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सत्यमेव जयते

भारत सरकार GOVERNMENT OF INDIA

रेल मंत्रालय MINISTRY OF RAILWAYS

REPORT ON REQUIREMENTS OF FACILITIES FOR TRAINSET MAINTENANCE DEPOT CUM WORKSHOP

IRCAMTECH/GWL/MECH/2021-22/TRAINSET/M/F/REPORT /1.0
NOVEMBER, 2021

अअमा सं RDS Transforming Railways

EXCELLENCE IN MAINTENANCE

Indian Railways
Centre for Advanced Maintenance Technology

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Contents

Foreword

Vande Bharat Express also known as Train-18 is India's first indigenously developed self-propelled train with the Train set technology. Train set configuration though, more complex than conventional train arrangement, is faster, easier to maintain, consume less energy, and have greater flexibility in train operation. It is equipped with modern and superior interior passenger facilities providing world class travel experience higher passenger comfort and safety. This design can also be integrated with the next generation and future technologies to optimise maintenance and operation of Train sets.

Having advantages as mentioned above, the adoption of Train set technology across Indian Railways network requires dedicated facilities for maintenance in Depots and Workshops. In order to ensure high reliability and availability of Train sets, necessary maintenance infrastructure for carrying out maintenance have to be to be planned in advance and developed simultaneously.

With the above objective, CAMTECH has prepared this report on the essential requirements of maintenance facilities required for train set maintenance in Depots and Workshops covering details of infrastructure required along with the tentative cost estimate. This document will be useful for detailed planning the infrastructure facilities for trainset maintenance by the Zonal Railways by taking into consideration all location specific constraint and requirements.

IRCAMTECH is thankful to the Zonal Railways, Workshop Projects Organization and RDSO for their valuable input and making this a comprehensive document.

Please feel free to write us for any suggestion for further improvements.

RDSO, Lucknow
Date: 30.11.2021

Jitendra Singh
Principal Executive Director

Preface

IR has planned to proliferate Semi High-Speed Self-Propelled Train sets over its network. The inherently new world class design of the Train sets have essential requirement to create new state of the art maintenance facilities to ensure its reliability during the operations.

Rly Board vide letter No. 2017/M(C)/141/2 Pt. dated 30.09.2021 advised CAMTECH to prepare a standard layout for Train set maintenance depot and workshop along with standard list of M&P and Tools.

This report is prepared with the objective to provide informative technical details on infrastructure required for Train set maintenance and will be useful for the guidance of staff and officers planning for Train set maintenance facilities. Estimated cost details have been provided to the extent these were made available. It is advised to update the cost estimates from time to time at later stages.

Since new technologies on rail operation and maintenance are evolving, developing and maturing at much faster pace with ultimate objective of enhancing safety, reliability, lower cost of ownership and overall maintenance cost, it would be prudent to incorporate such technologies in detailed estimates prepared at later stage.

This report does not supersede any existing instructions from Railway Board, RDSO & Zonal Railways. This Report is not statutory and contents are only for the purpose of guidance.

We welcome any suggestions from our readers for further improvement.

IRCAMTECH, Gwalior **Manoj Kumar**
Date: 30.11.2021 **Director / Mechanical**

Quality Policy

"We at IRCAMTECH Gwalior are committed to maintain and update transparent standards of services to develop safe, modern and cost effective railway technology complying with statutory and regulatory requirements, through excellence in research, designs and standards by setting quality objectives, commitment to satisfy applicable requirements and continual improvements of the quality management system to cater to growing needs, demand and expectations of passenger and freight traffic on the railways through periodic review of quality management systems to achieve continual improvement and customer appreciation. It is communicated and applied within the organization and making it available to all the relevant interested parties".

Our Objective

To upgrade maintenance technologies and methodologies and achieve improvement in productivity and performance of all Railway assets and manpower which inter-alia would cover reliability, availability, utilization and efficiency.

CAMTECH is continuing its efforts in the documentation and up gradation of information on maintenance practices of railway assets. Over the years a large number of publications on railway assets have been prepared in the form of handbooks, pockets books, pamphlets & video films etc. These publications have been uploaded on the internet as well as on rail net.
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Amendment and Revisions

The correction slips to be issued in future for this report will be numbered as follows:

IRCAMTECH/GWL/MECH/2021-22/TRAINSET/M/F/REPORT /1.0# XX date .....

Where “XX” is the serial number of the concerned correction slip (starting from 01 onwards).

Version	Date	Corrections	Remarks
1.00		First Release	--

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All technical information and guidelines are latest at the time of publishing and are subjected to change due to technology updates and requirements.

This report does not supersede any existing instructions from Railway Board, RDSO & Zonal Railways. This Report is not statutory and contents are only for the purpose of guidance.

1. INTRODUCTION

First two indigenously developed trains by ICF on Train set technology have been successfully running for over two years. Considering the advantages in train operation and patronage by passengers, Indian Railways have now planned to proliferate the same over its network. This makes it essential to create new state of the art maintenance facilities to ensure high reliability, safety and customer satisfaction during the operations.

This report covers following aspects of Train set maintenance depot cum Workshop :

- Conceptual design of Stabling lines, Inspection Shed and Workshop to provide maintenance facilities and stabling facilities for the Rolling Stock.
- Operational and functional safety requirements.
- Ancillary buildings for other maintenance facilities.
- Electrical & Mechanical Services, power supply system etc.
- Location for Depot cum Workshop

This report provides conceptual design of the depot and will only work as a guide for the detailed design later.

2. TERMS OF REFERENCE

Rly Board vide letter No. 2017/M(C)/141/2 Pt. dated 30.09.2021 advised CAMTECH to prepare a standard LAYOUT for Train set maintenance depot and workshop separately along with standard list of M&P and Tools keeping following broad features in view:

I. Pit line for train set of 16 coaches, extendable up to 20 coaches.
II. Pit lines with Covered shed.
III. Washing / stabling lines equipped with carriage watering system, high pressure water jet cleaning system, washable apron, adequate drainage, etc. for the interior cleaning and watering of the train sets.
IV. No work requiring cleaning with water shall be carried out on the maintenance pit lines.
V. OHE over the pit lines, along with proper systems for isolation. The feasibility of Re- tractable OHE, which can get slewed away whenever required, should also be examined.
VI. Bright, light-weight and energy efficient LED lights
VII. Under floor wheel lathe
VIII. Heavy and medium repair facilities, including facilities.
IX. Drop pits, traverser and electrical testing lines/equipments.

X. IT and Communication Facilities, its Networking along with Data centre
XI. Automatic Coach Washing Plant and Water Recycling Plant
XII. Machine Vision Systems with Automatic High-Definition Cameras
XIII. Wheel Profile Measurement System & Ultrasonic flaw detector
XIV. Latest design of M&P with a high degree of automation.
XV. Service building having common offices/ staff rooms for the Mechanical/Electrical and other staff in order to promote synergy in working.
XVI. Protection wall / boundary wall
XVII. All infrastructures with road approach.
XVIII. Other items required.

3. METHODOLOGY ADOPTED

The following methodology was adopted for collection of information and suggestions.

I. Information and suggestions collected by electronic means of communication from Zonal Railways, WPO & RDSO.

II. VCs held with WPO and RDSO and basic guideline for the infrastructure of trainset maintenance was decided.

III. Draft depot layout and list of M&P required was shared with Zonal Railways for their feedback.

IV. VC organized with Train set depot SSB (NR) as on their experience on Train set maintenance and their suggestions for the proposed infrastructure collected.

V. Feedback and comments from Zonal Railways collected and suitably incorporated.

4. MAINTENANCE PHILOSOPHY

The outline of the maintenance philosophy followed would be as below:

- Typical Maintenance schedules being followed by SSB Depot on Northern Railway as prescribed in the CAMTECH maintenance manual for Train sets finalised in consultation with ICF, RDSO and respective OEMs have been considered for determining the requirement of lines in depot.

- Monitoring of the performance of equipment by condition monitoring of key parameters. The concept is to progressively evolve the need-based

maintenance regime, which can be suitably configured in the form of minor & major schedules.

- Unit replacement and essential repairs to major equipment to be done by the OEMs.

- Automation with state-of-the-art machinery to ensure quality and reliability.

- Labour intensive procedures will be kept to the minimum.

- Maintenance staff shall be given special training to develop high-level skills in their trade to ensure quality and productivity in their performance.

- Multi skilling of the Maintenance staff to ensure quality and productivity in their performance

- Adequate facilities for the stabling have been provided at the depot.

- To maintain high degree of cleanliness, Automatic Train washing plant has been proposed for cleaning of rakes.

- The entire facility should be under CCTV surveillance 24X7.

- Energy conservation shall be given due attention.

5. ROLLING STOCK MAINTENANCE NEEDS

5.1. Maintenance schedule

Servicing requirements shall be determined from the CAMTECH maintenance manual which has prescribed the schedule in accordance to the guidelines recommended by respective manufacturers. Servicing facilities may be provided to include the ability to carry out the inspection, maintenance, overhaul and repair of the rolling stock fleet, which may include the following components:

- Body Shell
- Bogie Components and couplers
- Traction and Control equipment
- Train Lightingand Air Conditioning equipment
- Electronics; PA/PIS, CCTV etc.
- Brake system equipment
- Vehicle doors, windows and internalfittings.
- Sealed Gangways

- Vacuum Bio toilet System

The modern, fully equipped facilities are to be provided that meet these requirements efficiently and in full. In meeting these requirements, it is envisaged that the average daily distance travelled by each rolling stock unit is approximately 1500 km.

The following maintenance schedules as prescribed by ICF, RDSO and OEMs have been considered.

Schedule	Periodicity
Daily	Every Day
Trip	Every 3 Days or 5000 kms (Whichever is earlier)
Monthly	30 Days ± 2 Days
Quarterly	90 Days ± 3 Days
Nine Monthly	270 Days ± 3 Days
Shop Schedule-1 (SS-1)	18 Months ± 5 Days
Shop Schedule-2 (SS-2)	36 Months ± 5 Days
Shop Schedule-3 (SS-3)	72 Months ± 5 Days

Table: Maintenance Interval

5.2. WASHING NEEDS OF ROLLING STOCK

To maintain high degree of cleanliness, following schedules are proposed for cleaning of rakes.

S. No .	Kind of Inspection	Maint. Cycle	Time	Maintenance Place
1.	Outside Cleaning (wet washing on automatic washing plant)	3 Days	10 mins	Automatic washing plant of Depot Single Pass
2.	Outside heavy Cleaning (wet washing on automatic washing plant and Front Face, Vestibule/ Buffer area, Floor, walls inside/ outside and roof Manually)	30 days	3 Hrs	Automatic washing Plant & heavy cleaning on nominated stabling line

Table: Schedule of Cleaning

5.3. Trainset Coaches main Parameters

Designation	DTC	TC	NDTC	MC
Length of car-body (Over Coupler)	24000 mm	24000 mm	24000 mm	24000 mm
Width of car-body	3240 mm	3240 mm	3240 mm	3240 mm
Car height above top of rail	4140 mm	4140 mm	4140 mm	4140 mm
Distance between center pivots	14900 mm	14900 mm	14900 mm	14900 mm
Tare Weight	50.53 t	55.58 t	50.89 t	57.61 t
Gross Weight	55.95 t	64.06 t	59.37 t	66.09 t

Table: Trainset Parameters

6. MAINTENANCE DEPOT CUM WORKSHOP LAYOUT PLANNING

The layout plans of proposed Maintenance Depot cum Workshop will be evolved for maintenance of Train sets with following pattern of holding.

6.1. Line requirement for various holding capacities

RAKE HOLDING	No of WASHING LINES	No of STABLING LINES	No of INSPECTION LINES
Upto 10	1	2	2
11 - 20	1	3	3
21 - 30	2	4	4
31 - 40	3	5	6

Table: Line requirement for a trainset rake with different rakes holdings

Note: *For the purpose of initial planning, depot facilities shown in this document is for holding up to 10 train sets. As the population of trainset rakes is likely to increase, Zonal Railways while detailing the maintenance facility may plan to have adequate space for future expansion and resources availability as per the anticipated requirement.*

In case there is shortage of space particularly in brownfield projects, option of the part of depot Layout with elevated infrastructure in two levels for some of the facilities in the depot viz. stabling lines, automatic coach wash plant, pit

wheel lathe, ETU shed can be planned at elevated deck at a height of 13m and other maintenance and inspection facilities can be planned at ground level.

6.2. Proposed Layout for Maintenance Depot

As per the Terms of reference given by Railway Board, length of Pit line for train set of 16 coaches, extendable up to 20 coaches has been advised. This issue was deliberated with all Zonal Railways and It was suggested that minimum standard loop length of 675 Mtrs must be planned for all Train set Depots so that tracks provided in Trainset maintenance facilities can also be utilised to accommodate standard 24+2 LHB coach rakes to optimally utilise the resources and the same has been incorporated in this report.

The proposed layout of the Maintenance Depot for holding up to 10 rakes is shown in the drawing enclosed at ANNEXURE-5. The Depot Facilities are provided for meeting the requirements of the following schedules and activities.

- Daily
- Trip
- Monthly
- Quarterly
- Nine Monthly
- The depot provides following facilities for up to10 rakes for catering to the Schedules as mentioned above.
- Washing Lines (01 No.)
- Stabling Lines (02 Nos.)
- Inspection Lines (02 Nos.)
- Test Track (01 No.)
- Heavy Repair Shed
- Service Shed
- Shed for Underfloor Wheel Lathe for tyre turning
- Service Sections
- Supervisors and Staff Section
- AdministrativeBlock
- Yard Layout
- Stores Depot
- Services (Compressor Room, Sub-Station, Power Distribution)
- Amenities (Parking Facility, Lockers, Toilets, Canteen)

It is proposed to hire an expert agency for the detailed finalization of technical specifications for the proposed maintenance facility to cover following specific requirements.

- Study for requirement of the maintenance depot for the rolling stock according to the input data provided by customer after selection of site.
- Identify Various facilities required for the maintenance of the rolling stock to meet all regulatory and statutory regulations.
- Preparation of detailed layout of depot, which shall include: Architecture layout of depot building and lines (Inspection, workshop, stabling, wheel lathe, cleaning lines layout), track layout, Auto-coach washing plant placement along with length and track centers.
- Preparation for cross section of stabling, inspection, cleaning and workshop building/ lines, showing details along with 4 level maintenance facilities (wherever required).

6.3. Washing Lines

Assumptions: To assess the number of lines required to maintain the rakes, following assumptions are made:

For Washing of rakes, an automatic washing plant will be proposed. Hence no separate washing line is needed exclusively for washing. However, one line will be provided for heavy cleaning (Manual cleaning of Floor, walls inside/outside and roof).

Single washing line with length 675 m laid with washable apron and provided with good drainage, carriage watering system, high pressure water jet cleaning system and adequate supply of water for interior cleaning and watering of rakes of trainset. This line will have bio-tank discharge facility also. The washing line will accommodate full-length trainset rakes for 24 coaches.
Covered shed is optional and can be planned based on the local conditions and prevailing weather requirements.

6.4. Stabling Lines

Elaborate arrangement for stabling of rakes will have to be done in depot cum work shop, terminal stations and at few places enroute the section according to the holding planned in the Depot. Two stabling lines with length 675 m have been provided for stabling of full-length trainset rakes for 24 coaches as bare minimum requirement.

Placement of spare coaches and shunting operation of trainset coaches needed for placement in different sections, a concrete path-way to be made in between the stabling lines to facilitate movement of maintenance / Running staff, especially to avoid hindrance during rainy season.
Stabling line should be with provided with washable apron, good drainage,

carriage watering system, high pressure water jet cleaning system and adequate supply of water.

Total requirement of Stabling lines for the total no of Trainsets based on depot can be planned at following locations as per local availability of space.

- Stabling lines at the Station yard/terminal station
- En-route Stabling lines at convenient location
- Rakes to be stabled in the Depot

6.5. Shunting Neck

Shunting neck facility should be provided on both ends of the shed to facilitate the shunting of trainset so that while taking the rake from stabling line to inspection line or heavy repair shed or washing line or Vice-Versa, it should not require permission from traffic department which otherwise delays the movement.

6.6. Spur Lines

Spur lines have been provided so as to accommodate the loose coaches and spare/defective wheel sets.

6.7. Inspection Line

Inspection Shed with dimension 675 m X 21.5 m with two inspection lines could remain open at night and would cater for receipt & dispatch of trainset. Troubleshooting and inspection, night inspection can also be undertaken (if necessary). System of 4 tier inspections should be adopted with Inspection lines having sunken floors and raised platforms to facilitate easy entrance to any coach from both sides for carrying out the inspections. Provision of sunken floor facilitates easier/comfortable access and attention to under-frame equipments resulting in to better quality with lesser efforts and time.

Four Tier Inspection Shed will consist of –

I. Central Pits for under gear inspection :

Pits all along the length of the rake is made 1.5 m deep to facilitate working on the under frame equipment by shed staff. Working pits are equipped with stairs at each end to allow access. Moving trolleys “in pit” should be provided for under floor component transportation.

II. Floor level – for lateral side inspection

Tracks in the Inspection Shed are supported on steel columns, spaced 1.2 m

apart. This depth of 1.2 m allows easy crossing from the pit to the trainset rake side (and inversely) at any place of the tracks.
Sunken floor is constructed 1 m below rail level. This sunken floor helps eye level inspection of wheel-set, axle box and other under-gear equipments, on lateral side of the rake.

III. Coach Interior access platforms

Platforms at coach floor level is provided so that maintenance staff can easily access the coach interior as well as the driving cabs.

IV. Roof working platforms

Walking roof platforms for on-roof components maintenance all along the trainset rake length has been provided. Roof gangway helps in

- Easy access to roof equipment like pantograph, RMPU etc.
- Ease in replacement of roof equipments.
- In situ attention to equipment.

Walking roof platforms have safety devices inter-locked with (Overhead Equipment) OHE isolation to switch off electrical power supply whenever on roof activities have to be performed, thus ensuring safety of the staff working on roof.
The inspection shed shall be fully covered with transparent sheets on the roof at suitable locations to have maximum utilization of day light for general purpose lighting.In this shed, there shall be provision for pneumatic lines, welding points and at Inspection line.

Electric sockets, compressed air outlets and lighting shall be installed along and on each side of the pits. Running tables "in pit" will also be provided for under-floor component removal.

6.8. Test Track

This line is used for internal testing of train and other systems. Test track is equipped with signaling equipment. It is used for the commissioning of the new trains, their trials and testing of the trains after the Intermediate and Periodical Overhaul. In compliance to safety norms, the boundary of the track shall be completely fenced to prevent unauthorized trespassing across or along the track. Having dedicated test track for HT system optimises facility utilisation.

6.9. Heavy Repair Shed /Workshop

The shed with dimension 222 m X 20 m is provided with two 25 tonne overhead electrical cranes. This shed shall not be provided with overhead lines. The trainset body will be lifted and put on special tressels leaving the bogies on the pits. The bogies can be separately lifted and sent to the bogie repair shop.

Stripping and equipping shall be carried out in the heavy repair shed. The bogies shall be sent to bogie repair section with the help of EOT crane.

Attached to the Heavy Repair Shed, there shall be the following repair sections:-

- Pantograph
- VCB with earthing switch
- Traction transformer
- traction converter
- traction motors
- Auxiliary converter
- Train control & management system
- Driver desk equipment
- Passenger information system equipment
- Control panels (contactors, relays, breakers etc.)
- Inter-vehicular couplers
- RMPU with controller
- Cab air conditioning
- Twin beam head light, Flasher Light, Marker lights
- Speed recorder and gear box
- Isolation (pantry) transformer
- Brake System etc.

Rooms for above section will be sized in such a way so that they will not be required to be changed when holding increases and shed is augmented. For this, no. of similar type of activities initially may be carried out in one room and later on, after expansion, some activities may be shifted to new rooms constructed during expansion.

6.10. Service Shed

Service shed with dimension 60 m X 20 m will have one EOT crane of capacity 5 tonne shall be provided in this bay for lifting equipment for repairs, overhauling & testing of

- Transformers- bushings and oil pump.
- Compressors.

- Switch Groups.
- Rectifiers.
- Circuit Breakers.
- Pantographs.
- Resistors.
- High Voltage testing

7. Major Machinery and Plants

Major requirement of Machinery and Plants in Depot cum workshop is discussed below.

7.1. Underfloor Wheel Lathe

A separate building is planned for housing underfloor wheel lathe measuring 35 m x 15 m along with a clear space for storing the turnings should be provided with a separate line from both ends. Suitable arrangements for compressing of wheel turnings and their collection shall be made.
A clear space of 80m should be left on both sides of the shed to accommodate up to four coaches so that unit could be moved on its own power under the overhead line.

7.2. Drop Pit

With dimension 60 m X 15 m will have bogie drop table equipment consists of a large lifting table capable of accommodating a bogie. It moves transverse inside a pit.Bogie can be lower for maintenance without having to uncouple the rake.

7.3. Automatic Train Washing Plants

The automatic train washing plant shall be installed on a dedicated track with concrete floor. Underground tanks as advised by the machine supplier shall be provided to collect water after final rinsing for recirculation. The water used for washing with detergent shall be directed to the Effluent Treatment Plant.

The car wash facility shall be located with direct access from the main line. The car wash shall permit operating the vehicles automatically at a slow recommended speed, under their own power, through a series of water and detergent sprays, rotary brushes and plain water spray jets for rinsing. The design shall provide that the soak cycle recommended by the manufacturer is maintained. The car wash track shall be able to accommodate a trainset (20 cars) without interfering with other track movements.

The usual length required for a car wash facility location is about 100 m. Straight line alignments of 25 m are also required at the entry and exit ends to prevent car sweeping due to curves. Total washing machine width is about 10 m excluding technical rooms.

The car wash shall meet all environmental control standards, including reclaiming tanks automatic pH neutralization and recycling of rinse water. Overflow or non reclaimed water to be discharged into the local drainage

system shall be treated for oil and heavy metals removal and pH adjustment prior to discharge.

Associated water softening reclamation and suitable bacterial control equipment shall be provided. The rinse water recovery ratio shall meet or exceed the requirements of local jurisdictions.

Tanks for water reclamation or storage designed for location underground shall be anchored so that they shall remain stable when empty in high water table conditions.

Following precautions shall be applied during washing cycle:

- Pantograph of the trainset under washing shall remain raised.

- Water blowers shall be directed correctly and to avoid striking the OHE. This characteristic is part of the design of the plant and shall not be disturbed by the Operator. The train washing plant is designed for only washing the exterior of walls and not designed for washing the leading faces, the trailing faces and the roof. In case washing of leading and trailing faces is required it may be done using portable jets in manual washing and power would need to be switched off.

- Doors of trainset shall be closed during washing cycle.

7.4. Administrative Block

An administrative building close to the main entrance is planned. This block will contain technical & drawing office, planning office, conference room, computer room and library and the rooms of assisting officers. It can be suitably sized and architecturally designed at the detailed design stage. A time and security office is also provided close to main entrance. It shall be equipped with suitable Access control system for all the staff working in the complex.

7.5. Parking Facilities & Road Connectivity

Ample parking space shall be provided for the two wheelers and four wheelers at the following points.

- Close to the depotentry.
- Close to the stablinglines.
- Major facilities in the depot will be well connected by 5.5 m wide road

7.6. Boundary Wall and Security

The depot should be surrounded by boundary wall of double barbed wire with security check post at the entrance gate and patrolling road on either side of the fence. The premises should be under CCTV surveillance with recording facility. There shall be provision of adequate number of watch towers for the vigilance of depot boundary.

7.7. Stores

Covered area with dimension 60 m X 8 m for general stores is provided for 10 rakes with provision for future extension. These are served by road. An unloading platform should be provided for unloading from road vehicle. Adequate space should be provided for operation of battery operated pallet trucks and lift truck inside the depot. Open area should be provided in the stores enclosure for storage of steel bars, channels, angle iron, castings, empty drums etc.

A separate room should be provided for storing costly items by the side of the Stores Depot Clerk's Office. It is suggested that permanent concrete shelves be provided.

A small separate room should be made for storing petrol/kerosene, solvents and other inflammable things.

7.8. Wheel Diagnostic System

Wheel Diagnostic System (25 m X 10 m) is a fully automatic and in motion inspection and testing unit for the diagnosis of wheels of vehicles in operation. Wheel diagnostic system aims at the following types of diagnostic work

- Vehicle/wheel set identification
- Measurement of roundness of wheel and detection of value of out of roundness
- Detection and measurement of flat spots
- Measurement of tread diameter and detection of overshooting of operational tolerances
- Measurement of wheel profile and detection of overshooting of operational tolerances
- Detection of cracks

Wheel Diagnostic System is placed at the entrance of the depot so that the defects can be diagnosed at the entry of vehicle and corrective steps can be taken.

7.9. IT and Communication Facilities.

The movement of rakes will take place from main line to trainset depot and vice-versa for maintenance/overhauling work. To cater for the safe movement of rakes from/to connected main lines, Signaling infrastructure will be required. At the same time telecommunication infrastructure shall be required to help the officials of trainset depot in communication during maintenance work and for communication within the depot as well as with Zonal Railways.

The facilities pertaining to S&T infrastructure can be broadly categorized into following:

- Signal Interlocking setup for movement of rakes from Main line to trainset depot and vice-versa.
- Railway Telephone facility for internal as well as communication with Zonal Railways/Headquarters through railway telephone exchange.
- Railnet connection for e-office working and other official online communication.
- Announcement System for broadcast communication among admin building, control office and maintenance staff.

Requirements related to yard layout and signal interlocking need to be addressed by Zonal Railways on need basis while detailing the project.

7.10. Operation Control Centre and Depot Control Centre

Control of train operation will be done centrally from Operations Control Center (OCC), which will house Traffic Control Centre, SCADA System for Traction Power Control & Monitoring, SCADA System for Auxiliary Power, VAC Control & Monitoring, Telecommunication, CCTV Control & Monitoring etc. Movement of trains inside depot shall be controlled from Depot Control Centre (DCC) located inside the depot.

7.11. Power Supply and Lighting

ELECTRIC SUB-STATION

A separate 33 kV/415 or 11 kV /415 Volt sub-station of adequate capacity for power supply arrangement complete with transformers, HT VCB panel and LT panel board etc. shall be provided for electrical services. D.G Sets of adequate capacity shall be provided to take care of emergency loads.

LIGHTING ARRANGEMENT

- LED light fittings should be provided to obtain appropriate illumination as per latest guidelines or industry normsfor illumination in service buildings, sheds, under-pits, below catwalk area, above catwalk area, approach roads etc.
- To obtain high illumination level at work spots, inspection of under gear equipment directed portable LED lightsmay be used as per requirement. For directed maintenance, staff may use helmet based LED lights or portable LED hand lamps for precision work.
- High mast with LED flood lights should be provided for external illumination of circulating area and yard as per as per latest guidelines or industry norms.

POWER INSTALLATIONS

- Internal/External Electrification of service buildings and offices with earthing arrangement.
- Provision of A/C units, desert coolers, water coolers etc. for service buildings.
- Provision of Electrical pump for water supply and coach cleaning facility.
- Provision of TL/AC maintenance infrastructure like charging points, welding supply points etc.
- Provision of Power supply arrangements to facilitate power supply for Mechanical, Electrical and other Maintenance equipment.

EMERGENCY SUPPLY FROM OHE

Auxiliary Transformers of adequate capacity maybe installed for emergency lighting of service buildings, sheds, roads, yard etc.

SOLAR PLANT

Provision of Grid Connected Solar Panel of adequate Capacity complete with all arrangement may be planned.

25 kV OHE ARRANGEMENT

The tracks in the depot should be equipped with 25 kV overhead equipment (OHE) & provision of both ends sectioning arrangement with interlocking facility should be made in the inspection line/ washing line for the purpose of testing of traction equipment and movement of train sets.

The provision of retractable OHE in inspection bay is optional and can be included in the proposal based on requirement at a cost of Rs.14046/m based on LAR. NO- LCF/DR/OHE/665/2015/17 Dated: 26.10.2015 of

Dy.CEE©/MTP/DADAR.

However, while it is convenient to have it in the same premises where other maintenance is carried out, no other maintenance work can be done when OHE is energized. Therefore, in the long run and with increases workload, it is desirable to have a separate test track dedicated for OHE testing facilities.

7.12. Compressed Air Supply

Two Screw type air compressors of capacity 500 cfm & 10 kg/cm^2, to be provided in the compressor room. Normally, one compressor should meet the full requirement, the second serves as a stand-by. The compressors should be screw compressor to minimize noise and vibration inside the shed. Air reservoirs of adequate capacity should be provided and compressed air distribution mains with isolating facilities, filters and dryer should be run along the main column in the shed, and tappings provided so as to reach the working areas.

A separate line of adequate size should be taken from the reservoir to the pneumatic and brake equipment shop to ensure adequate air pressure. Air reservoirs should be located outside the compressor room and should have covering to avoid heating by direct sun.

The compressed air pipeline shall be leak free lightweight aluminum which does not degrade or corrode. It weighs much less than stainless, easy to transport, install and suspend. Push-together connectors make it even easier to fit and provide any additional tapping.

7.13. Water Supply, Sewerage and Drainage Works

In house facilities shall be developed for the water supply of the entire depot. Sewerage, storm water drainage shall be given due care while designing the depot for efficient system functioning. Past records of Municipal Corporation shall be used to design the drainage system. Rainwater harvesting would be given due emphasis to charge the underground reserves.

7.14. Sewage Treatment Plant

STP to treat the sewage by extended aeration process to limit the level of pollution.

7.15. Watch Towers

There shall be provision of adequate number of watch towers for the vigilance of depot boundary.

8. COST ESTIMATION

8.1. Cost Estimation of Maintenance Depot

The total estimate of maintenance depot for trainset has been mentioned in the table below.

S. No.	Description	Abstract Cost (in Rs. Thousand)	Details at
1	**2**	**3**	**4**
1	Civil Engineering Sub Estimate	**123,70,23.431**	Annexure -1, Table - 1
2	Mechanical Engineering Sub Estimate	**41,79,03.847**	Annexure -1, Table - 2
3	Electrical Engineering Sub Estimate	**13,48,45.318**	Annexure -1, Table - 3
4	S&T Engineering Sub Estimate	**63,72.953**	Annexure -1, Table - 4
GROSS TOTAL		**179,61,45.549 (Say Rs 179.62 Cr)**	

Note: Approximate cost shown here is exclusive of Contingency, D&G and other charges

9. Other Points to be considered in designing of Maintenance facilities

While any site selected for setting up of maintenance facilities to Rolling stock requires careful consideration to take care of all foreseeable problems likely to be faced in short term and long term, following are some of the issues Zonal Railways have been facing on existing infrastructure of Rolling Stock maintenance and due care must be taken at the planning stage.

9.1. Water logging and inadequate drainage

Almost all Workshops and Depots face problem in working during rainy season due to heavy and continuous rainfall. This coupled with construction in nearby area in future course of time causes accumulation of water and hampering maintenance activates. It must be ensured that entire yard, Railway track and floor levels are at sufficiently raised level from surrounding areas and liberal size of rain water drainage should be provided.

Rain water harvesting should be planned with the future requirements also and supplemented at later stage as per need.

9.2. Road approach for heavy vehicles and containers

The road approach may be planned for easy movement of heavy vehicles and containers so that material movement does not become bottleneck in future.

9.3. Dust proofing of Covered sheds / Workplaces

In order to maintain highest standards of maintenance, it is necessary that work places and Sheds are designed with provision of high-speed low energy consumption pressurized system to avoid ingress of dust into the work areas. This type of dust proof arrangement provides 5-7 degrees lower temperature at work place in the summer season and also helps in circulating high humidity air in rainy season to avoid accumulation of water droplets. It provides a conducive work environment to the maintenance staff and also protects Rolling Stock equipment and machines.

9.4. Maintenance of Infrastructure

All construction, electrical and S&T works tender should be processed with the warranty and maintenance contract for next five years post warranty with the provision of extension of maintenance contract for another five years if required by the management. The offers may be evaluated after including the cost of maintenance for five years. This will ensure use of quality material, workmanship and highest availability and reliability of the infrastructure.

9.5. Procurement of M&P, Tools, equipments, Test facilities

Indian Railways are going for Automated Train Diagnostic and detection system for Rolling Stock on IR. Following Road map of integration of AI, IoT, Machine Vision and Automated Train Diagnostic and detection system for Rolling Stock on IR is suggested.

The traditional mode of M&P procurement on IR is by getting it sanctioned through inclusion in composite Projects (Works program item) covering requirements of all departments. Once work is sanctioned, execution is carried out by the coordination department having major portion of funds. The items having technical complexities are normally dealt by concerned department. Over all coordination, execution and progress is monitored by coordinating department. Once the project is completed, entire facility is taken over by respective department. Operation, maintenance and any addition including subsequent replacement of these facilities is coordinated and looked after by respective department. In case of M&P and material handling items, individual indents are sent to the nodal agency ie COFMOW for procurement except dispensation of such items for which COFMOW's standing or specific dispensation is available. Such items are procured by respective department through their Stores department.

Procurement of M&P by COFMOW helps in consolidation of requirements of for those items which are commonly required by Zonal Railways including high tech items for which Zonal Railways lack requisite technical expertise. Consolidation of requirements helps in getting volume discount, competitive rates and provide incentive to reputed and established manufacturers to participate in IR tenders.

COFMOW procures wide range of machinery, from simple machines to complex CNC and state-of-the-art equipment. The mode of tendering is mostly through Stores tenders for individual MP& or consolidated requirement for same or similar nature of Machines having minor specific customer requirements to suite local conditions. After a contract is awarded, the contractor has to

- complete the work that might involve stages like Installation, Commissioning, Prove out
- Warranty period with or without Preventive Maintenance during warranty Period
- Annual Maintenance Contract for 5 years after warranty, if specified in the tender and as per requirement of the consignee

In addition, COFMOW undertakes turnkey projects for setting up of a new production or maintenance facility or expansion of existing facility for modernization and capacity augmentation involving M&P, Civil, Electrical and

any other associated works. Suck works are executed through composite Works tender. One of the biggest advantages of this mode over procuring individual M&P is that during the execution of the Work, minor changes in upgrading and revision of technical requirements can be done to derive maximum benefits of latest developments and change in related technology. Such situations can not be anticipated and tackled in normal Stores Tender done by COFMOW.

Moreover, technology is now changing very fast and all such new developments provide immediate and long-term operational cost benefits. It is therefore, always beneficial to adopt Works Tender system for all modern and high-tech machines. The scope of work shall include "Development, optimization and customization of M&P based upon tendered specification to suite local conditions which should be future ready to be compatible with the technologies which are under advanced stage of trial or being developed concurrently and have potential to provide better operational cost benefits".

It is generally seen that normal procurement cycle of high tech M&P procurement through COFMOW takes 3-4 four years to deliver the machine and another 1-2 years to bring the machine to its full rated production capacity which includes preparation of Foundation, local site fabrication and assembly, dry run, components prove out, training and learning curve of machine operators and maintenance staff to develop familiarity in troubleshooting and maintenance of the machine. Another major issue in ensuring proper working of such machines is no commitment of OEM to provide guaranteed availability of spares and subsystems of the machine within a reasonable time as they depend upon their sub vendor. Most of the time sub vendors either have discontinued production of such item or undertake manufacturing to OEM specifications on order basis. Since 80% of the cost of machine is paid on proof of dispatch, financial liability is incurred well before the machine starts giving its rated output.

In the present report we have attempted to identify suitable technologies for automatic train diagnostic and examination to upgrade, augment and modernize existing maintenance facilities. This will help IR to reduce overall train examination and maintenance time and gear up for quantum improvement in quality of maintenance and reliability of Rolling stock.

The rapid development in technologies for automatic train diagnostic and examination over last 20 years coupled with Industry 4.0, Artificial Intelligence (AI) and Internet of Things (IoT) has opened vast scope of development and improvement in every sphere of these technologies and these technologies are evolving at much faster pace as the time is passing by. To get these technologies adopted in our system through normal tendering process has limitation that our specs are frozen at the time of tendering and the system will

be deprived of further technological developments which will take place.

Moreover, while OEMs in this field have domain expertise in development and integration of such systems, they need actual data from field to develop and refine algorithms to accurately define the defect criteria for each component for a specific type of Rolling stock. This process may take few months to few years depending upon variation in actual dimensions and design parameters of Rolling Stock components.

Thus, in order to derive maximum benefit of continuous improvement, we may consider to have an agreement of setting up Automatic Train diagnostic and fault detection system by selected OEMs and allow them to develop an integrated system rather then buying individual machines/systems and then spend time and money in integrating different make of systems. Indian Railways will provide them site for installation of equipments at OEM's cost and pay on the basis of actual fault detection and quantifiable improvements in the health of Rolling stock. This arrangement will have following advantages.

- The implementation would be faster and in line with latest development in related technology.
- Least cost system for Indian Railways as IR is not bearing the cost of equipments and development of Algorithms for fault detection.
- Indian Railways will be able to develop its maintenance personnel in development of such items.

***

10. REFERENCES

Authority Letter

Railway Board letter No: 2017/M(C)/141/2 Pt. dated 30.09.2021 to IRCAMTECH.

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

No.2017/M(C)/141/2 Pt **New Delhi, dated: 30.09.2021**

Principal ED
CAMTECH, Gwalior

Sub: Detailed Plan and Drawings for the Maintenance Facilities for Train Sets

IR has planned to proliferate Semi High Speed Self Propelled trains sets over its network. The inherently new world class design of the train sets makes it essential to create new state of the art maintenance facilities.

In this regard, it is requested to prepare a standard LAYOUT for Train set maintenance depot and workshop separately along with standard list of M&P and Tools keeping following broad features in view:

i. Pit line for train set of 16 coaches, extendable up to 20 coaches.
ii. Pit lines with Covered shed.
iii. Washing / stabling lines equipped with carriage watering system, high pressure water jet cleaning system, washable apron, adequate drainage, etc. for the interior cleaning and watering of the train sets.
iv. No work requiring cleaning with water shall be carried out on the maintenance pit lines.
v. OHE over the pit lines, along with proper systems for isolation. The feasibility of Retractable OHE, which can get slewed away whenever required, should also be examined.
vi. Bright, light-weight and energy efficient LED lights
vii. Under floor wheel lathe
viii. Heavy and medium repair facilities, including facilities.
ix. Drop pits, traverser and electrical testing lines/equipments.
x. IT and Communication Facilities, its Networking along with Data centre
xi. Automatic Coach Washing Plant and Water Recycling Plant
xii. Machine Vision Systems with Automatic High Definition Cameras
xiii. Wheel Profile Measurement System & Ultrasonic flaw detector
xiv. Latest design of M&P with a high degree of automation.
xv. Service building having common offices / staff rooms for the Mechanical/Electrical and other staff in order to promote synergy in working.
xvi. Protection wall / boundary wall
xvii. All infrastructures with road approach.
xviii. Other items required.

The detailed report inclusive standard LAYOUT and other items with abstract cost for each item related to Train –set workshop and depot separately may be submitted within one month, so that the same may be available for Zonal Railways for reference before proposing works in PWP 2022-23.

30/09/2021

(Suman Kumar Tanti)
Dir. Mech. Engg. (Chg.)
Railway Board

C/-All PCMEs/Zonal Railways for kind information and necessary action please.

List of references

1. Draft Guidelines for Maintenance Facilities In Coaching Depot on IR
   Doc No: CAMTECH/M/GWL/MFCD/1.0 Dated: Nov 2014
2. Infrastructural Facilities for Maintenance of LHB Coaches in Open Line
   Doc no. CAMTECH/2016/M/LHB-INFRA/Open-line/1.0 Dated: May 2016
3. Guidelines for Layout of EMU / MEMU Car Shed for homing up to 30 / 20 / 10 rakes Of 12 / 16 Car rake formation
   Doc No: R.D.S.O./PE/RM/EMU/0006-2000(REV-0) Dated: AUGUST-2000
4. Best Practices for Virar Car Shed for 4 tier Inspection Shed
   Website:https://indianrailways.gov.in/railwayboard/uploads/directorate/eff_res/pdf/Best%20Practices.pdf
5. Detailed Project Report for Nagpur Metro Rail Project
   Dated: Nov 2013
6. Detailed Project Report for Rail Based Mass Transit System in Varanasi / RITES
   Dated: Feb 2016
7. Detailed Statement of Estimated Cost of MEMU Shed Bhusaval – Central Railway
8. S&T estimate for shifting of MEMU CarShed SRE/N Rly.
9. Details of Estimates of Mechanical M&P from GEM website
   Website: https://gem.gov.in/
10. COFMOW Compendium for year 2019-20 & 2021.
    Doc no. COFMOW/IR/M-003/2 Dated: 01/06/2018

ANNEXURES

ANNEXURE – 1

COST DETAILS OF DEPOT

Civil Engineering

Table 1 - Civil Engineering Sub Estimate						
SN	**Item Details**	**Unit**	**Quantity**	**Unit Rate(Rs)**	**Total Cost(Rs)**	**Remarks**
1	Earth work in filling	Cu.m	15000	462	6930000	
2	Moorum filling	Cu.m	200	802	160400	
3	Boundary wall/Compound wall (approximate)	m	2000	20360	40720000	
4	Rails & Fastening	per km	12	3694659	44335908	
5	Sleeper & Fastenings	per km	12	4431400	53176800	
6	Points & crossing	each	29	279802	8114258	
7	Glued Joint	each	8	41147	329176	
8	Dead end	L/s	6	1500000	9000000	
9	Derailing switch	each	5	279802	1399010	
10	P.Way for siding & rail connectivity	per km	12	3694659	44335908	
11	Administrative Building(approximate)	Sq.m	400	28662	11464800	
12	coaching washing plant shed 100X10 m	Sq.m	1000	26351	26351000	
13	Lean to shed service section supervisor & staff Shed 100X8 m	Sq.m	800	26351	21080800	
14	site office &store shed 40x8 m	Sq.m	320	26351	8432320	
15	store shed without crane 60X8m	Sq.m	480	26351	12648480	
16	PEB Shed including PUF panel, Ridge ventilator, Turbo ventilator, VD flooring, Cable Trench, embedded track and with 2 no's EOT crane (cap 25 t) (Heavy repair shed 222X20 m)	Sq.m	4440	31305	138994200	
17	Inspection shed 675 X 21.5 m without crane	Sq.m	14512	26351	382418887	
18	Service shed traction with crane 60x20 m	Sq.m	1200	31305	37566000	
19	Bogie repair shed with crane 70X25 m	Sq.m	1750	31305	54783750	
20	Scrap yard without crane 40x10m	Sq.m	400	26351	10540400	
21	drop pit shed without crane 60x15m	Sq.m		26351	0	
22	Inspection Pit (2 level)	m	1350	106647	143973450	
23	Underfloor wheel lathe without crane (35x15 M)	Sq.m	525	26351	13834275	
24	Electric Sub Station(approximate)	Sq.m	200	27280	5456000	
25	Concrete road (approximate 2000 m and 5.5 m wide)	Sq.m	11000	3527	38797000	
26	Washing line	m	675	61537	41537475	

27	Over head water tank capacity 2.5 Lakh Litre	Litre	250000	25	6250000	
28	Horticulture & Landscaping	L/s			1000000	
29	Fire Fighting	L/s			1000000	
30	Water Supply	L/s			1000000	
31	Entry gate with security hut	L/s			1500000	
32	Drain work (approximate)	m	2000	11143	22286000	
33	Service building(approximate)	Sq.m	400	27280	10912000	
34	Store Bldg(approximate)	Sq.m	675	27280	18414000	
	Total				**1218742297**	
	Survey, Soil investigation, Design & drawing etc	L/s			18281134	1.5% of cost
	Grand Total				**1237023431**	
Approximate cost shown here is exclusive of Contingency , D&G and other charges						

Mechanical Engineering

Table 2 - Mechanical Engineering Sub Estimate						
SN	**Item Details**	**Unit**	**Quantity**	**Unit Rate (Rs.)**	**Total Cost (Rs.)**	**Remarks**
1.	Detailed designing of Train set cum Maintenance Worksop to meet prevalent statutory regulations, local site conditions and as per detailed requirement of the customer and site conditions	LS	1	100000000	100000000	LS - 10 Crore
2.	EOT crane 25/5 Ton	No.	2	6000000	12000000	COFMOW Comp. 19-20 item sl.no. 271
3.	CNC Under Floor Wheel Lathe with Industry 4.0 features	No.	1	55100000	55100000	COFMOW Comp. 19-20 item sl.no. 29
4.	***Optional :*** *Tandem Under Floor Wheel Lathe with industry 4.0 feature*	*No.*	*1*	*155840410*	*0*	*As per BQ of M/s SAFOP, Italy (BSL Shed Estimation)*
5.	Automatic Coach Washing Plant (ACWP)	No.	1	23300000	23300000	COFMOW Comp. 19-20 item sl.no. 52.
6.	Wheel Diagnostic System	No.	1	104400000	104400000	As per estimate to WPO Dt. 13/07/2019
7.	Drop Pit Table	No.	1	31000000	31000000	COFMOW Comp. 19-20 item sl.no. 316.
8.	***Optional :*** *Rail Cum Road Shunting Vehicle (135 t)*	*No.*	*1*	*6835500*	*0*	*Rate taken from LOA of COFMOW issued to the M/s HYT Engg. Co. Pvt. Ltd. (17.01.2019.)*
9.	Set of (4+1) synchronized lifting jacks (25 t)	Set	4	4000000	16000000	COFMOW Comp. 20-21 item sl.no. 304 (Spec No - COFMOW/IR/ SJE/25/2012)
10.	Compressed air system for 8 drop points including 2 no's compressor (500cfm) 10 Kg/cm^2, piping, dryer etc	Set	1	3811000	3811000	COFMOW Comp. 20-21 item sl. No. 199 - COFMOW/IR/EDAC/2016
11.	Rake brake test stand (RTR) with SCADA	No.	1	979400	979400	BQ of M/s Orange Technologies ,Hyderabad
12.	Brake Panel Test Rig (SCTR)	No.	1	1201181	1201181	PO No. 52175839150359 Dtd 30.03.2018 of WR
13.	Jib crane 5 ton capacity 4m reach	No.	1	7430000	7430000	Accepted rate of ongoing CMLR/KNRT project CA No. 2016/WP/Kurnool/CMLR/ ENGG/WP- 03(open) Dtd. 03.01.18 item no. 88 of Schedule F-I
14.	Center Lathe	No.	1	1774071	1774071	Rate from Gem product Id 5116877-55826776309
15.	Portable Digital Ultrasonic Flaw Detector	No.	2	246620	493240	Rate as per PO no. 51185411150527 dtd

						12.10.2018 of NCR.
16.	Hand held Spectro Analyser (Hand held XRF analyser)	No.	1	1201000	1201000	Rate taken from price list of 911 Metallurgist (Unit cost $17500) $1=Rs.68.63
17.	Road mobile crane with earth moving attachment 15 ton	No.	1	2300000	2300000	COFMOW Comp. 19-20 item sl.no. 295.
18.	Fork lift electric 3 tons	No.	2	1638000	3276000	BQ of M/s Jaldoot Material Handling Pvt. Ltd., Pune
19.	***Optional:*** *Fork lift diesel 3 tons*	*No.*	*1*	*1855000*	*0*	*Rate from Gem product Id 5116877-13108359744*
20.	Platform Trucks 3 ton	No.	2	765440	1530880	BQ of M/s Jost Engineering Company Limited, Kolkata
21.	Inverter Based MIG/MAG Synergic pulse portable welding plant 400 Amp	No.	2	450000	900000	COFMOW Comp. 19-20 item sl. No. 328
22.	Air Plasma Cutting Machine	No.	1	205000	205000	Gem Rate - Product ID - 5116877 - 86528419743
23.	Airless Spray Painting Machine	No.	1	109642	109642	PO. no. L2185031150069 dtd. 02.02.2018 ofSWR With 10% price escalation.
24.	High pressure Jet cleaning machine	No.	2	432215	864430	Accepted rate of ongoing CMLR/KNRTproject CA No. 2016/WP/Kurnool/CMLR/ ENGG/WP- 03(open) dtd. 03.01.18
25.	***Optional:*** *Pipe Bending Machine*	*No.*	*1*	*177000*	*0*	*PO no. 25185056165327 dtd. 24.09.2018 of CLW.*
26.	Welding Machine 200A (Single Phase) Rectifier Inverter Based (IGBT) Double Bridge Type	Set.	2	29780	59560	Rate from Gem product Id 5116877-27197741595
27.	Small M&Ps and T&Ps, Gauges , Measuring Instruments etc.	LS	LS		4000000	Rate reference as per vetted estimate of BSL MEMU Shed
28.	Storage and Racking System	LS	LS		4000000	Rate reference as per vetted estimate of BSL MEMU Shed
29.	Hand pallets 3 ton	No.	2	129998	259996	Rate from Gem product Id 5116877-79403351089
30.	Wheel Barrow (140 liters)	No.	5	4799	23995	Rate from Gem product Id 5116877-96498188378
31.	Office Equipment & Furnitures	LS	LS		5000000	Rate reference as per vetted estimate of BSL MEMU Shed
32.	Water Recycling Plant & STP	LS	LS		20000000	WPO - Reference KRNT Coach Midlife Rehabilitation Workshop

						Estimate
33.	Truck (10 t)	No.	1	1770000	1770000	Rate from Gem product Id 5116877-75033869521
34.	Utility Vehicle	No.	2	639046	1278092	Rate from Gem product Id 5116877-49315216337
35.	Heavy duty floor scrubber & mopper - ride on types	No.	2	395000	790000	Rate from Gem product Id 5116877-71191541274
36.	Floor sweeper push type	No.	2	24990	49980	Rate from Gem product Id 5116877-56759829473
37.	Dry vacuum cleaner for coaches	No.	2	48000	96000	Rate from Gem product Id 5116877-29076779617
38.	LAB equipment	LS	LS		5000000	Rate reference as per vetted estimate of BSL MEMU Shed
39.	Design work station with 3D printer and other accessories	Set	1	6200380	6200380	Rate listed with reference of POs & LOAs of WPO Patna.
40.	Trolley Mounted Mobile Sewage Evacuation Machine	No	1	1500000	1500000	COFMOW Comp. 20-21 item sl. No. 120. - COFMOW/IR/TMMSEM/2017
	Total				**417903847**	
	Approximate cost of Mechanical M &P shown here is exclusive of Contingency, D&G and other charges					

Electrical Engineering

Table 3 - Electrical Engineering Sub Estimate						
SN	**Items**	**Unit**	**Quantity**	**Unit Rate (Rs)**	**Total Cost**	**Remarks**
1	Setting of 11 KV /440 Volt substation for power supply arrangement complete with 500 KVA transformers,H.T. VCB panel and LT Panel board.	Job	1	13397416	13397416	Detailed Estimate of MEMU Shed Bhusaval
2	Augmentation/Availing of H.T. 11 KV power supply from MSEDCL& Other Electrical ITEMS.	LS	1	2000000	2000000	-Do-
3	Provision of HT cables of adequate size complete with trenching, laying etc.	Job	1	7142940.2	7142940	-Do-
4	Provision of LT cables of different sizes complete with trenching, laying etc.	Job	1	6678044	6678044	-Do-
5	Provision of D.G sets of 500 kva capacity complete with installation.	No.	1	4106494.21	4106494.21	-Do-
6	Illumination of 2 pit proposed lights with LED fittings	Job	1	5166121	5166121	-Do-
7	Dismantling of existing infringements if any	Job	1	1000000	1000000	-Do-
8	Internal/External Electrification of service buildings and offices with earthing arrangement.	Job	1	3556458.736	3556458.74	-Do-
9	Provision of A/C units, water coolers etc for service buildings	Job	1	480224	480224	-Do-
10	External Illumination of circulating area and yard by providing high mast with LED flood lights.	No.	5	585924	2929620	-Do-
11	Provision of Grid Connected Solar Panel of 50 KW Capacity complete.	Job	1	4666208	4666208	-Do-
12	Providing TL/AC maintenance infrastructure like charging,welding and pit lighting etc.	Job	1	4408685.6	4408685.6	-Do-
13	Providing Electrical pump for water supply and coach cleaning facility.	Job	1	2000000	2000000	-Do-
14	Providing Power supply feederpillars and LT cables to facilitate power supply for Mech/Elect. Maintenance equipments.	Job	1	637051.87	637051.87	-Do-
15	Hiring of Vehicle (MUV) during execution of the Project		1	1004266.00	1004266.00	-Do-

16	OHE Total			75671789	75671789	-Do-
	Total				**134845318**	
Approximate cost shown here is exclusive of Contingency, D&G and other charges						

S & T Engineering

Table 4 - S & T Engineering Sub Estimate						
SN	**Item**	**Unit**	**Quantity**	**Unit Rate (Rs.)**	**Total Cost**	**Remarks**
Signalling items						
1	Design of PI/RRI including Selection Table, Panel diagram & Circuit diagram	Route	2	2400	4800	S&T estimate for shifting of MEMU CarShed SRE/N Rly.
2	Design of drawings of Cable Route Plan, Cable, Coverage Plan, Power supply Diagram etc.	No.	3	21161	63483	-do-
3	Design, Manufacture, Supply, Installation & Commissioning of Control cum Indication Panel/EI with other accessories	No.	1	242120	242120	-do-
4	Diagnostic Panel in ESM Room	No.	1	22576	22576	-do-
5	Simulation Panel	No.	1	3000	3000	-do-
6	Fabrication, Supply &Installation ofStation Working Rule Diagram	Job.	1	5500	5500	-do-
7	Warning Board (Stop Board, SLB,BSLB)	No.	2	9250	18500	-do-
8	Magneto Telephone	No.	4	2300	9200	-do-
9	Relay Rack	No.	1	11500	11500	-do-
10	HRC Fuse Base of 2/5/10 Amp & other rating	No.	10	118	1180	-do-
11	Tag Block 160/200 Way	No.	10	1025	10250	-do-
12	Wire 16/0.20	Meter	1000	5.5	5500	-do-
13	Cable marker	No.	50	110	5500	-do-
14	IPS with Batteries	No.	1	741341	741341	-do-
15	Installation of IPS	No.	1	28000	28000	-do-
16	Maintenance Free Earthing	No.	2	13000	26000	-do-
17	Furniture-Table for ASM	No.	1	2500	2500	-do-
18	Furniture-Chair for ASM	No.	1	1925	1925	-do-
19	Furniture-Table for ESM	No.	1	2500	2500	-do-
20	Furniture-Chair for ESM	No.	1	1925	1925	-do-
21	Electric Point Machine 110 V DC operation 143 mm non-trailable with ground connections	No.	02	80500	161000	Standard Bill of Quantities for S&Twork by RVNL
22	Prewired Crank Handle cum Key Lock Relay box	No.	01	7500	7500	-do-
23	Point Group	No.	01	76000	76000	-do-
24	Independent shunt signal complete with post, surface base, position light signal unit, anchor bolts, universal lock with key	No.	02	13000	26000	-do-

25	Integrated type LED Signal lighting unitfor Shunt Signal	No.	06	7000	42000	-do-
26	Shunt Signal group	No.	01	50000	50000	-do-
27	Route Group	No.	01	45000	45000	-do-
28	AC immunized Mini Group Relays	No.	06	5300	31800	-do-
29	Signaling Cable 12 Core X 1.5 sq mm	Km	1	201042	201042	-do-
30	Signaling cable 19 Core X 1.5 sq mm	Km	1	291817	291817	-do-
31	DC track Circuit equipments completewith secondary batteries	Set	02	26000	52000	-do-
32	Fixing & wiring of Track circuitequipments	TrackCircuit	02	7000	14000	-do-
33	Bonding of track circuits, connections jumpers, charging of batteries, supplyof TLJBS etc.	Track Circuit	02	14000	28000	-do-
34	Location Box Full case complete withhylam sheet, lock & key	No.	02	20000	40,000	-do-
35	ARA terminal 1 way	No.	100	90	900	-do-
36	Excavation of trench at depth of 1.0 m. deep and 300 mm wide and back fillingafter laying of cables	Meter	500	68	34000	-do-
37	Supply of bricks	Nos.	5000	6	30000	-do-
38	Laying of bricks after cable laying	Meter	500	8	4000	-do-
39	Laying of Signaling Cables in alreadydug trenches	Meter	600	56	33600	-do-
40	RCC pipes 150 mm dia 2 m long alongwith collars	Meter	20	156	3120	-do-
41	Laying of RCC pipes below track forcrossing of cables	Meter	20	70	1400	-do-
42	Shunt Signal erection complete withfoundation	No.	02	5000	10000	-do-
43	Installation of point machine includingwiring	No.	02	16,500	33000	-do-
44	Installation of location box includingfoundation and wiring	No.	01	10,000	10000	-do-
45	Earth Electrodes supply, installation &connection with equipment	No.	02	3000	6000	-do-
Telecom Items						
1	Coral make Electronic TelephoneExchange of 1000 ports with Analog & Digital key telephones	No.	01	290000	290000	Schedule rate of Contract work at MEMU Carshed, SRE
2	MDF Rack	No.	01	75000	75000	-do-

3	ADSL Modem	No.	40	2650	106000	GeM
4	ZYLE make 24 port IP DSLAM	No.	01	89700	89700	Schedule rate of Contract work at MEMU Carshed, SRE
5	Tejas make STM 1 with SDH MUX	No.	01	144494	144494	-do-
6	Puncom make PDH MUX	No.	02	90070	180140	-do-
7	Additional cards like E&M, FXS etc. forPDH MUX	No.	02	12000	24000	-do-
8	SMPS based power plant with maintenance free batteries	No.	01	313325	313325	-do-
9	Equipment Rack	No.	01	20641	20641	-do-
10	24 port Optical Switch	No.	02	50000	100000	-do-
11	CAT6 cable	305 m drum	03	8000	24000	-do-
12	I/O outlets for Railnet connection	No.	50	210	10500	GeM
13	24 core armored OFC Cable	m	1200	78	93600	RVNL Standard bill of quantities for S&T works
14	HDPE pipe suitable for 24 core armored OFC Cable including accessories	m	1200	66	79200	-do-
15	Laying of HDPE pipe in already madetrenches	m	1200	10	12000	-do-
16	Blowing of Armored OFC cable into duct	m	1200	14	16800	-do-
17	Rack mounted 24 fiber Fiber distribution Management system	No.	01	27673	27673	-do-
18	PIJF 20 pair 0.63mm cable	m	1000	125	125000	-do-
19	Cable Laying	m	3200	6	19200	Schedule rate of Contract work at MEMU Carshed, SRE
20	Digging of trench for cable laying	m	1000	46	46000	-do-
21	Boring	m	100	800	80000	-do-
22	Brick laying on cable after cable laying	m	1000	8	8000	-do-
23	Bricks	No.	10000	6	60000	
24	20 pair indoor PVC cable	m	200	108	21600	GeM
25	5 pair indoor PVC cable	m	2000	31	62000	-do-
26	Telephone Instrument	No.	100	810	81000	-do-
27	Ahuja make SSA 250 Amplifier	No.	01	15776	15776	RVNL Standard bill of quantities for S&T works

28	Speaker cable 2 core PVC sheathed	m	1000	56	56000	-do-
29	Ahuja make column speaker	No.	20	1977	39540	-do-
30	Ahuja make wall speaker	No.	50	1146	57300	-do-
31	Ahuja make microphone	No.	02	2146	4292	-do-
32	Ahuja make microphone stand	No.	02	177	354	-do-
33	VHF trans receiver Walkie Talkie sets of 5Wt. with rechargeable battery and battery charger	No.	04	26742	106968	-do-
34	8 Port PoE Switch WiFi	No.	05	4000	20000	Amazon
35	Access Point for WiFi	No.	10	4050	40500	India-Mart
36	Thermo-shrink Jointing Kit	No.	10	2124.50	21245	Estimate shifting of MEMU Car shed at Saharanpur DFCCIL (Deposit Work)
37	OFC Jointing with Enclosure	No.	5	11286.34	56431.7	-do-
38	Fabrication & erection of emergency socket rail post	No.	5	1361.3	6806.5	-do-
39	Emergency socket Box	No	5	2400.00	12000	-do-
40	Installation & wiring of item no.5 with all required material & fully wired for itsultimate capacity with 1 No. ADM Card(21 E1)	No.	1	11559.49	11559.49	-do-
41	Supply of OFC Jumper (patch cord) 10mlong with FC/PC/SC Euro-2000 or suitable connector at both ends	No.	20	365.18	7303.6	-do-
42	Installation & wiring of Item no.6	No.	02	8262.69	16525.38	-do-
43	RFID electronic marker for S&T cable with programmable memory for saving the user specific data inside the RFID Electronic marker memory chip later recordable by electronic marker locatorduring locating	No.	50	13972.5	698625.0	-do-
44	Supply of TEC approved electronic cable route locator for locating cable &compatible with item no.43	No.	1	139725	139725	-do-
45	Installation charges for item no. 43 & 44	Job	1	35010.68	35010.68	-do-
46	Surge suppressor for all the circuits derivedfrom primary MUX's	No.	02	6059.96	12119.96	-do-
47	Supply and installation of CT krone TAGBlock 100 pair and all its accessories	No.	3	1456.8	4370.4	-do-
48	Fiber Optic Modem with 4 PRI port outputand one Optical port input	No.	1	46000	46000	-do-

49	Supply Installation testing andcommissioning of analogue extension card	Port	50	1357.00	67850	-do-
50	Supply Installation testing andcommissioning of E1/PRI card	No.	1	38777	38777	-do-
51	Supply Installation Testing andcommissioning of Digital card 16 port	No.	2	43597	87194	-do-
52	Supply Installation Testing of ADSL cardor IP DSLAM for 16 lines	No.	1	78000	78000	-do-
53	Supply Installation testing and commissioning of ADSL 2 router within built splitter with one Ethernet port & USBport or better with data rate	No.	10	2000	20000	-do-
54	Supply and Installation of maintenance console Intel i5 Processor 2.33 Ghz,4GB, RAM, 500GB HDD,19" LCD monitor, mouse, key board & 0.8KVA UPS with preloaded software	No.	1	50000	50000	-do-
55	Earthing	No.	5	13100	65500	-do-
56	Screened PVC twin core copper conductorcable size 40/0.22mm	No.	500	24.0	12000	-do-
57	25mm PVC conduit, supply & fixing	No.	500	38	19000	-do-
58	12V/80 AH Batteries	No.	2	8000	16000	-do-
59	Table 3x2x2.5'	No.	1	2500	2500	-do-
60	Chair 16"x16"	No.	1	1925	1925	-do-
Total					**63,72,953**	
Approximate cost shown here is exclusive of Contingency , D&G and other charges						

ANNEXURE – 2

LIST OF M & P FOR TRAINSET DEPOT

Mechanical M&P

S.N	EQUIPMENT	QUANTITY	UNIT
1.	EOT crane 25/5 Ton	2	No.
2.	CNC Under Floor Wheel Lathe with Industry 4.0	1	No.
3.	*Tandem Under Floor Wheel Lathe with industry 4.0 (Optional)*	1	No.
4.	Automatic Train Washing Plant	1	No.
5.	Wheel Diagnostic System	1	No.
6.	Drop Pit Table	1	No.
7.	*Rail Cum Road Shunting Vehicle (135t) (Optional)*	1	No.
8.	Set of (4+1) Synchronized Lifting Jacks (25 t)	4	Set
9.	Compressed air system for 8 drop points including 2 Nos. of Compressor (500cfm), 10 kg/cm^2, piping, dryer etc	1	No.
10.	Rake brake test stand (RTR) with SCADA	1	No.
11.	Brake Panel Test Rig (SCTR)	1	No.
12.	Jib crane 5 ton capacity 4 m reach	1	No.
13.	Center Lathe	1	No.
14.	Portable Digital Ultrasonic Flaw Detector	2	No.
15.	Hand held Spectro Analyser (Hand held XRF)	1	No.
16.	Road mobile crane with earth moving attachment 15 ton	1	No.
17.	Fork lift electric 3 tons	2	No.
18.	*Fork lift diesel 3 tons (Optional)*	1	No.
19.	Platform Trucks 3 ton	2	No.
20.	Inverter Based MIG/MAG Synergic pulse portable welding plant 400 Amp	2	No.
21.	Air Plasma Cutting Machine	1	No.
22.	Airless Spray Painting Machine	1	No.
23.	High pressure Jet cleaning machine	2	No.
24.	*Pipe Bending Machine (Optional)*	*1*	*No.*
25.	Welding Machine 200A (Single Phase) Rectifier Inverter Based (IGBT) Double Bridge Type	2	No.
26.	Small M&Ps and T&Ps, Gauges, Measuring Instruments etc.	LS	LS
27.	Storage and Racking System	LS	LS
28.	Hand pallets 3 ton	2	No.
29.	Wheel Barrow (140 liters)	5	No.
30.	Office Equipment & Furnitures	LS	LS
31.	Water Recycling Plant & STP	1	No.
32.	Truck (10T)	1	No.
33.	Utility Vehicle	2	No.
34.	Heavy duty floor scrubber & mopper - ride on types	2	No.
35.	Floor sweeper push type	2	No.
36.	Dry vacuum cleaner for coaches	2	No.
37.	LAB equipment	LS	LS

38.	Design work station with 3D printer and accessories	1	No.
39.	Trolley Mounted Mobile Sewage Evacuation Machine	1	No.

Electrical M&P

S.N	EQUIPMENT	QUANTITY	UNIT
1.	Industrial vacuum cleaner wet and Dry Duty Cleaning	1	No.
2.	Air velocity measuring meter	4	No.
3.	Constant voltage constant current battery charger	2	No.
4.	LCR meter	2	No.
5.	Oil BDV testing kit	2	No.
6.	DGA facilities	1	No.
7.	Transformer oil filtration plant (oil centrifugal plant)	1	No.
8.	Oil filling plant with flow control for transformer	1	No.
9.	Light load run test facilities for traction motor (Auto transformer 3 phase)	1	No.
10.	Electrical and Electronics testing lab facility unit for PCB testing and handling , Oscilloscope with probe, multimeter (AC/DC), ammeter (clamp on), server grade laptop for data analysis	1	No.
11.	Integrated charge discharge regenerative type unit	1	No.
12.	Tool Kits in set	4	No.
13.	DG set with suitable capacity	1	No.
14.	Thermal Imaging Camera with Software	2	No.
15.	Induction Heater	1	No.
16.	Pressure jet cleaner	1	No.

ANNEXURE – 3

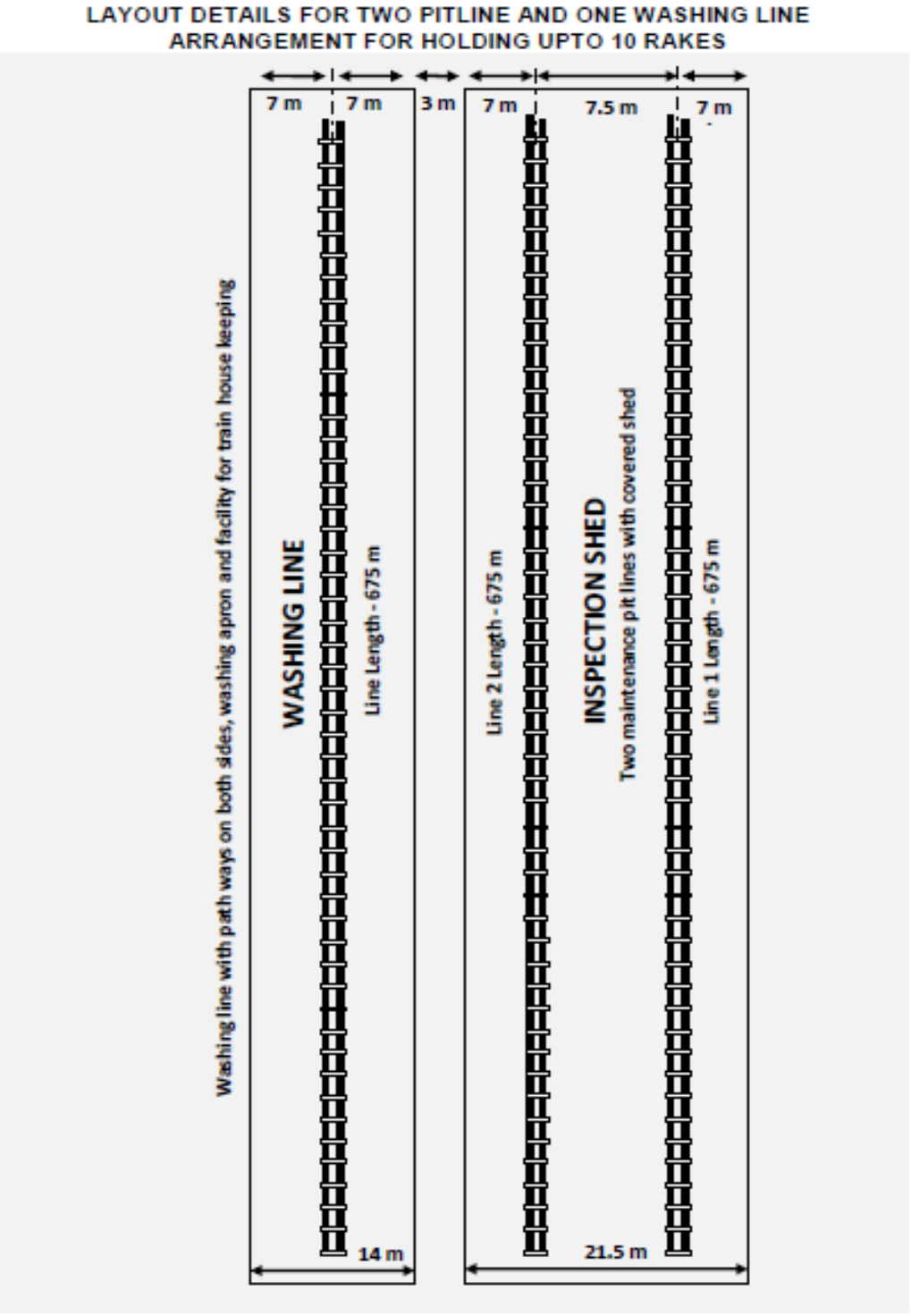
INFRASTRUCTURE DIMENSIONS

S No	Name	Size
1	Wheel Diagnostic System	25 X 10
2	Automatic Train Washing Plant	100 X 10
3	Heavy Repair Shed	222 X 20
4	Service Shed	60 X 20
5	Bogie Repair Section	70 X 25
6	Drop Pit	60 X 15
7	Underfloor Wheel Lathe	35 X 15
8	Store Shed	60 X 8
9	Site Office and Store for Outsource	40 X 8
10	Lean to Shed – Service, Sections, Supervisor and Staff	100 X 8
11	Inspection Shed	675 X 21.5
12	Washing Line (One No.)	675
13	Stabling Lines (Two No's)	675
14	Scrap Yard	40 X 10
15	Spur Line	120

Note: All dimensions in meters

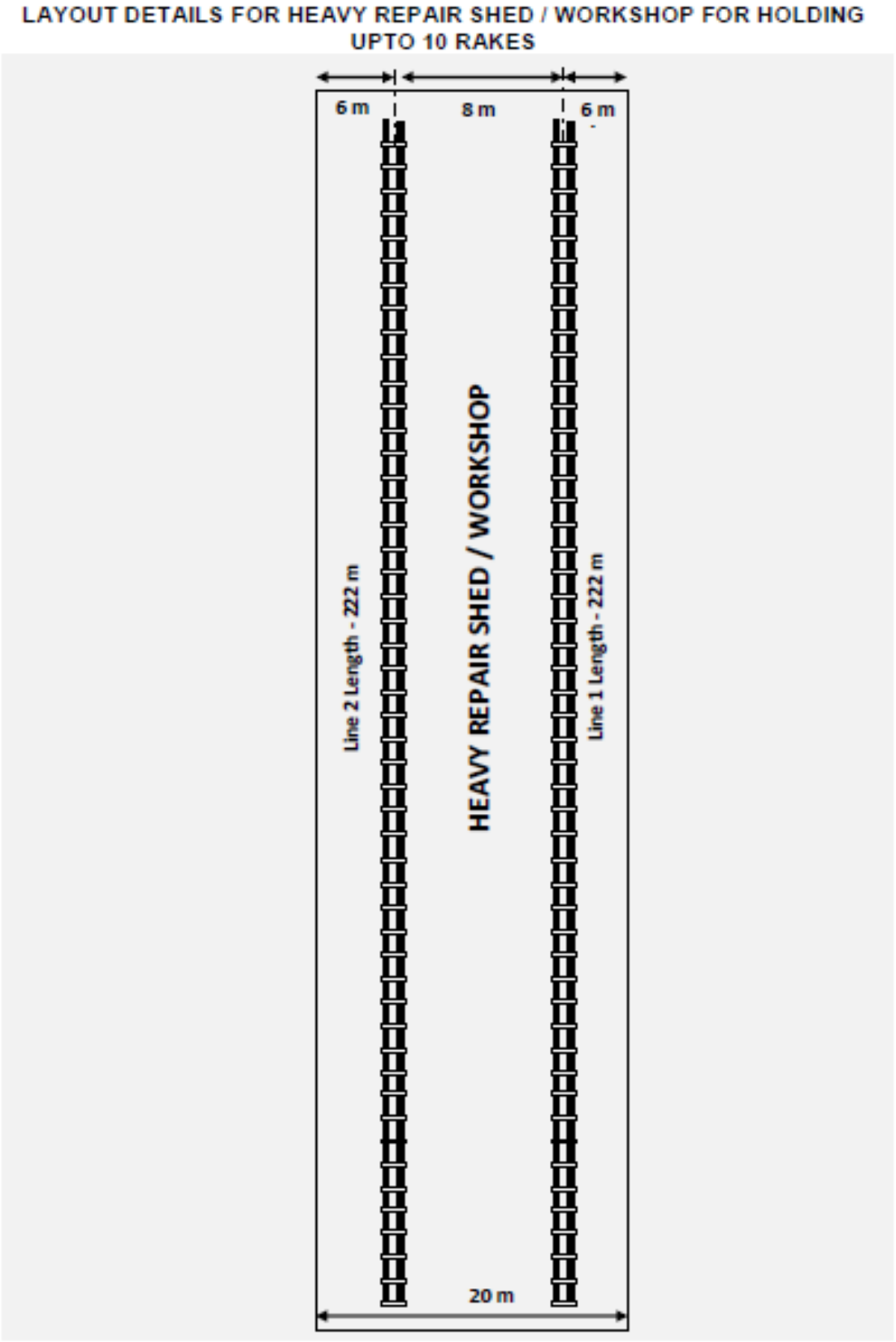
ANNEXURE – 4

LAYOUT DETAILS FOR TWO PITLINE AND ONE WASHING LINE ARRANGEMENT FOR HOLDING UPTO 10 RAKES



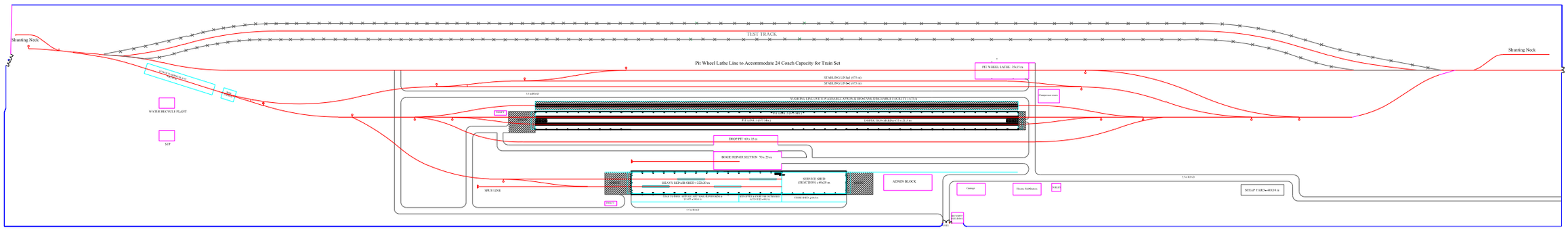
ANNEXURE – 4 (Part – B)

LAYOUT DETAILS FOR HEAVY REPAIR SHED / WORKSHOP FOR HOLDING UPTO 10 RAKES



ANNEXURE - 5

SCHEMATIC LAYOUT OF TRAIN SET DEPOT



NOTE:

1. This Layout is not to scale.
2. This Layout is for illustration purpose only, Railways may modify it as per site condition and requirement.

CAMTECH/ GWALIOR

Sketch - 1

LAYOUT OF TRAIN SET DEPOT FOR HOLDING UPTO 10 RAKES (16/20/ 24 COACH LENGTH)

CAMTECH/M/Train set depot/ Nov. 2021