Chapter 3
Traction

Member Traction at Railway Board is overall in charge of the Electrical department of Indian Railway. He is also responsible for Railway Electrification Workshops (exclusively for locomotives) and Energy/Fuel Management.

At Zonal level, Chief Electrical Engineer (CEE) is responsible for operation and maintenance of Electric Locos, Electric Multiple Unit train (EMU), Mainline Electric Multiple Unit train (MEMU), maintenance and operation of Overhead Electrical Equipment (OHE), electrical coaching stock etc. Maintenance of Diesel locomotives is supervised by Chief Motive Power (Diesel). Production Units (CLW and DLW) are managed independently by General Managers reporting to Member Traction at Railway Board.

The total expenditure of the Electrical department including manufacturing units of locomotives (CLW and DLW) during the year 2015-16 was ₹ 27593.01 crore. During the year, apart from regular audit of vouchers and tenders, 412 offices of Electrical department including CLW and DLW were inspected by Audit.

This chapter includes two long paragraphs. One relates to Diesel Locomotive Works, wherein Audit assessed the system of indigenization of suppliers for locomotive components and vendor development consequent to Transfer of Technology from a foreign firm. The second long paragraph is related to 'Energy conservation measures in Indian Railways' where Audit reviewed the steps taken by Indian Railways for energy conservation, both for diesel and electric energy.

In addition, this chapter also includes two individual paragraphs highlighting issues such as extra expenditure in import of crankcases, a locomotive component; and extra expenditure due to change of traction from electric to diesel locomotive and *vice versa*.

3.1 Diesel Locomotive Works (DLW) : Indigenization of suppliers for locomotive components and vendor development consequent to Transfer of Technology from foreign firm

3.1.1 Introduction

Diesel Locomotive Works (DLW) at Varanasi was established in 1961 in collaboration with M/s Alco, USA for manufacturing of locos (2600 Horse Power). The first locomotive was dedicated to nation on 3 January 1964. In order to upgrade technology and capacity in terms of High Horse Power (HHP), Indian Railways entered into a contract with M/s General Motors, now renamed as M/s Electro Motive Diesel (EMD) of United States of America (USA), in 1995 for Transfer of Technology (TOT) for manufacturing of 4000 HP diesel electric locomotives at DLW, along with the continuation of production of Alco locomotives. The first indigenous good and passenger version of HHP loco was manufactured at DLW in 2001 and 2003 respectively. DLW is managed by the General Managers under the overall supervision and control of the Railway Board. The General Manager (GM) is assisted by Principal Heads of the Departments (PHODs).

DLW manufactured a total 1783 HHP locos of various types till 31 March 2016. Average production cost of one locomotive of HHP is ₹ 13.80 crore and the material constitutes 88 *per cent* of the cost of locomotive.

Table 3.1 – Loco produced during the past five years at DLW, Varanasi

Year	ALCO Loco	HHP Loco	Total
2011-12	69	190	259
2012-13	63	231	294
2013-14	38	266	304
2014-15	17	249	266
2015-16	13	317	330
Total	**200**	**1253**	**1453**

Audit examined the progress as regard to TOT and status of indigenization, and vendor development mechanism at DLW during the period 2011-12 to 2015-16. The study has been undertaken with an objective to assess

- Whether TOT obtained from M/s EMD (USA) resulted into reduction of imports and the facilities created after the TOT were utilized for indigenization of loco components.
- Whether adequate vendor base was developed to have multi-sourcing of supplies to ensure competitive prices for procurement of materials.

Audit findings

3.1.2 Continuing imports despite purchase of Transfer of Technology for indigenization

Railway Board entered into an agreement (October 1995) with General Motors, now known as M/s EMD (USA), for TOT relating to 4000 HP, 1676 mm gauge,

GT46CW Model locomotive and family of Diesel Engines[113] on payment of US$ 1.75 crore (in four installments) extending over a period of ten years (1996-2006). The agreement *inter alia* provided for:

- Complete transfer of technology to manufacture 4000 HP locomotives.
- Complete drawings and details for 5000 plus HP locomotives

The payment schedule for obtaining TOT was decided in four installments viz.

(i) First 30 *per cent* of total TOT fee was to be paid on receipt of engineering/ manufacturing drawings and project reports,

(ii) Next 30 *per cent* was to be paid after successful indigenization of 50 *per cent* of the manufacturing cost of locomotive or after a period of five years whichever is earlier,

(iii) Next 25 *per cent* of the amount was to be paid after 75 *per cent* of indigenization of loco, and

(iv) Last 15 *per cent* was to be made after 95 *per cent* of indigenization.

Audit noticed that payment of three installments had been made till August 2003 i.e. after expiry of 7.5 years of the contract period. Last installment of 15 *per cent* was not paid due to non-achievement of 95 *per cent* indigenization level. At the end of TOT contract (February 2006) DLW claimed to have achieved 70 *per cent* indigenization. Audit, however, observed that the status of imports had not changed since then (i.e. after further expiry of 10 years) as can be seen from the following table:

Table 3.2 – Share of purchases through imports for last five years (₹ *in crore*)

Year	Total Purchase	Indigenous	Imported	Percentage of Import
2011-12	2612	1827	785	30.05
2012-13	3071	1642	1429	46.53
2013-14	4222	2563	1659	39.29
2014-15	3500	2560	940	26.86
2015-16	4222	2826	1396	33.06
Overall Average			**1250**	**35.16**

It is seen that import percentage as of March 2016 is 33 *per cent,* which indicates that there is no significant improvement in indigenization after February 2006.

Further, Audit review of the Category 'A' items (which constituted 70.22 *per cent* value of total material consumption in the year 2014-15) revealed that out of 31 such items, 15 items were still being imported even after 10 years of expiry

[113] Family of 710 diesel engines means 12, 16 and 20 (locomotive application) only cylinder GM diesel engines.

of TOT agreement in 2006. Six[114] of these items were imported fully and nine items[115] partly.

Thus, despite TOT, DLW was yet to attain the envisaged level of indigenization. It continued imports of one-third of its requirement, (average import of last five years 35.16 *per cent*), by payment of foreign exchange of about ₹ 1250 crore per annum. Further, most of the imports (almost 91.73 *per cent* - ₹ 4329 crore) were made from the single supplier M/s EMD (USA) from whom the technology was transferred. Adequate vendor base for indigenization was also not developed as discussed in Para 3.1.5.

In reply, DLW stated (September 2016) that indigenization was being pursued by design office of Chief Design Engineer (DLW) and a Committee had been constituted in June 2015 to identify items for vendor development for indigenization and multi-sourcing of HHP items in a phased manner.

3.1.3 Non-utilization of facility created for in-house production consequent to Transfer of Technology

Consequent to TOT of HHP Locomotive from M/s EMD (USA) involving payment of US$ 1.75 crore during 1996 to 2006, creation of facilities at DLW were sanctioned in phases for in-house production of components of HHP Locos as given below:

Phase I: ₹ 43.27 crore was sanctioned during 1997-1998

Phase II: ₹ 155.54 crore was sanctioned during 1998-1999

Phase I included seven projects which were completed (November 2006). Phase II included nine projects. The project envisaged purchase of Machinery and Plant (M&P) for production of the Crankcase fabrication and machining, Cylinder Head & Liner Machining & Assembly, Turbo Machining and Assembling, Connecting Rod Machining, Piston Pin and Camshaft, Engine Power Pack and Engine & Turbo Test Sales. DLW Administration stated (July 2016) that all the projects were completed except connecting Rod Machining. Audit observed that total four projects/facilities (out of which three were stated to be completed) were either not performing or under-performing.

Audit further noticed that no time schedule had been laid down either by Railway Board or by DLW for completion of these remaining projects. Audit undertook a detailed analysis of these four projects. The results of findings in respect of four such cases are discussed in subsequent paragraphs.

[114] Crankshaft, cylinder head stud assembly, cylinder power assembly fork, cylinder power assembly blade, Ecotip super stack injector, AC-AC traction system

[115] Turbo wheel impeller balance assembly, turbo inlet scroll assembly, turbo dwelling assembly, machined pistoned, cylinder liner stud, fully machined crankcase, traction alternator, 3 phase induction traction motor, supply of AC-AC traction system.

3.1.3.1 Connecting Rod Machining: Unfruitful investments of ₹ 16.63 crore and loss of envisaged savings of ₹ 75.18 crore

Phase II Project *inter alia* provided for setting up of facilities for machining of Connecting Rod fork and blade at an estimated cost of ₹ 14.37 crore in year 1998-99.The expected savings of this project was ₹ 6 lakh per loco[116]. Procurement of relevant machines had been going on since October 2003. The implementation of this project was not completed as of July 2016 as the machines[117] procured at the total cost of ₹ 16.63 crore, were not put to use.

Audit further noticed that one of the machines (CNC-HMC) for which purchase order was placed in 2013 could not be procured till date. The procurement of the machine is expected to be completed in October 2017. In reply to Audit query, DLW agreed (June 2016) that production of HHP Connecting Rod could not be started due to non-availability of CNC-HMC machine and same was expected to be commissioned by October 2017.

Thus, the whole project, despite expenditure of ₹16.63 crore and under implementation since 2003, had remained non-operational over the years. Due to non-completion of the project, DLW had to procure loco components (connecting rod blade and connecting rod fork) from outside sources (indigenous as well as foreign suppliers). In respect of 1253 HHP locos manufactured during 2011-12 to 2015-16, the expected savings of ₹ 6 lakh per loco (₹ 75.18 crore for 1253 locos) could not be derived. The machinery procured over the years is also liable to become obsolete and usability might have been impaired as 10-12 years have already passed since its commissioning and lying idle.

3.1.3.2 Cylinder Head, Liner Machining and Assembly: Unfruitful expenditure ₹21.81 crore and loss of expected savings of ₹ 125.30 crore

Phase II Project *inter alia* provided for setting up facilities for in-house manufacturing of Laser Hardened Cylinder Liner Stud Assembly at a total cost of ₹ 13.22 crore. The saving expected was ₹ 10 lakh per loco. Eleven machines[118] for this project were procured and installed between 2004 and 2014 at a total cost of ₹ 21.57 crore.

Audit observed that a Laser Hardening Machine (Surface Hardener) procured in March 2004 at a cost of ₹ 6.19 crore from M/s Sunag Engineering Corporation, USA was commissioned in December 2006 after a delay of two and half years. The machine went into breakdown in December 2011 due to its defective electrodes and capacitors. During the period December 2006 to December 2011, the machine was intensively being utilized for surface hardening operation on cylinder liner of locos. The retro-fitment was sanctioned only in February 2015

[116] calculated in the year 1998-99
[117] Ultrasonic Washer, Buffing Machine, Dot matrix stamper, Wheel blast, Internal Grinder, Creep Feed Grinder, Induction hardening
[118] Laser hardening, bead blast, liner washer, liner leak tester, CNC-VTL, profile check gauge, HMC, Paint booth, Honing machine, radial drill, EOT crane.

after delay of more than three years. The retro-fitted machine was received in January 2016 which was yet to be commissioned. Due to breakdown and delay in retro-fitment of the machine, raw material worth ₹ 2.17 crore purchased in 2008-10 for manufacturing of Cylinder Liner Stud Assembly had been lying in stock unutilized. Further, Honing machine received in July 2014 at a cost of ₹ 4.13 crore was also not yet commissioned.

In reply, DLW accepted (July 2016) that during the last five years, Cylinder Liner Stud Assembly had never been manufactured and requirement was met from imports only from M/s EMD (USA).

Thus, the entire expenditure of ₹ 21.81 crore incurred on creation of facilities for in-house production of Laser Hardened Cylinder Liner Stud Assembly remained unutilized. Further, the expected savings of ₹ 10 lakh per Loco estimated in the year 1998-99 could not be achieved. In respect of 1253 HHP locos manufactured during 2011-12 to 2015-16, the expected savings of precious foreign exchange worth ₹ 125.30 crore could not be derived.

3.1.3.3 Piston Pin and Camshaft: Unfruitful expenditure ₹ 18.47 crore and loss of expected savings of ₹ 313.25 crore

Phase II Project *inter alia* provided for an amount of ₹ 17.27 crore for setting up of facilities for in-house manufacturing of Piston, Pin and Camshaft. The expected saving of this project was ₹ 25 lakh per loco. Six machines[119] were purchased and commissioned between April 2003 and December 2013 at a total cost of ₹ 12.66 crore.

Audit observed that in addition to above machines, DLW separately procured (under M&P programme 2008-09), a CNC Cam Grinding machine at a cost of ₹ 5.81 crore from M/s Morara, Italy for in-house manufacturing of above items. The machine was commissioned in February 2011. However, the machine remained in breakdown condition since March 2011.

Despite creation of facilities at a total cost of ₹ 18.47 crore (₹ 12.66 crore + ₹ 5.81 crore) for in-house manufacturing of Piston, Pin and camshaft, it was observed that 17081 Piston Pin at a total cost of ₹ 32.28 crore were imported during 2011-12 to 2013-14 from M/s EMD (USA). Further, 8817 Piston Pin at a total cost of ₹ 10.91 crore were purchased from indigenous sources during 2012-13 to 2015-16 due to non-functioning of CNC Cam Grinding machine commissioned in February 2011. Similarly, 3465 Camshafts were purchased from indigenous sources during last five years at a total cost of ₹ 57.82 crore. DLW could produce in-house only 137 Piston Pin and 7 numbers of Camshafts during 2014-15 and 2015-16.

[119] CNC chucker milling machine, CNC cam milling machine, CNC horizontal machining centre, turning centre, drilling machine, cam milling machine

In respect of 1253 HHP locos manufactured during 2011-12 to 2015-16, the expected savings of ₹ 25 lakh per loco (₹ 313.25 crore for 1253 locos) could not be achieved.

3.1.3.4 Shortfall of in-house production of Crankcase: Wasteful expenditure ₹ 45 crore and loss of expected savings of ₹ 290 crore

Phase II Project, *inter-alia*, provided (November 2010) for procurement of Machinery and Plant for Crankcase fabrication and machining at a total cost of ₹ 18.72 crore and ₹ 35.21 crore respectively. The savings of ₹ 50 lakh per loco on account of in-house fabrication and machining of Crankcase was expected to be achieved. For machining of crankcase, one portal milling machine received in September 2004 was commissioned in June 2005, but it was handed over to Workshop for regular production only in November 2008, after delay of three years.

Further, for setting up facilities for production of 200 Locomotives, Railway Board sanctioned (2008-09) an amount of ₹ 78.46 crore. Two portal machines were required for the machining of 200 Crankcases per year. As such, the second machine was sanctioned (estimated cost ₹ 33.02 crore) along with the provision for construction of a New Block Shop (cost of ₹ 13.96 crore) to accommodate new portal milling machine.

Audit observed that against the indent (May 2008) of DLW, Central Organisation for Modernisation of Workshop (COFMOW) awarded (June 2010) the contract for procurement of the machine to M/s Cincinnati Machining, USA through an Indian agent M/s MAG India Ltd., Bangalore with scheduled delivery time as May 2011. On receipt of the foundation drawings submitted by the firm, DLW realised that sufficient space was not available in New Block Shop and therefore cancelled the order in September 2012.

This implies that new Block Shop was constructed to accommodate new portal machine disregarding the dimensions of the portal machines and also without waiting for foundation drawings of the machine.

While portal milling machine against the indent of May 2008, was under procurement, DLW obtained a separate sanction under M&P works programme 2010-11 for ₹ 45 crore for purchase of third portal milling machine. On the indent (April 2010), COFMOW procured the machine from the same contractor (M/s Toskurim, Czech Republic) in August 2014 and the machine was commissioned in November 2015.

COFMOW concluded (September 2013) another contract with M/s Toskurim, Czech Republic through their Indian agent M/s Swastik Overseas, New Delhi for procurement of the milling machine, which was received in May 2015, but yet to be commissioned.

During 2011-12 to 2015-16, DLW fabricated 673 crankcases of which only 556 crankcases could be machined at DLW. Machining of the remaining crankcases

was outsourced. Further, to meet their overall requirement, DLW procured 580 machined crankcases from M/s EMD (USA) for their remaining (1253-673[120]) requirement.

Thus, outsourced procurement of 580 crankcases resulted into loss of envisaged savings of ₹ 290 crore @ ₹ 50 lakh per Crankcase.

Thus, it could be seen from above instances that indigenization project envisaged in the year 1998-99 after procurement of TOT worth US $1.75 crore and commenced in the year 2003, is not yet complete even after lapse of 13-14 years and there is hardly any reduction in dependence on outsourcing in general and on imports in particular. The envisaged savings of ₹ 803.73 crore by DLW through these indigenization projects were not achieved.

3.1.4 Wasteful expenditure in production of 5500 HP locos: ₹ 54.51 crore

Transfer of Technology contract concluded with M/s EMD (USA) in 1995 also included provision of complete drawings and details for 5000 plus HP locomotives. On the basis of TOT received, Rolling Stock Programme (RSP) for 2009-10 had provided for manufacturing of 30, 5500 HP locomotives at a total anticipated cost of ₹ 420 crore. Keeping in view the advantages of improved fuel efficiency and emission control with higher balancing speeds as envisaged in the designing of 5500 version designed by DLW and RDSO jointly in consultation with M/s EMD (USA), Railway Board directed (October 2010) to procure materials for 10 prototype 5500 HP locomotives.

Audit observed that for manufacturing of 10 locos, DLW procured material worth ₹ 173.04 crore including imported material worth ₹ 63.76 crore. DLW manufactured the first prototype of the loco during 2011-12 at a total cost of ₹ 17.29 crore and dispatched (January 2013) to Sabarmati diesel-shed of Western Railway. The loco was commissioned in February 2015 after two years due to delay in clearance by Commissioner of Railway Safety. During the operation, multiple problems were reported (April 2015). The second loco manufactured by DLW at a cost of ₹ 18.62 crore during 2014-15 was also dispatched to Sabarmati Diesel Shed which was commissioned in July 2015. This loco also showed multiple problems such as Electrical/Mechanical maintenance and design during the operation.

While analyzing the loco problems, Railway Board found (September 2015) that the height of locomotives was beyond Indian Railway Schedule of Dimensions (IRSOD) and convened DLW and RDSO to sort out the problem. While problems in first and second Locos were under study, DLW manufactured three more locos and dispatched to Gooty Diesel Shed of South Central Railways.

Thus, without assessing the performance of two prototype locos and without fine-tuning the design, DLW continued to manufacture these locomotives disregarding the multiple problems faced in first and second loco observed in

[120] Crankcases fabricated in-house

the diesel-sheds. This resulted in wasteful expenditure of ₹ 54.51 crore (average manufacturing cost of ₹ 18.17 crore) in manufacturing of three locomotives, for which DLW should have waited until the results of the prototype were known and design fine-tuned accordingly. Further, material worth ₹ 55.12 crore purchased during 2011-12 is also lying in stock as of date.

In reply, DLW stated (August 2016) that on advice of Railway Board in May 2014, production of 5500 HHP locomotives were continued. It was further stated that decision taken in September 2015, did not speak to put on hold the further production which was started in November and December 2014. Reply of DLW reflects complete lack of sense of commitment towards their own responsibilities. If Railway Board did not ask them to put on hold further production, they should have requested Railway Board to let them put on hold further production until the appropriateness and efficacy of new design was proved.

3.1.5 Non-development of new vendors

As per bid conditions for procurement contracts, the purchases of items is to be made from RDSO or DLW approved sources. Further, as per Railway Board instructions (September 1999), Vendor Development Cell at DLW was required to lay down norms for development, inspect firms for their approval, review the vendors based on quality and performance of material supplied, upgrade vendors from Part II to Part I or from development to regular status and *vice versa*. At DLW, Chief Designing Engineer (CDE) is responsible for development of vendors for supply of various items of HHP locomotives.

It was observed that CDE, DLW had not laid down any norms/ procedure for vendor development. There was no register / list of receipt of applications, assessment and registration of vendors for their development. In reply to Audit query, CDE admitted (February 2016) that there was no written procedure for assessment and development of new vendors. They however, informed that online registration was now running with effect from May 2015. The list of Vendor Assessment Forms received, assessed and registered were called for by Audit. These were however, not made available to Audit by the CDE. CDE also did not provide details of new vendors added to Vendor List in the last five years. The status of vendor base (approved sources) in respect of DLW controlled items (2110 items), as provided by DLW as on 31.3.2016 was as under:

Table 3.3 - Number of indigenous approved sources

Divisions	Total Items	'Nil'	Single	Two	≥ 3
1. Electrical Machine	141	9	69	24	39
2. Engine	982	351	273	212	146
3. Traction Control	83	25	18	18	22
4. Vehicle	904	22	43	51	788
Grand Total	**2110**	**407 (19%)**	**403 (19%)**	**305 (14%)**	**995 (47%)**

Analysis of the above data showed that

- About 19 *per cent* of the total items had no indigenous sources and for their procurement, DLW was fully dependent on imports.
- For about one third of the total items, there were monopolized sources of supply as single or two sources in totality.
- For about only less than 50 *per cent* items the number of vendors was three or more.

Test check of 48 high value items (Category A and B) over five years of RDSO/DLW controlled items in Vendor Directory revealed that

- Out of 39 items having single Part I source in 2011-12, for 17 items (44 *per cent*) DLW continued to have a single source in 2015-16; for 18 items there was one Part I source, for two items two Part I sources and for the remaining two items three Part I sources only were added during 2015-16.
- Of the nine items having two Part I sources in 2011-12, five items (55 *per cent*) continued to have two Part I sources and for remaining four items one Part I source for each item was added during 2015-16.

Thus, DLW made only minor additions in the list of existing vendor base, which resulted in weak implementation of the development of multi-sourcing policy of the Indian Railways.

Also, non-development of new vendors led to continued dependence upon the foreign supplier leading to expenditure in foreign currency and resulted in monopolization in certain items. Audit also noticed cases of procurements, where DLW's failure to develop new vendors, led to dependence on foreign supplier or single supplier. Audit findings on these cases are discussed in subsequent paragraphs.

3.1.5.1 Rejection of tenders pending suitability assessment

While reviewing the tender cases of procurement for last five years, Audit noticed two instances where the tenders from new suppliers were rejected on the ground of suitability assessment pending/ to be decided later, though there was sufficient time available for completion of suitability assessment as the time taken between tender opening and its finalization was about three months or more. In these cases, the benefit of cheaper competitive price was not availed by DLW, due to non-completion of suitability assessment as discussed below:

- In response to tender floated for Cylinder Head Stud Assembly, six tenders were received on 4 July 2011. DLW rejected (30.09.2011) all the lower priced offers on the plea of pending suitability confirmation from RDSO and awarded the purchase order to M/s EMD (USA) at the highest tendered rate of ₹ 54151 per item in October 2011, for purchase of 2366 numbers at a total cost of ₹ 12.81 crore. The tenders received in July 2011 were actually accepted in October 2011 and during these three months DLW could have

obtained suitability of lower priced tenders from RDSO, instead of rejecting the same.

- In response to tender floated for purchase of Cylinder Head Stud Assembly, seven tenders were received on 3 June 2013. Offer of L1 to L5 ranging from ₹ 42,994 to ₹ 60,223 were rejected (22.07.2013) on the ground that the suitability for placing order to be given/decided later on. Offer of L6 M/s GE India Pvt. Ltd at ₹ 69936 was considered for extended trial order for 592 Cylinder Head Stud Assembly. DLW placed regular order of 3372 items upon M/s EMD (USA) @ ₹ 70712/- (the highest rate bidder) in August 2013. It was observed that the tenders received in June 2013 were actually accepted in August 2013 and during this time, DLW again could have obtained suitability of lower priced tenders from RDSO, instead of rejecting the same.
- It was further observed that in the above two instances, lower offers of M/s Maven Engineering Corporation, USA and M/s Ashok Iron works, Belgaon, (both are unapproved sources) were not considered by the Tender Committee.

It is evident from the above instances that DLW failed to take opportunity to develop indigenous sources at lower prices and continued to procure materials from foreign supplier at higher costs.

3.1.5.2 Continued purchases from single source

Review of records for procurement of various items at DLW, showed that even for non-technical/low-technical items, procurement from single suppliers continued years after years and no new vendor was allowed entry in the exiting vendor list leading situation of monopoly. This would be evident from the following instances:

i) Ecotip Injector

Ecotip Injector is critical assembly of fuel injection system, consisting of fuel metering pump and nozzle. In vendor directory, only M/s Inter-State Mcbee LCC, USA was listed as Part I approved source. No Indian source had been developed and approved despite the fact that a development order was placed on M/s Bosch Limited, Bangalore, which was successfully completed in March 2013.

DLW had been importing this item from the foreign supplier since 2003 onwards and purchased 36917 Ecotip Injectors between August 2001 and March 2016, at the rate ranging from US$ 395 to US$ 562, without any competition. Of these, DLW purchased 6000 Ecotip Injectors were purchased in 2013-14, 2507 in 2014-15 and 6177 in 2015-16. Thus, even after lapse of 15 years, DLW had not developed indigenous sources of this item.

ii) Radiator Cooling Fan

Radiator Cooling Fan is required for cooling of locomotives. DLW obtained technology of this item from M/s EMD (USA) and transferred to M/s Daulat Ram Engineering Services Private Limited (DRESPL), Bhopal. This item was first

procured in April 2005 from DRESPL at the rates ranging from ₹3.17 lakh to ₹4.55 lakh per unit and subsequently, at rates ranging from ₹ 4.23 lakh to ₹ 5.31 lakh up to October 2015 without any competition (3975 fans procured March 2001 to October 2015). Tenders though invited and offer received from other firms, were rejected on the ground of unsuitability and unapproved source. This led to monopoly of M/s DRESPL, rates of which were being accepted by comparing its own last purchase rates. No cost break up of rate of single source had been analyzed and found on record.

iii) Sealant compound

Sealant compound is required for application for pipe sealant which is a lock for high pressure for hydraulic & pneumatic fitting. DLW had been purchasing this item from a single source, M/s New Engineering System Pvt. Ltd. Varanasi at the rate ranging from ₹ 4990 to ₹ 7014 per kilogram from February 2008 to September 2013. DLW purchased 4886 Kilograms of item at total cost of ₹ 3.36 crore from above firm between 2008 and 2016 by rejecting other offers received.

In test check, Audit noticed that DLW received three offers in July 2014. The lowest offer was from M/s Haryana Chemical at ₹ 4357 per kg. However, the lowest offer was rejected on the ground that it had not mentioned the name of product in the offer and never supplied similar type of material to DLW. The rejection of lowest offer was not correct as in the tender tabulation statement it was stated that the firm had complied with SOR and indicated name of product as (GRIP) also. The highest priced offer of M/s New Engineering, Varanasi at ₹ 7154 per kg was accepted and Purchase Order placed in September 2014 for Purchase of 685 kgs at the total cost of ₹ 49.02 lakh. The rejection of lowest offer resulted in extra expenditure of ₹ 18.89 lakh in one Purchase order and also led to non-development of new source.

iv) Floor Mat

Audit scrutiny revealed that DLW purchased Floor Mat from M/s Emprise Marketing, Lucknow continuously since 2011-12. The eligibility criterion for the purchase of this item was that the tenderer should be a past supplier. Due to this unwarranted eligibility criteria, new suppliers could not become eligible for the said item. A total of 1235 floor mats had been purchased from M/s Emprise Marketing, Lucknow continuously from 2011-12 to 2015-16 as single source at a total cost of ₹ 51.55 lakh and DLW restricted the entry of new suppliers.

Thus, DLW did not take effective steps for development of new sources to ensure competitive rates and continued to remain largely dependent on the single source supplier.

3.1.6 Conclusion

Indigenization project envisaged in the year 1998-99 after procurement of TOT worth US $1.75 crore and commenced in the year 2003, was not completed

even after lapse of about 13-14 years. As a result, DLW continued import from foreign/indigenous suppliers and could not achieve savings as envisaged. DLW also did not take effective steps for development of new sources to ensure competitive rates and continued to remain largely dependent on the single source suppliers. Considering that IR is now going in for massive electrification as electric traction is considered more environment friendly as well as economical, indigenization project in DLW needs a fresh look before large scale investment is committed to this project.

The matter was referred to Railway Board in January 2017; their reply has not been received (February 2017).

3.2 Diesel Locomotive Works (DLW): Extra expenditure of ₹ 59.28 crore in import of crankcases

Despite specific instructions of Railway Board (August 2014) not to import crankcases, but to improve in-house production and indigenous sources and also to revise the production plan of locos, if required, DLW violated directives of Railway Board and continued import of crankcases from M/s EMD at higher cost and incurred extra expenditure of ₹ 59.28 crore in importing 81 crankcases between September 2014 to November 2015.

Crankcase Machining Assembly (Crankcase) is a main structural part of High Horse Power (HHP) Locomotives. Consequent upon Transfer of Technology (TOT) of manufacturing HHP Locomotives from M/s General Motors (now M/s Electro Motive Diesel (EMD)) of United States of America, Railway Board sanctioned (July 1999) ₹ 155.54 crore for creation of infrastructure at Diesel Locomotive Works (DLW), Varanasi for in-house fabrication and machining of 100 crankcases per year. For enhancing the capacity to 150 crankcases per year, Railway Board sanctioned ₹ 97.69 crore in the Works Programme 2008-09.

Audit reviewed the records related to procurement of crankcases by DLW since 2013-14. It was observed that in response to the tender floated by DLW in August 2012, three[121] quotations were received (October 2012) for procurement of 168 crankcases for production of HHP locos during 2013-14. The lowest rate (₹ 69.96 lakh per unit) was received from M/s EC Blades & Tool, Panchkula (L1). High Level Tender Committee (TC) of DLW though recommended this firm for development order, L2 was not considered due to pending orders and regular purchase of crankcases was recommended from L3, M/s EMD at the rate of ₹ 124 lakh per unit. The reasonability of rates was justified by comparing the same with the last purchase rate of M/s EMD itself. TC recommendation was sent (December 2012) to Railway Board, which was returned back to DLW stating that recommended rate was not compared with the cost of in-house production and indigenous sources. TC then compared the rates and found that recommended rate was 109 *per cent* higher than in-house production rate of ₹

[121] M/s EC Blades & Tools Pvt..Ltd. Punchkula (1st Lowest), M/s Amtek Transportation Systems Limited/New Delhi (2nd lowest) and M/s EMD/USA (3rd lowest but DLW Part I source).

59.42 lakh per unit and 72 *per cent* higher than the rate of the indigenous source (₹ 73.80 lakh). Subsequently, DLW submitted (January 2013) supplementary recommendations of TC to Railway Board. Railway Board, directed (May 2013) DLW for negotiation with M/s EMD to explore the possibility of reduction in rates. However, despite negotiations, the rate was not reduced by M/s EMD and DLW recommended the same rates to Railway Board. Finally, in August 2014 Railway Board while communicating the following observations of Hon'ble Minister of Railways (MR) directed DLW to furnish the comments on the said observations and re-submit the case:

1. The cost of importing fully machined crankcase is 2.5 times that of the in-house production as well as sourcing indigenously. It is stated that balance quantities have been planned to be sourced indigenously. However, it is not stated as to what steps are being taken to source indigenously.
2. The production capacity status of indigenous firms has been assessed as on 2012, but the same has not been updated as on today, which might have undergone considerable changes and may enable us to source indigenously more quantity than procuring the crankcase assembly by trade.
3. It is surprising to note that other than our in-house production, there is only one source of supply, which is quite expensive one also. Does it mean that in the entire world, every other Railway is procuring only from this single source? If not, why Indian Railways is confined to this single source?
4. There is a possibility of reduction in DLW's loco production and accordingly the requirement of crankcase assembly should also come down.
5. Fresh look at the entire tender is needed and purchase proposal should be revisited on account of higher import cost, indigenous sourcing not encouraged and reduction in the need for locos.

In view of the above observations of Railway Board, TC of DLW recommended (September 2014) that the projected in-house production and supply from indigenous sourcing will meet the requirement and the tender was finally discharged. The TC further stated that for the year 2014-15, they had already met the shortfall of 19 crankcases through emergency procurement and that from 2015-16 onwards, in-house production capacity would be able to meet the requirement of 240 crankcases including supply from all the indigenous firms.

Audit observed that the General Manager, DLW in exercise of his delegated financial powers for emergency procurement, had imported 176 crankcases from the same firm, M/s EMD during March 2013 to March 2014 at the higher rates ranging between ₹ 127 lakh to ₹ 149 lakh through nine Purchase Orders as given in the following table:

Table 3.4 Comparison of cost between cost of import and in-house production						
Purchase Order No & date	**Quantity**	**FOB Rate in US $**	**Landed rate in lakh (₹)**	**In-house production rate in lakh (₹)**	**Difference in lakh (₹)**	**Extra expenditure in lakh (₹)**
Import during March 2013 to March 2014						
13111865 dt.21.03.13	35	1,76,313	127	59.42	67.58	2365
13111883 dt.25.05.13	35	1,75,750	128	59.42	68.58	2400
13111913 dt.17.08.13	30	175,750	145	59.42	85.58	2567
13111971 dt.30.10.13	33	1,75,750	148	59.42	88.58	2923
14112100 dt.22.02.14	10	1,75,750	149	59.42	89.58	896
14112102 dt.01.03.14	33	1,75,750	149	59.42	89.58	2956
Total	**176**					**14107**
Import during September 2014 to November 2015						
14112164 dt.23-09-14	25	1,75,750	139	59.42	79.58	1990
15112322 dt.02-04-15	32	-	-	-	-	1860
15112400 dt.02-11-15	24	1,67,762	146	59.42	86.58	2078
Total	**81**					**5928**

From the above table, it can be seen that rates were 2.14 times to 2.5 times more than the in-house rate (₹ 59.42 lakh) involving additional cost of ₹ 141.07 crore.

Despite discharging the tender in September 2014, General Manager, DLW continued procurement from M/s EMD and imported another 81 crankcases during September 2014 to November 2015 in contravention to the Railway Board's observations. This procurement was made without the prior approval of Railway Board.

Thus, even after specific instructions of Minister of Railway not to import crankcases and to improve in-house production and indigenous sources, DLW imported further 81 crankcases resulting in extra expenditure of ₹ 59.28 crore during the period from September 2014 to November 2015.

In reply, DLW Administration stated (August 2015) that as acceptance of tender opened in October 2012 was pending with Railway Board, emergency purchase was made to meet the target of 270 HHP locomotives as production capacity at DLW was limited to 108 crankcase per year. It was also stated that prior approval of Railway Board was not required in emergency purchase of

crankcase. DLW further cited the breakdown of fabrication machine[122] as the reason for import beyond August 2014.

Thus, there were specific instructions of Railway Board (August 2014) not to import crankcases, but to improve in-house production and indigenous sources and also to revise the production plan of locos, if required. DLW however, violated directives of Railway Board and continued import of crank cases from M/s EMD at higher cost and incurred extra expenditure of ₹ 59.28 crore in importing 81 crankcases between September 2014 to November 2015.

The matter was referred to Railway Board in January 2017; their reply has not been received (February 2017).

3.3 Energy Conservation measures in Indian Railway

3.3.1 Introduction

Indian Railways (IR) is one of the largest transportation and logistics networks of the world, which as of March, 2016, *inter alia* runs 23,024 trains (passenger and goods) daily throughout its networks of 66,687 route kilometers connecting areas across the length and breadth of the country. IR carries nearly 3.03 million tonnes of freight traffic and 22.5 million passengers every day.

Total expenditure on energy/fuel during 2015-16 was ₹ 25783.63 crore as compared to ₹ 16730 crore in 2010-11. Considering such growing annual expenditure on energy consumption (diesel as well as electricity) for train operations efforts made in the area of energy conservation are of utmost significance. Efficient use of available resources of energy and effective monitoring of implementation of energy conservation measures are the catalyst in promoting efficiency and reduction of Energy bills. Indian Railways has taken several measures for energy conservation including:

a) Introduction of Three Phase Electric Locos and EMUs with regenerative braking features saving up to 20- 30 *per cent* of the energy.
b) Saving energy through improved measures in diesel traction such as:
   - Shutting down of locos where expected detention is more than 30 minutes and
   - Monitoring the fuel consumption with reference to Trip Ration[123].
c) Energy Audits to improve energy efficiency of Railway offices, stations buildings and workshop

Audit studied the fuel conservation measures taken up by Indian Railways during the six year period from 2010-11 to 2015-16 to assess their effectiveness.

3.3.2 Energy Conservation- Electrical Energy

Audit findings on the measures initiated by Indian Railways on electricity usage are discussed in the succeeding paragraphs.

[122] Portal Milling Machine.
[123] Quantity of fuel required in diesel loco for its scheduled journey over a designated section

3.3.2.1 Implementing the Three Phase technology in locomotives

With the increase in the train loads and need for the higher speed (both for passenger and freight trains) to enable hauling of more traffic with the existing infrastructure, it became important to upgrade existing technology of electric locomotives and thus IR decided to go for most modern Three Phase High Horse Power (HHP) electric locomotives, in which regeneration of power is available. About 15-20 *per cent* energy, is regenerated in the process of braking. Regenerative braking effort is available from the full speed till dead stop. Consequently, the overall efficiency of operations is higher. Maintenance cost of a 3-phase locomotive is also less as compared to conventional locos.

IR acquired 30 (10 passenger and 20 freight) High Horse Power (HHP) state of the art microprocessor controlled three phase drive electric locos from M/s Bombardier Transportation (earlier called ABB), Switzerland along with transfer of technology (TOT) to manufacture them indigenously at Chittaranjan Locomotive Works (CLW). First indigenously built 3-phase electric locomotive was turned out by CLW on 14 Nov 1998.

As of 31 March 2016, CLW manufactured 1075 three phase HHP locomotives, which included 705 freight locos and 370 passenger locos. During this period CLW also manufactured 2206 conventional Electric Locos. As such, 76 *per cent* of the total electric locos manufactured during 1998-99 to 2015-16 were conventional. The last conventional loco was turned out from CLW in October 2015. From 2016-17 onwards, no targets have been fixed for production of conventional locos and production of conventional locos has been stopped. Thus, IR has switched over from conventional electric locos to HHP three phase locos completely.

3.3.2.2 Non-induction of Three Phase Technology in Electric Multiple Units (EMUs)

Ministry of Railways decided to replace the existing Electrical Multiple Units (EMUs) with the new ones fitted with regenerative brakes by adopting three phase technology with Insulated Gate Bi-polar Transistor (IGBT) based system initially in Mumbai suburban area of Western Railway and Central Railway. During braking, the system is capable of regenerating 25 to 30 *per cent* of the energy used and these passenger trains have the ability to draw the same from the Over Head Equipment (OHE). The regenerated electrical energy reduces the consumption of equivalent grid electrical energy required by the powering train, thereby conserving electrical energy. Regenerated energy is recorded in the device (Data Card) fitted in the locomotive.

Audit reviewed records in respect of energy regeneration in the Three Phase EMUs for the period 2010-11 to 2015-16. Review of related records for the year 2010-11 to 2015-16 relating to 153 EMUs (85 EMUs in CR) and (68 EMUs in WR) revealed that electricity regeneration almost near the target of 35 to 40 *per cent* as indicated in the table below:

Table 3.5			
Period	**Number of EMUs test checked**	**Target for energy regeneration (%)**	**Energy regenerated (range in %)**
2010-11 to 2015-16	CR-85	35 – 40	28 - 43
2010-11 to 2015-16	WR-68	35 – 40	32 - 37

It was however, noticed that EMU over NR, ER and SER were not provided with regenerative braking features and EMUs with power regeneration features were provided in CR and WR only.

In view of the benefits derived in terms of the energy regeneration, IR needs to introduce regenerative braking features in EMUs of other Zonal Railways (NR, ER and SER) as well, where EMUs are run.

3.3.2.3 Feeding back of regenerated energy to Grid and claiming credit from Power Supply Companies

Three phase electric locomotives and EMUs inducted by Indian Railways have features of regenerative braking. The energy regenerated is being monitored through the energy meters installed in the locos. Regenerated energy could be used by the trains running in opposite direction. If no train is running in opposite direction, the regenerated energy would be fed back to the grid. Though the energy regenerated is fed to the grid, there is no metering arrangement/mechanism in regard to the energy fed back to the grid or used by the locos in the close vicinity. Further, there is no arrangement between the Railway Administration and the respective power supplying companies/State Electricity Board for claiming credit for the unused portion of the regenerated energy fed to the grid.

During the review of the records of Chief Electrical Engineer (CEE)/CR/Mumbai it was seen that though 3 Phase Electric Locos in Central Railway regenerated the power and fed such power to Maharashtra State Electricity Distribution Company Limited (MSEDCL) grid system, no credit was, however, given to Central Railway by MSEDCL. Though Chief Electrical and Distribution Engineer (CEDE) had taken up the issue with Maharashtra Electricity Regulatory Commission (MERC) regarding the methodology by which Railway had to register as a power producer to get credit of regenerated energy, no final action in this regard was taken (December 2016).

The matter of obtaining credit for the regenerated energy was also taken up by Traction Department of Bangalore division in SWR with Chairman, Bangalore Electricity Supply Company (BESCOM) in 2012. BESCOM, however, replied that there were no guidelines regarding net metering of an installation where power is regenerated and supplied to the grid. Matter was also referred (May 2014) to the Karnataka Electricity Regulatory Commission (KERC), no response was, however, received.

It is thus seen that though Railways have been able to derive savings in the energy consumption as a result of regenerative features of Three Phase technology, they have not devised any mechanism for metering and claiming credit for the unused portion of the regenerated energy fed to the grid.

3.3.3 Energy Conservation - Diesel Energy

Audit reviewed the measures initiated by Indian Railways specific to diesel usage. Audit findings are discussed in the succeeding paragraphs.

3.3.3.1 Shutting down of Diesel locos when expected detention is more than 30 minutes

Railway Board (May 2008) reiterated their earlier policy of shutting down locos when the detention at any location was likely to be more than 30 minutes. Operating Department (control room) should inform driver if expected detention was more than 30 minutes at any place and instruct the driver for switching off the loco. In the ATN on Para 2.1 (Fuel Management in Indian Railways) of Report No. 9 of 2000, Railway Board stated that locos were shut down to the extent operational exigencies permit and it was not always possible to predict the duration of detention. It was, however, observed that there was no mechanism of shutting down locomotives in all cases where expected detention was more than 30 minutes.

En-route detention of goods trains involves avoidable fuel/energy consumption. To analyze the extent of en-route detention across the zones, Audit collected the details of goods train detained *en-route* for 30 minutes and more from CRIS for the month of March 2015 and December 2016. The data furnished by CRIS showed that shutting down of locos was not done in cases of *enroute* detentions in excess of 30 minutes. The cost of diesel and electricity consumed as a result of detention of locos beyond 30 minutes is shown in the table below:

Table 3.6

Month of test check	Diesel traction			Electric Traction		
	Nos. of occasions the locos were detained	*Locos detained beyond 30 minutes (in hours)*	*Cost of diesel consumed (₹ in crore)*	*Nos. of occasions the locos were detained*	*Locos detained beyond 30 minutes (in hours)*	*Cost of electricity consumed (₹ in crore)*
March 2015	58301	3268	31.25	81230	3391	15.44
Dec 2016	46150	1623	15.52	77268	1681	7.66

Chief Project Engineer/CRIS while sharing the FOIS data (for the month of December 2016) pertaining to detention of goods trains at selected interchange points and detention of train (driven by diesel and electric locos) in excess of 30 minutes mentioned that any information regarding switching off the electric engine or shutting down of the diesel engine is not available in FOIS.

As discussed with railway administrations in Zonal Railways, the practice of shutting down the diesel engine was not being followed in most of the Zonal Railways. In WR, SECR and SCR, Zonal Railway administrations have issued further instructions for shutting down locos when detention of more than 30 minutes is expected and efforts are being made to enforce the same. In CR and NWR, though instructions have been issued, whether these are being followed could not be verified. In NCR and SER, the practice was not being followed. In SWR, instructions were issued for shutting down diesel locos where detention was expected to be more than 60 minutes. However, reasons for deviations from Railway Board orders were not recorded.

By not shutting down diesel engines, if the detention is expected to be beyond 30 minutes, Railways incur extra expenditure on fuel consumption.

3.3.3.2 Delay in handing/taking over trains at interchange points of zones

Chief Operations Manager of each Zone prepares a working time table for each division to be adhered to by operating staff for working of Goods trains. Adjacent Zones should also adhere to the schedule timings given in the working time tables. Detention of goods trains at interchange points would involve avoidable fuel/energy consumption. Audit observed that there were differences in the handing /taking over time recorded in the interchange points of the zones.

To analyze the extent of detention at interchange points over all the zones, Audit reviewed the details of goods train detained at 117 selected interchange points for thirty minutes and above from the records of Center for Railway Information System (CRIS) for the month of March 2015 and December 2016 as indicated below.

Table 3.7

Period of test check	Diesel traction			Electric Traction		
	Nos. of trains detained at interchange points	*Total detention beyond 30 minutes (in hours)*	*Cost of diesel consumed (₹ in crore) with reference to Col. 3*	*Nos. of trains detained at interchange points*	*Total detention beyond 30 minutes (in hours)*	*Cost of electricity consumed (₹ in crore) with reference to Col. 6*
March 2015	2850	19925.92	3.18	4190	27771.63	2.10
Dec 2016	3102	25952.52	3.36	5787	51529.06	3.80

The value of fuel/energy consumed worked out to ₹ 5.28 crore and ₹ 7.16 crore in March 2015 and December 2016 respectively.

Thus, due to detention of locos at the interchange points, Railways incur extra expenditure on fuel consumption. Minimising detentions would help in saving the cost of fuel consumption. Excessive detention at interchange points results in unproductive loco hours, which is likely to impact loco availability.

3.3.3.3 Consumption of fuel with reference to the Trip Ration

Trip ration[124] is the quantum of section wise diesel consumption fixed in respect of diesel locos by Senior Mechanical Engineer (Operating) in the Divisional Headquarter. Fixing of trip ration is a mechanism to fix and monitor consumption of diesel on designated sections. As per Para 1.10.8.2 of Indian Railway Maintenance Manual for Diesel Locomotive, Sr. DME (Operating) should fix trip ration after conducting trials. Normally, Trip Ration should be revised in the month of January every year after conducting trials. Trip Ration should further be reviewed in the month of July for any changes required. At Divisional level, after conducting trials, Divisional Railway Manager should circulate the latest section-wise/service wise trip rations to all fueling installations as and when revision is done. Further, driver wise consumption of HSD oil should be maintained in the divisional office and action against the drivers bursting trip ration should be taken up suitably. Audit test checked position of trip ration fixed in the zones and observations are tabulated below.

Table 3.8

Zonal Railway	Status on fixing trip ration and monitoring thereof
CR	The trip ration is fixed service wise and loco type wise based on trials at Divisional level duly allowing for fuel oil consumption due to unscheduled halt, train running through via loop line, shunting purpose, idle hours, caution orders and signal on approach etc. on the load to be hauled. Loco pilots are counselled for fuel economy.
ECR	Trip ration was fixed, but the process of fixing the same was not found on record. Excess consumption with reference to the trip ration fixed was noticed in nine cases in Mughalsarai Division and the same was attributed to chain pulling in trains by passenger.
ECoR, NR and NEFR	Trip ration has been stated to have been fixed, but nothing on record was found to show if the same was monitored with reference to trip ration fixed.
NCR	Trip ration was fixed in the year 2010, 2011 and during October to December 2016 in Jhansi and Allahabad division. In Agra division trip ration was fixed during October to December 2016.
NWR	Trip ration was fixed in Ajmer division in May 2015 and in fag end of the year in Jodhpur division. Loco pilot-wise consumption of HSD oil is being maintained in the Divisional Office and poorly performing loco pilots are counselled.
SECR	Trip ration was once fixed in June 2008 and was revised thereafter in October 2016. No record was, however, found to indicate if any action was taken against the loco pilot bursting the trip ration.
SWR	No trip ration was fixed in respect of Bangalore Division. While in respect of Hubli Division, trip ration was fixed on the basis of Specific Fuel Consumption (SFC) fixed by Railway Board. No monitoring of the trip ration was, however, done in these two divisions.

Reasons offered by the Railway Administration for excess consumption with reference to trip ration are given in the table below:

[124]Quantity of fuel required in diesel loco for its scheduled journey over a designated section

Table 3.9 - Reasons for variation in consumption of HSD oil with reference to trip ration	
Zonal Railway	**Reasons**
NR	Consumption of HSD oil exceeded the trip ration due to excess load, more number of coaches and late arrival of trains. However, such issues are required to be taken into consideration while fixing the trip ration.
SECR	Excess fuel oil consumed was due to traffic detention (Line not clear on approach of signal and passing over loop line) and large number of temporary caution.
ECR	In nine cases excess consumption of diesel with reference to trip ration was attributed to chain pulling in trains by the passengers.
SER	Divisional Authority attributed the reason to heavy detention in sections in Chakradharpur division.

No other zone assigned reasons for the excess consumption with reference to Trip Ration. Thus, many Zonal Railways were not fixing trip rations for various sections as envisaged in Indian Railway Maintenance Manual for Diesel Locomotives. There is a need to monitor consumption of fuel with reference to trip rations fixed in most of the Zonal Railways.

3.3.4 Energy Audit

After enactment of the Energy Conservation Act 2001, there was a thrust for adopting energy efficient measures. Energy conservation through energy audit techniques was considered to be a major opportunity for improving operating efficiency as well as in achieving the cost reduction.

Energy audit encompasses verification, monitoring and analysis of use of energy, including submission of recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption. On the basis of guidelines issued by Bureau of Energy Efficiency (BEE), RB directed (July 2007/2008) all Zonal Railways to conduct energy audit of areas like major administrative buildings, hospitals, pumping installations, loco sheds, major railway stations and workshops as a onetime exercise and send the reports to them. It further directed that energy audit of all Traction Sub Stations and Workshops be taken up periodically. As per the notification, every designated customer viz. TSS, Loco Sheds, Railway Production Units and workshops shall have its first energy audit conducted within 18 months of the notification issued by Government under clause (i) of section 14 of the Energy Conservation Act 2001. The interval of time for conduct and completion of subsequent energy audits shall be three years with effect from the date of submission of the previous energy audit report by the accredited energy auditor to the management of the designated consumer.

Position of energy audit conducted by accredited auditors was reviewed and it was observed that no energy audit was conducted in eight Zonal Railways[125], two Production Units and Metro Railway during the period of review. The

[125]ER, ECR, NER, SR, SER, SWR,WR and WCR

detailed position of Energy Audits conducted in the selected units of following activity centres in Zonal Railways during the period of review has been discussed in succeeding paragraphs:

- Traction Substations (TSSs)
- Stations, Buildings, Workshops and loco sheds
- Railway Production Units

3.3.4.1 Traction Substations (TSSs)

Review of records at 98 TSSs of 32 selected divisions of 17 Zonal Railways including Metro Railway, showed that energy audit was conducted only in the following places:

- Energy audit of one TSS in Bilaspur of SECR was conducted in 2010-11.
- Energy audit of one TSS at Diwana in Panipat in Delhi division of NR was conducted in 2015-16. However, recommendations of energy audit were partially implemented. A saving of ₹ 2.42 lakh was assessed on implementation of four recommendations. Further, Energy audit of TSS-Chanakyapuri in NR was conducted in 2015-16 and saving was assessed at ₹ 20.13 lakh on implementation of two recommendations.
- Energy audit of Krishna Canal TSS in Vijayawada division of SCR was conducted in November 2015.

3.3.4.2 Stations, Buildings, Workshops and loco sheds

Review of the records in Zonal Railways in respect of the energy audit of Stations Building, Workshops and loco sheds in Zonal railways revealed the following:

(i) Energy Audit of station buildings, Workshops and loco sheds was conducted during the review period by Bureau of Energy Efficiency (BEE) accredited energy auditors on seven Zonal Railways as indicated below:

Table 3.10

Zonal Railway	Station buildings	Workshops	Loco Sheds
CR	Nasik Road, Bhusawal	Manmad	-
NR	New Delhi, Delhi	-	Ghaziabad
ECoR	Vishakhapatnam, Khurda Road	Mancheswar Coach workshop	-
NCR	Allahabad	Jhansi	-
NFR	Katihar	-	-
NWR	Ajmer, Marwar, Phalna, Bhilwara, Jodhpur	Bhagat ki Kothi	Ajmer, Jodhpur
SCR	Kacheguda	-	Vijayawada, Kacheguda
SECR	Bilaspur	-	-

(ii) No record was available to show the number of activity centres (Stations, Buildings, Workshops and loco sheds) due for energy audit except in NR and NWR.

(iii) Recommendations of the energy audit were partially implemented in NR, NWR and SCR.

(iv) A saving of ₹ 3.34 crore was anticipated as a result of implementation of the recommendation of the energy audit on CR, ECoR, NWR and SECR. Details of the implementation of the recommendations of energy audit were not made available to Audit in respect of these four Zonal Railways.

(v) In other zones where the recommendations of the energy audit were either implemented or partially implemented, savings in energy bill anticipated as a result of implementation of the recommendation of the energy audit was not found on record.

3.3.4.3 Railway Production Units

Energy audit was conducted in Integral Coach Factory (ICF), Perumbur, in February 2013 covering performance assessment of compressors, furnaces, cranes and hoists, pressing machines, turning centres, substations, pumping Installations, lighting and other electrical systems. Similar Energy audit was also conducted in ICF in July/Aug, 2015. A saving of ₹ 1.33 crore per annum was anticipated as a result of implementation of the recommendations of the energy audit conducted in 2013. Though the recommendations were implemented, post audit activity wise energy consumed not assessed. Similar savings amounting to ₹ 1.59 crore was anticipated as a result of implementing the recommendation of the energy audit done in 2015. Implementation of recommendations was in progress (September 2016). No energy audit was, however, undertaken in respect of CLW, and DLW during the period 2010-11 to 2015-16.

Thus, instructions of Railway Board and regulation of Bureau of Energy Efficiency (BEE) on energy audit were not complied with by 50 *per cent* of Zonal Railways in their major energy consumption areas. Further, though the recommendations were implemented/ partially implemented, post audit activity wise energy consumed was not assessed.

3.3.5 Conclusion

Railways have initiated several energy consumption measures. These included switching over to three phase electric locos and induction of three phase technology in Electric Multiple Units. IR issued instructions for switching off diesel locos if expected detention was more than 30 minutes. IR also issued instructions for exercising control over diesel consumption through fixing of trip ration. To control energy consumption, IR also adopted mechanism of Energy Audit.

The last conventional loco was turned out from CLW in October 2015. From 2016-17 onwards, no targets have been fixed for production of conventional locos and production of conventional locos has been stopped. Thus, IR has switched over from conventional electric locos to HHP three phase locos completely. However, EMUs/MEMUs with the regenerative braking features has

been inducted in CR and WR only. These were yet to be inducted in other Zonal Railways viz. NR, ER, SER, SR and SCR. Test check in audit also revealed that instruction of non-shutting down of locos (in cases of expected detention of more than 30 minutes) were not followed resulting in excess consumption of energy/fuel. Besides, excessive detentions were also observed at the interchange points test checked in audit leading to excess consumption during idling of locos. All Zonal Railways were not using the mechanism of Trip Ration for monitoring and controlling consumption of fuel. Energy Audits were conducted sporadically and recommendations were partially implemented. Post audit activity wise energy consumed was also not assessed. Thus, energy conservation measures are needed to be adopted in more effective ways so as to achieve savings in energy consumption.

The matter was referred to Railway Board in June 2016; their reply has not been received (February 2017).

3.4 West Central Railway (WCR): Extra expenditure due to change of traction from electric to diesel locomotive and vice versa for placement/release of rakes in the electrified siding notified for charging on 'through distance basis' and loss of earning capacity due to detention of wagons

WCR administration did not adhere to the conditions laid down for charging freight on 'through distance basis' as per which there should be no detention to engine except for change of ends. This resulted in an extra expenditure of ₹3.77 crore on unwarranted haulage of diesel locomotives from/ to Kota station up to/from the Bhonra serving station. Railways also sustained loss of earning capacity of ₹ 5.70 crore due to detention of wagons at the Bhonra serving station as a result of change in traction.

The rules[126] relating to 'charging freight on through distance basis in case of sidings' provides that 'the system of charging freight on through distance basis shall be extended to all block rakes going into the siding directly or indirectly with the engine pulling or pushing, provided (a**)** there is no detention to engine except for change of ends and (b) no separate shunting staff is required exclusively for this purpose.

The siding for Chambal Fertilizer and Chemicals Limited (CFCL siding) dispatches fertilizer to various destinations and is served by Bhonra station in Kota division. The siding was electrified and Commissioner of Railway Safety (CRS) accorded sanction in December 2007 for running of electric locomotive up to the siding. This siding was notified for charging of freight on through distance basis in April 2009, which meant that the engines carrying rakes to and from CFCL siding should not be detained at serving station except for change of ends.

[126] Clause 1.1 of Master Rate Circular (regarding freight on through distance basis)2014 dated 24 September 2014

It was observed that during April 2013 to October 2016, 826 out of 1443 empty rakes were received at Bhonra station hauled by electric locomotives. These rakes were subsequently placed in the siding for loading using diesel locomotives. Similarly, 1034 out of 1443 loaded rakes released from CFCL siding were brought to Bhonra station using the diesel locomotive, and were subsequently hauled to destination by electric locomotives. Diesel locomotives on each occasion of placement/release were called from Kota station, which is 30 kms away from Bhonra. Due to this change of traction, the rakes were detained at the serving station both during placement and release. Hauling of diesel engine from Kota to Bhonra for placement/release of rakes from the siding was unwarranted and led to extra expenditure of ₹ 3.77 crore.

The matter was pointed out (July 2015)[127] to WCR Administration through a special letter. The Electrical Traction Department (July 2015) opined that there was no constraint in direct placement and release of rake by electric locomotive. The Operating Department (August 2015) stated that for safety considerations Over Head Equipment (OHE) has to be kept in off position and residual charge, if any, should be discharged and to undertake this activity, one staff has to be deputed from Chief Goods Supervisor/CFCL office to the farthest end for switching off OHE and till such time the loading process cannot be commenced due to safety considerations.

The reply indicated that there was difference of opinion within the different departments of Railways. During April 2013 to October 2016, 616 out of 1443 inward rakes brought up to the serving station using electric/diesel loco were placed by the same loco in the siding for loading. Similarly, 407 out of 1443 outward rakes released by electric/diesel loco up to the serving station from the siding were moved to destination station by the same loco. Thus, change of traction from electric loco to diesel and vice versa for loading/release of rakes into/from CFCL siding despite being an electrified siding and capable of accepting BCN/BOXN rakes with electric locomotive[128] was not necessary.

Thus, WCR administration did not adhere to the conditions laid down for charging freight on 'through distance basis' as per which there should be no detention to engine except for change of ends. This resulted in an extra expenditure of ₹ 3.77 crore on unwarranted haulage of diesel locomotives from/ to Kota station up to/from the Bhonra serving station. Railways also sustained loss of earning capacity of ₹ 5.70 crore due to detention of wagons at the Bhonra serving station as a result of change in traction[129].

The matter was referred to Railway Board in December 2016; their reply has not been received (February 2017).

[127] Reply to draft para issued to the Railway Administration (July 2016) is awaited.
[128] w.e.f. 20.05.2008
[129] Change of electric loco to diesel loco and vice versa for placement/release of rake into/from the siding.