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INDIAN RAILWAYS



**GUIDE FOR LAYOUT
OF
DMU CAR SHED**



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Guide for Layout of DMU Car Shed

1. Introduction:

1.1 Diesel Multiple Unit (DMU) has been developed to provide fast and efficient means of transport for short and medium distance intercity traffic. DMU plies between important population centers; a number of lines can be served by basing a few such units at a junction station. The scales of maintenance facilities to be provided will largely depend on holding. Concept of mother shop / shed and base depots may, therefore, have to be adopted. An existing shop, shed could be nominated as a mother unit for a base depot or a number of base depots. The requirement of facilities at the depots will depend on how these are linked to mother shop / shed.

1.2 The mother shop / shed may act as feeding unit for the following assemblies/sub-assemblies and other major spares to the base depots which will be for only day-to-day attention.

1. Power pack equipment i.e. engine and transmission
2. Electrical machines like traction generator/alternator and traction motors
3. Auxiliaries
4. Fuel pump and injectors – overhauling and calibration
5. Brake equipments
6. Electrical equipments like relays, contactors etc.
7. Wheel sets

1.3 Based on the above concept, the guide "Guide to the Layout of DMU Car Shed" had been prepared by RDSO and issued vide letter no. MC/RLC/D dated 23.12.1997. It was basically drawn for maintenance of 3/6 car consist, 700 hp DEMU. However, for hydraulic transmission certain addition to equipment facilities may be required.

Since then many developments have taken place keeping in view the traffic requirements. 8 car consist, 1400 hp DEMUs had been developed to give faster service for suburban areas where traffic density is high. 10 car consist 1600 hp DEMU are being developed to provide higher carrying capacity and better acceleration. This manual has been upgraded to be made applicable for all above DEMUs with electrical type transmission units. The introduction of state-of-the-art maintenance shed by DMRC for maintenance of Metro coaches and recently set up shed at Hubli for maintenance of high hp DE locomotives and modern Automatic washing plant at Madgaon for cleaning of coaches and also upcoming DEMU car shed at Badgam (Srinagar) have also been considered while upgrading the shed layout.

1.4 The main features of the Guide are as under:

- a) Location
- b) Yard Layout
- c) Maintenance shed
- d) Heavy repair bays

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- e) Light/Running repair bays
- f) Shed & Yard Lighting
- g) Manual / Auto coach washing
- h) Storage facilities of tools, oils and consumable items.
- i) Facilities for coach repair
- j) Automatic bogie washing
- k) Traction Motor washing & repair
- l) Machinery & Plant
- m) Environmental Protection

2. Location:

- 2.1 The Diesel Multiple Unit car shed can be an extension to an existing DMU shed or a new creation. Depending on site conditions, the shed layout may be suitably altered as per proposed conceptual layout arrangement shown in the Key plan of attached drawing No. CG-K8209 Design of all facilities needs to be based on optimizing the handling and maintenance time for a rake/coach in the shed. All M&P, tools should be modern, reliable and strategically located.
- 2.2 The entry and exit to the shed premises should have a direct connection to the station, so that the DMU does not suffer terminal detention. However, the connectivity shall be based on:
- a) A shunting neck may be provided within the shed premises for moving between the washing, stabling, and maintenance lines, load box and wheel lathe lines.
 - b) Provision of Double entry shall ensure non-blocking movements.
 - c) A by-pass line to the shed will be preferable.
- 2.3 The shed should have a road approach for the use of shed staff as also for getting supplies of fuel oil, lubricants and other stores by road.
- 2.4 **The Diesel Multiple Unit car Shed should comprise four major units viz., washing lines, running & light repair lines, Heavy repair lines and stabling lines.** The automated / manual washing lines, where washing and cleaning of the coaches both interior and exterior, will be undertaken, should be isolated from the running and light repair and heavy repair shed to avoid contamination with the effluents from the washing lines. The DMUs normally may not be required for night services. Therefore, it is likely that most of the units will be available in shed between the period 22 hours and 5 hours. However, in certain areas like JUC, DMUs are operative between 0315 hrs and 2355 hrs. In such cases, the stabling line requirement may be planned accordingly. These should be well protected and should preferably be inside the shed. Some portion of the stabling facilities can be at the other terminating end of the route served by DMU.
- 2.5 The open spaces should be liberally developed with greenery through landscaping and plantation of flowers, trees etc. to create a healthy & pollution free atmosphere. A high standard of cleanliness is required all over the premises.

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3. Yard Layout:

- 3.1 The yard shall be laid out in such a manner that DMU coming in should first be washed/swept and fuelled. Radiator water topping should also be possible at this location.
- 3.2 A boundary wall 2 m high with a double barbed fencing on the top should be provided around the yard. This should have gates for entry and exit of DMUs. At the main gate shed should have time office and RPF post.
- 3.3 The 'IN' and 'OUT' paths provided to and from the shed should be located in consultation with the associate Traffic/Engineering department, but care should be taken that terminal detention is minimized.
- 3.4 A typical layout of the yard and the various premises is given in the attached drawing No. CG-K8209.

4. Maintenance Shed:

- 4.1 The maintenance shed should be divided into two portions; one for routine servicing / running repair and the other for major and heavy repair. Level concrete pathway for crossing over from one bay to other shall be provided for easy movement of staff and material.
- 4.2 Running repair bay should be fully covered shed according to the rake length along with platform on one side only, as shown in RDSO drawing no **CG-K8209**.
- 4.3 The shed structure and the roof should be of a pre-engineered building design that would provide plenty of natural daylight, with provision of glazing if necessary. Roof of covered shed should be of aluminium meta clad sheets/prepainted GI sheets with 20% translucent sheets (Polycarbonate) for better day ambient light as indicated in RDSO drawing no. CG-K8209. Translucent sheets should also be used extensively on the sides. Center-swiveled windows with translucent sheets should be provided for better circulation of air in any direction.
- 4.4 Roof extractors should be provided to expel harmful diesel fumes.
- 4.5 Care should be taken to make the shed dust proof to the extent possible. Rolling shutters of robust design/ motor operated sliding/ folding flap doors suspended from the top should be provided on all entrance to prevent dirt and dust from entering the shed, especially when the weather is windy or stormy and for ensuring security of costly heavy components.
- 4.6 To minimize dust nuisance and soaking of soil with oil, a length of 30 metres should be paved all round the shed, where ever, there is opening. Trees should be planted in and around the shed to decrease dust nuisance.

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- 4.7 Sufficient covered space should be provided for berthing the fleet for maintenance. Typical requirements are estimated as under:

Rake holding	No of bays/ lines in Heavy & medium repair shop	No of bays/ lines in Running repair berths	Washing lines	
			Manual	Automatic
Upto 20	2	2	2	-
Upto 30	2	3	2	1
Upto 40	2	4	3	1
Upto 50	2	4	4	1

- 4.8 Lifting and load box shed shall be provided additionally as shown in the drawing.
- 4.9 The shed layout should have space provision for future expansion and more lines to be accommodated in the covered area.
- 4.10 Two level paving must be used all around the shed. This has a lower floor covered by sand with blocks placed on top. In case of oil spillage or heavy weight falling and damaging/ spoiling the floor the blocks and the sand is replaced and the floor is renewed.
- 4.11 The flooring should be such that spilt oil could be easily removed. Cement concrete flooring epoxy coated with hardonite or better floor in the shed and in the sections should be provided.
- 4.12 There should be sufficient welding points in the light repair bay so as to avoid the detachment of the coaches from the rake for the welding requirement.
- 4.13 Facilities for welding points/ bus bar with earthing should be provided in pit line throughout the pit length at convenient intervals.
- 4.14 Shunting neck should be provided of adequate length according to length of formation i.e. rake length.
- 4.15 **The length of the shed (end to end) should be a minimum of 2 Kms. to facilitate clear shunting of the 12-car rake formation on either side of the shed.**
- 4.16 The height of the shed should be clear 10 m from Rail level to the bottom most truss member of the shed roof. This is essential for clear lifting of the DPCs as also for uniformity of construction of sheds over IR.

5. Heavy Repair Bay:

- 5.1 The heavy repair shops shall have repair lines of specified lengths as mentioned in RDSO drawing no. CG-K8209. The repair lines shall have air floatation type turntables in addition to EOTs of the requisite capacity. The main purpose of providing air floatation type turntables will be useful for taking bogies/traction

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equipment to bogie washing room/ traction equipment cleaning room. The decision for providing turntables may be taken by Railways.

- 5.2 The pits of adequate size shall be provided for inspection of under gears.
- 5.3 The bogie and Traction Machines section shall be on one line, because assembly of the bogie requires a track underneath. The wheels shall be kept on this line as a wheel park. However, this line must be connected to the shunting neck on both sides for its proper operation.
- 5.4 The heavy repair shed should normally include following rooms and other facilities as shown in the drawing:

- a. Forklift & truck room
- b. Lockers room
- c. Lab
- d. Toilets
- e. Furnishing Mechanical
- f. Machine shop
- g. Welding section
- h. Traction equipment repair section
- i. Furnishing Electrical
- j. Battery charging room (with exhauster and acid proof tiles)
- k. Radiator cleaning room
- l. Axle box bearing section
- m. Switch & MTS room
- n. Major power pack rooms
- o. Minor power pack rooms
- p. Brake Bogie compressor room
- q. Hydro buffer/ Misc. Mech. Room
- r. Automatic Bogie washing room
- s. Traction equipment cleaning room
- t. Bogie turntables
- u. Carpenter section
- v. Painting section

- 5.4.1 All section rooms should be provided with roof mounted I-beams in a continuous loop. This I-beam should be able to support upto 1-ton load using a simple block and tackle mechanism.

5.5 Laboratory:

- 5.5.1 Facilities should be made available in the shed for carrying out the following tests on lubricating oils:
- a) Determination of viscosity.
 - b) Determination of flash point.
 - c) Determination of fuel dilution.
 - d) Determination of water content.

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5.5.2 Facilities should be available in all sheds to have the following tests carried out on lubricating oils either in a centralized laboratory of the Railway itself or elsewhere:

- a) Determination of insoluble matter.
- b) Determinations of metallic wear by spectrography.
- c) Determination of detergency and anti-corrosives.

5.5.3 The following facilities for testing shall be provided in the shed:

- a) Quality control of engine radiator cooling water
- b) Non Destructive Testing (NDT)
 - i) Red Dye Penetrant
 - ii) Magnaflux testing
 - iii) Zyglo Testing
 - iv) Ultrasonic testing of axles
 - v) Engine exhaust emission testing

5.6 Traction Equipment cleaning room:

Heavy repair shop shall be provided with closed type room. The traction motor may be carried on trolley to this room. The Traction Equipment cleaning room should have multiple high-pressure nozzles to force the air under pressure to clean dust / dirt from the body of traction motor. The provision/arrangement shall have to be made such that all the dust / dirt removed from the traction equipment may drawn at the bottom of floor by providing suitable draught fan or any alternative arrangement. An electrical oven for drying of traction motor armature and other equipments shall be provided near the traction Equipment cleaning room

5.7 Traction equipment repair section:

Traction motor section should be equipped to do overhauling of traction motors and repairs such as commutator turning, under- cutting, chamfering, field coils brush gear, interpole connections, labyrinths and pinion etc.

5.8 Battery charging room:

5.8.1 A separate battery room should be provided with the following facilities for easy and effective maintenance including all the safety equipments.

5.8.2 Care should be taken to provide exhausters to exhaust harmful fumes etc. from the battery room. For better ventilation the minimum exhaust rate shall be minimum 1.5 cfm/sq. ft as per Ashrae standards 62.1/2004.

5.8.3 Battery charging plant should be installed with points available beside the pits to allow direct charging of batteries while in position on DMUs.

5.8.4 Battery lifting and moving crane facility shall be provided in battery charging room.

5.8.5 Battery discharge plant to test the capacity of battery shall be provided.

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5.8.6 The following equipment shall be provided in battery charging room:

- a) CVCC charger
- b) Infra red temperature sensor
- c) Torque wrenches with suitable sockets
- d) Adequate charging/pre-cooling point
- e) Measuring instruments
- f) Trolleys for carrying batteries
- g) Puller for lifting individual cell

5.8.7 Flooring to be finished by providing acid proof tiles. However, Eco-friendly sheets/cribs are preferred. They can be welded together to form joint less and helps in preventing seepage of acid/ alkali.

5.8.8 Battery charging facilities for 24 volt & 110 volt should be provided in pit line through out the pit length.

5.9 Axle box bearing section:

To prevent the ingress of dust in the bearings, cleaning of bearings and packing of grease will be done in a dust proof room duly providing air curtain at the entrance and air supply system. Shelves for storing different types of grease and workbenches with steel top should be provided for cleaning & inspecting the bearings.

5.10 Brake equipment & compressor room:

The section deals with overhauling, repair and testing of brake cylinders, drivers brake valves, various electro pneumatic valves, limiting valves relays, air pressure governors, relief valves, wipers, horns etc. A test bench should be provided simulating the braking system on the DMUs where air brake valves under test could be mounted to check their proper functioning. Test benches shall also be provided for testing individual pneumatic relays, pressure governors, reducing valve and safety valves, wipers and horn etc.

5.11 Bogie washing room:

5.11.1 Heavy repair shop shall be provided with bogie washroom. The rolled out bogies may be directly taken to the bogie washroom.

5.11.2 Bogie washing room in heavy repair shop shall be closed type, which shall have multistage washing through high-pressure jet nozzles. The washing process starts with spray of degreasing solution followed by fresh water cleaning with a periodic cycle to clean surface of bogie. A separate high pressure-blowing nozzle may be used for drying the bogies.

5.12 Lifting Facilities:

5.12.1 The weight of the powerpack in 1400 hp DMU is approximately 10 tons, a power car bogie is approximately 6.5 tons and, a DPC is approximately 60 tons (gross). The top

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opening in DPC is provided for removing Powerpack and alternator. To attend the DPC the following lifting facilities are required to be provided:

- a) Electrically operated synchronized lifting jacks with long jaw of 20 t capacities for lifting whole DPC with 4 such jacks to roll out bogies for inspection and repair in heavy repair bay.
- b) EOT of 30-ton capacity for lifting DPC/TC bodies in heavy repair bay.
- c) EOT of 15 t capacity for removing powerpack and alternator from top of DPC in heavy repair bay.
- d) One overhead crane of 3 t capacities should be provided to serve the heavy repair bay, the free floor space and part of the Machine shop and Repair sections in heavy repair bay.
- e) A road mobile crane of 5 t capacity for removing power pack and alternator sideways from 700hp DMUs in both heavy as well as running repair bay separately.
- f) 2x5T EOT crane in running repair bay.
- g) Facilities of fork lifter/Platform truck of capacity 5 Ton both in heavy as well as Running repair bay separately.

5.12.2 High capacity under floor hydraulic lifting plant with pads alongside the lifting bay track should be provided to lift coach body. In case of under slung engine/transmission, however, a drop pit is recommended.

6. Running/ Light Repair Bay:

- 6.1 The Running/ light repair bays shall have pit less columnar design; track should be supported on steel column so as to get maximum working area accessibility to under gear equipment. The free walk way to be provided below floor as shown in drawing to walk below the car body for inspection and attending repair work. The flooring of walkway area shall have convenient slope and well connected drain holes for draining out the effluent. The rails used in this area should be 60-kg/m strength and the columns placed at 1 meter spacing. In this case, no separate support under the rail will be necessary and working space will be maximized.
- 6.2 Minimum 2 lines for running and light repair bay of maximum length of 375m, considering docking requirements of 1400HP DEMU upto 16-coach consists shall be provided. Additional bays may be considered based on holding of DEMUs as mentioned in para 4.7.
- 6.3 Gap between track centers in running repair bay should not be less than 7 meters so that material handling truck can move easily. This area also has to be used for other material handling aids like listers and forklifts, which require space for turning. This area shall also be utilized for storage bins for essential running repair spares for C&W and Diesel that are bulky and required all along the length of the bay for regular usage, for example Brake blocks.
- 6.4 The running / light repair bays should have a 3-level working floor arrangement with catwalk. The catwalk shall be easily accessible from all sides. This facilitates simultaneous and expeditious routine inspection, servicing as well as light repair work

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on engine of the DMU. Platform, however, is considered necessary on one side only, DMU being a full width stock.

6.5 The running / light repair bay should normally include following rooms and other facilities as shown in the drawing:

- a) ALF office
- b) Lobby
- c) Shift lab
- d) Paint stores
- e) Oil store
- f) Coaching & carpentry staff room
- g) Shift stores & spares room
- h) Shift tool room
- i) Shift supervisor room

6.6 Tool Room

6.6.1 A tool room conveniently located so as to be easily accessible should be provided. It is desirable that the tools of shed maintenance staff, other than train examining staff, being of a specialized nature, be kept in a centralized place, a system of periodic calibration is also put in place.

6.6.2 This room should be utilized for the safe keeping of hand power tools, torque wrenches, special hand tools etc. as well. The tool room should be provided with a split type door with a shelf for dispensing the tools.

7. Shed lighting:

7.1 It is recommended to use Shed level voltage stabilization and power factor correction, as these features shall extend the life of most electrical components. The DG set of the shed must also feed through these.

7.2 Lighting inside the shed below catwalks & in pits shall be with energy efficient LED lamps. At working level, adequate number tube of lights of 40 W types can be provided.

7.3 Inclined white lighting inside the shed must be provided. Metal Halide lamps with high-speed lighting voltage stabilizers are preferred as these have much higher luminosity. All lighting should be from columns and aimed at the track on the far side. Roof should be negligible lighting fixtures for internal lighting only. More light shall be made available horizontally into the areas where the maintenance is to be done.

7.4 The greatest possible amount of natural light should be allowed to enter the building. Enough artificial illumination should be provided to maintain the following lighting levels:

- a) Top and sides of DMU 300 lux
- b) Running gear & end side of the DMU 300 lux

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| c) Fuel injection equipment test and repair | 600 lux |
| d) Light Machine Shop | 300 lux |
| e) Store room, Lube oil storage, bogie repair shop | 200 lux |
| f) Locker room and toilets | 100 lux |
| g) Carriage washing lines | 300 lux |

7.5 Pit less under floor area shall be provided with bulkhead fittings for direct lighting of the under gear. Continuous strip lighting along the length using high luminosity swivel type tube lights preferably in IP65 or better enclosures shall be provided in between the column on steel tube / rod in continuous manner to either side of pillar at a distance of 3 m in Running/ light repair bay. All pit lighting should be on inverters and easily maintainable.

7.6 Bulk points of 24 volts should be available at all levels and in the under gear attention area for the use of hand lamps with flexible leads.

7.7 Plug points for portable tools should be made available at convenient locations.

8. Yard Lighting:

8.1 Yard lighting should result in an even illumination of 100 lux.

8.2 At all work points in the yard, an illumination of 200 lux should be provided.

8.3 The stabling lines should also be provided with adequate illumination similar to yard lighting.

9. Fuel Supplies:

9.1 For storage of fuel oil, the fuel tanks should be provided above ground level. The oil companies have their own standards which could be followed.

9.2 At least two fuel tanks should be provided for settling purpose and periodic bleeding of collected water.

9.3 The tank should be approachable by both rail and road.

9.4 Total storage capacity provided should hold a minimum of 10 days consumption or more, depending upon the location of the shed with respect to the supply points and the lead from these supply points.

9.5 Fuelling of the DMU should be done outside the covered Maintenance shed. While inside fuelling has the advantage of protection from dust and bad weather, the extreme risk of destroying the entire Depot in case of fire makes it desirable to be kept outside.

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9.6 In planning the installation of fuelling facilities, the following items should be provided:

- a) Tank and supports,
- b) Pipe fittings and valves,
- c) Strainer and filter with ability to remove moisture,
- d) Pump, motor and control,
- e) Hose and connection for filling storage tank,
- f) Nozzle and hose to fill DMU and
- g) Suitable housing for all components.

9.7 There should be as many fuelling points as the number of fuel tanks provided in one complete DMU set, to avoid unnecessary detention to DMUs at the fuelling stage if only one fuelling point is provided.

9.8 Fuelling should be possible on at least two running lines. Each fuelling point should be provided with a pump of minimum 250 liters per minute capacity. The delivery hose should be so installed that the nozzles do not touch the ground when not in use and are suitably protected from rain and dust.

9.9 The fuelling area should be completely paved with cement concrete to avoid eventual saturation of ground with spilt fuel and also contamination of fuel with dust during fuelling operation.

9.10 A provision of space for CNG filling in future may be kept.

9.10.1 CNG Dispensing stations:

CNG Dispensing station shall ensure all safety requirements as per Oil Industry Safety Directorate OISD – 179 permitted by Chief Controller of Explosives (CCoE) for installation of CNG station. Storage cascade comprises of 44/60Nos of CNG cylinders of 50 litres water capacity each. The storage cascades are to be installed at CCoE & EU-13638 approved safe distances above the ground level open to atmosphere. CNG station comprises of facilities of;

- i) CNG Compressors;
- ii) Storage cascade;
- iii) CNG dispenser; and
- iv) Electrical Panel room

9.10.2 Facility and Layout:

CNG refueling system shall comprise of a gas compression apparatus static/ mobile cascade/ pressure vessel and a gas dispenser incorporating a measuring device. The system shall be 'On Line' mother refueling or daughter dispensing system attached to a static/mobile cascade.

Layout for providing CNG storage system, CNG piping, valves, CNG hoses, pressure gauges, pressure relief valves, electrical equipment, safety for refueling into vehicles, Dispensing unit, fire protection, training etc shall be maintained as per OISD-179.

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Details of CNG filling station installed at SSB shed are as under. This has reference to Lay out plan drawing No. SARITA/DWG/IGL/DSL SHED/SSB.

Equipment List:

S.No	Equipment Name	Service	QTY
1	Gas Compressor	CNG	1
2	CNG Dispenser	CNG	3
3	Air Compressor	AIR	1
4	Metering Skid	CNG	1

Details of Storage Cascade Cylinders:

Make	No. of cascade	No. of cylinder in each cascade	Total No. of Cylinders	Water capacity of each cylinder (Litres)	Water capacity of each cascade (litres)	Total Water Capacity of the cascade (litres)
EKC	4	40	160	75	3000	12000

Note:

1. 4" Dia branch pipe line is laid from the existing main gas pipe line to suction point of the compressor
2. Gas storage system and dispenser is connected by SS tube work from compressor discharge.
3. The proposed CNG facilities shall be designed in accordance with the following code and guidelines
 - a) NZS 5425 – 1980
 - b) Petroleum Rules – 1976
 - c) Gas cylinder Rules – 2004 (Govt of India)
 - d) Guidelines of Chief Controller of Explosive Nagpur, IS: 2147

10. Washing:

The shed shall be provided with Manual or Automatic coach washing line. The type of washing plant shall be decided based on the local requirement, volume of fleet and budgetary sanction etc. refer para 4.7. A manual washing line and automatic washing plant shall have following features:

10.1 Manual washing:

- a) The washing of DMUs should be attended to outside the maintenance shed.
- b) The washing apron should be concreted and should be long enough to comfortably accommodate the complete railcar block rake.
- c) Standard carriage washing platform should be provided on both sides of the washing line.

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- d) Hydrant should be provided at frequent intervals at ground, platform and DMU roof level.
- e) A few points for high-pressure water jet cleaning of the under frame, bogies etc. should also be provided.

10.1.1 A portable car washing plant shall be available for coach washing at any place in the shed

10.2 Automatic coach washing plant:

10.2.1 The automatic coach washing plant shall consist of multistage operation to clean DEMU coaches externally by adopting technology of sensing and switching to control automatically the sequence and timing of various stage of cleaning.

10.2.2 As the train slowly enter in to plant automatic sensor should energized switch on the system. A medley of nylon brushes, water and soap solution immediately should come in to play at various stages and wash away dirt, dust, any material like grease, mud, sludge etc. from roof and body of the coach. There shall be provision for cleaning underneath special pressurized air jets.

10.2.3 A dryer unit shall be installed at the end where whole DEMU should be literally wiped dry with the help of cloth bristle whirling at high speed.

10.2.4 Apart from automatic washing system, a special portable motorized cleaning kit shall be made available for cleaning the inside of DEMU coach.

10.2.5 Automatic coach washing plant already installed at Madgaon of Konkan Railway may be adopted.

10.3 All the effluent water should be collected by carefully designed drainage facility. The discharge water should meet the local environment laws. Necessary treatment of discharge water should be planned through engagement of suitable consultant. Recycling of all water will be an ideal proposition.

11. Store:

11.1 The storeroom should be preferably at a platform level and provided at rail siding to help direct loading and unloading of store from wagons.

11.2 The store shall be nearer to main entry gate & should have an approach by road as well. The store should have facilities for loading and unloading the road trucks through a 3 t gantry crane.

11.3 Suitable trolleys should be provided for movement in shed of materials to avoid damage to components. Use of forklifts will be desirable.

11.4 Since the maintenance of DMUs requires ready stock of a large number of spares, generous accommodation should be provided for spare parts in the stores.

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- 11.5 Most items of diesel spares require careful handling and storage in properly kept bins. Care should be taken to provide adequate number and sizes of bins.
- 11.6 For larger items, movement through pellets should be introduced.
- 11.7 The DMUs have been designed around commercially available diesel engines. Therefore, full advantage of the dealer network of original manufacturer should be taken to keep minimum inventory in shed. The shed officers should be given sanctions of liberal amount as imprest and powers to purchase direct from authorized dealers of OEMs based on price list. The tendency to entertain any middleman to quote against such OEM spares has to be strongly resisted. Similarly, purchase of equivalent (i.e. spurious spares) should also be curbed. Such an approach will definitely save manpower and cost. Avoidance of multiple tiers of approval, sanction etc. will result in direct responsibility on the person making the purchase and it can be easily detected through the computerized MIS proposed for such stores.
- 12. Pit wheel lathe (depending on base shed holding):**
- 12.1 Pit wheel lathe should be planned as the rake holding reaches 180-200 coaches (say 20 rakes of 10 coach length). For lesser holding, tyre-turning workload should be managed by using the spare capacity of pit wheel lathe on the Railway.
- 12.2 The provision of space for pit wheel lathe shall be kept along with space for storing the turnings with separate line from both ends. Suitable arrangements for compressing of wheel turnings, their collection through a monorail loading and loading in wagon shall be made.
- 12.3 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.
- 13. Facilities for Coach Body repair:**
- 13.1 The maintenance facilities for the trailer coaches should be provided as per the maintenance manual for BG coaches of ICF design, 2002 with amendment 1&2. An area should be nominated for intensive repair to coaches where some body repair, paint touching up facilities would be available.
- 13.2 Adequate area for stacking of new and used brake blocks should be provided. Similarly, carpentry repair, window repair, seat repair etc. facility are to be provided in the shed.
- 13.3 Concept of multiskilling should be widely followed and the repair areas accordingly combined.
- 14. Shed Offices:**
- 14.1 An office should be provided, situated to provide a good view of the entire shed.

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- 14.2 The office building should be insulated such that disturbances from shed noise may be minimized.
- 14.3 The time office for recording worker's attendance should be equipped with modern computer controlled systems presently available.
- 14.4 A computer room should be provided in the office complex to utilize data base system for shed functions and computerization of MIS and other miscellaneous work.
- 14.5 A speedometer chart/strip examination facility may also be located in computer room.
- 14.6 Sr.DME's/DME's office, technical and drawing office, committee room, computer rooms and rooms of AMEs etc. are on first floor of administrative building in heavy repair bays block and shall be provided as shown in RDSO drawing NO. CG-K8209.

15. Toilets and Wash Rooms:

- 15.1 Proper toilet, washroom and locker facilities are essential in a well-organized maintenance depot. These should be equipped with equipments of modern design. Exclusive facilities for lady workers should be developed separately.

16. Fire Fighting Equipment, First-Aid and Safety:

- 16.1 Fire fighting equipment, First- Aid and Safety etc. should be provided in consultation with the local Fire Station authorities who should also be consulted on the actual location of various water hydrants, fire extinguishers and other equipment including sirens as may be needed. For example, high pressure isolated water pipelines in all rooms and all areas of the shed along with separate fire fighting water tank should be an integral part of a shed. There are specific fire safety guidelines for industrial units, including provision of fire exits etc., which must be implemented.
- 16.2 Oil company's experts should be consulted to ensure adequate safety measures being adopted against fire hazards in the shed, especially in respect of oil storage tanks.
- 16.3 First-Aid equipment should be provided in consultation with medical department.
- 16.4 A hooter arrangement is necessary for alerting workers when a unit is moved in or out of heavy repair area.

17. Radiator water:

- 17.1 Water available at shed site should be tested to ascertain whether a water treatment plant is required, or a distillation plant is necessary. Use of solar distillation plant is recommended to meet the requirement of distilled water.
- 17.2 Watering points for treated radiator water should be located at convenient locations in each berth in the shed with gravity feed direct to the radiators.

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17.3 Facilities should be provided to collect water drained from radiators for re-use. The drained water should be re-used only if found in satisfactory condition.

18. Compressed Air:

18.1 Proper design of compressed air supply is necessary. Specifically details regarding air storage reservoirs (corresponding to 30 min. of shed's compressed air requirements), piping design (change in diameters of pipes as we move away from source, slope provision, pipe joints especially the final drop pipe, specific outlets for Free Air Delivery and tool working, moisture traps and auto-drain mechanisms etc.) should be finalised with air compressor supplier. Provision of compressed air in sections through, indicative list of pneumatic tools and the associated tooling should also be made in consultation with supplier.

18.2 Supply of compressed air should be arranged with care being taken to install the air compressor in a place where minimum disturbance and vibration to the surrounding is caused. The air compressor should preferably be installed outside the maintenance shed.

18.3 Compressed air pipe lines should have a ring type of layout and be so laid as to permit installation of additional tapping points as and when required at a later date near work location, such as, the machine shop, the fitter benches, stores, black and copper smith shop etc.

18.4 Compressed air point shall be provided near each servicing berth.

18.5 Provision of tapping point of compressed air in pit line at an interval of about 10 meters, throughout the pit length may be done. Piping & Tapping points should be designed in such a way to avoid infringement to the movement of maintenance staff.

19. Lubricating oils:

19.1 Lubricating oil storage tanks should be located at convenient sites to make lubricating oil readily available at the servicing berth.

19.2 Lubricating oil hand – filling pumps on trolleys be provided for replenishment. Use of compressed air based, non-flammable lube oil lift pumps is also recommended.

19.3 Facilities for drainage of engine lubricating oil, trolleys should be provided to enable easy collection and removal of engine lubricating oil without spilling and soiling of servicing pits.

19.4 Facilities provided should ensure against mixing of lubricating oils of different brands.

19.5 Suspension bearing oil and gear case compound will require to be stored properly for issue to staff for topping up.

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20. Miscellaneous:

- 20.1 Water coolers should be placed at strategic points.
- 20.2 Work benches of standard design should be generously provided with vices etc. at strategic points.
- 20.3 Mobile welding facility may be kept on a battery-operated truck, which can freely travel to stabling lines for any emergency repair of body items.
- 20.4 Small parts bins, rotating parts bins, storage shelves, pans for carrying and storing small parts, test racks for repairing and testing injection equipment, washing tanks for washing small parts with jib crane arrangement, car body filter cart for transportation of car body filters etc. should be generously provided.
- 20.5 Proper desks should be provided and located strategically in the shed premises. A central office for keeping the maintenance records etc should also be provided.
- 20.6 Pigeonholes, shelves etc. should be generously provided for storing of blank forms and completed forms, maintenance manuals and renewal parts catalogues etc.

21. Drainage:

- 21.1 Proper drainage arrangements should be provided, washing platforms, toilet blocks, and rainwater from the roof and for shed premises. Yard should also have proper drainage arrangements so that rainwater does not accumulate anywhere. Arrangements for rainwater harvesting should be made. Manholes for rainwater drain inside the shed should be located to leave clear space for movement. The number of down pipes to drain rain water should be sufficient to cater for draining the rain water under worst circumstances, finally the water should discharged to the city main drain through pumping station etc. The drainage of the pits may be connected to a well/deep pit, which should have the provision of pumping out the collected water etc.

22. Shop flooring:

- 22.1 Shop flooring should be made of heavy-duty cement concrete reinforced with steel bars. Before concreting, the ground should be properly prepared by hard stone and adequate ramming.
- 22.2 The space between rails and concrete floor should be filled with concrete blocks and cemented.
- 22.3 Toilet and washing places should be provided with superior quality glazed tiles up to a height of 2 meters with mosaic flooring.
- 22.4 The approach road from the main entrance to the shed and the stores will be asphalted and water drain on either side should be provided.

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22.5 All the columns and steel structures should be aluminum painted. The following colour scheme may be followed.

- | | | |
|---|---|---|
| a) Columns up to height of 2 m | : | Light grey |
| b) Cranes | : | Yellow |
| c) Electric conduit pipes and switch board | : | Orange |
| d) Air pipes | : | White |
| e) Water pipes | : | Sea Green |
| f) Fire services | : | Red |
| g) Steel doors and windows | : | Olive green |
| h) Workshop rooms and walls | : | White washed |
| i) Sr. DME's/DME's office
and supervisor's rooms | : | Distempered with cream
or any light colour |
| j) Work benches | : | Battle ship grey or atural
colour |

23. Environment:

23.1 All attempts are to be made to make the shed environmentally futuristic and energy efficient. Suggestion has already been incorporated regarding tree plantation, use of solar distilled water plant, affluent water treatment recycling, and translucent roof sheets. A few more items requiring attention are also incorporated below:

- Garbage compactor
- White reflecting roof
- Storing and loading of released material
- Disposal of wheel lathe chips – bracketing
- Reuse of coolant water
- Used filter residual oil collection.

24. M & P Items

24.1 The shed should be provided with minimum machine tools as per requirements and should work on unit exchange principle of equipment. Converting the shed into a full-scale workshop should be strongly discouraged. Such strengthening of shed to attend to all items of engine, transmission overhauling causes lack of quality and also manpower.

A. Machine shop

- Universal Centre lathe machine
- Tool grinder
- Radial Drilling Machine
- Power Hack saw
- Pipe threading machine
- Hand operated shear
- Pipe bending machine
- Marking table
- Pedestal grinder double ended

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- B. **Lifting equipment**
Refer para 5.12 of report
- C. **Welding**
1. Portable welding set 300 Amp. DC
 2. Oxy – acetylene set with cylinders & cutters
- D **Tool room**
1. Special tools for diesel power pack
 2. Portable electric tools
 3. Torque wrenches
 4. General purpose tools with Tool kits and hand tools
 5. Special tools for trailer coaches
 6. Hydraulic tools
 7. Pneumatic tools
- E. **Compressed air room**
1. Air compressor with air dryer, filter, reservoir 600 cfm at 9 kg/cm²
 2. Compressor portable
- F. **Vacuum cleaning and water pumps**
1. Portable vacuum cleaner
 2. Pit dewatering portable electric pump
 3. Booster pump for washing line
 4. Industrial floor cleaner (dry + wet)
- G. **Other electrical equipment/miscellaneous requirement**
1. Battery charger set
 2. Distilled water plant 50 litres/hr.
 3. Crimping tool for power cables and control cables
 4. Air conditioner
 5. Fully automatic Commutator mica undercutting and de-burring machine
 6. Automatic surge comparison high voltage AC/DC test equipment
 7. Portable surge comparison high voltage AC/DC test equipment
 8. Baking oven
 9. Armature cleaning plant
- H. **Special purpose machines and tools for diesel power pack**
1. Cleaning tanks
 2. Grease guns and lubricating set
 3. Lifting tackles
 4. Bearing puller
 5. High pressure jet cleaning
 6. Pinion extractors
 7. Induction heater
- I. De-mineralizing plant
- J. Testing and measuring equipment
- K. Computers, Fax & Photo copier

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- L. Work benches, lockers etc.
- M. Special equipment for carriage maintenance
- N. PA System for shed & conference room
- O. Digital Projector

P. Transport, Lifting and handling equipment

S.No.	Item	Qty
1	Fork Lift 5 T	1
2	Fork Lift 3 T	1
3	Battery operated fork lifts	2
4	Battery operated platform truck	2
5	Road mobile crane 5 T	1
6	Truck 10T	2
7	Utility Van	2
8	Ambulance	1

Q. Other equipments/Miscellaneous requirement

S.No.	Item	Qty
1	Portable grit blasting machine	1
2	Centrifugal Oil cleaning plant	1
3	Effluent treatment plant	1
4	Spectrometer	1
5	Ultrasonic component cleaning plant	1
6	Ultrasonic flaw detectors	3
7	Computerized Load Box	1
8	DV /EP unit Test bench	1
9	Sand drier and filling equipment	1
10	R-O Water purifier system	1

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R. Details of Lab Equipments as per requirement

S.No	Description	Qty
1.	Equipments for testing lube oils	
1.1	For viscosity determination	
1.1.1	Constant temp water bath for kinematics viscosity	1
1.1.2	Viscometer tubes calibrated	12
1.1.3	Thermometer ASTM 28F and 46F	2
1.1.4	Stop watches	6
1.2	For fuel dilution determination	
1.2.1	Open Flash Tester with thermometers 15F and I.P16F	1set
1.2.2	Cleveland open cup ASTM D.92	1 unit
1.2.3	a small petrol gas generator	1
1.3	For water contamination test	
1.3.1	Hot plate with variable temp. control 2000W	1
1.3.2	Porcelain crucibles about 40mm dia.	12
1.3.3	Pair of tongs(in different sizes)	4
1.3.4	Water determination apparatus with ground glass joints, 500cc flask 2 cc receiver and suitable electric heater	1 set
1.4	For ash content test	
1.4.1	Muffle furnace with calibrated pyrometer Max temp range 1000 deg C	1
1.4.2	Silica or porcelain crucibles	12
1.4.3	Desiccators	1
1.4.4	Balance Analytical Physical balance (reading up to 10mg)	1
1.5	For sediment content test	
1.5.1	Variable speed centrifuge (ASTMD893)	1
1.5.2	Centrifuge tubes conical shaped	12
1.6	For neutralization value test	
1.6.1	Apparatus for neutralization value determination by potentiometer titration ASTM D-664	1
1.6.2	Alkali resistant conical flasks cap 250cc	12
1.6.3	Micro burette	2
1.7	Blotter test	
1.7.1	Whatman No.1 or any good quality analytical filter paper to be used	as per requirements
1.8	Miscellaneous Equipments	
1.8.1	Air oven range up to 150 deg C	1
1.8.2	Lube Oil sampling gun	2
1.8.3	Microscope for determining qualitatively the condition of additives in lube oil	1
1.8.4	Chemicals & reagents for qualitative analysis of metals and qualitative analysis of water	1 unit
1.8.5	Misc glass apparatus like test tubes, beakers, flasks etc	As per requirements

2.	Equipment for testing greases	
2.1	Penetrometer with accessories including 'grease worker' as per ASTM D-217	1 unit
2.2	Drop point apparatus as per ASTM D-566	1 unit
3	Equipment for testing Diesel Fuels	
3.1	Graduated hydrometer for density/specific gravity test	1
3.1.1	Thermometer (0-110 Deg. C) for density/specific gravity test	1
3.2	Viscometer tubes no. 100	6
3.3	Flash point apparatus with suitable thermometer	1
3.4	Total Sulphur Bomb Calorimeter with accessories	1
3.5	Carbon residue apparatus including calibrated pyrometer and cocking bulbs	1
3.6	Distillation apparatus with distillation flask & thermometers	1 unit
3.7	Apparatus for determination of Gum contents in fuels	1 unit
4	Equipment for engine cooling water test	
4.1	Porcelain dish 80 mm dia, Burettes 50 ml capacity, and burette stand with 2 clamps for chloride test.	1 unit
4.2	Pocket Refractro-meter for determining the oil content in the emulsions.	1
5	Equipment for testing metallic wear	
5.1	Spectrograph	1
	Rubber testing	1
6.1	Harness tester	1
6.2	Electric oven range up to 250 deg. C	1
6.3	Swelling test apparatus, 4 Pyrex beakers, branded mineral oils of known characteristics	1 unit
6.4	Soxhlet apparatus for extraction	2 unit
6.5	Rubber tensile testing machine with dumb belt cutters to prepare test specimen capacity 250 to 500 Kgs MAXIMUM	1
7	Ultrasonic flaw detector machine	1
8	Zyglo test machine	1