need to ensure that the deficiencies plaguing the planning process of diesel locomotives do not recur in planning process for electric locomotives in the coming years.

¹⁰ Expansion of infrastructural facilities, line capacity constraints (As per White Paper on IR, 2015, almost 40 *per cent* of the routes in IR are being operated beyond 100 *per cent* line capacity), pace of electrification, availability of manpower, ideal rake-locomotive ratio, actual growth of traffic etc.

1.9 Parameters for assessment of requirements

For assessment of requirement of locos, different parameters were considered. The various parameters required for assessment of requirement of locos are discussed below:

1.9.1 Projections made in XII Five Year Plan

While assessing the requirement of locos, Railway Board prioritised its loco production program with XII Five Year Plan (FYP) (2012-17) as benchmark. The assessed requirement for the period of 2012-17 was 400 per annum each for diesel and electric locos. This projection was based on the anticipated Gross Domestic Product (GDP) growth rate of nine *per cent*.

Audit observed that the actual growth rate in goods and passenger traffic was not factored into production plans of locomotives. It was seen that the projected growth rate was 10.8 *per cent* for passenger kilometres and 7.77 to 8.08 *per cent* for Million Tonne Load of freight. Against this, the actual growth rate was only 0.24 to 3.96 *per cent* for passenger kilometres and 0.36 to 4.37 *per cent* for freight load. Similarly, actual growth rate of NTKM over the previous year which was projected as 6.81 to 8.17 *per cent* was always less than 2.49 *per cent* and even negative in 2015-16 and 2016-17.

Thus, the actual growth rates were much lower than the projected rates and led to projection of requirement of locos higher than what was actually required. Details are shown in Annexure 1.2.

1.9.2 Loco Utilization Norms

Requirement of locomotives can also be assessed on the basis of Loco Utilisation Norms. For passenger traffic, loco requirement was assessed by dividing the total passenger engine kilometres by engine kilometre per day per passenger engine in use multiplied by number of days in the year. For goods traffic, loco requirement was assessed by dividing the NTKM (total goods traffic moved) by NTKM per goods engine per day in use multiplied by number of days in the year. Audit assessed the requirement of locos as per this norm and noticed that there was excess holding of locos during 2012-17 as shown in the Table 1.2.

Table 1.2 - Requirement of Locomotives on the basis of Locomotive Utilisation Norms in terms of NTKM per locomotive per day for goods and Engine KM per locomotive per day for passenger

Particulars	Diesel locomotives					Electric locomotives				
	2012-13	2013-14	2014-15	2015-16	2016-17	2012-13	2013-14	2014-15	2015-16	2016-17
Passenger Traffic										
Locomotive required for passenger traffic	1374	1492	1568	1590	1615	1048	1085	1113	1232	1235
Locomotive available for passenger traffic ¹¹	1840	1959	1974	2056	2039	1169	1242	1279	1329	1418
Excess passenger locomotive	466	467	406	466	424	121	157	166	97	183
Excess Passenger Locomotive	34%	31%	26%	29%	26%	12%	14%	15%	8%	15%
Goods Traffic										
Locomotive required for goods traffic	1720	1965	2063	2201	2090	2368	2650	3272	3292	2985
Locomotive available for goods traffic	1986	2128	2255	2431	2538	2824	2973	3127	3266	3326
Excess Goods locomotive	266	163	192	230	448	456	323	-145	-26	341
Excess Goods Locomotive	15%	8%	9%	10%	21%	19%	12%	-4%	-1%	11%

Thus, at the time of assessing the requirement of locomotives, above parameters, which provided the basis for actual requirement of locomotives, were not kept in view. This resulted in excess projection of requirement of locomotives especially diesel locomotives.

1.9.3 Rake-Locomotive ratio

Rake-locomotive ratio is the number of locomotives required per rake. In the General Managers' conference (April 2013), the Rake-locomotive ratio of 1:0.8 was quoted as ideal for passenger and goods rakes.

Audit assessed the requirement of locomotives on the basis of rake-locomotive ratio. Audit observed that the actual holding of locomotives, which was already in excess by 45 per cent in 2012-13, further increased by 12 per cent over the next five years to reach 57 per cent in 2017-18. Details are shown in **Annexure 1.3**.

As such, it can be concluded that the rake-locomotive ratio was not considered while assessing the requirement of locomotives and locomotives manufactured were more than the actual requirements.

¹¹ After deducting locomotives unavailable for operation i.e. ineffective

In the exit conference, Railway Board stated (May 2019) that ideal rake-loco ratio is a ballpark figure. The rake-loco ratio was changed with the advent of new high horse power (HHP) locos, implementation of right powering of freight trains to achieve higher mobility etc. Audit however, did not find any records of change in rake-loco ratio.

1.9.4 Electrification in Indian Railways

Audit observed that while assessing loco requirements for the period 2012-17, Railway Board did not properly review the increasing rate of electrification. Increase in the requirement of electric locos and the simultaneous reduction in utilisation of diesel locos was not adequately considered while assessing the loco requirements.

In the Mission Electrification and De-carbonization, Hon'ble Minister of Railways had given directives (September 2017) for 100 *per cent* Electrification in Indian Railways. Audit noted that Railway Board considered the increasing rate of electrification and increased the production target of electric locos in the middle of the year during 2017-18 and 2018-19. However, they continued to plan production of diesel locos including from Diesel Loco Factory (DLF), Marhowra. They did not revise the production plan of diesel locos in 2017-18 (manufactured 260 against the target of 254). Moreover, a production plan of 107 diesel locos was also made for 2018-19. Further, requirement of only electric locos in Dedicated Freight Corridors (which is targeted to be completed by 2021 and would be completely electrified), was not considered for arriving at requirements of diesel locos.

In reply, Railway Board stated (April 2019) that three years' plan was reviewed annually for making modifications because of modernization, technical changes, Zonal Railways requirements etc. Therefore, it was a long-term process and underwent many changes till finalization and it always remained dynamic with moderation and fluctuation. They also stated that assessment of requirement was done by a Committee of Additional Members/Executive Directors. The Committee duly considered many factors and submitted their recommendations to Railway Board, where they finally decided the production planning. It was admitted that in some years, actual production in previous years was the basis of production.

Audit, however, observed that Committees of Additional Members/Executive Directors of 2006-16 neither prescribed any criteria, nor could arrive at any

unanimous decision on the number of locos required. Further, outcome of various parameters, which affected the loco requirements as discussed above, was not contemplated while assessing the loco requirements.

Railways may evolve a suitable methodology for assessing the requirements of electric loco, wherein due consideration is given to all related parameters. Inputs of the user field offices at the planning stage should be ensured for realistic assessment of requirements. There is also a need to ensure that the deficiencies plaguing the planning process of diesel locos do not recur in planning process for electric locos in the coming years.

1.10 Actual production of locos

Audit compared the actual production vis-à-vis the targets set in the production programme of 2012-19 and observed the following:

Table 1.3 - Targeted and actual production & procurement of locos during 2012-19							
Year	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Diesel Locos							
Targets	300	340	352	300	300	254	107
Actual	293	331	330	319	316	260	102
Variation	-7	-9	-22	19	16	6	-5
Electric Locos							
Targets	250	250	264	280	300	352	1000
Actual	270	264	250	280	294	377	605
Variation	20	14	-14	0	-6	25	-395

After deciding to stop production of diesel locos from 2019-20, Railway Board enhanced the target of production of electric locos from 573 to 1,000 in the middle of the year (October 2018). Against this target, 605 electric locos were produced. During 2017-19, 86 diesel locos produced and supplied by DLF, Marhowra were also added to the fleet in addition to the 102 locos produced by Railways during 2018-19.

1.11 Infrastructure for loco procurement/ production in Indian Railways

Indian Railways has four loco production units, viz. DLW, CLW, DMW and ELAAU. The requirements of locos of Indian Railways are mainly met from these Production Units. Indian Railways also took measures to create new facilities for procurement of locos, as well as to augment the production capacity of the Production Units. These are discussed in succeeding paragraphs.

1.11 (i) New Greenfield Electric Loco Factory (GELF) at Madhepura

In the Works Programme of 2007-08, a project for setting up of GELF at Madhepura for annual manufacturing of 120 HHP (12,000 HP) electric locos was included for DFCs and pan India operations. Audit observed that the first loco was rolled out from GELF/ Madhepura as per timeline in February 2018. However, its validation trials by technical wings of Indian Railways were underway till 31 March 2019. As such, no electric loco could be inducted into service as of 31 March 2019.

1.11 (ii) Capacity augmentation of DLW for production of diesel locos

In November 2011, DLW submitted a proposal of ₹ 295.89 crore for augmentation of production capacity from 200 to 250 HHP locos. The work was scheduled to be completed by September 2017.

Meanwhile, in view of increasing electrification of routes, Railway Board took a decision (May 2016) to manufacture electric locos at DLW. During 2016-17, DLW manufactured two electric locos. The augmentation work for enhancing the production capacity of diesel loco from 200 to 250 locos was completed in February 2018 at a cost of ₹ 364.41 crore with cost overrun of 37 per cent.

Railway Board stated (April 2019) that capacity augmentation project also included commissioning of general utility equipment which can be used for all manufacturing activities including electric locos.

In view of increasing rate of electrification, Railway Board may take a view on how best to utilize the enhanced production facility of diesel locos. Simultaneously, Railway Board may also examine enhancement of capacity of manufacturing electric locos at DLW, due to the electrification programme.

1.11 (iii) Capacity augmentation of CLW for production of electric locos

A work for the augmentation of the production capacity of CLW from 200 to 275 HHP locos was sanctioned in 2011. The targeted date of completion was 31 December 2012. Audit noticed that as of March 2019, the physical and financial progress of this work was only 45 per cent and 33 per cent respectively. The work is now targeted to be completed by December 2019.

Further, to augment the resources of additional electric locos in future, Indian Railways planned (2009-10) to set up an ELAAU at Dankuni for production of 100 HHP locos. The cost of the project was estimated as ₹ 123 crore with targeted date

of completion as 31 March 2012. In May 2012, the work was transferred to Rail Vikas Nigam limited (RVNL). As of March 2019, the physical and financial progress of this work was 98 per cent and 105 per cent respectively. The work is also targeted to be completed by December 2019.

Thus, large amount of expenditure was incurred for capacity augmentation of DLW for production of diesel locos. The work of capacity augmentation of DLW was completed within five months from the targeted date of completion. However, works for augmentation of capacity of CLW and ELAAU for production of electric locos were running way behind schedule.

In the exit conference, Railway Board stated (May 2019) that augmentation of DLW would reduce vendor dependency for the maintenances of diesel locos in the loco sheds and the same may also be utilised in the production of electric locos at DLW. Railway Board further stated that the funds constraints were the impediment behind augmentation of electric locos capacity of CLW and production at ELAAU.

Railways have decided to stop production of diesel locos from 2019-20 onwards. Therefore, it is necessary that these works are completed at the earliest.

1.12 Allotment of locos to Zonal Railways and their commissioning

As per rules¹² Zonal Railways are required to submit requirement of new locomotives duly vetted by FA & CAO to Railway Board each year. A tentative loco allotment plan for electrical locos is prepared by Railway Board centrally and intimated to all GMs in December-January. Zonal Railways are also required to create infrastructural facilities along with creation of posts and deployment of staff in loco sheds for homing¹³ allotted locos. Audit noticed that the allotment plan for electric locos was being prepared by Railway Board without consulting the user Railways. Audit observed that the percentage of actual loco dispatch against proposed allotment was between 68 per cent and 133 per cent among Zonal Railways during 2012-16. As regards diesel locos, no annual tentative allotment plan was prepared. Only on the receipt of production details from PUs, Railway Board issued the allotment letters to PUs for dispatch to respective Zonal Railways.

¹² Para 1503 and 1526 of Indian Railway Code for Mechanical Department (Workshop)

¹³ Locos allotted to a particular shed is called "homing/owning of allotted loco in that loco shed".

After allotment, locos should be commissioned promptly after their receipt in loco sheds. Audit did not find any time frame fixed by Railway Board for commissioning of new locos. Audit reviewed the position of new locos commissioned for traffic use in the selected 16 diesel and 12 electric loco sheds during 2012-17. Audit observed that 18 per cent diesel locos and 13 per cent electric locos were commissioned after a delay of one month from the date of their receipt in the loco sheds. The average delays in commissioning of diesel and electric loco were 75 days and 33 days per loco after allowing a grace period of 30 days. Audit also observed that holding and maintaining locos much more than the homing capacity of loco sheds caused delay in maintenance of locos received in loco sheds **(as commented in Para 1.14)**. This factor also leads to the delay in commissioning of new locos. Moreover, shortage of man power, defective material, delay in Commissioner of Railway Safety (CRS) sanction and lack of adequate infrastructure in loco sheds further compounded the problem.

Thus, locos were allotted to Zonal Railways without assessing their requirements as well as infrastructure available. Further, newly allotted locos were commissioned after delays.

In reply, Railway Board stated (April 2019) that allotment was done based on the user Railways' requirement on receipt of requests from them and also considering the overall traffic requirements on monthly basis. Advance intimation for creation of infrastructure was communicated to Zonal Railways based on the production plan, which was again, based on the overall traffic requirements.

Audit, however, noticed huge mismatch between the planned allotments and the actual dispatch. In addition, delay in commissioning of new locos adversely impacted the efficient and optimum utilization of locos received at Zonal Railways.

1.13 Failure of newly commissioned locos

a) Within 50 days and 100 days of their commissioning

Position of failure of newly commissioned locos was examined in selected 15 diesel loco sheds (DLSs)¹⁴ and 10 electric loco sheds (ELSs)¹⁵. Data of new locos

¹⁴ Diesel Loco Shed – Kalyan/CR, Andal/ER, Samastipur/ECR; Visakhapatnam/ECOR; Lucknow/NR; Jhansi/NCR; Gonda/NER; New Guwahati/NFR; Abu Road/NWR; Erode/SR; Gooty/SCR; Kharagpur/SER; Krishnarajapuram/SWR; New Katni Jn./WCR and Sabarmati/WR,

¹⁵ Electric Loco Shed – Bhusawal/CR; Asansol/ER; Mugalsarai/ECR; Angul/ECOR; Ludhiana/NR; Kanpur/NR; Erode/SR; Vijayawada/SCR; Itarsi/WCR and Valsad/WR.

failed within 50 and 100 days of their commissioning was not provided by three loco sheds¹⁶. Audit observed that during 2012-17, overall 46 per cent locos failed within 100 days of their commissioning. Audit noticed that:

- Out of 696 newly commissioned diesel locos, 33 per cent (232 locos) failed within 50 days of their commissioning. Similarly, 14 per cent (94 locos) failed within 100 days of their commissioning.
- Out of 330 newly commissioned electric locos, 23 per cent (77 locos) and 21 per cent (68 locos) failed within 50 days and 100 days respectively of their commissioning.
- Uses of defective material in loco manufacturing, bad workmanship in handling etc. were the main causes of failure of newly commissioned locos.

b) Failure of locos within warranty period and time taken in arranging/repair/replacement of their parts

Audit examined the records of failure of locos within warranty period in the selected loco sheds. Audit noticed that during 2012-17

- 648 new diesel and 417 new electric locos failed on 1,315 and 459 occasions respectively within the warranty period.
- For these failures, 2,595 and 552 repair/replacement claims for diesel and electric locos respectively were lodged by the Zonal Railways with the Production Units.
- The repair/replacement claims of each failed part took an average of 37 days for diesel and 26 days for electric locos.
- No loco failed within warranty period in five loco sheds¹⁷.

Thus, Production Units could not monitor and ensure the quality of material supplied for manufacturing of locos by various firms. Failure of components/material adversely impacted the quality of in-house production of locos. Further, failure within warranty period resulted in additional expenditure and wastage of loco working days.

In reply, Railway Board accepted (April 2019) the audit comment and stated that large numbers of defaulting vendors were black listed on this account.

¹⁶ Raipur/DLS/SECR, TATA/ELS/SER (2012-15), and Bhilai/ELS/SECR (2012-17)

¹⁷ Asansol/ELS/ER, Angul/ELS/ECOR, Lucknow/DLS/NR, Kharagpur/DLS/SER & Itarsi/ELS/WCR.

Railways need to monitor the quality of material supplied for manufacturing of locos to avoid frequent failure. Also, Railways need to establish effective monitoring mechanism for early repair/replacement of failed locos.

Further, Audit recommends that high failure rate of newly commissioned locos should also be considered by Railways as a factor while assessing loco requirement.

1.14 Adequacy of Infrastructure in loco sheds

Homing¹⁸ capacity of a loco shed is its installed capacity to repair specified number of locos allotted to it during a financial year. Infrastructure facilities are designed accordingly. The holding of a loco shed is the actual number of locos assigned to a loco shed for attending to scheduled repairs. Ideally, the holding of locos should be equal to or not greater than the installed capacity. This minimises detention of locos and ensures the quality as well as timeliness of prescribed maintenance schedules of locos. Audit examined the homing capacities and actual holding of 42 diesel and 30 electric loco sheds over IR.

Audit observed that 33 out of 42 diesel loco sheds and 27 out of 30 electric loco sheds were holding and maintaining locos much more than their homing capacities. The overall gap between the homing capacities *vis-à-vis* actual holding was around 31 *per cent* in respect of diesel and 26 *per cent* in respect of electric loco sheds as on 31 March 2017. Details are given in **Annexure 1.4 A**.

To increase the homing capacity of loco sheds augmentation projects have been taken up in 12 DLSs¹⁹ and 27 ELSs²⁰ at various points of time since 2006-07. Analysis of the progress of augmentation in these loco sheds as on March 2019 showed that:

Of the 39 works in progress, the original target of completion of 26 works had already passed. While in six works the physical progress of work was more than 95 *per cent*, in 32 cases the physical progress ranged between six to 80 *per cent*. In one work, the physical progress is zero, though it was sanctioned in 2015-16 (Raipur/SECR).

¹⁸Locos allotted to a particular shed is called "homing/owning of allotted loco in that loco shed".

¹⁹ Pune/CR, Andal/ER, Vishakhapatnam/ECOR, Gonda/NER, Shakurbasti/NR, Maula Ali/SCR, Guntakal & Kazipet/SCR, Raipur/SECR, Erode/SR, Hubli/SWR, New Katni Jn/WCR and Sabarmati/WR,

²⁰ Ajni & Daund/CR, Angul/ECOR, Vishakhapatnam /ECOR, Howrah/ER, Jhansi & Kanpur/NCR, Gorakhpur/NER, Khanalampura, Ghaziabad & Ludhiana/NR, Guntakal, Kazipet, Lallaguda & Vijaywada/SCR, Bilaspur & Bhilai/SECR, Rourkela/SER, Erode & Royapuram/SR, New Katni Jn., Itarsi & Tuqlahabad/WCR, and Valsad & Vadodara/WR.

Audit further noticed that Hon'ble Minister of Railways directed (September 2017) to stop investment in new diesel locos maintenance infrastructure. As Indian Railways is targeting 100 *per cent* electrification by 2022, expenditure needs to be incurred judiciously so that the maintenance facilities are adequate for the existing diesel loco fleet as well as commensurate for the growing electric loco fleet. Details are shown in **Annexure 1.4 B**.

Holding and maintaining locos much more than the homing capacities of loco shed causes delay in maintenance of locos received in loco sheds. This also impacts the quality of maintenance which leads to unscheduled repairs as commented in Para 1.18 (a).

In reply, Railway Board stated (April 2019) that a decision has been taken for homing electric locos in existing diesel sheds. They also stated that in addition to the augmentation works, new loco shed is also being set up.

In view of reduction in fleet of diesel locos in coming years, the utilisation of diesel loco sheds would drastically reduce. As such, the decision to maintain electric loco sheds in the existing diesel loco sheds is appreciated. Railways need to upgrade the infrastructure of existing loco sheds without any delay to avoid the idling of existing loco sheds in coming years.

1.15 Availability of manpower for loco operations

Indian Railway Operating Manual (IROM) provided the detailed procedure for calculating the crew requirements. While assessing the requirement of locos, availability of manpower for running the locos is a significant factor to be considered. Audit examined the norms, status of sanctioned strengths (SS) and actual working (AW) of loco pilots as on 31 March 2017 in various Zonal Railways as detailed in **Annexure 1.5**. Audit observed that there were wide variations in the SS as well as in the AW requirements of loco pilots per diesel and per electric loco among the Zonal Railways. The same are discussed below:

- No norms have been fixed for number of loco pilots per loco.
- SS of loco pilots per diesel loco ranged between 2.23 (WCR) and 18.00 (NCR), and per electric loco it ranged between 2.23 (WCR) and 15.59 (NCR).

- AW of loco pilots per diesel loco ranged between 1.99 (WCR) and 13.36 (NCR), and per electric loco it ranged between 1.99 (WCR) to 10.81 (ECoR).

Member, Staff expressed (April 2016) his concern on the wide variation among the Zonal Railways and proposed formula to ensure uniformity in the SS. This concern has not been addressed so far.

There was no uniformity in loco pilots sanctioned and actual working requirements among Zonal Railways. No norms have been fixed for number of loco pilots per loco.

In reply, Railway Board stated (April 2019) that indents were pending with various Railway Recruitment Boards for Assistant Loco Pilots. Conversion courses were being conducted by Zonal Railways Training Centers to train diesel loco pilots to operate electric locos to overcome shortage. In the exit conference, Railway Board further stated (May 2019) that deployments of man power in locos were worked out on the basis of goods tonnage and passenger links. Common yardstick for man power was under consideration for both diesel and electric locos. Time taken in induction of new man power takes almost two years. Zero based review was under process for assessing the requirement of manpower for operation of locos. However, non-uniformity in SS of loco pilots among Zonal Railways were not addressed so far.

The number of loco pilots required should be a function of locos in hand and those planned to be added. Zonal Railways may ensure periodic review of the post of loco pilots as laid down in IROM for this purpose.

1.16 Efficiency indices for loco utilization

Efficient use of locos is a vital factor in maintaining the fluidity of movement of traffic for economical railway operations. To evaluate this, various indices are used in Indian Railways.

Diesel and electric loco holdings in Indian Railways increased by 20 *per cent* (947) and 24 *per cent* (1,123) respectively during 2012-18. Audit noticed that there is significant decline in the important indices over the past years, which are discussed in succeeding paragraphs.

1.16 (a) Engine Kilometers per day per engine 'in use' and 'on line'

Engine kilometres per day per engine 'in use' indicates average kilometres an engine in use, runs daily. Engine kilometres per day per engine 'on line'²¹ include²² engines in use, under or awaiting repair, good repair stored²³ and spares. Increased gap between these two indices would indicate the availability of more locos than the requirements. Audit observed that the gap between these two indices for diesel and electric locos was 86 and 58 in 2012-13. The same was 89 and 29 in 2017-18. Thus, increase in gap in diesel loco indicated availability of more locos than requirements.

1.16 (b) NTKM per goods engine per day 'on line' and 'in use'

NTKM²⁴ per goods engine per day 'on line', and 'in use' is the most comprehensive index for judging the productivity of locos in respect of freight traffic. During 2012-18, the NTKMs per goods engine per day 'on line' and 'in use' decreased by 11.6 per cent and 22.4 per cent for diesel locos. The same was decreased by 17 per cent and 27.2 per cent for electric locos.

The trends in the above efficiency indices indicated that even after adding 2070 new locos to the Indian Railways loco fleet during 2012-18 various efficiency indicators had deteriorated. This was mainly due to addition of new locos and under utilisation of existing locos. Thus, till the time efficient utilization of locos is ensured, railways would continue to manufacture more new locos than actually required.

In reply, Railway Board stated (April 2019) that main reason for low efficiency was under investment in rail infrastructure. Capacity utilization of golden quadrilateral was more than 100 per cent. These led to low average speed of the freight trains. Restrictions caused by track geometry, large number of surface crossings, speed

²¹ Engine Kilometres per day per engine on Line is compiled by services and for all services put together. The proportion that this figure bears to the corresponding figure of 'engine Kilometres per engine day per engine in use' indicates the proportion of available engines 'online' that was put to effective use during the period in question. (<http://trainguard.in/operating-statistics/>).

²² Para 2 to 5 of Instructions for compilation of different items of Statement 4-A of Manual of Statistical Instructions (Vol. I).

²³ Engines which although in good repair are not available for use owing to their parts having been greased or leaded, are kept under category Good Repair Stored (GRS) {Para 5 of Instructions for compilation of different items of Statement 4-A of Manual of Statistical Instructions (Vol. I)}.

²⁴ NTKM-Net Tonne Kilometre –Unit of measure of freight traffic which represent the transport of one tonne goods (including the weight of any packing but excluding the weight of the vehicle used for transport) over a distance of one kilometre.

differential between freight and coaching stocks also impacted the speed of freight trains.

However, the fact remains that Indian railways have more locomotives in their fleet than requirements and this leads to sub-optimal utilization of the locomotives, as reflected through various indices over the years.

1.17 Detention of locomotives in workshops and sheds

Detentions of locomotives at workshops and locomotive sheds before, during and after maintenance reduce the availability of locomotive for operations. Audit reviewed the detention of locomotives at workshops and locomotive sheds. The findings are discussed below:

1.17 (a) Detention at workshops during periodical overhauling (POH) beyond permissible time

The permissible time limits for POH are decided by the respective workshops on the basis of the infrastructure available in the workshop. Audit noted that permissible number of days for POH in various workshops ranged between 18 and 50 days. In the absence of uniform number of days for identical POH work, Audit inferred that a number of workshops did not have adequate infrastructure for POH of locomotives. Audit further reviewed the time taken for POH at the selected six diesel locomotive workshops (DLWS) and six electric locomotive workshops (ELWSs) during 2014-17 and observed that:

- POH of 82 *per cent* (814 out of 994) of diesel locomotives was done with delays. The average excess time taken was 17 days²⁵.
- POH of 65 *per cent* (703 out of 1,084) of electric locomotives was also done with delays. The average excess time taken was 20 days²⁶.
- Delays in POH were mainly on account of unavailability of material and heavy repairs.

Audit also noticed pre POH detentions²⁷ and post POH detentions²⁸ at the selected exchange yards. The average pre POH detentions per diesel and per electric locomotives were 5.3 and 2.8 days respectively in the selected workshops. Similarly, average

²⁵ Maximum of 27 days in Parel/CR and minimum of five days in Kharagpur/SER

²⁶ Maximum of 32 days in Bhusawal/CR and minimum of six days in Kharagpur/SER

²⁷ 44 *per cent* diesel locomotives (306 out of 702) and 14 *per cent* electric locomotives (69 out of 476) were detained for more than a day before their POH. Records for pre POH detention was not made available by Lucknow /ELWS/NR;

²⁸ 59 *per cent* diesel locomotives (344 out of 583) and five *per cent* electric locomotives (26 out of 476) were detained for more than a day before their POH. Records for post POH detention was not made available by Ajmer/DLWS/NWR.

post POH detentions per diesel and per electric locos were 7.7 and 4.3 days respectively. Details are shown in **Annexure 1.6 A and 1.6 B**.

Thus, there were significant detentions of locos at workshops before, during and after POH. This reduced the availability of locos for operational purposes. The delays were significantly more in respect of diesel locos. This also led to loss of earning capacity.

1.17 (b) Detention at loco sheds during loco maintenance

There are three²⁹ types of maintenance schedules for diesel locos (Alco-LHP and HHP)³⁰ in loco sheds. Time prescribed for these schedules are four days/16 days/21 days for Alco locos. Audit reviewed the time taken in maintenance of locos in loco sheds against the prescribed schedules. For HHP locos the median of number of days taken for maintenance in respective sheds has been adopted. Audit observed that during 2012-17, on an average an excess time of 17 days was taken for maintenance of 2,248 Alco locos in 15 diesel loco sheds³¹. Similarly, on an average excess time of 10 days was taken for maintenance of 619 HHP locos in 13 DLSS³².

For electric locos, two major maintenance schedules viz. Annual Overhauling (AOH) and Intermediate Overhauling (IOH) have been prescribed. The prescribed period³³ for maintenances is six days for AOH and nine days for IOH. Audit observed that during 2012-17 on an average the excess time of eight days each was taken for AOH of 3,484 locos and IOH of 1105 locos in 12 selected ELSs³⁴.

Audit reviewed the reasons behind excess time taken in maintenance schedules. This was due to shortage of man power, infrastructure and space, unplanned major repairs, defective material, constraints in supply of material etc. In addition, excess

²⁹ M12/M24/M48 maintenance schedules of Alco/LHP locos and M360/M720/M1080 maintenance schedules of HHP diesel locos

³⁰ Alco Diesel Locomotive is the Locomotive manufactured by the American Locomotive Company. Alco & LHP is the Low Horse Power Locomotive and HHP is the High Horse Power Locomotive.

³¹ Kalyan/CR, Andal/ER, Samastipur/ECR, Vishakapatnam/ECOR, Lucknow/NR, Jhansi/NCR, Gonda/NER, New Guwahati/NFR, Abu Road/NWR, Erode/SR, Gooty/SCR, Kharagpur/SER, Raipur/SECR, Krishnarajapuram/SWR, New KatniJn/WCR.

³² Kalyan/CR, Andal/ER, Vishakapatnam/ECOR, Lucknow/NR, Jhansi/NCR, Gonda/NER, Ajmer/NWR, Erode/SR, Gooty/SCR, Raipur/ SECR, Krishnarajapuram/SWR, New KatniJn/WCR, Sabarmati/WR.

³³ Chapter 23 of Operating Manual for Indian Railways.

³⁴ Bhusawal, Asansol, Mughalsarai, Angul, Ludhiana, Kanpur, Erode, Vijayawada, Tatanagar, Bhilai, Itarsi, Valsad.

holding of loco sheds against their homing capacities was also the reason for delay in maintenance of locos.

Thus, inadequate infrastructure and resources led to detention of locos at loco sheds during maintenance. This also impacted availability of locos for operation.

In reply, Railway Board accepted (April 2019) Audit contention. They stated that detention during POH was due to shortage of manpower, infrastructure and funds constraints. Regarding excess time taken in maintenance at loco sheds, Railway Board stated that an action plan was prepared by RDSO and DLW to improve the reliability and time taken for maintenance.

1.18 Quality of loco maintenance

Quality of loco maintenance/repairs in diesel and electric loco sheds was as under:

1.18 (a) Unscheduled repairs

In addition to the scheduled maintenance, unscheduled repairs/out of course repairs are undertaken when locos fail 'on line' or when a serious problem with their working is reported by the loco pilots. High incidences of the unscheduled repairs are reflection of the poor quality of maintenance. Audit reviewed the records of unscheduled repairs at the selected 16 DLSs and 12 ELSs loco sheds and noticed that unscheduled repairs of 17,530 diesel and 22,078 electric locos was undertaken during 2012-17. The diesel and electric locos were rendered ineffective for on an average 2.2 days and 1.8 days respectively. Reasons for unscheduled repairs were inadequate quality control, use of inferior material, poor supervision and inadequate internal control. Details are shown in **Annexure 1.7 A & 1.7 B.**

Unscheduled repairs added extra load on the already overstrained loco sheds.

In reply Railway Board stated (April 2019) that loco sheds and workshops were continuously being advised to take necessary corrective action by ensuring quality checks at all levels of maintenance schedules/production and with reliability action plan.

Railways should improve infrastructure facilities, quality of maintenance and good management practices in loco sheds to minimize unscheduled repairs in future.

1.18 (b) Failure of locos 180 days after POH

POH of locos is carried out in workshops nominated for this purpose. During POH, the loco is completely stripped and all its parts and components are repaired and/or replaced, as per required conditions. After POH, the locos are made to be in an 'almost new' condition. After POH and pre-commissioning, locos are also inspected to check the quality of work done. Audit reviewed the failure of locos within 180 days of its POH and noticed that

- In six DLWSs and six ELWSs, 37 *per cent* (641 out of 1715) diesel locos and 18 *per cent* (293 out of 1647) electric locos failed within 180 days of their POH.
- The percentage was more than 50 *per cent* for diesel locos POHed in ER, NWR and SER.

Defective material, defective equipment, poor inspection etc. were the main reasons for loco failures within 180 days of their POH as cited by the Zonal Railways. Details are indicated in **Annexure 1.8**.

In reply, Railway Board stated (April 2019) that procedures for pre and post POH checking was laid down in loco maintenance manuals. Instructions in this regard were reiterated to Zonal Railways from time to time. Failure on line was also monitored at highest level in Railway Board. However, the fact remained that every third diesel and every sixth electric loco failed within 180 days of their POH during 2012-17 on account of defective material, defective equipment, poor inspection etc.

Audit further observed that out of total 10,391 diesel and 6,190 electric locos failures during the review period, 5,363 and 2,800 failures (52 and 45 *per cent*) were after their scheduled maintenance by loco sheds. More than 60 *per cent* failures were in 10 loco sheds³⁵. These were on account of defective material. High value items such as crankshafts, engine blocks, power assembly, traction motors, alternators, under gears, transformers and turbo super chargers etc. also failed within warranty period during 2012-17. The number of failure of high value items of diesel and electric locos

³⁵ Andal/DLS/ER (68%), Asansol/ELS/ER (95%), Mugalsarai/ELS/ECR (70%), Angul/ELS/ECOR (82%), New Guwahati/DLS/NFR, Erode/DLS/SR (68%), TATA/ELS/SER (64%), Raipur/DLS/SECR (64%), Bhilai/ELS/SECR (61%), Sabarmati/DLS/WR (65%)

within warranty period increased by 62 per cent and 58 per cent respectively in 2016-17 as compared to 2012-13. This also indicated poor material management.

Railways should analyse reasons for failure within 180 days of POH of locos and take remedial actions to minimise the same. Railways need to revisit the monitoring system in vogue and improve internal control in their material management and inspection system. The aim should be to minimize loco failures on account of defective material.

1.19 Conclusion

Timely availability of locos is critical to the operation of train services. Indian Railways spent ₹ 52,198.21 crore on production of locos during the past six years (2012-18) through its Production Units.

Review of the planning process for assessing loco requirement revealed that it was not decided on the basis of actual need, but mainly aimed at utilising the production capacity. The main criteria adopted by Railway Board for the assessment of requirement of locos and production planning were actual production of locos in previous years. Factors like expansion of infrastructural facilities, line capacity constraints, pace of electrification, ideal rake-loco ratio and actual growth of traffic were not comprehensively considered. The production plan had been skewed towards production of diesel locos over the past years, as a result of which, the number of diesel locos have grown much more than electric locos. From 2019-20 onwards, Railway Board has decided to stop production of diesel locos. However, Railway Board need to ensure that the planning for production of electric locos is done taking into consideration parameters such as traffic growth in the coming years, loco utilisation norms, rake-loco ratio as well as production by new units at Madhepura and Marhowra (diesel). For this, they need to work out a scientific methodology giving due cognizance to relevant parameters.

Railway Board has decided (September 2017) to go for 100 per cent electrification of Railways by 2022. However, Indian Railways continued to manufacture diesel locos from its PUs till 2018-19. Moreover, a large amount of expenditure was incurred for capacity augmentation of DLW for production of diesel locos. However, works for augmentation of capacity of CLW and ELAAU for production of electric locos were

running way behind schedule. This is not in sync with the overall strategic vision of Indian Railways.

Locos were allotted to Zonal Railways without assessing their requirements as well as infrastructure available with them for maintenance. New allotted locos were commissioned after delays. Audit noticed failures of locos within warranty period after their receipt in Zonal Railways. This resulted in additional expenditure on their repairs and also wastage of loco working days.

There was no uniformity in loco pilots sanctioned and actual working requirements among Zonal Railways. No norms were fixed for number of loco pilots per loco. The issue was raised way back in April 2016 by Member Staff, but was yet to be addressed.

Holding of locos were noted to be more than their homing capacities in the loco sheds checked in Audit. This caused delay in maintenance of locos received in the loco sheds. This also impacted the quality of maintenance which led to unscheduled repairs. Audit noticed that augmentation works of diesel as well as electric loco sheds were going on since 2006-07 and 2008-09 respectively. Indian Railways is targeting 100 *per cent* electrification by 2022. As such, the expenditure needs to be incurred judiciously, so that the maintenance facilities would be adequate for the existing diesel loco fleet. This should also be commensurate for the growing electric loco fleet.

Inadequate infrastructure at the loco sheds/workshops caused detention to the locos at various stages of maintenance such as regular maintenance, Annual, Intermediate and Periodical Overhauling (AOH, IOH & POH) etc.

1.20 Recommendations

- 1. Railways may evolve a suitable methodology for assessing the electric loco requirements, with due considerations to the end user requirements.***
- 2. Railways need to examine the referred augmentation works in the electric loco sheds to avoid the delays/ detention in maintenance of locos.***

3. *Railways need to revisit upgradation of the infrastructure of existing diesel loco sheds judiciously taking into account the ongoing growth of electric loco fleet.*
4. *Railways should improve infrastructure facilities, quality of maintenance and promote good management practices in loco sheds to minimize unscheduled repairs in future.*