2022/M(N)/951/42

1491701/2023/Dev. Cell

भारत सरकार (GOVERNMENT OF INDIA)
रेल मंत्रालय (MINISTRY OF RAILWAYS)
रेलवे बोर्ड (RAILWAY BOARD)
*****

No.: 2022/M (N)/951/42 **New Delhi, Dated:** 15/06/2023

The General Managers
CR, ECoR, ECR, ER, NFR, NR, SECR, SER, WCR, WR

Sub.: Creation of 11 Next Generation Freight Maintenance Yards.

Ref.: RB's letter no. 2023-B/106/Umbrella dated 28/04/2023.

An umbrella work for "11 Next Generation Freight Maintenance Yards" is appearing at item no. 1164 in NR's PB/2023-24.

The following yards are covered under this work:

Sr. No.	Railway	Yard
1	WR	Gandhidham
2	CR	Bhusawal
3	WCR	New Katni Yard
4	ER	Andal
5	NR	Khan Alampura Yard
6	ECoR	Paradeep
7	SER	Bondamunda
8	SER	Nimpura
9	SECR	Classification Yard, Bhiliai
10	NFR	New Jalpaiguri Yard
11	ECR	Patratu

These works are related to creation of facilities to handle 3000 MT of freight traffic and as such needs to be prioritized at ZR level.

2022/M(N)/951/42

1491701/2023/Dev. Cell

Accordingly, the concerned Railways are advised to start the work for creating Next Generation Freight Maintenance Facilities at the nominated yards and work out the Detailed Estimates duly identifying yard specific unique upgradation requirements based on existing layouts & facilities, expected future traffic flow and type of wagons that are maintained/likely to be in these yards.

CAMTECH's report of November 2021 on "Next Generation Freight Maintenance Facility" may be taken as an indicative report for the assessment.

The Budget Order for distribution of total cost among Zonal Railways has also been issued by Finance Budget branch vide Board's letter dated 28/04/2023 (**Copy enclosed**).

The Fund projections may be made against item no. 1164 in NR's PB/2023-24 at appropriate budget stage.

This has the approval of Board (MTRS).

DA: As above

15|06|2023

(Anirudh Kumar)
EDME (Modernization)
रेलवे बोर्ड / Railway Board
edmemod@rb.railnet.gov.in

2022/M(N)/951/42

1491701/2023/Dev. Cell

भारत सरकार / GOVERNMENT OF INDIA
रेल मंत्रालय / MINISTRY OF RAILWAYS
रेलवे बोर्ड / RAILWAY BOARD

No.2023-B-106/ Umbrella

New Delhi, dated 28-04-2023

The General Managers,
Central, Eastern, Northern, Northeast Frontier, South Eastern, Western, East Central, East Coast, South East Central and West Central Railways

Sub:- Distribution of Umbrella work 2023-24 under PH-42.

In Works, Machinery & Rolling Stock Programme (Pink Book) 2023-24, the umbrella work of 'Northern Railway - 11 Next Generation Freight Maintenance Yards (Umbrella work sanctioned in 2022-23)' (PB No. 1164) costing Rs. 1502 cr (under Capital) has been included as an 'Umbrella work' under Planhead 42-Workshop incl. PUs in Northern Railway.

2. In terms of Procedure Order regarding Execution of 'Umbrella' Works under different Planheads, circulated through Board's letter No.2017/CE-I/WP/2018-19/1/Pt dated 22.3.2018, the Railway/Unit-wise distribution of the total cost and outlay provided to the 'Umbrella' work mentioned in Para 1 above, as advised by Mech.(Works) Dte, is communicated herewith as per the following-

(figures in thousands of rupees)

PB No.	Rly	Description	Alloc	Cost	Outlay 2023-24
				Voted	
871i	CR	Central Railway - Next Generation Freight Maintenance Yard (PB#1164/NR/2023-24)	CAP	136,55,00	9
596h	ER	Eastern Railway -Next Generation Freight Maintenance Yard (PB#1164/NR/2023-24)	CAP	136,55,00	9
1186j	NR	Northern Railway - Next Generation Freight Maintenance Yard (PB#1164/NR/2023-24)	CAP	136,55,00	9
585i	NF	Northeast Frontier Railway -Next Generation Freight Maintenance Yard (PB#1164/NR/2023-24)	CAP	136,55,00	9
532i	SE	South Eastern Railway - Next Generation Freight Maintenance Yards (02 yards) (PB#1164/NR/2023-24)	CAP	273,05,00	19
656k	WR	Western Railway - Next Generation Freight Maintenance Yard (PB#1164/NR/2023-24)	CAP	136,55,00	9
766g	ECR	East Central Railway - Next Generation Freight Maintenance Yard (PB#1164/NR/2023-24)	CAP	136,55,00	9
575h	ECOR	East Coast Railway - Next Generation Freight Maintenance Yard (PB#1164/NR/2023-24)	CAP	136,55,00	9
458i	SECR	South East Central Railway - Next Generation Freight Maintenance Yard (PB#1164/NR/2023-24)	CAP	136,55,00	9
591i	WCR	West Central Railway - Next Generation Freight Maintenance Yard (PB#1164/NR/2023-24)	CAP	136,55,00	9
Total			**CAP**	**1502,00,00**	**1,00**

3. Accordingly the work included in the Pink Book 2023-24, as item No. 1164 under Northern Railway may be treated as deleted.

(Puneet Meena)
Jt. Director, Finance (Budget)

New Delhi, dated 28-04-2023

No.2023-B-106/ Umbrella
Copy to: The PFAs, CR, ER, NR, NF, SE, WR, ECR, ECOR, SECR & WCR

Sd

(Puneet Meena)
Jt. Director, Finance (Budget)

Copy to: EDME(EnHM & Projects), EDME(Modernization), EDCE(G),F(X) and M(W) Branches, Railway Board New Delhi.
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भारत सरकार GOVERNMENT OF INDIA
रेल मंत्रालय MINISTRY OF RAILWAYS
(रेलवे बोर्ड RAILWAY BOARD)

रेल भवन, नई दिल्ली- 110001
Rail Bhavan, New Delhi-110001

No.2006/M(N)/951/28-Part(3)

Dated: 30.11.2021

The Principal Chief Mechanical Engineers
All Indian Railways (Except NFR)

Sub: Planning for next generation freight maintenance facilities.

Ref: Report on Next Generation Freight Maintenance Facilities (Copy enclosed).

****

As per National Rail Plan (NRP) draft, traffic is expected to become more than 6 times in the years to come. This is planned to be achieved through fixed infrastructure augmentation, improved operation in terms of speed/terminal turn-around and better wagons in terms of speeds/axle load/specialized design etc. It is imperative that the wagon maintenance practices and infrastructure are also formulated to meet the future needs.

With a view to planning for next generation freight maintenance facilities to cater to increase in demand, AM/ME (Railway Board) formed a committee comprising PCME/NFR, PCME/SER, PCME/SR, PCME/ECoR.

The committee has submitted it's report mentioned u/r above. The copy of the report is enclosed for ready reference.

It is requested that deliberate upon the report and advise considered comments of your office.

DA: As above.

Vivek 30/11/21

(Vivek Mohan)
Dir. Mech. Engg. (Freight)
Railway Board
Telephone No. 011-23047448
Email: dmef@rb.railnet.gov.in

Northeast Frontier Railway
Head Quarters' Office, Mechanical Branch
Maligaon, Guwahati – 781011, (Assam)

No. Mech/W/Maintenance/Pt.III/W-11 09 November 2021

EDME/Freight
Railway Board
New Delhi

Sub:- Planning for Next Generation freight maintenance facilities

Ref:- Railway Bd's Letter no. 2006/M(N)/951/28 Pt. 2 dated 25.06.2021

Railway Board vide the above referred letter had formed a Committee of PCMEs from NFR, SER, SR and ECoR to draw up a report detailing recommended infrastructural facilities for next generation 'State of the Art' facilities for freight maintenance. The committee had also co-opted PED/CAMTECH, RDSO and officers from COFMOW, CRIS, IRIMEE and WPO/Patna to get their input related to requirement of infrastructure facilities and the latest Technology and innovations for freight maintenance.

The Committee has collected data from the various Zonal Railways and held discussions, deliberations, and presentations through video conferencing in which all the Committee members, co-opted members and special guests participated and shared their input.

Draft report was prepared and was circulated to all PCMEs of Zonal Railways for their suggestions before finalizing the report. Their suggestions have been incorporated in the report wherever the same were considered appropriate.

The report of the Committee duly signed by the members is submitted herewith for consideration of Railway Board.

Encl.: Report in 114 pages

9/11/2021

(G K Gupta)
Principal Chief Mechanical Engineer
Convenor of the committee

2006/M(N)/951/28.-Part(3)
1020823/2021/O/o EDME (FREIGHT)

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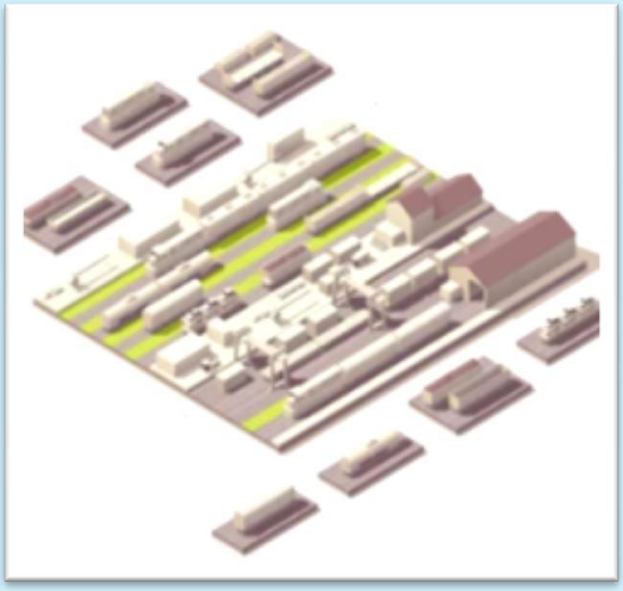
सत्यमेव जयते

भारत सरकार – रेल मंत्रालय
Government of India - Ministry of Railways



REPORT
ON
NEXT GENERATION FREIGHT MAINTENANCE FACILITY

IRCAMTECH/M/GWL/Freight Stock

November - 2021

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LIST of APPENDICES

PREFACE

Railway Board vide letter no. 2006/M(N)/951/28 Pt. 2 dated 25.06.2021, formed a Committee of PCMEs from NFR, SER, SR and ECoR to draw up a report detailing recommended infrastructural facilities for next generation 'State of the Art' facilities for freight maintenance. PED/CAMTECH, RDSO and other PCMEs were requested to provide requisite inputs to the Committee to enable preparation of a comprehensive report.

The Committee had co-opted members from COFMOW, CRIS, IRIMEE and WPO to get their input related to requirement of infrastructure facilities and the latest Technology and innovations related to freight maintenance.

The Committee has collected data from the various Zonal Railways and conducted discussions, deliberations, and presentations through video conferencing in which all the Committee members, co-opted members and special guests participated and shared their input. Draft report was prepared and was circulated to all the PCMEs of Zonal Railways for suggestions before finalizing and the same have been incorporated in the report.

Efforts have been made in the report to recommend infrastructural facilities for making freight maintenance to be highly efficient that shall use modern Technology and latest developments in ICT. Many of the proposed features are new and different from the existing maintenance practices. This report is expected to serve as a broad guidelines for new freight maintenance facilities as well as for modernizing the existing facilities.

The Committee is grateful to Shri Arun Arora, the then Additional Member (Mechanical Engineering), Railway Board for continuous encouragement and guidance during preparation of the report. The Committee is thankful to Shri Jitendra Singh, PED/CAMTECH for all the support, and the material input provided for the report. The Committee is also thankful to PCMEs of the Zonal Railways for providing data and practical suggestions, Shri Manish Jain, EDME (freight), Railway Board, Shri Ajay Nandan, Sr. Prof/IRIMEE, Shri P. Ananth, GM/CRIS, Shri Vikas Purwar, CME/IT/COFMOW, Shri Aniruch Kumar, CME/IT/COFMOW, Shri Utkarsh, GM/CRIS and Shri Manoj Kumar, Dir/CAMTECH for their valuable contribution during discussions and preparation of this report.

Finally, the Committee is grateful to Sri Rahul Jain, MTRS/Railway Board for his continuous support and direction during the course of finalising this report.

It is expected that the implementation of the proposed infrastructural facilities may result in paradigm shift in maintenance of Freight stock and result in improved availability & reliability of Freight Stock.

(R. Rajagopal)	(S. Srivinas)	(P. K. Mandal)	(G. K. Gupta)
PCME/ECoR	PCME/SR	PCME/SER	PCME/NFR
			Convener

EXECUTIVE SUMMARY

1. The freight operations over Indian Railways is poised for a major transformation. As per National Rail Plan (NRP) draft, freight traffic is expected to become more than 6 times in the years to come. This is planned to be achieved through fixed infrastructure augmentation, improved operation in term of speed / terminal turn-around and better wagons in terms of speeds / axle load / specialized designs etc. It is imperative that the developments in train maintenance technology, automation in train examination and use of Machine Vision technology integrated with AI is adopted on IR for wagon maintenance and the next generation 'State of the Art' infrastructure facilities are set up for Freight Maintenance to meet the future needs.

2. As a first step, Vision 2024 has been issued by Board, targeting to increase freight loading by 70% by 2024. This is planned to be achieved through increase in wagon population coupled with improved operations and up-gradation of Maintenance infrastructure.

3. Railway Board vide letter no. 2006/M(N)/951/28 dated 23-6-2021 has directed Zonal Railways to identify increased traffic flow in their respective zones and propose corresponding requirement for wagon maintenance infrastructure under 'traffic facilities works' for out of turn sanction in 2021-22.

4. Further, vide their letter no. 2006/M(N)/951/28 Pt. 2 dated 25.06.2021, Railway Board has formed a Committee of PCMEs from NFR, SER, SR and ECoR to submit a report detailing the infrastructure and other facilities required for freight maintenance.

5. PED/CAMTECH, other PCMEs of Zonal Railways and concerned Officers from COFMOW, CRIS, RDSO and IRIMEE were co-opted by the Committee to provide requisite inputs to enable preparation of comprehensive report.

6. Freight operation on IR contributes over 70% of the total revenue earned by Freight and Passenger transport services provided by IR. Availability and reliability of Freight stock plays very important role in IR's profitability.

   Availability of Freight Stock can be enhanced by improved operations to maximise loaded movement, minimizing empty movement, improving loaded to empty movement ratio, reduction in loading/unloading time, reduction in time taken for examination and shunting operations and final departure of freight trains. And the reliability can be enhanced by timely safety examination, preventive schedule maintenance of Freight Stock and use of 'State of Art' latest Technology.

   The three productive activities of Freight Train operations i.e. loading, unloading and safety examination are accompanied by avoidable delays (Pre departure delays, waiting time for placement

for loading/Unloading, waiting time for examination, shunting operations for detachment and attachment of wagons etc.). By minimizing time required for these activities, availability of wagons can be further enhanced.

7. This report is therefore directed towards the **optimization of total time required from arrival of the freight trains in the yard to final departure** including freight train examination and shunting activities and thus increase availability of freight stock for revenue earning. An effort has been made to identify technological inputs to bring quantum improvement in freight train examination and automated detection of defects of rolling stock and minimize the time required for shunting operations.

8. The Committee has analyzed the Data of existing system of maintenance and detachments during examination of freight trains, studied the recommendations made in earlier reports, deliberated on the facilities sanctioned for Road side diagnostic Equipment and ICT Integration of data generated from them with FMM and FOIS. After deliberations, Committee has made recommendations for the next Generation 'State of the Art' facilities for Freight Examination.

9. In the present system of freight train operations over IR, the turn round time of the freight rakes is around 4.64 days. The efforts are being made by IR to bring it down to 3.5 days by taking various steps including increasing the speed of rolling stock and the sectional speeds, reducing the terminal detentions at Loading / Unloading points, round the clock working of yards etc.

10. However, in order to further increase the availability and productivity of the Freight stock, the existing examination and maintenance facilities in the yards need to be upgraded so that detention of freight stock in the yards is minimized to decrease the turnaround time and thereby increase their productivity.

11. At present, the freight trains are examined by Train Examiner (TXR) staff, followed by in situ minor repairs, sick marking of the wagons, time consuming shunting process for detaching unfit wagons and attaching fit wagons, Engine on train, pressure continuity, brake power testing and departure of the train.

12. Over the years, the pattern of train examination has transformed significantly. From earlier system of End to End examination pattern, IR has moved to the Premium examination valid for 12 + 3 days and Closed Circuit (CC) examination valid for 30+5 days / 7500 Km, facilitating multiple loading/unloading between two examinations and thus increasing the productivity of Freight stock.

13. The Committee has noted that the average time taken from rake arrival to final departure in the examination yards varies from about 13.0 hrs for Premium rakes to 16.0 hrs for CC (Close Circuit) rakes. Whereas, the average examination time for a rake is just 4.0 hrs (for

premium rakes) and 5.30 hrs (for CC rakes). The rest of the time i.e. 10 to 12 hrs is consumed for pre-examination and post examination activities before the examined rake is made available for loading.

14. Thus, there is a need to minimize this detention of the rakes. This may be feasible by upgrading the maintenance facilities to next generation of maintenance infrastructure including in situ repairs and replacement of sick wagons with fit wagons as part of examination itself.

15. The following advantages are expected:

- These facilities shall minimize the shunting requirement for detachment / attachment of the sick / fit wagons (which is generally the largest part of yard in to yard out) and thus ensure faster release of the rakes for traffic use. In such a case, not only the availability of the rakes shall increase but the capacity of the yards shall also increase to handle more rakes.

- Facilities with all weather sheds and associated equipment would optimise maintenance time for the rakes by providing ergonomic working environment to the staff & by providing all necessary resources (machines & material) within a consolidated infrastructure.

- Proposed State of the art maintenance facilities would increase the proportion of in-situ repairs, thereby, reducing the need for sick marking which shall also get replaced by fit wagons inside the maintenance shed.

16. Keeping the above in view, the present report for Next Generation Freight Maintenance Facility has been prepared. The facilities recommended comprise of following components:

(a) All Weather working environment with in-situ repair facilities:

All weather covered shed of 750 meter length having two examination lines, one sick line and one fit line with center to center distance of 8.2 meters for movement of mobile workstations for in situ repairs have been recommended. EOT cranes for lifting of sick wagons in the rake and their replacement with the fit wagons, requisite M&Ps and material handling equipment for in- situ repair of defective wagons have been proposed to release the rake faster and thus reduce the total detention of the rakes.

The infrastructural facilities required for different yards have been divided into following three categories:

i. **Infrastructure for Green field projects:** The infrastructure facilities include ‘all weather covered shed’ with EOT cranes and other M&P for in situ repairs in those examination yards that

have no constraints of space availability. The facilities may be provided in the space adjoining the existing yards. Existing yard facilities may continue in addition to the proposed facilities. Similar facilities are recommended for new yards which may come up in future

ii. **Infrastructure for Brown field projects:** The existing yards where space availability is a constraint but setting up all weather covered shed facilities is feasible on existing examination lines by readjusting the center to centre distance between the lines to enable in situ repairs by mobile work stations and other M&P are recommended for setting up same infrastructure facilities as have been proposed for Green Field Projects. In this case, the proposed infrastructure facilities shall replace the existing facilities on the lines earmarked for such up-gradation.

iii. **Modification in existing yards:** These facilities have been proposed in existing yards where provision of covered shed is not feasible. In these yards, the maintenance facilities can be upgraded by adjusting the center to center distance between lines to enable movement of material handling equipment and mobile work stations but without 'all weather covered shed' and EOT cranes. These facilities shall enhance the in-situ repairs and thereby the detachment of wagons shall be reduced.

The details of the above have been discussed in detail in Chapter 3:

(b) Wayside Diagnostic Equipment:

The wayside diagnostic equipment form part of the sanctioned Smart yard project of IR and include installation of 'State of the Art' wayside monitoring and detection equipment for diagnosing the defects in freight stock. These Equipment are proposed to be installed at strategic locations which shall provide advance information to the Train Examiner (TXR) about the defects in the rakes so that TXR can mobilise the material and other resources in advance for the repair of the defective wagons in the rakes.

The aim is to reduce overall detention of rakes and to improve quality of repairs in the examination yards.

The wayside diagnostic equipment include OMRS (including ABD, WILD/WCM), Hot box detectors, Machine vision equipment (Comprising of Wheel Profile recording, Bogie Performance/ Defect Detector, Brake Equipment & Shoes detection, CBC coupler and Body Under frame detection & hanging parts etc.). These facilities have been sanctioned for 40 yards and is being dealt by COFMOW.

Besides above, RFID tagging is being provided on all the wagons over IR and the Fixed RFID readers are being provided at different locations for identification of the wagons enroute. The work of RFID tagging on the wagons is being implemented by COFMOW whereas

the Fixed RFID readers are being provided by CRIS at different locations over IR.

This issue has been discussed in detail in Chapter 4.

(c) ICT integration of wayside diagnostic equipment with FMM:

The information gathered by wayside monitoring and detection equipment would be available at different IT platforms. The information needs to be integrated and be made available at a single IT platform so that the same is transferred seamlessly to FMM and is made available to Train Examiner (TXR) in advance in a consolidated form. ICT Integration of various wayside equipment and feeding the Data to FMM is a sanctioned project and is being dealt by COFMOW / RITES.

The issue has been discussed in detail in Chapter 5:

(d) Seamless integration with FMM and FOIS:

FMM (Freight Maintenance Module) has already been implemented over Indian Railways. The details related to Examination of rakes, attention to sick wagons and ROH are being updated in FMM on continuous basis. BPC is now being generated from FMM. The requirement of equipment for its full-scale utilization is being arranged by CRIS. Besides this, hand held equipment have been planned to be provided to TXRs for data entry directly into the system and uploading in FMM. The work is being dealt by CRIS and is currently at DE (Detailed Estimate) stage. Committee has recommended that these equipment must be provided to TXRs for effective updating of Data in FMM without duplication of efforts for recording the relevant data.

FMM has been recommended to be integrated with FOIS in the Yards so that real time information about the likely arising of the rakes for examination is available in advance with the TXR and he can do advance planning for arranging the resources for attending the freight rakes. It shall also enable to have common ID of the freight trains in FMM and FOIS. Seamless exchange of data between FMM and FOIS is considered one of the most important inputs needed for increasing wagon utilization efficiency.

17. Costing of the recommended facilities:

The Cost of the recommended facilities for ‘all Weather working environment’ is estimated to be Rs. 207 Cr for each Green Project / Brown Field Project. For the remaining Projects where provision of ‘all weather covered shed’ facilities is not feasible, the costing shall depend on the facilities planned by the concerned Railway and may be worked out from the details provided in this report for respective facilities.

The tentative cost of the recommended facilities has been provided in Chapter 7.

18. Projected benefits of the recommended facilities:

The projected benefits may include:

a) All weather environment facilities may reduce the total detention time of the rakes in the yards by more than 50%.

b) Capacity of existing Yards to handle the freight rakes may increase by more than double.

c) In all weather environment projects, complete rake shall be formed inside the covered shed including replacement of sick wagons with fit wagons without the need of round the clock shunting requirement. Shunting requirement may be limited to just one shunting in a day to remove major repair sick wagons and placement of fit wagons in the covered shed.

d) Since most of the defects would be rectified at the examination yard itself, there would less detachment of sick wagons. Due to less detachment of sick wagons, the ineffectiveness shall be reduced and the availability of wagons would increase. As a result, more freight rakes could be formed.

e) Due to better maintenance facilities, the quality of repairs may improve. This would be most useful for CC and Premium rakes. *(Premium & CC rake formation is guided mostly by operational needs).*

f) The wagon failure en-route would reduce due to better attention to wagons on account of better maintenance facilities.

g) Maintenance would be equally effective in day and night in all seasons leading to better reliability.

19. Based on the feedback received from different Railways, Green field projects are feasible at 11 locations and Brown field projects are feasible at 32 locations. List places at Annexure-3E in Chapter 3

It is recommended that ‘all weather environment facilities’ may be sanctioned at these locations on top priority.

For other examination yards, Zonal Railways may decide about their requirement of facilities in each Yard from the list of the recommended facilities in this report and get them sanctioned as advised by Board vide letter no. 2006/M(N)/951/28 dated 23-6-2021.

Chapter 1

INTODUCTION

1.0 Background

As per draft National Rail Plan (NRP) circulated by Indian railways, traffic is expected to become more than 6 times in the years to come.

As a first step on the path of NRP, Vision 2024 has been issued by Board, targeting to increase freight loading by 70%. This is planned to be achieved through increase in wagon population coupled with improved operations. It is imperative that the wagon maintenance practices and infrastructure are also formulated to meet the future needs.

In view of above, Railway Board vide letter no. 2006/M(N)/951/28 dated 23-6-2021 has requested the Zonal Railways to identify increased traffic flow in their respective zones and propose corresponding requirement for wagon maintenance infrastructure under 'traffic facilities works' for out of turn sanction in 2021-22.

With a view that proposals are drawn up for next generation 'State of the Art' facilities for freight maintenance facilities in Indian Railways Railway Board, vide their letter no. 2006/M(N)/951/28 Pt. 2 dated 25.06.2021, formed a committee of following officers:

1. Mr. G. K. Gupta, PCME/NFR – Convener.
2. Mr. P. K. Mandal, PCME/SER
3. Mr. S. Srivinas, PCME/SR
4. Mr. R. Rajagopal, PCME/ECoR

As per the Railway Board's letter Mr. Jitendra Singh, PED/CAMTECH, RDSO and other PCMEs were requested to provide requisite inputs to the committee to enable preparation of a comprehensive report. The committee was to co-opt any other member as deemed necessary. Accordingly, the Committee has co-opted following Officers:

1. Mr. Jitendra Singh, PED/CAMTECH, RDSO
2. Mr. Ajay Nandan, Sr. Prof/IRIMEE
3. Mr. P. Ananth, GM/CRIS
4. Mr. Vikas Purwar, CME/IT/COFMOW
5. Mr. Anirudh Kumar, CME/IT/COFMOW
6. Mr. Utkarsh, GM/CRIS
7. Mr. Manoj Kumar, Dir/CAMTECH

The Committee was directed to draw up a report detailing the recommended next Generation infrastructural facilities for freight train maintenance.

1.1 Terms of Reference

Railway Board vide its letter No.2006/M(N)/951/28 Pt.2 dated 25.06.2021 (Annexure-I) constituted a committee of four PCMEs and PED/CAMTECH to prepare a report to plan for next-generation freight maintenance facilities for examination of freight trains as per international practice at all major freight examination points. The following inputs were to be considered for the report:

i. All weather working environment.
ii. In-situ wagons repair capability during examination within the allotted time with minimum detachment.
iii. Requirement of suitable M&P including material handling equipment and T&P of the latest specifications
iv. Facilities to be integrated with 'Smart Yard' project.
v. Facilities should be suitable for seamless use of FMM in real time.
vi. Any other latest innovation / technologies etc.

The Committee had initial deliberations to finalise objectives and methodology of the report as discussed below:

1.2 Objectives

Objectives of the report was to finalize and lay down the requirement of infrastructural facilities in major freight Yards and maintenance Freight Depots so as to significantly increase the availability of freight rakes by reduction in detention of rakes in the yard from arrival to final departure (including examination of rakes and detachment/attachment of sick wagons) by more than 50% from existing time taken which varies from around 13 hrs for premium rakes to around 16 hrs for CC rakes. This may be achieved by the way of:

1. All weather working environment to-
    a. Improve in-service reliability of rakes.
    b. Reduce cost of overall repair in real terms.
    c. Improve wagon maintenance practices.
2. In-situ wagons repair capability during examination with minimum detachment.
3. In situ replacement of sick wagons with fit wagons to reduce shunting requirement and thus faster release of rakes

4. Requirement of suitable M&P including material handling equipment and T&P of the latest specifications.

5. Facilities to be integrated with wayside diagnostic equipment sanctioned under 'Smart Yard' project.

6. Facilities for seamless integration of data generated from Wayside equipment with FMM and to be made available the same to TXR in advance in report form indicating the defects in the rake that need attention on real time basis.

7. Any other latest innovation / technologies etc.

1.3 Need to develop 'State of the Art' Freight Train examination facilities

Freight operation on IR contributes over 70% of the total revenue earned by providing nationwide Freight and Passenger transport services. Availability and reliability of Freight stock plays very important role in enhancing IR's efficiency and profitability.

Operation of freight train involves three distinctive productive cycles as under-

a) Movement of loaded /empty rakes,
b) Material/goods loading/unloading in Goods shed and
c) Safety examination & preventive maintenance schedules to ensure safety and reliability.

Each of these movement is accompanied by delays which can be minimized eg Pre departure delays, waiting time for placement for examination and loading/Unloading). By minimizing these delays, IR's profitability can be further enhanced.

Thus, overall efficiency and profitability of IR can be enhanced by optimizing operations in following areas-

a) Maximise loaded movement,
b) Minimise empty movement,
c) Improving loaded to empty movement ratio,
d) Reduction in loading & unloading time and
e) Reduction in time taken from arrival to departure in yards (including rake examination and shunting activities for detachment /attachment).

The scope of this report is limited to the optimization of total time required from arrival of rake to its departure including freight train examination and shunting activities.

There is no denying fact that Timely safety examination and preventive schedule maintenance of Freight Stock improves safety and reliability in train operation and enhances IR's earning and profitability. Thus, every effort of

providing technological inputs in train examination and maintenance activities, in situ repairs and replacement of sick wagons with fit wagons there itself may provide possibility of reduction in overall detention of the rakes in the yards and increase the availability of rolling stock for revenue earning.

Typically, on IR time taken in freight train examination is about 4-5 hrs whereas pre-examination and post examination activities account for 10 -12 hrs before the examined rake is made available for loading. This report is an effort to identify technological inputs to bring quantum improvement in freight train examination, automated detection of defects of rolling stock and replacing sick wagons with fit wagons inside the 'all weather environment' facilities.

1.4 Methodology Adopted

It was decided by Committee members to co-opt concerned Officers from CAMTECH, COFMOW, CRIS, IRIMEE and WPO/Patna to provide inputs to the committee for the related areas being dealt by them. All Zonal Railways were distributed among Committee members to coordinate and collect relevant information from them.

The following reports, publications and proposals have been taken into consideration:

i. Publications/Reports

a. **Standardization of Infrastructural facilities for Freight Stock maintenance**, Report No. CAMTECH/2003/M/INF-STD/1.0ofAugust2003

b. **Infrastructural facilities and layout of freight examination yard with world class facilities,** Report No. CAMTECH/2008/M/W/INFRA./1.0 of January 2008.

c. **Mechanized loading unloading of BOXN wagon** CAMTECH/M/W/Mechanized loading/unloading/1.0 Sept- 2010.

d. **Guidelines for Maintenance of Stainless-Steel wagons** Report No. M/W/SS wagon-1.1 of August 2013.

e. **Guidelines for Standardization of Infrastructural Facilities for Examination of BTPN wagons in ROH depots & Yards** Report No CAMTECH/2014-15/M/INF-BTPN/1.0 of January 2015.

f. **Wagon Maintenance Manual** No. CAMTECH/GWL/MECH/WMM/1.0 December 2015.

g. **Standardization of infrastructural facilities for CC rake maintenance depot Report No.** IRCAMTECH/M/GWL/2017/STD. CC. Rake depot/1.0 May 2017.

h. Final Report on Conversion of Freight Yards into Smart Yards, June - 2019, by RITES

ii. Suggestions from Zonal Railways were collected regarding present practices and infrastructural facilities required for 'next generation freight maintenance facilities' for wagon maintenance.

iii. The Committee studied requirement of suitable M&P, measuring instruments and others facilities required for next generation freight examination yard.

iv. Data of sick marking of wagons was collected to make analysis with a view to plan the infrastructure.

v. Analysis of data from arrival of a rake till departure of rake after examination has been carried out.

vi. Analysis of data regarding Rake examination, space availability, Sick line outturn etc. received from SER, ECR, NFR, ER & NWR, is considered. It is revealed that at present, only some depots deal more than 8 to 10 rakes per day. In other Depots, though the average number of rakes examined is less than 5 rake per day but the same may increase significantly in future in view of the projected increase in loading targets of IR as per NRP (National rail plan).

vii. Majority of the depots have space constraints for further expansion. All weather environment facilities may be provided where ever space for expansion is available in existing yards or in the new yards which may come up in future or the yards which may accommodate all weather covered shed facilities above existing examination lines. For other examination yards, Zonal Railways may decide about their requirement of facilities in each Yard from the list of the recommended facilities in this report.

Chapter 2

ANALYSIS OF DATA

Analysis of data collected from various Zonal Railways is done to highlight the problem area, shortcomings and constrain areas in the present system of freight train maintenance so that future planning can address the issues.

2.1 Rake Arrival to Departure Time in Examination Yard

Detention of freight rakes in the examination yard is an important parameter to be monitored to see overall availability of rake for loading. For analysis the total time from the rake arrival to its departure can be divided in to the following parts:

- Time from arrival to start of examination
- Time for examination
- Completion of examination to departure time

Data from 11 major yards of 7 Zonal Railways (SER, ECR, ECoR, WCR, SECR, SCR and SR) for the year 2020-21 is placed at Annexure 2A. The Summary of average timings for various types of examinations is as under:

Type of Examination	Arrival to start of examination (HH:MM)	Examination time (HH:MM)	Examination to departure (HH:MM)	Arrival to departure (HH:MM)
Close Circuit (CC)	1:46	8:02	9:00	18:49
PREMIUM	2:25	6:41	8:31	17:39
END TO END	2:54	4:32	7:34	15:01

From the data it is seen that bulk of the time (about 50% of total detention) is between completion of examination to the departure of rake. This time is mainly taken for carrying out shunting operations for detachment of wagons on account of POH/ROH/sickness and attaching of fit wagons. The figure varies widely among yard to yard (from 4:00 hrs minimum to 17:22 hrs maximum). More is the number of wagons to be detached; the shunting time is more, as the wagons needing detachment are at different positions in the rake. The other factors that affect shunting time are yard layout, availability of shunting engine, other shunting being carried out in same yard, availability of fit wagons etc. In order to increase utilization of the freight rakes: the future infrastructural facilities should address the issues with

a view to significantly reduce detachments by doing more repairs during examination during examination as well as better method for replacement of wagons that cannot avoid detachment.

Waiting time before the rake examination is also a matter of concern. High waiting time indicates lack of proper planning/co-ordination between the traffic and mechanical branches at field level as well as provision of insufficient manpower for rake examination. The examination time can reduced to optimum level by deployment of required manpower.

2.2 Depot wise Rake examination and Sick line outturn

Railway Board data of freight train examination data show that around 10,000 rakes are examined per month in Indian railway out of which about 20% are PME for CC rakes, 37% premium examination and balance 43% End to End examination. The tabulated data at Annexure 2B, collected from 63 major examination yards of 10 Zonal Railways viz. ECR, ER, NFR, NWR, SER, SCR, CR, SR, SWR and WR, also confirms the same.

The high % of End to End examination indicate insufficiency of facilities at the yards to carry out repairs during the examination to make the wagons fit for multiple loading, run for longer duration and thus make premium rakes. Up-gradations of the facilities would result the most of the rakes to operate as CC rakes and premium rakes which in turn would increase overall rake availability for traffic use.

From the data of sick repairs in the 63 major examination yards it is also seen that number of sick wagons (other than POH & ROH) per rake works out to be varying vastly among the various examination yards ranging from 0.7 wagons to 7 wagons. However, as per the data, the average sick per rake is 3.2 wagons. It shows the inadequacy of repair facilities at many yards as well as damage being caused to wagons during loading/unloading at many places.

2.3 Analysis of Detachment of wagons during examination of rakes:

The committee examined the major category for wagon detachment during the examination. The data of detachment of wagons from rake due to sickness, for ROH and for POH for the last two years viz. 2019-20 and 2020-21, collected from 10 major yards from SER, ER, ECR, ECoR, WCR, SECR, NFR and SCR is placed at Annexure 2C.

The data indicate that on the major cause of detachment is due to sickness of wagons. Proportion of sick detachment is maximum in SER and ECoR, where it contributes about 80%, and minimum in SECR (BIA) where it is about 40% (in 2020-21). Sick detachment of other Railways other zonal railways fall in between. The proportion of detachment for ROH and POH is less. The average summarized position of major causes for detachment for the year 2019-20 and 2020-21 is tabulated below.

DETACHMENTS	2019-20	2020-21
Sick detachment	47.56%	52.6%
ROH detachment	29.63%	23.32%
POH detachment	10.95%	10.59%
NPOH/ 'C 'category repair	6.75%	5.93%
Other detachments	5.13%	7.57%

Average ROH & POH detachment contributed 40.58% and 33.91% in 2019-20 and 2020-21 respectively whereas the other detachments are due to wagon sickness, damage etc.

A further analysis of detachments due to sickness/damage of wagons from the above yards/zones indicate the following system wise breakup:

BREAKUP OF SICK DETACHMENTS	2019 - 20	2020 - 21
Spring broken	0.11%	0.07%
Hot Axle/warm box/CTRB failure	1.25%	0.95%
Wheel defects	1.90%	2.07%
Air brake system failure (DV, BC, SAB, APM defects etc)	3.15%	4.30%
Brake gear/Brake rigging defects	1.26%	1.34%
EM pad defects	0.52%	1.01%
Door defects	16.33%	17.52%
Body damage (Side/End panel)	13.16%	14.12%
Floor damage	5.93%	6.45%
CBC, draft gear defects	2.53%	2.73%
Center pivot, side bearer defects	1.41%	2.04%

The above data indicates that the major concern areas for sickness are door defects, body damage, floor damage, Air brake system, CBC and Draft gear defects. The majority of the sickness is due to damages in door, body and floor with combined contribution of 35.42% in 2019-20 and 38.09% in 2020-21 of sick detachment. The damages in door, body and floor are mostly caused during loading/unloading of wagons and thus is the matter of concern.

Detachment due to majority of the defects indicated in the table can be minimized if upgraded facilities as indicated in subsequent chapters are provided at the examination yards itself for in situ repair of the wagons. For eliminating POH/ROH detachments in CC rakes during examination, it can be planned that the individual CC rakes be formed from the OFF POH wagons or OFF ROH wagons. Complete rake can be sent for POH or ROH whenever due.

The analyses of the data show that following areas must be addressed, in addition to other technological up-gradations, to decrease rake detention at examination yards:

- Facilities for in situ repair
- Alternate/efficient method of wagon replacement at examination yard
- All weather examination facility
- Steps to minimize wagon damages during loading/unloading
- Provision of adequate manpower

ANNEXURE 2A

Analysis of Time Taken from Arrival to Departure of a Rake (Period 2020-21)

RLY	DEPOT	TYPE OF EXAM	ARRIVAL TO EXAM START (HH:MM)	EXAM START TO FIT (HH:MM)	FIT TO RELEASE (HH:MM)	RAKE ARRIVAL TO DEPERTURE (HH:MM)
SER	BNDM	PME	0:47	6:03	10:03	16:53
		PRE	2:03	4:34	9:18	15:55
		E TO E	1:09	3:13	7:14	11:36
	BKSC	PME	0:52	5:04	10:52	16:48
		PRE	0:48	4:36	7:12	12:36
		E TO E	1:07	2:42	4:43	8:32
	NMP	PME	2:15	6:12	5:19	13:46
		PRE	4:18	2:27	4:34	11:19
		E TO E	2:58	2:21	4:23	9:42
ECR	DDU	PME	1:05	6:27	8:52	16:24
		PRE	1:03	6:04	10:47	17:54
		E TO E	0:58	4:38	8:06	13:42
ECoR	VSKP	PME	4:00	5:30	8:15	17:45
		PRE	3:15	3:30	10:00	16:45
		E TO E	6:30	3:15	6:15	16:00
WCR	NKJ	PME	1:45	5:23	12:27	19:35
		PRE	1:58	5:10	11:26	18:34
		E TO E	4:51	4:27	17:22	2:40
SECR	BIA	PME	2:57	4:15	7:40	14:52
		PRE	2:38	4:11	7:02	13:51
		E TO E	3:26	3:26	4:35	11:27
SCR	BZA	PME	0:15	4:50	4:45	9:50
		PRE	0:15	3:45	5:30	9:30
		E TO E	0:15	3:25	4:00	7:40
SR	JTJ	PME	0:50	19:16	8:00	28:06
		PRE	2:07	15:23	7:01	24:31
		E TO E	2:24	7:49	9:40	19:53
	TNPM	PME	2:55	17:26	13:52	34:13
		PRE	7:25	19:15	16:42	43:22
		E TO E	7:18	10:51	11:40	29:49
	ED	PME				0:00
		PRE	0:55	4:45	4:12	9:52
		E TO E	0:59	3:52	5:22	10:13
		TOTAL	76:21:00	204:05:00	267:09:00	547:35:00
		AVG	**2:23:09**	**6:22:39**	**8:20:54**	**17:06:43**

ANNEXURE 2B

Analysis of Depot wise Rake Examined and Sick Line Outturn

SL. NO	RLY.	FREIGHT DEPOT	CC	PRE.	END TO END	TOTAL	NO OF RAKES EXAMINED PER DAY	SICK LINE OUT TURN
1	ECR	DDU	180	224	66	470	15.67	1270
2		PEH	22	21.1	43.5	86.6	2.89	201.3
3		BRWD	17.9	18.7	26.9	63.5	2.12	249.4
4		PTRU	0	59	15.8	74.8	2.49	344.9
5		OBRA	5.3	16.3	28.3	49.9	1.66	223.1
6		NRPA	0	44	5	49	1.63	53
7		GHZ	0	14	2	16	0.53	40
1	ER	PAKUR	23	35	37	95	3.17	239
2		NH	0	17	47	64	2.13	300
3		CHITPUR	15	23	3	41	1.37	240
4		UP YD/UDL	33	13	59	72	2.40	232
5		EMPTY YD / UDL	0	4	44	48	1.60	293
6		WDD/ UDL	0	1	110	111	3.70	
7		DSEY/ UDL	0	36	162	198	6.60	301
8		SITARAMPUR YD	0	0	29	29	0.97	39
9		HIRAPUR YD	0	0	101	101	3.37	
10		MALDA YD	1	31	12	44	1.47	33
11		JAMALPUR YD	0	2	19	21	0.70	15
1	NFR	NJP	10	96	37	143	4.77	304
2		NBQ	0	50	46	96	3.20	160
3		NGC	0	93	33	126	4.20	522
4		NTSK	0	27	6	33	1.10	194
1	NWR	PHULERA	11	88	32	131	4.37	101

1	SER	BNDM	47	68	170	285	9.52	1757
2		ADTP	43	56	59	157	5.25	892
3		TATA	0	22	208	231	7.69	390
4		DPS	8	21	55	84	2.80	436
5		NMP	33	89	82	204	6.80	911
6		HLZ	0	0	246	246	8.20	1118
7		BKSC	48	57	167	272	9.07	1469.58
8		BJE	3	64	65	132.0	4.40	899.33
1	SCR	BZA	90	35	36	161	5.37	525
2		GY	52	35	30	117	3.90	356
3		RDM	62	45	16	123	4.10	434
4		COA	14	40	50	104	3.47	175
5		BPA	0	88	32	120	4.00	543
6		SNF	19	43	17	79	2.63	78
7		DKJ	0	20	11	31	1.03	79
1	CR	BSL	61	99	49	209	6.97	553
2		AQ	25	13	25	63	2.10	37
3		KYN	0	17	64	81	2.70	119
4		DD	6	21	21	46	1.53	26
5		WD	8	18	11	37	1.23	85
6		MRJ	0	33	20	53	1.77	106
1	SR	JTJ	11	27	28	66	2.20	300
2		TNPM	18	21	66	105	3.50	390
3		IPN	10	6	3	19	0.63	81
4		AJJ	21	0	10	31	1.03	30
5		ED	0.6	50	29	79.6	2.65	56
6		MAJN	1	40	14	55	1.83	184
7		ERM	3	17	7	27	0.90	20
8		MVN	0	20	7	27	0.90	30
9		TPGY	4	21	16	41	1.37	127
1	SWR	HPT	43	12	27	72	2.40	256

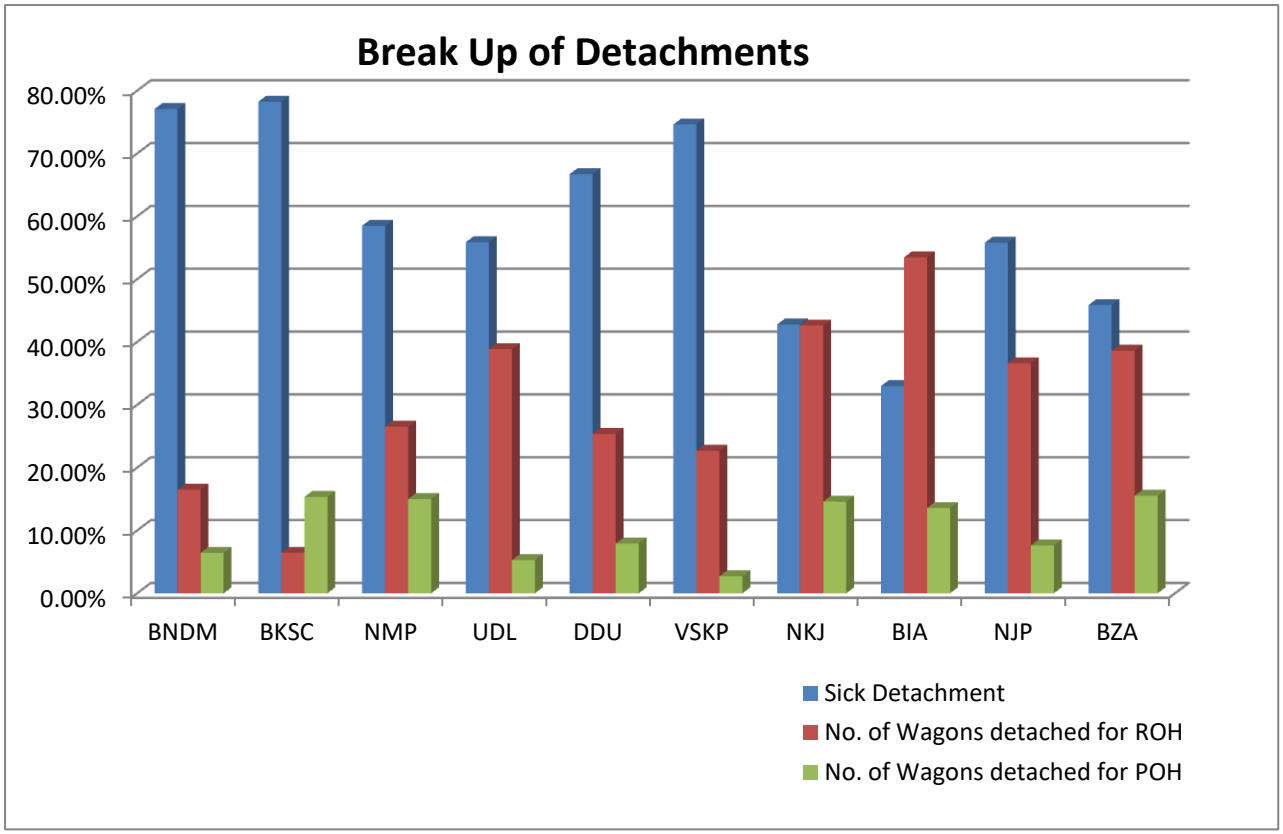
2		NVU	0	14	13	27	0.90	92
3		SGT	11	28	49	88	2.93	85
4		HRR	0	28	15	43	1.43	62
5		MNGT	0	22	12	34	1.13	69
1	WR	SBI	40	11	9	60	2.00	163
2		GIM	52	147	33	232	7.73	769
3		KRCA	49	64	6	119	3.97	412
4		SMP	48	80	18	146	4.87	551
5		HXP	5	77	32	114	3.80	161
TOTAL			1153.8	2482.1	2792.5	6383.4	212.81	20181.61

Average sick marking/Rake: 3.2 wagons

ANNEXURE 2C

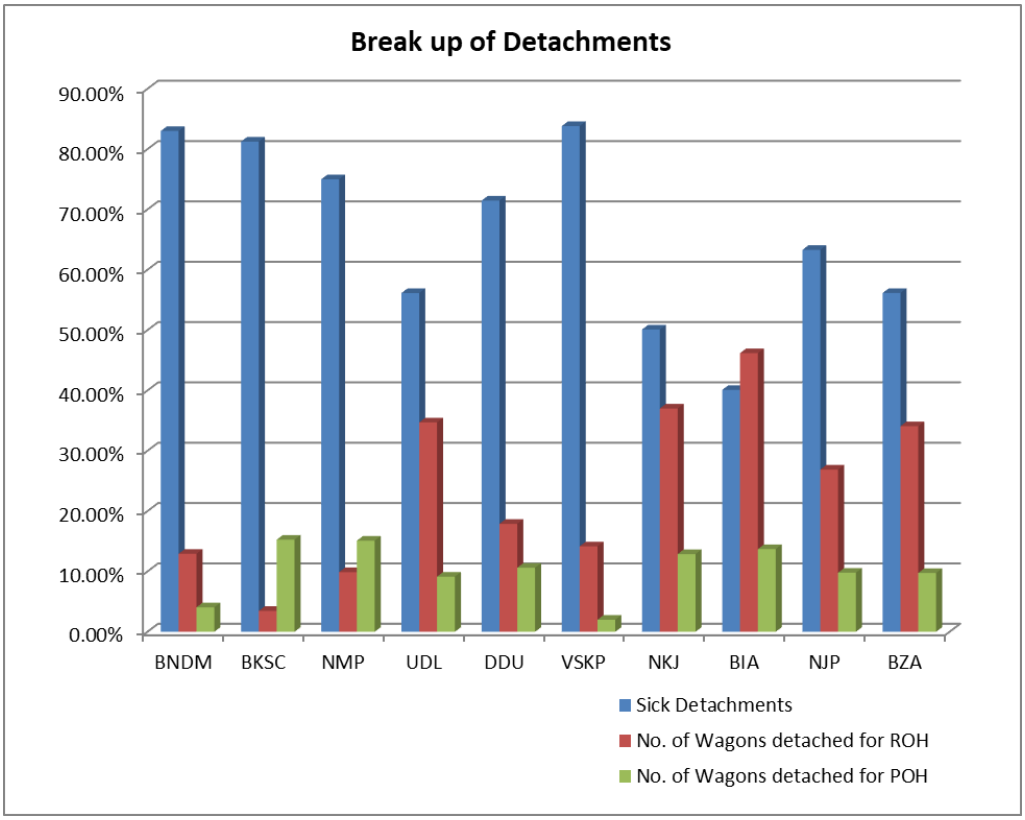
Break Up of Detachments -Percentage of total detachment for 2019-20

Items	SER	SER	SER	ER	ECR	ECoR	WCR	SECR	NFR	SCR
	BNDM	BKSC	NMP	UDL	DDU	VSKP	NKJ	BIA	NJP	BZA
Sick Detachment	77.08	78.23	58.48	55.87	66.70	74.62	42.79	32.98	55.79	45.87
No. of Wagons detached for ROH	16.48	6.44	26.51	38.86	25.38	22.68	42.62	53.46	36.60	38.61
No. of Wagons detached for POH	6.44	15.33	15.00	5.26	7.92	2.70	14.59	13.57	7.60	15.52



Break Up of Detachments 2020-21

Items	SER BNDM	SER BKSC	SER NMP	ER UDL	ECR DDU	ECoR VSKP	WCR NKJ	SECR BIA	NFR NJP	SCR BZA
Sick Detachments	83.01%	81.25%	75.00%	56.15%	71.47%	83.83%	50.10%	40.10%	63.31%	56.16%
No. of Wagons detached for ROH	12.93%	3.48%	9.89%	34.71%	17.90%	14.17%	37.01%	46.19%	26.90%	34.08%
No. of Wagons detached for POH	4.06%	15.27%	15.11%	9.14%	10.62%	2.00%	12.88%	13.71%	9.79%	9.76%



Chapter 3

ALL WEATHER WORKING ENVIRONMENT AND NEXT GENERATION INFRASTRUCTURE FACILITIES

3.1 DISCUSSION ON EXISTING SYSTEM OF MAINTENANCE

The present system of freight train examination in Indian Railway (IR) comprises of:-

1) Rolling-in examination of the rake while entering the yard of the train examining depot to detect undergear defects in motion.

2) Axle box feeling just after stopping of rake to detect warm/hot axle bearing

3) Examination of the rake and Air Brake testing of the rake as per IRCA Part – III. And carry out the repairs which can be attended in the yard.

4) Wagons that require repairs at sick line and wagons due for ROH/POH are marked for detachment from the rake.

5) The shunting operation is done to detach the sick wagons and attach fit wagons from available pool of fit wagons available in the yard to complete the rake.

6) After complete formation of the rake, engine is attached on train. Thereafter, TXR certifies air pressure continuity and issues Brake Power Certificate (BPC).

7) Over the years, pattern of train examination has been transformed. Concept of Premium rakes having validity of Brake Power Certificate (BPC) for 12+3 days and Closed Circuit (CC) rakes having validity of Brake Power Certificate (BPC) for 30+5 days has been introduced which has facilitated multiple loading/unloading between next examination of the rakes. This in turn has resulted in increased availability and enhanced earning for IR..

8) More than 10000 rakes are examined per month over IR. For examination and maintenance of these rakes, IR have a network of 120 examination depots that include 60 depots for CC examination and 49 ROH depots.

9) As has been noted in the analysis described in the previous chapter, major portion of the time consumed in the yards is for carrying out pre-examination and post examination activities including shunting operations for detaching sick marked wagons and attaching fit wagons. These activities in most cases take about 09 to 10 hrs. whereas the examination time taken by Train Examiner (TXR) varies from 3.5 hrs to 5.5 hrs depending upon the type of examination.

   Rake availability can be significantly enhanced by reducing its detention at examination yards. This can be achieved by utilizing latest ‘State of Art next Generation all weather infrastructure facilities’ for train examination and repairs as discussed below.

3.2 DISCUSSIONS ON PROPOSED SYSTEM:

The next generation infrastructure facilities for freight maintenance must be directed to carry out maximum repairs in the wagons in situ in the yard during examination and thereby to minimize the detachment of wagons.

A system for freight train examination that emerge out for next Generation of maintenance facilities is as under:

- All weather covered shed with EOT cranes plans may be provided for the examination and repair of the rakes where ever adequate space is available in the existing yards or may be provided in the new yards that may come up in future. All weather working environment may enable to carry out the maintenance and repairs without any hindrance in any weather conditions.

- Well before a rake is placed for examination, the details of defects to be attended is made available to the Train Examiner from wayside diagnostic equipment through FMM. The train examiner may plan in advance the required material and other resources for the maintenance of the rake.

- Once the rake is placed in the examination line, maintenance and repair activities may be carried out.

- The wagons requiring heavy repairs and those due for ROH and POH may be separated by creating gap by RCRV or a dedicated battery operated shunting engine and are subsequently lifted by EOT cranes and placed in adjoining sick line. These wagons may be replaced with the fit wagons available in adjoining fit line.

  Thus, the replacement of damaged wagons may be undertaken in the examination depot itself without any shunting requirement. The due ROH/POH and damaged wagons may be removed from the covered shed and the fit wagons may be placed in the shed once in a day.

- Forecast about the likely time of release of complete rake can be given in advance to the traffic to arrange the Locomotive for departure of train.

  It is expected that the proposed system may reduce the total detention to the rakes in the yard by more than 50%.

The provision of the proposed facilities may be differentiated for following three types of scenarios in Indian Railways:

(i) Green Field Projects: Projects having no constraints of space availability for covered sheds and other facilities.
(ii) Brown Field Projects: Projects at existing examination yards that may have some constraints in space availability but setting up all weather covered shed facilities is feasible with modifications on the existing lines.
(iii) Modification in existing yards: Existing examination yards where covered sheds are not feasible.

The list of yards/locations where Green Field and Brown Field projects are feasible, as per the feedback taken from the zonal railways, is placed at Annexure-3E.

It has also been noted that most of the wagons in Indian railway are of BOXN and BCN type and therefore the facilities being recommended are primarily for maintenance of these wagons. However, other type of wagons can also be maintained in the proposed infrastructure facilities. The facilities being recommended are for examination yards dealing with upto 10 rakes per day. For yards dealing with more than 10 rakes, the facilities to be added in multiple of these.

The main features of the proposed all weather environment maintenance facility are as under:

3.2.1 All Weather Covered Shed (Indicative diagrams are placed as Annexure 3A and 3B. Actual layout may be planned as per local requirements and conditions prevalent at site)

(a) Length of Shed

The length of covered shed is proposed to be 750 meters to accommodate full rake length and also to create gaps between the wagons which are required to be detached and placed on adjoining sick line. The gantry of the shed must be designed for holding eight numbers of 20/5 Ton EOT cranes.

(b) Number of Lines in the Shed

Four lines are proposed to be provided inside the Covered Shed. Two lines (1st and 3rd) shall be the rake examination lines. The 2nd line shall be the sick wagon line which shall be utilized for keeping detached wagons (i.e. heavy repair wagons, overdue ROH and POH wagons) lifted from the examination lines (1st and 3rd lines). The sick wagons marked for detachment shall be lifted by EOT cranes and placed on adjoining sick line. The 4th line is meant for keeping fit wagons. The fit wagons can be placed in adjoining 3rd line (rake examination line) by EOT cranes and the full rake may be formed. However, for attaching fit wagons to the 1st line (rake examination line), the same may be taken in one hook from fit line by dedicated battery operated RCRV provided inside the shed for this purpose.

Thus, the full rake may be formed and made ready for departure without any need of yard shunting which otherwise is the major cause of detention in the yards.

(c) Center to Center distance between the lines and Width of the Shed

There has to be adequate space on both sides of the examination lines for facilitating movement of mobile work stations, scissor lifter and other necessary

equipment for carrying out in situ repairs. It has been recommended that the center to center distance between the adjoining tracks may be kept as 8.2 meters so that clear 5.0 m pathway is available after leaving the space occupied by the wagon body on adjoining lines, considering overall width of 3.2 m for BOXN/BCN wagons. This would ensure seamless movement of mobile work station and other equipment all along the pathway for carrying out in situ repairs on the wagons.

To limit the overall width of the shed to 35 m (considered as optimal beyond which provision of crane gantry is not readily available), the distance of the track centres of 1st line and 4th line with the fixed structure have been adjusted according to the requirement of respective lines. Being the examination line, the distance of 6 m is proposed between the 1st line to fixed structure, leaving clear pathway of 4.4 meter. On the other hand, the distance between the 4th line (fit wagon line) from fixed structure has been kept at 4.4 m, leaving clear pathway of 2.8 meter as no repair activity to wagon is planned on this line.

Staircase to attend the EOT Cranes and its Gantry to be provided outside the shed on both ends. Also, vertical ladders to be provided along the shed structure columns to reach intermediate EOT Cranes.

(d) Height of the Shed

After lot of discussions, it was unanimously agreed that wagon over wagon movement is not safe for staff working inside the covered shed in the examination yard. The wagons required to be lifted for removal from examination line or placement from fit line may be lifted to safe height only by EOT cranes for movement from one line to another. The gantry height for the EOT cranes is thus considered to be 10 meters. The clear height of the shed may accordingly be kept as 13 m.

(e) Flooring

The complete area under covered shed to be provided with VD (Vacuum Dewatered) flooring. Higher strength, Greater Durability, High Abrasion Resistance flooring may enable ease of movement of material handling equipment, mobile work stations and other equipment for in situ repair of wagons. Shed floor should be suitably designed to avoid any stagnation of water inside the shed. Suitable drainage system with pump to be provided for removal of any stagnant water due to flooding during rainy season.

(f) Roof and side walls of the Shed

Covered shed roof as well as side walls may be provided with 30% translucent Perspex sheets and piped lights for natural light. Also roof turbo ventilators to be provided for proper ventilation inside the shed.*).* Side walls may be covered from roof top till the height of lean shed

(g) Lean to Shed

Lean to shed at a height of minimum 5 m and minimum 6m width may be provided at both sided of the shed to keep equipment and material for maintenance of rakes.

NOTE: There may be locations where it is not feasible to have 35 m wide covered shed due to space constraints. At such locations covered shed of 30 m width may be provided with 3 lines inside the covered shed having the center to center track distance of 8.2 m. The 1st and the 3rd lines to be the examination lines and the 2nd line be the sick cum fit wagon line. Detachment of wagons as well as attachment of wagons to be done by EOT cranes. For this, the fit wagons may be kept at one end. The detached wagons to be moved to one end and the fit wagons to be attached to be attached from the other end of the shed.

This system of three lines inside the covered shed shall involve excessive movement of lifted wagons towards one end of the shed and is thus not recommended unless the situation so demands that there is no other alternative. The length and the height of the shed remaining as discussed above. Indicative diagrams at Annexure 3C and 3D. Actual layout may be planned as per local requirements and conditions prevalent at site.

3.2.2 Mobile Workstations

Mobile workstations play vital role for in situ repair of wagons in the rake under examination and thus reduce number of detachments. The mobile workstations to be mounted on a suitable road vehicle (either engine operated or battery operated) modified to contain facilities/equipment to attend:-

- Wagon body, floor & door repairs
- Air brake systems repairs
- Brake rigging repairs
- Repairs related to coupler
- Spring, EM Pad changing, side bearer repair etc

The workstation shall also carry the regular spares required for replacement (such as brake block, knuckle, knuckle pin, air hoses, EM pad etc) and items needed for other repairs (such as door, body panel, CBC wear plate, yoke support plate, spring, DV etc).

Other important equipment proposed to be carried on the mobile work station are:-

- Plasma cutting machine for SS wagons– 1 No
- MIG/MAG welding machine for SS wagons – 1 No
- Gas cutting set – 1 No.
- Huck bolting machine – 1 No.
- Hand operated hydraulic jack 10 T – 2 Nos
- Portable electric/pneumatic grinder – 1 No.
- Other tools/spares - as per requirement after preliminary checking of the rake, the Work stations shall move from both sides of the rake to the wagons to be attended. Items to be replenished after the work in a rake is completed and to be ready for next rake. The requirement of mobile work stations is proposed to be @ 2 Nos. per examination line which shall move on either side of the rake and hence total 4 Nos. are required in each yard.

3.2.3 Self Propelled Battery Operated Scissor Lift

Mobile scissor lift is required to facilitate attending repairs at the upper portion of wagons such as door, body, roof etc. It may move behind the mobile workstation and to be utilized wherever needed. Lifting capacity of 500 Kg is considered sufficient. It should be self-propelled, battery operated and have lifting height of platform up to 4.5 m. Three such scissor lifts per examination line are proposed that include one scissor under battery charging. Hence total 06 (six) scissor lifts per shed are proposed to be provided.

3.2.4 EOT Crane

EOT crane in the covered shed is required for lifting of the wagons marked for detachment due to heavy repairs or due for ROH/POH and placing them on adjoining sick line instead of conventional method of shunting which is time consuming. Fit wagons are also to be attached to the rake by lifting from the fit wagons line. The lifting and shifting is quite efficient operation and would save the time for wagon replacement in the rake substantially.

It is considered that the EOT cranes may be placed at equidistance of 100 meters for their effective utilization and to prevent long travel of the lifted wagons. Accordingly, 08 numbers of EOT cranes of 20 T capacity covering entire length of the covered shed on the stipulation that 2 cranes are utilized for lifting one wagon and 04 wagons can be handled simultaneously. The EOT cranes should be fit for operation in pairs by synchronization. Higher capacity EOT cranes for lifting one

wagon by single crane has not been considered as it requires bigger and complicated lifting tackle with slings which is not easy to handle and it may not be suitable for all type of wagons to be lifted.

3.2.5 Battery operated Rail cum Road Shunting Vehicle

For making the examination depot self sufficient regarding minor shunting requirements for creating gaps between the wagons for their replacement by EOT cranes, a battery operated Rail cum Road Vehicle (RCRV) is proposed to be provided. The RCRV may also be utilized for shunting of wagons within the covered shed as and when required. A RCRV of 2000 T is considered sufficient to meet the shunting requirement. Minimum two such RCRV vehicles should be provided per depot for meeting the requirement of both the examination lines as per requirement as well to fulfill the requirement of periodic charging every day. Such RCRV has been provided at MLR workshop for LHB coach at Sonipat by RVNL.

3.2.6 Examination Yard Connectivity and Shunting Neck

The examination yard should have connectivity to mainline/ stabling yard from both the ends for placement and dispatch of rakes. Shunting neck may be provided at both the ends of the examination yard so that independent shunting operation of wagons could be carried out whenever required without any disturbance to main line. Spare stabling lines may be provided for traffic use as indicated in the drawing for keeping the spare rakes or any other allied activity. Existing Main sick line sheds for heavy repairs and ROH Depots with all infrastructure facilities would continue to remain attached to freight examination yard.

3.2.7 Illumination

In order to facilitate round the clock proper working with same efficiency and productivity, the examination yard must be provided with adequate lighting system to have an illumination level of 150 Lux during night. It is proposed that 150 W LED based lights may be provided inside the covered shed. 90 W LED Street light may be provided around the covered shed.

For round the clock examination of undergear of the wagons, it is proposed to provide knee height focused lights all along the examination lines as discussed below.

3.2.8 Knee Height focused lights

Wagon undergear portions generally fall in the shadows. It is not feasible to examine the undergear properly during night unless adequate lighting arrangement is made for undergear examination. One of the reasons for enroute

un-usuals experienced in the freight trains is the absence of such facilities in the existing yards.

There is need to provide adequate lighting arrangement for proper examination and repair of under gear components. It is proposed to provide Knee height lighting system with swiveling arrangement at an interval of 10 m along both sides of each examination line for examination/repair of undergear of the wagons. For the examination line near one side of the side wall, the lighting arrangement can be provided on the side pillars. Electrical panel with junction box and plug point of 3 phase 415V may be co-located with these lights for operation of small electric tools like grinders, portable CO_2 welding plants etc.

3.2.9 Welding points along the track

Welding is one of the important activities required for in situ repair of wagons. It is proposed to provide welding points at a distance of 10 meters all along the examination lines. The welding points may be co-located with the knee height focused lights to avoid creation of any additional obstruction in the pathways. Proper return current line and earth pits must be provided at suitable location. The requirement of welding facilities for attending Stainless Steel wagons have been proposed to be provided in the mobile work station as discussed above.

3.2.10 Compressed air line along the examination lines

Compressed air is required for air brake testing, plasma cutting, operating pneumatic grinders, riveting, huck bolting etc. Underground Pneumatic pipe line is proposed to be provided along the examination line with tapping at a distance of 20m interval at the alternate location of lighting points provided for undergear attention. Proper slope in pipe lines and water separator at both the ends of the shed or any other convenient location may be provided for avoiding any accumulation of water inside the pipe line. For the Leak proof system, Aluminum pipes are proposed to be used for supply of Compressed Air as has been provided at Sakurbasti and MCF, Raibarelli. Brief details provided at Appendix 9

3.2.11 High Resolution CCTV Cameras

As seen while discussing the analysis of cause of wagon detachments, the major areas of repairs to wagon are damage to the body, door and floor of the wagons. It is considered essential that if such damages and defects are known before the rake is placed on the examination lines, the time required for identification such repairs can be minimised.

High resolution CCTV cameras are proposed to be provided at the entrance of covered shed at both the ends for inspection of floor of open wagons and roof of covered wagons besides the repairs required on the body of the wagons. Three CCTV cameras i.e. one for inspecting the roof / floor from the top and two CCTV

cameras to see both sides of the wagon body are proposed to be provided on both ends of each examination line. Total CCTV Cameras may be six per examination line.

3.2.12 Stand Alone RFID Reader

Since all the wagons over Indian Railways are being provided with RFID tags, it is proposed that Standalone RFID readers are provided at both ends of the examination line to read the wagon numbers of the rake and match with the rake ID. It may be suitably integrated with CCTV camera provided for wagon inspection. Two RFID readers per examination line are required.

3.2.13 Handheld RFID Reader

Hand held RFID readers may be provided to the train examining staff (TXR) to record detachment and attachment of wagons. Four such systems per examination line are proposed to be provided.

3.2.14 Personal Digital Assistant

TXRs should be provided with rugged Industrial type Personal Digital Assistant (PDA) having pre-fed check sheets for recalling the data transmitted by road side diagnostic equipment through FMM so that they may plan and arrange the resources to attend the wagons in advance. They may also decide in advance about the wagons that may be attended in-situ and the wagons that may be required to be detached for attention in Main Sick line Shed/ ROH Shed / POH Workshop.

3.2.15 Railnet Connection and Wi-Fi Coverage

Railnet Network may be provided at Depot level with minimum speed of data transmission of 10mbps (upgradable up to 2Gbpsc for future video feed) in the freight examination yards. The network may be planned in such a way that it is a physical Optical Fiber Cable/wired connection upto TXR Office in the Yard, Sick line and in ROH depot. In remaining place, Wi-Fi may be provided so that hand held devices can be directly connected to the internet for uploading data as well as downloading memos, data, BPCs etc.

The network may be through Railnet Connection (Internet Connection if Railnet is not available).

3.2.16 Information Feed from Wayside Diagnostic Equipment

Data from wayside diagnostic equipment about the defects in the individual wagons, in a consolidated form, must be available to TXR in the depot in advance before arrival of the rakes. This shall facilitate the Train Examiners (TXRs) to plan in advance about the repairs to be carried out efficiently. This may

be done by real time ICT integration of outputs from the wayside diagnostic equipment with FMM. This issue has been dealt in detail in Chapter 5

3.2.17 OHE wiring

Since the covered shed has to be provided with EOT cranes for lifting of wagons and replacement of sick wagons with fit wagons, there shall be no OHE wiring over the lines in the covered shed. Top wiring at both the ends of the covered shed may however may be provided for placement of the rakes and for with drawl of rakes after release.

3.2.18 Road Connection to Stores and Sick line Shed

As most of the repairs on the wagons are to be done during the examination, frequent movement of material and equipment shall be required between stores/ sick line shed and the examination yard. Therefore, 06 meter concrete path way from both ends of shed/ examination lines need to be provided connecting sick line / stores for ease of movement as well as flexibility of operation of the road mobile equipment.

3.3 Requirement of M&P for all weather freight examination yards

SN	**Description**	**Recommended Requirement (Trains examined per day (average)**	
		Upto 10 rakes	**More than 10 rakes – upto 20 rakes**
1.	Battery operated Rail cum Road Shunting Vehicle (Cap. 2000 T)	02 no.	03no.
2.	EOT crane (20 T) with pendant and remote control facility	08 nos.	16 nos.
3.	Mini Truck (4W), Cap. 1 T (min) for mobile workstation	04 nos.	08 nos.
4.	Self propelled battery operated Scissor lift (Capacity – 500 kg, Lifting height – 4.5 metres minimum)	06 nos.	12 nos.
5.	Arc Welding Set (600 A)	10 nos.	20 nos.
6.	MIG/MAG welding machine	04 nos.	08 nos.
7.	Portable air plasma cutting machine (Cutting thickness up to 12 mm)	04 nos.	08 nos.
8.	Gas cutting set	04 nos.	08 nos.
9.	Huck Bolting machine	04 nos	08 nos.
10.	Electric Compressor (500 CFM) with Air Dryer	01 no.	02 nos.
11	Diesel Compressor (500 CFM) with Air Dryer	01 no.	02 nos.

12.	DG set 250 KVA (for compressor, light & welding)	01 nos.	02 nos.
13.	DG set 500 KVA (for cranes)	01 no.	01 no.
14.	Computerised Rake Test Rig	02 no	04 no
15.	Hydraulic CBC lifting device (2 T capacity)	02 no	04 no
16.	Hand operated hydraulic jack (Cap 10T)	08 nos	16 Nos
17	Motorised Hydraulic jacks (capacity 10 Ton)	04 nos.	08 nos.
18.	Electrode drying and heating oven, 50 KGS	01 no.	01 no.
19.	Door straightening machine (Hydraulic Press), Size -1700 x 980 mm	01 no.	02 nos.
20.	Portable electric/pneumatic grinding machine (Cylindrical and Angular)	04 nos.	08 nos.
21.	Riveting Machine (7/8”, 5/8”, 3/4”, 1/2”)	04 nos.	08nos.
22.	Pneumatic pipe line throughout the lines with trappings at 50m distance.	As per requirement	As per requirement
23.	Hand Crimping Tools	02 no.	04no.
24.	Fork lifter 3T	02 no.	04 no.
25.	Power tools like angle grinders, High torque drill, etc.,	As per requirement	As per requirement
26.	Hand trolley	1 per line	1 per line
27.	Portable drill machine 12 mm	As per requirement	As per requirement
28.	Bending machine	Not required	One per yard
29.	Stand alone RFID reader	04 no	08 no
30.	Hand held RFID reader	08 no	16 no
31.	CCTV camera for Floor/Body inspection	12 no.	24 no
32.	Industrial floor cleaner	01 no.	2 nos.
33.	Staff van	2 per yard	3 per yard
34.	Pick up van (for movement from outside)	2 per yard	2 per yard
35.	Truck	02 nos.	03 nos.
36.	Lister truck	4 nos.	6 nos.
37.	Road mobile crane (10 Ton capacity)	One no.	One no.

38.	Protective clothing with Helmet & Gloves	As per requirement	As per requirement
39.	Welding Apron & welding glass	As per requirement	As per requirement
	MISCELLANEOUS		
1.	Storage rack with pigeon holes		As per requirement
2.	Rack with Locker		As per requirement
3.	Rack with Locker		As per requirement
4.	Plain paper fax with P&T line		One per depot
5.	Palm hand computer		As per requirement
6.	Walkie Talkie set/ Mobile phone	25 nos.	50 nos.
7.	Railway Telephone		As per requirement
8.	BSNL Telephone		One per depot
9.	Computer, with printer, Scanner, UPS with preloaded software & modem	05 nos.	07 nos.
10.	C&W Office furniture		As per requirement
11.	Railnet Connection/ (Internet Connection if Railnet is not available)		As per requirement
12.	Plain paper copier for printing, copying & drawing with stabilizer		One per depot
13.	PA system		One per yard
14.	Miscellaneous tools and gauges		As per requirement
15.	Any other item including new technology equipment as per requirement identified by respected Railways.		As per requirement
16.	Training Aids for continuous technical up-gradation and use of latest technology.		As per requirement

3.4 FOR EXISTING YARDS (WHERE COVERED SHED IS NOT FEASIBLE)

In the existing yard, where covered sheds are not feasible, following facilities to be provided:

1. The track centre to centre distance should be 8,2 meter between the examination lines and adjacent lines. This can be done either slewing of existing lines or by removing intermediate lines and shifting to some other location in the yard. Clear 5 meter pathway on both sides of the examination lines to be provided to facilitate easy movement of maintenance equipment/ mobile repair vans. On both the ends, concrete cross pathways of 5m may be provided.

2. OHE mast, if any, coming on the pathways to be removed and converted to portal type masts.

3. Welding points to be provided all along the examination lines.

4. There should be knee level lights at suitable distances for undergear examination /repairs and body level lights for upper gear. This would be in addition to general lighting for the yards. Sufficient number of additional high mast lights must be provided in the yards wherever required.

5. All other M&P proposed at para 3.3 for Green field and brown field yards shall also be provided except EOT cranes in these yards.

3.5 List of M&Ps Recommended by Committee Members for the existing sick line sheds in addition to the M&P already available. M&P as per new & evolving technology may be provided as per requirement.

SN	Description	Recommended Requirement (Trains examined per day (average))	
		Upto 10 rakes	**More than 10 rakes – upto 20 rakes**
1	Hydraulic double column guillotine shearing machine, 10x2500 mm	01 no.	01 no.
2	Digital ultrasonic flaw detector m/c, 10 mm - 5 mtrs.	02 nos.	03 nos.
3	Bearing puller mobile hydraulic press,100/70 tons	01 no.	02 nos.
4	Computerised Test stand for DV	01 no.	02 no.
5	Hand held RFID readers.	As per requirement	As per requirement
6	Bogie turn tables in the covered shed.	As per requirement	As per requirement
7	Computerized Single Car test rig.	As per requirement	As per requirement

8	Stand alone RFID readers at the entrance of the depot.	As per requirement	As per requirement
9	CCTV surveillance system covering complete yard.	As per requirement	As per requirement
10	Digital wheel diameter gauge.	As per requirement	As per requirement
11	Whole yard shall be covered by high speed Wi-Fi.	As per requirement	As per requirement
12	Any other item as per requirement identified by respected Railways.	As per requirement	As per requirement

3.6 Other Discussions and requirements

3.6.1 Prevention of damage to wagons

The data at the previous chapter show that detachment during rake examination due to body damage, door damage and floor damage constitute about 45 % (including that for 'C' category repairs) of total detachments. These damages are primarily caused by improper loading/unloading equipment at sidings such as tipplers, bulk handling system and other mechanized equipment (such as pay loaders, JCB, grab cranes etc). There is a need to take up this issue with siding owners to use the equipment for unloading with due care so that the wagons are not damaged during loading / unloading.
For this purpose, CCTVs must be provided at private sidings so that appropriate action may be taken with them in case any such activity is noticed which has caused damage to the wagons. As a result, the repair requirements shall be reduced and rakes may be released faster and detachments due to heavy repairs are minimised.

Damages to the wagons can be reduced by the following:

(a) The tipplers and bulk handling systems, wherever provided, should be of RDSO approved specification. It should be commissioned only after personal inspection and issue of certificate by Sr. DME of the division. Periodic inspection of these systems to be carried out by the Sr. DME as per extent instructions to check that these are properly maintained to avoid any damage to wagons.

(b) For all mechanized equipment (such as pay loaders, JCB, grab cranes etc) to be used in the sidings only after certification by Railway. Such equipment used in open wagons should preferably be with high driver/operator seat so that the driver/operator can see the inside area of the open wagon. The equipment to be utilized should have following suggested features.

i. Driver seat height from Rail level should be about 4.2 meter or more.

ii. Buckets of capacity below 1.2 tons with smooth surfaces and no teeth to be used. The corner and back face may be suitably covered by non- metallic material.

iii. Dumping height – Bucket should clear the wagon top copping by a margin of 2.0 feet.

iv. Speed control during loading/ unloading.

(c) Adequate number of CCTVs should be provided at all sidings which are using mechanized equipment (such as pay loaders, JCB, grab cranes etc) for monitoring unsafe and rough operations causing damages to wagons.

(d) Physical barriers of adequate height (preferably in the form of rail fencing) should be provided along the loading/unloading line to prevent hitting of wheels, chains, booms of the pay loaders, JCB etc to the wagon body.

(e) Adequate lighting system should be provided at loading/unloading sidings, where night operation is done, so that driver/operator can clearly see the wagons.

3.6.2 Out sourcing of wagon repair activities

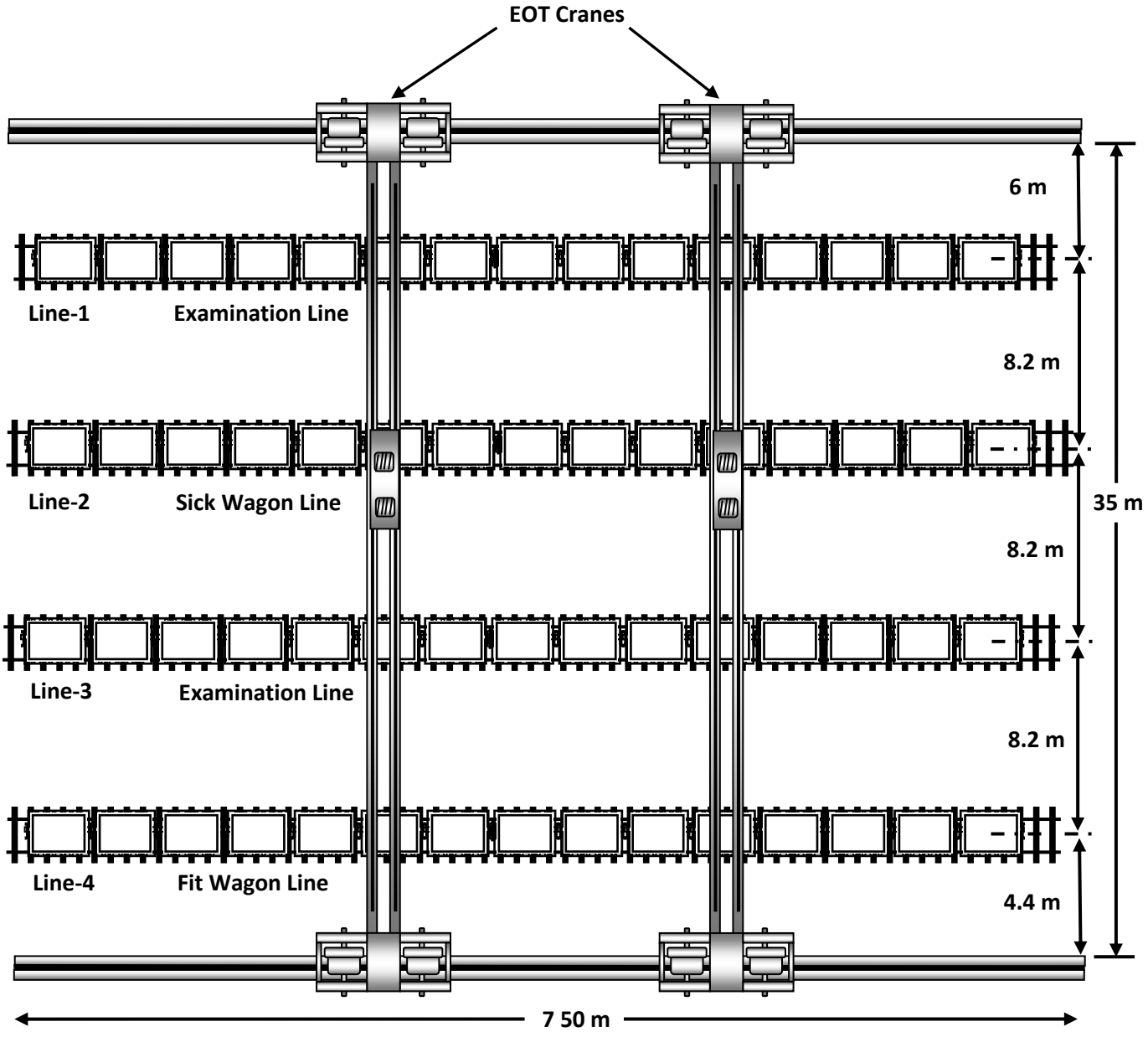
Even with the increase in the workload, the staff strength is not likely to increase in future. Hence, many of the activities at the examination yard can be outsourced with proper supervision. Such items may be

- Cutting and welding Repairs to body
- Cutting and welding Repairs to floor
- Repair/replacement/provision of damaged/missing doors
- Material loading/unloading and transport
- Assisting the skilled railway technicians, etc

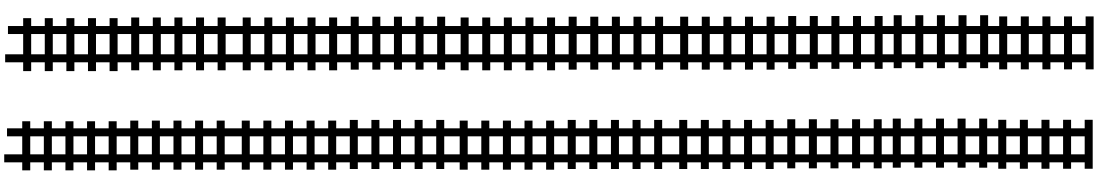
Out sourcing for minor repairs on the body, floor and door of wagons (mainly in the BOXN wagons) may also be done at loading points selectively as has been done by SECR. This would reduce further damages to the wagons in addition to reducing or avoiding the rejection of wagons at the loading points.

Annexure-3A

PROPOSED YARD UNDER COVERED SHED – 04 LINES

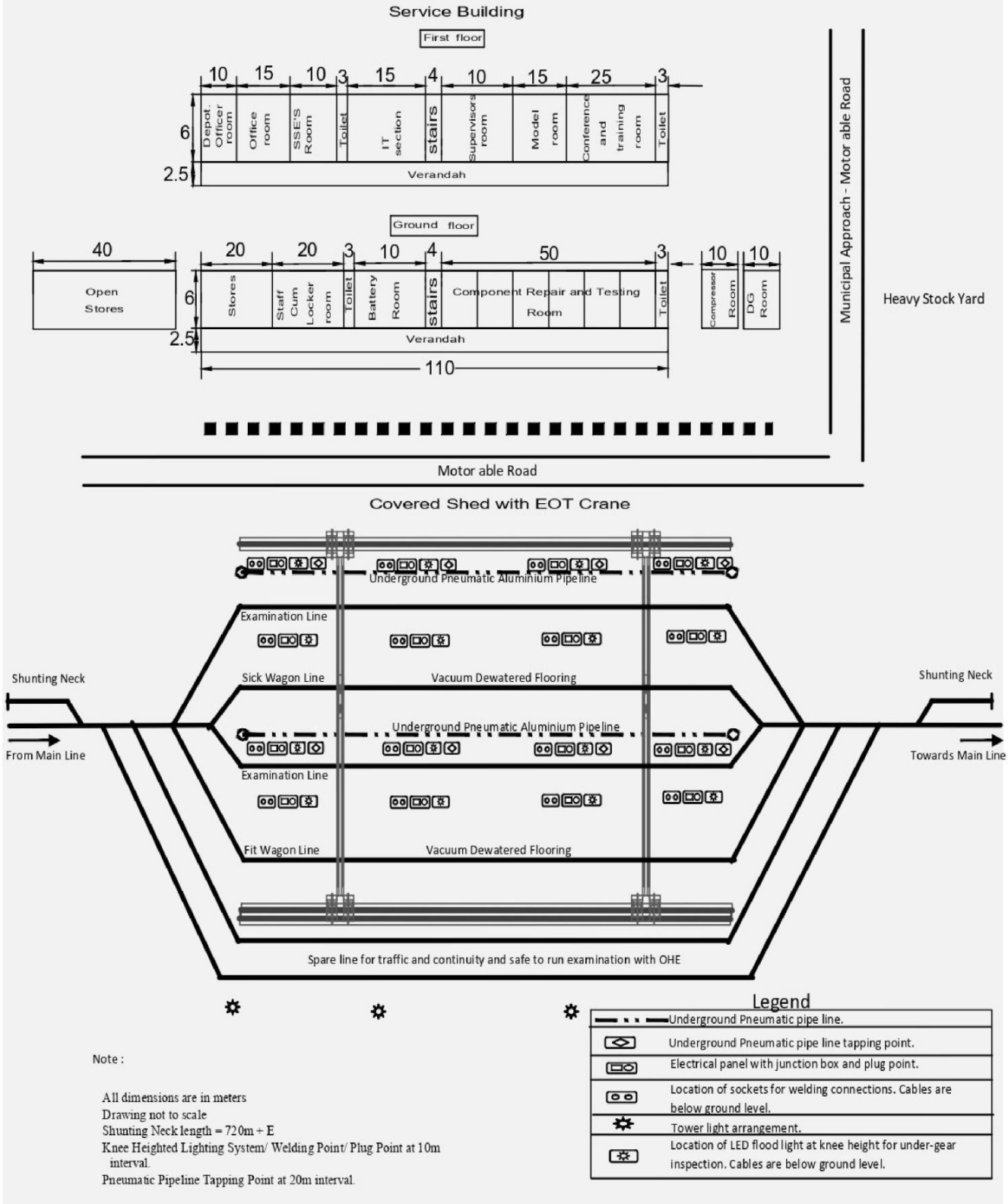


Spare lines for traffic & continuity and safe to run examination with OHE.



Annexure-3B

LAYOUT FOR NEXT GENERATION FREIGHT TRAIN EXAMINATION YARD – 04 LINES



Legend

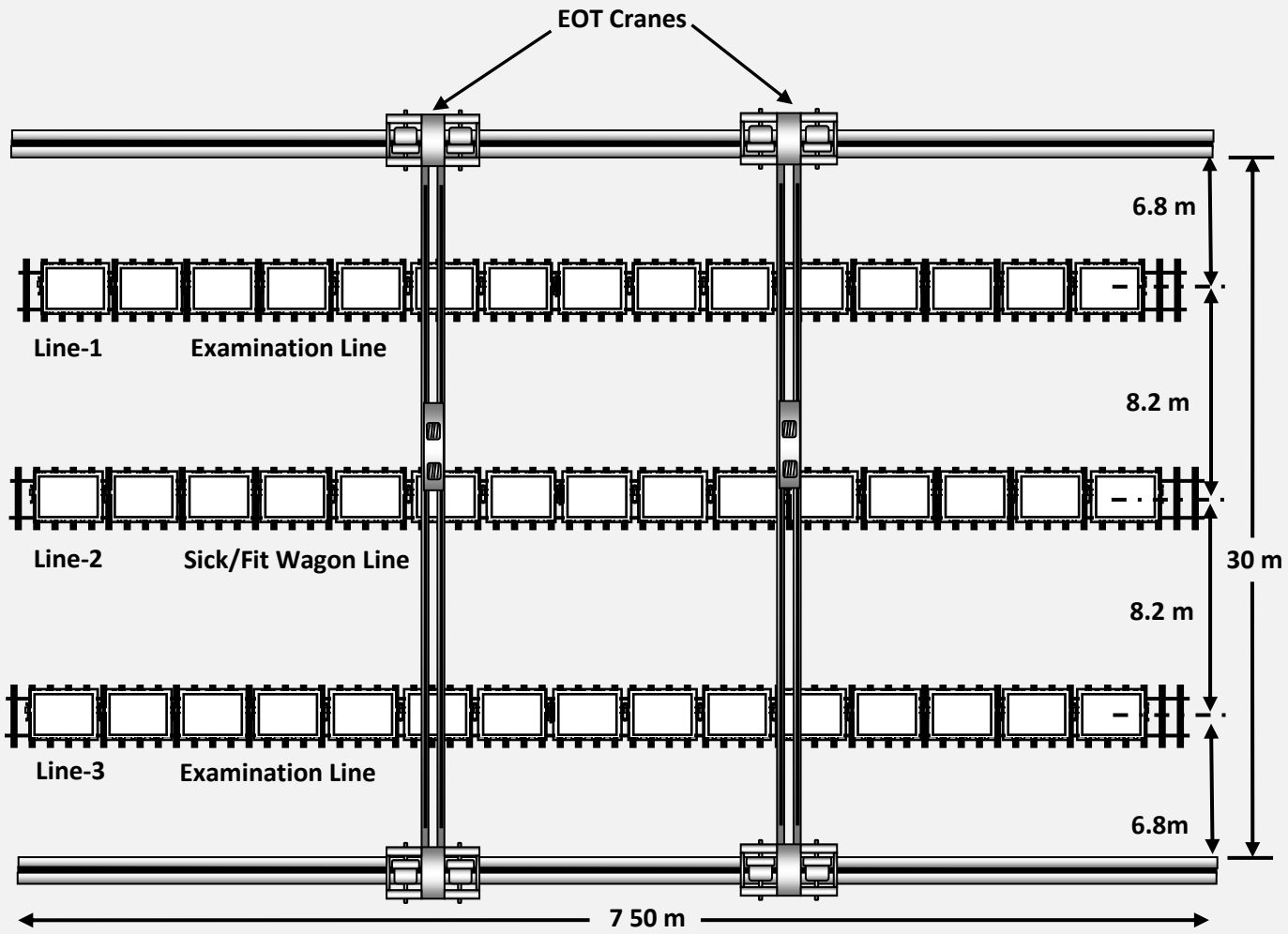
	Underground Pneumatic pipe line.
	Underground Pneumatic pipe line tapping point.
	Electrical panel with junction box and plug point.
	Location of sockets for welding connections. Cables are below ground level.
	Tower light arrangement.
	Location of LED flood light at knee height for under-gear inspection. Cables are below ground level.

Note :

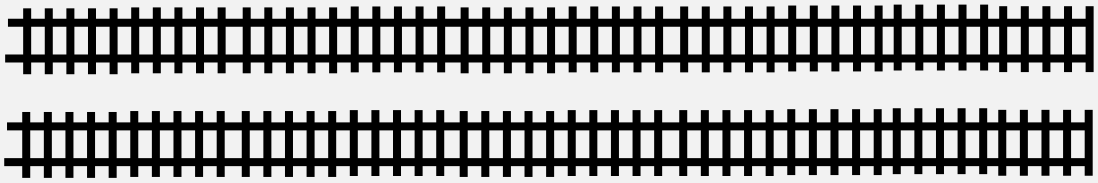
All dimensions are in meters
Drawing not to scale
Shunting Neck length = 720m + E
Knee Heighted Lighting System/ Welding Point/ Plug Point at 10m interval.
Pneumatic Pipeline Tapping Point at 20m interval.

Annexure-3C

PROPOSED YARD UNDER COVERED SHED – 03 LINES

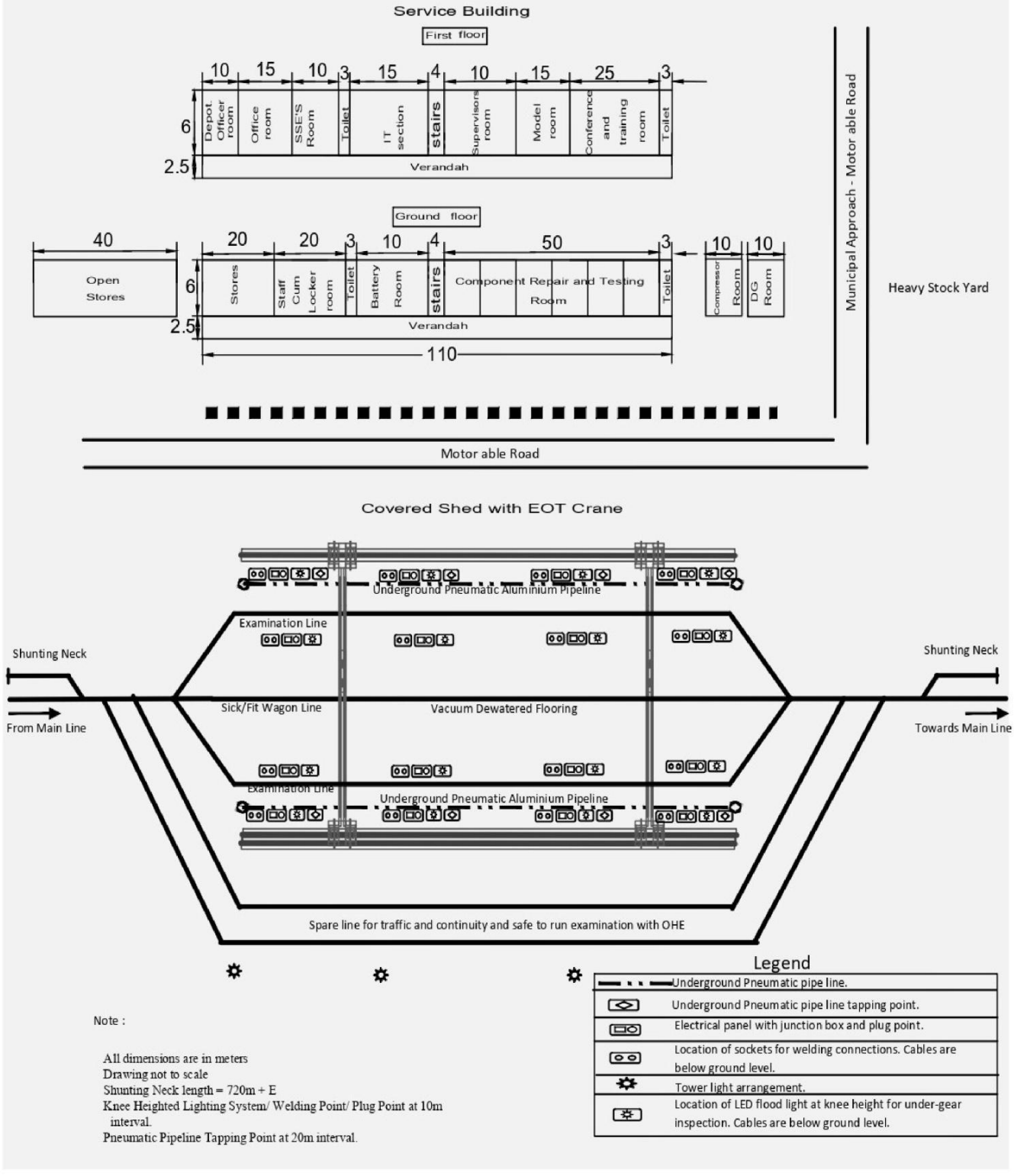


Spare lines for traffic & continuity and safe to run examination with OHE.



Annexure-3D

LAYOUT FOR NEXT GENERATION FREIGHT TRAIN EXAMINATION YARD – 03 LINES



Note :

All dimensions are in meters
Drawing not to scale
Shunting Neck length = 720m + E
Knee Heighted Lighting System/ Welding Point/ Plug Point at 10m interval.
Pneumatic Pipeline Tapping Point at 20m interval.

ANNEXURE 3E

EXAMINATION YARDS SUITABLE FOR GREEN FIELD AND BROWN FIELD PROJECTS

A. YARDS FOR GREEN FIELD PROJECTS

Sl. No.	RAILWAY	FREIGHT DEPOT	Whether covered in Smart Yard
1	ER	NH	NO
2		UDL (E Yd)	YES
3		MLDT	NO
4	NFR	NJP	YES
5	SECR	BIA (PP Yd)	YES
6		BIA (R Yd)	YES
7	SER	BNDM (E Yd)	YES
8		BKSC	YES
9	WCR	NKJ	YES
10		ET	NO
11		KOTA	NO
	Total	Under Smart Yard: 7	
		Not under Smart Yard: 4	

B. YARD FOR BROWN FIELD PROJECTS

Sl. No.	RAILWAY	FREIGHT DEPOT	Whether covered in Smart Yard
1	CR	BSL	YES
2		AQ	YES
3	ECR	DDU	YES
4		PEH	YES
5		BRWD	YES
6		PTRU	NO
7		OBRA	NO
8		NRPA	NO
9		GHZ	NO
10	ECoR	CTC	NO
11		KBJ	NO
12		PRDP	YES
13		VSKP/OEC	YES
14		VSKP/RYD	YES
15		VZP	NO
16		VSPS/RMUY	YES
17	NWR	FL	YES
18	SCR	COA	NO
19		SNF	NO
20	SR	TNPM	YES
21		IPN	YES
22		AJJ	NO
23		ED	NO
24	SWR	HPT	YES
25		SGT	NO
26		MNGT	NO
27	WCR	STA	YES
28	WR	SBI	YES
29		GIM	YES
30		KRCA	YES
31		SMP	YES
32		HXP	YES
	Total	Under Smart Yard:19	
		Not under Smart Yard: 13	

Chapter 4

WAYSIDE DIAGNOSTIC EQUIPMENT AND INTEGRATION WITH SMART YARDS

4.1 Concept of Smart Yard

The concept of smart yard is basically to utilize best and mechanised facilities for examination and repair of wagons with the objective to eliminate human error, attention of maximum possible repair without compromising quality of repair and thus improving reliability/safety in train operation, reduce embedded empties which are causing loss of revenue, reduce number of arising for NPOH and finally to improve availability of wagons for freight loading.

This concept has been mooted with following over all objectives:

a) Maintenance planning (men, materials, machines & tools) in advance based on the reports generated by way side and rolling in diagnostic equipment.

b) Reduced sick marking by deploying effective & mobile maintenance equipment.

c) Wi – Fi enabled yard for data transfer/ communications.

d) All weather maintenance including night time maintenance.

e) Improved quality of repairs on wagons eliminating multiple attentions.

f) Reduced overall detention to trains in yards, resulting in improved availability of wagons for freight transportation.

The list of Railway wise identified 40 freight examination yards considered by Railway Board as per DPR of RITES for implementation of Smart Yard work is tabulated below.

SN	Railway	Yard (code)	Full name of Yard
1	CR	BSL	Bhusaval
2		AQ (ICD)	Ajni
3	ECoR	VSKP/RMUY	Visakhapatnam/Raw Mat Yard
4		VSKP/RYD	Visakhapatnam/Reception Yard
5		VSKP/OEC	Visakhapatnam/Ore Exchange
6		PRDP	Paradeep
7	ECR	MGS	Mughalsarai
8		BRWD	Barwadih
9		PEH	Patherdih
10	ER	UDL	Andal
11	NCR	DER (ICD)	Dadri
12		BAD	Baad
13		GMC (ICD)	Kanpur
14	NFR	NJP	New Jalpaigudi

15		NTSK	New Tinshukia
16	NR	TKD	Tughlakabad
17		KJGY	Khanaalampura
18		UMB	Ambala
19	NWR	FL	Phulera
20	SCR	BZA	Vizaywada
21		RDM	Ramgundam
22		GY	Gooty
23	SECR	BIA	Bhilai
24		BSP	Bilaspur
25	SER	NMP	Nimpura
26		BNDM	Bandamunda
27		ADTP	Adityapur
28		BKSC	Bokaro Steel city
29		DPS	Dongaposi
30	SR	IPN	Irumpanam
31		JTJ	Jolarpet
32		TNPM (ICD)	Tondiyarpet
33	SWR	HPT	Hosepet
34	WCR	NKJ	New Katni Jn.
35		STA	Satna
36	WR	GIM	Gandhidham
37		HXP	Hapa
38		SBI	Sabarmati
39		KRCA	Karchia
40		SMP	Sambhupura

4.2 Identification of Suitable Detection Equipment for Yards

Detection equipment will enable the maintainers to get the condition of rolling stocks well in advance in respect of critical safety components and other defects which are normally being observed during the rolling in examination for effective planning of yard examination /maintenance of rake supposed to be received by yard. Such detection equipment shall provide advance data about hot axles and wheels, wheel flats, wheel profile & diameter, load imbalance, spring breakage, loose and hanging parts, wear condition of brake blocks etc. even before the rake arrives at the maintenance yard. The numbers of proposed mechanised detection equipment (Mainline/ Rolling-in) for each of identified yards have also been done by RITES on the basis of direction of movement of rakes received to by each yard for examination, as reported by the Zonal Railways.

The selection of defect detecting equipment is based on laid down maintenance and examination requirement of a freight train covered in maintenance manual and pattern/type of defects being identified during examination at present (for which wagon marked sick plus repairs being done in the yard itself). The proposed equipment are discussed as below.

4.2.1 For Examination of CTRB

For examination of CTRB, there are following two types of technology/equipment are available.

a) Hot Box Detector

The hot box detector works on temperature level of bearing sensed through infrared sensing equipment. It identifies positive defects only when CTRB becomes hot beyond a limit at which bearing will fail if continued in service and may result in train accident.

Although it does not give advance warning but detection of temperature beyond certain limit is a sign of real vulnerability / potential defects of bearing that require immediate attention/ replacement during the train examination in the immediate next yard.

b) Acoustic Bearing Detector (ABD)

It works on sound/vibration level of bearing recorded through the sensors placed near track. The correct identification of defects can only be done at minimum train speed of 30km/h.

There are 4 levels of defects reporting. The CTRB is supposed to be removed from the service after receiving 3rd and 4th level of defects to avoid train accident. For first two levels of defects, planned replacement within next 1000 km is possible.

Considering the above, ABD & HBD are proposed to be installed for the Smart yard. ABD is to be installed on mainline, whereas, HBD may be installed at rolling in location. If ABD already planned on main line approaching examination yard due to safety consideration, same can serve the purpose for smart yard.

4.2.2 For Examination of Wheels

a) Flat Tyre

For safety consideration wagons with flat type are required to be removed from service and attended.TXR staff examine wheel tread of all the wheels of the trains for flat tyre visually which can be detected by WILD. It is a part of OMRS with ABD and being installed by IR to identify flat type en-route due to safety consideration.Hence, WILD is supposed to be a part of wagon examination equipment for smart yard also.

b) Wheel Profile

The TXR and his staff are supposed to examine wheel profile of all wheels of all wagons of the rake visually for defects like deep flange, hollow tyre, root radius etc. and suspected wheel to be examined by tyre defect gauge. There is possibility of human error in wheel profile examination by this process. Wheel profile is a safety item.

Hence, Wheel Profile Recording Equipment should be part of wagon examination system of Smart yard.

c) Other Wheel Defects

There are other defects in wheel such as hot spot on wheel tread, cracks on wheel surface, hub etc.

TXR staffs is supposed to examine all wheels of all wagons to identify wheel defects visually and ensure that wagons having wheel with such defects are marked sick for repair. There is possibility of human error on examination of these safety items.

Hence, wheel defect detector should be part of wagon examination system for smart yard.

4.2.3 For Examination of Coupler &Draft Gear

Coupler& draft gear examination is a regular area for yard examination and defects like coupler head broken, CBC shifted/dropped, yoke broken, knuckle worn-out, draft gear slack or its housing crack etc. are regularly identified and attended.

The examination is done visually by the staff and to reduce human error, the examination can be done by vision based equipment such as “Coupler/draft gear View”.

4.2.4 For Examination of Bogie

Examination of bogies & equipment mounted on bogies is a important area for TXR during yard examination. This has safety implication. All bogie items such as suspension springs, bolster, side-frame, other suspension items etc are examined visually by the TXR.

These can be examined by vision based equipment such as “Bogie View” to reduce human error. However, the equipment may not be able to examine bottom area of bolster, centre pivot.

4.2.5 For Examination of Brake Block/Brake Shoe

The TXR staff is supposed to examine and attend brake block, brake shoe and brake shoe key etc. for all wheels of the train to identify worn out brake block, broken brake block, heavily biased wear on brake block, missing brake block key and damaged brake shoe etc. to ensure required braking power of the train.

This examination is also done visually and possibility of human error cannot be ruled out. Vision based equipment can be used to examine defects on brake block/ brake shoe area.

4.2.6 For Examination of Body (Underframe and Hanging Parts)

Body defects on top, side wall, end wall, under frame, floor and also gauging parts can be examined / identified by vision based equipment such as “body view” and this will reduce human error. The defects related to brake linkages/ hanging parts/missing fasteners etc. can also be identified by body view from bottom cameras. The angle cock status (closed/open) can also be examined by top camera and corrective action taken to avoid poor brake power. However, identification of air leakages and related defects cannot be identified by the vision based equipment.

4.3 Brief about the identified detection equipment

4.3.1 Wheel Impact Load Detector (WILD)

The equipment will measure wheel impact load which will be interpreted to detect the condition of wheel with respect to flat tyres and send report to the centralized command and control system, if the vertical impact loads are more than the prescribed limits.

Typical installation of Wheel Impact Load detector (WILD)

System shall offer a hardened electronic data collection device, which is capable of measuring vertical wheel forces on the rail via rail-mounted strain gauges fixed on neutral axis of rail with wheat-stone bridge configuration or through Accelerometers. The WILD system shall be capable of providing or having -

- Impact Force Monitoring and isolating wheel flat spots.
- Train, vehicle, axle, and wheel information in Bi-directional traffic.
- Self-diagnostics.
- Capable of carrying the measurements i.e. Nominal load, Peak load, Dynamic load (peak/nominal), Ratio (peak /nominal), Axle loads and Train speeds.
- The system shall be rugged and tamper-proof so as to work round the clock throughout the year in harsh and dusty outdoor environment exposed to sun, cold, rain, wind etc. without any need of air-conditioning of data acquisition system.

4.3.2 Acoustic Bearing Detectors (ABD)

Acoustic bearing detector shall monitor roller bearings of different types, provide information about the bearing condition and notify about the bearings that have internal defects related to cup, cone or rollers. They shall provide advance information about bearing defects before failures occur in service and identify defective axle boxes before they become hot. The system shall have an automated alarm notification with self-diagnostics.

The system should have following desirable features -

- Capable of monitoring tapered, spherical & cylindrical roller bearing conditions.
- Capable of providing train, vehicle, axle and wheel information.
- Capable of handling Bi-directional traffic.
- Robust hardware and Self-diagnostics features.
- Integrated with Wheel Data Management System.
- Capable of operation in mixed traffic and captive fleets over a wide range of train speeds. Capable of providing automated alarm notification.
- The system shall be able to cater for all wheel sizes ranging from 700 mm to 1100 mm tread diameter wheels.

ABDs shall be located in trackside cabinets with wake-up sensors triggered by approaching train. There shall be protective shutters and data acquisition process shall include measurement of sound signatures emitted by wheels & bearings, train speeds & wheel diameter. These signatures should be separated from extraneous noise, enabling fault identification & severity classification, providing an indication of remaining bearing life of each individual bearing.

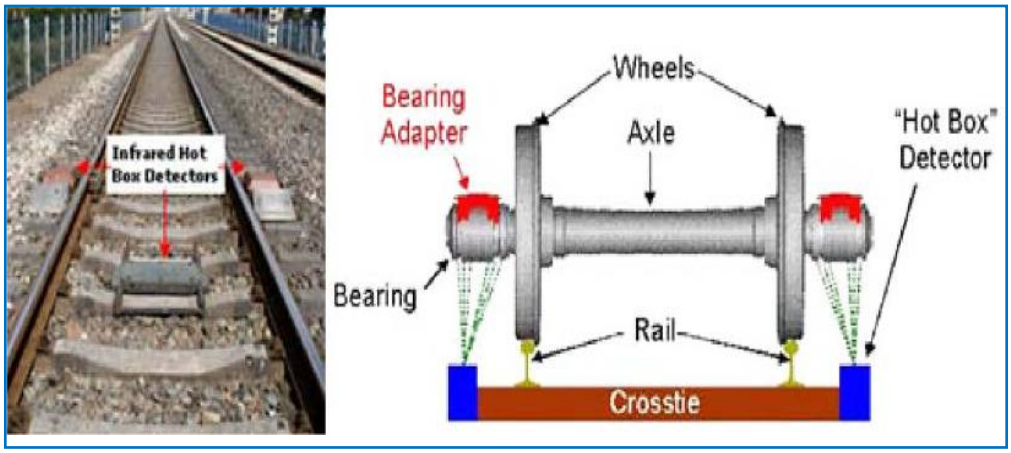
4.3.3 Hot Box Detectors

Hot Box and Hot Wheel detectors are trackside devices designed to monitor axle, wheel, brake temperatures and to indicate any overheating which could lead to derailments and transmits this data to the monitoring section. This is

an unmanned system, which consists of high speed pyrometers installed at axle box level to check the temperature in near axle and far axle and at the track level to measure the wheel temperature. These pyrometers are connected with real time embedded data acquisition system that wakes up on train arrival to capture and analyze the data from all pyrometers.

The real time software possesses the intelligence to process the recorded data and produces the report with axle wise temperature information and transmits the data to Traffic Control or Monitoring Station. The cut-off limits and the alarm limits can be set by the user for flagging the hot axles, hot wheel & cold wheels.

Typical Installation of Hot Box detector



Hot Box Detector System

4.3.4 Machine Vision Equipment

The basic principle of the machine vision equipment is that it takes photographs of the vehicles from sides and bottom, and software compares

these photos with the standard photos of that type of vehicle. This way it is able to detect loose / hanging parts, worn brake blocks, wheel dia. etc.

4.3.4.1 Wheel Profile Recording System

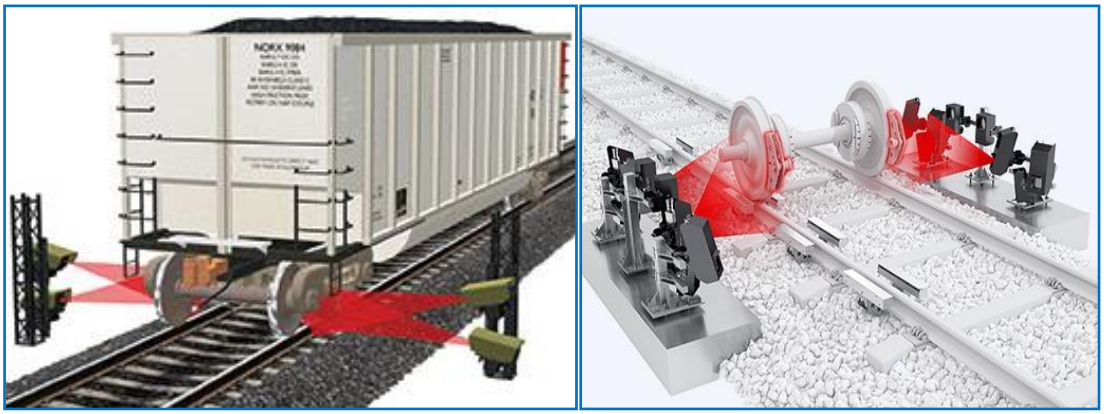
Wheel profile detector shall measure and monitor the wheel tread geometry. This is used to determine wheel profile condition related to thin flange, sharp flange, root radius, high flange and wheel diameter and notify wheel conditions that are unsafe or undesirable to railway operations. Wheel profile & diameter measurement system is real time solution that uses a combination of laser and cameras to automatically acquire the profile of wheel.

Wheel profile recording system

System may consist of a wheel detector to trigger the system by retracting optical window covers for the approaching train. Additionally, an Industrial computer, Electronic control unit, high-resolution cameras & lasers – optically configured to view the flange & tread area. On acquiring wheel images, computer shall process them & perform required measurements. All required information should be transmitted to a remote data server at the WCC. Raw information may be retained by the processing unit near the way side equipment.

4.3.4.2 Brake Equipment Monitor

This system shall measure and monitor the brake blocks, especially its wear. Unsafe brake block conditions shall be notified.



Machine vision Equipment

The system should have an adjusted field of view to detect brake shoes /pads. Cameras & lasers should be mounted close to the wheel profile detector on a wayside pillar. A structured laser light source shall illuminate the tread & brake areas for the high-resolution cameras to capture the images. System may consist of a wheel detector to trigger the system by retracting optical window covers for the approaching train. Additionally, an Industrial computer, Electronic control unit, high-resolution cameras & lasers – optically configured to view the brake & tread area. On acquiring brake shoes/pads images, computer shall process them & perform required measurements. All required information should be transmitted to a remote data server.

4.3.4.3 Hanging Parts Detectors

This equipment is for identification of hanging parts, which can hit track fittings or cause derailments, finally affecting performance of bearings & wheels. This shall have a non-contact measurement system to identify low hanging parts. It shall employ optical devices such as infrared light curtains to identify each hanging part by measuring the distance between the part and top of rail. This shall give graphical display of hanging parts and automated alarm notification.

The system should be capable of providing or having –

- Real-Time Notification of Low Air-Hoses
- Non-Contact Visual Inspection
- Measuring and Reporting Distance of hanging part to Top of Rail
- Standalone Report Generation System
- Automated Alarm Thresholds
- Integration capability with Wheel Data Management System

Hanging Parts Detector

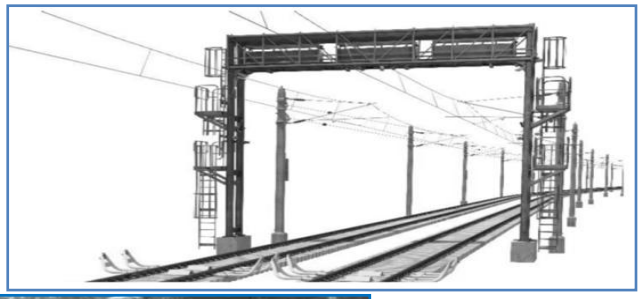
With the advancements in technology, this function is also performed by Machine vision equipment.

4.3.4.4 Broken Spring & Bogie performance detector

This equipment is designed to operate on passing trains at normal track speeds. It is a vision based system which uses a high speed imaging to provide high resolution images of every truck (bogie) for inspection and measurement. Every truck is viewed from up to two angles for a reliable inspection. The system inspects the spring condition, including its compression and breakage. This is used to compare the spring compression on two sides of the truck and evaluate the load balance of the truck and the car.

4.3.4.5 Body Inspection system for body defects/ hanging part

The system is based on the high accuracy laser and cameras detection units placed on the track side. The system captures images of sides, top & bottom and capable of determining wear breakages and body damages etc.



4.3.5 Vehicle Identification System (Radio-frequency identification - RFID)

Radio-frequency identification (RFID) is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders. The technology requires some extent of cooperation of an RFID reader and an RFID tag.

This consists of tags and readers. RFID tags will be installed on a portable basis on all the wagons in IR. Real time hardware & software interface consisting of tag readers & required software will be incorporated individually on the data detection systems. Detection mechanism will be such that it will get initiated on reading of RFID tag of wagons. Subsequently defect locations will be identified with the help of axle counters (in built into the systems) and wirelessly relayed to the yard centre.

Most RFID tags contain at least two parts, One is an integrated circuit for storing and processing information, modulating and demodulating a radio-frequency (RF) signal, and other specialized functions. The second is an antenna for receiving and transmitting the signal. There are generally two types of RFID tags: active RFID tags, which contain a battery, and passive RFID tags, which have no battery.

A point to be noted is that the detection equipment has in-built axle counter but without any vehicle identification system it has a limited use since each time alarm is raised by the system, the maintenance person, on arrival of

rake, has to count the wagon from the locomotive end and the system becomes cumbersome and impractical.

4.4 Status of Conversion of 40 existing Yards into Smart Yards in Indian Railways.

1. A work for **'**Conversion of 40 existing freight yards of Indian Railway to technology driven freight yards (Smart Yard)" (Umbrella Work 2019-20), Pink Book item no. 1166 of 2019-20 has been sanctioned at a cost of Rs. 1579.90 crores.

2. MoM issued by Railway Board Vide Letter No.2017/M(W)/964/83 dated 02.04.2018 advised RDSO to develop specification for Smart Yard.

3. Technical Specification No. RDSO-SPN-RE-SMART YARD dated 18.02.2019 for "Supply, installation and commissioning of automated wayside inspection and detection system for Smart Yard" was issued by RDSO in Feb'2019.

4. RITES was instructed by Railway Board to prepare a DPR for provision of Smart Yards at 40 different locations across IR and submit it to Railway Board. The report was accepted by Railway Board in August'2019.

5. As per RDSO specification, the scope of work involves:

(i) Online Monitoring of Rolling Stock (OMRS).

Consisting of Acoustic Bearing Detector (ABD) as per RDSO Specification no. RDSO/2008/TG/OMRS/003/Rev 0.0 dated 10.07.2008 or latest and Wheel Impact Load Detector (WILD) as per COFMOW Specification no COFMOW/WILD/IR/2013 or latest.

(ii) Hot Axle Hot Wheel (HAHW) as per RDSO Specification no. RDSO-SPN-RE-HAHW-2017 (Rev-1) or latest.

(iii) Machine Vision Inspection System (MVIS) as per RDSO Specification no RDSO-SPN-RE-MVIS-2018(Rev-1), dated :02.07.2020

(iv) All related civil and electrical works.

(v) Software application for integration of sub systems as above.

(vi) Provision of RFID readers at wayside locations.

6. As per Railway Board Letter No. 2018/Dev Cell/IGRI/3/Vol.3, dated 09.09.2019 and dated 04.03.2021 (placed as Annexures-4B); the following equipment were assigned to be procured by COFMOW:

SN	Item	Quantity	Cost (in Crores)
1.	Main Line Equipment (OMRS consisting of WILD & ABD)	81 of 40 Yards	384.75
2.	Vision Based Equipment rolling in Equipment. (Comprising Wheel Profile recording, Bogie Performance/ Defect Detector, Brake Equipment & Shoes, CBC coupler and Body Under frame detection & hanging parts etc.)	69 for 40 Yards	865.95
3.	Hot Box Equipment (at Rolling in Location)	69 for 40 Yards	138
4.	Cost of creation of ICT integration platform to have common interface for connectivity for all detection equipment for 40 yards and other available such equipment over IR	1 Platform (for all identified Yards)	10
5.	Expected Cost of Integration, analytics and the information presentation for each yard.	40 (for all Identified yards to be integrated)	80
	Total		**1478.70**

In addition to this, other equipments were procured by the various agencies of the Railways:

SN	Item	Quantity	Cost (in Crores)	Proposed executing Agency
1.	Portable RFID readers (6 per yard) for each 40 yards.	240 (4 to 6 per yard)	1.20	CRIS
2.	Additional T&P, PPE equipment, uniform designed by suitable agency for each of 40 yards	To be assessed for each yard	40	Zonal Railways
3.	Material Handling equipment & hydraulic equipment	To be assessed for each yard	40	
4.	Creation of Knowledge development Centre for each yard.(Provisioning of Porta Cabin, A/C, LED screen, Projector, Furniture, Library	One at each Yard	20	
	Total		**101.20**	

7. A tender has been floated for 121 nos. of OMRS Systems by COFMOW (due closing date of tender is on 09.07.2021).

8. Detailed estimate for procurement of Machine Vision Inspection System for 40 Smart Yards at cost of Rs. 946.70 crores have been prepared and vetted by the Associate finance of COFMOW. After finance vetting, it has been sent to Railway Board for sanction of detailed estimated by the competent authority (CRB).

9. The background information and current status of procurement of RFID Tags for Wagons is enclosed as **Annexure- 4A**. As on 30.06.21, RFID tags have been fitted on 20,897 wagons by three Vendors to whom the contracts have been awarded by COFMOW.

10. The procurement of RFID readers for Smart Yard will be done by CRIS as per Railway Board letter's no 2010/Dev. Cell/IMMI/12, dated 28.10.2019.

4.6 Site selection criteria for wayside detectors

The location of a new wayside detector system should be carefully evaluated and selected based on the following criteria and respective system characteristics recommended by the vendor or consultant firm:

1) Size and area required.
2) Traffic (kind and volume of rolling stock) and speed coverage (variable v/s constant speed requirements).
3) Track characteristics according to requirement.
4) Communication and data transfer feasibility.
5) Rail or road connectivity and maintenance features
6) No interference with existing wayside/ Track circuit systems.
7) Response time in case of triggered events.
8) Any other specific vendor requirements.

ANNEXURE 4A

Status of supply & Fitment of RFID Tags on Wagons of Indian Railway as on Dated.31.05.2021			
S.No.	**Date**	**Description**	**Remarks**
1.	01.01.2018	Vide Board letter no. 2010/Dev.Cell/IMMI/12, dated:01.01.2019, COFMOW has been nominated to execute the work "**Provision of RFID Tags on 2.5 lakh Rolling Stock (coaches & locos) @ Rs. 2000 per Tag**", sanctioned in Pink Book 2017-18 under PH-21, RSP item no. 1263 at the total cost ₹50.00 cr. (**Two tags on each Rolling Stock**)	
2.	01.07.2019	AT issued to M/s. E-Cartes(for 45,000 wagons 90,000 RFID tags at 06 locations in Phase –I. LOA issued on 27.05.2019 Value Rs. 3.08 Crores.	DP: 30.09.2020 Extended upto: 21.03.2021 Again extended up to: 21.09.2021
3.	18.10.2019	M/s. E-Cartes started dispatch of the RFID tags to the consignee after RITES inspection.	**List of consignees:** 1. KTT WS 2. JHSW 3. KJGY 4. JUDW 5. UMB 6. TKD
4.	15.11.2019	Fitment of RFID tags on Wagons started by M/s. E-Cartes.	
5.	30.06.2021	So far fitment of RFID Tags as on 30.06.2021 is (**23786 RFID Tags**) on **11893** wagons.	
PHASE- II "Supply and fitment of UHF RFID Tags on 1.8 lac Wagons of IR. **Tender No: OP- 308650**			
1.	02.08.2019	PHASE- II "Supply and fitment of UHF RFID Tags on 1.8 lac Wagons of IR." Floated on 02.08.2019	Closing date : 03.09.19
2.	06.11.2019	LOA issued to M/s. Syrma Technologies, Chennai for **111641** wagons at (33 locations) & M/s. ID Tech Solutions, Gurugram for **68,359** wagons at (24 locations).	

3.	26.12.2019	AT issued to M/s. Syrma& M/s. ID Tech	DP: 05.11.2021
4.	23.11.2020	M/s. ID Tech Solutions, Gurugram & M/s. Syrma Technologies, Chennai had submitted Portable Readers in Jan 2020 to CRIS to specify the reading distance as per Clause no. 3.4.3.3.1 of the Tag specification (v4.1) issued by CRIS.	Letter regarding technical clearance of portable reader (R-5) model issued by CRIS to the vendors on 23.11.2020
5.	05.01.2021	A joint meeting with CRIS, Vendors & COFMOW organised in CRIS.	meeting concluded that the Supply and fitment of RFID tag will be started by both firms which M/s. ID Tech & M/s Syrma Technologies by 14th Jan 2021 and 28.01.2021 respectively after getting their tags inspected M/s. RITES.
6.	24.02.2021	Fitment work has been started on 24th Feb 2021 by M/s I D Tech Pvt. Ltd., Gurugram.	(i) TATA (ii) BOKARO (iii) BANDAMUNDA (iv) KHARAGPUR (v) NEW KATNI (vi) ADITYAPUR (vii) NIMPURA (viii) SATNA (ix) DAHOD (x) PRATAP NAGAR
7.	30.06.2021	r fitment of RFID Tags as on 30.06.2021 is (**15002 RFID Tags**) on **7501** wagons by M/s. I D Tech. Pvt. Ltd.	
8.	28.01.2021	Location where fitment work to be started by M/s. Syrma Technologies, Chennai	(i) MGS ROH Depot (ii) JMP Workshop (iii) BAD (iv) KANPUR (GMC) (v) IZZAT NAGAR (vi) MORADABAD
9.	30.06.2021	r fitment of RFID Tags as on 30.06.2021 is (**3006 RFID Tags**) on **1503** wagons by M/s. Syrma Technologies.	

ANNEXURE 4B

ANNEXURE-2

Government of India
Ministry of Railways
(Railway Board)

No.2018/Dev Cell/IGR1/3/Vol 3 · New Delhi dated: 09.09.2019

CAO/COFMOW,
Railway Offices Complex,
Tilak Bridge,
New Delhi -110002.

Sub: Conversion of 40 Freight Examination Yards to Technology Driven Freight Yards (Smart Yards) over Indian Railways.

Ref.: Rly. Bd's Pink Book (RSP) item no. 1166 of FY 2019-20.

A work of **'Conversion of 40 Existing Freight Yards of Indian Railways to Technology driven Freight Yards (Smart Yards) (Phase-1) (Umbrella work 2019-20)'** has been sanctioned in Railway Board's RSP under Plan Head-21 at a cost of Rs.1579 cr. vide item no.1166 in Pink Book 2019-20.

Railway Board has nominated COFMOW as nodal agency for carrying out the overall subject work of **Smart Yards** including preparation of Detailed Estimate. A copy of scope of work is attached as annexure. However, activity at item no.1.3 (Hot box equipments at Rolling in locations) is proposed to be carried out through KRCL and activity at item no.2 (Creation of ICT integration platform) is proposed to be carried out by RITES.

COFMOW may kindly initiate necessary action in this regard as this is a high priority item.

The issues with the approval of competent authority.

DA/as above

9/9/19

(Mayank Tewari)
Exec. Dir. Mech. Engg.(Dev.)
Railway Board

Copy to:

- PCMEs/All Indian Railway for information & n/a.
- MD/RITES for information & n/a.

Annexure

Sub: Conversion of 40 Freight Examination Yards to Technology Driven Freight Yards (Smart Yards) (Phase-1) (Umbrella work 2019-20).

Ref.: Rly. Bd's Pink Book (RSP) item no. 1166 of FY 2019-20.

SN	Item	Quantity		Total cost (₹ Cr.)	Proposed executing Agency
1	Track Side Equipments (Main Line & Rolling-in)				COFMOW
1.1	Main line equipments (OMRS consisting WILD & ABD)	81 for 40 Yards	81	384.75	
1.2	Vision based Equipments Rolling-In Equipments. (Comprising wheel profile recording, Bogie performance / defect Detector, Brake Equipment & Shoes, CBC Coupler & Body Under Frame Detection &hanging Parts etc.)	69 for 40 Yards	69	865.95	
	Sub total (A)			**1250.70**	
1.3	Hot box equipments (at Rolling-In location)	69 (for all 40 yards)	69	138.00	KRCL
	Sub total (B)			**138.00**	
2	Cost of creation of ICT integration platform to have common interface for connectivity for all detection equipments for 40 yards and other available such equipments over IR (Legacy / new upcoming).	1 Platform (for all Identified yards)	1	10.00	RITES
2.1	Expected cost of integration, analytics and the information presentation for each yard	40 (for all Identified yards to be integrated)	40	80.00	
	Sub total (C)			**90.00**	
3	Portable RFID readers (6 per yard) for each 40 yards	240 (4 to 6 per yard)	240	1.20	COFMOW
	Sub total (D)			**1.20**	
4	Additional T&P, PPE equipments, uniform designed by suitable agency for each of 40 yards	To be assessed for each yard	40	40.00	Zonal Railways
5	Material handling equipment & hydraulic equipments	To be assessed for each yard	40	40.00	
6	Creation of Knowledge Development Centre for each yard. (Provisioning of Porta Cabin, A/C, LED Screen, Projector, Furniture, Library)	One at each yard	40	20.00	
	Sub total (E)			**100.00**	
	Total (A + B + C + D + E)			**1,579.90**	

भारत सरकार Government of India
रेल मंत्रालय Ministry of Railways
(रेलवे बोर्ड) (Railway Board)

No.2018/Dev Cell/IGR1/3 Vol-3 **New Delhi dated: 04.03.2021**

PCAO/COFMOW,
Railway Offices Complex,
Tilak Bridge,
New Delhi -110002.

Sub: Executing Agency for Conversion of 40 Freight Examination Yards to Technology Driven Freight Yards (Smart Yards) over Indian Railways.

Ref.: (i) Board's letter of even no. dated 09.09.2019.
(ii) COFMOW's letter no. COFMOW/IR/M-594 dated 25-11-2020.

Please refer to Board's letter at (i) above, wherein COFMOW was nominated to carry out the activities no-1.1, 1.2 & 3 of Smart Yards project as per Annexure. However, activities at item no.1.3 (Hot box equipments at Rolling in locations) and activity at item no.2 (Creation of ICT integration platform) were proposed to be carried out by KRCL & RITES respectively.

In partial modification to Board's above referred letter now, the Competent Authority has decided to nominate COFMOW as the executing agency for carrying out other two activities also i.e. item no. 1.3- Hot box and Rolling-In Equipments at Rolling-In location and item no.2-Creation of ICT integration platform as mentioned in the same Annexure.

Now, COFMOW may initiate necessary action for expeditious execution of the Smart Yards project.

This has the approval of Board (MTRS).

04/3

(A.K. Chandra)
EDME(W&T)
Railway Board

5/3/21

Copy to:

- **PCMEs/All Indian Railway** for information & n/a.
- **MD/RITES** for information pl.

o/c

CR, ECOR, ECR, ER, NCR, NER, NFR, NR, NWR
SCR, SECR, SER, SR, SWR, WCR, WR.

Please issue

04/03/2021

Chapter 5

ICT INTEGRATION WITH FMM

5.1 Interface Integration for Detection Equipment from different sources

The vision for transforming to smarter maintenance systems for freight stock must include fleet management system (s) that tracks vehicle health indices using data from all available data sources.

Indian Railway has planned to convert major freight examination and maintenance yards to technology enabled yards ("Smart Yards"). A key feature of these yards is advance intimation of likely defects in wagons of incoming trains through detection systems installed at way side and rolling in stage.

This would require well-defined communication protocol to assimilate signals/out puts generated by each equipment (across various likely suppliers) and their processing on common platform.

Indian Railways have already initiated deployment of both WILDs and OMRS. Machine vision systems shall also be deployed in due course. The effectiveness of reports generated by such equipment shall depend on a common data repository/interface for proper data analytics.

5.2 Current ICT systems

Various sensor based ICT systems are being used to capture mechanical faults in the rolling stock like bearing defects, wheel defects etc. These systems offer diverse functionality and are based on differing technology stacks.

Presently three major technology ecosystems exist in Indian Railways. Details of these ecosystems are listed below:

a) TrackIQ Ecosystem:

M/s TrackIQ is installing OMRS systems over IR. This is a wayside rolling stock inspection system to monitor the condition of rolling stocks in respect of bearing and wheel and consists of two subsystems - Acoustic Bearing Detector (ABD) and Wheel Impact Load Detector (WILD). OMRS captures and monitors the bearing noise signature and wheel impact load signatures through three sensor systems (**RailB**AM for Bearing, **WCM** for Wheel Impact and **PhotoTAG** for Vehicle ID). These are trended to an interface application called **FleetOne** to predict the onset of degradation in bearing and wheel so that they can be taken off from running service before they fail catastrophically.

b) CRIS Ecosystem:

CRIS is the IT arm of Ministry of Railways, Government of India. A number of rolling stock related applications have been developed and deployed by CRIS on IR. Prominent and relevant (for freight yards) among them are FMM, FOIS, COA.

c) ApnaTech Ecosystem:

A strain-gauge based design of Wheel Impact Load Detector (WILD) has been developed by M/s ApnaTech in collaboration with RDSO and IIT, Kanpur. This has been used for measurement of wheel impact caused by the wheel flat or uneven loading due etc. on IR for quite some time now.

The output signals in this system are trended to a web based interface application called **RailMan** for taking preventive actions.

A brief overview of such systems is presented in the table at Annexure I

Present levels of integration of these systems are listed as under:

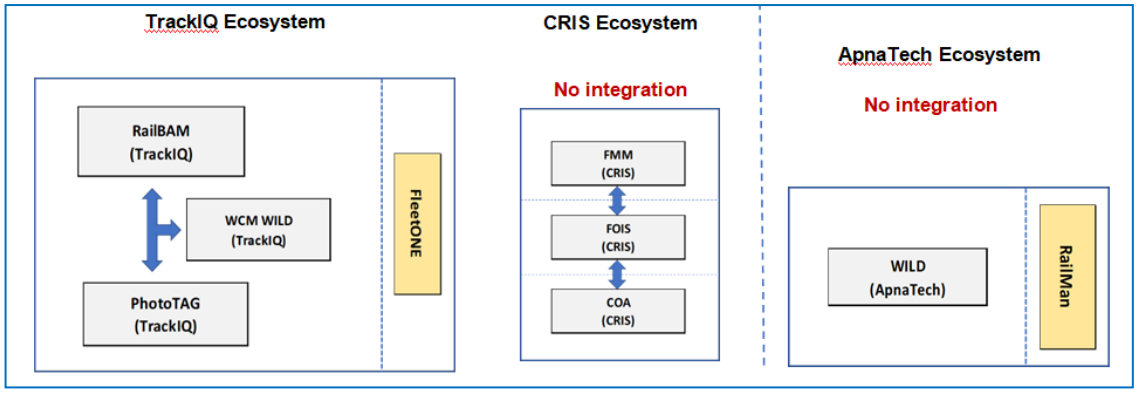


Figure : Integration Status

As seen in Figure above:

i) Rail BAM, WCM-WILD and Photo Tag are integrated with each other and interact with FleetOne i.e. the common application backend of TrackIQ. All modules are integrated using internal service oriented architecture.

ii) Components of CRIS ecosystems, FMM, FOIS and COA have limited integration based on web service. FOIS sends rake data in response to API requests raised from FMM. Similarly, COA sends/receives information from FOIS using a web service based interface.

iii) WILD is integrated with RailMan application and is not integrated with any other system.

iv) There is no standard and validated Vehicle Identification System.

Due to this fragmented scenario:

i) A complete 360-degree view of the wagon defect alerts raised across the route is not available. Non availability of a standard Vehicle Identification System further compounds this problem.

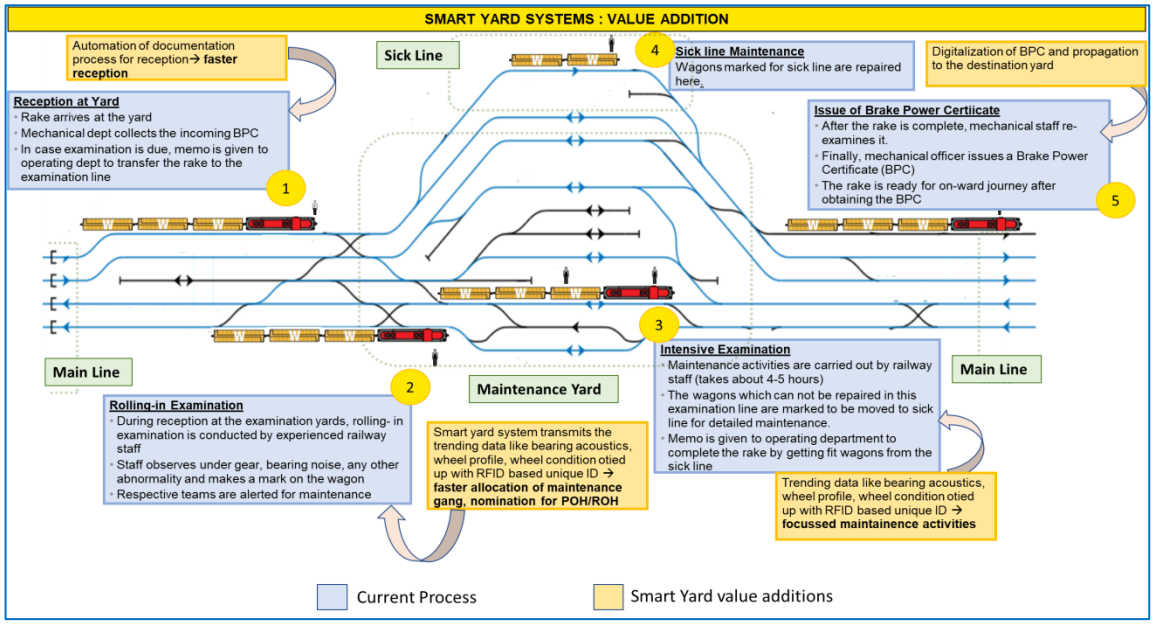
ii) Data cannot be shared to-and-from various modules which is a limiting factor. Data sharing can improve operations, for example, sharing of alerts data from other systems to FMM before the rake arrives in the yard would help in carrying out focused maintenance activities.

iii) The need for historical reports and analytics envisaged for the near future would not be fulfilled without maintaining a common data repository with consolidated and standardized metadata.

Further, this landscape is expanding and various sensor technologies would be added over time which could be handled by different vendors. There would be a need for a robust integration layer capturing maintenance and critical alerts being generated as outputs of various interfaces. Such a layer along with a common data repository shall facilitate and improve the maintenance processes and operational efficiency

5.3 The desired state in Next Generation Freight Management Systems

The Key objective of the integration of the ICT systems is to provide a holistic view of the rolling stock maintenance requirements.



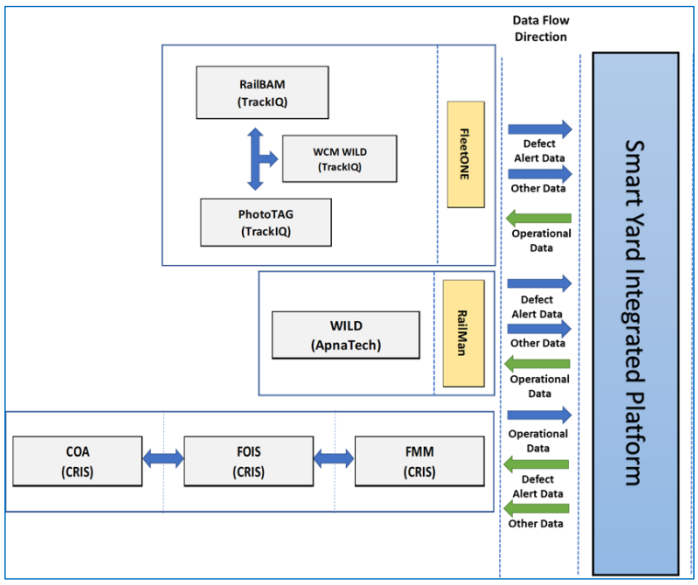
Smart Yard Systems: Value Addition

Post integration some of the value additions are summarized below:

a) There would be a RFID based Vehicle Identification System for Freight Stock. This is a prerequisite for a successful Smart Yard implementation. It shall facilitate faster reception of trains due to automation of data and it's advance availability.
b) Since alerts of likely defects in individual wagon has already been received through the way side and rolling in detection system eco systems, advance allocation of resources in form of manpower, material and tools is possible.
c) Advance intimation of wagons due for POH/ROH shall be available that shall facilitate faster replacement within the yard to reorganize the rake to it's original composition.
d) Currently, the wagon is the unit for maintenance scheduling, however, based on the component alerts, the system will be able to determine optimum maintenance schedules at the component level. Further, availability of parameter trends over a period of time would facilitate focused attention to wagons rather than each wagon being given similar level of attention.
e) Digitization in course of smart yard implementation shall facilitate faster and meaningful data analytics at management levels for informed decisions.
f) Integration with FMM shall ensure that the field level supervisors are interacting through this vast ecosystem through a single, easily available and understandable interface.

5.4 Integrated View of ICT Systems

To obtain a holistic view of all the defects in the rolling stock it is required to bring all the current and future system together, which is possible through a robust and modular integrated platform. An indicative level view of the integrated Platform is depicted below:



The defect related alerts and other data, for instance wagon condition data (trending/normal or faulty etc) raised by systems like RailBAM, WILD etc. **may be replicated to the Smart Yard Integrated Platform** in pre-defined data formats through a suitable data integration technique. The defects alert data will be shared from with FMM for increasing their operational efficiency and the operational data like that of Break Power Certificate will be replicated from FMM to Smart Yard Integrated Platform. Therefore, both the systems are mutually benefiting. The potential benefits of this integration would be:

i) A common data repository will be maintained which would enable the creation of a 360-degree view of rolling stock with all the defect alerts raised by the ICT systems. It could be logically extended for futuristic reporting/analytics needs as well.
ii) The defect alert data can be consumed by other ICT systems like FMM as per their requirement.
iii) The reporting needs across various dimensions such date, time, geography, wagon etc would be fulfilled by the common data repository.

To implement the integration and achieve the to be state, as define in the preceding paras, requirements at the application, database and reporting level are as under:

(A) Application Requirements

i) The system should obtain the wagon identity information from the source/ integrated systems. For this, a credible RFID based Vehicle Identification eco system is a prerequisite mandatory condition.

ii) The systems should provide a detailed view of all the maintenance and critical defect alerts with a rake which may be drilled down to the wagon level. The system should have the capability to visually represent the above data related to rake/wagon for ease of reference.

iii) The system should allow for gathering inputs from the field staff on the inventory of the defect alerts reported by the Smart Yard ICT systems. The field staff should be able to acknowledge the defect alerts reported by the system, submit actions taken and provide user feedback.

iv) The systems should be agnostic to the technology stacks of the upstream systems. In future, there may be new vendors or new systems and with ever evolving technologies the underlying technology stacks are bound to change. In such a scenario the system should allow for plug and play of the new ICT systems in the Smart Yard Integrated Platform without any limitations.

v) The system should enable future expansion to include analytics, predictive maintenance etc. This capability will be based on the alerts captured from various systems, as well as on the capability of the Smart Yard Integrated Platform to be able to incorporate analytics modules in its application layer

vi) The system should have a modular design to enable ease of development, maintenance and scalability

(B) Database Requirements

i) The system should have a data warehouse structure and include various masters and other tables to ensure proper reporting. For instance, it should have time and location dimension tables as well as fact tables as populated from the defect alerts data.

ii) The systems should receive data from the underlying integrated systems like FleetOne, RailMan, FMM etc in a pre-defined format to suit the reporting requirements. For instance, various integrated systems may use differing nomenclatures for the device ID or may have differing severity tables, however for the integrated platform they will transfer the data as per the defined nomenclature and fields.

iii) The database should enable configurable data fields in various schemes to ensure their compliance with the changing reporting requirements of the Railways. For instance, new data field may need to be configured with all the associated changes or severity levels may need to be redefined.

iv) All the alert outcome information from various interface systems is intended to be stored to help in generating trends and enable future analytics as well. However, to ensure efficient use of IT infrastructure the system should provide a high availability and high durability archiving mechanism

v) The master tables which have common representation in various modules will be standardised and maintained as unified masters for the integrated platform.

(C) Report Requirements

i) The system should provide different views of the report to suit the need of the user for instance it should have a high-level view for the executives and a detailed report for the maintenance staff.
ii) The system should be able to provide reports as per the given time frame for instance months, days etc.
iii) The system should be able to provide reports based on various dimensions in the database. Various dimensions in the database are Wagon ID, Time, Device ID, Location ID, Defect Alert etc.
iv) The system should generate trending reports for the wagons. These reports shall provide a timeline based information for a wagon. It should include various defect alerts raised for the wagon and should provide details of the associated component and defect.
v) The system should provide exception reports. Exception reports shall be based on the inputs from the users, who will report any false negative and false positive cases.

vi) The exception and tending report, in suitable formats, should be pushed to/pulled by the CRIS ecosystem (FMM) so that they can be made available to the field level supervisors and divisional freight stock management officers.

5.5 Key Factors for success of Smart Yard Integration

Smart Yard Integrated Platform as envisaged in this chapter is an interplay of various underlying systems, process and technologies. Key factors imperative to the success of the integration effort are listed here:

a) Organisation Factors

i) There are multiple stakeholders involved in the smart yard ecosystem: Indian Railways, various Zonal railways, railway staff, vendors, OEMs, system integrator etc. Robust coordination mechanism is essential to ensure successful implementation.
ii) A clear definition of roles and responsibilities of each stakeholder is needed as this project will warrant prompt actions from different agencies.
iii) Railway staff responsible for daily maintenance activities need to be sensitized of the positive impacts of this system. It would ensure rapid uptake of the system.
iv) Clear rules and processes need to be defined and circulated to all the concerned railway staff to ensure standardization of practices related to maintenance yards.

b) Technical Factors

i) RFID system is a pre-requisite for successful integration. It will ensure error free capture and transmission of wagon ID. Presently, the wagon IDs are capture by vision based devices, which fail to capture the wagon numbers due to a variety of factors like faded numbers, multi numbers marked on the wagon, non-standard placement of wagon ID on the wagon body etc.

ii) Vendors such as TrackIQ, ApnaTech (and other future vendors), will need to make modifications to their existing systems to provide data alerts to the Smart Yard Integrated Platform in the manner and format defined for that purpose.

iii) Railway organizations (like CRIS, COFMOW, CAMTECH, Zonal Railways) leading the integration effort would need to drive the finalization of the data table formats, standardization of critical data fields like severity levels etc.

iv) Time bound final validation of the data and information fields will need to be provided by railways by co-relating the alerts generated by the detection systems with actual physical defects in the wagons.

v) For the source data assessment, various vendors may be required to provide access to their databases to the implementing agency.

5.6 Final ICT Ecosystem

The diagram shown at Annexure II provides a high level view of the ICT Ecosystem that shall provide the defect detection and fleet health management services to all the maintenance and operations teams. This is summarized as under:

a) RFID based Vehicle Identification Eco System shall capture credible data to act as pivot field.

b) Data shall be captured at various sites deploying way side and rolling in equipment like WILD, WCM, OMRS, and Machine Vision Equipment etc.

c) Data alerts through their respective interfaces like RailMan, FleetOne (and new future interfaces) shall be replicated to a common data repository.

d) Data Integration platform shall communicate with the respective interfaces/repository to generate exception/trending data reports in pre-defined formats through a API based system.

e) The exception/trending data reports (in pre-defined formats) shall be pushed to/pulled by FMM and onwards made available to he field level operatives on their PCs/Laptops/Hand Held devices for informed decisions.

ANNEXURE 5A: ICT Systems Overview

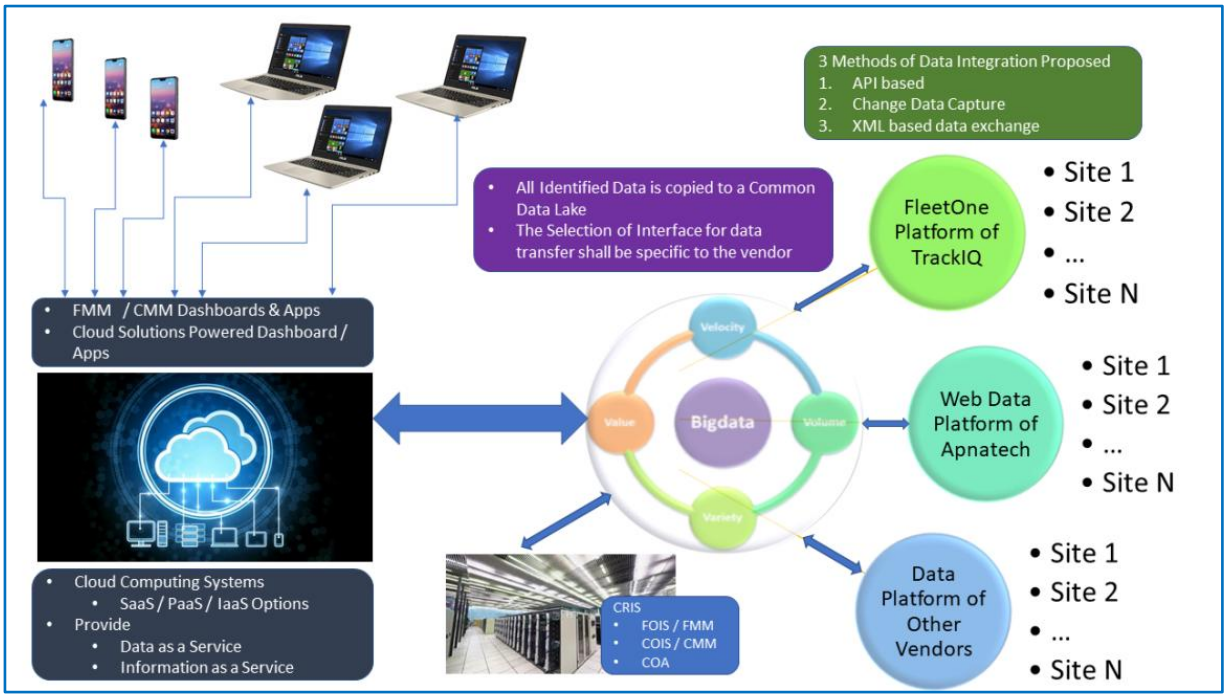
S.No.	Description	OEM/Agency	Sensor Type	Purpose of the ICT System	Details	Backend Application & Data Sharing provisions	Installation Status
1.	RailBAM (Rail Bearing Acoustic Monitor)	TrackIQ	Microphone Array	To detect bearing defects	This is an acoustic sensor based system. It uses beam forming arrays on either side of track, operating in master-slave mode to detect bearing defects like cup, cone, roller, extended surface etc.	FleetOne Data Sharing Provision: API based interface XML based data sharing	25 such systems are being installed across 20 sites. Installation of 9 systems has been completed.
2.	WCM-WILD (Wheel Condition Monitor-Wheel Impact Load Detector)	TrackIQ	Piezo-electric	To detect wheel defects	This is piezo- electric sensor based system. It monitors the wheel contact surface condition by detecting load exerted by the wheel on the track.	FleetOne Data Sharing Provision: API based interface XML based data sharing	25 such systems are being installed across 20 sites. Installation at of 9 systems has been completed.

3.	PhotoTAG	TrackIQ	Camera	To identify Wagon number	PhotoTAG is a high-speed camera based system which captures wagon identification number. It is installed alongside RailBAM and WCM to map the defects to a wagon	FleetOne Data Sharing Provision: API based interface XML based data sharing	25 such systems are being installed across 20 sites. Installation at of 9 systems has been completed.
4.	FleetOne	TrackIQ	_	Backend application for TrackIQ devices	Provides a platform for data collection, collation and reporting for the TrackIQ devices	Data Sharing Provision: API based interface CDC/ETL based data sharing XML based data sharing For bi-directional data interchange with Smart Yard Integrated Platform	FleetOne application is hosted at the OMRS data centre, Kishanganj Delhi
5.	WILD (Wheel	ApnaTech	Strain Gauge	To detect wheel defect	This is strain gauge based system. It	RailMan Data Sharing	18 such systems have been installed

	Impact Load Detector)				monitors the wheel contact surface condition by detecting load exerted by the wheel on the track.	Provision: API based interface XML based data sharing	and being used currently.
6.	RailMan	ApnaTech	_	Backend application for ApnaTech device (SN. 4)	Provides a platform for data collection, collation and reporting for the ApnaTech device	Data Sharing Provision: API based interface CDC/ETL based data sharing XML based data sharing For bi-directional data interchange with Smart Yard Integrated Platform	RailMan application has been procured by various zonal/divisional railways which have procured WILD system from ApnaTech Technologies.
7.	RFID Tags	CRIS	Radio Frequency Tags	Provide unique identity to the wagon	An RFID tag is envisaged to be a unique identity for each wagon.	_	RFID tags are being installed in the new wagons. Retro fitting of the wagons is also

							planned.
8.	RFID Readers	Various vendors	Radio Frequency Reader	Read RFID tags	RFID readers use radio frequency antennas to read the RFID tags installed in the wagons	_	Planned to be deployed shortly by CRIS
9.	FMM (Freight Maintenance Management)	CRIS	_	Digitize the maintenance management processes for freight rolling stock	FMM is an application which provides for IT enablement of processes like offering memo, defect inventory, wagon nomination to sick line/POH/ROH. It has three modules: Yard, Sick Line and Depot.	Data Sharing Provision: API based interface CDC/ETL based data sharing XML based data sharing For bi-directional data interchange with Smart Yard Integrated Platform	FMM has been developed indigenously and being maintained by CRIS.

ANNEXURE 5B : Final ICT Ecosystem



Chapter 6

FMM

1 Network to be provided at depot level with minimum of 10mbps (upgradable to upto 2Gbpscfor future video feed) in the freight yards. The network may be planned in such a way that it is a physical Optical Fiber Cable/wired connection upto Yard office/Sick line and in ROH depot and in remaining places WiFi be provided so that hand held devices can directly connect to the internet for uploading data as well as downloading memos, BPCs etc. If feasible then even 1 or 2 or even 3 cell phone towers covering critical areas in the yard as elucidated below may be planned with 4g connectivity. This should later be upgradable to 5G especially if it is planned that video feed of the wagons either from the top using a static or drone camera (to check floor damage, body bulge, etc.) can be transmitted from the yard to the control centre / yard office during rolling in examination. The following areas should necessarily be covered while planning the network in the yard.
   a) Train examiners Yard office.
   b) Sick line office.
   c) IOH/ROH depot office and sections.
   d) Wheel lathe
   e) Departure yard at locations where Locomotives are attached to the trains for train departure.
   f) Depot Stores.

2 As suggested by CRSE/CR the following may also be considered: Availability of mesh networks in yards, sicklines, and depots is absolutely critical for the future growth. This activity can be undertaken by CRIS or alternatively, ZRs can be authorised to undertake such activities. In the beginning some ZRs can be asked to take the lead in this area to gain experience.

3 For recording of various parameters in readings of wagons, tools and gadgets with digital data storage & transfer facility be made available so that manual feeding of various parameters is avoided. From these tools and gadgets can be directly collected into FMM. Some of these tools can be axle box temperature gauge, piston stroke measurement gauge, knuckle profile gauge etc. Even portable inkjet printers (prints character size upto 2") can be used for painting nos. on the wagon body. Use of spray guns with stencils stickers could also be explored.

4 Integration with OMRS & other wayside equipment to be done so that others etc. can directly be sent to the concerned yards where attention has to be provided or was provided.

5 FMM rollout sanction has provision of more than 1500 desktop PCs, 300+ laser printer and multi-function printers to 150+ depots. It is expected that the supply of the above hardware would be expedited in the current financial year. Till such time network facilities are not fully functional, divisional offices should utilise their powers under SOP to procure and provide multiple 4G dongles which can cater to multiple devices.

6 CRIS has proposed a separate work for provision of hand-held devices like tablets (proposed 1400+) and 4" mobile printers (400+) for ease in work in the yards. This proposal is currently under active consideration on Railway Board for inclusion in Plan Head 17 Umbrella works. If the same is sanctioned and advised early, CRIS can be asked to get the DE sanctioned, MOU signed and then process for the hardware in the current year itself.

7 A uniform code for reasons for sick marking across various wagons types to be formalized and implemented.

8 To improve the effectiveness of FMM, a planned strategy of shifting all MCDO figures from manual feeding to directly being collected through FMM should be laid out. A start has already been made in this regard but the same needs to be enforced. This would enable true data to come in directly from the yard/sick line which would automatically be compiled and seen by HQs and Railway Board. Similarly, all requirements of RDSO should also be routed through primary data of FMM. This would not only build up a strong data bank but would go a long way in using this primary data for AI/ML purposes along with the inputs from OMRS and other wayside monitoring equipment..

Chapter 7

COST ESTIMATE

A. COST FOR INFRASTRUCTURAL FACILITY (INCLUDING M&Ps)

(For Green Field and Brown Field Projects)

Sr. No.	Item	Abstract Cost in crores of Rs.	Remarks
1	Civil Engineering (incl. covered shed, track, crane gantry)	150.07	*Based on estimate by WPO/Patna for BNDM/SER
2	Electrical Engineering	12.13	* - do-
3	Signal & Telecommunication	7.73	* - do-
4	Machinery & Plant	37.06	*COFMOW Compendium and other sources
	Total	**206.99** **Say 207**	

* Brief calculation placed at Appendix 3 and 4

Note:

1. For modification of yards, where all weather covered shed is not feasible, the cost may be worked out without the covered shed, EOT gantry and EOT cranes but providing the other facilities. The above does not include cost for Wayside Diagnostic Equipment, work of ICT integration and FMM were not included.
2. Details furnished at Appendix 3, and appendix 4.

B. COST OF WAYSIDE DIAGNOSTIC EQUIPMENT

Sr. No.	Item	Cost in crores of Rs.	Remarks
1	Wayside Diagnostic Equipment (including ICT integration)	39.5 per yard	Based on available sanction in PINK BOOK for Smart Yards (Item No. 1166 of 2019-20

For the examination yards under the project of Smart yard, the cost of Wayside Diagnostic Equipment would not be applicable. For other examination yards cost of the Wayside Diagnostic Equipment is to be included.

Chapter 8

PROJECTED BENFITS

Following benefits are expected with the provisions of the next generation infrastructural facilities having covered shed, EOT cranes and other facilities:

1. Reduction in the rake detention in the examination yard by more than 50%. From the current level of 16-17 hrs. This would significantly increase the availability of rake for traffic use and rake utilization.
2. Capacity of existing Yards to handle the freight rakes may increase by more than double.
3. In all weather environment projects, complete rake shall be formed inside the covered shed including replacement of sick wagons with fit wagons without the need of round the clock shunting requirement. Shunting requirement may be limited to just one shunting in a day to remove major repair sick wagons and placement of fit wagons in the covered shed.
4. Since most of the defects would be rectified at the examination yard itself, there would less detachment of sick wagons. Due to less detachment of sick wagons, the ineffectiveness shall be reduced and the availability of wagons would increase. As a result, more freight rakes could be formed.
5. Due to better maintenance facilities, the quality of repairs may improve. As a result, more CC and Premium rakes may be formed.
6. The wagon failure en-route would reduce due to better attention to wagons on account of better maintenance facilities.
7. Maintenance would be equally effective in day and night leading to better reliability.

Chapter 9

Recommendations

After the detailed deliberations and discussions, the committee recommendations for the Next Generation Freight Maintenance Depots are stated in the following paras.

9.1 Infrastructural and in-situ repair facilities at examination yard (Details at Chapter 3)

The facilities being recommended are for examination yards dealing with upto 10 rakes per day. For yards dealing with more than 10 rakes, the facilities to be added in multiple of these facilities.

9.1.1 For Green Field and Brown Field Projects

(i) All weather covered shed in the examination yard should be provided either as Green field or Brown field project.

(ii) The covered shed size should be 750 m long, 35 m wide (Gantry width) and 13 m clear height. The gantry rail height to be 10 m. There should be 4 lines in the covered shed of minimum 750 m length. The 1st and 3rd to be rake examination line, 2nd to be sick wagon line and the 4th to be fit wagon line.

(At the locations where there is inadequate space for shed width, covered shed of 30 m width can provided with 3 lines inside the covered shed having the centre to center track distance of 8.2 m. This should, however, be adopted only as exception).

(iii) Lean to shed to be provided at one or both sides of the covered shed as per availability of space.

(iv) The track centre distance between the lines to be 8.2 m to provide 5 m clear path for movement of equipments for wagon maintenance.

(v) The complete area under covered shed to be provided with VD (Vacuum Dewatered) flooring.

(vi) The Covered shed roof and the side wall sheets to be provided with 30% translucent Perspex sheet or piped light for natural light. Roof turbo ventilators to be provided for ventilation.

(vii) Eight EOT cranes of 20 T be provided in each shed.

(viii) Mobile workstations mounted on road vehicle to be provided @ 2 per examination line i.e. 4 numbers per shed.

(ix) Self propelled Battery operated scissor lift to be provided @ 2 per examination line. Total 6 numbers per shed to be provided (keeping 2 for battery charging).

(x) Two numbers of Battery operated Rail cum Road Shunting Vehicle per depot for internal shunting and gap creation between wagons.

(xi) The yard should also have spare lines under traffic for allied activity.

(xii) The examination yard should have connectivity to mainline from both the ends for easy placement and departure of rakes.

(xiii) Full length shunting neck may be provided on both the ends of the examination yard so that independent shunting operation of wagons could be carried out inside the depot.

(xiv) To facilitate 24 hr working, the examination yard should be provided with proper lighting system to have an illumination level of 150 Lux during night.

(xv) Knee height lighting system to be provided at an interval of 10 m along each examination line for examination/repair of undergear components.

(xvi) Adequate welding points along the length of the examination lines to be provided at an interval of 10 m to be co-located with the knee height lights provided for under gear examination to avoid creation of any additional obstruction.

(xvii) Underground Pneumatic pipe line to be provided throughout the examination lines with trappings at 20m interval (i.e. with the alternate lighting location). Aluminium pipes should be used to avoid corrosion and to have leak proof system.

(xviii) High resolution CCTV cameras should be provided at both ends of the examination lines for inspection of floor/roof and body of the wagons. Six such cameras are required in each examination line.

(xix) Stand alone RFID reader at both ends of the examination line to be provided.

(xx) Hand held RFID readers @ 2 numbers to be provided per examination line.

(xxi) TXRs should be provided with Industrial type Personal Digital Assistant (PDA) having pre-fed check sheets.

(xxii) Wi-Fi Network to be provided at depot level with minimum of 10mbps (upgradable to upto 2Gbpsc for future video feed) in the freight yards. It may be through Railnet Connection (Internet Connection if Railnet is not available).

(xxiii) Feed through FMM, from wayside diagnostic equipment, of defects, in a consolidated form, on individual wagons in the rake for examination to be available in to the depot before arrival of rake.

(xxiv) There should be no OHE wiring over the lines in the covered shed. Top wiring at both the ends of the covered shed can, however, is provided for dropping the rake and for waiting for crew/loco after release.

(xxv) 6m concrete cross pathway on both ends of shed/ examination lines need to be provided connecting sick line/stores for ease of movement as well as flexibility of operation of the road mobile equipments

9.1.2 FOR EXISTING YARDS WHERE COVERED SHED IN NOT FEASIBLE

In the existing yard, where covered sheds are not feasible, all the facilities of Green Field and Brown field projects should be provided except for the following

- Covered shed with crane gantry
- EOT cranes

Additional recommendations for such location

(i) The track centre to centre distance at 8.2 meter between the examination lines and adjacent lines may be done either slewing of existing lines or by removing intermediate lines.

(ii) OHE mast, if any, coming on the pathways to be removed and converted to portal type masts.

9.2 Machinery and Plants (M&P)

Machinery and Plants (M&P) to be provided as per the list given at Chapter 3 at para 3.3 and 3.5

However, EOT cranes need not be provided at the locations where covered shed is not feasible.

9.3 Wayside Diagnostic Equipment

The wayside diagnostic equipments should monitor and give advance feed to the examination depots and hence need to be essentially provided to serve all the examination yards. Presently these are proposed to be installed at strategic locations all over Indian Railways. The wayside diagnostic equipment include OMRS (including ABD, WILD/WCM), Hot box detector, Machine vision equipment (Comprising Wheel Profile recording, Bogie Performance/ Defect Detector, Brake Equipment & Shoes, CBC coupler and Body Under frame detection & hanging parts etc.).

In future more features, such as Wagon body inspection, may be added to get advance information about defects in body, roof, floor and door.

9.4 ICT integration of wayside diagnostic equipment with FMM:

The information gathered by wayside monitoring and detection equipment would be at different IT platforms. The information need to be integrated and desired information need to be made available at a single platform so that the same is transferred to FMM and is made available to Train Examiner in advance in a consolidated form. Work on ICT Integration, being done by COFMOW for various wayside equipment for feeding the Data to FMM against a sanctioned project, should cover all the examination yards.

9.5 Seamless integration with FMM and FOIS

FMM has already been implemented over Indian Railways. The details related to Examination of rakes, attention to sick wagons and ROH are being updated. BPC is now being generated from FMM. The requirement of equipment for its full-scale utilization is being coordinated by CRIS. One Work has been sanctioned and is under process and another Work is under DE stage and has been proposed to be approved to make the Data entry during examination and repair of wagons directly into the system.

FMM has been recommended to be integrated with FOIS in the Yards so that real time information is available in advance with the TXR about the likely arising of the rakes for examination and to ensure advance preparation for attending the same.

9.6 Other Important recommendations

9.6.1 Damage to wagons

For effective output from the examination yards, it is essential that damages to wagons during loading/unloading is minimized. For this following need to be ensured at loading/unloading sidings:

(a) The tipplers and bulk handling systems, should be of RDSO approved specification and to be commissioned only after personal inspection and issue of certificate by Sr. DME of the division. Periodic inspection of these systems to be carried out by the Sr. DME as per existing instructions.

(b) Mechanized equipment (such as pay loaders, JCB, grab cranes etc) to be used in the sidings only after certification by Mechanical department of Zonal Railway. Such equipment used in open wagons should preferably with high driver/operator seat so that the driver/operator can see the inside area of the open wagon.

(c) Adequate number of web based CCTV should be provided at all sidings using mechanized equipment.

(d) Physical barriers of adequate height should be provided along the loading/unloading line to prevent hitting mechanized equipments to the wagon body.

(e) Adequate lighting system should be provided at loading/unloading sidings, where night operation is done.

9.6.2 Out sourcing of wagon repair activities

(i) Following activities of wagon repairs may progressively be outsourced with proper supervision:

(a) Repairs to body and floor by cutting and welding.

(b) Repair/replacement/provision of damaged/missing doors.

(c) Material loading/unloading and transport

(d) Assisting the skilled railway technicians, etc

(ii) The sourcing for minor repairs on the body, floor and door of wagons may also be extended to loading points selectively to control wagon damages to reduce/avoid rejection of wagons at the loading points.

9.6.3 Formation of CC rakes

The individual CC rakes may be formed from the off POH wagons or Off ROH wagons so that there is no in-service detachment from the rake for POH/ROH. Whenever due the complete rake to be taken for POH/ROH. This will eliminate detachments on this account from CC rakes.

9.6.4 Review of progress and future improvements

CAMTECH should be entrusted to co-ordinate for periodic review of the implementation of various recommendations in this report in Indian Railway and to bring out further improvement in future based on technological advancements.

APPENDICES

APPENDIX 1

भारत सरकार GOVERNMENT OF INDIA
रेल मंत्रालय MINISTRY OF RAILWAYS
रेलवे बोर्ड RAILWAY BOARD

No. 2006/M(N)/951/28 Pt. 2 **New Delhi, dated 25.06.2021**

Principal Chief Mechanical Engineers,
All Zonal Railways and KRCL.
Sr. Executive Director,
CAMTECH, RDSO

Sub: Planning for Next Generation freight maintenance facilities.
Ref: Railway Board letter no. 2006/M(N)/951/28 dtd. 23-6-2021.

The freight operation over IR is poised for a transformation. As per National Rail Plan (NRP) draft, traffic is expected to become more than 6 times in the years to come. This is planned to be achieved through fixed infrastructure augmentation, improved operation in term of speed / terminal turn-around and better wagons in terms of speeds / axle load / specialized designs etc. It is imperative that the wagon maintenance practices and infrastructure are also formulated to meet the future needs.

As a first step on the path of NRP, Vision 2024 has been issued by Board, targeting to increase freight loading by 70%. This is planned to be achieved through increase in wagon population coupled with improved operations. Accordingly letter under ref. has been issued by Board for submitting proposals under traffic facilities. The increase in wagon population indicated in that letter is erroneously written as 15%. As per NRP the wagon population projected for loading of 2096 MT is 4,07,769 viz. an increase of 23-24% over the current year's population of 3,30,365 wagons.

With a view that proposals are drawn up for next generation 'State of the Art' facilities, AM/ME has decided to form a committee of the following officers:

1. Mr. G. K. Gupta, PCME/NFR – Convener.
2. Mr. P. K. Mandal, PCME/SER
3. Mr. S. Srivinas, PCME/SR
4. Mr. R. Rajagopal, PCME/ECoR

Rail Bhawan, Rafi Marg, New Delhi – 110001.

Mr. Jitendra Singh, PED/CAMTECH, RDSO and other PCMEs are requested to provide requisite inputs to the committee to enable preparation of a comprehensive report. The committee may co-opt any other member as deemed necessary.

The committee would draw up a report detailing the recommended infrastructural facilities. The following inputs may be considered for the report:

I. All weather working environment.
II. In-situ wagons repair capability during examination within the allotted time with minimum detachment.
III. Requirement of suitable M&P including material handling equipment and T&P of the latest specifications
IV. Facilities to be integrated with 'Smart Yard' project.
V. Facilities should be suitable for seamless use of FMM in real time.
VI. Any other latest innovation / technologies etc.

The Committee may please submit it's repot by 10th July 21.

26/6/21

(Manish Jain)
Exec. Dir. Mech. Engg. (Freight)
Railway Board

APPENDIX 2

भारत सरकार **GOVERNMENT OF INDIA**
रेल मंत्रालय **MINISTRY OF RAILWAYS**
रेलवे बोर्ड **RAILWAY BOARD**

No: 2006/M(N)/951/28 **New Delhi. Dated: 23.06.2021**

General Manager
All Zonal Railways

Sub: Facilities for wagon maintenance to achieve Vision-2024.

During a meeting with Board, GM/NFR had conveyed that document Vision 2024 circulated by Railway Board does not cover projects related to augmentation of maintenance facilities of freight stock in yards, sickline, ROH Depots and POH workshops. This issue has also been highlighted by other ZRs during interaction at various levels with Railway Board.

Considering these inputs, an umbrella work was proposed for sanction in Budget 2021-22 under Traffic facilities planhead with approval of Board (M/O&BD). In the limited time available, proposals from only 7 ZRs could be collected for the same. However, the umbrella work could not be sanctioned due to paucity of time.

It is imperative that the wagon population would increase to be able to carry traffic targeted in the Vision 2024. The National Rail Plan Document, which is currently under finalization also envisages increase in wagon population by atleast 15% to match such traffic volumes duly taking into consideration the improved operational efficiencies etc.

In view of above, it is requested that the increased traffic flow in respective Zonal Railways to achieve Vision 2024 may be identified and corresponding requirement for wagon maintenance infrastructure be proposed under 'traffic facilities works' for out of turn sanction in 2021-22. The following aspect may be considered while framing the proposals:

1. Requirement of new wagon examination yards / ROH depots etc. as per the projected traffic flows by 2024.

2. Requirement of augmentation of existing wagon examination yards / ROH depots / POH workshops etc. as per the projected traffic flows in 2024.

3. The efforts for increasing CC and Premium examinations as applicable in terms of rake operations should continue, to minimize End-to-End examinations.

The proposals should be sent with the consent of PCME and PCOM. Considering the urgency, the proposals may please be sent at the earliest.

This issues with the approval of AM/TT and AM/ME, Railway Board.

Manish Jain
Digitally signed by Manish Jain
Date: 2021.06.23 12:44:37 +05'30'

(Manish Jain)
Exec. Dir. Mech. Engg. Freight
Email: edmef@rb.railnet.gov.in
3rd floor, Room No.323

Copy:
PCMEs, all Zonal Railways
PCOMs, all Zonal Railways

APPENDIX 3

Civil Engineering, Electrical engineering and Signal engineering estimates

	Detachment Free Rake examination Facilities at BNDM (WPO/Patna's Estimate No. WP/LHB/BNDM/DE/2019, Sanction on 03.01.2020				Abstract estimate for NEXT GEN FRT EXAM FACILITY		
	Qty	Unit	Rate	Amount in Rs.	QTY	Amount in Rs.	Remarks
(A) CIVIL ENGINEERING							
Preliminary expenses							
Soil investigation, Design, Drawing etc.				726769			
Formation							
Earthwork	10000	cum	254.05	2540500			
Mechanical compaction with road	10000	cum	14.14	141400			
Tender increase on cost	2681900		0.85%	22796.15			
Permanent Way							
Rail fastening for embedded track	2100	m	6905.288	14501104.8	3000	20715864	
P. Way	1	km	11354801	11354801.06	5	56774005.3	
Sleeper & Fastening	1	km	3692766	3692766	5	18463830	
Point & Crossing	6	set	1303936.2	7823616.96	14	18255106.24	
Derailing Switch	2	set	350387	700774	4	1401548	
Ballast	2633.14	cum	2281.6	6007772.224	13165.7	30038861.12	
Bridges						0	
Extension of existing Bridge	1	each	8395709	8395708.99		0	
Station & Buildings						0	
Service Building	900	sqm	25448.34	22903506	1870	47588395.8	
Covered shed	5600	sqm	43381.183	242934624.8	26250	911004843	Rate taken 20% less due to lower shed/ gantry height and lower crane tonnage
Storage Shed/Lean to shed	600	sqm	18848.62	11309172	9000	169637580	
ESS	153	sqm		2741423.27		0	
Training Hostel	500	sqm		8280861.69		0	
Drain work	250	m	4210.29	1052572.5	4000	16841160	
Road work 4 m wide	250	m	5206.675	1301668.75	2000	10413350	
CC flooring	3000	sqm	2406.122	7218366	26250	63160702.5	
Sub TOTAL				**353650204.2**		**1364295246**	
TOTAL with 10% escalation (for 2 years)						**1500724771**	Last sanction on 03.01.20
(B) ELECTRICAL ENGINEERING	Main shed area 5600 sqm			**23522274**		**110260660**	Main shed area 26250 sqm
TOTAL with 10% escalation (for 2 years)						**121286726**	Last sanction on 03.01.20
(C) SIGNAL ENGINEERING	Main shed area 5600 sqm			**14983730**		**70236234**	Main shed area 26250 sqm
TOTAL with 10% escalation (for 2 years)						**77259857.4**	Last sanction on 03.01.20

APPENDIX 4

M&P Estimate

SN	Description	Qty	Rate	Cost (000)	Rate reference
1	Battery operated Rail cum Road Shunting Vehicle (Cap. 2000 T)	2	39272	78544	RVNL for Sonipat project
2	EOT crane (20T) with pendant and remote control facility	8	10000	80000	COFMOW compendium (Escalation due to span added)
3	Mini Truck (4W), Cap. 1 T (min) for mobile workstation	4	2000	8000	GeM
4	Self propelled battery operated Scissor lift (Capacity – 500 kg, Lifting height – 4.5 metres minimum)	6	2000	12000	LPR of NFR
5	Arc Welding Set (600 A)	10	500	5000	COFMOW compendium
6	MIG/MAG welding machine	4	600	2400	COFMOW compendium
7	Portable air plasma cutting machine (Cutting thickness up to 12 mm)	4	800	3200	COFMOW compendium
8	Gas cutting set	4	300	1200	Last P.O
9	Huck Bolting machine	4	2200	8800	COFMOW compendium
10	Electric Compressor (500 CFM),10Kg/cm2	1	2700	2700	COFMOW compendium
11	Diesel Compressor (500 CFM), 10Kg/cm2	1	3500	3500	
12	DG set 250 KVA (for compressor, light & welding)	1	9700	9700	COFMOW compendium
13	DG set 500 KVA (for cranes)	1	10700	10700	COFMOW compendium
14	Computerised Rake Test Rig	2	450	900	LPR of NFR
15	Hydraulic CBC lifting device (2 T capacity)	2	10	20	LPR of NFR
16	Hand operated hydraulic jack (Cap 10T)	8	25	200	LPR of NFR
17	Motorised Hydraulic jacks (capacity 10 Ton)	4	50	200	

18	Electrode drying and heating oven, 50 KGS	1	200	200	LPR of NFR
19	Door straightening machine (Hydraulic Press), Size -1700 x 980 mm	1	4284	4284	COFMOW compendium for Hyd. Press Double Ram (20T + 20T)
20	Portable electric/pneumatic grinding machine (Cylindrical and Angular)	4	200	800	LPR of NFR
21	Riveting Machine (7/8", 5/8", 3/4", 1/2")	2	200	400	LPR of NFR
22	Pneumatic pipe line throughout the lines with trappings at 50m distance.	LS	22848	22848	B.Q. of Parker Legris
23	Hand Crimping Tools	2	250	500	LPR of NFR
24	Fork lifter 3T	2	915	1830	COFMOW Compendium
25	Power tools like angle grinders, High torque drill, etc.,	LS	2000	2000	
26	Hand trolley	1	50	50	LPR of NFR
27	Portable drill machine 12 mm	LS	100	100	LPR of NFR
28	Stand alone RFID reader	4	50	200	CRIS Rate
29	Hand held RFID reader	8			
30	CCTV camera for Floor/Body inspection	12	20	240	
31	Staff van	2	1200	2400	GeM
32	Pick up van (for movement from outside)	2	1500	3000	GeM
33	Truck 12T	2	2000	4000	GeM
34	Lister truck	4	600	2400	GeM
35	Road mobile crane (10 Ton capacity)	1	2400	2400	COFMOW
36	Protective clothing with Helmet & Gloves	LS	200	200	

37	Welding Apron & welding glass	LS	200	200	
	MISCELLANEOUS				
38	Storage rack with pigeon holes	LS	300	300	
39	Rack with Locker	LS	300	300	
40	Rack with Locker	LS	300	300	
41	Plain paper fax with P&T line	LS	150	150	
42	Palm hand computer	LS	1000	1000	
43	Walkie Talkie set/ Mobile phone	LS	200	200	
44	Railway Telephone	LS			
45	BSNL Telephone	LS			
46	Computer, with printer, Scanner, UPS with preloaded software & modem	LS	3000	3000	
47	C&W Office furniture	LS	2000	2000	
48	Railnet Connection/ (Internet Connection if Railnet is not available)	LS			
49	Plain paper copier for printing, copying & drawing with stabilizer	LS	200	200	
50	PA system	LS			
51	Lumpsum for New Technology items, Training Aids and other miscellaneous items	LS	50000	50000	
	SUB TOTAL			**332566**	
	D&G @ 6.49 %			21584	
	TOTAL			**354150**	

Cost of additional List of M&Ps Recommended By Committee Members for sickline sheds					
SN	**Description**	**Qty**	**Rate**	**Cost**	**Rate Reference**
1	Hydraulic double column guillotine shearing machine, 10x2500 mm	1	3500	3500	COFMOW
2	Digital ultrasonic flaw detector m/c, 10 mm - 5 mtrs.	2	500	1000	LPR
3	Bearing puller mobile hydraulic press,100/70 tons	1	700	700	LPR
4	Computerised Test stand for DV	1	1500	1500	
7	Hand held RFID readers.	LS			
8	Bogie turn tables in the covered shed.	LS	1000	1000	
9	Computerized Single Car test rig.	1	1000	1000	
10	Stand alone RFID readers at the entrance of the depot.	1	50	50	
12	CCTV surveillance system covering complete yard.	LS	1000	1000	
13	Digital wheel dia gauge.	1	150	150	
14	Whole yard shall be covered by high speed Wi-Fi.	LS	500	500	
15	Other items as per requirement identified by respected Railways.	LS	5000	5000	
	SUB TOTAL			**15400**	
	D&G 6.49%			1000	
	TOTAL			**16400**	

GRAND TOTAL **370550**

APPENDIX 5

BOQ of RVNL for Rail cum road shunting vehicle

Bill No 13A RAIL CUM ROAD VEHICLE

SN-A3, A4, A5

1. **GENERAL**

The scope covers design, manufacture, supply, testing and commissioning of diesel/ battery-operated rail cum road vehicle along with standard accessories and items required to make vehicle fully functional for hauling and shunting of rolling stock.

2. **BROAD PARAMETERS**

Rail cum road vehicle should meet broad technical parameters detailed hereunder.

2.1 **RAIL CUM ROAD VEHICLE 300T ELECTRIC**

a) For starting, hauling and pushing rolling stock trailing load of 300T on a straight, flat and dry rail track or trailing load of 132T on 1/1000 gradient/ 2^0 curve (850 m radius) and wet rail track.
b) Compact design with maximum overall dimensions of 2200 mm length, 2200 mm width and 1600 mm height above rail level
c) Turning radius on road should not exceed 2000 mm
d) Travel speed infinitely variable about 0-5 kmph on road and on track
e) Braking distance about 20 m with full load at 5 kmph
f) On board control panel with folding platform for operator for road and rail mode and radio remote control in rail mode
g) Battery operated vehicle with rechargeable type battery, capacity 350 AH for continuous operation for minimum 6 hours, recharging of battery in less than 10 hours, on board charging facility compatible with input supply and battery life up to 1500 charging cycles
h) Vehicle should have facility for remote control operation in rail mode from a compatible machine control panel

2.2 **RAIL CUM ROAD VEHICLE 2000T ELECTRIC**

a) For starting, hauling and pushing rolling stock trailing load of 2000T on a straight, flat and dry rail track or trailing load of 800T on 1/1000 gradient, 2^0 curve (850 m radius) and wet rail track.
b) Compact design with maximum overall dimensions of 5000 mm length, 2500 mm width and 3500 mm height above rail level
c) Turning radius on road should not exceed 11000 mm
d) Travel speed infinitely variable about 0-15 kmph on road and on track
e) Braking distance about 20 m with full load at 5 kmph
f) Cabin operated for road and rail mode and radio remote control in rail mode
g) Battery operated vehicle with rechargeable type battery, capacity 1800 AH for continuous operation for minimum 6 hours, recharging of battery in less than 10 hours, on board charging facility compatible with input supply and battery life up to 1500 charging cycles

3. **SCOPE**

Scope covers supply of rail cum road vehicle complete in all respect along with necessary accessories and items required to make vehicle fully functional.

a) Scope covers supply of power supply arrangement (clause #2.14), necessary spares, consumables, tools and tackles (clause #3), inspection and test certificates (clause #4), installation and commissioning (clause #5), documentation (clause #6), training (clause #7) and warranty (clause #8) as per General Terms and Conditions applicable for Bill #13.

b) Complete shunting vehicle

c) Radio remote control device for rail mode operation- 01 set for each vehicle

d) (Applicable for each 2000 T vehicle)- One AAR coupler and one SHAKU coupler with interchangeable mounting arrangement for hauling rolling stock and one tow bar with hook for hauling bogies etc, on both sides of vehicle.

e) (Applicable for vehicle fitted with pneumatic tyre) spare pneumatic rubber tyre- 01 number for each vehicle

4. **DESIGN FEATURES**

4.1 **ELECTRIC-BATTERY OPERATED VEHICLE**

Vehicle should be driven by electric motor and powered by battery. Capacity of battery and motor should be sufficient to generate tractive effort required for hauling specified trailing load. Scope covers supply of on board battery charging station for recharging of battery in less than 10 hours. Vehicle should have centralized water topping facility. Battery should have lifetime up to 1500 charging cycles.

4.2 **COMMON FEATURES**

a) Vehicle should be provided with metal wheels for guidance on railway track and pneumatic/ solid rubber/ high polyurethane (Vulcollan) tyres for movement on track and on road. Vehicle should be compact and have high degree of maneuverability. Vehicle should be capable to transfer itself from track to road and vice versa by inbuilt in railing mechanism when operated from driver's desk.

b) Driver's desk/ control panel in vehicle should have speedometer, emergency stop switch, audio-visual alarms, light switch, indication for mode of operation (rail/ road and remote/ manual), battery level, functions like forward/ backward, audio visual alarm for malfunctioning of engine, low hydraulic oil, engine temperature, low thickness of parking brakes shoes, parking brake etc for operation on road and rail. Vehicle should be provided with safety features normally required for operation on rail and road. Headlights should be provided on both sides. Parking brakes should be provided. Horn sound of about 70 dB should be provided one for each direction. Vehicle should be provided with lifting pads for lifting vehicle using screw jacks/ crane. Braking should hydraulically actuated and controlled by a foot pedal. Vehicle should have automatic flash light indication for movement. Vehicle should incorporate features like protection against low oil level in hydraulic system, provision of auto parking brake, provision of dead man switch, no traction with parking brakes on etc.

c) (Applicable for 2000 T vehicle) Vehicle should have a cabin for driver's desk with seat. Roof-mounted cabin should have all around visibility, illumination, lockable door, safety glass, screen wipers etc. Driver seat should be cushioned, adjustable and facing

direction of movement forward and reverse with 360^0 visibility and maneuverability. Vehicle should have facility to monitor rail position with the help of video camera and LCD display while vehicle moves on rail. Vehicle should have black box on board and provision to download data at any point of time. It should be possible to decouple CBC coupler adapter from cabin/ remote control.

d) Portable remote radio control should also be provided for operation on rail from minimum distance of 200 m. Remote should have controls to raise/ lower speed in forward/ reverse direction, emergency stop, accelerator, brakes, warning horn etc. Controls from driver's seat and radio unit should be interlocked to prohibit simultaneous operation.

e) Coupler on vehicle should be flexible to adjust to coupler height range of rolling stock. Vehicle should be provided with height adjustable tow bar with hook for hauling/ pushing. Coupler height should be flexible to adjust to height range of 1030 to 1105 mm. Standard height of coupler in coaches is 1090 mm. Standard height requirement for towing bar should be 560 mm from road/ ground level.

5. **SOURCES**

Likely sources of manufacturers and suppliers are Zephir, Zagro.

Rates

Rail cum road vehicle 2000 T	3,92,72,000
Rail cum road vehicle 300 T	1,42,30,000

APPENDIX 6

www.zagro.de

ZAGRO

To
Mr. S. Birua
CRSE, Freight, NFR

No.	2018- 31046 (1)
Date	23.07.2021
Client No.	
Our Ref.	
Your tax ID	
Your name	
Your Ref.	
Shipment	pick-up
Delivery	FCA
Contact	T. B. Sarkar
email	sarkar@premierindia.org

Dear Sirs,

We wish to thank you for your order which we confirm as follows:

Offer for E-MAXI XXL 2000 Ton Rail-Road

ZAGRO E-MAXI XXL –ElectricPower
Rail/Road operation
For open and embedded rails

- Track gauge 1676 mm
- Track guiding with UIC Profile
- Rubber tyre to drive on rail and road
- Shunting capacity: approx. 2000 t at 0‰ gradient (dry condition)
- Base frame: welded self-supporting steel construction
- Chassis with 4 x 20 KW motorseparate driven with rubber tyre
- Lithium Battery
- Radio remote control with 200 m range for rail and road
-Driving direction indicator LED lamps round red/white on road
- signaling device with driving direction 3 x white front and 2 x white rear alternately on the rail
- Horn
- Working brake: electrical brake over all 4 x motor
- Parking brake: Hydraulic brake in the gear
- Emergency brake via discs brake hydraulic
- Stepless drive
- Speed: 6 km/h atshunting, 19 km/h solo
- Color: RAL 1004 yellow / Chassis RAL 9005 black
- Weight: approx. 21.000 kg
- Crane eyes on front and rear side
- Waggonbrake system for 2000 t shunting capacity with 6 tanks each 85 l, Tank pressure 10 bar, Electric compressor with 800 l/min, air exclusion with 5bar and 10 bar at front and rear side

Cabin
- One door
- Safety glass with windscreen wiper and spray system in front and rear side
- Seat with 360° view
- Headlight front and rear

ZAGRO Bahn- und Baumaschinen GmbH
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74906 Bad Rappenau-Grombach
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Geschäftsführer Wolfgang Zappel
Amtsgericht Stuttgart HRB 103763
USt-IdNr. DE152590472
Steuernummer 65446/55006

Raiffeisenbank Kraichgau
BLZ 66762332 Konto 4459008
IBAN DE42667623320004459008
BIC GENODE61KIR

Commerzbank Heilbronn
BLZ 62040060 Konto 318633500
IBAN DE06620400600318633500
BIC COBADEFF620

- Emergency stop
- steering wheel
- Gas pedal
- Brakepedal
- On/Off switch at control panel
- Drive direction switch at control panel
- Horn at control panel
- SIFA switch

Additional equipment according tender specification:

Incl. 1 spare rubber tyre
Additional display in the driver cabine
Camera system
Data logger

Coupling system
Height adjustabe coupling device
AAR coupler head (special version)
SHAKU coupler head

Details of the coupling system have to be provided!

Training
1 day for SAT
2 days for training

Documentation
Laguage: English
- Operating and maintenance instructions
- Electric diagram
- Display
- Hydraulic diagram
- Drawings + Spare parts list
- Radio remote control
- Batteries
- Battery charger
- Certificate of conformity

3 printed versions and 1 version on USB-stick

Warranty extension
for the ZAGRO scope of supply
- for the ZAGRO scope of supply

The warranty includes spare parts and work time. The travel cost are not included.
- except normal wearout and damages, that are caused by inappropriate handling

Total: 425.000,00 EUR net per Vehicle

tax-free export to the third party country in accordance with § 4Nr.1a in conjunction with § 6 UStG

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BLZ 62040060 Konto 318633500
IBAN DE06620400600318633500
BIC COBADEFF620

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ZAGRO

Seite/Page: 3/3

Payment condition:

- 30 % advance payment against bank guarantee
- 70 % against LC with credit period of 30 Days

Taxes, duties etc. are not included and have to be paid by customer.

Price validity: 30 September 2021
Subject to prior sale. Based on our General Sales Conditions.
10 Months for 2000 t Shunters

The stated prices are understood EXW except if stated otherwise.

Should any questions arise, please do not hesitate to contact us.

Kind regards
ZAGRO Bahn- und Baumaschinen GmbH

Wolfgang Zappel, General Manager

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Commerzbank Heilbronn
BLZ 62040060 Konto 318633500
IBAN DE06620400600318633500
BIC COBADEFF620

APPENDIX 7

BOQ of RVNL for Scissor Lifts

1.4.1 **SCISSOR LIFT 1 T**

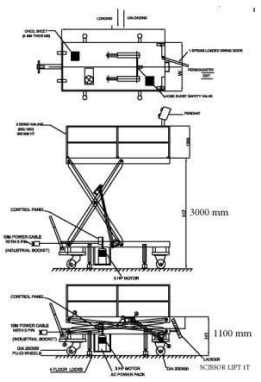
1. GENERAL

The scope covers design, supply, testing and commissioning at site of a scissor lift which can be raised and lowered through scissor lift mechanism hydraulically and with all accessories to make it fully functional.

2. BROAD PARAMETERS

The following are the important technical parameters to which the machine should conform

Load Capacity	1 T UDL
Table/Platform size	2900 mm x 1350 mm covered with MS plate. The three sides of the working PF are protected with hand railing (bolted to the platform) up to 1.2-meter height. One side (2.9-meter-wide) is completely open to access work area. One of the less wider side (1.35 m) is provided with a ladder and hand railing is with a sliding/swing door which can be latched properly for safety
Closed Height	About 1100 mm
Open height	not less than 2900 mm



Hydraulic System	AC 3 Ø /415 V, 2 HP motor driven hydraulic gear pump with direction control and flow control valve with filter and check valves. Hydraulic items are of Rexroth, Parker and other reputed makes. All hydraulic cylinders will be ground smooth and hard chrome finished and provided with high pressure chevron seal, Teflon/polymer guide strip, gun metal guide bush and wiper seal.
No of Scissors	1 no with 2 hydraulic cylinders
Bellow covering scissor mechanism	Silicone coated fire-resistant grade collapsible bellows should cover the scissor mechanism on all 4 sides during up and down operation.
Wheels	The Scissor lift is supported on polymer/rubber wheels with brake and swivel arrangement. Swivel brackets to be supported on bearings (roller/ball)

Stability	Structure should be sturdy and stable while working on the platform at the highest point.
Hydraulic System	AC 3 Ø /415 V, 2 HP motor driven hydraulic gear pump with direction control and flow control valve with filter and check valves. Hydraulic items are of Rexroth, Parker and other reputed makes. All hydraulic cylinders will be ground smooth and hard chrome finished and provided with high pressure chevron seal, Teflon/polymer guide strip, gun metal guide bush and wiper seal.
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Bellow covering scissor mechanism	Silicone coated fire-resistant grade collapsible bellows should cover the scissor mechanism on all 4 sides during up and down operation.
Wheels	The Scissor lift is supported on polymer/rubber wheels with brake and swivel arrangement. Swivel brackets to be supported on bearings (roller/ball)
Stability	Structure should be sturdy and stable while working on the platform at the highest point.

3. SCOPE

Scope covers supply of power supply arrangement (clause #2.14), necessary spares, consumables, tools and tackles (clause #3), inspection and test certificates (clause #4), installation and commissioning (clause #5), documentation (clause #6), training (clause #7) and warranty (clause #8) as per General Terms and Conditions applicable for Bill #13 for each machine.

1.4.2 **SCISSOR LIFT SELF PROPELLED**

1. GENERAL

The scope covers supply, testing and commissioning of electrically operated scissor lift along with standard accessories and items required to make scissor lift fully functional.

2. BROAD PARAMETERS

Scissor lift should meet broad technical parameters detailed hereunder.

a) Lifting capacity 450 kg minimum at 5750 mm platform height with slide-out platform extension deck capacity 110 kg minimum.
b) Steel platform dimension minimum 1600 mm x 700 mm with slide-out extension deck 900 mm and folding rails with half height swing platform.
c) Proportional lift and drive, drive speed in raised position about 0.8 kmph, dual front wheel drive
d) Hydraulic dynamic braking/ disc braking, solid non-marking tyres
e) Battery 24 V, capacity minimum 200 AH

3. SCOPE

The scope covers self-propelled scissor lift complete in all respect along with necessary accessories and items detailed hereunder to make self-propelled scissor lift fully functional.

a) Scope covers scope of works (clause #1), power supply arrangement (clause #2.14), necessary spares (clause #3), inspection and test certificates (clause #4), installation and commissioning (clause #5), documentation (clause #6), training (clause #7) and warranty (clause #8) as per General Terms and Conditions applicable for Bill #13 for each scissor lift.
b) Battery charger- 01 number for each scissor lift

4. CODES AND SPECIFICATIONS

Self-propelled scissor lift should be designed, manufactured, erected, tested and commissioned in accordance with IS codes and specifications detailed hereunder or equivalent international standard like DIN or ANSI.ANSI/SIA A92.6-2006 (latest) Self-propelled elevating work platform. If any condition mentioned in this specification is at variance with that of IS standard, technical specification hereunder shall prevail.

5. DESIGN FEATURES

a) Self-propelled scissor lift should be designed as per codes and specifications (or equivalent international standard like DIN or ANSI) and broad technical parameters, detailed herein above.
b) Platform control with battery charge indicator and diagnostic, manual platform lowering valve, manual brake release, emergency stop button at both platform and ground controls, tilt level sensor with alarm, descent alarm, electronic horn, hour meter, dual flashing beacons, motion alarm etc.

1.4.3 SCISSOR LIFT TABLE 4T

1. GENERAL

The scope covers design, manufacture, supply, testing and commissioning of scissor lift along with standard accessories and items required to make it fully functional for fitment of underslung components to coach under frame.

2. BROAD TECHNICAL PARAMETERS

Scissor lift should meet broad technical parameters.

Lift capacity	4T UDL
Lifting mechanism	Hydraulic
Table/Platform size	3000 mm x 1200 mm
Closed Height	About 550 mm
Open height	About 1700 mm
Lifting/lowering time	About 30 secs
Travelling Speed	2 to 3 kmph Driving arrangement is by a 24V motor driven by 220 AH batteries
Wheel Arrangement	UHMWPE/steel reinforced solid polymer/rubber hard wheels with brake and swivel arrangement. Swivel brackets should be supported on bearings.

3. SCOPE

3.1 Scope covers scope of works (clause #1), supply of power supply arrangement (clause #2.14), necessary spares, consumables, tools and tackles (clause #3), inspection and test certificates (clause #4), installation and commissioning (clause #5), documentation (clause #6), training (clause #7) and warranty (clause #8) as per General Terms and Conditions applicable for Bill #13 for each equipment.

3.2 Scope covers supply of standard accessories and items including the following along with each equipment: battery charger with power supply chord

4. DESIGN

4.1 The platform surface should be able to slide 200 mm on either side through hydraulic cylinder to enable location of under slung equipment properly.

4.2 Scissor lift shall be able to move loaded condition easily to position it under the coach for fitment of heavy under slung components like inverters, transformers etc. Once in position there should be provision to lock the wheels so as not to permit any movement while lifting or lowering operation is carried out.

4.3 Hydraulic System: AC 3 Ø /415 V motor driven hydraulic pump with control and flow valve with filter and check valves. Hydraulic items are of Rexroth, Parker and other reputed makes. In addition to hydraulic motor driven pump emergency hand pump is also to be provided.

SN	Item	BOQ rate	Accepted Rate	Remarks
1	SCISSOR LIFT 1 T	7,70,726	7,25,021.94	Below 5.93%
2	SCISSOR LIFT SELF PROPELLED	18,76,345	17,65,077.74	Below 5.93%
3	SCISSOR LIFT TABLE 4T	15,91,192	14,96,834.31	Below 5.93%

APPENDIX 8

Genie
A TEREX BRAND

Self-Propelled Scissor Lifts

GS™-2046, GS-2646 & GS-3246

E-drive

Specifications

Models	GS-2046		GS-2646		GS-3246	
Measurements	**US**	**Metric**	**US**	**Metric**	**US**	**Metric**
Working height maximum - indoor[1]	26 ft 1 in	8.13 m	32 ft 1 in	9.96 m	38 ft 1 in	11.78 m
- outdoor[1]	22 ft 4 in	6.98 m	25 ft 8 in	7.99 m	28 ft	8.71 m
A Platform height maximum - indoor	20 ft 1 in	6.13 m	26 ft 1 in	7.96 m	32 ft 1 in	9.78 m
- outdoor	16 ft 4 in	4.98 m	19 ft 8 in	5.99 m	22 ft	6.71 m
B Platform height stowed	3 ft 6 in	1.07 m	3 ft 11 in	1.2 m	4 ft 4 in	1.32m
C Platform length - outside	7 ft 5 in	2.26 m	7 ft 5 in	2.26 m	7 ft 5 in	2.26 m
extended	10 ft 5 in	3.18 m	10 ft 5 in	3.18 m	10 ft 5 in	3.18 m
Roll-out platform extension deck	3 ft	0.91 m	3 ft	0.91 m	3 ft	0.91 m
D Platform width - outside	3 ft 9.5 in	1.16 m	3 ft 9.5 in	1.16 m	3 ft 9.5 in	1.16 m
Guardrail height	3 ft 7 in	1.1 m	3 ft 7 in	1.1 m	3 ft 7 in	1.1 m
Toeboard height	6 in	15 cm	6 in	15 cm	6 in	15 cm
E Height - stowed: folding rails	7 ft 2 in	2.17 m	7 ft 7 in	2.32 m	8 ft	2.43 m
rails folded	5 ft 2 in	1.58 m	5 ft 7 in	1.7 m	6 ft	1.82 m
F Length - stowed	8 ft	2.44 m	8 ft	2.44 m	8 ft	2.44 m
extended	10 ft 11 in	3.33 m	10 ft 11 in	3.33 m	10 ft 11 in	3.33 m
G Width	3 ft 10 in	1.16 m	3 ft 10 in	1.16 m	3 ft 10 in	1.16 m
H Wheelbase	6 ft 1 in	1.85 m	6 ft 1 in	1.85 m	6 ft 1 in	1.85 m
I Ground clearance - center	5 in	12 cm	5 in	12 cm	5 in	12 cm
- with pothole guards deployed	0.9 in	2.3 cm	0.9 in	2.3 cm	0.9 in	2.3 cm

Productivity

Maximum platform occupancy (in/out)	2/1		2/1		2/1	
Lift capacity	1,200 lbs	544 kg	1,000 lbs	454 kg	700 lbs	318 kg
Lift capacity - extension deck	250 lbs	113 kg	250 lbs	113 kg	250 lbs	113 kg
Drive height	full height		full height		full height	
Drive speed - stowed	2.0 mph	3.2 km/h	2.0 mph	3.2 km/h	2.0 mph	3.0 km/h
Drive speed - raised	0.5 mph	0.8 km/h	0.5 mph	0.8 km/h	0.5 mph	0.8 km/h
Gradeability - stowed[2]	25%		25%		25%	
Turning radius - inside	zero		zero		zero	
Turning radius - outside	7 ft 6 in	2.29 m	7 ft 6 in	2.29 m	7 ft 6 in	2.29 m
Raise / lower speed	32 / 26 sec		41 / 30 sec		53 / 34 sec	
Tilt sensor activation - front to back	3°		3°		3°	
- side to side	1.5°		1.5°		1.5°	
Controls	proportional		proportional		proportional	
Drive	dual AC electric drive, front wheel		dual AC electric drive, front wheel		dual AC electric drive, front wheel	
Brakes	dual electric, front wheel		dual electric, front wheel		dual electric, front wheel	
Tires - solid non-marking	15 x 5 in	38 x 13 cm	15 x 5 in	38 x 13 cm	15 x 5 in	38 x 13 cm

Power

Power source	24 V DC (four 6 V 210 Ah batteries)					
Hydraulic system capacity	4.0 gal	15.1 L	4.0 gal	15.1 L	4.5 gal	15.1 L

Weight[3] / Floor Loading[4]

Weight - ANSI/CSA/CE	3,913 lbs	1,775 kg	4,346 lbs	1,971 kg	5,218 lbs	2,367 kg
Tire load, maximum:	2,017 lbs	915 kg	2,127 lbs	965 kg	2,227 lbs	1,010 kg
Tire contact pressure:	139.5 psi	938 kPa	124.6 psi	935 kPa	146 psi	1,021 kPa
Occupied floor pressure:	183 psf	8.63 kPa	192 psf	9.83 kPa	210 psf	10.23 kPa

Standards Compliance

ANSI A92.20, CSA B354.6, CE EN280, AS 1418.10

[1] The metric equivalent of working height adds 2 m to platform height. U.S. adds 6 ft to platform height.
[2] Gradeability applies to driving on slopes, see operator's manual for details regarding slope ratings.
[3] Weight will vary depending on options and/or country standards.
[4] Note: Floor loading information is approximate and does not incorporate different option configurations. It should be used only with adequate safety factors.

www.genielift.com

Genie
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Self-Propelled Scissor Lifts

GS™-2046, GS-2646 & GS-3246
E-drive

Features

Standard Features

Measurements
GS-2046
- 26 ft (8.10 m) working height
- Up to 1,200 lbs (545 kg) lift capacity

GS-2646
- 32 ft (9.92 m) working height
- Up to 1,000 lbs (454 kg) lift capacity

GS-3246
- 38 ft (11.75 m) working height
- Up to 700 lbs (318 kg) lift capacity

Productivity
- 89 x 45.3 in (2.26 x 1.15 m) steel platform
- 36 in (.91 m) extension deck
- Folding rails with full height swing gate
- Drive at full height
- Dual front wheel AC electric drive motors (E-drive)
- Universal 27A smart charger
- Rear recessed charger receptacle
- SmartLink™ - dual zone control
- Proportional lift and drive
- Platform load sense system
- Platform control guard
- Platform control with battery charge indicator and diagnostic display
- On-board diagnostic system
- AC power to platform
- Lanyard attachment points
- Manual platform lowering valve
- Emergency stop at both platform and ground controls
- Dual front wheel electric brakes
- Electric & manual brake release
- Swing-out component trays
- Solid non-marking tires
- Pothole guards
- Tilt level sensor with audible alarm
- Side & rear forklift pockets
- Maintenance free diamond plate platform

Standard Features

Productivity (continued)
- Dual flashing LED beacons
- Descent alarm
- Electronic horn
- Hour meter
- Motion alarm
- Tech Pro™ Link compatible

Power
- 24 V DC (four 6 V 210 Ah batteries)

Options & Accessories

Productivity Options
- Air line to platform
- Automotive horn*
- Biodegradable hydraulic fluid
- Platform control guard
- Lift Tools™ Pipe Cradle
- Lift Tools Panel Cradle
- Lift Tools Work Tray
- Lift Guard™ Contact Alarm
- Lift Connect™ Telematics
- XH (GS-2646, GS-3246) Full Outdoor Height

Power Options
- Power inverter (120 V/60 Hz)[1]
- EE rating
- AGM maintenance-free batteries
- Drive cutout while charging

[1] Not available with EE rating

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www.genielift.com

APPENDIX 9

Dated: 22.07.2021
Ref: Legris/RDSO/07/001

To,
Executive Director:
Research Designs & Standards Organization
Manaknagar, Lucknow - 226011

Re: Budgetary Quote for Supply Erection, Testing & Commissioning of Compressed Air Pipeline along with suitable Compressor

S.No	Description	No's	Qty	Rate	Total
1	**Supply Erection fixing testing & commissioning of Pipeline: 101.8 mm OD x 07.2 mm ID)** Material used must be corrosion resistant on the inside and outside by use of materials Aluminum alloy ASTM T5- 6060/6063, ASTM B241, ASME B31.1 EN755-2, EN755-3 & EN573-3, 2014/68/EU, Qualicoat Certified, ISO 8573:2001 & 2919 Class 1.1.1 Operating Pressure 0 to 10 kg/cm2	Rmtr	2952	3,679	1,08,59,375
2	**Supply Erection fixing testing & commissioning of Pipeline: 25 mm OD x 22 mm ID)** Material used must be corrosion resistant on the inside and outside by use of materials Aluminum alloy ASTM T5- 6060/6063, ASTM B241, ASME B31.1 EN755-2, EN755-3 & EN573-3 2014/68/EU, Qualicoat Certified, ISO 8573:2001 & 2919 Class 1.1.1 Operating Pressure 0 to 10 kg/cm2	Rmtr	1410	660	9,30,261
3	**Supply Erection fixing testing & commissioning of Full Bore Butterfly Valve for 101.8 mm OD x 07.2 mm ID Pipeline** Butterfly Valve made out of non-corrosive metal, Class # 150, inside locking plate /. Ball to be of Stainless steel material Complete with SS 304 flanges, gaskets & fasteners	No's	6	42,302	2,53,814
4	**Supply Erection fixing testing & commissioning of Threaded Ball Valve for 3/4" NB** Valve made out of brass, Ball to be of Stainless steel material Complete with SS 304 flanges, gaskets & fasteners	No's	470	1,344	6,31,563
5	Supply Erection fixing testing & commissioning Down take Bracket & TWO PORT WALL Bracket from (**101.8 mm OD x 07.2 mm ID)** as per EN Norms to 3/4" NB as per EN Norms The bracket should be made out of non-corrosive material and must have full bore. Operating Pressure 0 to 10 kg/cm2	No's	235	14,019	32,94,483
6	Supply Erection fixing testing & commissioning of Pressure Gauge with 150 mm Dial Size, 0 to 16 kg/cm2 pressure range, along with 1 no. Isolating Valve & necessary fittings. Preferred make Wike, Mass, H Guru	No's	10	11,019	1,10,188
7	Supply Erection fixing testing & commissioning of Pipe Supporting, weldable Supporting Iron Structure to be fitted with fasteners at site for easy and quick installation. Painted with approved paints	Ton	5	80,625	4,03,125
8	Supply Erection fixing testing & commissioning of Screw Type Air Compressor, Capacity - 618 CFM, Operating Pressure - 10 Bar along with Air Dryers High Efficiency Filters & Air Receiver Tank	Set	1	26,29,719	26,29,719
9	Interconnection of Compressors, Dryer & Air Receiver Tank	Set	1	2,50,000	2,50,000
				Sub Total	1,93,62,526
				GST	34,85,255
				Grand Total	**2,28,47,781**

With Regards

Authorised Signatory

APPENDIX 10

Specification of Additional Digital Equipments for measurement of various parameters in Freight Depots

Sl. No.	Digital Instruments /Equipment being used by depots	Technical details	Remarks
1	Digital ultrasonic flaw detector	RDSO specification no. M&C/NDT/1254/2004, Rv.II,January2017.	Electronic & Engineering Company India Pvt. Ltd Dadar and Nagar Haveli,Pin-396230 PO no.33205042100001 Dated-15.01.2021cost for 2nos. machine Rs.472000/
2	Digital surface wheel lathe machine	WITH PROBE TYPE MEASUREMENT (WLS) COFMOW/ CNC/SWL/ BG/ 2015 (with AMC)	Rs. 613.00 lakh
3	Hot Axle Box Detector (Infra Red thermometer)	Non contact Video Infra Red Thermometer with Data Logger	a) International motors, 8,khairuplace,nearbroadway hotel, kolkata-700072, cost-2,86,740/- , Quantity-03 b) Allied General Sales Corpn-Chennai,31,ELAKANDAPPAN STREET,CHENNAI,TAMILNADU-600003,po NO.33205056100110 DT 19.12.2020
4	Digital Wheel diameter measuring gauge	Digital automatic wheel diameter measuring gauge fitted with digital dial indicator. Modal WD-3 for BG or similar, accuracy through Vernier	Jyoti Enterprises, Roorkee PO No. IG-17-5247-1-50293 dt.31.10.2017 - 5 No. Rs. 205320/- Cost- Rs 41890/-per unit

		scale-0.1mm, Dial indicator accuracy 0.01mm, Dial indicator range -12mm, measuring range -800 to 1100mm. the wheel dia gauge fitted with dial indicator plunger with spring loaded with locking device and carrying in wooden box with locking arrangement.	Make-PIE/Jyoti Enterprises/Prasad Engineering/AOGE
5	Digital Wheel distance gauge	Product specification • Measure wheel gauge to 0.1mm • Robust and easy to use LED/LCD display • Fitted with levelling vial/spirit level • All wheel contact point a made from carbide • Spring loaded for faster measurements • Records up to 25 wheel readings.	• Ananad Optical glass & engineering works Roorkee 247667 • Paragon Instrumentation Engineers Private Limited
6	Digital Snap gauge	Digital Snap Gauge Range 150-175Mm to be supplied with Digimatic Indicator Resolution 0.001Mm.	Make-Mitutoyo Model No.201-107 or Mehr Germany Model No.4450041 Range 150-200 Mm or Starrett Model No. 1150
7	Torque Tester	Cap-21Nm to 1200 Nm Least count- 1Nm (Max.)	Rs. 1, 20,000/-
8	SCADA RTR	For Rake test Rig	Rs 6.0 Lac
9	Computerized SWTR Machine	For single wagon test rig	RS. 5.0 Lac
10	Computerized DV Test Bench	For DV test testing	Rs. 1000000/-
11	Computerized BC Test Bench	For Brake cylinder testing For LSD testing	Rs. 5.0 lac

12	Digital Vernier Caliper/ Depth Gauge, Screw Gauge	For measurement of depth (0-300mm)	Rs. 42000/-
13	Digital Micrometer for Journal diameter	For measurement of Journal diameter	Rs. 60000/-
14	CNC Surface Wheel Lathe	COFMOW/ CNC/SWL/ BG/ 2015 (with AMC)	Rs. 34.05 lakh
15	Digital Plate Shearing Machine	GSDC 1331 ,COFMOW/IR/DCGSM/2016	Rs. 15 lac
16	Laser based Wheel profile meter	For wheel profile measurement	
17	Digital spring height gauge	0-300 mm	Rs. 32,000/-