Part- VI

Design Criteria

(Depots, Yards and Workshops)

CONTRACT NO: NGNDD01

INDEX

PART-I

Design Criteria (General)

Depots, Yards and Workshops

1.0 General

This section presents design criteria of a general nature applying to the areas of the system intended for the stabling, servicing, repair and overhaul of transit vehicles. They also contain other functions as herein defined. For terminology, these areas are collectively termed depots regardless of their specific functions. Because of the unique characteristics of any depot facilities the design criteria can only encompass the broadest of requirements and may not address all the design criteria can only encompassed the broadcast of requirements and may not address all design challenges that arise in the course of developing the total system design. The designer is encouraged to view these requirements as standards, which express the overall intent of the NNMRC to achieve an efficient operation of the storage and maintenance of the system and to adopt this general intent to the specific design under consideration. However, any clear variation from these criteria must be identified and brought to the attention for appropriate direction before the design proceeds.

1.1 General Climatic Conditions

- The recorded highest and lowest temperature in past 10 years is 45.4 degree Celsiusand 2.4 degree Celsius respectively.
- Summer season is from April to June and the winter season is from November to March.
- Wind pressure is 150 kg/m^2 for Noida-Greater Noida areas.
- Rainy season is from June to August sometimes extending to middle September.

1.2 Seismic Zone

Noida-Greater Noida falls in seismic zone IV as at present. If there is any change subsequently during the pendency of the work the design shall have to be revised accordingly. Earthquake of maximum magnitude 7 on modified Mercalli scale has been experiences in the past

1.3 Not Used

2.0 Codes and Standards

- The design and the construction of the depot shall comply with the codes of practice and standards current at the time of submission of tender documents. Regulations made and requirements issued by the Indian Government and by relevant utility companies shall be followed and specified.
- Alternative or additional codes, Standards and specifications proposed by the DDC shall be internationally recognized shall be equivalent to or better than Indian Standards issued by the Bureau of Indian Standards subject to being, in the opinion of the Employer's Representative, suitable for incorporation into the specification.

3.0 Deleted

4.0 Depot Layout

The buildings and other structures and the track in the depot have been arranged to accommodate the intended functions within the available land area in the most efficient manner. The functions for the depot, as defined in Table 1, can be summarized as:

- Stabling of EMU vehicles awaiting revenue service, inspection, repair or overhaul.
- Internal and external cleaning. Maintenance and Inspection of EMU vehicles.
- Provision for Emergency Response equipment.
- Repairs and overhaul of EMUs.

4.1 Deleted

4.1.1 Deleted

4.1.2 Deleted

4.1.3 Public Road Access

Movement of pedestrians and vehicles in and out of the depot shall be controlled

through the use of a minimum number of entrances. Appropriate security measures such as gates and checkpoints shall be incorporated to permit adequate vehicular inspections both leaving and entering the depot. Pedestrian paths shall be provided to separate foot and vehicular traffic to the maximum extent possible. Clearly identifiable entrances shall be provided and shall be situated to allow adequate surveillance of incoming traffic. Separate entrances shall be provided, where appropriate for non-maintenance or operations related traffic such as trainees, goods delivery and visitors. Adequate turning radium shall be provided for large vehicles carrying EMU bodies / rails for entrance into the workshop area/P. way material stacking area for delivery of vehicles.

4.1.4 Internal Traffic Pattern

The internal traffic patterns must also be designed considering rail borne vehicles, road vehicles such as automobiles, trucks, and other rubber typed equipment and foot traffic of personnel moving about the depots. In general, the layout of all tracks, roads and footpaths shall be arranged to separate the traffic and avoid, as far as possible, intersecting paths that expose either persons or equipment to hazards due to collisions. Level crossings of tracks and roads shall be kept to a minimum. All level crossings shall be protected by height gauge and should not path through the points and crossings.

5.0 Deleted

6.0 Deleted

7.0 Deleted

8.0 Not used

9.0 Deleted

9.2 Stores:

- Storage of consumable, capital spares and spares parts for maintenance of Rolling Stock.

- Storage of tools, consumable, capital spares and spares parts for maintenance of Metro Corridor assets such as P-way, Signalling & Telecommunication, etc.

The main storage area will be located close to the workshop area. The DCOS Stores will provide facilities, to account for all NMRC Metro Corridor maintenance and operation requirements for material and supplies, spare parts and overhauled components waiting to be put back in service. Design of these facilities will fully account for security and climatic considerations, included shall be the provision of all racking, shelving, bins and material handling equipment.

9.3 Water supply, Sewerage, Drainage:

9.3.1 Water supply, sewerage system:

- Bore wells are planned for water supply for the depot including washing of rakes, drinking water for the staff, fire fighting purpose, etc.
- Adequate water storage for minimum 12 hours is needed.
- Adequate standby arrangement for Bore-well failure or pump failure to be incorporated in the system design.
- Sewerage can be disposed off by soak pits.
- Overhead storage tank of adequate capacity and height.
- Planning & design of sewerage & drainage disposal as per requirement of facility planned by NMRC in future.

9.3.2 NOT USED

9.3.3 Waste Water Treatment:

- Waste water of the workshop after cleaning of trains, bogies, bearings, traction motors, filters etc. shall be treated by a waste water treatment plant so as to limit the effluents to the general standards for discharge of environmental pollutions as specified in The environment (Protection) to check up from relevant books Rules, 1986 Schedule-IV, notified vide G.S.R. 422 (E) dated 19/05/1993.

- Similar treatment is required for the wastewater released after washing of the cars by detergents or acids before the same may be discharged.

9.5 Deleted

9.6 Staff facilities:

Staff facilities such as canteen, toilet, changing room, cycle / scooter / cark parking etc. shall be planned.

Employee welfare areas shall consist of rest rooms, locker areas, showers, first aid room, and lunch facilities. The facilities shall be sized for the number of persons employed in the workshop as well as in the inspection shed in shifts. Separate facilities will be provided for both sexes where appropriate.

9.7 Security:

Entry to depot by road and rail by suitable security arrangements with a suitable height of boundary wall all around the depot to be provided.

10.0 Civil Work

10.1 Foundations

For heavier structures like depot, workshop, staff quarters, RCC Deck slab over stabling lines (for a future load of 6 storey building over deck slab / or number of storey as intimated by NMRC) etc. particularly those with crane loading, and above stabling lines, pile foundations shall be such that no cracks or settlement is notified.

10.2 Super – Structure

Super structure shall be of Reinforced concrete cement framed structure or steel column, supplemented by brick work in shed structures and of brickwork in other buildings and ancillary works.

10.3 Roofing

Shed structures such as Main Workshop, Inspection bays, stabling lines, ETU workshop etc. shall have steel truss roof/Pre Engineered Structures with steel cladding. The office & other structures and staff quarters shall have normal flat Reinforced concrete roofing.

10.4 RCC Deck Slab over Stabling lines

Deleted.

10.5 Flooring

Heavy-duty flooring (Cement, concrete reinforced with short steel bars or iron casting) is prescribed in heavy repair and lifting bays for EMUs. Other buildings such as sub-station shall also be provided with heavy-duty floorings. The flooring should be suitable for withstanding jacks of 15-tonne capacity used for lifting of EMUs. Generally plinth level should be 460 mm (minimum) above the natural ground level or centre of road whichever is higher. In acid storeroom, acid and alkali resistant tiled floor is envisaged. In rest of the buildings cement concrete floorings are prescribed.

10.6 Steel Work

Workshop doors shall be of collapsible steel shutters. Gantry girders for overhead cranes shall be of built-up steel sections. Doors and windows in all the other structures shall be of steel, with glazed shutters shall be provided.

10.7 Wood Work

Door shutter in offices and other buildings shall be of flush panel and glazed type.

10.8 Paved Area

A 20 m space on either side of depot and workshop shall be paved with cement concrete of given mix to reduce dust nuisance.

10.9 Miscellaneous work

Utility diversion works if any, boundary wall, earth work & site development/landscaping work etc**.**

11.0 Design Life

The design life of the Permanent Works shall be:

a.	for civil engineering structures	120 years
b.	for building structures	50 years
c.	for Plant and equipment	30 years
d.	for road pavements	20 years

TABLE 1

Major Facilities in TRANSPORT NAGAR Depot cum Workshop

S.no	Description	Facilities	
1	Stabling Lines	13x2=	26 Rakes
2	Stabling Lines (coverd)	6x2=	12 Rakes
3	Inspection Bays (for 3 lines)	3	
4	Workshop Bay	1	
5	Workshop Bay (Future)	1	
6	Autocoach washing plant	1	
7	ETU double storey building	1	
8	Heavy internal cleaning building	1	
9	Emergency building	1	
10	Pit wheel lathe	1	
11	Test track (650 mtr.)	1	
12	Shunting Neck (csl 165 mtr.)	2	
13	ETP/STP	1	
14	P-Way material section (open storage) & cover store	1	
15	Tower wagon shed	1	
16	Engineering Siding (csl 140 mtr.)	1	
17	Radio tower	1	
18	D.C.C & S&T	1	
19	U.G Tank	1	
20	O.H TanK	1	
21	R.S.S	1	
22	Canteen	1	
23	Sub station	2	
24	Feeding post	1	
25	CWM office	1	
26	Time & Security office	1	
27	DCO store Cum Inflamable & Dangerous item	1	
28	Offices & Repair section building		
29	Contractor's staff Cleaner room		

TABLE 2

MAJOR CHARACTERISTICS OF VEHICLES

S.No.	ITEM	RAIL CORRIDOR
1.	Supply voltage system	25 KV flexible OHE on surface
2.	Type of OHE	Flexible (and or rigi centenary)
3.	Current collection	By Pantograph
4.	Min. Height of Contact wire from Rail Level	4570 mm
5.	Train Control System	CBTCS
6.	Train Control Mode	(i)Automatic Mode (Normally) (ii) Manual Mode (infrequently)
7.	Tare Weight of Motor Car	40 tonnes
8.	Tare Weight of Driving Trailer Cars & Traile Cars	25 tonnes
9.	Max. speed	90 Km/h
10.	Length Over Body	21340 mm/ 21640mm
11	Max Width Over Body	2900 mm
12.	Overall Car Height from top of Rail to Roo centre	3690 mm
13.	Height of Floor from Rail Level	1130 mm
14.	Wheel Diameter (New)	860 mm
15.	Wheel Diameter (Fully Worn)	780 mm

PART-II

TRACK LAYOUT CRITERIA
Depots, Yards and workshops

1. GENERAL

The purpose of this section is to define the general approach and specific requirements for the track layout. In addition, track configuration is defined for co-ordination with other design disciplines.

2. DEFINITIONS

Ballast: Crushed hard rock material placed below and around the sleepers on ballasted track. Bottom ballast is that ballast placed below the sleeper. Top ballast is that ballast placed around and between the sleepers.

Ballasted Track: Track elements comprising of running rails, rail-fastening assemblies, base plates, concrete sleepers, ballast and sub-ballast. Also, track consisting of rails attached to concrete sleepers that are supported by ballast on a concrete slab or on a layer of sub-ballast that is resting on a track bed of compacted sub-trade, may incur at-grade, on a raised or retained embankment, in an open or retained cut, on a deck bridge. .

Ballastless Track: Track elements comprising of running rails, rail-fastening assemblies, rail pads, sleeper blocks/RCC, resilient pads, embedded in concrete, on slab, on earth or directly fixed steel column.

Bonded Joint: A rail joint that use high-strength adhesives in addition to bolts to join two rail lengths together. The joint may be insulated or non-insulated.

Cant: The designed vertical distance that the that the outside rail of a curve is set above the inner rail on a curve (also called super-elevation).

Cross level: The vertical relationship of the top of one running rail to that of the opposite running rail at any point in the track.

Crossover: Two turnouts connecting one track to another. Crossovers may be facing or trailing.

Direct Fixation Track: Track constructed of rail and direct fixation fasters attached to a concrete plinth of slab. May occur on viaductsand on at-grade concrete track slabs.

Direct Fixation Fastener (DFF): A resilient device for securing running rail to a concrete track bed in direct Fixation track.

Double Crossover: Two- single crossovers in close proximity enabling moves in either direction.

Electrical Isolation: The electrical resistance required between the running rail and the ground to prevent harmful levels of stray current from the DC traction power circuit.

Friction Buffer: An energy-dissipating device consisting of a steel frame, a cushioned head to engage the vehicle-end and friction shoes attached to the railhead.

Scissors (Diamond) Crossover: A double crossover where the two crossovers are superimposed.

Shop or Pit Track: Special track where the rails are embedded in the concrete floor of a shop or supported on columns in a service or inspection pit.

Sub-ballast: An aggregate material that is placed and compacted between the ballast and sub-grade to prevent migration of ballast in to the sub-grade and to prevent the migration of sub-grade into the track ballast.

Turnout: Switching-and-crossing mechanism that allows rolling stock to divert from one track to another. Turnouts may be facing (diverting from the line in the direction

of normal running) or trailing converging to the line in the direction of normal running).

3. RAILWAY ALIGNMENTS

3.1 Criteria

3.1.1 General Criteria

S.	Criteria	Dimension
1.	Gauge (14 mm below top of rail crown)	1435 mm
2	Maximum Train speed	80 km/h
3.	Operational speed in Depot	25 Km/h
4.	Maximum axle load loaded Condition AW4	16 tonnes
5.	Maximum axle load empty Condition AWD (Depot)	10 tonnes
6.	Maximum gradient running track Maximum Depot connecting track	4% compensated 4% compensated
7	Minimum vertical curve radius Minimum horizontal curve radius	1500m 120m Running track) 100m (Depot track)
8	Electric Power collection – SC-BP Corridor	Overhead catenary – AC 25 KV

3.1.2 Track Standard

S.	Criteria	Broad gauge
1.	Maximum Cant	110 mm
2.	Maximum Cant deficiency	80 mm

3.2 Horizontal Alignment

3.2.1 Transition Curves

In general for all running and depot lines transition curves shall be provided where possible between a circular curve and adjoining straight, between the different radii of a compound curve and at the adjoining ends of circular curves forming reverse curves. Transition curves are not required in sidings.

Transition curves will not normally be required between different radii of a compound curve where the change of radius of curvature does not exceed 15% of the smaller radius and provided that the cant deficiency and/or cant excess criteria are not exceeded for either curve.

Transition curves shall be in the form of cubic parabolas or clothoid spirals for which the equations are:

a) Cubic Parabolas

(i) $y = \frac{d^3}{6RL}$

(ii) $A = \frac{d^2}{2RL}$

(iii) $S = \frac{L^2}{24R}$

a) Clothoid spiral

$$S = \frac{L^2}{24R} - \frac{L^4}{2688R^3}$$

Where L = length of transition

R = radius of circular curve

S = shift

y = offset from tangent

d = distance along transition

A = deviation angle of transition

3.2.2 Cant Gradient

The cant gradient (nor cant deficiency) shall be subject to the following limits:

Absolute maximum = 1 : 440

Preferred maximum = 1 : 720

The rate of change of cant or cant deficiency shall be limited to:

Absolute maximum = 40 mm/sec.

Desirable maximum = 25 mm/sec.

3.2.3 Compound Curves

Where a compound curve is employed with a change of radius greater than 15% of the smaller radius, or where the cant deficiency or cant excess criteria necessitates a change in cant between the circular curves suitable transition curve shall be interposed between the two parts of the curve may be omitted. In this case, the required change of cant shall take place over the calculated length of the transition, or 15 m which ever is the greater, and in the same location as if the transition had been provided.

When the actual shift of any calculated transition curve would be less than 10 mm the actual transition curve may be omitted. In this case, the required change of cant shall take place over the calculated length of the transition, or 15 m which ever is greater, and in the same location as if the transition had been provided.

3.2.4 Reverse Curve

Where a a reverse curve is employed, a minimum straight length of 30m shall be kept between two transitions of reverse curves. Where this length is not possible and the straight is less than 50m between the reverse curves, the same should be eliminated by suitably extending the transition length. In doing so it should be ensured that the rate of change of cant and versine along two transitions so extended is kept the same.

3.3 Vertical Alignment

3.3.1 General

Vertical curve shall be provided whenever the change of grade exceeds 0.4%. Vertical curves shall wherever possible be positioned such that coincidence with horizontal transitions is avoided.

Vertical curves shall, for each location, be selected on the basis of the largest practicable vertical curve radius subject to:

- Minimum desirable radius 1500 m

3.3.2 Length of Vertical Curve

The length of constant grade between consecutive vertical curves shall be as follows:

Desirable minimum	50 m
Absolute minimum	20 m

3.4 Gradients

The limits of gradients shall be:

- The desirable maximum gradient shall be 0.1% on stabling tracks and the absolute maximum gradient shall be 0.25% for all other tracks expect in workshop inspection shed where level track should be laid.

3.5 Points and Crossings

Whenever possible points and crossing work shall not coincide with vertically or horizontally curved track.

Where it is not possible to avoid coincidence with vertical curves the switches and rails shall not be laid on vertical curves.

Points and crossing work shall not coincide with horizontal transitions

No part of the switches, switch operating gear or crossing nose shall be over a structural movement joint.

3.6 Types of Tracks

There will be four types of tracks in depots:

- Ballast less track in washable aprons, automatic coach washing plant, workshops
  etc.
- Ballast less track elevated above an open depressed floor area for raising the cars 1.1m above the sunken floor level.
- Blasted track in rest of the depot such as stabling lines, test track etc.
- Blasted track on level crossings.

3.7 Derailment Protection

Trap points must be provided for isolation of main line & trial track from other depot lines to restrain vehicles from colliding with other vehicles.

Trap points must be provided for isolation of main line & trial track from other depot lines to restrain vehicles from colliding with other vehicles.

Part-III

Building Services (Electrical and Mechanical)

1.0 GENERAL

This section presents outline design requirements for electrical and mechanical works such as:

- Distribution system including main LV panel, switchboard panel, bus ducting, cabling, distribution and sub-distribution boards, feeder pillars etc.
- Standby power supply system including diesel generating set, associated control, changeover, automatic mains failure panel.
- Building Services including air conditioning, lighting (both indoor and outdoor), water pumping, storage and distribution system, and sanitation;
- Cable supports, ducts and drawpits for cables to be installed by others;
- Earthing and lightning protection;
- Fire fighting system;
- Access Control System
- The DDC shall assist NMRC to get the necessary clearances from the local fire safety authority for the preliminary approval of the Depot design as per Fire safety norms.

  These requirements only give the system requirements in the broader sense and may not address all design challenges that may arise in the course of developing the total system design. The designer is encouraged to view these requirements as standards, which express overall intent of NMRC to adopt this general intent to the specific design under consideration. However any clear variation from these criteria must be identified & brought to the attention for appropriate direction before the design proceeds.

2.0 ABBREVIATIONS

Abbreviations used in this specification include:

HV	High Voltage

MV	Medium Voltage
LV	Low Voltage
AC or ac	Alternating Current
DC or dc	Direct Current
DCOS	Divisional Controller of Stores
KVA	Kilo volt-amps
KW	Kilowatts
V	Volts
A	Amps
Mm	Millimeters
Db	Decibel (sound pressure level)
NC	Noise creation
NFPA	National Fire Protection Association, USA
FAP	Fire alarm panel
BS	British Standards
ISO	International Standards Organisation
IES	Illumination Engineering Society
SCADA	Supervisory Control and Data Acquisition
IS/BIS	Bureau of Indian Standards

AMF	Auto Main Failure
LT	Low Tension

3.0 CODE AND REGULATIONS

Main Electrical Design:

Equipment, materials and systems shall be designed, in accordance with the latest issue of codes and standards.

Electrical design shall be based on BS 7671:1992 “Requirements for Electrical Installations” or other internationally recognized equivalent standard approved by NMRC examples of which are:

IE Rules & IE Act

National Building Code

ANSI	American National Standards Institute
ASME	American Society for Testing and Materials
ASTM	American Society for Testing and Materials.
DIN	Deutsche Industrie Normen (German Industrial Standards)
IEC	International Electrotechnical Commission
JIS	Japanese Industrial Standards
NEC	International Electrical Manufacturers Association (USA)
NEMA	National Electrical Manufacturers Association (USA)
NEPA	National Fire Protection Association (USA)
VDE	Verband Von Deutsche Standards (German standards association)

Mechanical design shall be based on the following codes:

IS 1172	Code of basic requirements for water supply, drainage and sanitation.
IS 1742	Code of Practice for Building Drainage.

IS 2064	Code of Practice for selection, installation and maintenance of sanitary appliances
IS 2065	Code of Practice of water supply in buildings.
IS 2470	Code of Practice for installation of septic tanks.
IS 3114	Code of Practice for laying of Cast iron pipes.
IS 4111	Code of Practice for ancillary structures in sewage system.
IS 4127	Code of Practice for laying of glazed stoneware pipes.
IS 5329	Code of Practice for sanitary pipe work above ground for buildings.
IS 7740	Code of Practice for construction and maintenance of Road Gullies.
IS 12251	Code of Practice for drainage of building basements.
IS 12288	Code of Practice for use and laying of ductile iron pipes.

3.1 Local Codes, Regulations and Standards

Unless otherwise stated, the electrical system design shall be governed by all applicable local codes, regulations and standards issued by the local agencies such as:

BIS	Bureau of Indian Standards
IEEMA	Indian Electrical & Electronic Manufacturers Association

The DDC shall specify the regulations laid down by the local authorities i.e., Government of Municipal agencies including fire safety regulations, fire insurance regulations or other local codes and make provision so that NMRC obtains approvals from relevant authorities at appropriate stages of work. Such regulations are:

Indian Electricity Rules
Indian Electricity Act
National Building Code
Inspectorate of Lifts and Escalators
Central Pollution Control Board
U.P. Police & Fire Brigade
Central Public Works Department
U.P. Vidut Board
National Safety Council
Building Bye Laws – U.P. Govt.

3.2 Additional Codes, Standards, Specifications and Manuals

In addition to the local requirements, electrical system designs shall comply with the codes of practice and standards specified herein. Local codes regulations and standards shall take precedence where their standards or requirements are more onerous than other national standards. All codes and standards shall be submitted in English language. The design of any one system shall be to a single code or specification. The parallel use of different codes for one particular item or component will not be allowed.

A checklist based on relevant standards for ensuring conformity shall be prepared. The checklist should cater for design, manufacture, supply/storage, packing, erection/commissioning and operation as applicable.

4.0 Standardisation

In establishing his design, the principles provided below shall be followed in the design and specification all plant, equipment and components.

- Similar plant and equipment shall be replaceable/interchangeable, modular in design, adaptable and extendable.
- The technical specifications and design criterion shall be uniform. Uniform standards for clear spaces, working clearances, protection of equipment and physical dimensions of equipment and interfacing with other systems shall be followed.
- Type testing, routine testing and endurance test shall be required under similar conditions.
- A standard procedure shall be followed for identification of each category of equipment explicitly (suffixing or prefixing while marking and numbering for each category of equipment).
- Equipment and accessories shall be provided with uniform standard space capacity, protection.
- Piping, cabling etc shall be suitably colour coded for identification and categorization for each kind of use/type.

5.0 DESIGN CRITERIA MECHANICAL WORKS

This section covers the requirements of the water supply, storm water drainage, sewerage system air-conditioning, lifts, water coolers and fire fighting systems in the deports.

5.1 Water Supply and Sanitation

The DDC shall be responsible for assessing the water/drainage requirement, pipe sizing, effluent treatment procedure, fire-fighting requirements and submit calculations to the Employer's Representative.

5.1.1 Water Services

Water Storage Tanks

RCC water storage tanks shall be installed at the height of 20 metres or adequate height at a possible location within each depot.

Requirement of water shall include:

1 Coach Washing
2 Depot/Workshop/Machinery requirement
3 Personal use
4 Gardening
5 Road watering
6 Fire Fighting (make up water)

5.1.2 Mains and Water Pipe Installation

The mains water and water services shall be installed as a grid iron system and shall be graded to ensure satisfactory drainage.

Pressure head of water in pipes shall not be more than 70 m. For up to double storey buildings the pressure head may be 50m.

Minimum size of C1 mains shall be 100 mm for one sided mains fed & 80mm for

both sided mains fed. Any branch feeder or main distribution shall not be less than 50mm. Wherever a pipe has to pass through floor or wall, it shall pass through a sleeve.

No service pipe shall be directly connected to distribution pipes to avoid contamination due to backflow from flush cistem etc.

Velocity of flow shall be 0.75 m/s to 3 m/s (preferably 1.5 m/s). In no case it shall be less than 0.6 m/s.

Internal mains water pipes shall be installed in heavy grade galvanized steel. Pipe fittings shall be compatible metal fittings to Indian Standards.

Valves

All valves used on water services shall be in accordance with the requirements of the water authority. All valves shall be non-dezincifiable.

All valves and drain cocks shall be located for ease of maintenance. Valves located behind panels within toilet or other areas shall be clearly identified via appropriate marking on the external face of the panel.

5.2 Sewage System

Pipes

Cast iron soil waste and ventilating pipes, fittings and accessories shall conform to BS 416, with approved coating providing fire and corrosion protection.

Pipe of minimum dia of 250 mm shall be used.

Soil Waste, Waste and Ventilating Pipes Installation

All pipe runs shall be arranged to present a neat appearance and where practicable be parallel both with one another and with the building structure. All vertical pipes shall be in plumb

The minimum clearance between a pipe and any adjacent finished building surface, fixing or pipe shall be 35 mm.

Pipe-work runs shall in all cases be installed with a view to co-ordinate with other services, whether provided by the DDC or not.

Careful consideration must be given to the low flow rates when designing suspended drainage schemes. Self-cleansing velocities must be achieved, minimizing potential blockages etc., therefore a normal minimum installation gradient of 1:60 should be achieved. Any flatter gradient than 1:60 must be proven by the DDC prior to receiving consent.

Septic Tank:

Minimum width & depth of septic tank shall be 750 mm & 1000 mm respectively. Length of septic tank shall be 3 to 4 times that of the width. Minimum liquid capacity of a tank shall be 1.14 cum.

Manholes.

Side of a manhole shall not be lessthan90 cm and it shall not be less than 1 m deep. Manholes shall be kept 45 to 100m apart.

Soakpits.

Soakpits shall be kept at least 30 m away from any residential/office building.

5.3 Storm Water Drainage

The drainage disposal shall be gravity flow. In case the same is not possible and needs mechanical disposal then suitable pumping system shall be designed (e.g. sunken floor inspection area, waste water treatment plant etc.)

Basis for storm water drainage system design shall be the rainfall of 80mm/hr – 25 years to 30min. Storm water drains shall be laid at a gradient not flatter than 1 in 400 to achieve a self cleaning velocity of 1m/s.

To avoid the chocking of drains during lean period, they should have trapezoidal section except those crossing under the track, which shall be rectangular cross-section.

6.0 VENTILATION & AIR-CONDITIONING

6.1 General

The ventilation and air-conditioning systems are to be based on the current “hard Book” series by the American Society of Heating Refrigeration and Air-conditioning Engineers and also National Building Code, India and relevant IS code.

6.2 Ventilation

The design of ventilation system shall be based on the latest National Building Code (INDIA) & I.S 3103 – 1975 or ASHRE guidelines.

If the air changes cannot be achieved by the natural ventilation then mechanical ventilation shall be provided.

The ventilation in the workshop and Inspection Bay shall be provided through Industrial type Air – circulators mounted on the steel structural column.
In the repairs & overhauling sections, offices, control rooms, plant room etc. the ceiling fan shall be provided.
In addition, exhaust fans of suitable capacity shall be provided in the plant rooms, control rooms, etc. where heat dissipation takes place, the air changes shall be based on actual heat gain of the equipment. Exhaust fan shall also be provided in the bathrooms, toilets, cloakroom & kitchen.

The paint shop and places where harmful dust, fumes, vapors, gases etc. are released in the working area, special care has to be taken and adequate exhaust system provided.

6.3 Air Conditioning

The following room shall be air-conditioned

- Officers’chamber
- Computer room

- Conference room
- S&T relay room & telecom exchange room

The air-conditioning unit shall be air-cooled unitary or ductible split type or package type air conditional depending upon the size of the space to be air-conditioned, in accordance with relevant Indian standards.

Out Door / Indoor Design Conditions

Summer	Dry Bulb 43^{o} C	Wet Bulb 28^{o} C
Monsoon	Dry Bulb 35^{o} C	Wet Bulb 29^{o} C
Winter	Dry Bulb 7^{o} C	Wet Bulb 5^{o} C

Inside

Summer	24 ± 1^{o} C	50 ± 15% RH
Winter	20 ± 1^{o} C	50 ± 15% RH

7.0 WATER COOLERS

150 litre storage capacity water coolers along with stabilizers & control units in inspection shed, workshops, canteen & other places shall be provided at strategic location depending upon the occupancy of the building.

8.0 FIRE PROTECTION, DETECTION, ALARM AND FIRE FIGHTING SYSTEM

Adequate Fire Protection, early detection, alarm and fire fighting equipment are essential for car depot and workshop including service and ancillary buildings. The design of car depot and workshop shall include provision for following:

- Fire Prevention Measures
- Fire detection system
- Fire control measures
- Access for fire engine and firemen to various locations in depot
- Means of fire fighting

1. Fire Prevention Measures

Fire prevention measures will be designed and implemented to minimize the risk of out-break of fire by appropriate location of machinery and plant, material and equipment storage.

2. Fire Detection System

The following types of smoke/fire detector shall be provided in depot and service and ancillary buildings where necessary

- Ionization Smoke Detector
- Optical Smoke Detector
- Heat Detector

3. Fire Fighting Equipment

The choice of fire – fighting equipment and its installation details shall be governed as per NFPA or as per relevant Indian Standard

4. The fire fighting as proposed for depot, services and ancillary buildings shall be as per the requirement and rules of the Local Fire Safety Authority.

Table-1

S.No.	DESCRIPTION OF BUILDING AND LOCATION	TYPE OF DETECTION	TYPE OF FIRE FIGHTING EQUIPMENT
1.	Stabling shed	NIL	i) fire hydrants with stand pipe and hose system. (Manually Actuated) ii) CO_2 portable/trolley mounted fire extinguishers
2	Inspection Bays	NIL	Portable CO_2 fire extinguishers. Portable/trolley mounted
3	Work shop area	NIL	Portable and trolley mounted CO_2 fire extinguishers.

4	Substation	Smoke detection, Alarm system	i) Portable and trolley mounted CO_2 fire extinguishers
5	DCOS Store	Early smoke detection and alarm system	i)Sprinkler system for DCOS store
6	Repair section and offices Including WM office	Early smoke detection and alarm system	i)Water hydrant and FHR ii) Portable fire extinguisher CO_2 and dry chemical Powder fire Extinguisher
7	ETU	NIL	Manually actuated CO_2 fire Extinguishers and dry chemica Powder fire Extinguisher
8	Depot Control Centre and back up control centre	Early smoke detection and alarm system	Portable CO_2 and dry chemical powder fire Extinguisher
9	Other Service and ancillary buildings	NIL	Local fire fighting with manually activated CO_2 fire extinguishers at strategic locations

Note: **External fire hydrant at strategic location around service and ancillary building shall be provided.**

9.0 DESIGN CRITERIA ELECTRICAL WORKS

9.1 POWER SUPPLIES

An auxiliary sub station along with HV switch gear & step-down transformer etc. is being entrusted for design to another system-wide contractor. The sub station will be fed through a 33 KV feeder by loop-in-loop out arrangement.

The capacity of the substation shall be adequate to support the electrical loads of all the installation inside the GREATER NOIDA Depot except the traction power. The DDC shall make the assessment and calculation of he electrical loading. The LV switchgear panel and requirement of the low voltage feeders based on his proposed design of the depot shall be designed by DDC

The system will be rated 415+-6%, 3 phase 4 wire 50 c/s. The LV cable will be connected from the main LV switchboard and from AMF cum load panel to individual load center. The power distribution on board for lighting & small power will be located at the convenient places in the respective buildings. Additional sub-main power distribution board shall be provided at strategic location to overcome excessive voltage drop in the final circuit. The power supply distribution for the small distributed load shall be grouped to achieve minimum outgoing feeders.

9.2 STANDBY POWER SUPPLY

The standby power supply through D.G. set with AMF panel at 415V 3-phase 4 wire system, 50Hz shall be provided. The capacity of the DG set shall be adequate to supply all essential loads without over loading of the DG set. The complete stand by generator installation and operation will comply with National Fire Protection Code requirement. The generator flue The generator will be equipped with fuel storage, which will have sufficient capacity to support the generator for 12-hour operation.

The maximum generator for 12 hour operation.

The AMF panel with incoming and outgoing feeders shall be capable of starting DG set in the event of main power supply failure; single phasing or low voltage

going below specified limit. Any variation of ± 10% of voltage, which also includes single phasing and power failure should be taken as unhealthy conditions.

The generator will support depots emergency load, which includes:

- Workshop and Inspection Bay Lighting
- Pumping installation
- High mast lighting
- Tower wagon shed
- Canteen
- Jib cranes
- DCOS & other stores officer chambers
- CWM office
- Pit Jacks
- Electrical Sub-Station
- Depot control center with all signaling load (without a/c)
- Officer & supervisor's chamber in workshop building.
- Complete Inspection Bay
- Covered Stabling Shed
- Computer section
- PPIO
- Fire Engine Shed
- Telecom Exchange
- Air conditioning of critical rooms.

9.3 SWITCH BOARD DISTRIBUTION BOARD FEEDER PILLARS

LV switchboard distribution board for indoor application shall be of protection class I.P.54 and that for outdoor application they shall be of I.P. 65 class.

The clearance in front of all assemblies of switchgear and control gear shall be not less than 1.2m the maximum height of the switch board shall be 2.2m. The switchboard shall be of modular design and extendable on both sides, preferably there should be separate chambers for the cables/bus-bars which are duly portioned with easy access for inspection and maintenance. Adequate protection from access to any live part inside to be ensured.

Switchgear should be designed to have adequate clearance as per the relevant standard rules for various components installed there.

The LV circuit breaker, air brake switches & miniature circuit breakers shall comply with IEC 157, IEC 408 & IEC 898 respectively.

Allowance shall be made for the provision of 25% spare capacity in switchboard cables and wire ways.

Metering Equipment

Current transformers shall be capable of withstanding the maximum short time withstand current for the value and duration specified for the assembly within which it is mounted. Test links shall be provided in the secondary connections of all current transformers to facilitate testing of instruments, meters and protection devices. These shall be so arranged as to ensure that the transformer secondary winding cannot be open circuited.

Voltmeters, ammeters, frequency indicators and power factor indicators shall comply with an internationally recognized standard.

The wiring to voltmeters and the potential coils of frequency indicators and power factor indicators shall be protected by separate fuses.

9.4 POWER FACTOR CORRECTION PANEL

Power Factor Correction Panel shall be provided and connected to the main LV panel in the substation. The automatic power factor correction panel shall be suitable for operation on 415 V, 3-phse, 4-wire, system with neutral directly earthed. The system will consist of modular rakes accommodating capacitor sub-units, switching contractor and protecting MCCB.

The PF correction panel shall have relay/Microprocessor based controllers with PF setting range from 0.5 lag to 0.5 lead. The panel shall be provided with digital PF meter, auto-manual operation facility & LED indication for various functions.

The PF correction capacitor banks shall be of suitable capacity and shall be metalised, polypropylene, self healing type, self protected by two in rush current limiting coil for switching surges and discharge resistors to reduce residual voltage less than 50 volts in one minute. The capacitors will conform to IS 2834-1986.

9.5 CABLES

The cable for use at 415 V shall be cross polyethylene (XLPE) insulated single wire armoured. Al/Cu conductor and 1100V grade cable in accordance with an approved international standard.

The cable shall be laid as per code of practice for cable laying, I.S-1255-1983. IE rules, 1956 & Indian Railways regulations for electrical crossings of railway tracts 1987.

As far as possible the alignment of cable should be decided taking into consideration the present and future requirements of other services like water supply, sewage, and telecom. The corrosive soil and water logging areas should be avoided.

Cables of different voltages i.e. HT cables, LT cables and control cables shall be laid in different trenches. Wherever power cables and telecom cables cross each other they will cross at right angle to avoid interference.

Wherever the cables are to be laid under the track they shall be laid in RCC/C1 pipes not less than1000 mm depth measured from the botto0m of the sleeper. The pipe should extend 3000mm from the center of the track on both sides.

The cable shall be laid directly in ground where it is passing open country and along the road. Open cable duct with suitable removable covers shall be provided in substations, switch room, plant rooms, DG set room; workshop and inspection's shed.

Cable route markers should be provided along the route of cable laid in the soil.

9.6 EARTHING AND BONDING

9.6.1 General

Earthing and bonding is to be designed by the Contractor in accordance with BS 7671:1992 or approved equivalent in order to protect persons and equipment from the effects of an electrical fault anywhere in the system.

The earthing system shall ensure that touch and step voltage does not exceed the safe limit.

The system should give protection both in normal and in case of fault. Earth fault leakage protection should be achieved through equipotential bonding.

The earthing shall consist of copper or stainless steel earth mats, or a network of specially drawn copper-clad steel rods bonded together, to give the necessary low impedance for an effective system. The whole of the earth resistance should have a combined resistance to earth not exceeding 1 Ohms.

Test facilities shall exist for disconnecting down conductors at earthing points to allow testing of the individual earthing points. Where aluminium tapes are employed great care shall be exercised in protecting the system components from electrolytic corrosion due to dissimilar metals being in contact with each other. Special Bi-metallic connectors shall be employed at junctions of copper and aluminium conductors. Copper air and down conductor tapes shall be PVC sheathed.

9.6.2 System Earthing

The neutral of 3 phases 4 wire system shall be earthed at sub stations by not less than 2 separate and distinct connections with each having its independent earth electrode. The electrode will be interconnected to achieve system earth resistance such that when any earth fault occurs for which system earthing has been designed to give protection, the protection gear will operate the circuit breaker, thus isolating the faulty mains or defective plant.

9.6.3 Equipment Earthing

All medium and high voltage equipment shall be earthed by two separate and distinct connections with earth; each having its own electrode. The equipment

earthing shall ensure freedom from dangerous electric shock to persons in that area and provide current carrying capacity both in magnitude and duration in case of ground fault.

The metal frame of all LT switchgear shall be connected to earth by means of two separate earth conductors.

Besides, provision of earth stations all cubicles and panels, sub panels, main distribution boards, sub distribution boards, light fixtures and fans shall be connected to earth by means of earth continuity conductor (through armour of cable and separate earthing conductors run along cable or separately from earth bus).

9.7 LIGHTNING PROTECTION

Lightning protection shall be designed to a high standard in accordance with local regulations (or a recognized approved standard such as BS 6651: “Protection of Structures against Lighting”).

Concrete structures shall employ roof tapes (air tapes) while steel structures may use the structural steelwork frame as a collector and as a down conductor system. The lightning conductor and earthing system shall be designed to conduct lightning discharges without damage or injury to personnel, structures or the conductor system.

9.8 LIGHTING

9.8.1 General

General lighting shall be provided in all areas of the Depot Extension part. Lighting system

Requirements associated with electrical system and equipment shall comply with the relevant latest versions of the following standards.

BS 8206	Lighting for Buildings
BS-EN60598	Road Lighting

The type and quality of fittings and their luminous shall relate to the space being illu8minated and will take in to account the effect of architectural space concept and colours scheme. Light level shall be uniformly distributed throughout the relevant area and shall be designed such that flare, dark recesses and areas of poor lighting levels are avoided.

9.8.2 Inspection Pit Lighting

Inspection pit lighting shall be provided in all the inspection pits at suitable spacing to give adequate illumination for inspection of the under gear of the rolling stock.

9.8.3 Outdoor Lighting

Outdoor yard lighting shall be provided by using high mast of 30m height at suitable locations to avoid glare and long shadows. Floodlights can also be provided on the workshop and Inspection shed structures. Lighting levels shall be of 16-30 lux. The lux level on points and crossings will be maintained at 30 lux.

The high mast shall be designed in a manner so that it is capable of withstanding the forces exerted on it by wind speed specified in the S 875 with an adequate load factor. The mast shall comprise of 3 section with minimum length of 10m each mast section shall have only longitudinal welds & not have any circumferential welded points. Steel to I S 226/BS4360 shall be used for the construction of the mast. The lantern carriage shall be of mild steel in the form of a ring split on the one diameter enabling it to be assembled or removed from the shaft after erection. Each mast shall be provided with double drum winch. Power winch shall be driven by 3 phase 415V reversible A/C motor & it shall have remote control unit for operation to provide safety to operational personal.

The street lighting for security patrolling shall be provided by using HPSV street light luminaries. Where necessary street light luminaries shall be provided on the building structures also.

Tentative outdoor lighting arrangement is shown in depot lay out drawing no. RC/Depot cum Workshop layout/001 sheet no. 1 of 2.

The outdoor light shall be controlled with the help of 24 hr dial time switches and light sensitive switches. The switches shall be provided with "on-off" by-pass switches to completely override preset switching functions.

The illumination level in various indoor and outdoor areas shall be as given below:

S.	AREA	ILLUMINATION LEVEL	
		GENERAL	LOCALISED
1.	Workshop Bays	300	-
2.	Inspection Bays	300	-
3.	Repair & Overhauling Sections	300	500
4.	Offices & Conference Room, PPIO, Computer room, Classroom	300	500
5.	Sub stations, Switch Room, Plant & equipment control area, Pump house, Compressor room, DG set room	150	-
6.	Clock room, Bath room, toilets, locker room	100	-
7.	Store ward	100	-
8.	Paint Shop	300	-
9.	Covered Stabling Lines	100	-
10.	Covered Stabling Lines & Relief train SDI	16	-
11.	Canteen (Kitchens) (Dining Hall)	150 200	-
12.	Heavy Washing Line	50	150
13.	Stair Case	100	-
14.	General security Lights	15	-
15.	Points & Crossings	30	-

9.9 INTERNAL WIRING

The wiring in the workshop, inspection shed and associated buildings shall be in recessed conduit wiring system with rigid steel conduits. The conduit shall comply with 3S 4568 or approved equivalent and shall be of screwed classification. The minimum size of the conduit shall be 30 mm Dia. The conduit shall not be of gauge less than 16 SWG for conduit up to 32 mm dia and not less than 14 SWG above 32 mm dia.

The concept of Point Wiring Circuits and Group Wiring shall be followed depending upon the requirement, type of Point Wiring Circuits and Group Wiring shall be followed depe3nding upon the requirement, type of installation and electrical load.

I. Point Wiring

For Point Wiring of light, fans and plug socket, the length of conduit from Distribution/Sub. Distribution Board upto farthest fitting shall constitute point. The Point Wiring shall be sub-divided into short point, long point and extra point depending upon the length of conduit upto 2, 5, 8.5 & 12m respectively

II. Group Circuit

The Group Wiring circuit shall be subdivided into short-way, medium-way, long-way and extra-long-way depending upon the length of Conduit from distribution/sub distribution board of 30, 60, 100 & 150m.

9.10 24 V HAND LAMP

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9.11 PORTABLE MACHINE SOCKETS

The 15 A single-phase socket for transportable M/c shall be ironclad switch-cum-plug unit. They shall be provided at a distance of 20 m in the workshop bays, inspection bays and repair & overhauling section. Three phase power outlets for welding machine shall be provided at a distance of about 40m in the inspection & workshop bays.

9.12 PUMPS

9.12.1 General

To meet the requirement of the water supply a submersible pumps of adequate capacity shall be provided with 100% standby. One pump shall be able to pump the total requirement of the water in 12 hours. The pump shall be of submersible type conforming to I.S 8034-1976. All accessories to the pump will conform to respective Indian standard. The motor fitted with submersible cable of suitable type. The motor shall conform to I.S. 9283-1979 & I.S. 325-1987, latter as far as it can be applied to submersible motor. The motor rating shall be 10% higher than the maximum BHP required by the pump. The motor should not be overloaded throughout the working range of pump even when voltage is as low as 350V.

9.12.2 Control Panel

The control panel shall be complete with auto start/stop control gear and level guards. Up to 7.5 HP the starter shall be air break AC/3 category, heavy duty, DOL, starter with over load/under voltage protection release. Above 7.5HP the starter shall be air break AC/3 category, heavy-duty auto transformer starter.

10.0 ACCESS CONTROL

The Access control system will be required to control entry and exist of personnel from the following areas:

- External Areas of the Building
- All Public areas inside the workshop
- Monitor intrusion at various strategic locations.

The system shall utilize Proximity Cards which will be issued to both staff and visitors, to monitor flow of the people. All doors to and from public areas shall be equipped with readers and automatic electric magnetic locks. The system shall, depending on the coded information on the Proximity cards, allow the persons access to certain parts of

the building.

The system shall have facility to generate attendance statement of staff regularly employed in a building.

The system shall have a provision of interconnection to Fire System and shall automatically open in condition of Power Failure of the Access control system or in case of fire detection.

The system shall consist of Daisy wheel chain connected Door controllers, Door Position detectors and card readers with keypads to press access code or finger print reading in addition to the Access cards. The entire system shall be console operated

S. No.	DESCRIPTION OF BUILDING & LOCATION	TYPE OF ACCESS CONTROL
1.	Stabling shed	NIL
2.	Inspection Bays	Access Control for Attendance only
3	Work shop area	Access Control for Attendance only
4	Substation	Access Control
5	DCOS Store	Access Control with Integration to Attendance as well as double confirmation with Finger Print reading or in Access code
6	Repair section and offices including WM office	Access Control with integration to Attendance
7	ETU	Access Control with integration to Attendance
8	Depot Control Centre and back up control centre	Access Control with integration to Attendance as well as double confirmation with Finger Print reading or an Access code.
10	Other Service and ancillary	Access Control with integration to Attendance