

Bid invitation

Information

Description: Tender for Bhopal Rail Plant

Bid invitation number: 6300040354

Version: 1

Bid invitation rules

Bid invitation currency: INR

Timezone: INDIA

Submission period: 10.03.2026 13:00:00

Tech Opening date: 10.03.2026 13:30:00

Created On: 10.02.2026 14:04:43

Bid invitation text:

NAME OF THE WORK : : Engineering, Procurement & Construction pertaining to establishment of Rail coach factory including Civil Construction of manufacturing blocks, testing bay, other utility buildings (Non factory buildings), Railway Track sidings, water supply and distribution System, Roads, Drainage and sewerage systems, General Electric works including regular and emergency power supply and distribution system, related installations & services (Fire, Gas, Compressed air, IT, BMS, etc.), MFA (Miscellaneous fixed assets) and other Land & Site development works including grading, levelling works in connection with setting up of a Rail Coach Factory hereinafter referred as BEML RAIL HUB FOR ADVANCE MANUFACTURING (BRAHMA) near Umaria village, Obaidullaganj, District- Raisen, Madhya Pradesh (India) PIN code 464993 on EPC Mode.

Bids should be only on SRM Portal. (Quotations sent by Fax / Email / Quotations on letter heads or in any other mode will not be considered). Conditional offers are liable for rejection.

TENDER CLOSING DATE : 10.03.2026.

Earnest Money Deposit (EMD) :

EMD Amount Rs.13,14,04,465

FIRST PRE BID MEETING : DATE OF First - PRE-BID MEETING IS SCHEDULED ON 18-02-2026 @ 10:30 HOURS.

Date of Second Pre-bid meeting is scheduled on ON 28-02-2026 @ 14:30 HOURS.

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Contact Person : For Civil Engineering related issues , Technical specification & Drawings contract : Mr. Nagendra Mishra , Project Manager , Rail plant Bhopal (Mobile- 8310857967)

CIVIL Maintenance Rail plant Bhopal- Mr. Vinodh (Sr. Manager, Rail plant, Bhopal) (Mobile- 8285252187)

QUOTE: LUMPSUM VALUE WITH GST TO BE QUOTED ON SRM COMMERCIAL BID ONLY.

BOQ; Bill of Quantities are as per NIT & BOQ (PDF File) for your reference & to arrive at the Total contract Value including GST. Firm to submit breakup for the same
Signed filled BOQ to be uploaded in SRM PORTAL at 'Notes & price attachments' only, No Price documents as a part of technical bid under "C-folder technical attachments " otherwise bid will be rejected.

For details refer NIT Document

Order shall be finalized as per QCBS Formulation
Completion period- 18 MONTHS from work commencement.

PAYMENT TERMS : As per NIT

Bidders are requested to indicate / select SRM code = L046 (100% payment against certification of user departments) while quoting Bid.

NOTE :

Bidders are advised to check corrigendum if any and up loading the signed with seal corrigendum's are mandatory for Technical Evaluation of the Bid. This Letter + Tender document + Corrigendum if any, will be part of the contract.

Please contact BEML SRM Team for getting user ID & password / clarification during the submission of bid through SRM / guidance on submission of bid in SRM system. Phone : 080-22963269 e-mail ID : admin.srm@beml.co.in, anithak@bemlltd.in

For any tender related clarification, please Mr. Atul Thombre, Sr. Manager, Rail plant, Bhopal (9632270759) Mail- atulthombre@bemlltd.in

NO PRICE SHOULD BE INDICATED IN TECHNICAL BID.

General Information while uploading Docs in SRM

a. Use Edge Browser with Internet Explorer mode ONLY for SRM portal.

b. SRM Portal Link : <https://bemlepci.bemlindia.in:50001/irj/portal>

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c. Mail to admin.srm@beml.co.in / anithak@bemltd.in for creation of SRM User Credentials
After Logging in, search for the tender.

d. Open the tender, click on "Technical Rfx" to download the tender documents.

All necessary training manuals are available in the link for ready reference

<https://www.bemlindia.in/eprocurement/Valid> Class 3 Organization Digital Signature with Signing and Encryption certificate is mandatory for submission of bid in SRM e-Procurement System.

General Note :

(a) Bidders are suggested to upload all documents well in advance before closing date not resorting to last date last minute uploading, which may result in improper / missing of documents uploading.

(b) Bidder has to submit all the requisite documents for qualifying in Technical bid. It is Recommended to cross check all the documents against the list after uploading on SRM to ensure that all the necessary documents are correctly uploaded.

(c) In case any of the required documents are not submitted / uploaded by the bidders/ if clarity in documents are not found, BEML reserves the right to reject the bid. Decision of BEML in this regard will be final and binding.

(d) To have better clarity and easy identification, bidders are advised to upload the documents separately by giving appropriate names, i.e.,

(1) For signed & sealed NIT Acceptance letter – FILE NAME = NIT_AL_Signed & Sealed

(2) For Annual Turnover certificate – FILE NAME = Annual Turnover, etc., Do not club all the documents in one single file.

General Note :

(a) FIRM has to study and understand complete scope of Work and Terms & conditions before quoting the tender.

(b) Subject contract comprises of full and satisfactory completion of the works as per the Bill of Quantities, Terms and conditions.

(c) Scope of work as per NIT to be executed all as per instructions / directions of Contract in-Charge of Civil Maintenance /Electrical Maintenance/Project Manager, Rail plant Bhopal.

Please quote lump-sum charges inclusive of all taxes.

Attachments:

SOIL_REPORT

FURNITURE_DETAILS

DRAWINGS

DESC_OF_FACILITIES

COLOUR_CODES

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Attachments:

BOQ

ANNEXURES_OF_NIT

NIT

Bid invitation details

Item	Product Price Condition	Description	Vendor product number	Delivery date/ performance period	Quantity
1		CIVIL & MEP TENDER FOR BHOPAL RAIL PLANT			1 NO
	Basic Price		INR		

BEML LIMITED

A Govt. of India Mini Ratna Company under Ministry of Defence)

BEML RAIL HUB FOR ADVANCE MANUFACTURING (BRAHMA), BHOPAL- MADHYA PRADESH

TENDER DOCUMENT

Title : Engineering, Procurement & Construction pertaining to establishment of Rail coach factory including Civil Construction of manufacturing blocks, testing bay, other utility buildings (Non factory buildings), Railway Track sidings, water supply and distribution System, Roads, Drainage and sewerage systems, General Electric works including regular and emergency power supply and distribution system, related installations & services (Fire, Gas, Compressed air, IT, BMS, etc.), MFA (Miscellaneous fixed assets) and other Land & Site development works including grading, levelling works in connection with setting up of a Rail Coach Factory hereinafter referred as **BEML RAIL HUB FOR ADVANCE MANUFACTURING (BRAHMA) near Umaria village, Obaidullaganj, District- Raisen, Madhya Pradesh (India) PIN code 464993 on EPC Mode.**

Tender Notice No.	6300040354 Date: 10.02.2026
Approx. Estimated Value.	Rs. 657,02,23,268.00 In Words- Rupees. Six hundred fifty seven crore two lakhs twenty three thousand two hundred sixty eight only
EMD (Earnest Money Deposit)	Rs. 13,14,04,465.00 In Words- Rupees Thirteen crore fourteen Lakhs four thousand four hundred sixty five only
Completion Period	18 Months
Initial Pre bid Meeting at BEML, Bhopal	18.02.2026 at 10.30 Hrs
Final Pre bid Meeting at BEML, Bangalore Complex	28.02.2026 at 14.30 Hrs
Due Date & Time for Submission of Tenders	10.03.2026 at 13.00 Hrs
Date & Time of Opening of Technical Bid	10.03.2026 at 13.30 Hrs
Defect liability Period	Two Years from the date of final handing over completed project.
Date of Bidders presentation	Presentation, as part of QCBS evaluation, to be made by the

	bidders team within 3 working days from the date of communication from BEML

Address for Communication - Interested eligible Bidders may obtain further information from the following address-

1. Atul Thombre, BEML Ltd, Sr. Manager, Rail Plant Bhopal, Chittod Complex, Zone-1 MP Nagar, Bhopal, Pin-462011

E-Mail atulthombre@bemltd.in (9632270759)

2. Nagendra Mishra, BEML Ltd, Sr. Manager, Rail Plant Bhopal, Chittod Complex, Zone-1 MP Nagar, Bhopal, Pin-462011

E-mail - nagendra.mishra@bemltd.in
(8318667229)

Quotations are invited from reputed & capable EPC contractors for the tendered work as above.

Quotations should be submitted online (E-mode) in SRM Portal of BEML, Ltd in 02-Bid system as below:

- 0 **Technical Bid (Part-A, A1) – through e-mode (BEML SRM portal)**
- 0 **Financial Bid (Part-B - through e-mode (BEML SRM portal)**

Note:

- 1) The selection of suitable bidder shall be through Quality & Cost Based Selection (QCBS) process. Financial bids of only technically acceptable firms with score more than 70 out of 100 marks against stipulated criteria will only be opened and considered for further evaluation by BEML.
- 2) No Financial terms to be indicated in the technical bid else the offers of such bidders will be summarily rejected and not considered for further Financial evaluation.
- 3) The intending bidders should only submit their Bid if they consider themselves meeting the eligibility and qualification criteria.

• **TYPE OF TENDER**

The tender consists of two parts: -

Sl. No	Nature of Bid	Mode of Submission	RFP
1	Technical Bid	E-mode (BEML SRM Plat form)	Technical Bid Submission
2	Financial Bid	E-mode (BEML SRM platform	Financial Bid Submission

BEML to receive Bids comprising of Technical Bid and Financial Bid through e-mode SRM portal from prospective Bidders desiring to be selected as Contractor for construction of manufacturing blocks, testing bay, other utility buildings (Non factory buildings), Railway Track sidings, water supply and distribution System, Roads, Drainage and sewerage systems, General Electric works including regular and emergency power supply and distribution system, related installations & services (Fire, Gas, Compressed air, IT, BMS, etc.), MFA (Miscellaneous fixed assets) and other Land & Site development works including grading, levelling works in connection with setting up of a Rail Coach Factory near Umaria village, Obaidullaganj, Disrict- Raisen, Madhya Pradesh (India).PIN code : 464993

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1. NOTICE INVITING TENDER (NIT) WITH INTRODUCTION, SITE DESCRIPTION & ITS FEASIBILITY

Introduction, Site Description & its feasibility

A. BRIEF ABOUT BEML:

BEML Limited is a leading multi-technology Schedule-A company under the Ministry of Defence, playing a pivotal role in serving India's core sectors like Defence & Aerospace, Rail & Metro and Mining & Construction through its world-class product portfolio. The company operates four state-of-the-art manufacturing facilities located at Bangalore, Kolar Gold Fields (KGF), Mysore and Palakkad, supported by a strong R&D infrastructure and a nationwide sales and service network. All manufacturing divisions are accredited with ISO 9001:2015 and ISO 14001:2015 certifications.

BEML's strategic direction is closely aligned with the national 'Make in India' initiative aimed at driving sustainable GDP growth through indigenous capability development. From its modest beginnings in 1964, manufacturing and supplying rolling stock to Indian Railways at its Rail Coach Factory, the company has evolved to design and manufacture sophisticated metro rail coaches, advanced equipment for the Indian Army, and a wide range of mining and infrastructure machinery.

With a strong focus on customer satisfaction, BEML has established a robust after-sales and service ecosystem comprising 12 Regional Offices, 15 District Offices, 7 Service Centres and 5 Parts Centres across the country, and continues to expand its presence overseas.

Across its business verticals, BEML offers a comprehensive range of products:

- Rail & Metro: Vande Bharat sleeper coaches, EMUs, metro cars, and maintenance and utility vehicles.
- Defence & Aerospace: High mobility and recovery vehicles, bridge systems, missile project vehicles, mine marking equipment, armoured recovery vehicles (including for Arjun MBT), tank transportation trailers, power packs for battle tanks, military rail wagons, mine ploughs, crash fire tenders and aircraft towing tractors.
- Mining & Construction: Bulldozers, excavators, dumpers, rope shovels, walking draglines, loaders, water sprinklers, motor graders, pipe layers, tyre handlers and C-cranes.

1.1. BACKGROUND

BEML, a Schedule 'A' PSU, has consistently demonstrated agility in responding to market requirements. Over the years, the company has continually transformed itself by strengthening its core business areas while simultaneously diversifying into adjacent

opportunities. To accelerate growth and ensure sustainable financial performance, BEML aims to significantly scale up its operations by further reinforcing and expanding its core businesses, as well as pursuing new and adjacent opportunities with a strong focus on exports and globalization. The vision is anchored in the national objective of 'Atmanirbhar Bharat' (self-reliance).

BEML limited is a premier heavy engineering manufacturing company working in India for more than 50 years. The company is a Public Sector Schedule 'A' Company Undertaking under the Ministry of Defence, Govt of India. BEML Limited (formerly known as Bharat Earth Movers Limited) as a full-fledged corporation was established in 1964 with Bengaluru Complex as the mother unit. The Bengaluru Complex (the then Rail Coach Factory) was in existence from 1947 as a part of Aircraft Factory (currently Hindustan Aeronautics Limited). Initially, the division was manufacturing Rolling Stock producing various models of Broad-Gauge Coaches.

Aligned with this overarching strategy, BEML is in the process of developing a Detailed Project Report (DPR) for establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh, to cater to Commuter Rail and Metro Cars, covering Car Body, Bogie, Interior & Exterior Furnishing, Assembly and Testing facilities.

B. PROPOSED WORKS:

To meet the growing business requirements, the proposed work is tendered on ***EPC Mode (Design and Build basis).***"

The proposed master Layout of Manufacturing facility is enclosed in 'Drawings'. Area of around 148 Acres (approx)

The work shall be executed on EPC Mode (Engineering, Procurement & Construction) which includes land survey, soil testing, design & engineering, construction, supply , Installation, commissioning & Handing over of manufacturing facilities with required systems and services including liaisoning work to facilitate BEML for getting all local body clearances viz., obtaining commencement certificate, completion/occupancy certificate, or/and any other legal/statutory compliance which is required for operation of business as per the scope of this NIT Consents to establish and operate from pollution control board in accordance with the requirement of project as enumerated in the tender, enclosed drawings (Plan, Architectural, Elevation, section, etc.) and broad specifications mentioned therein.

C. SITE FEASIBILITY

The project BRAHMA is located at Obaidullaganj, approximately 30 km south-east of Bhopal City, in Raisen District, Madhya Pradesh. Nearest railway station is Obaidullaganj. Its distance from the site approx. 3.15 km. Nearest airport is Raja Bhoj Airport, Bhopal. Its distance is 53 km from the site.

Based on the Topographic survey (Report Enclosed Annexure -A) conducted, it was found that the entire project area is a barren rocky field with elevation varies from EL +446 m MSL to EL +473 m MSL.

Further the Soil investigation report (Report Enclosed Annexure -A1) indicates the presence of moderately weathered (Grade-III)/ slightly weathered (Grade-II) fine to medium grained quartzite (Layer-IA) right from the top of existing ground level. The field data and laboratory test results evaluated at all the bore hole locations reveals that the strength of underlying rock below the foundation are very high, which is generally expected to be significantly higher than the design requirement.

Shallow foundation may be provided at a depth of 0.6m to 1.0m inside Layer-I

(a) to carry the load from superstructure.

(b) The suggested safe bearing pressure of different sizes of footings when placed at 0.6m to 1.0m below the existing ground level may be taken as 40 t/m².

Since no water table has been encountered in the explored boreholes, foundation embedded in rocky stratum is less vulnerable to chemical attacks. The results of chemical analysis of water sample collected from approximately 90m depth below ground level from the existing nearby Submersible Pump shows that the water is not harmful. Therefore, no special cement or treatment is required in concrete. However, concrete to be used in foundation construction should be in line with recommendations of IS:456 – 2000.

A detailed elaboration on Site characteristic has been depicted in Annexure -A1) and the same may be referred to for further appreciation. The Site is feasible for construction considering the terrace level of plant building at MSL 458.6m.

D. General Instructions to Bidders

The Bidders are advised to carefully go through, read and understand this tender documents completely including terms and conditions, Annexures and Appendices etc. before submitting bids.

- a. This NIT is not transferable under any circumstance.
- b. All entries in the NIT shall be in English either typed or written legibly. Erasing, over-writings and use of correction fluids are not permitted. All cancellations and insertions should be duly signed / attested by bidder concerned.
- c. All the corresponding documents shall be attached along with the quotation/offer in first go.
- d. Late and/or incomplete bid shall not be considered.
- e. Canvassing in any manner including unsolicited letters and request for post tender corrections shall render offers of such parties liable for rejection.
- f. Bidder shall ensure that all the information & documents submitted by them are true & correct.
- g. In case, it comes to the knowledge of BEML that the bidder has submitted false information before awarding of contract then the offer would be rejected.
- h. In the event, it comes to the knowledge of BEML that the successful bidder has submitted false information, subsequent to the award of contract, the contract shall be cancelled/short closed by the company and shall invoke Risk purchase clause with liabilities on such bidder for the entire contract quantity. The PBG shall also be encashed as a result of consequence of breach of contract at the discretion of BEML.
- i. In case any person/persons, Company, firm, Associations having any litigation, arbitration cases between themselves and BEML Ltd, pending before any court of law/ Arbitrator shall not be eligible to participate in this tender.
- j. Non-compliance with any of the tender conditions, incomplete offers, conditional and ambiguous offers are not acceptable and liable for rejection.
- k. The bidder shall fill in all the required particulars in the blank space provided for the purpose in the tender document.
- l. All the documents shall be uploaded in SRM Portal.
- m. Fax/email quotations are not acceptable.
- n. BEML reserves the right to accept or reject all tenders or any tender in part or full without assigning any reasons thereto, which is final & binding on the Bidder.

This tender document is available on BEML SRM e-portal (i.e. <https://bemlepci.bemlindia.in:50001/irj/portal>)

BEML website (www.bemlindia.in) & CPPP portal for downloading and study of documents. **However potential bidders have to submit their bids in BEML SRM e-portal only.** Bidders willing to participate in the tender may contact through e-mail: admin.srm@beml.co.in to obtain the user name & password for submitting the bids.

In case of any queries relating to bid submission, you may send the same by e-mail to admin.srm@beml.co.in & anithak@bemltd.in you may contact BEML SRM Team on phone no. 080- 22963269/141 on working days from Monday to Friday (9 AM to 5 PM) or atulthombre@bemltd.in

Note: To participate in this e-tender bidder should have a valid Class III Organization Digital Signature with Signing and Encryption issued by authorized Certifying Authority.

1.1 Clarifications

A bidder requiring any technical / document clarification may obtain clarification during pre-bid meeting or may email to nagendra.mishra@bemltd.in & atulthombre@bemltd.in & before tender closing date.

- 1.2 **Site visit for the subject tender is mandatory-** The tenderers shall visit the site and acquaint themselves of the prevailing local conditions, soil conditions, geography of the area etc., before submitting their bid. The bidder may visit the site at their own responsibility and cost to understand the scope of work and acquaint themselves of the prevailing local conditions before submitting their bid. Bidders shall not have any claim against BEML on these accounts at any time with regard to their site visit. Bidder have to enclose a certificate issued by the authorized officer of BEML Bhopal at site for having visited the site or else the offer may be liable for rejection.

For visiting the Site, the bidder shall contact the following officer.
District Head - BEML Bhopal, Mr. Nagendra Mishra. (8318667229)

E. Requisite of Bidders:

Subject to provisions in the Tender Document, participation in this Tender Process is open to all bidders who fulfil the 'Eligibility' and 'Qualification criteria'. Bidder should meet the following requirements.

- a. The Bidder shall be any Private, Public, Quasi Govt, PSU, Govt Organisation and must be a registered company/entity with valid GSTIN, PAN, ESI, PF & CIN etc.,
- b. Bidder must fulfil qualification criteria of tender.
- c. Must not be insolvent, in receivership, bankrupt or being wound up, not have its affairs administered by a court or a judicial officer, not have its business activities suspended and must not be the subject of legal proceedings for any of aforesaid reasons.
- d. Bidder must not be stand declared ineligible/ blacklisted/ banned/ debarred by the Procuring Organization or its Ministry/ Department from participation in its Tendering Processes. **(Annexure-13 A)**
- e. Bidder must not be convicted (within Five years preceding the last date of bid submission) or stand declared ineligible/ suspended/ blacklisted/ banned/ debarred by appropriate agencies of public sector undertaking/Government of India from participation in Tender Processes of all of its entities, for: **(Annexure 13)**
 - i. offences involving moral turpitude in business dealings under the Prevention of Corruption Act, 1988 or any other law; and/or
 - ii. offences under the Indian Penal Code or any other law for causing any loss of life/ limbs/ property or endangering Public Health during the execution of a

public procurement contract and/ or

- iii. suspected to be or of doubtful loyalty to the Country or a National Security risk as determined by appropriate agencies of the Government of India.
- f. Bidder must not have changed its name or created a new "Allied Firm", consequent to having declared ineligible/ suspended/ blacklisted/ banned/ debarred as above.
- g. Bidder must not have an association (as a bidder/ partner/ director/ employee in any capacity) of any retired personnel (of Gazetted Rank) or any retired Gazetted Officer of the Central or State Government or its Public Sector Undertakings if such a retired person has not completed the cooling- off period of one year after his retirement. However, this shall not apply if such managers/ officers have obtained a waiver of the cooling- off period from their erstwhile organization.
- h. Bidder must not have an association of the near relations of executives of BEML involved in this Tender Process.
- i. Bidder must not have a conflict of interest, which substantially affects fair competition. The prices quoted should be competitive and without adopting any unfair/unethical/anti-competitive means. No attempt should be made to induce any other bidder to submit or not to submit an offer for restricting competition.
- j. This NIT, Purchase Order or any agreement hereinafter, shall not create an employer or employee relationship between the parties, its employees, agents, sub- contractors or alike, of any nature whatsoever.
- k. The successful bidder shall hold BEML indemnified and harmless against any or such acts or omissions of its employees, agents, sub- contractors or alike, of any nature whatsoever.
- l. Bidder must not have any litigation or arbitration, with respect to breach of contract, pending against BEML.

2. SUBMISSION OF BIDS IN SRM PORTAL & ELIGIBILITY AND QUALIFICATION CRITERIA

A. Submission of Bids:

Tender is in Two-BID system (Technical & Financial Bid).

(Technical & Financial Bid) Bids should be submitted e-mode (SRM Portal) only as follows:

B. Pre-Bid Meeting:

Initial Pre-bid meeting - The bidder or his authorized representative with the authorization letter of the firm is invited to attend the PRE-BID MEETING which will take place at BEML Ltd., Ground Floor, Chittod complex, Zone-1 MP Nagar, Bhopal Pin-462011 on date & time as stated in the Tender.

The purpose of the Pre-Bid meeting is to clarify issues related to the tender and to address queries on any matter that may be raised at that stage.

Final Pre-bid meeting shall take place specified date & Time at BEML Ltd, Bangalore Complex.

C. Pre-Bid Meeting:

Initial Pre-bid meeting - The bidder or his authorized representative with the authorization letter of the firm is invited to attend the PRE-BID MEETING which will take place at BEML Ltd., Ground Floor, Chittod complex, Zone-1 MP Nagar, Bhopal Pin-462011 on as stated in the Tender.

The purpose of the Pre-Bid meeting is to clarify issues related to the tender and to address queries on any matter that may be raised at that stage.

Final Pre-bid meeting shall take place specified date & Time at BEML Ltd, Bangalore Complex.

D. Submission of Technical Bid (Through e-mode on BEML SRM system)

The technical bids shall be uploaded in SRM e-portal only.

Please upload the following scanned documents in the Collaboration Folder in the E-portal as part of Technical Bid. Bidders will be technically qualified based on providing documentary proof for each of the eligibility & qualification criteria clause. If bidder is not complying for these clauses or not uploaded required documents, their bid will be liable for rejection.

Final technical acceptance of the bid will be based on the documentary evidence and if a bidder fails to upload/provide documentary evidences, in such cases bid will be rejected.

Bidders will be technically qualified based on providing documentary proof for each of the below

mentioned documents in Technical Bid.

This is an E-mode of Tendering through SRM and evaluation shall be done on QCBS Method and Complete Process as explained here under the heading **Evaluation & qualification criteria**. Any manual or technical errors committed before uploading or during the process of uploading the Document shall bound to be duly accepted by the Bidders. The Bidders shall not have claim whatsoever in this regard.

The Experience and requisite Documents should be in the name of Bidder only and prior experience as any other business entity and / or requisite documents in the name of any other business entity shall not be considered.

E. EVALUATION AND QUALIFICATION CRITERIA

Bidders has to upload all supporting documents duly self- attested with seal along with the Tender for the following criteria failing which offer is liable for rejection

Technical Bid (PART – A)- Pre-Qualification

SN	PARTICULARS	BEML'S REQUIREMENT (To be submitted)	Remarks
ENVELOPE – A - Pre-Qualification			
1	Check List	Annexure-1	To be submitted Thru SRM portal
2	Earnest Money Deposit (EMD)		
3	Bid form	Annexure-2	
4	General Declaration Certificate	Annexure-3	
5	Financial Capacity of Bidders	Annexure-4	
6	Power of Attorney	Annexure-5	
7	Integrity Pact Agreement	Annexure-6 Annexure-J1	
8	Bid Guarantee format (for submission of EMD other than online payment/DD/Bankers Cheque)	Annexure-7	
9	Compulsory site visit certificate issued by BEML	Annexure-8	

Technical Bid Part-A (Pre-Qualification) bid should have following documents, The bidders shall mandatorily meet all of the following criteria to be eligible to participate in further evaluation.

- 1) Earnest Money Deposit (EMD)
- 2) Information in the prescribed format as in (Annexure-2 to Annexure-4- i.e Bid form, General declaration

form, Financial capacity of the bidders) and supporting documents.

- 3) Power of Attorney for Signing of Bid in Annexure-5.
- 4) Integrity Pact Agreement – Annexure-6 & J1
- 5) Bid Guarantee format (for submission of EMD other than online payment/DD/Bankers Cheque) -Annexure-7

The bidder should have at least an average annual turnover in India of INR 197.10 Cr. from contract execution (engineering & construction works) during the last three years, 2022-23, 2023-24 & 2024-25. Documents to be submitted: Audited Balance Sheet and Profit & Loss Account indicating annual turnover duly certified by the authorized signatory or; Certificate from statutory auditors indicating the annual turnover of the bidders. Information to be submitted as per Annexure-4

Note:

- (i) The Bidders must ensure that the documentary proofs to substantiate clauses above are given, without which their bid will not be considered.
- (ii) Relevant documents are to be meticulously uploaded by the bidder as part of the technical bid.
- (iii) Please ensure that no price details are mentioned in the technical bid. Offers with price details in Technical Bid will not be considered & liable for rejection.
- (iv) Incomplete/invalid tenders will be rejected and no correspondence will be entertained in case of rejection.

F. Technical Bid – Part–A1 (Quality and cost based selection)

S no.	Eligibility Criteria	Supporting Documents
1	Bidder has to upload the compliance of Scope of work as indicated in Annexure – 9	Upload compliance for scope of work as per Annexure-9
2	Bidder has to upload the compliance of Bill of Quantity (BOQ) As indicated in Appendix – C	Upload compliance for BOQ as per Appendix – C (Signed scope to be uploaded as token of compliance)

3	Must be Indian Registered Company under Companies Act 1956/ Public or corporation, registered with the appropriate government authority as / Limited company/ Private limited company/ and shall be in the Construction business for at least last 5 years (LLP, Proprietorship or Partnerships and Joint ventures are not allowed)	Copy of the incorporation / registration certificate clearly indicating the nature of business.
2	The bidder should have valid Class I contractor enlistment with Central / State Government department for civil works. And The agency themselves should have a valid Electrical contractor licence of appropriate voltage issued by any state Govt. Under clause 45 of Indian Electricity Rules 1956 or as amended from time to time. Or Should engage an Electrical Contractor for execution of Electrical Work, who has the above mentioned Licence and requisite experience. In such case, the main agency shall give an Undertaking in the Technical Bid that he would engage an Electrical Contractor who possesses a valid Electrical contractor licence of appropriate voltage issued by any state Govt. Under Clause 45 of Indian Electricity Rules 1956 or as amended from time to time. The clause shall be incorporated in the tender documents.	(Please submit the proof of the same.)
3	Original Authorization Letter to sign the Tender/Power of Attorney to sign the Tender	Annexure-5
5	Letter of Transmittal on bidder letter Head to submit Technical Bid	(Annexure-11)
6	Must possess a valid CIN GST, PAN, ESIC, EPFO number	Copies CIN, GST, PAN, ESIC, EPFO, ESI / PF details to be enclosed
7	Name, Address, details of the Organization, Name(s) of the Owner/Partners/Promoters and Directors of the firm/company.	(Annexure-12)
8	Bidder should not be blacklisted/ debarred by any government/ semi government department/ PSU. Bidder should submit the declaration of not being ineligible for corrupt or fraudulent practices.	(Annexure-13 & Annexure- 13A)

9	Letter of understanding the project site on bidder letter Head (Site Visit certificate)	ANNEXURE-8
10	Contact details of supplier	(Annexure-12)
11	NIT ACCEPTENCE LETTER: Letter has to be uploaded by the bidders stating that they have read, understood and agreeing to all tender terms and conditions of the tender.	(Annexure-15)
12	Average annual financial turnover on similar work should be at least Rs. 197.10 Crores Only during the immediate last three consecutive financial years ending 2024-25. The turnover, profit, net worth certificates must be certified by Statutory Auditor of the firm/company	Annexure-4
13	The Contractor should not have incurred any loss in more than 2 years in last five financial years. This should be duly audited by Chartered Accountant. Any such certificate must carry UDIN (Unique Document Identification Number).	Annexure-16
14	The bidder should have a solvency of an amount of Rs. 262.80 Crores. The solvency certificate should be from a Nationalized I Scheduled bank and must have been issued after the date of publication of NIT & be addressed to the tendering authority quoting the name of the work. The solvency certificate should not be dated beyond the last date of submission of the bids. The certificate should carry the name, designation & power of attorney number of the bank official.	

15	The contractor should have satisfactorily completed the works as mentioned below during the last seven years ending previous day of last date of submission of tender. One similar* completed work costing not less than 80% of the estimated cost of work Or Two similar* completed works of order value each not less than 50% of the estimated cost of work Or Three similar* completed works of order value each not less than 40% of the estimated cost of work	Annexure-18
16	The Bidder should have successfully completed an industrial project during last 07 Executed on design and build basis with total construction area (Built up area) of Industrial Shed and RCC Buildings combined together should not be less than 82,150 Sqm (Design and Build.	Annexure-18A
17	The Bidder should have executed steel fabrication work to the tune of minimum 16,000 MT in a single completed contract.	Annexure-18B
18	The bidder should have executed RCC Work to the tune of minimum 50,000 CuM in a single contract.	Annexure-18C
19	The Bidder should have the credential of having executed civil constriction works of similar nature (Involving Fabrication and /or RCC) of minimum value of Rs.25 Crore per month on an average in a completed contract of similar works. (This should be the billing amount against works and not the advance received, if any) Substantial documentary evidence to be provided in support of above	Annexure-18D

20.	The Bidder should have in-house engineering capability in all of the following disciplines G. Civil & Structure H. MEP I. IT & Data Communication Bidder is required to submit Organogram of engineering setup available with them Should have successfully executed minimum 02 no's Railway workshops/ Industrial/commercial project involving all above disciplines during last 07 years with In-House Capabilities	Annexure-18E
Similar* work shall mean Railway workshops, Industrial project (Manufacturing industries, Process Industries, Power Plants, and Metro depots, etc.) The value of executed works shall be brought to current costing level by enhancing the actual value of work at simple rate of 7% per annum, calculated from the date of completion to the last date of receipt of applications for tenders. In case of Substantially completed works "means an ongoing work in which payment equal to or more than 90% of the present contract value has been made to the contractor in that ongoing contract, and the work or a major part of it is in a usable condition for its intended purpose. No proceedings for termination on account of the contractor's default should be pending in such cases. The Engineer-in-Charge or the Employer shall issue a certificate of substantial completion containing two parts. Part -I shall contain both the financial value of the work executed and certified for payment as a percentage of total current contract value, and part-II shall contain 'certificate of functional completion of the work or a major part of it'. To remain valid for tender evaluation, such certificates should have been issued within sixty days prior to the date of invitation of the tender. Note: 1. Work Orders, Agreement, Completion Certificates to be submitted 2. TDS (26 AS) downloaded from the web matching with the experience certificate should be attached. Experience certificate issued by the same management/sister concern/ joint ventures/ as a sub-contract etc. are not acceptable.		

21	Equipment & Machinery required for construction of factory Bidder should have following construction equipment and machinery of specified number/quantity in full working order, in their own name or should have assured access to these through hire, lease, purchase agreement or other Financial/commercial means. Self-certification in this regard from bidder is mandated. BEML reserves the right to ask for copy of the registration and fitness certificate.	Bidder shall submit a self-certified certificate on their company Letter head confirming the listed equipment as per Annexure-19 is either owned or the bidder has assured access through hire, lease, purchase agreement, other commercial/Financial means, in full working order

SL A	Concreting Machineries	Nos
1	Batching Plant 30 cum incl Silo (CP30)	1
2	Transit Mixer	8
3	Boom Pump	2
4	Backhoe Loader	1
5	JCB	1
6	Concrete Pump	2
B	Common Machineries	Nos
1	Trailer	2
2	Farana	2
3	JCB	1
4	Tractor with trolley	2
5	Mini Truck	1
6	Water Tanker 12KL	1
7	Gas cutting equipment	200
8	Welding equipment	200
C	Reinforcement Steel	Nos
1	Bar bending machine	10
2	Bar Shearing machine	10
D	On-site fabrication/PEB Works Machineries	Nos.
1	Crawler Crane 150MT	2
2	Crawler Crane 75/90/100MT	4
3	Tyre mounted 50 MT Crane	2
4	Manlift 120 Ft	6
5	Hydra (New Generation 23 MT)	2
6	Hydra (New Generation 15 MT)	3
7	Tailor (40T)	2
8	Goliath Crane	1
E	Earthwork Equipment	Nos
1	20–22T Excavator	4
2	30–35T Excavator	8
3	Rock Breakers (attachments)	3
4	Wheel Loader	2
5	Vibratory Roller	1
6	Tippers (16–20T)	30
7	Water Tankers (04 KL/05 KL)	2
Firm to arrange to supply all required tools & tackles, required equipment for construction of the plant.		

22	Key personnel's and their minimum qualification Form-Annexure-20 & Annexure-21 <i>to be certified on the company letter head by the HR Head or Head of the company that the same are available on the Payroll of the company</i>			
	S. No.	Position	Qualification	No's of persons
	1	Project Manager	Bachelor degree in Civil Engineering	1
	2	Construction Manager	Bachelor degree in Civil Engineering	1
	3	Planning Manager	Bachelor degree in Civil Engineering	1
	4	Planning Engineer	Bachelor degree in Civil Engineering	1
	5	Design Manager	Bachelor Degree in Architecture or Civil Engineering	1
	6	Lead Architect	Bachelor Degree in Architecture or Civil Engineering	1
	7	Lead Structural Engineer	Masters in Structural Engineering	1
	8	Sustainability Manager	Bachelor Degree in Environment/sustainiabilty Engg.	1
	9	Structural Engineer	Masters in Structural Engineering	1
	10	Lead Mechanical Engineer	Bachelor degree in Mechanical Engineering	1
	11	Mechanical Engineer	Bachelor degree in Mechanical Engineering	1
	12	Lead Electrical Engineer	Bachelor degree in Electrical Engineering	1
	13	Electrical Engineer	Bachelor degree in Electrical Engineering	1
	14	Construction Engineer	Bachelor degree in Civil Engineering	2
	15	HSE Engineer	Bachelor degree in Civil/ Mechanical Engineering	1
	16	QA/ QC Engineer	Bachelor degree in Civil/ Mechanical Engineering	1
	17	Quantity Surveyor	Bachelor degree in Civil Engineering	1

G. SCORING CRITERIA

The bidder meeting the eligibility criteria will be evaluated by scoring method on the basis of details furnished by them

- Financial strength -Maximum 20 Marks (Last Three years)
- Experience in similar nature of work - Maximum 40 Marks (Past 07 years)
- Plant and Equipment- 07 Marks
- Key personnel -Maximum - 15 Marks
- Presentation - Maximum 18 Marks

Gross Marks Total 100 Marks

Sr N	Attributes	Maximum Marks	Evaluation
FINANCIAL STRENGTH			
1	Annual turnover for Last 03 (Three) years (Turnover: Average Annual financial turnover during the last Three (3) years, ending 31st March of the previous financial year ending 2025, should be at least 30% of estimated cost. (i.e., Rs. 197.10 CR) to put to tender. Profit & loss statement duly certified by chartered accountant for evaluation of turnover for the respective financial Year. (Audited copies of Profit & Loss account balance sheet for previous three financial years duly certified by CA shall be uploaded in the e-folder.)	20 Marks	i) 60% Marks for minimum eligibility. ii) 100% Marks for twice the eligibility criteria or more iii.) In between and - On pro-rata basis (
EXPERIENCE IN SIMILAR NATURE OF WORK			

2	Experience in similar nature of work		40 Marks	i) 60% Marks for minimum eligibility ii) 100% Marks for twice the eligibilit y criteria or more In between (i) and (ii) - On prorata basis
	Note: In case of experience certificate obtained from other than Government organizations/Public Sectors, the same shall be supported with TDS certificate by the contractor. (Documentary proof i.e., Completion certificates clearly indicating the value of the order, final bill value, date of completion etc., shall be uploaded in the c- folder.)			
	Particulars	Marks		
	Similar work experience during last 7 years' Experience: Experience of having successfully completed similar Civil works during last 7 years ending last day of month previous to the one in which tenders are invited should have at least be either of the following. One similar completed works each costing not less than an amount equal to 80% estimated value mentioned against work in the tender notice Or Two similar completed works each costing not less than an amount equal to 50% estimated value mentioned against work in the tender notice Or Three similar completed works each costing not less than an amount equal to 40% of estimated value mentioned against work in the tender notice.	10		
	The Bidder should have successfully completed an industrial project during last 07 Executed on design and build basis with total construction area (Built up area) of Industrial Shed and RCC Buildings combined together should not be less than 82,150.00 Sqm (Design and Build)	6		
	The Bidder should have the credential of having executed civil constriction works of similar nature (Involving Fabrication and /or RCC) of minimum value of Rs. 25 Crore per month on an average in a completed contract of similar works.(This should be the billing amount against works and not the advance received, if any.)	6		
	The Bidder should have executed steel fabrication work to the tune of minimum 16,000 MT in a single completed contract.	6		
	The bidder should have executed RCC Work to the tune of minimum 50,000 CuM in a single contract.	6		
	The Bidder should have in-house engineering capability in all of the following disciplines • Civil &Structure • MEP • IT & Data Communication Bidder is required to submit Organogram of engineering setup available with themShould have successfully executed engineering of minimum 02 no's Railway workshops/ Industrial/commercial project involving all above disciplines each valuing not less than Rs. 263 Crores during last 07 years with In-House Capabilities	6		

PLANT AND EQUIPMENT

3 Plant and Machinery required for construction of factory

07 Marks

SL A	Concreting Machineries	Nos	Marks
1	Batching Plant 30 cum incl Silo (CP30)	1	1
2	Transit Mixer	8	
3	Boom Pump	2	
4	Backhoe Loader	1	
5	JCB	1	
6	Concrete Pump	2	

B	Common Machineries	Nos	Marks
1	Trailer	2	1
2	Farana	2	
3	JCB	1	
4	Tractor with trolley	2	
5	Mini Truck	1	
6	Water Tanker 12KL	1	
7	Gas cutting equipment	200	
8	Welding equipment	200	

C	Reinforcement Steel	Nos	Marks
1	Bar bending machine	10	1
2	Bar Shearing machine	10	

D	On-site fabrication/PEB Works Machineries	Nos.	Marks
1	Crawler Crane 150MT	2	2
2	Crawler Crane 75/90/100MT	4	
3	Tyre mounted 50 MT Crane	2	
4	Manlift 120 Ft	6	
5	Hydra (New Generation 23 MT)	2	
6	Hydra (New Generation 15 MT)	3	
7	Tailor (40T)	2	
8	Goliath Crane	1	

E	Earthwork Equipment's	Nos	Marks
1	20-22T Excavator	4	2
2	30-35T Excavator	8	
3	Rock Breakers (attachments)	3	
4	Wheel Loader	2	
5	Vibratory Roller	1	
6	Tippers (16-20T)	30	
7	Water Tankers (04 KL/05 KL)	2	

PRESENTATION

To be submitted in ppt form in Technical Proposal and shall be called for presentation during evaluation process (Annexure-10)

4	Understanding the Scope of project	18 Marks	3 Marks
	Design Concept		6Marks
	Construction Methodology & Techniques to be adopted for Completing the project as per given timeline, logistics plan, site establishment (including porta cabin), Manpower deployment schedule		6Marks
	Work Plan, QAP including proposed team structure		3 Marks
5. KEY PERSONNEL- Marks – 15 Marks			
Table is as below			

S.No.	Position	No's of persons	Qualification	Marks based on qualification (A)	Experience	Marks based on Experience (B)	Total Marks (C= A+B)
1	Project Manager	1	Bachelor degree in Civil Engineering	25% of Total Marks	Total experience of over 20 years with relevant experience of 10 years	75% of Total Marks	1.5
2	Construction Manager	1	Bachelor degree in Civil Engineering	25% of Total Marks	Total experience of over 15 years with relevant experience of 5 years	75% of Total Marks	1.5
3	Planning Manager	1	Bachelor degree in Civil Engineering	25% of Total Marks	Total experience of over 10 years with relevant experience of 5 years	75% of Total Marks	1.5
4	Railway Engineer	1	Bachelor degree in Civil Engineering	25% of Total Marks	Total experience of over 10 years with relevant experience of 5 years	75% of Total Marks	0.5
5	Design Manager	1	Bachelor Degree in Architecture or Civil Engineering	25% of Total Marks	Total experience of over 15 years with relevant experience of 5 years in design	75% of Total Marks	1.5
6	Lead Architect	1	Bachelor Degree in Architecture or Civil Engineering	25% of Total Marks	Total experience of over 5 years	75% of Total Marks	1
7	Lead Structural Engineer	1	Masters in Structural Engineering	25% of Total Marks	Total experience of over 15 years with relevant experience of 10 years	75% of Total Marks	1
8	Sustainability Manager	1	Bachelor Degree in Environment/sustainability Engg.	25% of Total Marks	Total experience of over 5 years	75% of Total Marks	0.5
9	Structural Engineer	1	Masters in Structural Engineering	25% of Total Marks	Total experience of over 5 years	75% of Total Marks	0.5
10	Lead Mechanical Engineer	1	Bachelor degree in Mechanical Engineering	25% of Total Marks	Total experience of over 15 years with relevant experience of 10 years	75% of Total Marks	1
11	Mechanical Engineer	1	Bachelor degree in Mechanical Engineering	25% of Total Marks	Total experience of over 5 years	75% of Total Marks	0.5

12	Lead Electrical Engineer	1	Bachelor degree in Electrical Engineering	25% of Total Marks	Total experience of over 15 years with relevant experience of 10 years	75% of Total Marks	1
13	Electrical Engineer	1	Bachelor degree in Electrical Engineering	25% of Total Marks	Total experience of over 5 years	75% of Total Marks	0.5
14	Construction Engineer/ Road Engineer	2	Bachelor degree in Civil Engineering	25% of Total Marks	Total experience of over 5 years	75% of Total Marks	1
15	HSE Engineer	1	Bachelor degree in Civil/ Mechanical Engineering	25% of Total Marks	Total experience of over 10 years with relevant experience of 5 years	75% of Total Marks	0.5
16	QA/ QC Engineer	1	Bachelor degree in Civil/ Mechanical Engineering	25% of Total Marks	Total experience of over 10 years with relevant experience of 5 years	75% of Total Marks	0.5
17	Quantity Surveyor	1	Bachelor degree in Civil Engineering	25% of Total Marks	Total experience of over 5 years	75% of Total Marks	0.5

Formulation of pro-rata basis – for scoring

Criteria is **value based- Turnover criteria.**

For Example, Bidder A – Average Annual Turnover – Rs. 240 Cr.

(i) For meeting minimum eligibility of Average Annual Turnover (INR 197 Cr.) – 12 Marks

(ii) Pro-rata marks for the turnover value above the minimum eligibility criteria – (8/197)
 $*(240-197) = 1.74$

Total Marks (i)+(ii) = 12+1.74 = 13.74

• **Number based criteria for - Experience in similar nature of work**

For Example, Three similar completed works each costing not less than an amount equal to 40% of estimated value mentioned against work in the tender notice.

For 40% of similar work value eligibility, 3 similar works of each more than 262.8 Cr. which will fetch 6 marks. Additionally,

Marks for 04 Contracts	1.3
Marks for 05 Contracts	2.7
Marks for 06 Contracts	4

Same formulation shall apply for 50% & 80% of bid estimated value of similar work also .

H. SUBMISSION of FINANCIAL BID – (Through e-mode on BEML SRM system)

Bidders shall bid prices using price condition tab/as prompted in SRM portal. Bidders to quote by entering Lump Sum price and with applicable IGST or CGST & SGST or UGST in SRM portal.

The bidder should be very careful and check quoted prices carefully.

Duly filled Bill of Quantities with PRICE as per BILL OF QUANTITIES should be uploaded in SRM portal at 'Notes and price Attachments only, No Price document to be as part of technical bid under "C-folder technical attachments" otherwise bid will be rejected.

a) Price details sent through Manual Mode/Fax/E-mail will lead to rejection of the Bid.

Price bid of only those firms shall be considered for opening who secure score more than 75 marks out of 100 against SCORING CRITERIA as mentioned above, which accounts for 70% of total evaluation.

a. Submission of Financial bid:

- i. Price Bid to be submitted through e-mode in SRM portal.
- ii. Price details in specified field on SRM Portal to be submitted.

Note:

- a. Bids must be uploaded till the last date/extended date for submission mentioned in Tender Notice/amendment.
- b. No manual Bids shall be made available or accepted for submission (except for originals of scanned copies as per sub-clause).
- c. Bidder must comply with the conditions of the e Procurement portal, including registration, compatible Digital Signature Certificate (DSC) etc. In the case of downloaded documents, Bidder must not make any changes to the contents of the documents while uploading, except for filling in the required information.
- d. BEML at its sole discretion reserves the right to seek the hard copies of the documents which are already been uploaded in SRM, through Courier / post pertaining to technical bid of this tender enquiry at a later date, if required.

In such cases, only the documents uploaded in SRM platform in original has to be couriered at the request of BEML. Any irrelevant documents furnished through courier will not be considered.

I. Bid Opening

Bids received shall be opened online at the specified date and time given in NIT or extended date and time. If the office is closed on the specified date of opening of the bids, the opening shall be done on the next working day.

J. Disclaimers and Rights of Procuring Entity

The issue of the Tender Document does not imply that the Procuring Entity is bound to select bid(s), and it reserves the right without assigning any reason to:

- a. Reject any or all of the Bids, or
- b. Cancel the tender process; or

- c. Abandon the procurement of the Services; or
- d. Issue another tender for identical or similar Services

K. Evaluation of Bidders:

The bidders meeting the qualification criteria shall be evaluated as per the Quality Cost Based System (QCBS) which will include 70% weighted score for quality (Technical bid) and 30% weighted score for the price (price bid).

Evaluation of technical proposal will be as follows:

BEML will constitute a Technical Committee to evaluate the responses of the Bidders in QCBS Method.

The Technical Committee constituted by BEML shall evaluate the responses to the RFQ and all supporting documents

/ documentary evidence. Inability to submit/upload requisite supporting documents / documentary evidence, may lead to rejection.

The decision of the Technical Committee in the evaluation of responses to the RFQ shall be final. No correspondence will be entertained outside the process of negotiation/discussion with the Committee.

The Technical Committee may right to seek clarifications from the bidder/s for the documents already uploaded by the bidder/s at any point of time during the technical evaluation if required.

The Technical Committee reserves the right to reject any or all proposals on the basis of any deviations. Quality Cum Cost Based Selection (QCBS) Evaluation Criteria

The broad criteria for evaluation of the bids would be a Quality cum Cost Based System (QCBS) as follows:

Sl. No.	Particulars	Item	Percentage (Weightage)
1	Level-I	Technical Bid Evaluation	70%
2	Level-II	Financial Bid Evaluation	30%
3	Level-III	Combined Evaluation of Technical & Financial Bid	-
		Total	100%

The score of the bidder, as per the documents submitted, shall be allotted by Evaluation committee constituted by BEML and its decision will be final.

After opening and evaluating the financial proposals of technically qualified bidders, a Relative Technical Score (RTS) & Relative Financial Score (RFS) shall be arrived based on the formulas.

- i. Level-I : Technical Bid Score : The Relative Technical Score(RTS) of the Bidder shall be derived as under :

a) $RTS = (TS / HS) * 100$

where, RTS = Relative

Technical Score.

TS = Technical Score obtained by concerned Bidder.

HS = Highest Technical Score obtained among all the Technically Qualified Bidders.

ii. Level-II : Evaluation of Financial Bids: The Financial Bids of the Bidder, who are Technically Qualified shall be considered to determine Relative Financial Score (RFS) and shall be derived as under:

a) $RFS = (LFB / QFB) * 100$ where,

RFS= Relative Financial Score.

LFB= Lowest total quoted Financial Bid per year among
all the Technically Qualified Bidders

QFB = Total Quoted Financial Bid per year by concerned Bidder

viii. Level-III : Combined Evaluation of Technical & Financial Bid : A Final

Composite score shall be arrived as per the following formula based on the weightage mentioned in technical scoring criteria

Final Score = $(RTS \times 70\%) + (RFS \times 30\%)$

The proposal with the Highest Final Score (quality and cost) as per the predefined formula shall be declared as the "Selected Bidder".

In the event that there are 2 or more bidders having the same weighted composite score after technical and financial evaluation, the bidder securing the Highest Relative Technical Score (RTS) will be declared as "selected Bidder" for award of the Contract.

For example:

Bidder	Technical Score	Weighted Technical Score (0.70)	Weighted Technical Score	Financial Score	Weighted Financial Score (0.30)	Combined Score	Ranking
A	80	88.88	62.2	100	30	92.2	H2
B	90	100	70	90	27	97	H1

The Bidder obtaining the highest combined score shall be recommended for award of

contract by the evaluation committee.

L. Submission of EMD (Earnest Money Deposit):

EMD: The bidders shall submit EMD along with their bids. The EMD/bid security shall be accepted in the form of Account Payee Demand Draft, Banker's Cheque or Bank Guarantee from any of the commercial banks or online payment in an acceptable form. **No Benefits of EMD exemption and price preference shall be extended to MSE Firms, as the subject tender falls under works category**

The scanned image of earnest money deposit to be uploaded online in technical bid and **original one to be submitted to the address mentioned below so as to reach Latest by last date of submission superscribing the tender No & work description on envelope.**

The EMD amount can be submitted in any one of following mode as detailed below:

- i. Earnest Money Deposit as specified to be furnished in the form of Demand Draft / Bankers cheque / Pay Order drawn in favour of "BEML Limited" payable at Bhopal, from a Nationalized Bank / Scheduled Bank.
- ii. Online Payment of EMD amount can be made as mentioned below:
 - Open the link to <https://www.onlinesbi.com/sbicollect/icollecthome.htm> pay EMD through SBI Collect.
 - Read the Disclaimer Clause and click on "check box" to proceed for payment against EMD and Click "Proceed".
 - In 'Select State' dropdown Option, Select "All India"
 - In 'Type of Corporate / Institution, select "PSU-Public Sector undertaking" and Click on the "Go" button.
 - In PSU-Public Sector undertaking- Name dropdown, select "BEML Limited Bangalore Complex" and Click "Submit" Button.
 - In 'Select Payment Category', dropdown option, select "EMD Tender Fee BEML Bhopal complex"
 - Enter details of payment, details of Bank Account for refund and click on Submit to make the online payment of the required EMD amount.

Please ensure that online payment of EMD amount is made well ahead of the Tender Closing Date & Time mentioned in the Tender. Bidder may do the NEFT/RTGS payment to the following bank details

Account Number: 00000010918220589

Name: BHARAT EARTH MOVERS LIMITED

BRANCH: HAL (01114)

IFSC CODE: SBIN0001114

iii. Payment of EMD amount through Bank Guarantee:

An irrevocable Bank Guarantee from a Scheduled Commercial Bank authorized by RBI to issue a Bank Guarantee in favour of the Purchaser as per format in Annexure-III having a validity period of bid validity + 45 days from the date of opening of Tender.

II. No Benefits of EMD exemption and price preference shall be extended to MSE Firms, as the subject tender falls under works category General Instructions with regard to EMD:

- a) Bid submitted online without submission of EMD in-time will not be considered.
- b) EMD submitted in any other form will not be accepted and the offer is liable to be rejected.
- c) EMD lesser than mentioned in tender will not be accepted and the quotation is liable to be rejected.
- d) EMD of technical disqualified bidder's will be returned.
- e) EMD of unsuccessful bidders will be returned after finalization of the contract and the EMD of successful bidder will be released after submission of Performance Bank Guarantee / Security Deposit.
- f) EMD does not carry any interest on return.

M. Forfeiture of Earnest Money Deposit (EMD):

- a) Any bidder who withdraws offer / modifies within the bid validity period or before finalization of the tender.
- b) If the successful bidder withdraws the offer after the tender is submitted/ acceptance of the tender.
- c) if any firm withdraws the tender submitted or refuses to execute the order for reasons whatsoever
- d) If there is any breach of terms and conditions of the contract on part of the successful bidder after award of contract and before submission of Performance Bank Guarantee.
- e) If H-1 backs out for any reason, the EMD Amount will be forfeited by BEML Ltd. Please do note that, failure of the successful Bidder to perform the work satisfactorily in any respect after award of Contract will entail for forfeiture of SECURITY DEPOSIT and en- cashing of Performance Bank Guarantee.

The Bidder is advised to carefully go through the terms & conditions of tender before submitting the tender.

Details of EMD online payment acknowledgements & Integrity pact have to be uploaded in the technical BID and Original DD/Banker's cheque and integrity pact has to be submitted to below mentioned address on or before tender closing date and time.

The Sr. Manager

**BEML LIMITED.,
Rail plant,
Bhopal
Chittod complex,
Zone-1 , MP
Nagar, Bhopal-
462011**

Note: Demand Draft / Bankers cheque / Pay Order /bank guarantee/exemption certificate should reach the above-mentioned address before 13.00 Hrs on the last/extended date of submission for tender, failing which tender will not be considered. Any postal delay or any other reasons what so ever may be will not be considered. The tender will be liable for rejection.

M. Submission of Integrity pact: Bidders shall submit filled, signed & sealed Integrity Pact with the BEML as per 'Format: Integrity Pact'. Bids without filled, signed & sealed Integrity Pact shall be liable for rejection. (Integrity Pact is applicable if the Estimated value is more than Rs. 1.00 Crore) Integrity pact have to be uploaded in the technical BID.

The bidder / contractor should upload duly signed & stamped **Integrity Pact** (if the tender value is more than or equal to Rs.1.00 crore) as per prescribed format (**Annexure-6 & Annexure-J1**) on plain paper as part of technical bid.

The bidder should put their authorized signature in the Integrity pact as a Contractor / bidder with their company seal along with witness's signature, name & address.

The agreement shall be in full as per format enclosed on a plain A4 size paper duly signed & stamped on all pages.

The Integrity Pact envisages an agreement between the prospective Bidders and the buyer committing the persons/officials of both the parties not to exercise any corrupt influence on any aspect of the contract.

For the successful bidder, the integrity pact will remain valid up to 12 months after the last payment under the contract, and for all other Bidders 6 months after the contract has been awarded.

The Central Vigilance Commission (CVC) has appointed Shri Kasividyasagar & Shri Lt. Gen. Abhay Krishna as Independent External Monitor (IEM) to oversee the implementation of the Integrity Pact.

Address of IEM is as
below: - Shri
Kasividyasagar, IAS
(Retd.) House no. 55,

Dream valley gated community,
Manikonda, Hyderabad –
500089. Mobile no. +91
9771407778
Email: kasividyasagar@gmail.com

Shri Lt. Gen. Abhay Krishna ,
(Retd.) 4A-902, Gurjinder
Vihar,
AWHO Township, Sector
CHI-1 Greater Noida, UP -
201310 Mobile no: +91
9871234353 Email:
abhayabk@gmail.com

The Earnest Money Deposit / Bid Guarantee shall remain deposited with the Purchaser for the period of bid validity (180 days)+ 45 days from the date of opening of Tenders. If the validity of the offer is extended, the Earnest Money Deposit / Bank Guarantee duly extended shall also be furnished failing which the offer after the expiry of the aforesaid period shall not be considered by the Purchaser.

N. General Terms:

Contractors / agencies are subject to be disqualified, even though they meet the qualifying criteria, if they make misleading or false representations in the request, statements and attachments submitted in proof of qualification requirements including holding information and / or have record of poor performance such as abandoning the works, not properly completing the contract, inordinate delays in completion, litigation history, or financial failures, requesting for claims not admissible under the contract conditions, etc.

O. CLARIFICATION ON TECHNICAL BID EVALUATION.

- a. During evaluation and comparison of bids, BEML may, at its discretion, ask the bidder for clarifications on the bid. The request for clarification shall be given in writing through registered/speed post/email within the specified date. If the Bidders does not comply or respond by the specified date, his tender will be liable to be rejected. No change in prices or substance of the bid including specifications, shall be offered or permitted. No post-bid clarification at the initiative of the bidder shall be entertained.
- b. BEML also reserves right to seek confirmation/clarification from the issuer agency, on the supporting documents submitted by the bidder.

P. TAX CLAUSE

a) Any tax and/or duty, which may hereafter be imposed outside India, shall be on Supplier's account. On the other hand, any tax and/or duty, which may hereafter be imposed in India, shall be on BEML's account. Notwithstanding the foregoing, tax on supervising fee and/or other training fees shall be on Supplier's account,

however, it shall be withheld and paid by BEML in India on behalf of Supplier according to provisions of the corporation tax law, the local inhabitant tax law and convention between Republic of India and the respective

Suppliers country, for the avoidance of double taxation and the prevention of fiscal evasion with respect to taxes on income.

b) Where the government of the supplier's country exempts goods in export from any or all of such taxes, levies, duties on imports, the supplier shall charge the purchase price, which are exclusive of and free from such taxes, levies, and duties on imports.

Note:

1. Corrigendum / addendum / amendments / clarification, etc., with respect to works, if any, shall be hosted in BEML e-portal. Bidders are advised to visit BEML e-portal regularly as no separate information/advertisement shall be published in the newspaper or no other communication in this regard including any postponement of tender closing date.

Q. EMD.

- EMD in the form of online payment is to be made before the bid closing date and time. EMD in the form of DD / Banker's Cheque / EMD exemption certificate / BID Guarantee Form to be submitted through Courier / Post in a sealed cover, superscribing the bid number and closing date, address etc. before the bid Closing Date & Time. Failure to do so will result in rejection of the bid.

EMD submitted in any other form will not be accepted and the offer is liable to be rejected.

EMD lesser than Rs 13,14,04,465.00 will not be accepted and the quotation is liable to be rejected.

EMD of technical disqualified bidder's will be returned.

EMD of unsuccessful bidders will be returned after finalization of the contract and the EMD of successful bidder will be released after submission of Performance Bank Guarantee / Security Deposit.

EMD does not carry any interest on return.

EMD will be forfeited if any firm withdraws the tender submitted or refuses to execute the order for reasons whatsoever .

The Earnest Money / Bid Guarantee deposited is also liable to be forfeited (encashed in case of BG if the tenderer withdraws or amends impairs or

derogates from the tender in any respect within the period of validity of his offer.

No responsibility will be taken for postal or non-delivery/non-receipt of EMD/firms claiming EMD exemption.

No interest will be payable by the Purchaser on the EMD / Bid Guarantee.

Cheque and other mode of payment will not be accepted.

The Demand Draft must be sent through courier in a sealed cover & should reach BEML Soudha half hour before the closing date & time of e- bid, failing which, the tender will be rejected.

The Earnest Money Deposit through RTGS will be returned.

For successful bidder/(s) who enters into contract with BEML, the EMD will be returned after receipt of performance bank guarantee for 10% of the Contract value after award of Contract.

Likewise, if the tender is cancelled for what so ever reason, then EMD will be refunded to all the bidders, without any interest.

The Earnest Money Deposit will be Forfeited under the following circumstances:
If the bidder withdraw/modifies the offer during the Validity Period of the tender.

If the successful bidder withdraws the offer after acceptance of the contract.

If the successful bidder fails to furnish a Performance Bank Guarantee (PBG) as specified in bank guarantee format against this tender within the specified period for satisfactory execution of contract.

R. Refund of EMD:

Bid securities of the unsuccessful bidders shall be returned to them at the earliest after expiry of the final bid validity period and latest by the 30th day after the award of the contract. Bid security shall be refunded to the successful bidder on receipt of a performance security. However, in case of two packet or two stage bidding, Bid securities of unsuccessful bidders during first stage i.e. technical evaluation etc. shall be returned within 30 days of declaration of result of first stage, i.e technical evaluation. Bid security shall be refunded to the successful bidder on receipt of a performance security. Else, Bid security of successful bidder shall be converted as part of security deposits and the balance amount of security deposits will be met by the bidder as the part of contract/agreement conditions.

Please attach the details duly filled-up for refund of EMD amount in the following format along with the DD / Banker's Cheque for EMD:

Sno	Particulars	To be filled & submitted along with DD/Banker's Cheque
1	BANK NAME	
2	BRANCH NAME	
3	CITY	
4	IFSC CODE	
5	ACCOUNT NO	

6	BENEFICIARY NAME	

- **IMPORTANT NOTE** to submit EMD, Integrity Pact & other specified documents.
- Bidders to ensure submission of EMD, Integrity Pact & other specified documents in tender.

Annexure-9

3. SCOPE OF WORK

A. INTRODUCTION

The Tendered Work envisages

Civil Construction of manufacturing block(s), Inspection and testing bay(s), Utility buildings, other service buildings, Railway Track sidings, Water supply and distribution System, Roads, Drainage, and sewerage systems, Associated MEP works excluding production related plants and machineries and Land & Site development works including grading & levelling works for setting up a Rail Coach Factory by the side of Umaria village of Goharganj Tehsil near Obaidullaganj, District-Raisen, Madhya Pradesh (India).

The project area is located at Obaidullaganj, approximately 30 km south-east of Bhopal City, in Raisen District, Madhya Pradesh. Nearest railway station is Obaidullaganj. Its distance from the site approx. 3.15 km. Nearest airport is Raja Bhoj Airport, Bhopal. Its distance is 53 km from the site

B. SCOPE OF PRESENT TENDER

The EPC contractor shall provide end to end services of engineering, procurement, construction, testing commissioning and handing over including but not limited to

1. Detailed engineering (Civil, Structural, Architectural, MEP, BIMS, IT & Telecommunication services, Other Utility & Services, Landscaping/Horticulture and other Infrastructure etc.)
2. Procurement of all materials, equipment, Tools & Tackles, consumables excluding production related plants & Machinery
3. Complete construction including civil, structural (PEB/conventional), MEP works, BIMS, IT & Telecommunication services, other utility services, external development.
4. Testing commissioning statutory approvals and certification (As required).
5. Preparation of as-built drawing, providing O & M Manuals and product Guarantee/Warranty certificates from OEM (in case it is for a longer period than the defect liability period), training of BEML personnel (as required)
6. Handing over of the facility to BEML ensuring, completeness in all respect.as per scope

C. Detailed engineering scope

The EPC contractor shall perform

1. Surveys and investigations
Topographical survey (Topographical survey report carried out at the time of DPR preparation available with BEML has been annexed with this tender (**Report**). However, **verification/ validation** of the same with respect to the MSL of

Obaidullaganj Railway Station shall be the sole responsibility of EPC contractor as it is very critical for railway siding work and Land & Site Development Work (Because dispatch railway track is to be connected to the broad gauge line passing by the side of project site with slope as permitted by the Indian railways.

Soil investigation and geotechnical report available with BEML is also enclosed with this tender (Report) which is not a detailed one and is preliminary investigation carries out for DPR preparation. It is advised that fresh soil investigation be carried out for the assessment of soil bearing capacity and decision regarding type of foundation.

Hydrological and drainage study

- Design Engineering
- Architectural Planning and building layout
- Structural analysis and Design of factory sheds, various utility/ service buildings, machine/equipment foundation, civil infrastructure related to MEP and extra developmental works.
 - Preparation of civil construction drawings with BOM.
 - Design & engineering of MEP systems & services including preparation of PFD, P & ID Drawings, Preparation of BOM and specifications.
 - Design & engineering of sewage treatment plant, including that of related civil infrastructure.
 - Design & engineering of BIMS, IT & Telecommunication services & other utility services.

Note :

- Coordination of all disciplines while designing and preparation of a drawing taking care of all aspects/related disciplines is the sole responsible of the EPC contractor. **All design and drawings are to be duly vetted by premier institution like IIT/IISC before final submission to BEML for its acceptance and release for construction.**

Minimum four sets of drawings to be submitted on appropriate size of drawing sheets along with soft copy of the same.

- Master Layout of the proposed manufacturing facility is enclosed with this tender. Though, the master layout is going to remain unchanged, minor change in facilities location /orientation may not be ruled out. Plan & Elevation of all major facilities are also enclosed with the tender

D. Procurement Scope

EPC contractor shall supply:

1. All construction materials, plants/ machinery/ equipment & accessories pertaining to MEP and other utility packages.
2. Manufacturing and testing equipment as specified under the heading car body fabrication and assembly line equipment list & car body inspection and testing line equipment list.
3. Supply of EOT & Goliath crane as specified.
4. All supplies are to be made as per approved make and shall conform to mentioned specifications and code (IS/CPWD/MoRTH/ MoEFCC & any other codes/specifications specified).

E. Construction scope

1. Land and site development works
2. Site clearing, grubbing, dismantling & demolition (if any)
3. Disposal of unusable material
4. Grading and levelling works

- **Civil & Structural works pertaining**

5. Manufacturing blocks
6. Inspection & testing bays
7. Traverser foundation
8. All Utility and Service building
9. MEP (Mechanical & Electrical Plumbing)
10. Foundation for machine & equipment
11. Other facility and infrastructure
12. External development works viz railway siding, Hard stand for parking & dispatch area, roads, culverts & trenches, storm water drainage & sewerage system, RCC trenches, Landscaping & horticulture, Footpaths & Kerb stones, Signages etc.

F. MEP and Other Services

Supply, Installation, testing and commissioning of followings:

MEP systems described below has design basis considering one manufacturing block envisaged in near future after 03 years

1. Electrical supply, distribution system
2. Compressed air System
3. Industrial gases storage & distribution System
4. RO Water and distribution system
5. HVAC/ ventilation systems
6. Firefighting and fire alarm system
7. Water supply and distribution system
8. Sewage treatment plant & effluent distribution.

G. Testing and commissioning

EPC contractor shall perform:

- Load testing of structural elements
- Testing of material and equipment's
- Crane testing and alignment
- Electrical test (IR, HV rely coordination etc)
- Pressure testing of pipelines
- Testing and commissioning of STP, fire pumps, utilities etc
- Demonstration of performance parameters



H. Documentation and handover

EPC contractor shall submit

- As built drawings 4-sets
- Structural stability certificates
- Test certificates and reports
- O&M manuals of all supplied equipment's
- Warranty cards/ documents
- Training records of BEML team
- Statutory approval documents from relevant authorities

The above scope of work is not exhaustive and any/all incidental works associated with the tendered work shall deemed to be integral part of scope without any cost implication

EXCLUSION

- Production machineries and process equipment

I. Major building/structure/facilities/infrastructure covered under the scope are as follows:

Sl. No.	Item	
Particulars	Time Frame	
A. Land & Site Development		
1	Earthwork in formation	
1A	Cutting	802660 CuM
1B	Filling	822490 CuM
2A	RCC Road (Carriage width-7 m)with both side 1 m wide berm & either side drain of min 0.8 m width & 0.8 m avg. depth	4400 mtr
2B	RCC Road (Carriage width-4 m) with both side 1 m wide berm & either side drain of min 0.8 m width & 0.8 m avg. depth	2044 mtr
2C	RCC Road (Carriage width-3.5 m) with both side 1 m wide berm & either side drain of min 0.8 m width & 0.8 m avg. depth	2350 mtr
3	Storm water drainage system min 0.8 m width & 0.8 m av depth	4472 meter
4	Sewerage system excluding STP	3920 meter
5	RCC service trench	9800 meter
6	Greenbelt Development	37 acres
B. Other External Development works		
7	Main Gate Complex with security office (G+1)	1-lot
8	Gate Complex for railway siding (G+3)	1-lot
9	Material Gate (G+1)	1-lot
10	Laying of Stabling and dispatch Railway Track (4 km) with OHE	1-lot
C. Civil & Structural Works		
C.1. Civil Works		
1	Car Body manufacturing cum storage Block (72 m x400 m)-1No. with Annexe offices on both sides	1-lot

2	Car body inspection and testing line facility (24 m x 852 m)- (1No)	1-lot बी ई एम एल
3	Raw material storage yard(Hard Stand)	 1-lot
4	Water supply & Fire water pump house including sump	1-lot
5	Main Receiving Sub Station – MRSS	1-lot
6	Emergency Power Supply System - EPSS (Hard stand)	1-lot
7	Centralised Gas bank Shed	1-lot
8	Safety Office	1-lot
9	RO Plant (Hard Stand)	1-lot
10	Chiller Plant Building	1-lot
11	Fire station	1-lot
12	Sewage Treatment Plant (STP)	1-lot
13A	Traverser Foundation – 01 No. (240 m x 32 m)	1-lot
13B	Traverser Foundation – 01 No (160 m x 32m)	1-lot
14	Goliath Crane Foundation-01 no.	1-lot
15	Combination track of 420 m length in between two traversers	1-lot
16	Office complex (G+5)	1-lot
17	Canteen Building Single Storey	1-lot
18	Medical Centre	1-lot
19	Multi-level parking (G+2)	1-lot
20	Toilet Cum Parking facility area (Near Main Gate Complex)	1-lot
D. Material Handling Equipment		
1	Interplant Traverser (75 t)	2-Nos.
2	Double Girder Goliath Crane with Lifting Beam	1-Nos.
3	DG EOT Crane -25/5T	4-Nos.
4	DG EOT Crane -10/2T	4-Nos.
5	Single girder under Slung 02 Ton Crane for Water Pump House	1-Nos.
E. MFA (Miscellaneous fixed Assets)		
1	Plant Electrics	1-lot
2	Instrumentation and Process control	1-lot

3	AC & Ventilation System, Chiller Based	1-lot बी ई एम एल
4	Air cooled VRF type Air conditioner (40 ton) for Main security complex	 BEML Beyond Possibilities
5	Split Air Conditioner for Annexe-Building to Manufacturing block (1.5 Ton Capacity of 5 star rating)	50 Nos.
6	Screw Compressors – 12 Bar Capacity	5-Nos.
7	Fire Fighting System	1-lot
8	Water Supply Facilities	1-lot
9	RO Facility	1-lot
10	STP (MBR technology)	1-lot
11	DG Set 750 KVA	3-Nos.
12	Gas Bank and Supply System	1-lot
13	Weigh Bridge – 100 Ft (70 T weight measuring capacity)	1-lot
14	Required Furniture for the plant (Furniture Annexure)	1-lot

J. Bench marks:

The existing benchmark available at site are established by the contractor engaged by the employer at the time of DPR preparation. The contractor along with the Engineer should verify the details of these bench marks in the first instance, soon after taking possession of the site. The reduced level of these bench marks should be verified with respect to MSL (Mean sea Level) of Obaidullaganj railway station. If any mistakes are detected/observed in the details of these bench marks, the same should be brought to the notice to employer. The mistakes detected should be corrected in consultation with the employer. These corrections should be got approved by BEML before starting of any other work.

The contractor shall then in presence of the employer engineer establish working bench marks at short intervals, adequately connecting them to the reference bench marks set up by the employer at project site. The working bench mark levels should be got approved from the Engineer. An up-to-date record of all bench marks including approved corrections if any, shall be maintained by the contractor and also the employer.

All levels taken for making out the longitudinal section and cross section should be related only to these working bench marks.

The contractor will be entirely responsible for accurate setting out of the works

and safeguarding all survey monuments, bench marks, alignment references etc. The work of setting out shall be deemed to be a part of the general work preparatory to the execution of work and no separate payment shall be made for the same.



The above-mentioned points shall be applicable for all works envisaged under the scope.

K. INTERFACING AND INTEGRATION OF WORKS

Interfacing for the purpose of integration of works between different groups/agencies working simultaneously is of paramount importance so that the progress of work is not hampered. Coordination between all working agencies has to be ensured by EPC Contractor.

The commissioning of this tendered project requires close coordination among various agencies executing the works and Employer. The contractor shall therefore plan all his works requiring interfacing with other agencies, meticulously, in consultation and coordination with all concerned parties, in advance, for expeditious execution, without causing any delay either to his works or those of others.

The contractor shall strictly adhere to the work plan made for works requiring interfacing. Any delay either on his part or on the part of other agencies and other bottlenecks that could affect the pace of works shall be informed to the Engineer in time so as to enable him to take corrective steps.

If, in the opinion of Engineer, any delay in execution of any part of the Project requiring interfacing is attributable to the Failures of the contractor to take adequate steps for smooth execution of such works, then the Engineer shall have the right to take necessary steps to organize and streamline such works, including excluding the requisite portion of work from the scope of the Contractor and getting the same executed by other agencies, at the risk and cost of the contractor.

Damages to property:

The contractor shall organize all his activities so as not to cause any damage, loss, breach to the property of BEML or that by any other agencies or any third party. Despite of taking all precautions, in the unfortunate event of any damage to the property, then the contractor shall not only indemnify the Employer of the claims made by the affected parties but also settle the matters with the affected parties as per law. If the nature of damage is one of that causing a safety hazard to the public, then the situation will be treated as an emergency and the Engineer reserves the right to take all necessary steps as deemed necessary to remove the hazardous situation or to mitigate the damage, at the risk and cost of the contractor.

Damage to Boundary wall of the factory site shall be made good by the EPC contractor.

Tentative scheduling of major works:

The works are required to be completed as per the key dates and time of completion for different milestones as decided mutually between EPC Contractor and BEML, meeting the overall project timelines, specified in the tender.

L. SURVEY EQUIPMENT

All survey shall be done with Total Stations and high precision Auto levels. The contractor should provide the survey equipment and other accessories as per the instructions of Engineer as and when required. He should also provide all necessary help as required by the Engineer for checking the works, whenever required.

M. GENERAL SPECIFICATIONS - Mechanical Engineering Works

- a) The bidder should perform all activities necessary in connection with execution of contract and should deem to be responsible for design, manufacture, fabrication, supply, painting, packing, forwarding, insurance, freight, handling, loading, unloading, unpacking, safe custody and storage, erection, testing, commissioning, performance test till final handing over of machines/ equipment/ items to BEML.
- b) Bidder should be responsible for short shipment and any damage including transit, custody, handling, installation, erection and testing damages prior to successful commissioning and handing over of machines/ equipment/ items to the employer/ BEML.
- c) The successful bidder is responsible for proper and secure packing of machines/ equipment/ items to ensure that stores are not damaged during transit, handling and storage. Consignment should be insured by bidder at his own cost. Stores should be delivered at site.
- d) Bidder or his authorized representative should carry out a joint check of materials supplied at site along with authorized representative of the employer after unpacking.

1.1. SOURCING CONDITION

- a) The successful bidder should offer machines/ equipment/ items covered under this schedule from reputed firms, who have successfully supplied and commissioned similar capacity machines/ equipment/ items in past five years.
- b) Bidder should ensure that necessary facilities are available with bidder/ OEM/ or his authorized agent for providing adequate after sales service during warranty and post warranty periods. Bidder should provide details of service organization, which should be responsible for after sales service at the time of commissioning/ handing over of machines/ equipment/ items.
- c) Bidder should offer machines/ equipment/ items covered under this schedule as per Technical Specifications detailed in Bid Document.
- d) The successful bidder should take prior approval from the employer, regarding vendor/ OEM from whom machines/ equipment/ items is likely to be supplied, well in advance so that scheduled time lines of commissioning of machines/ equipment/ items can be adhered to by the bidder. For obtaining approval of vendor/ OEM, successful bidder should submit requisite documentary evidence in support of above to the employer.

1.2. FOUNDATION (WHERE APPLICABLE)

- a) The successful Bidder should provide and construct necessary foundation works, track works, civil works required for installation and commissioning of machines as per drawings supplied by OEM using expansion type bolts and buffer pads for vibration free operation of machine and cost of the same (bolts, pads, rails, fittings etc) should be included in the cost of machine.

1.3. POWER SUPPLY TO MACHINE/ EQUIPMENT (WHERE APPLICABLE)

The successful bidder should provide necessary power supply arrangement from distribution panel in the shed to control panel of machine/ equipment.

1.4. STATUTORY GUIDELINES (WHERE APPLICABLE)

The successful bidder should ensure that equipment is designed, manufactured, installed and commissioned in conformity with the latest applicable norms of State/ Central Pollution Control Board, Factory Act, Indian Electricity Rules/ Act, Fire Safety Rules, IS standards, Explosive rules and regulations for gas pipelines, manifolds etc and

statutory guidelines applicable in the State.

2. GENERAL DESIGN

2.1. GENERAL CHARACTERISTICS (As Applicable)

- a) Machines, equipment, plant, tools and instruments covered in this tender should be designed for high reliability and ease of maintenance. Equipment should be compact, dependable and reliable in operation and should fully meet functional requirement under severe conditions.
- b) Machine should be capable of operating in severe workshop conditions of temperatures 0-50 °C and for relative humidity of up to 98% and dusty atmosphere.
- c) Machine should be robust, rigid and sturdy construction. Machine should be vibration free even when working at full capacity. Machine castings should be made of close-grained high-grade cast iron like MEEHANITE or equivalent materials meeting IS210 standards to ensure durability and rigidity. Casting should be stress relieved to ensure stability and continued accuracy. Machine fabrications of critical load bearing assemblies like beds, columns etc should be adequately strengthened and stress relieved.
- d) Change in ambient temperature should not affect performance of machine. Machine performance should not change either on switching on machine or after continuous running. Machine should not have resonant vibrations throughout working range of machine at all load levels.

2.2. MACHINE MAINTAINABILITY

- a) Machine should be designed to ensure minimum possible maintenance and to give trouble free service. Machine should not require major disassembly for checking and replacement of a particular part, especially for parts requiring periodical checkup and replacement. Assemblies/ parts of machine should be easily accessible for maintenance.
- b) Manufacturer must provide means of access, e.g., stairs, ladders, cat walks etc to allow access to all areas used for production, adjustments and maintenance operations.
- c) Original built in accuracy of machine should be maintained conveniently and economically by suitable adjustments for taking up wear on slides, bearings and load screws.

2.3. LIGHTING

- a) Integral LED lighting suitable for operations in night should be provided. In addition, where lack of light is likely to cause a risk despite availability of ambient lighting in daytime. Manufacturer must ensure that there is no area of shadow, which is likely to cause nuisance; that there is no irritating dazzle and that there is no dangerous stroboscopic effects due to lighting.
- b) Integral parts and areas requiring frequent inspection, adjustment and maintenance should be provided with appropriate lighting. Machine lighting should be low voltage to prevent any hazard to operator.

2.4. OPERATIONAL CONTROLS

- a) All controls should be governed by push button/ touch controls for all possible operations and should be conveniently located on fixed panel of equipment. Basic rules for direction of operation of controls and corresponding direction of movements of machine tools should be as per IS 2987-1985.
- b) Control devices should be clearly visible and identifiable, ergonomically positioned for safe operation without hesitating or loss of time, and without ambiguity. CNC controls (where applicable) should meet the general requirements of CNC controls.

2.5. SAFETY CONTROLS (As Applicable)

- a) Machine should incorporate safety devices to provide protection to operator and machine against all possible operational and machinery failures. Suitable interlock should be provided to prevent machine operations in case of faulty sequence of operation, fluctuation in supply voltage, resumption of power supply after power failure, non-positioning of safety guards, failure of hydraulic system (where applicable), failure of lubricating system (in case of automatic including drop in pressure lubrication). A fault or damage in control circuit or interruption re-establishment after an interruption of fluctuation in whatever manner in power supply to machine must not lead to dangerous situations in particular.
- b) Machine should not start without command. Machine should not be prevented to stop if command has been given. No moving part of machinery or piece held by machinery should fall or be ejected. Protection devices must remain effective. Machine should be fitted with an emergency stop device to avert any actual or impending danger. This device must be conveniently located, clearly identifiable and stop machine as quickly as possible without causing additional hazards. Emergency stop must remain engaged. It should be possible to disengage it only by appropriate operation. Disengaging control must not restart machinery but only permit restarting.
- c) Safety features should also include safety device against overload for mechanical and electric items to extent possible and safety stops against over-running of slides.
- d) Guard and protection devices should protect exposed persons against risks related to moving transmission parts (such as pulleys, belts, gears, rack and pinion, shafts etc) and moving parts directly involved in process to extent possible and should meet requirements of robust construction, not give rise to additional risk, not easy to by-pass or render non-operational, located at adequate distance from danger zone, minimum obstruction to the view of production process, rigidly connected and not prone to rattling and enable essential work to be carried out without guard or protection device having to be dismantled.

2.6. COOLANT SYSTEM (WHERE APPLICABLE)

- a) Suitable coolant system with pump, motor, tank, filter etc should be provided. Coolant pump should be as per IS 2161-1962. Filter should be reusable/ cartridge type and indigenously available. Supply of coolant should be in ample volume. Provision to re-circulate coolant should be available. A chip and coolant tray should be provided. Volume of coolant flow should be adjustable. An enclosure should be provided to prevent coolant from splashing outside machining zone.

2.7. LUBRICATION SYSTEM (WHERE APPLICABLE)

- a) Machine should be provided with an automatic lubricating system for ensuring delivery of adequate quantity of lubricant to areas requiring continuous lubrication. Suitable arrangements should be provided for indication of failure of lubricating system. System should be provided with interlock to prevent machine operating/ starting in case of lubrication system failure. Reusable/ cartridge type filter capable of filtering chips, dust particles etc should be provided. Indicators for showing clogged condition of filters should be available. Lubrication and filter cleaning chart should be provided at

conspicuous location on machine indicating (a) Specific location of points on machine



to be oiled lubricated/ greased (b) Periodicity of lubrication of these points (c) Filters to be cleaned (d) Periodicity of cleaning filters (e) Periodicity of replenishing lubricating oil for centralized system (f) Any other similar relevant information. Points requiring manual lubrication should be separately indicated with frequency of lubrication.

2.8. **PNEUMATIC SYSTEM (WHERE APPLICABLE)**

- a) Suitable filter/ moisture trap should be provided in system of pneumatic air intake. Filter should be reusable/ cartridge type. Air pressure regulator, if necessary, should be provided. Pneumatic control equipment should be of reputed make.

2.9. **HYDRAULIC SYSTEM (WHERE APPLICABLE)**

- a) Hydraulic circuit must be equipped with following safety and inspection equipment:
 - pressure gauges where pressure has to be set up or inspected
 - safety valves for hydraulic circuit if relief valve does not fulfill this function
 - equipment for checking of temperature in circuit/ pump wherever necessary
 - arrangement to show if filters (including those in pump set) are choked and need cleaning (filters should be of reusable/ cartridge type)
 - Alarm for low oil level.
- b) Sump aggregate should have following:
 - oil level sight gauges or any other equipment showing minimum and maximum oil levels in sump
 - drain plug at lowest portion of tank
 It should be possible to drain oil from tank without disconnecting any pipes or other fittings.
- c) Temperature of oil in hydraulic circuits should not exceed 60 °C in any case. Suitable arrangement should be incorporated to avoid overheating of oil under local weather conditions at continuous normal working of machine. Facilities for bleeding of air in case of air lock should be provided. Hydraulic reservoir, pump and allied equipment should be suitably segregated from machine in order to remove major source of heat. Hydraulic oils used on machine should be available in India. Hydraulic system elements should be from reputed manufacturers.

2.10. **PAINTING (As applicable)**

- a) Steel surfaces should be thoroughly cleaned by disc grinding/ sanding/ shot blasting/ sand blasting and painted (except mating surfaces) with two coats of red oxide, zinc chromate primer IS2074. Painted surface of bought out items should not be disturbed. Welded joints should be cleared from slag and spatters before painting.
- b) Fixed machine/ equipment/ support structures should be painted with two coats of synthetic enamel paint/ powder coated in apple green color shade #281 IS5-1978. Total dry film thickness on steel surfaces including primer should be about 50 microns.
- c) Moving machine/ equipment like crane, traverser, turntable, forklift, trolley etc should be painted with two coats of synthetic enamel paint/ powder coated in color shade RAL 2005, handrails in RAL 3026 and electric panels in RAL 7035. Total dry film thickness on steel surfaces including primer should be about 50 microns.

2.11. **STANDARDS (As per Latest applicable IS codes)**

Equipment and materials should comply with appropriate Indian Standards (latest). The following standards should be applicable in particular:

IS325-1979 (latest)- Three phase induction motors (corresponding to IEC Pub-34-1) (Latest)

IS1248 (latest)- Direct acting indicating analogue electrical measuring instruments and their accessories (corresponding to IEC Pub-51) (Latest)

IS1231-1974 (latest)- Dimensions for three phase induction motors (corresponding to IEC Pub 72-1) (Latest)

IS1271-1985 (latest)- Classification of insulation material for electrical machinery and apparatus in relation to their thermal stability in service (corresponding to IEC-Pub-85) (Latest)
 IS6875 (latest)- Push buttons and related control switches (corresponding to IEC Pub/73) (Latest)
 IS375-1963 (latest)- Marking and arrangement of switch gear, bus-bars, main connections and auxiliary wiring
 IS996-1979 (latest)- Single phase small AC and universal electrical motors
 IS1356 (latest)- Electrical equipment of machine tools
 IS2516 (latest)- Circuit breakers (corresponding to IEC Pub-56) (Latest)
 IS7752-1975 (Pt-I)- Guide for the improvement of power factor in consumer's installation

2.12. ELECTRICAL

Control gear for AC/ DC motors should incorporate following protection devices:

a) **NO VOLTAGE PROTECTION**

No voltage protection should be provided so that machine should not start up again by itself when, following an interruption supply is restored. This is achieved by incorporating contactor in control circuit, which goes off when supply interruption occurs. This contactor can be made ON only by pressing push button.

b) **SHORT CIRCUIT PROTECTION**

To protect against short circuits due to insulation failure or faulty connection HRC type fuses should be provided for each motor. Rating of fuse should be such as to take care of over current due to motor starting.

c) **OVER LOAD PROTECTION**

To prevent motors from overloading, overload protection should be provided separately for each motor. Three phase motors should be protected by overload tripping devices on each phase. For achieving above function, integrated motor protection relay with suitable contactor can be used.

d) **SINGLE PHASING PROTECTION**

A separate current sensitive delayed action single phasing preventer should be provided for each motor separately. Overload protection should not be treated as single phasing preventer.

2.13. Control equipment should be mounted in separate drip proof enclosures. Control enclosures and compartments should be designed to give adequate protection against ingress of dust, oil, coolant or chips and rodent bite. Control devices like contractors etc should be front mounted on a rigidly fabricated metal panel for ease of operation. All other electrics should be so installed that they are readily accessible when doors and covers are opened. Hinged covers should be interlocked with machine tool control to prevent operation of machine when cover is open. Motor should be energy efficient TEFC type (totally enclosed with or without fan-cooled frame). Screen protected drip proof type motor if used should be mounted inside protective enclosures. Electrical equipment should comply with requirements of Indian Electricity Act and Rules. All instruments should be of industrial grade A (IS 1248) switch board type. Range of instrument should

be such that maximum load expected in circuit should produce a deflection 60% to 80% of full scale. For main motor, F-class insulation should be provided. Motors should be designed to withstand frequent starts, stops, and reversals as demanded in operation of machine. Two earthing terminals should be provided on all electric motors including control gear.

2.14. **POWER SUPPLY (As applicable)**

Machine should be suitable for operation on 415V, 3 phase, 50 cycles AC, 3 wire or 4 wire system with neutral solidly earthed and should accept supply voltage variation up to $\pm 10\%$ and frequency variation up to $\pm 3\%$. However, rated power of the motor should be available at nominal voltage. Bidder should provide voltage stabilizer for machine if electrical motor power requirement is more than 30kW as detailed hereunder:

- a) In case of machine not equipped with NC, CNC and Thyristor controlled devices a suitable servo controlled voltage stabilizer of adequate capacity to cater for entire electrical load of machine having electrical motor load requirement exceeding 30 kW should be offered along with machine. Voltage stabilizer should be from reputed sources. Voltage stabilizer should conform to: (i) Input voltage 320-460 V 3 phase 4 wire unbalanced supply (ii) Output voltage 415V (iii) Regulation $\pm 1\%$ from No load to Full load (iv) Rate of correction 20 V per second per phase (v) Wave from distortion Nil (vi) Efficiency not less than 97% (vii) Winding and class of insulation copper wire wound with B class of insulation or better.
- b) In case of machine equipped with NC, CNC, Thyristor controlled devices and other sophisticated electronic gadgets including microprocessors etc, which are susceptible to power line spikes and surges, a suitable voltage stabilizer and ultra-isolation transformer of adequate capacity to cover for entire electrical load of machine should be offered conforming to specification for voltage stabilizer as mentioned above and isolation transformer to parameters (i) Transformer ratio 1:1 (ii) Winding copper wire wound with B-class insulation or better (iii) Protection to arrest spikes and surges to the order of 3 kV for 200-400 micro seconds duration (iv) Common mode noise rejection 120 dB (v) Isolation Capacitance 005 Pf resistance greater than 1000 mega Ohm.
- c) Voltage stabilizer should be equipped with a protective relay to trip AC power supply to machine instantaneously with audio and visual indication to operator. Settings of protective relay for low and high voltage should be 320 V and 460 V respectively. Protective relay should be provided on machine having electrical load below 30 kW. Indigenous make voltage stabilizer and isolation transformer from reputed manufacturer are acceptable.

3 **SPARES, TOOLS & TACKLES AND CONSUMABLES (as Applicable)**

3.1 **COMMISSIONING SPARES**

- a) The scope covers necessary commissioning spares as may be required during erection, start up and initial operation of machine until successful commissioning and performance guarantee/ proving tests.
- b) Process related consumables like gas, paint etc should be supplied by EPC Contractor only and equipment related materials up to performance guarantee tests like lubricant, refractory, hydraulic oil, grinding wheel, cutting tools, inserts, welding electrodes etc are to be supplied by bidder.
- c) Bidder should also supply machine specific consumables as specified in technical specification. Cost of commissioning spares should be included in the cost of machine/equipment.

3.2 **OPERATING & MAINTENANCE SPARES**

- a) The scope covers supply of normal perishable and non-perishable maintenance spares along with machine for normal operation and maintenance of machine, covering complete range of mechanical, hydraulic and electrical equipment including controls, for two years (warranty period) Cost of spares should be included in the cost of machine.
- b) Bidder should ensure proper identification of operating and maintenance spares.

- c) Spares mentioned in technical specification are minimum spares. Bidder should provide and include cost of additional items/ spares as recommended by OEM over and above the spares provided in technical specification.

3.3 **TOOLS & TACKLES**

- a) The scope covers supply of necessary tools, tackles, instruments and appliances for erection, testing, commissioning, operation and maintenance of machine. Cost of the same should be included in the cost of machine.
- b) Bidder should provide specification including names of suppliers giving sufficient details to enable BEML to procure at a later date when necessary such special tools, tackles, instruments and appliances.

3.4 **CONSUMABLES (as Applicable)**

- a) The scope covers supply of equipment related consumables including oils, lubricants, greases, fuel, chemicals, tools, inserts, welding electrodes, usual stores, materials and other consumables required for flushing/ initial fill/ fitment in machine till successful commissioning and taking over of machine by the employer/ BEML. Cost of the same should be included in the cost of equipment.
- b) Bidder should supply adequate quantities to cover wastage/ breakage during transportation, storage, handling, erection and commissioning until taking over.
- c) Bidder should also furnish optimal consumption rates of consumables along with estimated annual requirement, ordering specification and sources of supply to enable BEML to procure these for uninterrupted operation of machine. Bidder should furnish such information at the time of commissioning of equipment.

4 **INSPECTION AND TEST CERTIFICATES**

- 4.1. The scope covers supply of all items covered under schedule duly inspected, tested and certified by authorized representative of the employer or any other inspection agency nominated by the employer. Inspection charges of inspection agency should be borne by the employer. However, cost of testing should be borne by bidder.
- 4.2. For inspection of equipment as stated in clause #4.1 above, bidder should provide likely delivery and inspection schedule of items to the employer at least 60 days in advance of actual date of inspection for the employer to nominate the inspection agency. Bidder should be responsible for any delay in inspection and supply of equipment arising out of delayed submission of inspection & delivery schedule of equipment to the employer.
- 4.3. The employer may authorize the bidder to dispatch item in case it is not possible to carry out inspection as stated in clause #4.1 above. In such cases, after obtaining written permission of the employer, bidder should ensure that items are supplied duly inspected, tested and certified by original equipment manufacturer (OEM) along with bidder's/ manufacturer's test & guarantee certificates.
- 4.4. The employer should have the right of inspecting and testing equipment at any time during manufacture or before dispatch. Bidder should carry out such tests in appropriate manner in presence of authorized representative of the employer or any inspection agency nominated by the employer. Inspection, examination or testing carried out by the employer/ inspection agency should not relieve the bidder from any of his obligations under this contract.
- 4.5. Where special tests, in addition to agreed tests are required by the employer, bidder should bear the cost of testing only if such special test proves that equipment is not in accordance with specifications.
- 4.6. When tests have been satisfactorily completed at bidder/ OEM's premises, authorized representative of the employer or inspection agency nominated by the employer should forthwith issue a certificate to that effect. Issuance of certificate by authorized representative of the employer or inspection agency should not discharge the bidder of

his liability should the equipment on further inspection/ test during or after erection for not to comply with requirement of contract.

- 4.7. The scope covers supply of wire ropes, hooks, chains, slings, lifting tackles etc along with necessary test certificates, from government recognized test house, for having tested the item in accordance with relevant IS standards. Proof load test as per IS Specification should be conducted, either in-house or from a recognized test house.
- 4.8. The scope covers supply and commissioning of equipment conforming to statutory guidelines detailed in clause #1.5 along with necessary certificates from the concerned authorities for having met the requisite norms.
- 4.9. The scope covers supply of electrical and mechanical equipment duly tested in accordance with appropriate Indian Standard and as per technical specification specified in this schedule at bidder/ OEM premises. Bidder should provide relevant test certificates to the employer.

5 **INSTALLATION & COMMISSIONING**

- 5.1 The scope covers installation, erection and commissioning of machine/ equipment/ items under supervision of adequate number of technical experts/ technical advice from OEM (original equipment manufacturer). Bidder should ensure that earthing of equipment is tested as per Indian Electricity Rules. Bidder should ensure that machine has been properly erected and installed and there is no misalignment, slackness, skewness, vibration and unusual noise in equipment.
- 5.2 Bidder should commission machine within 30 days from the date of intimation by the employer. Bidder should carry out startup and trial operation tests (commissioning test) on receipt of authorization from the employer. On completion of erection of plant and equipment, tests should be by bidder to prove that unit has been supplied as per contract and after erection is fit for startup and commissioning. Tests should be performed on individual subassembly of unit wherever necessary and should be designed to conduct systematic check of components and functional operation thereof.
- 5.3 Trials should be carried out under no load and rated load conditions. During trial operation, all necessary adjustments should be made to ensure compliance with operating characteristics for complete equipment as stipulated in technical specifications. Bidder should demonstrate machine performance for a period of two shifts of eight hours each at site. BEML should associate his operating personnel as may be available for normal operation for purpose of startup and commissioning under guidance of bidder/ OEM.
- 5.4 Test results should be recorded jointly by bidder and authorized representative of the employer/ BEML. Bidder should rectify defects observed during commissioning. On completion of tests and liquidation of defects observed, the employer should issue a commissioning certificate within 7 days when the bidder has:
 - a) Submitted all documents in compliance with provisions of this contract as per clause #6.
 - b) Supplied all accessories/ items/ spares as per specification as per clause #3 and #2.14 above.
 - c) Resolved to the satisfaction of the employer/ BEML all objections/ observations, if any.
- 5.5 The employer/ BEML should take over machine/ equipment/ item physically after issue of commissioning certificate. After successful commissioning of machine at site, machine performance should be watched by BEML for a period of one month (each working day having two shifts of 8 hours) before final acceptance certificate is issued. Final acceptance certificate should be issued by the employer/ BEML when:
 - a) Bidder has rectified in a definitive manner all defects/ objections/ observations mentioned in commissioning certificate.
 - b) Bidder has submitted final documentation incorporating latest modifications.
 - c) Bidder has met any and all other obligations under this contract.

6 DOCUMENTATION (as Applicable)

The scope covers submission of necessary documentation as detailed hereunder. Cost of documentation should be included in the cost of equipment.

- 6.1 Bidder should submit documents detailed hereunder to the authorized representative of the employer at the time of joint check of equipment after unpacking.
- a) Original inspection/ test/ warranty/ guarantee certificates of equipment as per clause #4 above
 - b) Packing list
 - c) Copy of purchase order detailing specifications only.
- 6.2 Bidder should submit documents detailed hereunder (three copies each in English) to the authorized representative of the employer/ BEML at the time of commissioning of equipment.
- a) Foundation & layout drawings of machine and accessories used in installation and commissioning of machine.
 - b) Operating instructions & maintenance manuals including electrical circuitry and wiring, electronic control, safety features and circuitry, hydraulic, lubrication and pneumatic systems. Manual should also cover guidelines for trouble shooting of machine.
 - c) Catalogue giving part list number of each component and assembly drawings.
 - d) Complete machine spares part details indicating part no/ ordering specification and drawings along with list of suppliers to enable BEML to procure operating and maintenance spares post warranty period.
 - e) Consumption rates of consumables along with estimated annual requirement, ordering specification and sources of supply to enable BEML to procure these for uninterrupted operation of unit.
 - f) Details of service organization (contact person, address, phone, fax, e-mail), which should be responsible for after sales service
 - g) For CNC machines following additional documentations are to be supplied: Operators guide & Programming guide for CNC control system Diagnostic and troubleshooting guide of CNC control system Machine software listing

7 TRAINING

- 7.1 The scope covers necessary training by bidder/ OEM in operation and maintenance of machine for BEML personnel at site premises after machine has been installed and successfully commissioned. Period of training should be adequate and cover all aspects to make nominated staff of BEML to carry out operation, schedule attention, trouble shooting and repairs to these machines as and when required. Training should cover preventive maintenance including electrical & electronic circuit (card/ module replacement), hydraulics etc. Training should be imparted in English/ Hindi. Cost of training should be included in the cost of equipment.
- 7.2 The scope also covers training of a group of about eight officials of BEML/ employer for a period of around eight working days in design, operation and maintenance at OEM's premises for machines, which may be imported from abroad by bidder. Boarding, lodging and travel expenses of officials nominated for training will be borne by BEML/ employer. Bidder should bear cost of imparting training including training materials and will provide local transport. While the training program will be drawn in advance through mutual consultations, bidder will have no financial liability if no nomination is made for such training or nominated officials are not able to proceed for training.

4. Contract Key Dates:

Tentatively, key dates for different mile stones are tabulated hereunder which may undergo after change after mutual discussion, meeting the project requirement and timelines. These key dates shall be crucial and form the basis for project progress monitoring.

Key Dates	Date	Description of Stages
Key Date #1	DOC (Date of commencement)	DOC - Maximum within 07 days from the date of award, Submission of construction programme, mobilization of survey and soil investigation team.
Key Date #2	1 month from DOC	Submission of Soil investigation report, Design Basis (PDR Report), GADs & architectural drawings with material specification for manufacturing block, inspection block and other non-factory/utility buildings and facilities. Mobilization of resources for site development/formation works
Key Date #3	2 months from DOC	Submission of detailed structural design & drawings including foundation details for civil works pertaining to manufacturing and inspection blocks. (PFDR- pre final design review). Site development activity to start for Grading/Levelling/formation works
Key Date #4	4 months from DOC	Submission of structural design & drawings including foundation details for non-factory/utility buildings and other civil infrastructure. (PFDR)
Key Date #5	6 months from DOC	Submission of final design document (FDD) Start of foundation for other non-factory/utility buildings and other facilities, covered under phase-1
Key Date #6	6 months from DOC	Completion of earthwork/formation and area development as well as commencement of foundation work for manufacturing block No. 1 and inspection block.
Key Date #7	8 months from DOC	Final completion of 100% foundation work for manufacturing block No. 1 and inspection block also start of structural steel fabrication work for manufacturing block No. 1
Key Date #8	10 months from DOC	Final Completion of foundation for other non-factory/utility buildings and other facilities, covered under phase-1.
Key Date #9	13 months from DOC	Completion of non-factory buildings including entry exit gates, stabling and testing rail tracks excluding Office Complex & Multi level Car Parking
Key Date #10	14 months from DOC	Final Completion of structural steel fabrication & erection work of manufacturing block No. 01 and inspection block
Key Date #11	15 months from DOC	Final Completion of complete sheeting work of manufacturing block no. 1 and inspection block, including construction of side walls. Completion of Civil works of Office Complex and Multilevel Parking
Key Date #12	16 months from DOC	Completion of all works of manufacturing block -1 and inspection block, including Ground floor and First floor slab

Key Date #13	17 months from DOC	Completion of stabling track, dispatch track, run test track, pavements, foot paths, hard stands, drainage, Roads, Green Belt, Land scaping & horticulture works, street & area lighting etc.
Key Date #13A	17 months from DOC	Completion of MEP works of all buildings & Facilities
Key Date #14	18 months from DOC	Readiness of block-1 & Inspection Bay including MEP systems including cleaning of site
Key Date #15	18 months from DOC	Final Commissioning and hand over of manufacturing block 1 including all MEP's passenger/service lifts, Rain water harvesting, addressing punch points & handing over.

5. PAYMENT SCHEDULE

Payment against a building/facility/ infrastructure shall be made as per the percentage of total price of the facility against completion of milestone as mentioned below

A. Payment terms of RCC building

Milestone	Building Storey						
	G	G+1	G+2	G+3	G+4	G+5	
Design and Engineering	2%	2%	2%	2%	2%	2%	
Sub-structure up to plinth	20%	15%	15%	15%	13%	12%	
RCC superstructure up to ground floor Slab	25%	15%	10%	8%	7%	6%	
RCC upto 1 st floor slab		15%	10%	8%	7%	6%	
RCC upto 2 nd floor slab			10%	8%	7%	6%	
RCC upto 3 rd floor slab				8%	7%	6%	
RCC upto 4 th floor slab					7%	6%	
RCC upto 5 th floor slab						6%	
Masonry and Plaster	15%	15%	15%	15%	15%	15%	
MEP services*	10%	10%	10%	10%	10%	10%	
Finishes including water proofing	15%	15%	15%	15%	15%	15%	
External Development	5%	5%	5%	3%	2%	2%	
Completion and stability Certificate inclusive of furniture	8%	8%	8%	8%	8%	8%	

MEP services* also includes IT & data communication infrastructure in all facilities falling under the scope (wherever applicable).

B. Inspection & Testing Block

Activity	Payment (%)
Engineering	3%
Earth work and Substructure	15%
Structural steel Fabrication	27%
Structural steel Erection	10%
Roofing and cladding	15%
Industrial flooring	15%
Services and utilities	5%
Finishes and external Work	5%
Completion and structural stability certificate	5%

C. Car body manufacturing Block (Each)

Activity	Payment (%)
Engineering	5%
Sub structure up to Plinth	12%
Structural steel supply and Fabrication	27%
Erection	10%
Composite floor	7%
Roofing	10%
Wall cladding and Openings	8%
Industrial floorings	7%
MEP Fire and other Services	6%
External development and Finishing	3%
Completion and stability certificate inclusive of complete furniture	5%

D. STP

Activity	Payment (%)
Design and engineering	3%
Sub structure	30%
Super structure	20%
Waterproofing and protective works	7%
Pipe supports, trenches and chambers	7%
Building and ancillary & MEP	18%
Road drains and external development	5%
Installation of equipment	10%

For Services like road work, Trenches, Drains, Pathways, Hard stand, Parking areas, railway siding Payment shall be regulated as per percentage completion in terms of a square meter or running meter which ever is applicable

E. Switchyard

Activity	Payment (%)
Design and engineering	3%
Transformer Foundation	10%
Equipment Foundation	60%
Trenches	7%
Gravel Filling & Fencing	12%
External work, Finishing & Completion	3%
After Erection of switchyard equipment	5%

F. MEP Equipment/system

Activity	Payment (%)
Supply as per BOM	75%
Erection/installation	15%
Testing & Commissioning	5%
Final Handing over	5%

G. Completion schedule

Phase-1- 18 Months from the date of commencement.

The contractor is required to commence the work within 07 days from the date of award of works. The Contractor is expected to deploy adequate no. of manpower plants, machinery and all required resources commensurate with the required number / quantity for expeditious execution of works. The contractor may require to ensure working in all three shifts including Sundays and holidays (Non Deployment of a requisite number of skilled personnel as specified hereunder shall attract penalty as specified.

6. DEPLOYMENT OF TECHNICAL STAFF AND EMPLOYEES

Contractors Superintendence, Supervision, Technical staff & Employees

- A. The contractor shall provide all necessary superintendence during execution of the work and all along thereafter as may be necessary for proper fulfilling of the obligations under the contract.

The Contractor shall immediately after receiving letter of acceptance of the tender and before physical commencement of the work, intimate in writing to the Engineer-in-Charge, the name (s), qualifications experience, age, address (s) and other particulars along with certificates, of the principal technical representative to be charge of the work and other technical representative (s) who will be supervising the work. Minimum requirement of such technical representative (s) and their qualifications and experience shall not be lower as specified hereinunder. The Engineer-in-Charge shall within 3 days of receipt of such communication intimate in writing his approval or otherwise of such a representative (s) to the contractor. Any such approval may at any time be withdrawn and in case of such withdrawal, the contractor shall appoint another such representative (s) according to the provisions of this clause. Decision of the Engineer-In-Charge shall be final and binding on the contractor in this respect. Such a principal technical representative and other technical representative (s) shall be appointed by the contractor soon after receipt of the approval from Engineer-in-charge and shall be available at site before start of work.

All the provisions applicable to the principal technical representative under the clause will also be applicable to other technical representative(s). The principal technical representative and other technical representative (s) shall be present at the site of work for supervision at all times when any construction activity is in progress and also present himself/themselves, as required to the Engineer-in-Charge and / or his designated representative to take instructions. Instructions given to the principal technical representative or other technical representative (s) shall be deemed to have the same force as if these have been given to the contractor. The Principal Technical Representative and other technical representatives shall be actually available at site fully during all stages of execution work, during recording / checking/ test checking of measurements of works whenever so required by the Engineer- in-Charge and shall also note down instructions conveyed by the Engineer-in-Charge or his designated representative (s) in the site order book and shall affix his/their signature in token of noting down the instructions and in token of acceptance of measurements / checked measurements/ test checked measurements. The representative (s) shall not look after any other work. Substitutes, duly approved by engineer - in-Charge of the work in similar manner as aforesaid shall be provided in event of absence of any of the representative (s) by more than two days. If the Engineer-in-Charge, whose decision in this respect is final and binding on the contractor, is convinced that no such technical representative (s) is/are effectively appointed or is/are effectively attending

or fulfilling the provision of this clause, a recovery (non-refundable) shall be effected from the contractor as specified hereinunder and the decision of the Engineer-in-Charge as recorded in the site order book and measurement recorded checked/test checked in Measurement Books shall be final and binding on the contractor.

Further if the contractor fails to appoint suitable technical Principal technical representative and / or other technical representative (s) and if such appointed persons are not effectively present or are absent by more than seven days without duly approved substitute or do not discharge their responsibility satisfactorily, the Engineer-in-Charge shall have full powers to suspend the execution of the work until such date as suitable other technical representative (s) is/ are appointed and the contractor shall be held responsible for the delay so caused to the work.

The contractor shall submit a certificate of employment of the technical representative (s) (in the form of copy of **Form- 16 or CPF deduction** issued to the Engineer employed by him) along with every running account bill / final bill and shall produce evidence if at any times so required by the Engineer- in-Charge.

The contractor shall provide and employ on the site only such technical assistants as are skilled, and experienced in their respective fields and such foremen and supervisory staff as are competent to give proper supervision to the work. The contractor shall provide and employ skilled, semi-skilled and unskilled labour as is necessary for proper and timely execution of the work. The Engineer-in-Charge shall be at liberty to object to and require the contractor to remove from the works any person who in his opinion misconducts himself, or is incompetent or negligent in the performance of his duties or whose employment is otherwise considered by the Engineer-in Charge to be undesirable. Such person shall not be employed again at works site without the written permission of the Engineer-in-Charge and the persons so removed shall be replaced as soon as possible by competent substitutes.

The contractor shall not change his engineer/supervisory staff deployed at site. If Contractor wants to replace any of his staff due to unavoidable circumstances, he will seek permission of Engineer-In-Charge indicating reasons for such change, qualification and experience of the alternative employee suggested by him. The qualification and experience of the alternative staff shall not be inferior to the person employed earlier.

B. Requirement of Technical Representative(s) and recovery rate

Requirement of Technical Representative(s) and recovery rate

SI. No.	Minimum Qualification of Technical Representative	Discipline	Designation (Principal Technical representative)		Rate at which recovery shall be made per month from the contractor in the event of not fulfilling aforesaid provisions. (Monthly Deduction shall also be on pro-rate basis)	
					Figures Rs.	Words
1.	Bachelor degree in Civil Engineering	Civil	Project Manager		2,00,000	Two Lacs
2.	Bachelor degree in Civil Engineering	Civil	Construction Manager		1,50,000	One lac fifty thousand
3.	Bachelor degree in Civil Engineering	Civil	Planning Manager		1,50,000	One lac fifty thousand

4.	Bachelor degree in Civil Engineering	Civil	Railway Engineer	1,50,000	One lac fifty thousand
5.	Bachelor Degree in Architecture or Civil Engineering	Civil	Design Manager	1,50,000	One lac fifty thousand
6.	Bachelor Degree in Architecture	Architecture	Lead Architect	1,50,000	One lac fifty thousand
7.	Masters in Structural Engineering	Structural	Lead Structural Engineer	1,50,000	One lac fifty thousand
8.	Bachelor Degree in Environment/sustainability Engg.	Environment/sustainability	Sustainability Manager	1,50,000	One lac fifty thousand
9.	Masters in Structural Engineering	Structural	Structural Engineer	1,00,000	One Lac
10.	Bachelor degree in Mechanical Engineering	Mechanical	Lead Mechanical Engineer	1,00,000	One Lac
11	Bachelor degree in Mechanical Engineering	Mechanical	Mechanical Engineer	1,00,000	One Lac
12	Bachelor degree in Electrical Engineering	Electrical	Lead Electrical Engineer	1,00,000	One Lac
13	Bachelor degree in Electrical Engineering	Electrical/Mechanical	Electrical Engineer	1,00,000	One Lac
14	Bachelor degree in Civil Engineering	Civil	Construction Engineer/Road Engineer	1,00,000	One Lac
15	Bachelor degree in Civil/Mechanical Engineering	Civil Engg.	HSE Engineer	1,00,000	One Lac
16	Bachelor degree in Civil/Mechanical Engineering	Civil Engg. / Architecture	QA/ QC Engineer	75,000	Seventy Five thousand
17	Bachelor degree in Civil Engineering	Civil Engg.	Quantity Surveyor	75,000	Seventy Five thousand

- a. Technical representative at Sr. No 1 TO 16 shall be deployed during the complete project duration (construction work). Deployment of other technical representative shall be based on work program as approved by Engineer-In-Charge.

C. Equipment

The Bidder shall deploy, as per the mutually agreed programme.

The capacity of equipment plant and machinery of various MEP systems have been envisaged in the tendered work as per preliminary assessment and design basis report. Upon award, during planning, the requirement need to be re-assessed and finalized in consultation with BEML and system may be designed accordingly.

As per the design of system BOM to be finalized and supply may be done accordingly in line with project schedule and requirement.

Note:

Numbers of plant, machinery/equipment indicated in the list is tentative and is not final. This has been worked out based on preliminary assessment. Which shall be used for the purpose of evaluation of bidders capability in line with QCBS parameter, Final numbers shall be arrived after mutual discussion upon award of work for deployment at site as per requirement . Failure to deploy the above equipment as per mutually agreed programme shall attract penalty @ Rs. 5,000/- per day of delay in deployment for each equipment .

7. **INSTRUCTIONS TO BIDDERS**

1. Bid Validity: The tender shall be valid for 180 days from the last date of submission of the tender. In case the day upto which the bids are to remain valid falls on/ subsequently declared a holiday or closed day for the Procuring Entity, the bid validity shall automatically be deemed to be extended upto the next working day. In exceptional circumstances, before the expiry of the original time limit, the Procuring Entity may request the bidders to extend the validity period for a specified additional period. The request and the bidders' responses shall be made in writing or electronically. A bidder may agree to or reject the request. A bidder who has agreed to the Procuring Entity's request for extension of bid validity, in no case, he shall be permitted to modify his bid.
2. BEML Limited shall not be bound to accept the lowest tender and reserves the right to reject any or all the Tenders without assigning any reason.
3. Late tenders and conditional tenders are liable to be rejected. The Company does not bind itself to accept the lowest or any tender or give any reasons for not doing so.
4. The Bidders shall not be at liberty to withdraw or modify his tender or any terms and conditions thereof before the expiry of said period. Bidders are expected to clarify only such points as asked for specifically by the Purchasing Officer in writing. Any withdrawal or modification made within the said period constitutes breach of contract and the Bidder shall be liable for damages to the Company in consequence thereof. He shall, in addition, forfeit to the Company the EMD.
5. Supplier' means a person having been included in a contract as a Contractor and also means a firm or company with whom the order for supply/execution of work is placed and shall be deemed to include the supplier's successors, (approved by BEML Ltd.,) representatives, heirs, executors and administrators. The supplier may also be referred to as the supplier, Contractor or vendor.
6. Any tender which proposes any alterations to any of the conditions laid down or proposes any other conditions of any description whatsoever is liable to be rejected.
7. The following requirements shall be strictly complied with
 - a) The tender should be accompanied by a certified true copy of the power of attorney of the signatory of the documents to be uploaded online.
 - b) The drawing should be returned along with the tender documents if any.
 - c) Bidders shall ensure that their tender is up loaded well in advance before the time and date stipulated in the tender notification/documents.
8. The submission of a tender by a Bidder implies that he has read all the terms and condition of tender and has made himself aware of the scope and specifications of the work to be done and local conditions and other factor bearing on the execution of the work.
9. This instruction shall be deemed to form an integral part of the contract to be entered for this work.
10. Should a Bidder find discrepancies of omissions in the drawings or any of the tender documents or should be in doubt as to their meanings he should at once address the authority inviting the tender for clarification. Every endeavour is made to avoid any error which can materially affect the basis of the tender but the successful Bidder shall take upon himself to provide for the risk of any error which may be subsequently discovered and shall make no subsequent claim on account thereof.

11. The Contractors responsibility for this contract shall commence from the date of commencement mentioned in the work order which will be issued by the Engineer in- Charge after acceptance of work.
12. If the Bidder deliberately gives wrong information in his tender or creates conditions favourable for acceptance of his tender, the Accepting Officer reserves the right to reject such tender at any stage, forfeit the EMD, and take Administrative Action against the Bidder like non-issue of tenders etc., as deemed fit by the Accepting Officer.
13. The Bidder shall not increase their quoted rates in case the Accepting Officer negotiates for reduction in rates, such negotiations shall not amount to cancellation or withdrawal of the original offer and the rates originally quoted shall be binding on the Bidder.
14. In the event of a tender being submitted by a Partnership Firm, it is necessary to upload the Partnership Deed along with name of the authorized signatory to deal on this contract through a Power of Attorney by the other partners. The copy of the power of attorney along with the tender shall be uploaded.
15. All concrete shall generally conform to I.S. 456. Any concrete that does not conform to required strength shall be redone at the cost of contractors. Concrete cubes will be prepared by the contractors and same to be tested as per code of practice at the cost of contractor as directed by Engineer- In-Charge.
16. Plank/Steel shuttering shall only be used as ordered by the Engineer-in-charge. The concrete shall be consolidated by Mechanical Vibrator, as directed by Engineer-incharge.
17. Bailing out of rain water, if required during excavation, shall be the responsibility of the contractor and no extra payment shall be allowed for bailing out of sub soilwater.
18. Works shall be executed with the materials of Indian standards specifications of approved quality and manufacture and best workmanship.
19. The Agency should give undertaking that they have not been blacklisted debarred from quoting by any Govt./PSU organizations in the last Five years from the date of Tender Notice.
20. Manufactured Sand can be used in Civil Works including plastering works and subjected to every load should accompany with a NABL Test Report/trip shall be accompanied with MTC.
21. After Complete QSBS evaluation, the highest resulted value (Technical and Financial in the ratio of 70:30) tender has to submit the original documents for verification and for award of work if requested by BEML. If the document submitted is found fake PEMD/EMD shall be forfeited and agency is liable for rejection and debarring minimum two years from quoting to BEML.
22. In case of any increase/decrease in new taxes or introduction of new taxes by enactment of law by the State or Central Govt after the submission of the tender or during the tenure of contract, such increase/decrease in tax will be reimbursed to the extent applicable to that contract on production of proof of remittance.
23. The Contractor may use Ready Mixed Concrete (R.M.C) without claiming for anyextra cost subjected to satisfying the following conditions. The agency whichsupplies R.M.C to be got approved by BEML. The R.M.C shall comply with therequirements of approved design mix and the quality plan for the same shallinclude the Supplier's certificate along with inspection of materials in the bins atthe site of mixing by BEML at the cost of Contractor.
- 24.** Works comprising of concreting work exceeding 6 cum per day involving casting of flooring, roofing, columns Retaining wall and other RCC members may compulsorily be undertaken with

ready mix concrete or as directed by Engineer-in-Charge. **Procuring Entity - Rights and Disclaimers**

a) The Procuring Entity

Bids are to be addressed to the BEML. The Tender Inviting Authority (TIA) is the designated officer for uploading and clarifying this Tender Document. The contract may designate, as required, counterpart Contract Manager/ Civil Engineer-In-charge (or Contract Management Team); interim/ ultimate Beneficiaries of Services and Paying authority who shall discharge designated function during contract execution.

b) Right to Intellectual Property and confidentiality:

- I. The Tender Document and associated correspondence are subject to copyright laws and shall always remain the property of the Procuring Entity and must not be shared with third parties or reproduced, whether in whole or part, without the Procuring Entity's prior written consent.
- II. However, Bidders may share these to prepare and submit its bid with its employees, subcontractor(s), or holding Company. Bidders shall obtain from them an undertaking of confidentiality similar to that imposed on Bidder under this clause.
- III. This condition shall also apply to bidders who do not submit a bid after downloading it or who are not awarded a contract in the process.
- IV. The obligation of the Bidders under sub-clauses above, however, shall not apply to information that:
 - a. now or hereafter is or enters the public domain through no fault of Bidder;
 - b. is legally possessed by Bidder at the relevant time and was not previously obtained, directly or indirectly, from the Procuring Entity;
 - c. Otherwise lawfully becomes available to Bidder from a third party that has no obligation of confidentiality.
- V. The provisions of this clause shall survive completion or termination for whatever reason of the Tender Process or the contract.

c) Right to Reject any or all Bids

The Procuring Entity reserves its right to accept or reject any or all Bids, abandon/ cancel the Tender process, and issue another tender for the same or similar Goods at any time before the award of the contract. It would have no liability to the affected Bidder or Bidders or any obligation to inform the affected Bidder or Bidders of the grounds for such action(s).

d) Regarding Documents/ guidelines

The Tender Document, ensuing communications, and Contracts shall determine the legal and commercial relationship between the bidders/ contractors and the Procuring Entity. No other Government or Procuring Entity's document/ guidelines/ Manuals including its Procurement Manual (for internal and official use of its officers), notwithstanding any mention thereof in the Tender Document, shall have any locus-standii in such a relationship. Therefore, such documents/ guidelines/ Manuals shall not be admissible in any legal or dispute resolution or grievance redressal proceedings.

e) Regarding Information Provided

Information contained in the Tender Document or subsequently provided to the Bidder(s) is on the terms and conditions set out in the Tender Document or subject to which that was provided. Similar terms apply to information provided verbally or in documentary or any other form, directly or indirectly, by the Procuring Entity or any of its employees or associated agencies.

f) Regarding Tender Document:

- I. The Tender Document does not purport to contain all the information Bidder(s) may require.

It may not address the needs of all Bidders. They should conduct due diligence, investigation, and analysis, check the information's accuracy, reliability, and completeness, and obtain independent advice from appropriate sources. Information provided in the Tender Document to the Bidder(s) is on a wide range of matters, some of which may depend upon interpreting the law. The information given is not intended to be an exhaustive account of statutory requirements and should not be regarded as a complete or authoritative statement of law. The Procuring Entity, its employees and other associated agencies accept no responsibility for the accuracy or otherwise for any interpretation or opinion on law expressed herein.

- II. The Procuring Entity, its employees and other associated agencies make no representation or warranty for the accuracy, adequacy, correctness, completeness or reliability, assessment, assumption, statement, or information in the Tender Document. They have no legal liability, whether resulting from negligence or otherwise, for any loss, damages, cost, or expense that may arise from/ incurred/ suffered howsoever caused to any person, including any Bidder, on such account.

g) Facilities to be Provided by the Procuring Entity

- I. Unless otherwise stipulated in the Tender Document, no Facilities (including Reference Documents, Medical facilities, Rooms, Furniture, Transport, Access to IT Services etc.) shall be provided by the Procuring Entity to Contractor at Site.
 - II. Unless otherwise stipulated in the Tender Document, The Procuring Entity may supply without any obligation to do so, to the contractor part or whole of the quantity of the water and electricity required for the delivery of Services from the Procuring Entity's existing water/ electricity supply system at or near the site of Services on specified terms and conditions and on chargeable basis (unless specified otherwise), provided that the contractor shall arrange, at his own expense, to effect the connections and lay additional pipe/ power lines and accessories on the site. Nevertheless, it shall be the responsibility of the contractor to install adequate alternative arrangements to tide over outages in utilities or failure in supply by the Procuring Entity, and that the contractor shall not be entitled to any compensation— nor shall this be a reason for the delay in delivery of Services.
 - III. If so, stipulated in the Tender Document, The Procuring Entity may hire to the contractor non-key Equipment owned and separable by Procuring Entity for use during execution of the Services on terms and conditions and on a chargeable basis as may be stipulated in the contract or a separate agreement for Hire of such equipment.
25. Unless otherwise stipulated in the Tender Document, the currency of bid and payment shall be quoted by Bidder entirely in Indian Rupees. All payments shall be made in Indian Rupees only.

26. Corrigenda/ Addenda to Tender Document

Before the deadline for submitting bids, the Procuring Entity may update, amend, modify, or supplement the information, assessment or assumptions contained in the Tender Document by issuing corrigenda and addenda. The corrigenda and addenda shall be published in the same manner as the original Tender Document. Without any liability or obligation, the Portal may send intimation of such corrigenda/ addenda to bidders who have downloaded the document under their login. However, the bidders' responsibility is to check the website(s) for any corrigenda/ addenda. Any corrigendum or addendum thus issued shall be considered a part of the Tender Document. To give reasonable time to the prospective bidders to take such corrigendum/ addendum into account in preparing their bids, the Procuring Entity may suitably extend the deadline for the bid submission, as necessary. After the procuring entity makes such modifications, any Bidder who has submitted his bid in response to the original invitation shall have the opportunity to either withdraw his bid or re-submit his bid superseding the original bid within the extended time of submission.

27. Clarification on the Tender Document

A Bidder may seek clarification of the Tender Document from Office/ Contact Person/Help Desk as mentioned in NIT, provided the clarifications are raised before the clarification end date mentioned in NIT (or if not mentioned, within 7 days before the deadline for the bid submission). The Procuring Entity shall respond within 5 working days of receipt of such a request for clarification. Any modification of the Tender Document that may become necessary due to the clarification shall be made by the Procuring Entity through an Addendum/ Corrigendum.

28. Preparation of Bids

a) The bid

I. Language of the bid

Unless otherwise stipulated in the Tender document, the bid submitted by Bidder and all subsequent correspondence and documents relating to the bid exchanged between Bidder and the Procuring Entity shall be written in English. However, the language of any printed literature furnished by Bidder in connection with its bid may be written in any other language provided a translation accompanies the same in the bid language. For purposes of interpretation of the bid, translation in the language of the bid shall prevail.

II. Acquaintance with Local Conditions and Factors

The Bidder, at his own cost, responsibility, and risk, is required to visit, examine, and familiarize himself with all the site/ local conditions and factors. The Bidder acknowledges that before the submission of the bid, he has, after a complete and careful examination, made an independent evaluation of the Site/local conditions, infrastructure, logistics, communications, the legal, environmental, and any other conditions or factors, which would have any effect on the performance of the contract. Bidders shall themselves be responsible for compliance with Rules, Regulations, Laws and Acts in force from time-to- time at relevant places. On such matters, the Procuring Entity shall have no responsibility and shall not entertain any request from the bidders in these regards.

III. Cost of Bidding

The Bidder(s) shall bear all direct or consequential costs, losses and expenditure associated with or relating to the preparation, submission, and subsequent processing of their Bids, including but not limited to preparation, copying, postage, delivery fees, expenses associated with any submission of samples, demonstrations, or presentations which the Procuring Entity may require, or any other costs incurred in connection with or relating to their Bids. All such costs, losses and expenses shall remain with the Bidder(s), and the Procuring Entity shall not be liable in any manner whatsoever for the same or any other costs, losses and expenses incurred by a Bidder(s) for participation in the Tender Process, regardless of the conduct or outcome of the Tender process.

IV. Interpretation of Provisions of the Tender Document

The provisions in the Tender Document must be interpreted in the context in which these appear. Any interpretation of these provisions far removed from such context or other contrived or between-the-lines interpretation is unacceptable.

V. Alternate Bids not allowed.

Unless otherwise stipulated in the NIT/ Tender document, conditional offers, alternative offers, multiple bids by a bidder shall not be considered. The Portal shall permit only one bid to be uploaded.

29. General:

- i. BEML reserves right to reject the tender due to unsatisfactory past performance in the

execution of a contract at any of BEML projects / units.

- ii. Bidders participating in the tender should declare in their offer that whether they have been black-listed / kept on hold for a specified period / given Business holiday for a specified period by any public sector undertaking or Government departments. The reasons for such action with details and the current status of such hold shall be furnished to BEML.
- iii. In case any person/persons, Company, firm, Associations having any litigations, arbitration cases between themselves and BEML Ltd, pending before the Court / Arbitrator or initiated litigations/arbitrations in connection with any contract / tender issued by BEML Ltd and any contractor has defaulted against the BEML's orders, they are not eligible to participate in this tender.
- iv. BEML may decide to scrap the tender/refloat the tender without assigning any reasons thereof before LOI/PO is committed. BEML reserves the right to accept, split, divide, negotiate, cancel or reject any tender or reject all tenders at any time prior to the award of the contract without incurring any liability to the affected Bidders or any obligation to inform affected Bidder, the grounds of such action.
- v. BEML reserves the right to verify, in its sole discretion, any information given by the bidders independently through any third-party agencies. During this process, if it is found that any of the information given by the bidder is false / misleading, offers of such bidders would be out rightly rejected.
- vi. BEML also reserves the right to independently assess the capability and capacity of the bidder for execution of the order/contract. BEML's decision on any matter regarding short listing of bidders shall be final.
- vii. The Tender / Notice Inviting Tender is not an offer or a contract.
- viii. Bidders will not be compensated or reimbursed for the costs incurred in preparing Proposals. Proposals shall become BEML property.
- ix. BEML's decision is final for Evaluation of the offers.
- x. Refer BEML Purchase Manual (can be accessed in BEML website www.bemlindia.in) for Important terms and conditions of tender and General Terms & conditions applicable to contracts & purchase orders refer General Terms & Conditions

8. **GENERAL CONDITIONS OF CONTRACT (GCC)**

A. DEFINITIONS & CONDITIONS OF CONTRACT:

A.1 Contract: The contract means all the documents forming part of the tender and acceptance there of and the formal agreement executed between BEML and the Contractor, together with the entire contents of these documents viz.,

- a. Notice inviting Tender (NIT)/ Invitation to Bid (ITB).
- b. SRM- Supplier Relationship Management
- c. BOQ- Bill of Quantities
- d. GTC- General Terms and Conditions
- e. SG – Standard Gauge, BG – Broad gauge of rail tracks.
- f. Instructions to Bidders.
- g. Technical Specifications & Particulars of specifications, Bill of Quantities.
- h. Tender Drawings.
- i. Price Bid.
- j. Contract Agreement.
- k. General Conditions of Contract as per standard form.
- l. Special Conditions of Contract.
- m. Any Clarifications/Amendments/Addendum issued before submission of tender.
- n. Acceptance Letter by the Accepting Officer and Work Order by Officer-in-Charge and any correspondence that has taken place between the Contractor and BEML from the time the tender is submitted till the acceptance is communicated.
- o. Final Deviation Order signed by BEML & the Contractor.
- p. Mutually agreed amendment/s executed by Parties.

All the above documents taken together shall be deemed to form one contract and shall be complementary to one another.

A.2 In the contract, the following expressions shall, unless the context otherwise requires, have the meanings, hereby respectively assigned to them: -

- I. The expression "Works" or "Work", shall unless there be something either in the subject or context repugnant to such construction, be construed and taken to mean the Works by or by virtue of the Contract contracted to be executed whether temporary or permanent and whether original, altered, substituted or additional.
- II. "WORKS SITE" and "SITE OF WORKS"/"SITE", shall mean the extent of land which the company places at the disposal of the Contractor or provides access to, from time to time for the purpose of executing the contract Works. In other words, the site shall mean the land, places on, into or where Work is to be executed under the Contract or any adjacent land, path or street or where Work is to be executed under the Contract or any adjacent land, path or street which may be temporarily permitted to be used for the purpose of carrying out the Contract.
- III. "CONTRACTOR", shall mean the individual, partnership firm or company undertaking the Works and shall include the legal / personal representative of such individual or the persons composing such firm or or company, or the successors / administrators of such firm or company and the permitted assignees of such individual, firm or company.
- IV. "BIDDER OR TENDERER", shall means the person, firm or company submitting a tender

- (bid) against the invitation to Tender(bid) and includes his/its/their staff, consultants, parent and associate and subsidiary companies, agents, sub-contractors and suppliers, heirs, executors, administrators, representatives, successors.
- V. "CONTRACTOR'S REPRESENTATIVE", shall mean the person responsible for execution of the contract who shall be so declared by the Contractor and who shall be authorised under a duly executed power of attorney to comply with the instructions. He shall be capable of taking responsibility for proper execution of Works.
 - VI. "SUB-CONTRACTOR", shall mean the individual, firm, LLP, Company, Corporation to whom any part of the Work has been sub-contracted by the Contractor and shall include his heirs, his executors, administrators, successors, legal representatives, as the case may be.
 - VII. "ENGINEER", "ENGINEER-IN-CHARGE(EIC)", "OFFICER-IN-CHARGE (OIC)", "PROJECT IN CHARGE(PIC)", shall mean the Engineer / Representatives of BEML who shall supervise and be in charge of the Work or as may be notified at the time of Tender or issuance of Letter of Acceptance.
 - VIII. "CONSULTANTS", "ARCHITECTS" and "CONSULTING ENGINEERS", means third party consultants/professionals appointed by BEML for the specific project, including the consultant's representative.
 - IX. "ACCEPTING OFFICER", Authorized officer who accept the contract and under whose authority acceptance letter is issued.
 - X. "COMPANY", "EMPLOYER", "BEML", "CLIENT", SHALL MEAN "BEML LIMITED".
 - XI. "TENDERED VALUE" Shall mean the value of the entire Work as stipulated in NIT (Notice Inviting Tender) at estimated value.
 - XII. "THE DATE OF COMMENCEMENT OF WORK", The date of commencement of Work shall be the date of start as specified in acceptance letter or the first date of handing over of the site, whichever is later, in accordance with the phasing if any, as indicated in the tender document.
 - XIII. "THE ACTUAL DATE OF COMPLETION OF WORK", shall mean the date mentioned in the Completion Certificate issued by BEML.
 - XIV. "GST", shall mean Goods and Service Tax - Central, State and Inter State.
 - XV. "ORIGINAL CONTRACT VALUE/ Contract sum", shall mean the sum stated in the Letter of Acceptance/Contract Agreement.
 - XVI. "LETTER OF ACCEPTANCE (LOA)", shall mean the letter from the Accepting Authority to the Contractor, conveying acceptance of the Tender. Legally communication of acceptance of offer is considered complete as soon as it is submitted to Postal authorities / Email.
 - XVII. "DRAWINGS", shall mean the plans, sections, elevations and details of Works annexed to tender document and such further drawings as the Engineer may issue from time to time, during the progress of Works and shall include tracings and photographic prints.
 - XVIII. "SCHEDULE BANK", shall mean a bank included in the second Schedule to the Reserve Bank of India Act 1934, or modification there to
 - XIX. "TENDER OR BID", shall mean the offer (Technical and/or Financial) made by individual, firm, LLP, Company or corporation for the execution of the Works.
 - XX. "BILL OF QUANTITIES(BOQ)", is a description showing items of work with detailed specification/s and their respective estimated quantities, based on which the Bidder is required to quote.
 - XXI. "SPECIAL NATURE OF WORK", shall mean any Work(s) or part thereof for which Defect Liability Period is more than One year as indicated in the BOQ.
 - XXII. "CONTRACT AGREEMENT/AGREEMENT", shall means the agreement between the parties

as per the format provided.

A.3 Interpretations:

- I. Where the context so requires, words imparting the singular only also include the plural and vice versa. Any reference made to masculine gender includes all genders, as the context may require.
- II. Headings and Marginal notes to these General Conditions of Contract shall not be deemed to form part thereof or be taken into consideration in the interpretation or construction thereof or of the contract.

A.4 WORKS TO BE CARRIED OUT:

The Work to be carried out under the Contract shall, except as otherwise provided in these conditions, include all laborers, materials, tools, plants, equipment, transport, etc. which may be required in preparation of and for and in the full and entire execution and completion of the Works. The descriptions given in the Bill of Quantities shall, unless otherwise stated, be held to include wastage on materials, carriage and cartage, carrying and return of empties, hoisting, setting, fitting and fixing in position and all other labor necessary in and for the full and entire execution and completion of the Work as aforesaid in accordance with good practice and recognized principles.

A.5 SUFFICIENCY OF TENDER:

- a) The Contractor shall be deemed to have satisfied himself before tendering as to the correctness and sufficiency of his tender for the Works and of the rates and prices quoted in the Bill of Quantities, which rates and prices shall, except as otherwise provided, cover all his obligations under the contract and all matters and things necessary for the proper completion and maintenance of the Works, including the Site conditions.
- b) Quoted rates shall also include the following:
 - i) Working hours as per factory timings.
 - ii) Movement of men, material and stacking all as per conditions of contract and as directed by the OIC/EIC.
 - iii) Removing of surplus materials and stacking all as per conditions of contract and as directed by the OIC/EIC.
 - iv) Shall be for Work on all floors and heights unless otherwise specifically sought by BEML in tender documents.

A.6 DISCREPANCIES, ADJUSTMENT OF ERRORS AND ORDER OF PRECEDENCE:

The several documents forming the Contract are to be taken as mutually explanatory of one another; detailed drawings being followed in preference to small scale drawing and figured dimensions in preference to scale. If any contradictions are observed in different components of the tender, the following precedence shall be observed:

- i. Mutually agreed amendment/s executed by Parties.
- ii. Final Deviation Order signed by BEML & the Contractor
- iii. Acceptance Letter by the Accepting Officer and Site handing over letter (workorder) by Officer-in-Charge.
- iv. Any written clarifications issued by OIC/EIC after submission of tender.
- v. Any Clarifications/Amendments/Addendum issued before submission of tender.
- vi. Notice inviting Tender (NIT)/ Invitation to Bid (ITB)
- vii. Instructions to Bidders.
- viii. Contract Agreement.
- ix. Price Bid / BOQ.

- x. Technical Specifications & Particulars of specifications.
- xi. Tender Drawings.

- xii. Special Conditions of Contract.
- xiii. General Conditions of Contract, as per standard form.

Note:

1. If there are varying or conflicting provisions made in any one document forming part of the Contract, the PIC/OIC/EIC shall be sole deciding authority with regard to the intention of the document and his decision in this respect shall be final and binding on the Contractor.
2. In the event of any error in the description or in the quantity in Price bid or any omission there from shall not vitiate the Contractor or release the Contractor from the execution of whole or any part of contract comprised there in according to the drawings and specifications, or from any of his obligations under the contract.

A.7 SIGNING OF CONTRACT:

A) Contractor on receipt of Purchase order/Work order, shall submit the signed copy of same accepted in all respect within seven days from date of Purchase order/Work order to PIC/OIC/EIC. Further, Contractor, shall submit agreement on a non-judicial stamp paper of suitable value in a prescribed format provided in the tender within 30 days from the date of Acceptance Further, no payment for the Work done will be made unless contract is signed by the Contractor.

Contractor shall sign the contract consisting of:-

- i. Formal contract agreement on a non-judicial stamp paper in a prescribed format provided in the tender.
 - ii. The Notice inviting tender (NIT), all the documents including drawings, if any, forming the tender as issued at the time of invitation of tender and acceptance thereof together with any correspondence leading thereto.
 - iii. All Standard forms mentioned in the tender document consisting of
 - (a) Various standard clauses with corrections up to opening date of tender along with annexure thereto.
 - (b) Safety Code mentioned in the tender.
- B) Any Agreement, Bank Guarantee, any Hypothecation deed etc. required to be executed under this Contract shall be submitted by the Contractor with proper stamp duty as per the Formats enclosed respectively. However, the Accepting Officer shall have the rights to alter, modify, delete any content in such formats as deemed fit by him.

A.7(A) TENDER OR AGREED RATE:

1. The contractor shall agree not to petition for revision of rates tendered for by him under any circumstances at any stage of the work, either during execution or when the final claims are settled.
2. In the event of anything evidently necessary to the due and complete performance of the works being omitted to be shown on the drawings or described in the specification or being omitted from the Bill of Quantities through oversight or error, the contractor shall, notwithstanding, execute (in the most perfect manner) all such works the same as if they had been severally shown, described and included without being entitled to make any extra claim or charge.
3. The contractor shall satisfy himself or shall be deemed to have satisfied himself as to the nature of the sub-soil, the three dimensions, levels, character and nature of all roads, existing drains, sewers, water, gas or other mains, electric cables and other things as regards any connection they may have with the works the subject of the

contract, and he shall also inspect the site of the works and surroundings, the means of access there to and egress therefrom and shall generally obtain his own information on all matters and things which can in any manner influence his tender, No claims for extra works otherwise will be allowed in consequence of any misunderstandings, error or incorrect information on these points, or of any other in- accuracies in reference thereto, which may appear on the drawings, or in the specification, nor shall the contract be nullified in consequence of any such misunderstanding, error incorrect information or in-accuracies

A.8 LANGUAGE OF CONTRACT & MODE OF CORRESPONDENCE

a. Language of Contract:

The Contract document shall be drawn up in English. All certificates, notices, written orders or letters, to be given by the BEML or the PIC/OIC/EIC to the Contractor, shall be deemed to have been served, if the same are delivered to the Contractor or his Authorised Representative, or delivered or left at or posted by speed post /registered post to the given address of the Contractor or Contractor's registered office or principal place of business and essentially delivering the same by e-mail duly attached with scanned copy of such certificates, notices, written orders or letters and Proof of Dispatch (POD). Such documents shall be deemed to have been received on the day they are left or delivered, or in the case of postal transmission, on the day they would ordinarily have reached but not exceeding 7 days from the date of posting inclusive of day of posting, in any case.

b. Address for communication:

The Contractor shall furnish his postal address/ registered office address which shall also include e-mail address for communication.

c. Change of Address:

Either party may change the nominated address by prior written notice to the other party. However, either party shall not change their email address during currency of the contract without obtaining prior consent from the PIC/OIC/EIC.

A.9 LAWS GOVERNING THE CONTRACT:

The contract shall be governed by the laws in force in India, and the State of Madhya Pradesh, to the extent they may apply.

A.10 HANDING OVER OF SITE FOR COMMENCEMENT OF WORK:

The Contractor having signed the contract, the PIC/OIC/EIC will forthwith give him notice to commence the Work by issuing Work order mentioning handing over of Site and the Contractor shall upon receipt of such notice commence the works and carry them on at such point or points and in such portions as directed by PIC/OIC/EIC from time to time. Work shall start on priority basis as per BEML requirement/notification. However, if any portion of site is not made available by BEML for any reason whatsoever no claim on account of this towards compensation or otherwise will be entertained. The handing over of Site for carrying on the Works shall not confer any right over work site except temporary possession only for the purpose of the Works under the Contract.

B. SECURITY DEPOSIT

- a. The successful Bidder shall be required to furnish security deposit for the fulfilment of contract and the amount shall be 10% of the value of the contract, to be paid by the contractor. No waiver can be allowed in this regard. Such security deposit shall not entail any interest payment on refund.

- b) The contractor shall choose any one of the following options for payment of security deposit in writing as under:
- i. The contractor shall within 30 days of acceptance of the contract deposit, the difference between Earnest Money and full Security Deposit by Demand Draft/Banker's cheque drawn on any of the commercial bank made in favour of Company. PEMD held with BEML cannot be considered for such adjustment in the Security Deposit payable by the contractor.
 - ii. Security Deposit amount shall be deducted from the running bills of the contractor at the rate of 10% or higher of the gross value of each bill. However, the entire security deposit amount shall be deducted before completion of 90% of work.
 - iii. Performance bank guarantee shall be submitted within 30 days of acceptance of the contract and Bank guarantee drawn on any of the commercial bank made as format enclosed in the NIT and it should remain valid for a period of 60 (sixty) days beyond the date of completion of all contractual obligations of the contractor, including Defect Liability Period (DLP).
- c) The above deposit shall be held by the Company as security for the satisfactory performance of the contract. All compensations or other sums or money payable by the contractor to the Company under the terms and conditions of this contract shall be deducted from this security deposit or from any other sums that shall be due, or shall become due to the contractor by the Company on any account whatsoever and in the event of the security deposit being reduced by reasons of any such deductions the contractor shall within ten days there after make good these deductions.

B.1 Claims of performance guarantee/Security Deposit:

BEML shall have full rights whatsoever to encash any bank guarantee submitted under this Contract at any time during the validity of the guarantee and the Contractor shall have no right or claim whatsoever in the matter of encashment of the bank guarantee amount by BEML and any disputes/ claim whatsoever in this regard shall only be settled by means of Dispute Resolution as provided for in contract and the decision of BEML as to what amount is due to BEML from the said bank against the guarantee and as to Contractor has committed breach of contract or not, shall be final and binding on the guarantor-bank and the Contractor shall have no right to interfere with the same and the bank shall have full rights in terms of the guarantee to make immediate payments against the bank guarantee to BEML without the Contractors consent and without referring the matter to the Contractor.

Notwithstanding the above and in addition thereto,

BEML shall make a claim under the performance guarantee (notwithstanding and/or without prejudice to any other provisions in the Contract Agreement) in the event of:

- i. Failure by the Contractor to pay BEML any amount due, either as agreed by the Contractor or determined under any of the Clauses/Conditions of the agreement, within 30 days of the service of notice to this effect by OIC/EIC.
- ii. BEML on expiry of the contract, shall retain such portion of the said bank guarantee as may be considered sufficient to cover any incorrect or excess payments made on the bills to the Contractor, until the final audit report on the account of Contractor's bill has been received and examined.
- ii. In the event of the contract being determined or rescinded under provision of any of the Clause/Condition of the contract, the performance guarantee shall stand forfeited in full and shall be absolutely at the disposal of the BEML.

B.2 REFUND OF SECURITY DEPOSIT:

- a) The above deposit, as the name itself signifies, shall be held as Security for performance of the contract. One half of the Security Deposit i.e, 50% shall be refunded to the contractor on completion of the contract based on the recommendations of the Chief Engineer in writing that the work has been physically completed in all respects.
- b) The balance 50% of the security
- c) deposit shall be refunded to the contractor on written demand from the contractor after the expiry of the DEFECT LIABILITY PERIOD or on payment of final bill whichever is later, with the recommendation of the Chief Engineer, provided the Chief Engineer is satisfied that there are no dues outstanding against the contractor.

If the Security Deposit is in the form of Bank Guarantee, on completion of the contract, the contractor can give a fresh Bank Guarantee for 50% of the total security value for a period required by BEML and the original Bank Guarantee shall be returned there after on written demand from the contractor and shall be released subject to rectifying all defects noticed during the defect liability period indicated by BEML. Any refund of security deposit shall be made only with the recommendation of the Chief Engineer.

C. LIQUIDATED DAMAGES FOR DELAY IN COMPLETION OF WORKS:

- a) In case the Contractor fails to complete the works and clear the site on or before the stipulated time mentioned in the Work order he shall without prejudice to any other right or remedy of the Company in this behalf pay, as agreed Liquidated Damages and not as penalty, pay sum equal to 0.5% of the Contract sum (excluding non-tendered/extra items, if any) for every week's delay subject to maximum of 10% of the total final bill value of the Contract.
- b) Liquidated Damages shall be applicable in the following cases:

- i. Where the contractor fails to complete the work within the stipulated time;
 - ii. Where the extension of time is granted with levy of LD;
 - iii. Where extension of time is granted without levy of LD but the contractor has failed to complete the work within the extended period.
- c) The amount of Liquidated Damages shall be adjusted or set off against any sum payable to the contractor under this or any other contract/s awarded by the Company.
- d) In case where the contract is subjected to levy of LD, the Chief Engineer shall be the authorised person to issue 'Work Completion Certificate', which shall be final and binding the Company as well as the Contractor concerned.

D. EXTENSION OF TIME:

The time allowed for execution of the Works as specified in the tender document or the extended time in accordance with these conditions shall be the essence of the contract. The execution of the Work shall commence from such time period as mentioned in Tender/PO or from the date of handing over of the site, notified by the OIC/EIC, whichever is later. If the Contractor commits default in commencing the execution of the Work as aforesaid, the performance guarantee shall be forfeited by BEML and shall be absolutely at the disposal of the BEML without prejudice to any other right or remedy available in law

D.1 As soon as possible but within 7 (seven) Working days of award of Work and in consideration of

- (a) Schedule of handing over of site as specified in Work order.
- (b) Schedule of issue of designs/Drawings as specified in Work order.

- i. The Contractor shall submit a Time and Progress Chart for each mile stone. The OIC / EIC may within 7 (seven) Working days there after, if required modify, and communicate the program approved to the Contractor failing which the program submitted by the Contractor shall be deemed to be approved by the Officer -in Charge. The Work programme shall include all details of balance drawings and decisions required to complete the contract with specific dates by which these details are required by Contractor without causing any delay in execution of the Work. The chart shall be prepared in direct relation to the time stated in the contract documents for completion of items of the Works. It shall indicate the forecast of the dates of commencement and completion of various trades of sections of the Work and may be amended as necessary by agreement between the OIC/EIC and the Contractor within the limitations of time imposed in the Contract documents
- ii. In case of non-submission of construction programme by the Contractor, the program approved by the OIC/EIC shall be deemed to be final and binding on the Contractor.
- iii The approval by the OIC/EIC of such programme shall not relieve the Contractor of any of the obligations under the contract.
- iv. The Contractor shall submit the Time and Progress Chart and progress report using the mutually agreed software or in other format decided by OIC/EIC for the Work done during previous month to the Officer-incharge on or before 5th day of each month. This shall also indicate the equipment & manpower schedule. Contractor shall maintain hindrance register at site wherein details of physical hindrances are recorded and it shall be attested by the Engineer-in-charge or his authorized representative at site, as and when the hindrances have occurred.

D.2 If the Work(s) be delayed by:

- i. Force majeure Clause as defined in NIT, or
- ii. Serious loss or damage caused by fire to the Works, or
- iii. Civil commotion, local commotion of workmen, strike or lockout, affecting any of the trades employed on the Work (by reason not attributable to Contractor), or
- iv. Delay on the part of other Contractors or trades men engaged by BEML in executing Work

not forming part of the contract, or

- v. Any other cause like above which, in the reasoned opinion of the BEML is beyond the Contractor's control then upon the happening of any such event causing delay, the Contractor shall immediately give notice thereof in writing to the OIC/EIC but shall nevertheless use constantly his best endeavours to prevent or make good the delay and shall do all that may be reasonably required to the satisfaction of the BEML to proceed with the Works. It is made clear that local commotion, strike or lock-out, etc. of personnel of Contractor or its Sub-contractor shall not entitle any relief to the Contractor.

The Contractor shall have no claim of damages for extension of time granted or rescheduling of milestone/s for events listed in 4.2.

D.3 In case the Work is hindered by the BEML or for any reason / event, for which the BEML is responsible, BEML, if justified, give a fair and reasonable extension of time and reschedule the milestone/s for completion of Work. Such extension of time or rescheduling of milestone/s shall be without prejudice to any other right or remedy of the parties in contract or in law; provided further that for concurrent delays under this sub clause and sub clause (4.2) to the extent the delay is covered under sub clause (4.2) the Contractor shall be entitled to only extension of time and no damages

D.4 Request for rescheduling of Milestones or extension of time, to be eligible for consideration, shall be made by the Contractor in writing for seeking rescheduling of milestones or extension of time to the OIC/EIC, not later than 14 days of the Scheduled date of Completion. The Contractor shall indicate in such a request the period by which rescheduling of milestone/s or extension of time is desired. With every request for rescheduling of milestones, or if at any time the actual progress of Work falls behind the approved programme by more than 10% of the stipulated period of completion of contract, the Contractor shall produce a revised programme which shall include all details of pending drawings and decisions required to complete the contract and also the target dates by which these details should be available without causing any delay in execution of the Work.

D.4.1 In any such case the BEML may give a fair and reasonable extension of time for completion of Work or reschedule the milestones. OIC/EIC shall finalize/ reschedule a particular milestone before taking an action against subsequent mile stone. Such extension or rescheduling of the milestones shall be communicated to the Contractor by the OIC/EIC in writing, within 21 days of the date of receipt of such request from the Contractor in prescribed form. In event of non-application by the Contractor for extension of time OIC/ EIC after affording opportunity to the Contractor, may give, supported with a programme (as specified under 4.4 above), a fair and reasonable extension within a reasonable period of occurrence of the event. Any or all such extension/s, if any, shall be deemed to have been granted under paragraph 3 of Section 55 of the Indian Contract Act, 1872 with right to claim LD, if intended. Contractor shall be required to continue the Works till the decision regarding extension of time is communicated by OIC/EIC.

D.5 In case the Work is delayed by any reasons, in the opinion of the OIC/EIC, by the Contractor for reasons beyond the events mentioned in Clause 4.2 or Clause 4.3 or Clause 4.4 and beyond the justified extended date; without prejudice to right to take action, BEML may grant extension of time required for completion of Work without rescheduling of milestones. The Contractor shall be liable for levy of liquidated damages for delay for such extension of time.

For all contracts awarded, time is the essence of the contract. The contractor is bound to complete the work within the stipulated time. The Chief Engineer has to assess the delay arising out of default of the contractor. Where the delay is due to default of the contractor, and if there is no financial loss due to such delay, the Chief Engineer can recommend for grant of extension of time by the same authority who accepted the tender/awarded the contract, subject to recording the reasons for granting such extension of time.

E. MEASUREMENT BOOK(MB)

- i. OIC/EIC shall, except as otherwise provided, ascertain and determine by measurement the value of Work done in accordance with the contract.
- ii. All measurements of all items having financial value shall be entered by the Contractor and compiled in the measurement Book as per the format so that a complete record is obtained of all the items of Works performed under the contract.
- iii. All such measurements and levels recorded by the Contractor or his authorized representative along with BEML authorized representative from time to time, during the progress of the Work, shall be got checked by the Contractor from the OIC/EIC as per interval or program fixed in consultation with Officer-in-Charge or his authorized representative. After the necessary corrections made by the OIC/EIC, the measurement sheets shall be returned to the Contractor for incorporating the corrections and for resubmission to the OIC/EIC for the dated signatures by the OIC/EIC and the Contractor or their representatives in token of their acceptance.
- iv. Whenever bill is due for payment, the Contractor would initially submit draft measurement sheets after joint measurement and these measurements would be got checked/test checked from the OIC/ EIC.
- v. The Contractor shall, thereafter, incorporate such changes as may be done during these checks/test checks in his draft measurements, and submit to the BEML a measurement book, duly bound. The OIC/EIC and/or his authorized representative would thereafter check this MB, and record the necessary certificates for their checks/test checks.
- vi. The final, fair measurement book given by the Contractor, duly bound should be 100% correct, and no cutting or over-writing in the measurements would thereafter be allowed. If at all any error is noticed, the Contractor shall have to submit a fresh MB and bound, after getting the earlier MB cancelled by the OIC/EIC. The Contractor shall submit two spare copies of such MB's for the purpose of reference and record of BEML.
- vii. The Contractor shall also submit to the OIC/EIC separately his abstract of cost and the bill based on these measurements, duly bound along with two spare copies of the bill. Thereafter, this bill will be processed for payment.
- viii. The Contractor shall, without extra charge, provide all assistance with every appliance, labour and other things necessary for checking of measurements/levels by the OIC/EIC or his representative.
- ix. Except where any general or detailed description of the Work expressly shows to the contrary, measurements shall be taken in accordance with the procedure set forth in the specifications notwithstanding any provision in the relevant standard method of measurement or any general or local custom. In the case of items which are not covered by specifications, measurements shall be taken in accordance with the relevant standard method of measurement issued by the Bureau of Indian Standards and if for any item no such standard is available then a mutually agreed method shall be followed.
- x. The Contractor shall give not less than seven days' notice to the Officer-in Charge or his authorized representative in charge of the Work before covering up or otherwise placing beyond the reach of checking and/or test checking the measurement of any Work in order that the same may be checked and/or test checked and correct dimensions thereof be taken before the same is covered up or placed beyond the reach of checking and/or test checking measurement and shall not cover up and place beyond reach of measurement any Work without consent in writing of the Officer-in-Charge or his authorized representative in charge of the Work who shall within the aforesaid period of seven days inspect the Work, and if any Work shall be covered up or placed beyond the reach of checking and/or test checking measurements without such notice having been given or the Officer-in-Charge's consent being obtained in writing the same shall be uncovered at the Contractor's expense, or in default thereof no payment or allowance shall be made for such Work or the materials with which the same was executed.
- xi. The payments to Contractors for the Work done or other services rendered are made on the

basis of measurement recorded in the measurement book.

- xii. The measurement book is the basis of all accounts of quantities of Work done by Contractor. It should be so written that the transactions are readily traceable.
- xiii. OIC/EIC or his authorized representative may cause either themselves or through another officer of the department to check the measurements recorded by Contractor and all provisions stipulated herein above shall be applicable to such checking of measurements or levels.

It is also a term of this contract that checking and/or test checking the measurements of any item of Work in the measurement book and/or its payment in the interim, on account of final bill shall not be considered as conclusive evidence as to the sufficiency of any Work or material to which it relates nor shall it relieve the Contractor from liabilities from any over measurement or defects noticed till completion of the defects liability period.

F. RAR (RUNNING ACCOUNT REMITTANCE) BILLS PAYMENT

- i. RAR bills can be processed as and when Contractor submits the bill and subject to maximum of two bills in a month. Contractor shall claim RAR Bill indicating the quantities of Work done/executed and rates adopted. In case payment is regulated on the basis of milestone completion, the contractor shall submit the bill accordingly clearly indicating completed milestone against the facility/infrastructure. The quantities billed shall be as per the joint measurement taken at site along with the representative of OIC/EIC duly certified from OIC/EIC. Following documents shall be submitted by the Contractor along with each RAR Bill:
 - a. Delivery challan /Private property form (PP form) for the materials incorporated in the Work for which bill is submitted for payment.
 - b. Purchase cash memo / Proforma Invoice as applicable for major items incorporated in the Work.
 - c. Wage certificate for proper payment to the labourers as per labour laws.
 - d. Compliance of statutory payments as per law for the labours/ Workers engaged such as ESI, PF remittance challans etc.
 - e. Test certificates for various materials wherever required as decided by EIC.
 - f. Laboratory Test certificates if carried out during the period of billing from NABL accredited laboratory to ensure the quality as per the contract specification / standards specified.
 - g. The theoretical consumption of cement, re-conciliation statement of reinforcement and Structural Steel statements, RMC statement must be enclosed along with each bill for civil Works.
 - h. RAR Bill shall not be considered having been submitted by the Contractor unless it is in the manner and accompanied by documents as set forth above.
- ii. On submission of RAR bills by Contractor to the OIC/EIC, 50% of the RAR Bill value shall be released within Ten (07) working days without detailed check on the claim. The balance shall be released after the claim is scrutinized in detail as per procedure by BEML within Twenty-Eight (28) working days.
- iii. The payment timelines as stated above is on an ideal condition and in the even of any delay in payment, no claims whatsoever due to delays on payment including that of interest shall be payable to the Contractor.
- iv. The payments towards the items ordered as deviation, either due to variation in quantity or due to inclusion of non-tendered item will be allowed in RAR Bill subject to approval of same by the BEML.
- v. The item of Work partially executed / being executed shall be admitted for payment in RAR Bill as per the certification of OIC/EIC. The statement showing rate analysis how part rates are derived is to be enclosed along with bill. A register shall be maintained for this purpose at site. The rate for such item as decided by OIC/EIC is final and binding on the Contractor.

- vi. Any payment made by BEML against an RAR Bill shall be regarded as payment by way of advances against final payment only and shall not preclude the requiring of bad, unsound and imperfect or unskilled Work to be rejected, removed, taken away and reconstructed or re-erected. Any certificate given by the OIC/EIC relating to the Work done or materials delivered forming part of such payment, may be modified or corrected by any subsequent such certificate(s) or by the final certificate and shall not by itself be conclusive evidence that any Work or materials to which it relates is/are in accordance with the contract and specification. In case of any discrepancy, the OIC/EIC shall have the right to alter, modify, reduce or diminish the quantities or classification entered in the Measurement Books, any such interim payment, or any part thereof shall not in any respect conclude, determine or affect in any way powers of the OIC/EIC under the contract or any of such payments be treated as final settlement and adjustment of accounts or in any way vary or affect the contract. In such cases, BEML shall have the right to recover any amount paid in an earlier bill/bill from a subsequent bill/bill and should the amount to be recovered be more than the amount of the subsequent bills, the Contractor shall on demand from the OIC/EIC immediately refund the amount to the BEML within 7 days, failing which he shall have to pay interest 1% per month till the said extra amount is paid back by him.
- vii. Pending consideration of extension of date of completion, RAR Payments can continue to be made as herein provided without prejudice to the right of BEML to take action under the terms of this Contract for delay in the completion of Work, if the extension of date of completion is not granted by the competent authority.

G. PAYMENT OF BILLS AFTER SUBMISSION OF STATUTORY DOCUMENTS

No RAR Bill shall be paid for the Work till the applicable labour licenses, registration with EPFO, ESIC and BOCW (Building & other Construction Workers) Welfare Board, whatever applicable is submitted by the Contractor to the Engineer-in-Charge.

H. PAYMENT OF PRE - FINAL BILL

RAR Bill post the completion of Work can be admitted for payment and can be considered as Pre-Final Bill in the following cases:

- I. Where the Final Deviation quantities including NTI are agreed without any protest / reservations by the Contractor, the Contractor has, in writing, accepted the final quantities as per the Pre-Final Bill and Final Deviation Order is pending approval of BEML.
- II. Where the Contractor is not in a position to prepare and submit the Final Bill for various reasons which are attributable to Contractor and Contractor requests for payment of Pre- Final Bill with the valid reasons.
- III. In case extension of time is not approved even after completion of the Work, the applicable LD amount shall be withheld and released only after approval of extension of time along with Final Bill.

I. COMPLETION CERTIFICATE AND COMPLETION PLANS

Within ten days of the completion of the Work, the Contractor shall give notice of such completion to the OIC/EIC and within thirty days of the receipt of such notice, the OIC/EIC shall inspect the Work and if there is no defect in the Work, shall furnish the Contractor with a final certificate of completion, otherwise a provisional certificate of physical completion indicating defects:

- i. To be rectified by the Contractor and/or
- ii. For which payment will be made at reduced rates, shall be issued.

But no final certificate of completion shall be issued, nor shall the Work be considered to be complete until the Contractor shall have removed from the premises on which the Work was be

executed all scaffolding, surplus materials, rubbish and all huts and sanitary arrangements required for his/their Work people on the site in connection with the execution of the Works as shall have been erected or constructed by the Contractor(s) and cleaned off the dirt from all wood Work, doors, windows, walls, floor or other parts of the building, in, upon, or about which the Work is to be executed or of which he may have had possession for the purpose of the execution; thereof, and not until the Work shall have been measured by the OIC/EIC. If the Contractor fails to comply with the requirements of this clause as to removal of scaffolding, surplus materials and rubbish and all huts and sanitary arrangements as aforesaid and cleaning off dirt on or before the date fixed for the completion of Work, BEML may at the expense of the Contractor remove such scaffolding, surplus materials and rubbish etc., and dispose of the same as he(OIC/EIC) thinks fit and clean off such dirt as aforesaid, and the Contractor shall have no claim in respect of scaffolding or surplus materials as aforesaid except for any sum actually realized by the sale thereof.

J. PAYMENT OF FINAL BILL

On completion of the Work and recording of measurements of all the items executed including NTI's and deviations, a final deviation statement will be drawn duly representing the actual quantum of Work executed against each item in the BOQ, Non-tendered Items and deviations.

- I. On receipt of approved final deviation order from PIC/OIC/EIC, the Contractor shall submit the Final Bill in the prescribed format within three months. To enable the Contractor to do so, the OIC/EIC will furnish to him necessary statements showing recoveries to be made on account of stores issued, hire charges for tools and plant supplied, charges recoverable for electricity and water consumed etc., if any.
- II. Along with submission of the Final Bill, the Contractor shall sign a 'No Claim Certificate' against BEML stating that they do not have any claim or demand in respect of the Contract except for the payment of Final Bill and the Defect Liability Deposit or any other refundable deposits like, retention money, if any etc. If the Contractor does not sign the 'No Claim Certificate', the amount due will not be disbursed to the Contractor pending issue of such No-claim Certificate or settlement of disputes, if any. No interest shall be paid by BEML on any pending dues in case No-claim Certificate is not issued or any dispute is raised by the Contractor.
- III. No further or additional claims shall be made by the Contractor after submission of the final bill and any further or additional claims (if any) shall be deemed to have been unconditionally waived and extinguished. The Contractor shall not be entitled to make any claim whatsoever against BEML under or by virtue of or arising out of this Contract, nor shall BEML entertain or consider any such claim, if made by the Contractor, after he has signed a "No Claim Certificate in favour of BEML. The Contractor shall be debarred from disputing the correctness of the item/s covered by "No Claim Certificate". The "No Claim Certificate" furnished by the Contractor shall be treated as the "Discharge Certificate" by the Contractor, which discharges the BEML from all liabilities under the Contract, except to the extent provided in sub-clause (ii) above.
- IV. Where the Contractor is not in a position to prepare the final bill, or not submitting the final bill due to whatsoever reasons even after three (3) months from approval of Final Deviation Order, the OIC/EIC may give due notice by registered post/speed post indicating a specific time limit for submission of final bill, which shall not exceed 45 days from the expiry of the said three- month period.
- V. If the Contractor does not respond and submit the Final Bill, within the aforesaid period of 45 days, the Officer- in- charge / Engineer In Charge shall be entitled to prepare & process the Final Bill ex-parte and the same will be binding on Contractor, and no further claim or submission of any bill (final or otherwise) from the Contractor shall be accepted.
- VI. On receipt of the Final Bill duly signed by the Contractor, the same will be scrutinized by the Engineer-in-Charge to see that the claim is in order. He will also attach to the Final Bill, a statement showing the Stores issued for incorporation in Work along with recoveries, if any, a statement showing the theoretical requirement and actually incorporated by the Contractor in the Work, and whether there has been any over – issue / under– issue of stores to the Contractor.

- VII. Where either the Contractor has not fully utilized the Stores issued for incorporation in the Work or where the quantities used are less than those theoretically required resulting in Work being below specifications, BEML will examine the case to see what action should be taken against the Contractor.

K. PAYMENT OF CONTRACTOR'S BILLS TO BANKS & RECOVERY OF TAXES.

- i. All payments to the Contractor shall be made through Electronic Clearing System (ECS) or National Electronic fund transfer (NEFT) or Real time gross settlement (RTGS). The Contractor shall furnish his bank account details, as certified by his Bankers. All amounts payable to the Contractor shall be directly credited to his bank account.

In case, the Contractor is having his account with a bank not having Electronic Clearing System (ECS or NEFT, RTGS), the Contractor is required to open a bank account with the bank having this facility.

All payments to the Contractor shall be made by above means only.

ii. TAXES

(a) PAYMENT OF GST:

Contractor shall be entitled to reimbursement of GST paid, upon submission of GST Invoice and GST Challan for having paid the same to the Department.

(b) PAYMENT OF WELFARE CESS:

It shall be the sole responsibility of the Contractor as employer to ensure compliance of all the statutory obligations under the building and other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996 (hereafter referred as "BOCW Act") and the building and other Construction Workers' Welfare Cess Act, 1996 and the rules made thereunder (hereafter referred as "Cess Act"). The Contractor undertakes that it shall apply and obtain registration certificate specifying the scope of work under the relevant provisions of the Construction Workers' Act from the appropriate Authorities prior to commencement of work under the Contract. If at any point of time during the contract period, non-compliance of the provisions of the Construction Workers' Act and the Cess Act, and the rules made thereunder is observed, BEML reserves the right to withhold a reasonable amount from the payables to discharge any obligations on behalf of Contractors. The Contractor shall declare to undertake any liability or claim arising out of employment of building workers and shall indemnify BEML from all consequences / liabilities / penalties in case of non-compliance of the provisions of the BOCW Act and the Cess Act.

(c) RECOVERY OF INCOME TAX:

Recovery of Income Tax under Section 194(c) of Income Tax 1961 introduced by the Finance Act 1972 and further Amendments thereon will be made from the gross payments payable at source on all contract Works with value above Rs.10,000/-, at the prevailing rates.

In addition to above tax recoveries, any statutory recoveries introduced by the Central or State Governments can also be recovered and deposited as mandated by the respective Governments.

L. MATERIALS TO BE PROVIDED BY THE CONTRACTOR

- I. The Contractor shall, at his own expense, provide all materials, required for the Works other than those which are stipulated to be supplied by the BEML as mandated in the tender document. The Contractor shall, at his own expense and without delay, supply to the

Engineer-in- Charge samples of materials to be used on the Work and shall get these approved in advance. All such materials to be provided by the Contractor shall be in conformity with the specifications laid down or referred to in the contract. The Contractor shall, if requested by the OIC/ EIC furnish proof, to the satisfaction of the OIC/EIC that the materials so comply, including with appropriate laboratory test reports, if required. The OIC/EIC shall within thirty days of supply of samples or within such further period as he may require intimate to the Contractor in writing whether samples are approved by him or not. If samples are not approved, the Contractor shall forthwith arrange to supply to the OIC/EIC for his approval, fresh samples complying with the specifications laid down in the contract. When materials are required to be tested in accordance with specifications, approval of the OIC/EIC shall be issued after the test results are received.

- II. The Contractor shall at his risk and cost submit the samples of materials to be tested or analyzed and shall not make use of or incorporate in the Work any materials represented by the samples until the required tests or analysis have been made and materials finally accepted by the OIC/EIC. The Contractor shall not be eligible for any claim or compensation either arising out of any delay in the Work or due to any corrective measures required to be taken on account of and as a result of testing of materials.
- III. The Contractor shall, at his risk and cost, make all arrangements and shall provide all facilities as the OIC/EIC may require for collecting, and preparing the required number of samples for such tests at such time and to such place or places as may be directed by the Engineer-in Charge and bear all charges and cost of testing unless specifically provided for otherwise elsewhere in the contract or specifications. The Engineer -in- Charge or his authorized representative shall at all times have access to the Works and to all Workshops and places where Work is being prepared or from where materials, manufactured articles or machinery are being obtained for the Works and the Contractor shall afford every facility and every assistance in obtaining the right to such access.
- IV. All rejected material will at once be removed from the site by the Contractor; the cost of removal shall be borne by the Contractor. The Engineer-in-Charge shall have full powers to require the removal from the premises of all materials which in his opinion are not in accordance with the specifications and in case of default, the Engineer-in-Charge shall be at liberty to employ at the expense of the Contractor, other persons to remove the same without being answerable or accountable for any loss or damage that may happen or arise to such materials. The Engineer-in-Charge shall also have full powers to require other proper materials to be substituted thereof and in case of default, the Engineer-in-Charge may cause the same to be supplied and all costs which may attend such removal and substitution shall be borne by the Contractor.

M. QUALITY CONTROL DURING EXECUTION OF WORK

- I. Quality Lab: For field testing of materials and Workmanship, quality lab shall be set-up by the Contractor at Works site. This shall be in conjunction to the approved quality plan.
- II. Testing of materials: Testing of materials will be made as per Quality Plan provided in the Contract in the field laboratory established at the site. However, certain tests which cannot be done at site shall be got done at NABL approved laboratory and expenditure on this account shall be borne by the Contractor and no extra claim whatsoever shall be entertained.
- III. Regular mandatory test and any additional tests if required, shall be carried out in accordance with the procedure laid down in Indian Standards/ as directed by Engineer-in- Charge by the Contractor at his cost.
- IV. A list of mandatory tests to be conducted is indicated in the Quality plan it may be specifically noted that the tests to be conducted are not limited to the mandatory tests alone and additional test if required and directed by the Engineer-In-Charge on any material including the approved Works etc., shall be carried out by the Contractor at his cost.
- V. In the case of non-availability of cube test results for any batch of concrete / structural member,

the Engineer may resort to core test or any other destructive/ Semi destructive /non-destructive tests for ascertaining the strength of concrete. If the strength of the concrete is found to be lower than the strength specified, the remedial measures and penal recovery thereof will be regulated as per relevant IS code/ Standards.

- VI. The Contractor may specifically note that the testing shall be done in Govt. / Govt. (NABL) approved laboratory only.
- VII. Total station, Theodolite, levelling instruments, prismatic compass / chain, steel and metallic tapes and all other surveying and material testing instruments found necessary on the Works shall be provided by the Contractor at his expense for the due performance of this contract as instructed by the Engineer-in-Charge.

N. WORK TO BE EXECUTED IN ACCORDANCE WITH SPECIFICATIONS, DRAWINGS, ORDERS ETC.

- I. The Works, the subject of the contract, specified and provided for, or that may be necessary to be done to form and complete any part thereof, shall be executed and completed in the best and most substantial manner, with materials of the best and most approved quality of their respective kinds, agreeable to the particulars contained in or implied by the specification, or as referred to and represented by the drawings and memorandum thereon/or as referred to by any of the said further drawings, instructions and directions, and shall be to the full satisfaction of the OIC/EIC.
- II. The Contractor shall comply with the provisions of the contract and with the care and diligence execute and maintain the Works and provide all labour and materials, tools and plants including for measurements and supervision of all Works, structural plans and other things of temporary or permanent nature required for such execution and maintenance in so far as the necessity for providing these, is specified or is reasonably inferred from the contract. The Contractor shall take full responsibility for adequacy, suitability and safety of all the Works and methods of construction.
- III. The OIC/EIC shall have full liberty at all reasonable times to inspect and examine the Works, materials and Workmanship which to him, may appear defective, unfit or improper for the several purposes to which they are applied, or intended to be applied, or not in accordance with the specifications of the said drawings, memoranda instructions or directions respectively and every such time reject any or all of such Works, materials and Workmanship.

O. DEVIATIONS/ VARIATIONS EXTENT

BEML shall have power

- (i) to make alteration in, omissions from, additions to for the original specifications, drawings, designs and instructions that may appear to him to be necessary or advisable during the progress of the Work, and
- (ii) to omit a part of the Works in case of non- availability of a portion of the site or for any other reasons and the Contractor shall be bound to carry out the Works in accordance with any instructions given to him in writing signed by the OIC/EIC and such alterations, omissions, additions shall form part of the contract as if originally provided therein and any altered, additional which the Contractor may be directed to do in the manner specified above as part of the Works, shall be carried out by the Contractor on the same conditions in all respects.
 - a) Every deviation shall be subject to the limits specified as under:
 - i) The net value of all deviations including non-tendered items, of the value of work completed, shall not exceed 20% of the approved contract value.
 - ii) Even in cases where, the net value of all deviations excluding non-tendered items is less than 20%, of the approved contract value, but more than 40% in respect of any individual item, indicated in BOQ,

- iii) In case of non-tendered items, the total value of such non tendered items shall not exceed 5% of the approved contract value. In case the deviations exceed 5% of the approved contract value.

Then shall be treated as amendment to contract. Any variation in above mentioned limit shall be mutually discussed with PIC/OIC/EIC and amendment to contract will issued.

b) The basis for ascertaining the non-tendered items shall be as follows:

- i) The value of all deviations shall be ascertained by measurements, on the basis of the rates or prices for similar work in the bill of quantities of the same contract in so far as such rates or prices apply.

- ii) Where the rates or prices in Bill of Quantities do not apply, the value shall be based upon rates or prices deduced there from to the extent practicable to do so.

- iii) The rates for Non-Tendered (NT) items shall be based on the SSR rates after proportionate adjustment in comparison with the tendered rates of like items in the contract. The basis to be adopted for working out the NT rate is the comparison of the NT item with similar trade item in the bill of Quantity for which the contractor has quoted.

- iv) Wherever NT items cannot be deduced from the like items quoted in the tender or SSR rates, market rate shall be allowed based on vouchers/invoices as per the actuals including transportation, labour etc., plus 10% overheads and the labour rate shall be taken as per minimum wages in force, based on the recommendations of the Chief Engineer.

The deviations and NT items shall be technically checked and processed by the respective "Engineer-in-charge/Officer-in-charge".

All deviation orders will be signed by the Contractor for their acceptance.

P. FORECLOSURE OF CONTRACT DUE TO ABANDONMENT OR REDUCTION IN SCOPE OF WORK

If any time after acceptance of the tender BEML decides to abandon or reduce the scope of Work for any reason whatsoever and hence not require the whole or any part of the Works to be carried out, the Officer-in-Charge shall give notice in writing to that effect to the Contractor. The compensation, if any payable for such foreclosure of Work will be discussed mutually between BEML and the Contractor and settled after taking into consideration the actual financial loss, if any, suffered by the Contractor on account of foreclosure of the contract, which in no case shall exceed 2% of cost of incomplete work on the date of closure. The Contractor shall have no claim to any payment of compensation or otherwise whatsoever on account of any loss of profit or advantage which he might have derived, but for the foreclosure of the whole or part of the Works or reduction in Scope of work. BEML shall have the option to take over the Contractor's materials or any part thereof, either brought to the site or for which the Contractor is legally bound to accept the delivery from the suppliers.

Q. DEFECT LIABILITY PERIOD:

The period of maintenance for the subject work shall be **TWO YEAR FROM THE DATE OF COMPLETION OF WORK**

During this period, the contractor shall be responsible to rectify all the defects noticed and attributable to the work done by him in respect of works executed by him. As soon as any defect in the work come to the notice, the Chief Engineer shall inform the contractor, in writing, to rectify the defect and inform him that in case he fails to do so within a reasonable time, the Company would rectify the defects at his risk and expense as per the conditions of the contract.

If the contractor does not attend to the rectifications in spite of repeated requests, the Company shall proceed at his risk and expense and get the work completed. The cost incurred by the Company shall be recovered from the defaulting contractor. The Company shall forfeit the balance 50% of the Security Deposit retained and adjust this amount against the expenses so incurred. The balance amount, if any, after recovering the expenses incurred shall be refunded to the contractor. In case the amount available is insufficient to cover the expenses in full, that portion of the expenditure still remaining unadjusted shall be recovered from any of the subsequent bills due for payment to the contractor against any other contract.

Even after such adjustments, the amount available is insufficient to cover the expenses in full, the Company reserves the right to take legal course of action to recover such unadjusted amount.

L. CONTRACTORS LIABILITY AND INSURANCE:

From commencement to completion of the works, the contractor shall take full responsibility taking precautions to prevent loss or damage. He shall be liable for any damage or loss that shall happen to the works or any part thereof.

In addition, the contractor shall indemnify and keep the Company indemnified against all losses and claims for injuries or damages to any person or any property whatsoever which shall arise out of or in consequence of the construction works. For this purpose, the contractor shall take an insurance policy-"Contractors All Risks Insurance"- to cover the risks, as per the Conditions of the Contract. The insurance policy has to be kept valid till the work is completed and the possession handed over to the Company. The policy shall be taken at his cost showing the Company as the :principal to simplify the work in the matter of raising claims and settlement thereof.

1. MATERIALS obtained from demolition/dismantling work shall remain with the Contractor at his own risk till such time the Contractor removes them to BEML stores or as directed within 10 days from the date of completion. If he fails to remove such dismantled materials to BEML stores or as directed within 10 days from the date of completion, the Engineer-in-charge will be entitled to remove them at the risk and cost of the Contractor.
2. THE various provisions in this special condition shall be deemed to take precedence over those in General conditions/specifications to the extent applicable.
3. The quoted rate is deemed to include for execution of work in a phased manner/part by part if necessary and as directed by BEML and no extension of time nor extra claims shall be entertained in the regard.

M. LEANING DOWN:

The contractor shall clean all the floors, walls, glass panes, fittings and fixtures, etc., touch up all painter s works and carryout all other necessary items of work in connection therewith and leave the whole premises clean and tidy before handing over the buildings.

N. ATTENDANCE UPON BUILDING:

The contractor shall permit free access and generally afford facilities and usual convenience to other agencies and or departmental workmen to carryout works under separate arrangements.

Therefore, the rates quoted by the contractor shall be deemed to include for all such costs as consequence for having to work in the circumstances described above and no claim shall in any event be entertained on this account.

O. EXCAVATION AND EARTH WORK:

THE earthwork, excavation, filling etc., in ordinary/hard soil shall be carried out to the extent ordered/indicated in the drawings. Excavation inadvertently made deeper than what is ordered or indicated in the drawings shall be made good by the contractor with PCC 1:4:8 using not larger than 40mm graded granite aggregate with out extra cost to the company.

The earth obtained from excavation shall be filled, spread, watered and well rammed in layers not exc. 20 cm thick around foundations, under floors and in other situations to make up levels / slopes as directed/shown in drawings. Use of vegetable soil, turf, peat and black cotton soil in filling shall not be permitted. No lead whatsoever shall be allowed extra for earth obtained from excavation and reused for filing around foundation and under floors. If on the actual excavation, hard rock or ordinary rock is met with the contractor shall intimate the Engineer-in- charge in writing for making necessary price adjustment. Excavation done in ordinary/hard rock will be priced as an authorized extra item

P. CARRYING OUT PART WORK AT RISK & COST OF CONTRACTOR

If Contractor:

- I. At any time makes default during currency of Work or does not execute any part of the Work with due diligence and continues to do so even after a notice in writing of 7 Working days in this respect from the Officer-in-Charge; or
- II. Commits default in complying with any of the terms and conditions of the contract and does not remedy it or takes effective steps to remedy it within 7 Working days even after a notice in writing is given in that behalf by the OIC/EIC; or fails to complete the Work(s) or items of Work with

individual dates of completion, on or before the date(s) so determined, and does not complete them within the period specified in the notice given in writing in that behalf by the IC/EIC.

- III. The Officer-in-Charge without invoking action under Clause-3 may, without prejudice to any other right or remedy against the Contractor which have either accrued or accrue thereafter to BEML, by a notice in writing to take the part Work / part incomplete Work of any item(s) out of his hands and shall have powers to:
 - (a) Take possession of the site and any materials, constructional plant, implements, stores, etc., thereon; and/or
 - (b) Carry out the part Work / part incomplete Work of any item(s) by any means at the risk and cost of the Contractor.
- IV. BEML shall determine the amount, if any, recoverable from the Contractor for (a) non- completion of part of the Work or (b) for removal of any item(s) from the Contractor and got executed at the risk and cost of the Contractor, by third parties. BEML shall be entitled to recover such loss / damages from payments due to the Contractor. The liability of Contractor on account of loss or damage suffered by BEML because of action under this clause shall not exceed 10% of the tendered value of the Work.
- V. The certificate of the Engineer-in-Charge as to the value of Work done shall be final and conclusive against the Contractor provided always that action under this clause shall only be taken after giving notice in writing to the Contractor. Provided also that if the expenses incurred by the BEML are less than the amount payable to the Contractor at his agreement rates, the difference shall not be payable to the Contractor.
- VI. Any excess expenditure incurred or to be incurred by BEML in completing the part Work/ part incomplete Work of any item(s) or the excess loss of damages suffered or may be suffered by BEML as aforesaid after allowing such credit shall without prejudice to any other right or remedy available to BEML in law or as per agreement be recovered from any money due to the Contractor on any account, and if such money is insufficient, the Contractor shall be called upon in writing and shall be liable to pay the same within 30 days.
- VII. If the Contractor fails to pay the required sum as per this clause within the aforesaid period of 30 days, the Engineer-in-Charge shall have the right to sell any or all of the Contractors' unused materials, constructional plant, implements, temporary building at site etc. and adjust the proceeds of sale thereof towards the dues recoverable from the Contractor under the contract and if thereafter there remains any balance outstanding, it shall be recovered in accordance with the provisions of the contract. In the event of this action being adopted by the Officer-in- Charge, the Contractor shall have no claim to compensation for any loss sustained by him by reason of his having purchased or procured any materials or entered into any engagements or made any advance on any account or with a view to the execution of the Work or the performance of the contract.

Q. ACTION IN CASE WORK NOT DONE AS PER SPECIFICATIONS

All Works under or in course of execution or executed in pursuance of the contract, shall at all times be open and accessible to the inspection and supervision of the Officer in – charge or his authorized subordinates in charge of the Work and all the superior officers, or any organization engaged by the BEML for Quality Assurance and of the Chief Technical Examiner's Office, and the Contractor shall, at all times, during the usual Working hours and at all other times at which reasonable notice of the visit of such officers has been given to the Contractor, either himself be present to receive orders and instructions or have a responsible agent duly accredited in writing, present for that purpose. Orders given to the Contractor's agent shall be considered to have the same force as if they had been given to the Contractor himself. If it shall appear to the Officer- in-charge or his authorized subordinates in charge of the Work or his subordinate officers or the officers of the organization engaged by the BEML for Quality Assurance or to the Chief Technical Examiner or his subordinate officers, that any Work has been executed with unsound, imperfect, or unskilful Workmanship, or with materials or articles provided by him for

the execution of the Work which are unsound or of a quality inferior to that contracted or otherwise not in accordance with the contract, the Contractor shall, on demand in writing which shall be made within twelve months of the completion of the Work from the Officer-in Charge specifying the Work, materials or articles complained of notwithstanding that the same may have been passed, certified and paid for forthwith rectify, or remove and reconstruct the Work so specified in whole or in part, as the case may require or as the case may be, remove the materials or articles so specified and provide other proper and suitable materials or articles at his own charge and cost. In the event of the failing to do so within a period specified by the Officer-in- Charge in his demand aforesaid, then the Contractor shall be liable to pay compensation at the same rate as under LD Clause of the contract (for non-completion of the Work in time) for this default. In such case the Officer-in- Charge may not accept the item of Work at the rates applicable under the contract but may accept such items at reduced rates as the authority specified in price bid may consider reasonable during the preparation of on account bills or final bill if the item is so acceptable without detriment to the safety and utility of the item and the structure or he may reject the Work outright without any payment and/or get it and other connected and incidental items rectified, or removed and re executed at the risk and cost of the Contractor. Decision of the Officer-in Charge to be conveyed in writing in respect of the same will be final and binding on the Contractor.

R. CONTRACTOR LIABLE FOR DAMAGES, DEFECTS DURING DEFECT LIABILITY PERIOD

- i. If the Contractor or his working people or servants break, deface, injure or destroy any part of building in which they may be working, or any building, road, road kerb, fence, enclosure, water pipe, cables, drains, electric or telephone post or wires, trees, grass or grassland, or cultivated ground contiguous to the premises on which the Work or any part is being executed, or if any damage happens to the Work while in progress, from any cause whatever or if any defect, shrinkage or other faults appear in the Work within twelve months after a certificate final or otherwise of its completion shall have been given by the Officer in- Charge as aforesaid arising out of defect or improper materials or workmanship the Contractor shall upon receipt of a notice in writing on that behalf make the same good at his own expense or in default the Officer-in Charge cause the same to be made good/ repaired/rectified by other workmen and deduct the expense from any sums that may be due or at any time thereafter may become due to the Contractor, or from his security deposit. The security deposit of the Contractor shall not be refunded before the expiry of twelve months from the actual date of completion indicated in the completion certificate or till the final bill has been prepared and passed whichever is later.
- ii. The materials as well as the workmanship and finish of the whole of the contract Works shall be best of their kind, and should any materials be brought upon the Site or on the land or property of the Company or on the places where any operations are being carried out in connection with the Works, which are in the judgement of the Officer- in- charge /Engineer in charge of an inferior description and improper to be used in the Works, the said materials shall be removed. All inferior workmanship or finish shall be amended by and at the cost of Contractor forthwith, or within such period or periods as the Officer- in- charge / Engineer in charge direct, and the Contractor shall pull down, amend and reconstruct any Work he may have erected upon an insufficient foundation, or that he may have insufficient cured and protected against immediate and further injury whether arising or likely to arise in the future from weight pressure, action of water or otherwise, on being required to do so by the Officer- in- charge/ Engineer in charge.

T. SECURITY DEPOSIT AND DEFECT LIABILITY PERIOD (DLP)

- i. Except for special nature/ item of Work where separate defect liability period or specific performance is mentioned in the tender document, the defect liability period is Two (2) year
- ii. For all the Works from the date of completion as indicated in the completion certificate. During this period the Contractor will be responsible to rectify all the defects noticed and attributable to the Work done by Contractor.

- iii. If any defects are noticed during this period by BEML, it will be informed to the Contractor in writing to inspect and rectify the defects noticed. In case Contractor fails to attend the defects within a reasonable time as indicated in the intimation letter, OIC/EIC shall proceed ahead with rectification of defects at the risk & cost of the Contractor.
- iv. The cost incurred by BEML towards rectification shall be recovered from the defaulting Contractor from the Security Deposit. If this money to be recovered is higher than the Security Deposit, it will be recovered from any amount due to Contractor from any other contract in BEML or by any other means.
- v. **Prior to completion of DLP**, to assess the defects, if any, representative of the Contractor along with OIC/EIC has to carry out a final joint inspection of the completed Works on the previous month to the end of DLP. Findings have to be recorded and certified and necessary corrective action to be taken up by the Contractor for rectification of identified defects if any. OIC/EIC will recommend for release of Security Deposit amount at the end of defect liability period or after rectification of defects whichever is later.
- vi. In addition to conditions as above, Security Deposit amount of the Work shall not be refunded till the Contractor produces a clearance certificate from the OIC/EIC. As soon as the Work is virtually complete, the Contractor shall apply for the clearance certificate to the OIC under intimation to the Engineer-in-Charge. The Engineer-in-Charge, on receipt of the said communication, shall write to the OIC to intimate if any complaint is pending against the Contractor in respect of the Work. If no complaint is pending, on record till after month after completion of the Work and/or no communication is received from the OIC to this effect till six months after the date of completion, it will be deemed to have received the clearance certificate and the security deposit amount will be released if otherwise due.
- vii. In case of Works of routine maintenance/ services in nature, terms contract & AMC Works, the security deposit submitted by the Contractors shall be refunded within one month from the date of final payment or within one month from the date of completion of the maintenance contract whichever is earlier.
- viii. Normally the period of maintenance for all the works shall be one year. However, for special cases, viz., waterproofing contracts etc., the Defect Liability Period shall be based on case-to-case basis at the discretion of the Chief Engineer.
- ix. Similarly, there could be certain special works for which Defect Liability Period shall not be applicable. For example: survey of land etc.
- x. The applicability of Defect Liability Period or otherwise, has to be decided by the Chief Engineer with specific approval of respective Complex Chief
- xi. During this period, the contractor shall be responsible to rectify all the defects noticed and attributable to the work done by him in respect of works executed by him. As soon as any defect in the work comes to the notice, the Chief Engineer shall inform the contractor, in writing, to rectify the defect and inform him that in case he fails to do so within a reasonable time, the Company would rectify the defects at his risk and expense as per the conditions of the contract.
- xii. If the contractor does not attend to the rectifications inspite of repeated requests, the Company shall proceed at his risk and expense and get the work completed. The cost incurred by the Company shall be recovered from the defaulting contractor. The Company shall forfeit the balance 50% of the Security Deposit retained and adjust this amount against the expenses so incurred. The balance amount, if any, after recovering the expenses incurred shall be refunded to the contractor. In case the amount available is insufficient to cover the expenses in full, that portion of the expenditure still remaining unadjusted shall be recovered from any of the subsequent bills due for payment to the contractor against any other contract.
- xiii. Even after such adjustments, the amount available is insufficient to cover the expenses in full, the Company reserves the right to take legal course of action to recover such unadjusted amount.

U. LABOUR LAWS TO BE COMPLIED BY THE CONTRACTOR

The Contractor shall obtain a valid license under the Contract Labour (Regulation and Abolition) Act 1970, Contract Labour (Regulation and Abolition) Central Rules, 1971, or any license required under the relevant Labour Codes and other applicable laws/rules before the commencement of the Work from Competent Authority within thirty days of issue of acceptance letter and submit to the Officer-in Charge / Engineer-in-charge. Contractor shall continue to have a valid license until the completion of the Work. The cost of obtaining license i.e., licence fee etc., shall be borne by the Contractor. Contractor shall not commence the Work without obtaining valid labour license. The Contractor shall also submit an Indemnity Bond executed on a appropriate value stamp paper indemnifying BEML against all the statutory requirement of the Labour Department.

The Contractor shall also comply with provisions of the Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979 or under the relevant Labour Codes.

The Contractor shall also abide by the provisions of the Child Labour (Prohibition and Regulation) Act, 1986.

The Contractor shall also comply with the provisions of the building and other Construction Workers (Regulation of Employment & Conditions of Service) Act, 1996 and the building and other Construction Workers (BOCW) Welfare Cess Act, 1996 or under the relevant Labour Codes. Any failure to fulfil these requirements shall attract the penal provisions of this contract arising out of the resultant non-execution of the Work.

Any other legal or statutory compliance which shall be applicable/ and contractor liable to comply from time to time under the extant local or state laws.

V. ENGAGEMENT OF LABOUR

The Contractor shall not employ any labour below the age of 18 years directly or through petty contractors or sub-contractors for execution of the Work.

SAFETY OF WORKERS & REPORTING OF ACCIDENT

The Contractor shall be responsible for safety of all employees/labour employed by him on Works, directly or through petty Contractors or sub- Contractors and shall report accidents, occurring on Works to the Engineer or the Engineer's representative, and shall make every arrangement to render all possible assistance and to provide prompt and proper medical attention.

In case of fatal accident, it will be Contractor's responsibility to report accident to police keeping the Engineer advised of the same. The compensation for affected Workers or their relatives shall be paid by the Contractor in such cases with utmost expedition in accordance with the Employees's Compensation Act

W. ACTION IN CASE OF CONTRACTOR NOT FOLLOWING LABOUR LAWS

Should it appear to the Engineer-in-Charge that the Contractor(s) is/are not properly observing and complying with the provisions of the Contract Labour (Regulation and Abolition) Act 1970, and the Contract Labour (R& A) Central Rules 1971, for the protection of health and sanitary arrangements for Work-people employed by the Contractor(s) (hereinafter referred as "the said Rules") the Office-in-Charge shall have power to give notice in writing to the Contractor(s) requiring that the said Rules be complied with and the amenities prescribed therein be provided to the Work-people within a reasonable time to be specified in the notice. If the Contractor(s) shall fail within the period specified in the notice to comply with and/ observe the said Rules and to provide the amenities to the Work- people as aforesaid, the Officer-in-Charge shall have the power to provide the amenities hereinbefore mentioned at the cost of the Contractor(s). The Contractor(s) shall erect, make and maintain at his/their own expense and as per approved

standards all necessary huts and sanitary arrangements required for his/their Work-people on the site in connection with the execution of the Works, and if the same shall not have been erected or constructed, according to approved standards, the Engineer-in-Charge shall have power to give notice in writing to the Contractor(s) requiring that the said huts and sanitary arrangements be remodelled and/or reconstructed according to approved standards, and if the Contractor(s) shall fail to remodel or reconstruct such huts and sanitary arrangements according to approved standards within the period specified in the notice, the Engineer-in-Charge shall have the power to remodel or reconstruct such huts and sanitary arrangements according to approved standards at the cost of the Contractor(s).

X. EMPLOYMENT OF SKILLED/SEMI SKILLED WORKERS

The Contractor shall provide and employ on the Site only such personnel who are technically and otherwise sufficiently skilled and experienced in their respective fields and such foremen and supervisory staff as are competent to supervise the Work, as per the Contract requirements. The Contractor shall provide and employ skilled, semiskilled and un-skilled labour as is necessary for proper and timely execution of the Work.

Y. MINIMUM WAGES ACT TO BE COMPLIED WITH

The Contractor shall comply with all the provisions of the Minimum Wages Act, 1948 (Code on Wages, 2020), and Contract Labour (Regulation and Abolition) Act, 1970 (Occupational Safety, Health and Working conditions Code, 2019), as amended or substituted from time to time and rules framed there under and other labour laws affecting contract labour that may be brought into force from time to time. Any change in the minimum wages shall be the sole responsibility of the Contractor.

Z. DISPUTE RESOLUTION AND JURISDICTION:

A. Conciliation between Parties to Dispute:

All disputes or differences whatsoever arising between the parties out of or relating interpretation or application of the terms and conditions of NIT, PO or agreement whatsoever, pertaining to construction, meaning and operation or effect of the contract or the breach thereof etc. arising during the progress of work or during or after completion or abandonment thereof shall be mutually discussed and settled amicably by a conciliation Committee comprising of an independent subject experts and one representative from each party to dispute to be constituted by BEML, within a period of 30 days from the date when the dispute has been intimated by either part to this contract.

The conciliation proceedings shall be completed within a period of 90 days, the minutes of the conciliation proceedings shall be recorded by the Conciliator.

B. Arbitration between Parties to Dispute

a). In event of failure of both the parties to contract to reach any amicable settlement or conciliation of the dispute within 90 days from the date of first notice of dispute and within 15 days of failure of conciliation proceedings, either party to contract shall refer the dispute for settlement by "Arbitration" consisting of a sole arbitrator to be appointed by the IIAC, New Delhi (Plot No 6, Vasant Kunj Institutional Area, New Delhi-110070), as per the Rules of IIAC New Delhi and in accordance with the Rules of IIAC.

The arbitration proceedings shall be conducted at New Delhi (Seat of Arbitration) or any other place mutually decided by and between BEML Ltd and the supplier/contractor.

All arbitration proceedings shall be conducted in English language.

d) . The court at the place of awarding of contract only shall have exclusive jurisdiction to entertain any Dispute/ Appeal, Challenge to the award etc. relating to the contract (i.e. Bhopal, Madhya Pradesh)

In case of any dispute between the Company and any other Public Sector / Government department relating to the interpretation and application of the provisions of the contract, such disputes / differences shall be referred by either party to the arbitration of one of the arbitrators in the Department of Public Enterprises as per AMRCD Scheme of dispute resolution. The Arbitration and Conciliation Act, 1996 and amendment thereof shall not be applicable to this clause.

The award of the Sole Arbitrator shall be final and binding on all the parties.

DURING ARBITRATION

The contractor shall be liable to "works/service as per the terms and conditions under this NIT/ Agreement/Purchase Order, during the pendency of any dispute / Arbitration proceedings".

Failure to comply with the terms and conditions of the said NIT or Agreement whatsoever, during the pendency of any dispute shall incur additional penalty/liquidated damages etc. as per the terms of this contract.

AA. WATER FOR WORKS

Contractor should make their own arrangements for supply of water. Water if available only will be supplied by the BEML and the Contractor shall be charged for the quantity of water consumed by him at commercial tariff of the respective area or as indicated in the tender document. The Contractor shall make his own arrangements to tap and store water from the point indicated by the water supply section. The Contractor should also provide a meter. In case the meter is not provided or the meter goes out of order, the assessment of water consumption will be based on Rs.20/- per thousand rupees value of Work done priced only in respect of such items where the consumption of water is involved.

Further, Contractor may dig borewell with the prior written approval of BEML at his cost. In this case, no recovery shall be made for the water used. On completion of the Work, borewell may be handed over to BEML along with accessories on as is where basis without any claim for the borewell expenses incurred by the Contractor. The Contractor shall obtain all statutory approvals and all statutory payments shall be borne by the Contractor. The quality of the water from the borewell shall be tested by the Contractor by bearing all the costs and water will be permitted to be utilized only after meeting the relevant standards and on approval of OIC/EIC.

BB. ELECTRICITY FOR WORKS

The LT power supply if available at the project site, shall have to be tapped off by the Contractor from the tap off point indicated to him by the BEML authorities at his own cost. The Contractor has to lay the cables, provide required joints and terminate to their power supply board which consists of suitable rating energy meter, safety devices like MCB / MCCB / ELCB etc., for control and distribution. The energy will be supplied on chargeable basis based on the prevailing norms set by Electric Supply Company /Board of the respective areas towards temporary power connection for construction purpose. The supply shall not be given unless the temporary electric installation is certified as safe by the EIC/OIC. However, no claim for extension of Work shall be entertained on account of non-availability of power by BEML. The Contractor thus shall have his own back-up arrangement for such circumstances. In case power supply is not available at the project site, the agency shall arrange the same without any extra claims on this account. In case

the energy meter is not provided or the energy meter goes out of order, the assessment of electricity consumption will be based on prevailing tariff of the respective city/state.

CC. LEVY/TAXES PAYABLE BY CONTRACTOR

- i. Unless specifically mentioned other-wise elsewhere in the Contract, all rates quoted in the Bill of Quantities;
 - (a) Shall be deemed to be inclusive of all types of taxes, duties levies, fees and charges etc., imposed by Central/State Govt. and local bodies Compensation Cess, Labour Cess, Custom Duty, royalties and other levies. It shall also include all other costs including loading, unloading, insurance, transportation, testing and certification expenses except GST.
 - (b) GST at prevailing percentage is added in the BOQ at the end or as specified in the BOQ.
 - (c) Payment of GST on Works Contract is the entire responsibility of the Contractor. Contractor shall be entitled for reimbursement of GST paid, upon submission of GST Invoice and GST Challan for having paid the same to the Department
- ii. The following Acts to be referred hereunder and elsewhere in the tender document as "GST":
 - (a) Central Goods & Services Tax Act 2017 (CGST),
 - (b) Integrated Goods & Services Tax Act, 2017 (IGST),
 - (c) Union Territories Goods and Services Tax Act, 2017 (UTGST),
 - (d) Goods and Services Tax (Compensation to States) Act, 2017 (Compensation Act),
 - (e) Karnataka Goods & Service Tax Act 2017 or applicable State's GST Acts,
 - (f) Any other statutory regulation passed by the Central / State Government/s on Goods & Service Tax.
 - (g) Any other tax levied by any statutory authority in addition to Goods and service tax and charged in the Tax Invoice raised by the Contractor.
- iii. Bidder warrants having valid registration under applicable GST. A copy of the registration certificate should be submitted along with the offer.
- iv. Contractor's right to getting payment is subject to submission of a Valid Tax Invoice which would enable the Service Recipient (BEML) to claim Input Tax Credit in compliance with the provisions of the GST. Tax Invoice submitted by the Contractor shall mention the SAC/ HSN Code as applicable, Basic Price with applicable GST Rate and amount and all other essential information required to be mentioned as per the provisions of GST Rules, 2017.
- v. Contractor shall warrant the value that is attributable to GST and the corresponding rate of tax that is chargeable is included in the total price charged in the Tax Invoice. The total amount as per the Tax Invoice shall be considered as the final price inclusive of GST and no claim for payments, whether or not, for only taxes or a price inclusive of taxes, shall be admitted at a later stage on any ground whatsoever.
- vi. Any tax in the nature of Goods & Service Tax (GST) would be payable, when the invoice submitted by the Contractor is compliant with the provisions of GST law and contains all particulars as per statute.
- vii. In case there is an upward revision in the applicable rate of tax (GST) post submission of bid, the Contractor shall submit a copy of the relevant statute/notification evidencing change of applicable rates for claiming payment from BEML as per revised GST rates. Similarly, if there is downward revision of applicable tax rate post submission of bid, the benefit of lower tax liability shall be passed on to BEML.
- viii Contractor also warrants to duly comply all relevant provisions of the GST Laws including filing returns, paying taxes within the stipulated period so that no hindrance can be faced by BEML to claim Input Tax Credit as per provisions of the GST Law.

- viii. Contractor shall fully indemnify to Service Recipient (BEML) on first demand against any claims, liabilities, actions, demands, Loss, costs and expenses occurred/imposed to the Service Recipient (BEML) on account of his failure to fully/partially discharge the statutory levies in time, or his failure in adherence of the applicable laws in force. For any such non-compliance, BEML reserves the right to withhold the payment until appropriate action are taken in a mutually agreeable manner.

DD.TERMINATION OF CONTRACT

i. Termination for Contractor's Default

BEML shall, without prejudice to any other rights or remedies available under the Contract or in law, shall be entitled to terminate the Contract, in whole or in part, by issuing a written Notice of Termination to the Contractor, upon occurrence of any of the following events:

- a) Failure to commence the Work within the stipulated time after issuance of Letter of Acceptance / Work Order.
- b) Failure to achieve milestones or maintain progress of work as per the approved Project Schedule, and such failure continues for a period of 14 days after receipt of written notice from BEML.
- c) Persistent or repeated non-compliance with instructions of BEML Ltd
- d) Abandonment of the Work or substantial portion thereof.
- e) Failure to deploy adequate manpower, machinery, key personnel, or resources as committed in the Technical Bid.
- f) Sub-letting or assignment of the Contract or any part thereof without prior written approval of BEML.
- g) Submission of false information, forged documents, or misrepresentation at any stage of bidding or execution of the Contract.
- h) Breach of Integrity Pact, or involvement in corrupt, fraudulent, collusive, coercive or unethical practices.
- i) Insolvency, bankruptcy, winding up, receivership or appointment of liquidator over the Contractor.
- j) Failure to rectify defective work or non-conformity with specifications despite notice.
- k) Failure to obtain statutory approvals, clearances, or compliances required under the scope of EPC obligations.
- l) Any material breach of terms and conditions of the Contract.

Upon such termination:

- BEML shall be entitled to **encash the Performance Bank Guarantee (PBG)** and any other securities.
- BEML shall be entitled to execute the balance work through **Risk & Cost Purchase** at the risk and cost of the Contractor.
- The Contractor shall not be entitled to any compensation except for the value of work satisfactorily executed and certified by BEML up to the date of termination.
- Any extra expenditure incurred by BEML in completing the balance work shall be recoverable from the Contractor.

2. Termination for Convenience of BEML

BEML reserves the right to terminate the Contract, in whole or in part, at any time for its convenience, by giving **30 days' written notice** to the Contractor.

In such an event:

- The Contractor shall stop the work in an orderly manner.
- The Contractor shall be paid for the work executed satisfactorily up to the date of termination, as certified by BEML.
- No claim for loss of profit, overheads, idle charges, loss of opportunity, or any consequential damages etc. shall be payable.
- The Contractor shall hand over all drawings, designs, documents, and partially completed works to BEML.

3. Termination for Force Majeure

If a Force Majeure condition continues for a period exceeding **90 days**, either party may terminate the Contract by giving written notice.

In such case:

- Payment shall be made for the work executed up to the date of termination.
- No party shall be liable for any damages or compensation arising out of such termination.

4. Effect of Termination

Upon termination for any reason whatsoever:

- a) The Contractor shall immediately vacate the site after handing over all works, materials, drawings, documents, designs, and equipment etc. belonging to BEML.
- b) All designs, Intellectual Property, drawings, data, reports, and documents prepared by the Contractor under the EPC scope shall become the property of BEML.
- c) BEML shall have the right to use all such Intellectual property documents for completion of the project without any restriction.
- d) BEML shall take possession of all construction equipment, temporary works, and materials at site for the purpose of completing the balance work.

5. No Waiver

Termination shall not prejudice any accrued rights, claims, or remedies of BEML arising prior to the date of termination.

6. Blacklisting / Debarment

In case termination is on account of Contractor's default, misrepresentation, Integrity Pact violation, or corrupt practices, BEML reserves the right to initiate **blacklisting / debarment proceedings** against the Contractor as per prevailing Government of India guidelines.

7. Survival

Clauses relating to indemnity, intellectual property, confidentiality, risk purchase, damages, and dispute resolution shall survive termination of the Contract.

EE. RISK PURCHASE CLAUSE and FORCE MAJEURE CLAUSE:

The time and the date of delivery of the stores stipulated in the PO shall be deemed to be the essence of PO and delivery must be completed not later than the date specified therein. Shall the supplier fail to deliver the stores or any consignment thereof within the period prescribed for such delivery, BEML shall be entitled at their option either;

- a. To purchase elsewhere, without notice to the supplier on the account and at the risk and cost of the supplier the stores not delivered or other of a similar description (where stores exactly complying with the description and readily procurable) without cancelling the PO in respect of consignment not due for delivery

Or

- b. To cancel the purchase order.

In the event of action being taken under clause (a) or (b) above, the supplier shall be liable for any loss, which BEML may sustain on that account but the supplier shall not be entitled to any gain or purchases made against default. As soon as it is apparent that the scheduled dates cannot be adhered to, an application shall be sent by the supplier to BEML, well before the expiry of the delivery period specified in the purchase order. Without prejudice to the foregoing rights, if such failure to deliver in proper time as aforesaid shall have arisen from any cause which BEML may admit as a reasonable ground for an extension of the time (and their decision shall be final) they may allow such additional time as they may consider justified by circumstances of the case.

Delivery required to be made in lots shall be made in lots only and any extra deliveries involved either on account of repeated rejections or variance in supply of lots shall be liable for service charges of 5% of the purchase order value for each extra delivery.

c. Force Majeure clause.

Notwithstanding anything contained in the Contract, neither the Supplier nor the Purchaser shall be held responsible for total or partial non-execution of any of the contractual obligations, shall the obligation become unreasonably onerous or impossible due to occurrence of a Force Majeure conditions which directly affect the obligations to be performed by the Purchaser or the Supplier. Such events include war, military operations of any nature, blockages, revolutions, insurrections, riots, civil commotions, insurgency, sabotage, acts of public enemy, fires, explosion, epidemics, quarantine restrictions, floods, earthquake, or acts of God, restrictions by Govt. authorities over which the Supplier or the acts on which the Purchaser has no control.

The party claiming to be affected by Force Majeure clause shall notify the other party in writing without delay, within two weeks on the intervention and on the cessation of such circumstance. Extension of time sought by the supplier along with supporting evidence and so granted by the purchaser for the supply/work affected, if any, shall not be

construed as waiver in respect of remaining deliveries.

Notwithstanding above provisions, Purchaser shall reserve the right to cancel the order /Contract, Wholly or partly, in order to meet the overall delivery schedule and make alternative arrangements including arrangements with third party for completion of deliveries and other schedules. Purchase may takeover partly processed material at a mutually agreed price.

FF. QUOTED RATE TO REMAIN FIRM THROUGHOUT THE CONTRACT

- i. The rates as per the accepted Bill of Quantities shall be firm and hold good till the completion of the works, and no additional claim or amount shall be admissible on account of fluctuations in market rates, increase in fees royalties unless specifically provided for in the Contract, under any circumstances. Hence, the Contractor shall agree not to petition or claim for revision of rates tendered by him under any circumstances or at any stage of the Work, either during execution or at the time when the Final Bills are settled.
- ii. Price variation shall be allowed, only if applicable, as per the Contract.

GG. UNDERSTANDING OF SITE CONDITION:

The Contractor shall fully satisfy himself or shall be deemed to have fully satisfied himself as to the nature of the Site, the soil, sub-soil, natural and man-made surroundings, existing structures (if any) at Site or in the vicinity, weather conditions, requirements, availability of resources, third party claimants or occupants (if any), the dimensions, levels, layout, character and nature of all roads, existing drains, sewers, electricity, water, gas or other mains, electric cables and other things as regards any connection they may have with the works of the subject of the Contract. The Contractor shall also inspect the site works and surroundings, the means of access thereto. Contractor shall generally obtain his own information on all matters concerning the Site and works to be executed thereon and of all matter and things which may in any way influence his Tender or the works. No claims for extra works, delay due to site conditions or otherwise will be allowed in consequence of any misunderstanding, error, incorrect information on these points, or if any other inaccuracies in reference thereto, which may appear on the drawings or in the specification nor shall the contract be nullified in consequence of any such misunderstanding, error, incorrect information or inaccuracies.

HH. CONTRACTOR'S LIABILITY AND INSURANCE:

- a) From commencement to completion of the works, the contractor shall take full responsibility taking precautions to prevent loss or damage. He shall be liable for any damage or loss that shall happen to the works or any part thereof.
- b) In addition, the contractor shall indemnify and keep the Company indemnified against all losses and claims for injuries or damages to any person or any property whatsoever which shall arise out of or in consequence of the construction works. For this purpose, the contractor shall take an insurance policy-"contractors all risks insurance"- to cover the risks, as per the Conditions of the Contract. The insurance policy has to be kept valid till the work is completed and the possession handed over to the Company. The policy shall be taken at his cost showing the Company as the 'principal' to simplify the work in the matter of raising claims and settlement thereof.

II. INDEMNIFICATION

Indemnity against all actions of Contractor, Agents, Employees::

The Contractor shall hold and save harmless and indemnify BEML and its employees, from all actions, suits, proceedings, loss, costs, damages, charges, claims and demands of every nature and description brought against or recovered from BEML and their employees by reason of any act, deed, omission or commission of the Contractor and/or his representative and/or his Employees and/or his sub-contractors in the execution of the works under the Contract. All the sums payable by BEML by way of compensation to any third party/ies, under any of these conditions, shall be recovered from the dues of the Contractor, without reference to the actual loss or damage sustained, and whether or not any damage shall have been sustained.

JJ. CAR POLICY

- i. The Contractor's All Risk (CAR) policy shall be taken for the risk to commence from the date of actual commencement of Work as per Work Order for the Contract Sum till actual completion of Work against fire, Lightning, explosion, impact, flood, inundation, storm, earthquake, subsidence, landslide, theft, burglary, riot and strike, civil war and terrorist damage. The policy compensates individual against death, loss of limbs, loss of eyesight, permanent total disablement, permanent partial disablement and temporary total disablement, solely and directly resulting from accidental injuries. Any item not covered under above policy shall be the responsibility of Contractor. The policies of the Contractor shall remain in force throughout the period of execution of the works except for any specific insurance covers necessary for a shorter period. Before commencing the Work, it shall be obligatory for the Contractor to obtain, at his own cost, insurance cover in the joint name of the Contractor and BEML under the following requirements.
- ii. Liability for death or injury to any person or loss to any property (other than the Work) arisen out the performance of the Contract.
- iii. Construction plant, Machinery and Equipment brought to site by the Contractor\ Any other insurance cover as may be required by the law of the land like Workmen Insurance etc. with Insurance Company approved by the PIC/OIC.
- iv In case of such loss or damage as aforesaid, the money payable under any such insurance shall be received by BEML. This will be subject to:-
 - (a) Risk covered.
 - (b) Claims on realization shall be passed to the Contractor according to value of the claims accepted by the insurance company for his damaged portion of Work after deducting 15% towards services rendered by the BEML for processing the claim(s). The amount so disbursed to the Contractor(s) shall be limited to the amount calculated on the basis of his accepted rates in the contract with the BEML.
 - (c) The Contractor shall also obtain any additional insurance cover as per the requirement of the contract in the event of his contract not having been previously cancelled under contract conditions.
 - (d) Such insurance shall be one in respect of all works, unless otherwise expressly specified in the tender conditions.
- v. If the Contractor fails to effect or keep in force or provide adequate cover as acceptance to the Engineer-in- Charge in the insurance policies mentioned above, then in such cases, the

Engineer-in-Charge may effect and keep in force any such insurance or further insurance on behalf of the Contractor. The recovery shall be made at the rate of 1.5 times the premium /premiums paid by the EIC in this regard from the payment due to the Contractor or from the Contractor's performance security. However, the Contractor shall not be absolved from his responsibility and / or liability in this regard.

KK. PROGRESS REVIEW MEETINGS

The Contractor/s shall agree to execute the Work progressively in co-ordination with the concerned OIC/ EIC. Further, Contractor is required to attend progress review meetings regularly. The purpose of a progress review meeting shall be to review the work done, to plan for remaining Work and to deal with the matters related to the Work. The OIC/EIC or his nominee shall record the minutes of the progress review meetings and minutes will be shared with all the attendees. The responsibilities of the parties for actions to be taken is to be decided by the OIC/EIC either at the progress review meeting or after the progress review meeting and stated in writing to all who attended the meeting.

LL. APPROVAL OF WORKS BY STAGES:

- i. All Works consisting of more than one process shall be subject to examination and approval at each stage by the Officer-in-Charge/ Engineer-in-charge or his nominee thereof and the Contractor shall give due notice in writing to the Officer in-Charge/ Engineer-in charge when such stage is ready. Approval of works by stages shall be recorded in Work / Stage Passing Register. In default of such notice being received, the Officer-in-Charge/ Engineer- in-charge shall be entitled to disallow the Work or any part thereof at any time he may choose and in the event of any dispute, the decision of the Officer-in-Charge/ Engineer in- charge thereon shall be final and conclusive.
- ii If any Work is so disallowed, the same shall be redone by the Contractor at his cost to the satisfaction of the Officer-in-charge/ Engineer-in-charge. Also, in the event of failure of the Contractor to give notice, he shall uncover any part of the works and/or make openings in or through the same as the Officer-in-charge/ Engineer-in-charge may direct for his verification and shall make good such part to the satisfaction of the Officer-in-charge at the Contractor's expense.

MM. SITE RELATED

A NIGHT WORKS:

Night Works will be permitted depending on requirement/need basis subject to obtaining prior approval from BEML and other statutory authorities. However, no additional payment will be made for night work. The Contractor shall make adequate lighting and safety arrangements for night working. He shall also be responsible for any claim on account of any injury to or loss of life, of anyone, arising out of inadequate lighting, safety arrangements or due to any other failure of the Contractor.

B. CONTROLLING OF CONTRACTOR LABOUR & POLICE VERIFICATION

- i. The Contractor is to keep all persons under his control and within the boundaries of the Site, and he will be held responsible for the care of the works until their completion and handover, including all works executed and materials deposited on the sites by himself or suppliers, together with all risks arising from weather, carelessness of apprentices, damage or loss by thefts or by any other cause and is to allow for all necessary watching and protective lighting.
- ii. The Contractor shall submit Police Verification Certificate to move inside BEML premises

during execution of Work and shall submit as affidavit for conduct and credibility of the labour force engaged for the Work to the OIC/EIC.

NN.BRIBES AND GIFTS:

Any bribe, commission, gift or advantage given, promised or offered by or on behalf of the supplier or his partner, agent or servant or anyone on his or their behalf to any officer, servant, representative or agent of BEML or any person on his or their behalf in relation to the obtaining or to the execution of or any other contract with BEML shall in addition to any criminal liability which the supplier may incur, subject the supplier to the cancellation of the PO and all other contracts with BEML and also to payment of any loss or damage resulting from any such cancellation to like extent as is provided in case of cancellation under **Clause-15** hereof. Any question or dispute as to the committing of any offence under the present clause shall be settled by BEML in such manner and on such evidence of information as they may think fit and sufficient and their decision shall be final and conclusive.

9. **ADDITIONAL CONDITIONS OF CONTRACT**

(UNDER WHICH THE WORKS HEREINAFTER DESCRIBED ARE TO BE PERFORMED)

A. INTERPRETATION CLAUSE: In these General Conditions and the Specifications attached, the word 'COMPANY' shall be held to mean 'BEML LIMITED', the work 'CONTRACTOR' shall be held to mean one or more contractor or contractors jointly or generally engaged in the works to which these General Conditions and the specifications relate, and shall include his/their heirs, executors and administrators. The word 'ENGINEER-IN-CHARGE, shall be held to mean a Member of the staff of the BEML to supervise the work. The expression 'SITE OF WORKS, shall be held to mean the extent of land which the Company places at the disposal of the Contractor from time to time for the purpose of executing the contract works. The word 'DRAWINGS' shall be held to mean 'THE PLANS, SECTIONS, ELEVATIONS AND DETAILS OF WORKS' annexed to the contract

and such further drawings, as the Engineer in charge may issue from time to time during the progress of the works and shall be held to include tracings and photographic prints. The word SPECIFICATIONS shall be held to include the tender General Conditions, Specifications, Schedule of Prices and Bill of Quantities.

B. CONTRACT NOT TO BE ASSIGNED OR UNDERLET AND CONSEQUENCE OF GRATUITIES BEING GIVEN:

The contractor shall not assign or make over the contract to any other person, or underlet it, or make a sub-contract with any workmen or workman for the execution of any part of work(s), but shall employ his own workmen for the labour thereof, who shall be paid by him in wages by the day. And in case the Contractor assigns or makes over the contract, or underlet or make sub-contract, contrary to this clause or either himself or his agents give any gratuity to any employee of the Company, the company shall be at liberty to terminate the contract.

C. TENDER OR AGREED RATE: The contractor shall agree not to petition for revision of rates tendered for by him under any circumstances at any stage of the work, either during execution or when the final claims are settled.

D. In the event of anything evidently necessary to the due and complete performance of the works being omitted to be shown on the drawings or described in the specification or being omitted from the Bill of Quantities through oversight or error, the contractor shall, notwithstanding, execute (in the most perfect manner) all such works the same as if they had been severally shown, described and included without being entitled to make any extra claim or charge.

E. The contractor shall satisfy himself or shall be deemed to have satisfied himself as to the nature of the sub-soil, the three dimensions, levels, character and nature of all roads, existing drains, sewers, water, gas or other mains, electric cables and other things as regards any connection they may have with the works the subject of the contract, and he shall also inspect the site of the works and surroundings, the means of access there to and egress there from and shall generally obtain his own information on all matters and things which can in any manner influence his tender, No claims for extra works otherwise will be allowed in consequence of any misunderstandings, error or incorrect information on these points, or of any other in-accuracies in reference thereto, which may appear on the

drawings, or in the specification, nor shall the contract be nullified in consequence of any such misunderstanding, error incorrect information or in-accuracies.

F. ENGINEER IN CHARGE'S ORDERS TO COMMENCE WORKS AND AS TO NON-

DELIVERY OF SITE: The Contractor having signed the contract, the Chief Engineer will forthwith give him notice to commence the works and the contractor shall upon receipt of such notice, commence the works and carry them on at such point and points and in such portions as the Engineer in charge may direct.

The Company shall, with the Engineer in charge written order to commence the works, give to the contractor, the use of so much of the site of works, as may in the opinion of the Chief Engineer be required in order to enable the contractor to commence and continue the construction of the works, and shall from time to time as works proceed give the contractor the use of such further portions of such site as the Engineer in charge may from time to time consider proper in that behalf, but the non-delivery in manner aforesaid of the use of such site or any portion thereof shall not vitiate or affect the contract, nor any provision contained in the specification nor entitle the contractor to any increased allowance in respect of money.

G. SETTING OUT WORKS AND NOTICES: The Contractor shall set out the whole of the works and be responsible for the correctness of the position, levels and dimensions of the several works, according to the drawings and written instructions of the Engineer in charge. If at any time during the progress of the works any error shall appear or arise in the position, levels or dimensions of the several works, the contractors on being required to do so by the Engineer in charge, shall at his own expense remove and amend the works to the satisfaction of the Engineer in charge, notwithstanding that he may have been assisted by Engineer-In-Charge in setting out the same. The contractor shall observe, perform and comply with the requirements of all statutes and byelaws and shall also serve notice on the authorities having control of the road surfaces before the same are broken up and he shall likewise serve notices on the owners of the sewers, drains, water, gas or other mains, electric cables and other things which may be in any way affected by the execution of the contract work.

H. TIME OF WORKING (APPLIES ONLY FOR FACTORY AREA): As the entry and exit of the workmen into the factory area is controlled by the Security Authorities of the Factory, the contractor should strictly adhere to the timings of entry and exit, laid down by the authorities and the rates quoted are deemed to include for this provision.

I. NIGHT WORKS: The works shall be carried as per applicable labour laws on day and night continuously without extra charge. If bad or treacherous ground be met with or if there be any other causes whatsoever, which in the judgment of the Engineer-In-Charge, requires, it, but no work shall be carried on in the night without the knowledge and sanction of the Engineer-in-charge.

J. WATCHMEN, LIGHTS, ETC., TO BE PROVIDED BY THE CONTRACTOR: The Contractor, shall at his own cost provide night watchmen to all parts of the work where necessary required by the Engineer-in-charge. He shall also keep all open trenches, excavation or other dangerous places properly and sufficiently lighted between sunset and sunrise, and shall provide and fix proper fencings and boarding and temporary bridges to protect. The contractor shall also at his own cost erect temporary fences on the site of works where required by the Engineer-in-charge.

K. TEST MATERIALS: All the materials to be used in and on every part of the works shall be subjected from time to time to such tests as the Consultant and Engineer in charge may direct. Such tests shall be performed at the expense of the contractor but the Company shall refund to the Contractor the actual cost of testing any of the materials which are proved to conform with the conditions of the specifications but the samples shall be, in all cases, selected by the Engineer in charge, and supplied by the contractor as part of the contract. If, at any time, any materials so tested is not equal to the test for such materials, hereinafter specified, the same shall be removed from the site of works, and other materials substituted therefor, but in the absence of any specified test, the decision of the Engineer in charge, shall be final as to whether the said material or materials shall be used in the works, or forthwith removed and other materials substituted.

L. MATERIALS, TOOLS ETC., BROUGHT ON TO WORKS TO BECOME PROPERTY OF COMPANY DURING CONTINUANCE OF CONTRACT:

All materials, tools, implements and other things brought by the Contractor upon Company's works shall there upon become and shall continue to be the absolute property of the Company and be considered in its possession, the Contractor having only the right of using the same for the purpose of the contract. After the works have been completed and all obligations under the contract duly fulfilled, the Company shall return to the Contractor the tools, implements and surplus or waste materials then remaining upon the Company's works to be removed by him forth-with and cleared away. Nevertheless, the Company shall not at any time be liable for the loss of any of the said materials, tools, implements or other things but the whole of this liability shall fall upon the Contractor, the same as if they had remained in his possession.

M. POWER TO VARY WORKS: The Company shall have full power and authority from time to time, and at all times, to order works additional to the contract, and to make and issue such further drawings and to give such further instructions and direction as may appear necessary or proper for the guidance of the contractor and the good and sufficient execution of the contract, and the contractor shall receive, execute, obey and be bound by the said further drawings, instruction and directions, according to the true intent and meaning thereof and as fully and effectively as though they had accompanied, or had been mentioned or referred to in the original drawings and specifications. The company shall also have power to vary or alter the levels or position of any of the works, the subject of this contract, or may order any of the works contemplated thereby to be omitted with or without the substitution, of any other works in lieu thereof, or may order any work, or any portion of work executed or partly executed , to be removed, changed or altered, and if needed that other work shall be substituted in lieu thereof and the difference of expense occasioned by any such increase, diminution or alterations so ordered and directed shall be added to or deducted from the amount of the contract agreeable to the prices for similar works set forth in the Bill of Quantities, or failing which the Schedule of Prices attached hereto, and in the absence of any such similar work being scheduled, the Engineer in charge shall determine the amount to be paid for such additions or deductions. The company will in no case become liable to the payment of any charge in respect of any such conditions, alteration or deviations, unless the instructions for the performance of the same shall have been given in writing and signed by the Engineer in charge ,, nor unless such instructions distinctly states that the matter thereof is to be subject of an extra or varied charge, in the form of an order hereinafter set forth nor unless the claim thereof shall be made in writing, signed by the Contractor

and in the form of claim herein as set forth and properly filled up nor unless such claim be made within the week in which the work is executed and materials used, and before the same shall have been placed out of view, or beyond check of measurement, nor unless the value of any altered or varied works, or any further works shall wherever practicable have been determined and settled before such altered, varied or further works shall have been commenced. Such value in case of dispute shall be ascertained by the Engineer in charge, who shall determine in all cases whether such previous determination and settlements were practicable or not, and in all the cases where he shall consider the same to have been practicable, the contractor shall not be entitled to make any claim in respect of such altered, or varied or further works if it shall, in the opinion of the Engineer in charge, if any special instance become necessary to execute any additional or substituted work, either wholly or in part by the day the claim therefor, shall not be recognized unless the contractor shall have delivered to the Engineer-in-charge, within one working day, and so on from day to day a true and exact list of the name, occupations, time and wages of the several workmen engaged during the previous day on any and every such works in respect of when a charge 'BY THE DAY' is intended to be made in the next succeeding weekly claim of contractor, Nevertheless, no charge 'BY THE DAY' shall be made unless, in the opinion of the Engineer in charge, it is impracticable or unreasonable to determine the value of the amount of work in manner otherwise provided for in these general conditions.

N. SUSPENSION OF WORK: The Contractor(s) shall suspend the execution of work or any part or parts thereof whenever called upon in writing by the Chief Engineer to do so and shall not resume work thereon until so directed in writing by the Chief Engineer. The Contractor will be allowed by the Chief Engineer an Extension of time (not less than the period of suspension) for completion of the item or group of items of work for which a separate period of completion is given in the contract and of which the suspended work forms part but not other claims in this respect for completion or otherwise, however, shall be admitted. The contractors shall have no claim to any payment of compensation or otherwise, whatsoever on account of suspension of work.

O. WORKS TO BE EXECUTED IN APPROVED MANNER: The works, the subject of the contract, specified and provided for or that they may be necessary to be done to form and complete any part thereof, shall be executed and completed in the best substantial manner, with materials of the best and most approved quality of their respective kinds agreeable to the particulars contained in or implied by the specification or as referred to and represented by the drawings and memoranda thereon or as referred to by any of the said further drawings and memoranda thereon or as referred to by any of the said further drawings, instructions and directions and shall be to the full satisfaction of the Engineer in charge. The Engineer in charge, shall have full liberty at all reasonable time to inspect and examine the works, materials and workmanship, and may every such time reject any or all of such works, materials and workmanship which to him/them or either of them may appear defective, unfit or improper for the several purposes to which they are applied, or intended to be applied, or as not in accordance with the specification or the said drawings, memoranda, instruction or directions respectively.

P. WORK TO BE CARRIED ON WITH EXPEDITION FAILING WHICH THE COMPANY MAY EMPLOY OTHER CONTRACTOR WITHOUT VITIATING THE CONTRACT: The Contractor shall commence to carry on the works with due diligence, and as such expedition as the Engineer in charge, may reasonably expect, having regard to the specified time of completion of the whole of the works. In case the contractor fails to do so, or neglect to provide proper and sufficient materials, or to employ a sufficient number

of workmen to execute the work, then the company shall have full power, without vitiating the contract, to take the works wholly or in part out the hands of the contractor to engage or employ any other person or workmen to procure all requisite materials and implements for the due execution and completion of the said works, and the cost and charges incurred by the company in so doing shall be ascertained by the Chief Engineer and be paid for or allowed to the company by the contractor and it shall be competent for the Company to deduct the amount of such costs and charges along with overheads out of any sum or sums due or to become due from the company to the contractor under this or any other contract.

Q. INFERIOR MATERIALS OR WORKMANSHIP TO BE AMENDED: The materials as well as the workmanship and finish of the whole of the contract works shall be best of their kind and should any materials be brought upon the site of works or on any land or property of the company or on the places where the operations are being carried out in connection with the works, which in the judgment of the Engineer in charge, is of an inferior description and improper to be used in works, the said materials shall be removed. All inferior workmanship or finish shall be amended by and at the cost of the contractor forthwith, or within such period or periods as the Engineer in charge, may direct, and the contractor shall pull down, amend and reconstruct any work he may have erected upon an insecure or insufficient foundation or that he may have insufficiently secured and protected against immediate and future injuries, whether arising or likely to arise in future from weight, pressure action of water or otherwise, on being required to do so by the Engineer in charge. In case the contractor neglects or refuses to remove such materials or comply with such directions it shall be lawful for the Chief Engineer, on behalf of the company and by its agents, servants and workmen to remove the materials and amend the workmanship and finish, so objected, to, or any part thereof, and to replace the same with such other materials, workmanship and finish as shall be satisfactory to the company and on the certificate of the Chief Engineer to deduct the expense thereby incurred, or to which the company may be put or be liable or which may be incidental thereto, from the amount of any sum or sums due to or become due to contractor, or to recover the same by action at law or otherwise from the contractor as the company may determine.

When it is apparent to the Chief Engineer that defects exists in the work, or that damage or accident has occurred to the works, or that the works are not upheld or maintained in good sound and water right conditions, or repair or in working order, but the cause thereof is not apparent, a general requisition in writing by the Chief Engineer to the contractor to amend, make good or maintain the works in sound, perfect and water tight conditions shall be under no obligation to specify the work or repair, but such requisition shall be conclusive evidence against the contractor that he is not performing his obligations under the contract.

R. PRECAUTIONS AGAINST INJURY TO PROPERTY ADJACENT TO THE WORK IN PROGRESS: The contractor shall take special care, by the erection of temporary fences and by every other means which circumstances may render necessary, to prevent all injury and damage to or trespass upon the lands, roads, fences or property adjacent to the site of works and shall confine the passage of his workmen to existing public roads, foot paths. He shall likewise pay and satisfy all claims whatsoever and from whomsoever, for temporary occupation, way-leaves, damages, the trespass or otherwise, in reference to the said lands, roads, fences and property adjacent and bear the company harmless from any and all such claims. If any greater extent of land than the site of work be required by the contractor for his operations, he shall obtain and occupy the same at his own cost and

charge.

- S. PRECAUTIONS AGAINST ACCIDENTS OR INJURY:** The Contractor shall, at his own expense, shore, sling, protect, support, alter, restore make good and maintain as may be necessary, all buildings, water and gas pipes, sewers, drains, electric cables and other things which may be disturbed, exposed or injured during the execution of works or in consequence of the execution of the works and shall also provide any extra timbering which may be temporarily required and all labour in fixing and removing the same and shall, at his own expenses provide for the continuous use of all buildings, pipes, sewers, drains electric cable, water sources and other things, the use of which may be liable to interruption during the progress of the work. The Contractor shall at his own expense restore all such buildings, water and gas pipes, sewers, drains, electric cables and other things to the satisfaction of the owners thereof and he shall like wise, at his own expense, construct and maintain such works as may be necessary for the due permanent support of all such buildings, pipe, sewers, drains, electric cables and other things met with in the construction of works, and shall indemnify, save, harmless and keep indemnified, the Company and its officers from and against all action, suits, claims, penalties, liabilities, cost, expenses and demands whatsoever, by reasons or on account of damage to such buildings, pipes, sewers, drains, electric cables and other things whether caused by the execution of the contract works or in the insufficiency of the aforesaid permanent support. The Company may deduct the expenses thereby incurred or to which the Company or its Officers may thereby be put or be liable or which may be incidental thereto from, the amount of any sum or sums due or to become due to the contractor or may recover the same by action at law or otherwise from the contractor and the Company may compromise any such action suits or other proceedings, or such terms as it shall see fit and contractor shall thereupon forthwith pay the Company the sum or sums paid by the Company upon the occasion thereof, and shall in every case pay such sum or sums as shall fully indemnify the Company according to the present stipulation.
- T. COVERING OF CONSTRUCTION SITE:** The Contractor shall, at his own expense, make arrangements to cover/wrap the construction site in mesh material of green color to prevent the dust from the escaping into the adjoining Properties or premises and atmosphere and also to prevent accidental fall of debris onto the people. The contractor at his own expense should make arrangements to remove the cover after completion of the work.
- U. ROYALTIES:** The Contractor shall be liable to pay all royalties chargeable on Government or Company materials required for the work.
- V. REJECTED MATERIALS:** All rejected materials will at once be removed from site by the contractor to such distance as may be desired, failing which the company after giving three days notice in writing may do so and recover the cost of removal from the contractor.
- W. COMPANY'S PLANT:** No Company's plant, materials or Labour will ordinarily be lent or hired to the contractor. Exceptional cases must have the approval of the company in writing.
- X. SCOPE OF COMPLETION:** Completion includes completion of all work in accordance with the plans and specifications, removal of all yard mess accumulated during construction, levelling and cleaning up the site and generally cleaning the whole building or works.

Y. FINAL MEASUREMENTS TIME:

The final measurement must invariably be preceded by a thorough remeasurement of the whole of the work, performed which will be made by the company's authorized representative and at which the contractor or his accredited agent must be present. For this purpose, a written notice will be sent to him at least THREE DAYS before the date fixed for the measurements, appointing the day, hour and place of meeting. Should he not attend to this the measurements will proceed without him, and he will be precluded from making any protest.

If a dispute arises between the company and contractor as to the quantity or quality of work, performed, involving sum larger than Rs.500.00, the contractor may appeal in writing to the company for remeasurement or reappraisal, as the case may be. If the company considers that Contractor's claim is valid, they may appoint an officer, other than the Officer who made the final measurement and inspection vide Paragraph-28 above, and his report shall be considered as final and binding on the contractor. The Contractor shall have a representative present when the remeasurement or the appraisal is being made

Z. ATTENTION:

- a. Time will be the essence of the contract and the contractor is to complete the whole of the work in the time stated in the tender, subject to the schedule of conditions.

- b. The contractor is to provide at all times during the progress of work and the maintenance period proper means of access, with ladders, gangways, etc., and the necessary attendance to move and adopt as directed for the inspection of their representative (no separate rate will be allowed).
- c. The Contractor is to keep all persons under his control and within the boundaries of the site and he will be held responsible for the care of the works generally until their completion including all works executed and materials deposited in the sites by himself or suppliers, together with all risks arising from weather, carelessness of operatives, damages or loss by thefts or by any other cause, and is to allow for all necessary watching and protective lighting.

AA. LABOUR ACTS:

- i. The Contractors shall employ labour in sufficient number to achieve the required rates of progress and quality to ensure best workmanship of the degree required under various specifications and to the satisfaction of Engineer-in-charge. The contractors shall remain liable for the payment of all wages or other remunerations to his labourers or employees under the Code on Wages 2019, Code on Social Security, 2020, the Occupational Safety, Health and Working Conditions Code 2020. In the event, the contractor fails or neglects to pay any amount due by him under any of the labour Codes relating to Employees compensation Act, ESI , EPF or other Labour Laws, the Company is entitled to withhold the same from any other amount payable by it to the contractor and remit the same to the authority concerned and such payment shall be binding on the contractor.
- ii. In the event of contract, the contractor shall be responsible for implementing the provision of the Labour Codes and also responsible for any repercussions arising there from for non-compliance thereof.
- iii. The intending tenderers should quote their organization registration/code numbers for the registration with ESI/PF Authorities. It may be noted that other things being equal, preference will be given in the acceptance of tender to firms having independent registration with ESI/PF Authorities.
- iv. BEML shall arrange to recover from the contractors bills requisite amounts of both Employer's and Employee's contribution for both ESI and PF calculated on the basis of 25% of the value being taken as the labour cost and recover such amounts from the respective bills and keep the same in suspense account. On production of requisite documentary evidence supporting payment of ESI/PF Authorities/supported by the acquaintance rills, the amount earlier recovered from contractor's bills shall be paid duly adjusting the shortfall in remittance, if any.
- v. In the event of any accident/injury/disablement, the contractor shall arrange to pay the requisite compensation legally payable to the concerned employee/dependents and also indemnify to BEML in case of any claim arising therefore later.
- vi. CONTRACTOR should employ only ESI Registered workmen on any item of work. If contractors have workman who have not yet been Registered under the ESI they should ensure that the workers have been duly registered before employing them in work.
- vii. CONTRACTORS should produce his MUSTER ROLL duly certified by Engineer-in-charge once in a month say before 5th of each month to the Pay roll section, so that the ESI amount can be ascertained and recovered/payment obtained irrespective of the fact whether work order is issued or not.

- viii. If there is any default on the part of the contractor, an estimated amount towards ESI liability including the would-be penalty/damage, will be recovered by the company from the bills of the contractors.
- ix. CONTRACTORS should maintain all registers and records required for ESI, PF Payment of wages, etc., under the statutes and produce them for verification as and when called for by company inspecting Authorities.

BB. FAIR WAGES: The Contractor shall not pay less than fair wage to labour, workmen engaged by him on the work. Fair wages means wage for the various categories of labour, workmen, fixed from time to time by the labour authorities of the area. The contractor shall ascertain the minimum fair wages prevailing in the area before submitting his tender. The Contractor should also abide by labour regulations in regard to the payment of wages, wage period, fines and deductions from wages, maintenance of wage book, wage slip, publication of scales of wage and other terms of employment, inspection and submission of periodical returns and all other matter relating to labour rule in force.

CC. The contractor shall arrange qualified Engineers with experience in similar construction work to be at the work spot throughout the period of construction to ensure correct undertaking and execution of the work as per drawings and specifications.

DD. The setting of the building shall be done by the contractor himself. All measurements shall comply with the dimensions noted on the drawings if any. The contractor shall construct centre line pillars and Bench Marks wherever necessary at his own cost and the setting out shall be got checked, approved and certified by the Engineer-in-charge before execution of the work.

EE. Foundations shall generally conform to the dimension indicated on the drawings, unless the nature of soil after excavation examined by the Engineer-in-charge, of works necessitates modifications. The foundation trenches for RCC columns and walls after excavation indicated on the drawing shall be got inspected, approved and certificated by the Engineer-in-charge of works before laying concrete.

FF. Provision shall be made during the progress of work for embedding Electric conduits etc., wherever necessary as directed. Openings shall be left for service lines, machine foundations, as required and as per instructions of the Engineer-in-charge.

GG. Care shall be taken in execution of work not to damage service lines etc., coming in the way of construction. If any damage is caused in the lines, the cost of replacing or repairs shall be borne by the contractor.

HH. CONTRACTOR(S) shall provide himself/themselves with requisite number of welding sets, mixers with hoppers, vibrators builders hoist, Tools, meters and testing equipments, transport vehicles, etc., required for the complete satisfactory execution of work.

II. THE Contractor shall agree to execute the work progressively in co-ordination with the

concerned officers or shop supervisors and as directed by Engineer-in-charge.

- JJ.** THE specifications contained in the MES Schedule (referred to in the tender) in appropriate sections shall apply to this contract to the extent applicable, cement co- efficient shall also form part of MES Schedule.

KK. CONCRETE MATERIALS

- 8.1 **CEMENT:** Cement used in the work shall be ordinary PORTLAND/PUZZOLANA cement and shall be stored by the contractor in a dry place under proper cover and stack. Stacks shall not be more than 10 bags high.
- 8.2 **PPC 53 Grade / OPC 43 Grade mixed with fly ash** confirming to relevant IS codes mixed with fly ash in allowable percentage meeting the required properties in accordance with the relevant IS code to be used for green construction.
- 8.3 Re-enforcement: reinforcing bars for concrete will be TMT bars of grade of FE500D with strength requirements confirming to latest suitable IS codes.
- 8.4 **FINE AGGREGATE:** Fine aggregate (sand) for concrete shall be of approved quality natural sand. Fine aggregate shall be clean, free from any admixture of clay, loam, silt, organic matter and other impurities.

- 8.5 **COARSE AGGREGATE:** Coarse aggregate for concrete shall be of approved broken granite stone and shall conform to IS-383-1963.
- 8.6 **WATER:** Water used in concrete shall be clean, fresh and non-saline.

The various concrete surfaces shall be finished as under:

- a) All concrete surfaces occurring in conjunction with wall and the like: Immediately after the formwork is removed all irregularities shall be removed and air holes shall be stopped with CM 1:3 so that the surface is ready for application of plaster which is paid for separately.
 - b) Soffits & edges of roofs, soffits & edges of chajjas, facias, soffits and sides of beams and columns, exposed surfaces of shelves, not occurring with conjunction of walls: These shall be finished as described above to receive plastering which is paid for separately.
 - c) Exposed surfaces of concrete members other than those specified above and tops and edges of chajjas and the like, independent columns and other concrete surfaces not specified to be plastered: These surfaces shall be finished fair and smooth. On account of any reason whatsoever, if fair and smooth surface cannot be achieved, the contractor is permitted to plaster these surfaces with CM 1:3, to obtain a fair, uniform and smooth finish. However, he shall ensure that the thickness of plaster is kept to a minimum. The contractor shall not be paid anything extra for the application of this CM 1:3 plaster.
 - d) The rate quoted for pre-cast concrete shall include for cost involved in the cutting of grooves, etc., in walls, etc, and fixing as specified.
- 8.7 **Mixing concrete:**
All concrete shall be mixed in mechanical concrete mixers with hopper/RMC. The mixing drum shall be washed and cleaned on completion of work, every day and on every stoppage of work, if the stoppage exceeds 30 minutes

LL. Autoclaved Aerated Cement (AAC) BLOCKS:

AAC blocks masonry with Grade 1 AAC blocks as per IS 2185 (Part III) in superstructure above the plinth line in cement mortar 1:4 (1 cement:4 coarse sand) are to be used. AAC blocks shall be sound, free from cracks, broken edges, honey combing and other defects that would interfere with the proper placing of blocks or impair the strength or performance of construction. The water absorption should be less than 10% by mass.

MM. VALUATION OF DEVIATIONS:

Every deviation shall be subject to the limits specified as under:

- a. The net value of all deviations (additions and deductions) including non-tendered items,

- of the value of work completed, shall not exceed 20% of the approved contract value.
- b. In case of non-tendered items, the total value of such non-tendered items shall not exceed 5% of the approved contract value.

The basis for ascertaining the non-tendered items shall be as follows:

- (i) The value of all deviations shall be ascertained by measurements, on the basis of the rates or prices for similar work in the bill of quantities of the same contract in so far as such rates or prices apply.
- (ii) Where the rates or prices in Bill of Quantities do not apply, the value shall be based upon rates or prices deduced there from to the extent practicable to do so.
- (iii) The rates for NT items shall be based on the SSR rates after proportionate adjustment in comparison with the tendered rates of like items in the contract. The basis to be adopted for working out the NT rate is the comparison of the NT item with similar trade item in the bill of Quantity for which the contractor has quoted.
- (iv) wherever NT items cannot be deduced from the like items quoted in the tender or SSR rates, market rate shall be allowed based on vouchers/invoices as per the actual including transportation, labour etc., plus 10% overheads and the labour rate shall be taken as per minimum wages inforce, based on the recommendations of the Chief Engineer.
- (v) As a last resort a tender shall be floated to ascertain the rate for NT items. All Deviations in contracts for works including non-tendered items shall be approved by the Competent Authority as per DoP within the limits prescribed in the contract. The deviations and NT items shall be technically checked and processed by the respective "Engineer-in-charge " in concurrence with Finance Department of the respective division.

NN. PROVISION OF FITTING/FIXTURES OF DIFFERENT MAKE: The contractor shall

provide the same make of fittings/fixtures specified in the tender documents unless he has quoted for other equivalent for genuine reasons. In case due to exigency of the work and difficult market conditions, the contractor is not able to provide the same make, he shall be allowed to provide equivalent approved make subject to his obtaining the concurrence of the Chief Engineer for the price adjustment as between the quotation and the purchase price for the item involved. The base for reckoning shall be the date of purchase. The contractor shall produce purchase invoice as a proof of expenditure for the items other than those specified in the tender documents allowed for incorporation in the work. Construction Department in respective Divisions/Regional/District Offices shall ensure the reasonableness of the rate in the purchase bill produced by the contractor. The price adjustment shall be the difference between the two makes on the date of purchase.

The Company reserves the right to accept the tender in parts i.e. on the basis of lowest quotation in each part or as a whole, at its own discretion and hence it is important that the tenders take sufficient care and quote reasonable rates in each part, so that if one part only is separated and entrusted to one Contractor he should be able to do it without difficulty. The rates quoted for similar items should be consistent. THE company also reserves the right to accept the lowest or any other tender at its discretion without assigning any reasons whatsoever.

LL. Scope Variation / Change Management

1. Definition of Scope Variation

Scope Variation shall mean any **addition, deletion, modification, substitution, or change** in the scope of work, specifications, drawings, standards, capacities, quantities, layout, sequencing, or methodology of execution, **instructed by the Employer/Engineer-in-Charge**, which is not expressly included in the original Scope of Work forming part of this EPC Contract.

2. Authority to Order Variations

The Employer or Engineer-in-Charge shall have the right, at any time during the Contract Period, to instruct the EPC Contractor in writing to carry out Scope Variations. The Contractor shall comply with such instructions **provided they are issued in writing** and duly authorized.

3. Variations Related to Buildings and Civil Works

(a) For **buildings, manufacturing blocks, and civil works** where **built-up area and broad specifications** have been defined and payments are linked to **percentage completion against milestones**, variations shall be dealt with as follows:

- **Increase or decrease in built-up area** beyond the tendered area shall be measured on actual executed quantities.
- The **rates for additional or reduced area** shall be derived from the **accepted EPC price**, prorated based on the percentage of contract value quoted for the respective building/facility, unless otherwise agreed.
- Variations that **do not affect the built-up area** but involve changes in specifications, loadings, finishes, or construction methodology shall be evaluated based on **cost impact plus 15% overheads and profit**. Cost impact shall be assessed jointly on the basis of latest MPSR/DSR. In the absence of non-availability of references of the item/specification in MPSR/DSR, it shall be assessed based on prevailing market supported by documentary evidence. The decision of Engineer-in-Charge shall be final and binding on the contractor.

b) Milestone payments shall be **adjusted proportionately** to reflect the revised scope and value of work.

4. Variations Related to MEP, Utilities, and Services

a) For **MEP systems, utilities, and services** tendered on a **lump-sum (one-lot) basis**, the Contractor shall submit a **detailed system-wise and item-wise breakup** of quantities and costs.

b) Any Scope Variation in MEP and utility services for the changed project requirement as notified by Employer/Engineer-in-Charge shall be valued based on:

- Agreed item rates derived from the submitted cost breakup, or
- In the absence of agreed rates, on the basis of **actual cost plus 15% overheads and profit**, supported by documentary evidence.
- The specification of item/product to be supplied beyond scope will be specified by Engineer-in-Charge
- The decision of Engineer-in-Charge regarding settlement shall be final & binding on the contractor.

c) Payments for MEP and utility works shall be **regulated in accordance with the approved breakup and revised scope**, and linked to system-wise completion or agreed milestones.

5. Valuation Principles

Unless otherwise specified, valuation of Scope Variations shall follow the principles below, in order of precedence:

1. Rates already quoted in the Contract
2. Derived rates from similar items in the Contract
3. Derived rate based on MPSR/DSR/Market-based rates with cost justification
4. Actual cost plus 15% overheads and profit

No variation shall entitle the Contractor to claim loss of profit on unexecuted work.

6. Time Impact

If a Scope Variation results in an increase or decrease in the time required for completion, the Contractor shall submit a **Time Impact Analysis**.

Extension of Time, if any, shall be granted strictly to the extent attributable to the approved variation.

7. No Deemed Variation

Differences arising due to **coordination of drawings, minor adjustments during execution, compliance with statutory requirements, or EPC design obligations** shall not be considered Scope Variations unless they result in a demonstrable change to the defined scope, quantities, or capacities.

8. Continuity of Work

Pending agreement on valuation, the Contractor shall **proceed with the instructed variation** so as not to delay the Project, and the cost shall be settled subsequently as per this clause.

10. **SPECIAL CONDITIONS OF CONTRACT (SCC)**

A. SUFFICIENCY OF PRICED BILL OF QUANTITIES AND TENDER:

On the acceptance of his tender, the Contractor shall forthwith satisfy himself as to the correctness and sufficiency of his tender for the works as well as prices percentage stated in the bill of quantities and the schedule of prices and within seven days of the acceptance of his tender he shall sign the acceptance, which shall be construed and taken as an acknowledgement on his part of his complete satisfaction and acquiescence in the sufficiency of the prices.

B. CONTRACTOR TO EXECUTE CONTRACT WITH COMPANY:

The Contractor shall within thirty days of the issue of purchase order enter into and execute a formal agreement of contract. The Contractor shall not be entitled to make any charges for the perusal of the contract. The contractor shall within ONE month of the issue of acceptance letter submit the detailed work schedule in the form of master plan, monthly plan, weekly work execution plan clearly indicating the various activities. Work shall start on priority basis as per BEML requirement. However, if any portion of site not made available by BEML for any reason whatsoever no claim on account of this will be entertained.

C. ENGINEERS ORDER TO COMMENCE WORKS AND AS TO NON-DELIVERY OF SITE:

The Contractor having signed the contract, the Accepting authority will forthwith give him notice to commence the works and the Contractor shall upon receipt of such notice commence the works and carry them on at such point or points and in such portions as the Engineer may direct. The company shall, with Engineer's written order to commence the works, give to the Contractor the use of so much of the site of works as may, in the opinion of the Accepting authority, be required in order to enable the Contractor to commence and continue to construction of the works, and shall from time to time consider proper in that behalf, but the non-delivery in manner aforesaid of the use of such site, or any portion thereof, shall not vitiate or effect the contract, nor any provision contained in the specification, not entitle the Contractors to any increased allowance in respect of the money.

D. SETTING OUT WORKS:

The Contractor shall set out the whole of the works & be responsible for the correctness of the position, levels & dimensions of several works, according to the drawings & written instructions of the Engineer. If at any time during the progress of the works any error shall appear or arise in the position, levels or dimensions of the several works, the Contractor, on being required to do by the Engineer, shall at his own expense remove & amend the work to the satisfaction of the Engineer, notwithstanding that he may have been assisted by the Engineer in setting out the same.

The setting out of the building shall be done by the Contractor himself. All measurements shall comply with the dimensions noted on the drawings. The Contractor shall construct center line pillars wherever necessary at his own cost and the setting out shall be got checked, approved and certified by the Engineer in-Charge before execution of work.

E.MATERIALS TOOLS ETC., BROUGHT ON TO WORKS BECOME THEPROPERTY OF THE

COMPANY DURING CONTINUATION OF CONTRACT:

All materials, tools, implements and other things brought by the Contractor upon the Company's works shall thereupon become, and shall continue to be the absolute property of the company and be considered in its possession, the Contractor having only the right of using the same for the purpose of the contract. After the works have been completed and all obligations under the contract duly fulfilled, the Company shall return to the Contractor the tools, implements and surplus or waste materials then remaining upon the company's works to be removed by him forthwith and cleared away. Nevertheless, the company shall not at any time be liable for the loss of any of the said materials, tools, implements or other things, but the whole of this liability shall fall upon the Contractor, the same as if they had remained in his possession.

F. WORKS TO BE CARRIED WITH AN EXPEDITION FAILING WHICH THE COMPANY MAY EMPLOY CONTRACTORS WITHOUT VITIATING THE CONTRACT:

The Contractor shall commence to carry on the works with due diligence, and as much expedition as the Officer- in- charge /Engineer in charge may reasonably expect, having regard to the specified time of completion of the whole of the works. In case the Contractor fail to do so or neglect to provide proper and sufficient materials or to employ a sufficient number of workmen to execute the works then the Company shall have full power, without vitiating contract, to take the works wholly or in part of the hand of the Contractor, to engage or employ any other person or workmen, and to procure all requisite materials and implements for the due execution and completion of the said works and the costs and charges incurred by the Company in so doing shall be ascertained by the Accepting Officer and be competent for the company to deduct the amount of such costs and charges along with overheads out of any sum or sums due or to become due from the Company to the contractor under this or any other contract.

G. EMERGENCY POWERS:

In the event of any accident or failure occurring in or on the works which in the opinion of the Engineer, requires immediate attention either during the construction or during the period of maintenance, the company may, by their own or other workmen make necessary repairs at the expense of the Contractors.

H. OPENINGS TO BE MADE FOR EXAMINATION OF WORKS:

Should the Engineer require it for his more perfect satisfaction, the Contractor, shall at any period during the continuance of the contract pull down any part of the works, and make such openings, and to such extent, through any part of the works as the Officer in charge / Engineer in charge may direct, and the Contractor shall make such works good again to his satisfaction. Should the works be found faulty in any respect the whole of the expenses thereby incurred shall be defrayed by the Contractor, but of otherwise, by the company.

I. SCOPE OF COMPLETION:

Completion includes completion of all works in accordance with plans and specifications, removal of all yard mess accumulated during construction, leveling and cleaning up the site and generally cleaning the whole building or works.

J. FINAL MEASUREMENT:

The final measurement can be through re-measurement of the whole of the work performed, as decided by OIC/EIC if required will be made by the Company's authorized representative at which the Contractor or his accredited agent must be present. For this purpose, a written notice will be sent to him at least three days before the date fixed for the measurement, appointing the day, hour and place of meeting. Should he not attend to this, the measurements will proceed without him, and he will be precluded from making any protest. If a dispute arises between the company and the Contractor as to the Quantity and Quality of work performed involving a sum of larger than Rs.500/- the Contractor may appeal in writing to the company for measurement or reappraisal, as the case may be. If the company considers the Contractor's claims is valid, they may appoint an Officer other than the Officer who made the final measurements and inspection and his report shall be considered as final and binding on the Contractor. The Contractor shall have a representative present when the re-measurement or reappraisal is being made.

K. SIGN BOARD AND HOARDINGS:

The Contractor shall not affix to place any placards or advertisement of any description or permit the same to be affixed or place in or upon any hoarding, gantry, building/structure other than that approved by the OIC/EIC.

L. FOUNDATIONS

Foundations shall generally conform to the dimensions indicated in the drawings, unless the nature of soils after excavation examined by the engineer-In –charge of works necessitates modifications. The foundation trenches for RCC columns and walls after excavation indicated on the drawings shall be got inspected, approved and certified by the Engineer-In-charge of works before laying concrete.

M. DAMAGE TO SERVICE LINE ETC., OF THE COMPANY:

Care shall be taken in execution of work so as not to damage service line etc., coming in the way of construction. If any damage is caused to the line, the cost of replacing or repairs shall be borne by the Contractor. The work schedule shall be submitted on the enclosed activity schedule along with the equipment & manpower mobilization schedule envisaged for timely completion of work within the stipulated time for completion of work.

N. PROVISION OF MACHINES, TRANSPORT ETC.:

Contractor shall provide himself with requisite number of welding sets, hoisting equipment, transport vehicles etc., required for the complete satisfactory execution of work. The Contractor shall furnish list of specific equipment's to be mobilized by him, of acceptance of contract as agreed / directed by the Engineer-in-charge.

O. MATERIALS SUPPLIED BY THE CONTRACTOR:

The Contractor shall furnish / produce purchase vouchers and manufacturer's test certificates of Structural Steel and steel from the reputed manufacturers / suppliers. In addition to the testing of materials, in accordance with technical specifications and quality plan enclosed with this tender. However, OIC/EIC shall decide the usage of the same while in-incorporating in the work based on the manufacturers test report and then test certificate obtained from the approved laboratory as per quality plan.

a. CEMENT

- i. Cement required for the work when specified in the contract shall be Contractors own supply. The cement shall be of approved INDIAN MANUFACTURE Co., conforming in all respects with the latest Indian Standard specification for Cement including latest amendments as stated in technical conditions and shall be ISI marked.
 - ii. Prior to commencing the work, the Contractor shall inform the Engineer the brand of cement and the manufacturer's name he proposes to use and if required, shall produce certificates from the firm from whom he obtains the cement. The Engineer reserves the right of rejecting cement of any brand which has not established itself as a high-grade Portland cement and has not for three years or more given satisfactory result in use under climatic or other conditions of exposure similar to those of the works proposed.
- c) Contractor binds to deliver the cement on the work so as to allow ample time for testing in order that if a brand or batch fails at the test there will be time to receive and test other cement before it is required to be used. This is to ensure that there shall be no delay on the works consequent on the rejection of the cement, which does not satisfy in the test from Authorized laboratory. Failing this, the responsibility for such delay will rest on the Contractor.
 - d) Immediately after the work order is signed, Contractor shall procure and store at the site of the works such stock of cement as the Engineer directs to do so for satisfactory completion of work. The Contractor shall give to the Engineer-in-Charge notice of the arrival of each consignment of cement on the work and shall give the Engineer sufficient time for testing the same before it is issued on the work. Only cement certified by the Engineer to conform to Indian Standard Specification shall be used on the works. The Contractors shall maintain a register at the work spot for the receipt and use of cement on the work and such entries shall be got attested daily by the Engineer-in-Charge or his authorized representative.
 - (a) Quantity of cement used on the works shall conform to cement co-efficient schedule. If in the event of being discovered that the quantity of cement used is less than the quantity ascertained as herein before provided, the cost of the quantity of cement not so used shall be recovered from the Contractor.
 - (b) All rejected cement not conforming to technical specifications shall be removed by the Contractor from the work spot immediately at his own RISK AND COST.
 - (c) The cement shall be stored in barrels or bags at the site on a wooden floor or a platform not less than 1' above the ground level staked in rows of 10 bags high 2' clear from the walls in a covered shed affording adequate protection against the weather and moisture from any source.
 - (d) After completion of work, the theoretical quantity of cement to be used on work shall be calculated on the basis of cement co-efficient schedule for various items of work involving the use of cement.
 - (e) Over the theoretical quantity of cement, a variation of 3% plus/minus shall be allowed.
 - (f) In the event of it being discovered that the quantity of cement used is less than the quantity ascertained as herein before provided (allowing variation on minus side as stipulated above). The cost of the cement not so used shall be recovered from the Contractor on twice the basis of Market Rate plus 10% to cover profit and overheads deemed to have been allowed in the tender rate

P.STRUCTURAL STEEL / REINFORCEMENT STEEL

a) Mild steel / HYSD / TMT and Structural steel required for the work shall be Contractors own supply. The structural steel / reinforcement steel elements shall be of approved Indian Manufacture conforming in all respects with the appropriate Indian Standard Specification.

b) Prior to commencing the work, the Contractor shall inform the Engineer the brand of steel and the manufacturer's name he proposes to use and if required, shall produce certificates from the firm from whom he obtains the Structural Steel. The Engineer reserves the right of rejecting Structural Steel / reinforcement steel of any brand.

c) Contractor binds to deliver the Structural Steel / reinforcement steel on the work so as to allow ample time for testing in order that if a brand or batch fails at the test there will be time to receive and test other Structural Steel / reinforcement steel before it is required to be used. This is to ensure that there shall be no delay on the works

consequent on the rejection of the Structural Steel, which does not satisfy in the test. Failing this, the responsibility for such delay will rest on the Contractor.

d) Immediately after the work order is signed, Contractor shall procure and store at the site of the works such stock of Structural Steel / reinforcement steel as the Engineer directs to do so for satisfactory completion of work. The Contractor shall give to the Engineer-in-Charge notice of the arrival of each consignment of Structural Steel / reinforcement steel on the work and shall give the Engineer sufficient time for testing the same before it is issued on the work. Only Structural Steel / reinforcement steel certified by the Engineer to conform to Indian Standard Specification shall be used on the works. The Contractors shall maintain a register at the work spot for the receipt and use of Structural Steel / reinforcement steel on the work and such entries shall be got attested daily by the Engineer-in-Charge or his authorized representative.

e) All rejected steel not conforming to the appropriate Indian Standard Specifications shall be removed by the Contractor from the work spot immediately at his own risk and cost.

f) Rates for all items involving use of structural steel / reinforcement steel shall be based on the price of structural steel conforming to IS as mentioned in technical specifications.

g) Rates for all items involving use of Structural Steel / reinforcement steel conforming to IS as mentioned in technical conditions.

h) After the completion of work, the theoretical quantity of steel section to be used on works shall be taken as the quantity required as per design or as authorized by the Engineer-in-charge including authorized lappages plus 5% wastage due to cutting into pieces. Over this theoretical quantity plus 5% and minus 4% shall be allowed as variation due to wastage being more or less.

i) In the event of it being discovered that the quantity of steel used is less than the quantity ascertained as herein before provided (allowing variation on the minus side as stipulated above) the cost of the quantity of steel not so used shall be recovered from the Contractor at twice Market Rate plus 10% to cover profit and cartage to site deemed to have been allowed in the tender rates.

j) The provisions made above are without prejudice to the right of the Company to take action against the Contractor under the condition of the contract for not doing the work according to the prescribed specifications

Q. FABRICATION OF STRUCTURAL STEEL BY THE BIDDER ONACCEPTANCE OF WORK AND CUTTING & BENDING OF REINFORCEMENTSTEEL.

a) The tender rate for steel work shall be deemed to include for all works with fabrication drawing. The work "Fabrication" does not however include any manufacturer's job. The shop drawing for Fabrication to be submitted for the approval of OIC/EIC. The Fabrication at site shall confirm to the approved shop Drawings.

b) The bar bending Schedule for reinforcement steel shall be submitted for the approval of Engineer-in-charge and the work thereafter shall be executed as per the approved drawing.

c) **OTHER MATERIALS**

All other materials required for the work shall also be supplied by the Contractor.

These shall conform to appropriate Indian Standard Specification and procured from approved manufacturer.

R. ACCEPTANCE OF TENDER:

The Company reserves the right to accept tender in parts (i.e. on the basis of the lowest quotation for each part) or as a whole at its own discretion and hence it is important that the Tenderers take sufficient care and quote reasonable rates in each part so that if one part is separated and entrusted to the Contractor he should be able to do it without difficulty. The rate quoted for similar item should be consistent.

S. RIGHT TO ACCEPT THE CONTRACT:

The Company also reserves the right to accept the lowest or any other tender at its own discretion without assigning any reason whatsoever.

T. MODIFICATION OF SPECIFICATIONS:

No modifications or changes of specification in the Bill of Quantities will be accepted & such tenders are liable to be rejected.

U. EARNEST MONEY DEPOSIT:

Earnest Money Deposit amount which a Contractor shall deposit along with the tender shall be equal to:

(a) For works, 2% (Two Percent) of the estimated cost or as notified from time to time:

The EMD shall be deposited in the form of pay order / Demand Draft/ Banker's cheque/ Bank Guarantee in favour of BEML Limited, payable at Bhopal. EMD deposited by the Bidder shall not bear any interest to the Contractor.

V. MOVEMENT OF RCC DUE TO TEMPERATURE

To prevent movement of RCC due to temperature difference, the top of wall on which the slab rests should be plastered smooth and spread with a layer of sand before casting the slab. Lintels with chajja when cast monolithic should be provided with a lug in the centre so as to prevent the ingress of moisture on to the inner face of wall

W. INTERPRETATION

If sectional completion is specified in the contract data, references in the conditions of contract to the works, the completion date, and the intended completion date apply to any section of the work (other than references to the completion date and intended completion date for the whole of the works).

X. SHOW-CAUSE NOTICE

In case where the Competent Authority decides that action against the Contractor is called for, a show-cause notice shall be issued by the BEML, containing the imputation of misconduct. The Contractor should submit within 15 days a written statement in its defense.

Y. PERFORMANCE STANDARDS AND QUALITY ASSURANCE

1. TECHNICAL SPECIFICATIONS

The works in general shall be executed as per relevant specifications amended up to date, unless given otherwise in this tender document and as per direction of Engineer-in- Charge. In case of discrepancy among the specifications / conditions as mentioned above, the precedence given in general condition of contract shall be followed.

2. TESTS TO BE CONDUCTED BY CONTRACTOR AT HIS COST

The material before incorporation in the work shall be informed to BEML along with Manufacturers Test report on direction of OIC/EIC may permit such materials for the work subjected to Laboratory Testing. Any adverse Test results, such material shall be removed from the site immediately and the work carried out shall be demolished / dismantled / removed from the site as directed by OIC/EIC.

3. LIST OF APPROVED VENDORS / MANUFACTURER'S LIST OF APPROVED VENDORS /

SL. No.	Item	Make / Manufacture
1.	Cement 43/53 Grade (OPC/PPC)	Birla, Rajashree, ACC, J.K cement, RAASI, Coramandel, Ultratech, Ramco, Ambuja
2.	White Cement	Birla White, JK White
3.	Putty	Asian Paint, Berger, Nerolac, ICI, J.K., Birla.
4.	Reinforcement Steel (HYSD/ TMT)	SAIL, TATA, Vizag Ispat [RINL], Jindal.
5.	Structural Steels for use in Structural Memebbers.	SAIL, TISCO, Vizag Ispat [RINL], Jindal.
6.	Structural Steels works Like Window grills, Handrails, cable trench covers	Any brand confirming to BIS standards.
7.	Ceramic Tiles	Kajaria, H&R Johnson, Nitco, RAK
8.	Vitrified Tiles.	Kajaria, H&R Johnson, Nitco, Euro, RAK,
9.	Aluminum Hardware Fittings.	ISI Mark/BIS Mark
10.	Aluminum Extruded Sections.	Jindal, Indal, Hindalco.
11.	Glass	Modi Float, Saint Gobian, Hindustan Pilkington, Triveni, Asahi & Atul.
12.	Plywood (BWR/BWP) /Particle Board / Block Board	Kitply, Kenwood, Greenply, Archid, century, Trojan, Anchor.

13.	Tile Adhesive	Lactcrete, Ardex Endure, Weber, Pidilite, Sika, Asian Paints, Fosroc, Tremco.
14.	Door Closer & Floor Springs	Everite, Godrej, hardwyn, Dorma, Ozone.
15.	Flush Door Shutter & Block Board.	Mysore Plywood, Kuttu, Indian Plywood Manufacturing Co, Kenwood, Durian, Greenlam, National, Shakti, Archid, Nikki.
16.	Laminates/ Particle Board	Archid, Greenlam, Formica/Marino, Sandek, Euro
17.	M.S. Windows, Ventilators	Madhu Industries, Concorde Industries, Deccan Structural, Hercules, Shakti.
18.	Low VOC Paints (OBD / Interior/ Exterior Emulsion Paint, Synthetic Enamel)	Asian, Berger, Jenson & Nicholson, ICI, Nerolac
19.	Cement Paints.	Snowcem India Ltd, Jenson & Nicholson, Asian, Berger.
20.	SS Hardware for Wooden Doors:	GARG, Janata, Mukund, Jyothi Pag, Godrej, harrison, Laxmi, doorma, doorset.

21.	MS Pipes	SAIL, TATA Steel Limited, Jindal, Indian Hume Pipe co Ltd., Appolo
22.	Sanitary Fittings & Fixtures.	Parryware, Johnson, Jaguar, Hindware, Cera.
23.	Gun Metal Valves.	Kirloskar, VAG, AVK, any material confirming IS Make.
24.	G.I. Pipes (any Dia.)	Indian Tube Co, Zenith, TATA, Jindal, Suryaprakash.
25.	C.P. Fittings	Jaguar, ESS ESS, Hindware, Kohler, Parryware, Cera, Marc
26.	Construction Chemicals / Admixtures / water proofing compound.	Cico, Roff, Fosroc, Pidilite, Sika/BASF, Tikidan, STP, Asian paint, BASF and Tremco.
27.	GI Fittings.	IS Make
28.	Cast Iron Pipes & Fittings.	SKF/NECO/BENGAL IRON CO.
29.	D.I Pipes	KAPILANSH, Kesoram, Electrosteel, SriPipes, Jindal.
30.	Galvalume Sheet for Roofing, Cladding, Sandwich panel, etc.,	Lloyd, Indal, Jindal, Tata steel [Tatablue Scope], bhushan, JSW, Essar, Metecno
31.	ALUMIN COMPOSITE PANEL	Alcobond, Durabond, Eurobond, Alstrong.
32.	Modified APP membranes	Fosroc, Sika-Texa, STP, Pidilite Industries, Asian Paints, Tikidan, Tremco.
33.	UPVC / CPVC Pipes including Fittings	Flow guard (Astral), Ashirvad, Finolex, Kisan, Supreme, Prince.

34.	Epoxy/PU Flooring & other specialised floorings.	Fosroc, Pidilite, Sika, Dr.Beck, Ardex Endura, Asian, Tikidan, STP, Tremco.
35.	PVC Doors /FRP Doors	Rajashree, Fimen, Sintex
36.	Manufactured Sand confirming to IS 383	Thriveni, Neo Sand, Chaitanya Enterprises, TAVARA, Jyothi, Solutions India Pvt Ltd, Sand masters, AVS Tech building.
37.	RMC	Any supplier approved by Quality Council of India and using approved brand of Cement as stated at Sl.No.1
38.	Polycarbonate Sheet	Tufflite, danpalon, Gallina, Tatablue Scope.
39.	UPVC Partition/Doors/Windows	Fenesta, Saint Gobian, Encraft, Deccan Woodmate, LG, Madhu Industries
40.	M.S sliding Doors- Motorised/ Hangar doors/Boom Barriers./ .MS rolling Shutters-Motorised.	Areen, Gandhi Automations, Securetronix, SaiAutomation, Avians,
41.	Fire rated Doors.	Shakthi Horman, Indigatech, Ozone overseas Pvt Ltd. Sukhri

42.	PUF sandwich Panel using the materials as specified at S.No.30	Manufactured by AlFa, Karthik, Lloyd, Kirby, Metecno, TATA Bluescope,
43..	False Ceiling	Saint Gobin (Gyproc), Armstrong, Shera, Hunter Douglas, Metalium, USG Borel.
44.	S.S Pipes	Jindal, TATA, Apollo, Suryaprakash Pipes.
45.	Concrete Paver Blocks	Eurocon Tiles, Basant Beton, Sobha, Apco, Nitco (Rockard), Jyothi Group.
46.	Wooden Flooring	Armstrong Flooring, Mohawk Flooring, Greenply, Tarketsomer.

Note:

1. Contractor shall obtain prior approval of BEML before procurement of the Materials from the manufacturers listed above for the work. If any of the above Brands of Materials are not available, Engineer-in-charge shall allow use of other brand material duly approved by OIC/EIC provided they confirm to the requirement of IS as per Technical Specification/Quality Plan.

2. BEML reserves the right to reject or accept any of the make given above without assigning any reasons and contractor is bound to supply other brands in the list.

4. LIST OF TESTING LABORATORIES (NABL APPROVED)

- Govt. Labs or any other NABL accredited Laboratory with the approval of OIC/EIC.

5. GENERAL SAFETY CLAUSES

i. General:

The Contractor shall take all safety precautions / measures and ensure safety for the

works, he has been contracted to execute. He shall follow all relevant safety codes of BEML/MES/CPWD and IS codes and safety manuals. The Contractor shall indemnify BEML from any consequences arising due to Contractor's failure in respect of safety measures. Some of the more important measures are listed below. The Contractor shall implement any further measures which may be required as per the safety codes of BEML/MES/CPWD/IS codes etc. and the measures which the Engineer may call for during the execution of the work.

The Contractor shall engage labourers aged 18 years and above.

Suitable Technical devices shall be used as much as possible to avoid or limit the loads by manual transport.

The Contractor shall engage suitably qualified persons for training / instructing working techniques, methods of lifting, putting down, unloading and stacking of different types of loads; with a view to safeguarding health & preventing accidents.

The Maximum permissible weight which may be transported manually by a Male worker shall not be more than 50 Kgs.

As far as possible adult women workers should not be assigned to regular manual transport of loads. Women workers should not be assigned to manual transport of loads during pregnancy which has been medically determined.

Where adult women workers are engaged in the manual transport of loads the maximum weight of such loads should be substantially less than that permitted for adult Male workers.

The firm should use required PPE while executing the work viz., Safety Helmet, Safety Belt, fall restraint, Crawler board, Safety net etc.,

Before start of work a work permit has to be obtained by the firm which will be valid for one day.

The firm should inspect the work area before starting execution, prepare a risk assessment and get approved by Safety Engg. Department.

The workmen engaged by the firm shall be medically fit, they should undergo Vertigo test along with other tests and submit medical fitness certificate.

ii. Scaffolding:

Suitable scaffolds shall be provided for workmen for all work that cannot safely be done from the ground, or from solid construction except such short period work as can be done safely from ladders. When a ladder is used an extra labourer shall be engaged for holding the ladder and suitable footholds and handholds shall be provided on the ladder and the ladder shall be given an inclination not steeper than $\frac{1}{4}$ to 1 ($\frac{1}{4}$ horizontal and 1 vertical).

iii. Guard Railing in Scaffolding / Staging / Platforms:

Scaffolding or staging more than 3.25 meters above the ground floor or floor swung or suspended from an overhead support or erected with stationary support, shall have a guard rail properly attached, bolted, braced and otherwise secured at least 1 meter high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as may be so fastened as to prevent it from swaying from the building or structures

iv. Working Platform / Gangway / Stairway:

Working platform, gangways and stairways shall be so constructed that they do not sag unduly or unequally, and if height of a platform or gangway or stairways is more than 3.25 meters above ground level or floor level, it shall be closely boarded, have adequate width and be suitably fenced provided with guard rail as described in 2 above.

v. Access to working platforms and other working places:

Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 5 meters in length. Width between side rails in a rung ladder shall in no case be less than 30 cm. for ladders up to and including 3 meters in length. For longer ladders this width shall be increased at least 6 mm. for each additional 30 cm. of length. Uniform step spacing shall not exceed 30 cm.

vi. Hoisting Machines:

Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following:

Those shall be of good mechanical construction, sound material and adequate strength and free from patent defects and shall be kept in good repair and in good working order.

Every rope used in hoisting or lowering materials or as a means or suspensions shall be of durable quality and adequate strength, and free from patent defects.

Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 shall be in charge of any hoisting machine including any scaffold winch or give signals to operator.

In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or lowering or as means of suspension, safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be plainly marked with safe working load. In case of hoisting machine having a variable safe working load, each safe working load and the condition under which it is applicable shall be clearly displayed on the machine prominently. No part of any machine or of any gear referred to above in this paragraph shall be loaded beyond safe working load except for the purpose of the testing.

Motors gearing, transmission, electric wiring and other dangerous parts of hoisting appliances shall be provided with efficient safeguards; hoisting appliances shall be provided with such means as will reduce to the minimum, risk of accidental descent of load. Adequate precautions shall be taken to reduce to the minimum risk of any part of a suspended load becoming accidentally displaced.

When workers are employed on electrical installations which are already energised, insulating mats, working apparel such as gloves, sleeves and boots, as may be necessary shall be provided. Workers shall not wear any rings, watches and carry keys or other materials which are good conductors of electricity.

Load tests: All cranes, hoisting machines etc. shall be load tested. Contractor shall submit test certificate from competent, authorised person before use.

vii. Demolition works: Before any demolition work is commenced and also during the process of the work:

- a. All roads and open areas adjacent to the work site shall either be closed or suitably protected.
- b. No electric cable or apparatus which is liable to be a source of danger over a cable or apparatus used by Contractor shall remain electrically charged.
- c. All practical steps shall be taken to prevent danger to persons employed, from risk or fire or explosion, or flooding. No floor, roof, or other part of a building shall be so overloaded with debris or materials as to render it unsafe.
- d. All blasting materials shall be stored and handled as per guidelines of relevant authorities.

viii. Barricades:

Contractor shall erect and maintain barricades required in connection with his operation to guard or protect:

- a. Excavation / Hoisting / Lifting areas

- b. Slab Openings
- c. Areas adjudged hazardous by Contractor's or Engineer's Inspection.

- d. Existing property subject to damage by Contractor's operations.
- e. Contractor's employees and those of his sub-Contractors shall become acquainted with BEML / Engineer's barricading practice and shall respect the provisions thereof

ix. Net & Protective Platform:

The Contractor shall provide & maintain closely knitted PVC net all-round tall buildings throughout the construction period. He shall also provide all-round from external face about 1.5 M+ wide temporary platforms at every 6-7th floor covered with welded steel mesh. This shall be maintained & updated throughout the construction period to avoid any accident due to dropping of construction materials/debris. This shall be strictly followed and work shall be permitted only when complied with satisfaction of the Engineer. If the above are not fully taken care of the Engineer reserves the right to get the same carried out through other agency at the risk and cost of the Contractor.

x. Prevention of Fire and Protection:

All combustible waste materials, wood scaling, soiled rags, etc. should be removed daily and burned in suitable areas.

Fire, welding, and flame cutting should not be permitted in combustible areas.

Fires and open flame devices should not be left unattended.

Smoking should be prohibited in all flammable material storages, viz. carpentry, paint shops, garages, service stations, etc. "No Smoking" signs should be posted on all such areas. Accumulation of flammable liquids on floor, walks, etc, should be prohibited. All spills of flammable liquids should be cleaned up immediately.

Flammable liquids, lubricants, etc. should be handled and transported in safety containers and drums which can be kept tightly capped. Petrol or other flammable liquids with a flash point below 100 Deg F should not be used for cleaning purposes.

Oxygen cylinders should not be stored with combustible materials.

All electric installations should be properly earthed. Repairs should not be made on electrical circuits until the circuit has been de-energized.

Fire extinguishers & fire buckets, painted red, should be provided at all fire hazardous locations. Extinguishers should be inspected, serviced & maintained in accordance with manufacturer's instructions. The inspections should be evidenced by notations on the tag attached to the extinguisher. Handling of Hazardous materials shall be as per statutory regulation.

xi. Electrical Equipment:

All temporary and permanent electrical installations, power distribution and supply required for execution of Work shall be carried out conforming to existing industrial and domestic safety rules and regulations. Important specific points to be noted are as under:

Meter room and main switches should be freely accessible at all times and fully protected against all weathers.

Power distribution system shall be identifiable with display marking on switches.

All power distribution shall be carried out with coated, adequately insulated and of appropriate current / load rating cables. It shall be securely routed for this purpose. No loose, naked, hanging wires shall be permitted.

Over load protection devices shall be installed whenever and wherever heavy current / load consuming construction or plant machinery susceptible to hazard is in use and as directed by the Engineer.

Metallic plugs and sockets shall be used in field work. Switch board shall be in close proximity so as to have quick control over the supply.

Proper and adequate earthing connection to be provided for all installation, plant machinery and distribution system.

Hand lamps and inspection lamps shall be adequately insulated and guarded with wire mesh and will have proper plugs for use. Security and illuminatory light shall be secured firmly and protected to withstand all weather.

xii. Protective equipment / gears:

All necessary personal protective equipment as considered adequate by the BEML and the Engineer shall be available for use of the persons employed on the site and maintained in a condition suitable for immediate use; and the Contractor shall take adequate steps to ensure proper use of equipment by those concerned.

- Workers employed on mixing cement concrete shall be provided with protective footwear & protective goggles, hand gloves of polythene type.
- Those engaged in handling any material which is injurious to eyes shall be provided with protective goggles.
- Those engaged in welding works shall be provided with welders protective eye
- The following safety equipment should be provided to workers as required and their use enforced. Rubber boots; hard toe protective safety boots; hard hats & helmets, safety belts; goggles for stone/concrete cutters, gas welding aprons, respirator shields, manila ropes and slings for life lines, gloves, flash lights, battery lamps, safety nets, boatswains chairs, helmets, life and ring buoys.

Items of personal wear should be maintained in serviceable condition and should before being reissued to other employees or returned to stores to be cleaned, sterilised, inspected and repaired, if necessary.

Loose and frayed clothing, hand rings, loose watch chains, etc. should not be worn around moving machinery or other sources of entanglement.

xiii. Other Safety Measures:

Every receptacle used for raising or lowering stones, bricks, tiles, slates, or other subjects should be enclosed, constructed or designed so as to prevent the accidental fall of such objects.

All gears, tools, goods or loose material should be properly loaded into the bucket or receptacle in which they are being raised or lowered. If necessary, they should be properly secured or effective precautions should be taken to prevent their fall.

No timber or materials with projecting nails should be used in any work because they can be a source of danger to people.

Adequate precautions shall be taken to prevent danger from electrical equipment.

No materials on any of the sites shall be so stacked or placed as to cause danger or inconvenience to any person or the public. The Contractor shall provide all necessary fencing and lights to protect public accidents and shall be bound to bear expenses of defence of every suit, action or other proceeding at law that may be brought by any person for injury sustained owing to neglects of the above precautions and to pay any damages and costs which may be awarded in any such suit, action or proceedings to any such person or which may with the consent of the Contractor be paid to compromise any claim by any such person.

xiv. First Aid and Industrial Injuries:

i. Contractor shall maintain first aid facilities for his workmen. First aid appliance including an adequate supply of sterilised dressings and sterilised cotton wool should be maintained in a readily accessible place. Appliances should be kept in good order and they should be placed under the charge of a responsible person who should be readily available during the working hours.

ii. Contractor shall make adequate arrangements for ambulance service and for treatment of injuries. Names of those providing these services shall be furnished to BEML prior to start of constructions and their telephone numbers shall be prominently posted in Contractor's field office.

iii. All critical industrial injuries shall be reported promptly to the ENGINEER – IN – CHARGE and a copy of Contractor's report covering each personnel injury requiring the attention of a physician shall be furnished to BEML

xv. Maintenance:

All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in a safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities shall be provided at or near places of work.

xvi. Enforcement:

To ensure effective enforcement of the rules and regulations relative to safety precautions, arrangements made by the Contractor shall be open to inspection by the Engineer or his representatives and the Inspecting Officers.

xvii. Displays:

These safety provisions shall be brought to the notice of all concerned by display on a notice board at prominent places at the work spot. Persons responsible for ensuring compliance with the Safety Code shall be named therein by the Contractor.

xviii. Work permits:

Contractor shall take work permits from concerned departments of BEML as per requirements before commencement of the work every day.

The contractor shall at his own expense arrange for the safety provisions in respect of all labour directly or indirectly employed for performance of the works and shall provide all facilities in connection therewith.

IS codes	As applicable to the relevant work (Latest Revisions)
3696-1987	Safety code for scaffolds and ladders.
4014 (part 2) -1986	Safety regulations for steel tubular scaffolding
3764-1966	Safety code for excavation work
4081-1986	Safety code for blasting and related drilling operation.
4130-1976	Safety code of demolition of building.
4138-1977	Safety code for working in compressed air
4912-1978	Safety requirements for floor and wall openings, railings and toe board
7969-1975	Safety code for handling and storage of building materials
13415-1992	Safety code for protective barriers in and around the building
13416-(part 2) – 1992	Recommendations for preventive measures against hazards at workplace- fall prevention
5916-1970	Safety code for construction involving use of hot bituminous material.
7293-1974	Safety code for working with construction machinery.
8989-1978	Safety code for erection of concrete framed structure
7205 – 1973	Safety code for Erection of Structural steel works

APPENDIX – A

COMPLIANCE REPORT OF GENERAL CONDITIONS OF CONTRACT (GCC)

(To be submitted along with Technical Bid)

Bid Invitation No :

Firm :

Item details :

Sl. No.	Terms / Clause	Complied	Not Complied	Remarks
1.	DEFINITIONS & CONDITIONS OF CONTRACT			
2.	SECURITY DEPOSIT			
3.	LIQUIDATED DAMAGES FOR DELAY IN COMPLETION OF WORKS			
4.	EXTENSION OF TIME			
5.	MEASUREMENT BOOK(MB)			
6.	RAR (RUNNING ACCOUNT REMITTANCE) BILLS PAYMENT			
7.	COMPLETION CERTIFICATE AND COMPLETION PLANS			
8.	PAYMENT OF FINAL BILL			
9.	MATERIALS TO BE PROVIDED BY THE CONTRACTOR			
10.	WORK TO BE EXECUTED IN ACCORDANCE WITH SPECIFICATIONS, DRAWINGS, ORDERS ETC			
11.	DEVIATIONS/ VARIATIONS EXTENT			
12.	FORECLOSURE OF CONTRACT DUE TO ABANDONMENT OR REDUCTION IN SCOPE OF WORK			
13.	CARRYING OUT PART WORK AT RISK & COST OF CONTRACTOR			
14.	ACTION IN CASE WORK NOT DONE AS PER SPECIFICATIONS			
15.	CONTRACTOR LIABLE FOR DAMAGES, DEFECTS DURING DEFECT LIABILITY PERIOD			
16.	LABOUR LAWS TO BE COMPLIED BY THE CONTRACTOR			
17.	CODE ON WAGES TO BE COMPLIED WITH			

18.	DISPUTE RESOLUTION AND JURISDICTION			
19.	ARBITRATION			
20.	WATER FOR WORKS			
21.	ELECTRICITY FOR WORKS			
22.	LEVY/TAXES PAYABLE BY CONTRACTOR			
23.	TERMINATION OF CONTRACT ON DEATH OF CONTRACTOR			
24.	RISK PURCHASE CLAUSE and FORCE MAJEURE CLAUSE			
25.	QUOTED RATE TO REMAIN FIRM THROUGHOUT THE CONTRACT			
26.	UNDERSTANDING OF SITE CONDITION			
27.	CONTRACTOR'S LIABILITY AND INSURANCE			
28.	INDEMNIFICATION			
29.	CAR POLICY			
30.	PROGRESS REVIEW MEETINGS			
31.	APPROVAL OF WORKS BY STAGES			
32.	SITE RELATED			
33.	BRIBES AND GIFTS			
34	Banned / Blacklisted (Annexure-B)			
35	NON – DISCLOSURE AGREEMENT (Annexure-22			

Authorized signatory with company seal / stamp

APPENDIX – B

CONTACT DETAILS OF THE SUPPLIER

(To be filled and submitted by supplier along with the technical bid)

1) Authorised Person details.

- (a) Name :**
- (b) Designation :**
- (c) Telephone :**
- (d) Fax :**
- (e) Mobile :**
- (f) Email :**

2) Head Office :

**3) Complete address
 including the website :**

**4) Details of the proposed plant from
 where item is to be supplied :**

**5) Complete address of the Plant
 including Website :**

6) Contact person details in plant

- (a) Name :**
- (b) Designation :**
- (c) Telephone :**
- (d) Fax :**
- (e) Mobile :**
- (f) Email :**

7) Bank Details:

- a) Name of the Bank :**
- b) Full Address of the Bank :**
- c) Suppliers Account Number and Type :**
- d) IFSC/Swift Code :**

NIT ACCEPTENCE LETTER

To:
The Chief General Manager (Materials),
M/s. BEML LTD
Bhopal Rail plant – Bhopal

Dear Sir,

We bidder Have examined the tender documents of **Bid Invitation No. 6300040354** **dated xx xx xxxx**, the receipt of which is hereby duly acknowledged, we, the undersigned, hereby confirming that we read, understood and accepting all the terms & conditions available in the tender. Further, we indicate that upon selection, we will execute the assignment as per the tender terms and conditions.

Signature with date of Authorized signatory

Name: _____

Designation: _____

Appendix – C

Compliance to Bill of Quantity (BOQ)

Engineering, Procurement & Construction pertaining to establishment of Rail coach factory including Civil Construction of manufacturing blocks, testing bay, other utility buildings (Non factory buildings), Railway Track sidings, water supply and distribution System, Roads, Drainage and sewerage systems, General Electric works including regular and emergency power supply and distribution system, related installations & services (Fire, Gas, Compressed air, IT, BMS, etc.), MFA (Miscellaneous fixed assets) and other Land & Site development works including grading, levelling works in connection with setting up of a Rail Coach Factory near Umaria village, Obaidullaganj, District- Raisen, Madhya Pradesh (India) on EPC Mode

SL. NO	DESCRIPTION OF WORKS		UOM	QTY	COMPLIANCE / VENDOR's REMARK
1	Earthwork in formation (Cutting & Filling)- RCC Road- Storm water drainage system- Sewerage system excluding (STP) RCC service trench Greenbelt Development Other External Development works Gate Complex for Truck entry & exit Gate Complex for railway siding Material Gate Laying of Stabling and dispatch Railway Track (4 km) Combination track of 420 m length in between two traversers 1. Car Body manufacturing cum storage Block – 01 No. Manufacturing line will have dimension of 400m X 72 m. A road of 10 m has been proposed in between the Production line for the logistic support and for meeting the Fire safety norms.		1	AU	

2. Car body inspection and testing line facility - 01 No. Inspection & Testing line will have dimension of 852m X 24 m. A road of 10 m has been proposed in between the Production line for the logistic support and to meeting the Fire safety norms. 3. Raw material storage yard Hard Stand of 50mx40m 4. Water supply & Fire water pump house including sump - single-storey industrial form with adequate internal clear heights for pump installation, maintenance, and overhead piping size - 30x 28 Mtr (Inclusive of Sump area) 5. Main Receiving Sub Station – MRSS- 01 RCC/partially steel structure, 40 m X12.5 m 6. Emergency Power Supply System - EPSS Hard stand- 01 RCC Structure of Size- 30x30 M 7. Centralised compressed air station 01 No. RCC Structure of Size- 12M x 20 M 8. Centralised Gas bank Shed – 01 OPEN/ RCC of size 40 M x 16 M 09. Safety Office- 01 Single floor RCC building of size 14.4m x 25.2 m 10.RO Plant (Hard Stand)- 01 RCC structure of size - 15mx10m 11. Chiller Plant Building – 01 RCC Structure with 46.6mx16m 12. Fire station 01				

RCC structure with 32.4mx10.8m 13. Sewage Treatment Plant (STP) – 01 RCC structure with 15mx13.5m 14. Traverser Foundation – 02 Nos (Hard stand – 240m x 32m- 01 No. Hard stand 160m X 32M -01 No.) 15. Office complex This facility shall be RCC Framed structure with Ground + 5 Floor configuration. The ground floor size of building shall be 75.6m x 18.9 m 16. Canteen Building – The size of the building shall be 64.8m x 56.4 m. 17. Medical Centre- 01 shall be RCC Framed single storeyed structure. The infill material used shall be brick wall or cement concrete blocks. The Overall size of the building shall be 28.8 m x 10.8m approximately. 18. Multi-level parking (G+2). Size is as mentioned- 61.6m x 64.4m 19. Toilet Block- The size of the building shall 7.6m x 13.6 m. 20. Storage Yard 21. Required Furniture for the plant 22. Air conditioner for the annexe-building 23. Main Plant & Equipment Interplant Traverser (75 t) - 02 Nos Interlay Track Shifter (50 t)-01 No 24. Miscellaneous fixed Assets (MFA)				

A. Material Handling – Crane • DG EOT Crane- Ground floor- 25 T- 04 Nos First floor - 10 T -) - 04 Nos • 2T SG Under slung crane- Water pump house • Goliath Crane - 01 24. HVAC System for Canteen, admin building, safety office, Medical Centre 25. Fire Fighting systems 26. WATER SUPPLY FACILITIES 27. Compressed air facilities 28. STP (MBR technology) 29. DG Set 750 KVA 02 Nos 30. Industrial Gases 31. Weigh Bridge (100 Ft, 70 T) – 01 No. 32. Fire Detection and Alarm System- 01 No. 33. Test Track with covered accommodation 34. Electrical Works 35. Instrumentation & Process Control All connected inside & out side electrical works, mechanical works, fire and safety works, plumbing, retaining walls, storm water waters, Rain water harvesting, cable trenches, laying of tracks both standard gauge and board gauge, hard standing, cement concrete connectivity roads , perimeter roads, site formation, filling of land, demolishing of any existing old building/ structures both RCC/steel etc. complete project. liasoning work etc in EPC mode (design and				

	build basis) As per the scope of work mentioned in Technical Bid.				

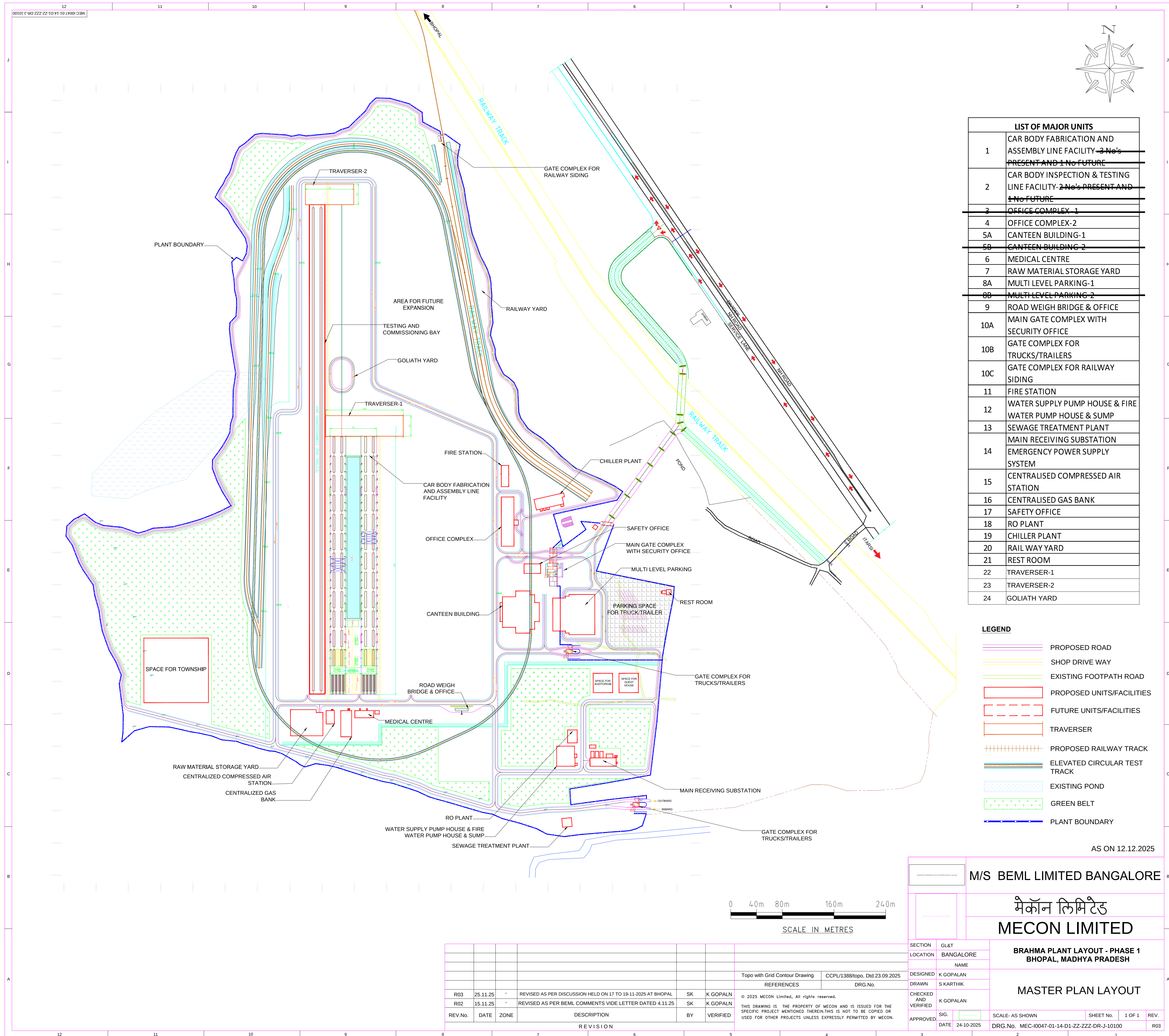
Authorized signatory with company seal / stamp

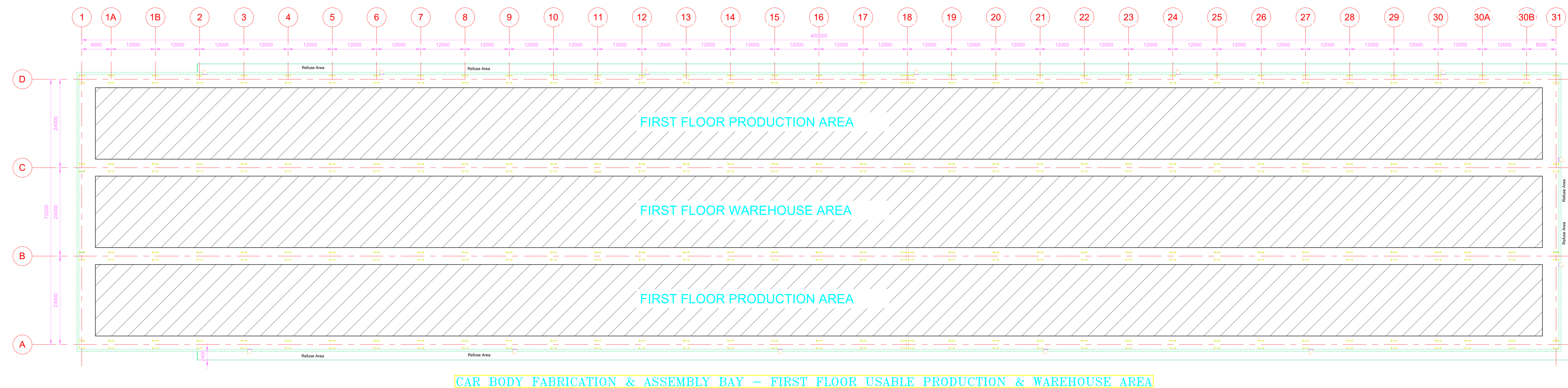
[illegible]

Meeting Chairs	40									
Conference table 24/26 PAX	2							1		
Conference Chair	140							72		
Table	100							60	Includes DGM AGM and Executives	
Chair	300							180	Includes DGM AGM and Executives	
Security Reception and office 3 seater set	2							2		
medium height storage	500									
Receptionist Chairs	2							2		
Security Reception and office single seater	2							2		
Security rooms tables	12							12		
Security rooms chairs	40							40		
	Safety Office									
	DGM	SM & below (06)								
Table	1	6						7		
Main Chair	1	6						7		
Visitor Chair	3							3		
Single sofa	2							2		
Centre Table	1							1		
Coffe Table	2							2		
Three set sofa	1							1		
Conference Room Table 8 pax	1						8	1		
Conference Chair	8							8		
Pantry	The quantity shall be assessed based on the requirement by the EPC Contractor									
Over head cabinet										
under counter cabinet										

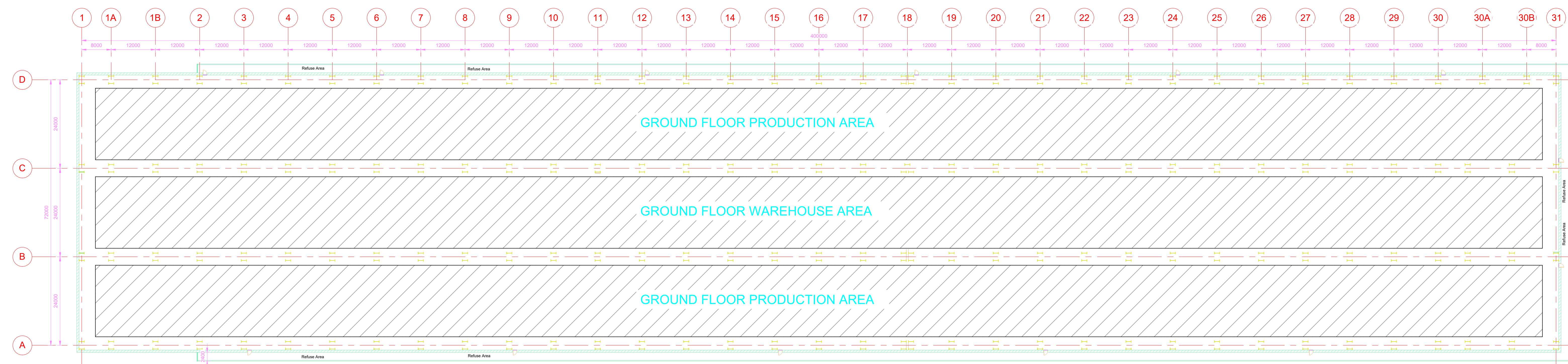
Overall master list of DraWings/DoCument				
SI No	Name of Building / Facility	Facility Code	MECON Drawing reference No	Drawing Description
1	<u>Master Plan Layout-Orientation 01</u>		MEC-I0047-01-14-D1-ZZ-ZZZ-DR-J-10100-01	Buildings Facilities orientation
A	ARCHITECTURAL DRAWINGS			
1	CAR BODY FABRICATION AND ASSEMBLY FACILITY	01A	MEC-I0047-01-48-D1-XX-01-A-01100	FLOOR PLAN
2	CAR BODY FABRICATION AND ASSEMBLY FACILITY	01B	MEC-I0047-01-48-D1-XX-01-A-01200	SECTIONS
3	CAR BODY FABRICATION AND ASSEMBLY FACILITY	01C	MEC-I0047-01-48-D1-XX-01-A-01300	ELEVATION
4	CAR BODY INSPECTION AND TESTING FACILITY	02A	MEC-I0047-01-48-D1-XX-02-A-01100	FLOOR PLAN
5	CAR BODY INSPECTION AND TESTING FACILITY	02B	MEC-I0047-01-48-D1-XX-02-A-01200	SECTIONS
6	CAR BODY INSPECTION AND TESTING FACILITY	02C	MEC-I0047-01-48-D1-XX-02-A-01300	ELEVATION
7	OFFICE COMPLEX -2	4	MEC-I0047-01-48-D1-XX-04-DR-A-01101	SECOND FLOOR PLAN AND THIRD FLOOR PLAN
8	OFFICE COMPLEX -2	4	MEC-I0047-01-48-D1-XX-04-DR-A-01102	FOURTH FLOOR PLAN AND FIFTH FLOOR PLAN
9	OFFICE COMPLEX -2	4	MEC-I0047-01-48-D1-XX-04-DR-A-01200	SECTIONN AND ELEVATION
10	OFFICE COMPLEX -2	4	MEC-I0047-01-48-D1-XX-04-DR-A-01201	SECTIONS AND VIEWS
11	CANTEEN BUILDING	05A	MEC-I0047-01-48-D1-XX-5A & 5B-DR-A-01100	CANTEEN BUILDING-GROUND FLOOR PLAN AND SECTION
12	CANTEEN BUILDING	05B	MEC-I0047-01-48-D1-XX-5A & 5B-DR-A-01101	CANTEEN BUILDING-3D - RENDERS
13	MEDICAL CENTRE	6	MEC-I0047-01-48-D1-XX-06-DR-A-01100	GROUND FLOOR PLAN AND SECTIONS
14	RAW MATERIAL STORAGE YARD	7	MEC-I0047-01-48-D1-XX-07-DR-A-01100	SITE PLAN, OFFICE FLOOR PLAN, SECTION & 3D RENDER
15	MULTILEVEL CAR PARKING(OPTION-1)	08A&08B	MEC-I0047-01-48-D1-XX-8A&8B-DR-A-01100	GROUND FLOOR PLAN
16	MULTILEVEL CAR PARKING(OPTION-1)	08A&08B	MEC-I0047-01-48-D1-XX-8A&8B-DR-A-01101	FIRST FLOOR PLAN & VIEWS
17	MAIN GATE COMPLEX WITH SECURITY OFFICE	10A	MEC-I0047-01-48-D1-XX-10A-DR-A-01100	GROUND FLOOR PLAN AND FIRST FLOOR PLAN
18	MAIN GATE COMPLEX WITH SECURITY OFFICE	10A	MEC-I0047-01-48-D1-XX-10A-DR-A-01200	SECTION, FRONT ELEVATION & VIEWS
19	GATE COMPLEX FOR TRUCK ENTRY / EXIT	10B	MEC-I0047-01-48-D1-XX-10B-DR-A-01100	GROUND FLOOR PLAN, SECTION,ELEVATION & VIEWS
20	GATE COMPLEX FOR RAILWAY SIDING	10C	MEC-I0047-01-48-D3-XX-10C-DR-A-01100	FLOOR PLANS, SECTION, ELEVATION AND 3-D RENDER
21	FIRE STATION	11	MEC-I0047-01-48-D1-XX-11-DR-A-01100	GROUND FLOOR PLAN AND SECTIONS
22	PUMP HOUSE AND SUMP	12	MEC-I0047-01-48-D1-XX-12-DR-A-01100	GROUND FLOOR PLAN ,ELEVATIONS, SECTION & VIEW
23	100 KLD MBR BASED STP BUILDING	13	MEC-I0047-01-48-D1-XX-13-DR-A-01100	GROUND FLOOR PLAN , SECTION & VIEW
24	MRSS BUILDING	14	MEC-I0047-01-48-D1-XX-14-DR-A-01100	GROUND FLOOR PLAN, SECTIONS AND VIEW
25	MRSS BUILDING	14	MEC-I0047-01-48-D1-XX-14-DR-A-01200	ELEVATIONS AND VIEW
26	AIR COMPRESSOR STATION BUILDING	15	MEC-I0047-01-48-D1-XX-15-DR-A-01100	GROUND FLOOR PLAN , SECTION & VIEW
27	CENTRALISED GAS BANK	16	MEC-I0047-01-48-D1-XX-16-DR-A-01100	GROUND FLOOR PLAN , SECTION,ELEVATION & VIEW
28	SAFETY OFFICE	17	MEC-I0047-01-48-D1-XX-17-DR-A-01100	GROUND FLOOR PLAN, SECTION & 3D RENDER
29	COMMON CHILLER PLANT	19	MEC-I0047-01-48-D1-XX-19-DR-A-01100	GROUND FLOOR PLAN & SECTIONS
30	TOILET BLOCK AND RESTROOM AT PARKING AREA	21	MEC-I0047-01-48-D1-XX-21-DR-A-01100	GROUND FLOOR PLAN,ELEVATION, SECTIONS AND VIEW
31	MASTER PLAN LAYOUT	ZZZ	MEC-I0047-01-14-D1-ZZ-ZZZ-DR-J-10100	
B	ELECTRICALS			
1	CAR BODY FABRICATION & ASSEMBLY LINE FACILITY	ZZZ	MEC-I/0047-01-E1-D1-ZZ-ZZZ-DR-E-07220	SINGLE LINE DIAGRAM KEY POWER DISTRIBUTION SCHEME

SI No	Name of Building / Facility	Facility Code	MECON Drawing reference No	Drawing Description
C	EPSS			
1	EPSS	ZZZ	MEC-I/0047-01-40-D1-ZZ-14-DR-N-03003	LAYOUT & SECTIONS OF DG SETS FOR EMERGENCY POWER
D	INSTRUMENTATION&PROCESS CONTROL			
1	CAR BODY FABRICATION & ASSEMBLY LINE FACILITY	ZZZ	MEC-I/0047-01-E5-D1-XX-01-DR-I-00001	SCHEMATIC FDA SYSTEM
2	CAR BODY FABRICATION & ASSEMBLY LINE FACILITY	ZZZ	MEC-I/0047-01-E5-D1-XX-01-DR-I-00002	SCHEMATIC LAN SYSTEM
E	COMPRESSED AIR			
1	CAR BODY FABRICATION AND ASSEMBLY FACILITY	ZZZ	MEC-/I0047-01-40-D1-ZZ-15-DR-N-03002	PDF OF COMPRESSED AIR FACILITY
F	GAS BANK			
1	CAR BODY FABRICATION & ASSEMBLY LINE FACILITY	ZZZ	MEC-I/0047-01-40-D1-ZZ-16-DR-N-03004	PFD OF INDUSTRIAL GASES
G	HVAC			
1	CAR BODY FABRICATION & ASSEMBLY LINE FACILITY	ZZZ	MEC-I/0047-01-40-D1-ZZ-ZZZ-DR-H-05001	CHILLED WATER SYSTEM P&ID
H	WATER SUPPLY SYSTEM			
1	CAR BODY FABRICATION & ASSEMBLY LINE FACILITY	ZZZ	MEC-I/0047-01-40-D1-ZZ-12-DR-N-03001	PFD OF WATER SUPPLY FACILITIES
I	FIRE FIGHTING SYSTEM			
1	FIRE FIGHTING SYSTEM	ZZZ	MC-I0047-01-14-D1-ZZ-ZZZ-DR-N-04002	P&I DIAGRAM OF AUTOMATIC SPRINKLER SYSTEM
2	FIRE FIGHTING SYSTEM	ZZZ	MEC-I0047-01-14-D1-ZZ-ZZZ-DR-N-04001	P&I DIAGRAM FIRE WATER PUMPING SYSTEM
3	FIRE FIGHTING SYSTEM	ZZZ	MEC-I0047-01-14-D1-ZZ-ZZZ-DR-N-04100	FIRE WATER PIPELINE NETWORK
J	FUNCTIONAL LAYOUT			
1	CAR BODY FABRICATION AND ASSEMBLY LINE FACILITY	1	MEC-I/0047-01-31-D1-XX-01-DR-T-13200	CAR BODY FABRICATION AND ASSEMBLY LINE FACILITY FUNCTIONAL LAYOUT-USABLE PRODUCTS & WAREHOUSE AREA
2	CAR BODY FABRICATION AND ASSEMBLY LINE FACILITY	1	MEC-I/0047-01-31-D1-XX-01-DR-T-13201	CAR BODY FABRICATION AND ASSEMBLY LINE FACILITY FUNCTIONAL LAYOUT-FUNCTIONAL ZONE AREA
3	CAR BODY FABRICATION AND ASSEMBLY LINE FACILITY	1	MEC-I/0047-01-31-D1-XX-01-DR-T-13202	CAR BODY FABRICATION AND ASSEMBLY LINE FACILITY FUNCTIONAL LAYOUT-FLOOR PLAN
4	CAR BODY FABRICATION AND ASSEMBLY LINE FACILITY	1	MEC-I/0047-01-31-D1-XX-01-DR-T-13203	CAR BODY FABRICATION AND ASSEMBLY LINE FACILITY FUNCTIONAL LAYOUT-DETAILED FLOOR PLAN
5	CAR BODY FABRICATION AND ASSEMBLY LINE FACILITY	1	MEC-I/0047-01-31-D1-XX-01-DR-T-13300	CAR BODY FABRICATION AND ASSEMBLY LINE FACILITY FUNCTIONAL LAYOUT-TYPICAL SECTION
6	CAR BODY INSPECTION AND TESTING FACILITY	2	MEC-I/0047-02-31-D1-XX-02-DR-T-13200	CAR BODY INSPECTION AND TESTING FACILITY FUNCTIONAL LAYOUT-FLOOR PLAN
7	CAR BODY INSPECTION AND TESTING FACILITY	2	MEC-I/0047-02-31-D1-XX-02-DR-T-13300	CAR BODY INSPECTION AND TESTING FACILITY FUNCTIONAL LAYOUT-TYPICAL SECTION





CAR BODY FABRICATION & ASSEMBLY BAY – FIRST FLOOR USABLE PRODUCTION & WAREHOUSE AREA



CAR BODY FURNISHING BAY – GROUND FLOOR USABLE PRODUCTION & WAREHOUSE AREA

WORK SHOP BAY – USABLE PRODUCTION & WAREHOUSE AREA



1. All dimensions are in MM unless otherwise mentioned

FUNCTIONAL LAYOUT DRAWINGS

R22.0	09-01-26	FOR FINAL DPR SUBMISSION	GK	GK	PJG	PJG			
R31.0	29-11-25	FOR DPR SUBMISSION	GK	GK	PJG	PJG			
REV	DATE	DESCRIPTION	BY	CHK	RWW	APP			

CLIENT _____



COMPREHENSIVE DETAILED
PROJECT REPORT (DPR) FOR
ESTABLISHING A
STATE-OF-THE-ART
GREENFIELD ROLLING STOCK
MANUFACTURING PLANT AT
BHOPAL, MADHYA PRADESH

CAR BODY FABRICATION &
ASSEMBLY LINE FACILITY



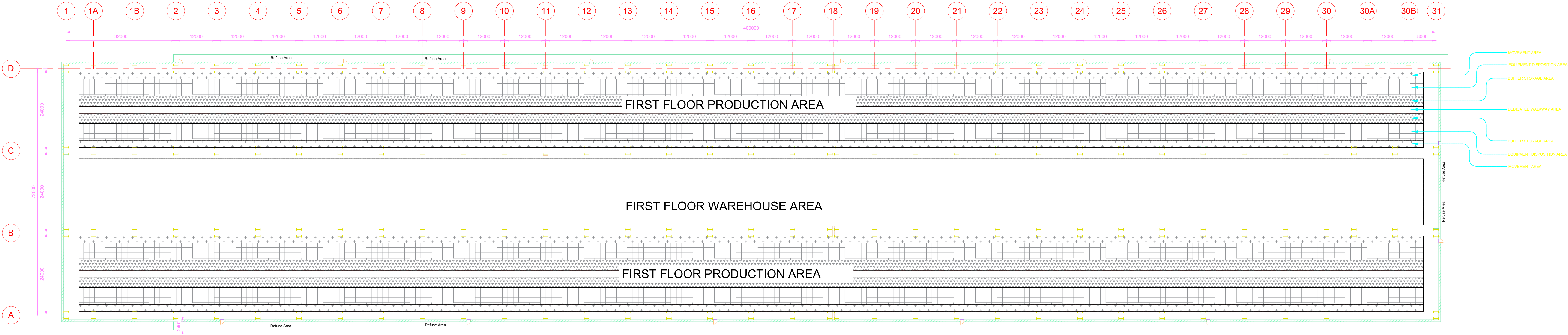
TITLE	CAR BODY FABRICATION & ASSEMBLY LINE FACILITY

FUNCTIONAL LAYOUT - FLOOR PLAN

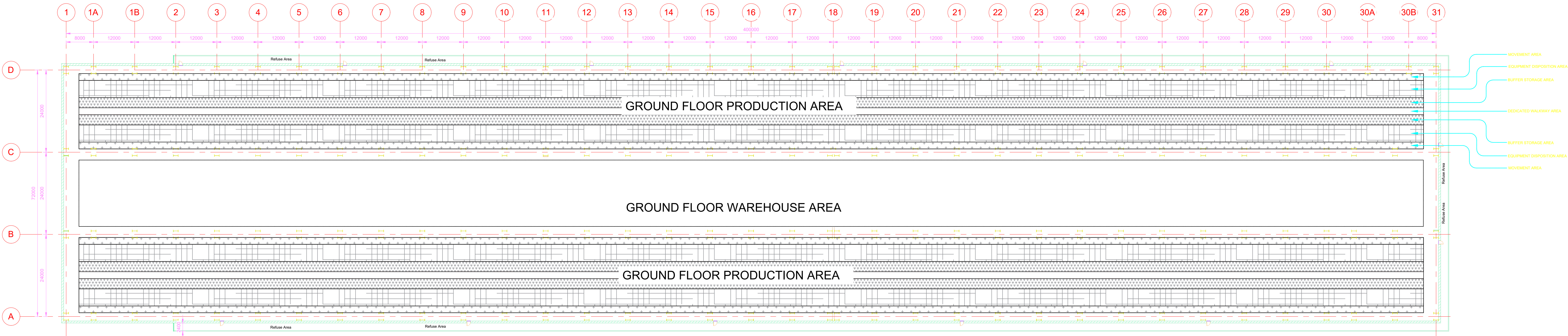
DRAWN: GK		REVIEWED: PKJ	APPROVED: PKJ
DATE: 29-11-2025		SCALE:	SIZE: A0
REF No.: 59000633403-6 dated 31.10.2025		PROJECT No.: IV0047	

DRAWING No.:	REVISION:
MEC-I/0047-01-31-D1-XX-01-DR-T-13200	

WORK SHOP BAY – USABLE PRODUCTION & WAREHOUSE AREA



CAR BODY FABRICATION & ASSEMBLY BAY – FIRST FLOOR FUNCTIONAL ZONE AREA



CAR BODY FURNISHING BAY – GROUND FLOOR FUNCTIONAL ZONE AREA

WORK SHOP BAY – FUNCTIONAL ZONE AREA



KEY PLAN

NOTE:

1. All dimensions are in MM unless otherwise mentioned.

FUNCTIONAL LAYOUT DRAWINGS

REV	NO	DATE	DESCRIPTION	BY	CHK	APP
R02	0	04-11-25	FOR FINAL OPS SUBMISSION	OK	OK	PKJ
R01	0	24-11-25	FOR OPS SUBMISSION	OK	OK	PKJ
REV	DATE	DESCRIPTION	BY	CHK	APP	
REVISIONS						
CLIENT						



COMPREHENSIVE DETAILED
PROJECT REPORT (DPR) FOR
ESTABLISHING A
STATE-OF-THE-ART
GREENFIELD ROLLING STOCK
MANUFACTURING PLANT AT
BHOPAL, MADHYA PRADESH

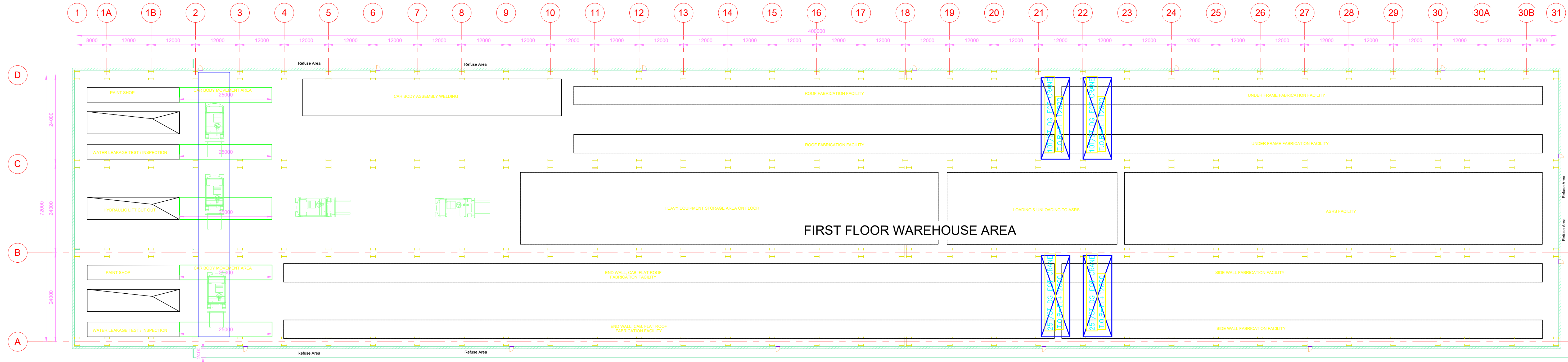
CAR BODY FABRICATION &
ASSEMBLY LINE FACILITY



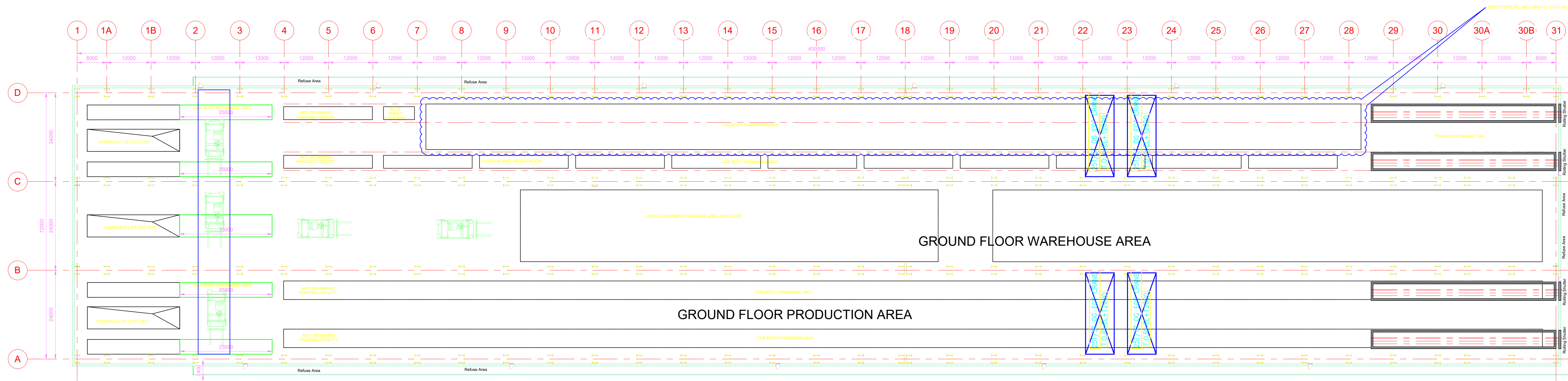
MECON LIMITED
BANGALORE

TITLE
CAR BODY FABRICATION & ASSEMBLY
LINE FACILITY
FUNCTIONAL LAYOUT -
FLOOR PLAN

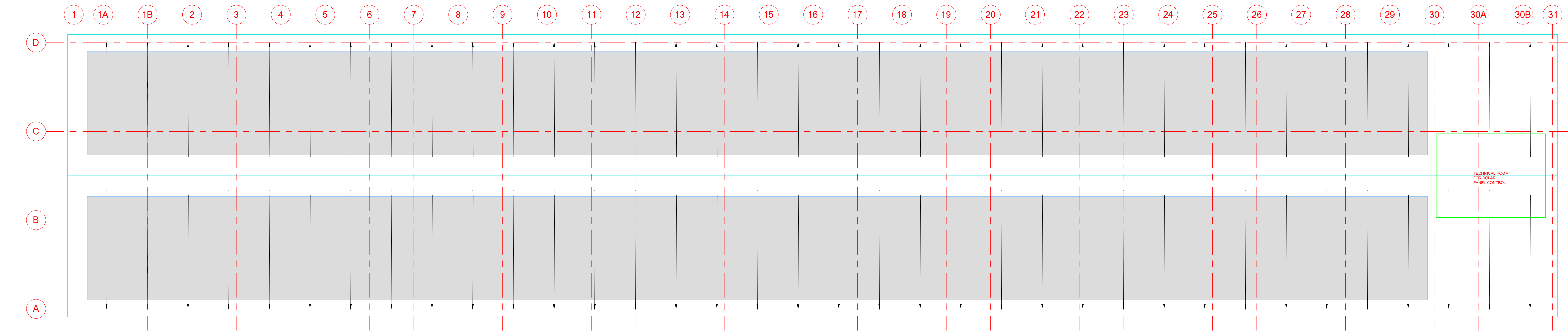
DRAWN: GK	OK	REVIEWED: PKJ	APPROVED: PKJ
DATE: 29-11-2025	SCALE: 1:100	SIZE: A0	
REF No.: MEC-I0047-01-31-D1-XX-01-DR-T-13201	PROJECT No.: I0047		
DRAWING No.: MEC-I0047-01-31-D1-XX-01-DR-T-13201	REVISION:		



FIRST FLOOR PLAN_ VANDE BHARAT /LHB - CAR BODY FABRICATION & ASSEMBLY BAY



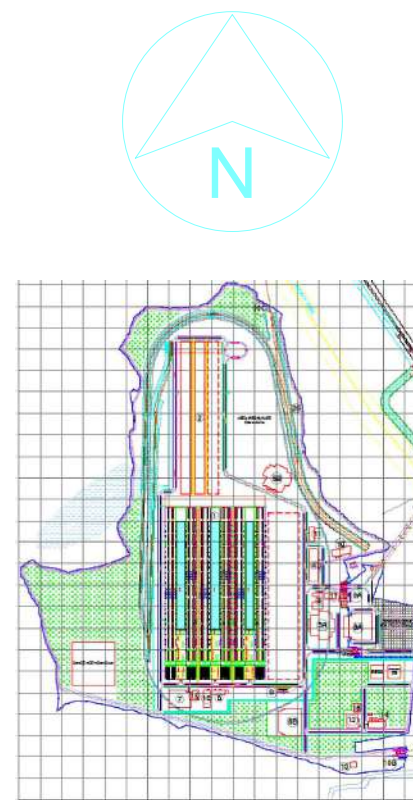
GROUND FLOOR PLAN_ VANDE BHARAT /LHB - CAR BODY FURNISHING BAY



ROOF PLAN_ VANDE BHARAT /LHB - CAR BODY ASSEMBLY BAY

Car Body Fabrication & Assembly Line Equipment List - TENTATIVE

S.No	Equipment	Quantity



KEY PLAN

NOTE :

1. All dimensions are in MM unless otherwise mentioned.

FUNCTIONAL LAYOUT DRAWINGS

REV	DATE	DESCRIPTION	BY	CHK	RW	APP
R001	08-01-20	FOR FINAL OPR SUBMISSION	OK	OK	PKU	PKU
R002	08-11-20	FOR OPR SUBMISSION	OK	PKU	PKU	PKU
R003	15-11-20	SUBMITTED FOR APPROVAL	OK	PKU	PKU	PKU
REV	DATE	DESCRIPTION	BY	CHK	RW	APP

REVISIONS
CLIENT

BEML LIMITED
BANGALORE

COMPREHENSIVE DETAILED
PROJECT REPORT (DPR) FOR
ESTABLISHING A
STATE-OF-THE-ART
GREENFIELD ROLLING STOCK
MANUFACTURING PLANT AT
BHOPL, MADHYA PRADESH

CAR BODY FABRICATION &
ASSEMBLY LINE FACILITY

MECON LIMITED
BANGALORE

TITLE
CAR BODY FABRICATION & ASSEMBLY
LINE FACILITY

FUNCTIONAL LAYOUT -
FLOOR PLAN

DRAWN: GK
DATE: 25-11-2025
REF No.: 10047
DRAWING No.: MEC-V0047-01-31-D1-XX-01-DR-T-13202

REVIEWED: PKU
SCALE: 1:100
PROJECT No.: 10047
REVISION:

APPROVED: PKU
SIZE: A0
PROJECT No.: 10047
REVISION:



KEY PLAN

NOTE :

All dimensions are in MM unless otherwise mentioned

FUNCTIONAL LAYOUT DRAWINGS

R02.0	09-01-26	FOR FINAL DPR SUBMISSION	OK	OK	PJK	PJK			
R01.0	20-11-25	FOR DPR SUBMISSION	OK	OK	PJK	PJK			
REV	DATE	DESCRIPTION	BY	CHK	RWW	APP			

CLIENT



BEML LIMITED
BANGALORE

COMPREHENSIVE DETAILED
PROJECT REPORT (DPR) FOR
ESTABLISHING A
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MANUFACTURING PLANT AT
BHOPAL, MADHYA PRADESH

CAR BODY FABRICATION & ASSEMBLY LINE FACILITY



MECON LIMITED
BANGALORE

TITLE CAR BODY FABRICATION & ASSEMBLY
LINE FACILITY

FUNCTIONAL LAYOUT - FLOOR PLAN

DRAWN: GK [REDACTED] GK REVIEWED: PKJ APPROVED: F

DATE: 29-11-2025 SCALE: SIZE: A2

REF No.: 5900062343/0 dated 30 July 2025	PROJECT No.: 10047

DRAWING No.: _____

MEC-I/0047-01-31-D1-XX-01-DR-T-13203

NOTE :

All dimensions are in MM unless otherwise mentioned



REV	DATE	DESCRIPTION	BY	CHK	R/W	APP
R02.0	09-01-05	FOR FINAL DPR SUBMISSION	OK	OK	PKJ	PKJ
R01.0	20-11-05	FOR DPR SUBMISSION	OK	OK	PKJ	PKJ

REVISIONS

CLIENT



BEML LIMITED
BANGALORE

COMPREHENSIVE DETAILED
PROJECT REPORT (DPR) FOR
ESTABLISHING A
STATE-OF-THE-ART
GREENFIELD ROLLING STOCK
MANUFACTURING PLANT AT
BHOPAL, MADHYA PRADESH

CAR BODY FABRICATION & ASSEMBLY LINE FACILITY



MECON LIMITED
BANGALORE

TITLE CAR BODY FABRICATION & ASSEMBLY
LINE FACILITY

FUNCTIONAL LAYOUT - FLOOR PLAN

DRAWN: GK		REVIEWED: PKJ	APPROVED: PKJ
DATE: 29-11-2025		SCALE:	SIZE: A0
REF No.: 59009633401-0 dated 31.10.2025		PROJECT No.: U0047	

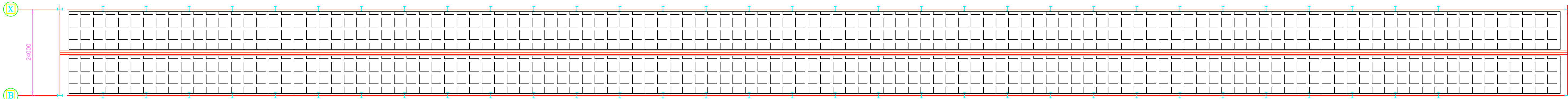
DRAWING No.:	REVISION:
MEC-I/0047-01-31-D1-XX-01-DR-T-13300	



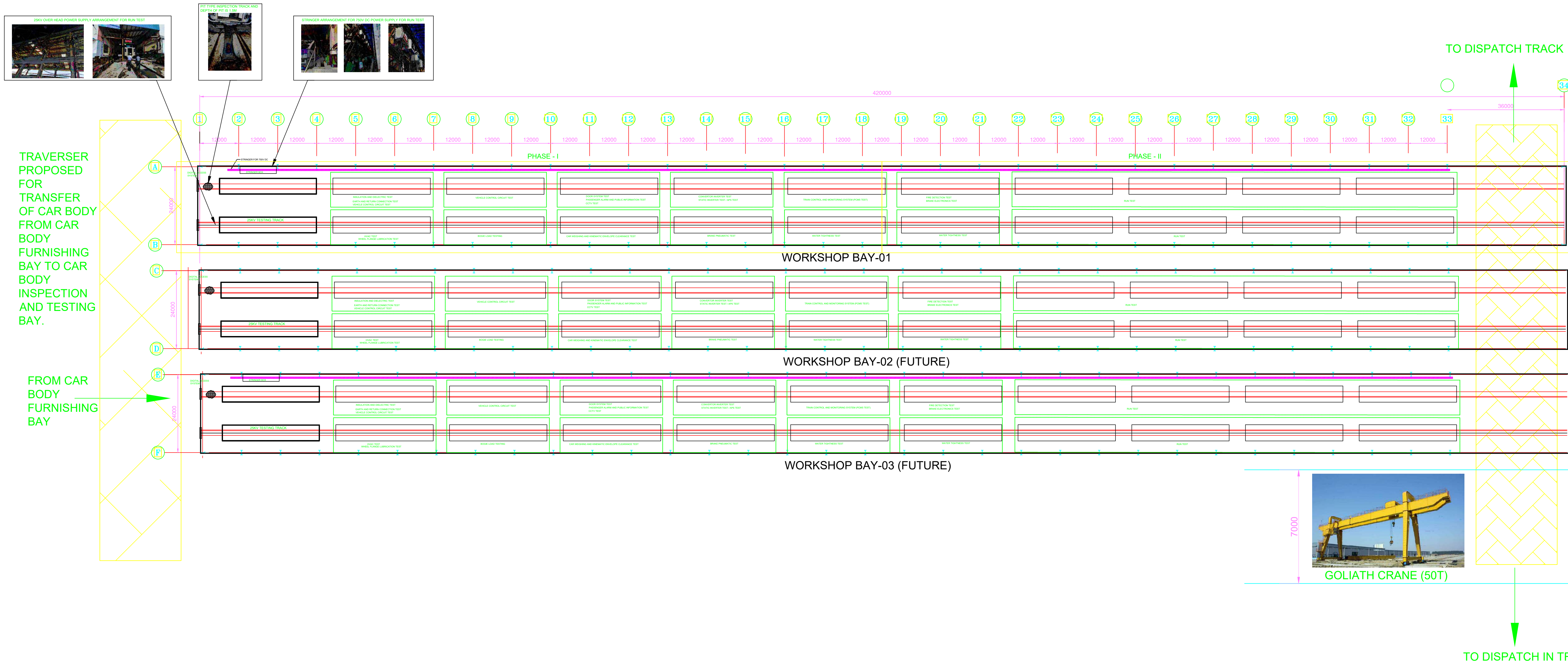
KEY PLAN

NOTE :

1. All dimensions are in MM unless otherwise mentioned.



SOLAR PANEL AT ROOF TOP(TYPICAL)



Car Body Inspection & Testing Line Equipment List -TENTATIVE		
S.No	Equipment	Quantity
1	750 V DC power supply Stinger box	1
2	25 kV AC power supply (OHE System)	1
3	Bogie Load Testing Equipment	1
4	Car Weighing Equipmet	1
5	Universal Brake System Test Benches	1
6	Megger Tester	4
7	Hipot Tester	4
8	Kinematic Envelope gauge	1
9	water leak testing system(Nozzles,Pumps)	1
10	Ground Bond Testers	1
11	Digital Multimeters (DMMs)	4
12	Automotive Oscilloscopes	2
13	Circuit Testers/Test Lights (LED/Probe-based)	2
14	Rain Test Chamber	1
15	All-in-One CCTV Testers	1
16	Programmable DC Supplies	1
17	Regenerative AC Loads/Supplies	1
18	Traverser	1
19	HVAC Testing Facility	1
20	Dielectric and Insulation Testing Facility	1
21	Vehicle Control Circuit Test Facility	1
22	All Electrical Testing Facility	1
23	PCMS	1
24	Fire Detection Testing Facility	1
25	Brake Electronics Testing Facility	1
26	Brake Pneumatics Testing Facility	1
27	Passenge Alarm and Public Information Test Facility	1

FUNCTIONAL LAYOUT
DRAWINGS

REV	DATE	DESCRIPTION	BY	CHK	RW	APP
REV 3	09-11-25	FOR FINAL DPR SUBMISSION		OK	PKJ	PKJ
REV 2	26-11-25	FOR DPR SUBMISSION		OK	PKJ	PKJ
REV 1	15-11-25	SUBMITTED FOR APPROVAL		OK	PKJ	PKJ

REVISIONS
CLIENT



COMPREHENSIVE DETAILED
PROJECT REPORT (DPR) FOR
ESTABLISHING A
STATE-OF-THE-ART
GREENFIELD ROLLING STOCK
MANUFACTURING PLANT AT
BHO PAL, MADHYA PRADESH

CENTRAL SCRAP YARD & DUMMY
BOGIE & JIGS STORAGE COMPLEX



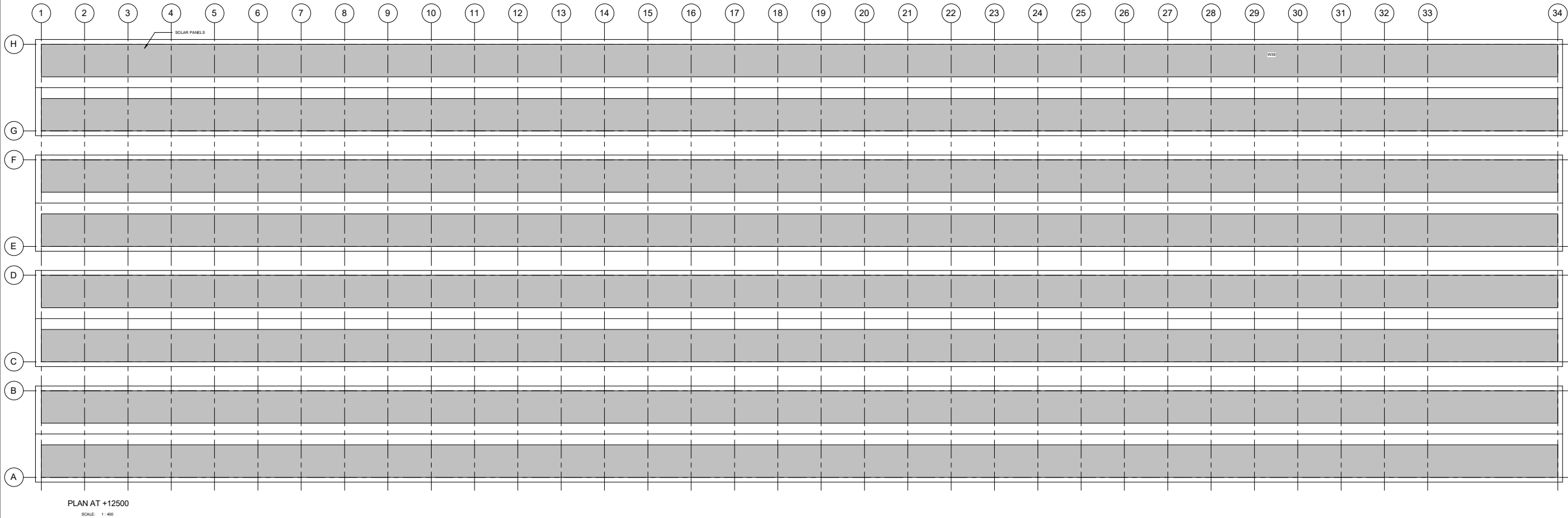
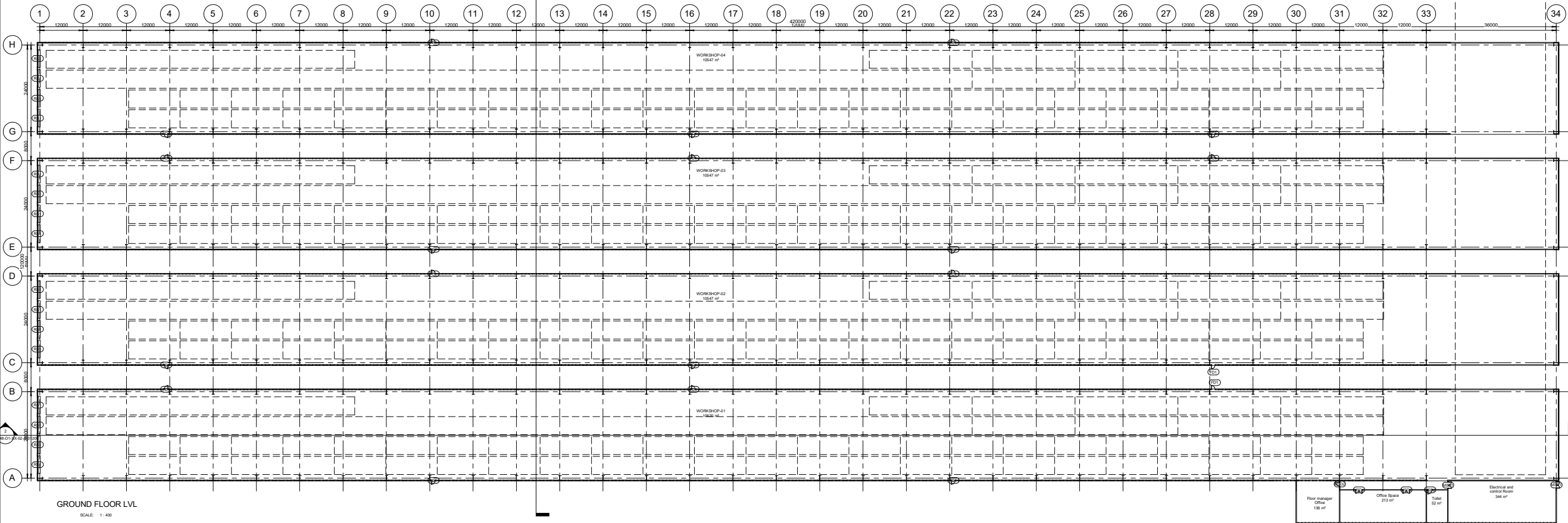
TITLE
CAR BODY INSPECTION & TESTING
LINE

FUNCTIONAL LAYOUT -
FLOOR PLAN

DRAWN: MK CHECKED: OK REVIEWED: PKJ APPROVED: PKJ
DATE: 25-11-2025 SCALE: SIZE: A0

REF No.: PROJECTED & REVISED PROJECT No.: 10047

DRAWING No.: MEC-I0047-01-31-D1-XX-02-DR-T-13200 REVISION:



CONCEPT DRAWING

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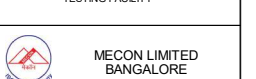
REVISIONS

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Comprehensive Detailed Project Report (DPR) for Establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh

CAR BODY INSPECTION AND TESTING FACILITY



TITLE

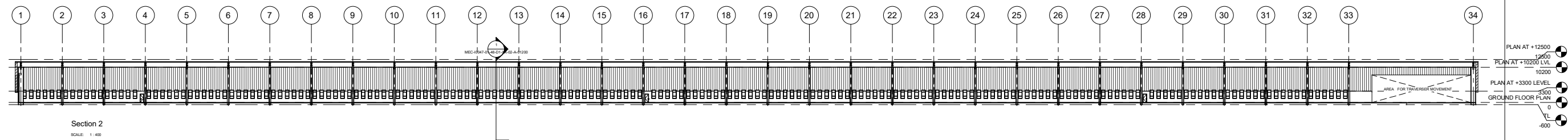
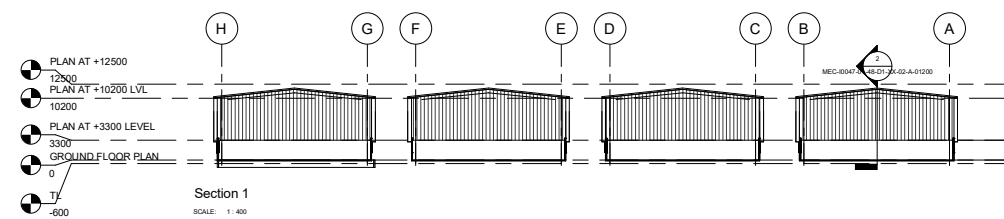
FLOOR PLAN

DRAWN	CHECKED	REVIEWED	APPROVED
JT	MTB	MB	BUS
DATE	DATE	SCALE: 1:400	SHEET: 40

REF No.	
DRAWING No.	

MEC-10047-01-48-01-00-02-A-01100

REVISION



CONCEPT DRAWING

REV	DATE	DESCRIPTION	BY	CHK	RWN

REV	DATE	DESCRIPTION	BY	CHK	REVW	A



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Comprehensive Detailed Project Report (DPR) for Establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh

CAR BODY INSPECTION AND TESTING FACILITY



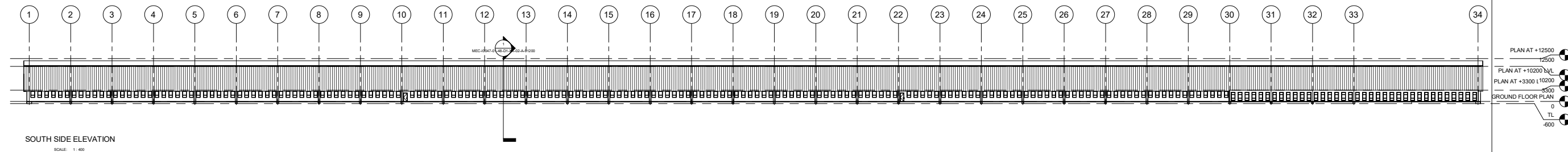
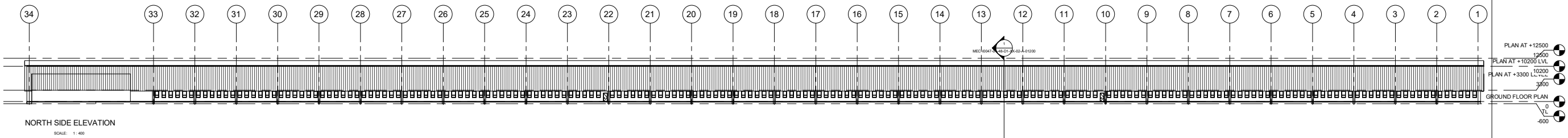
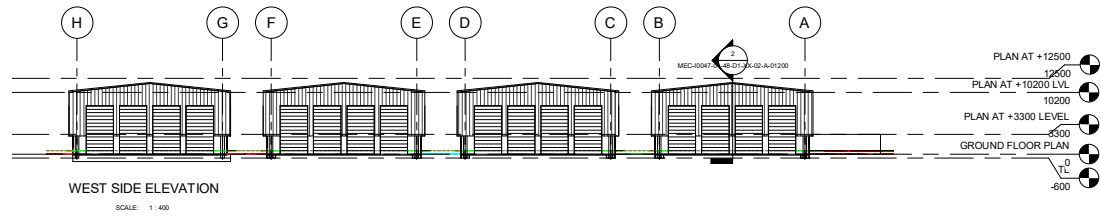
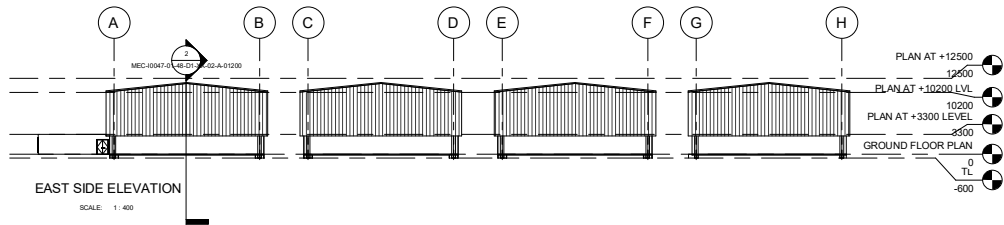
MECON LIMITED
BANGALORE

TITLE	SECTIONS
1. <i>Introduction</i>	1.1. <i>Background</i>
2. <i>Methodology</i>	2.1. <i>Study Design</i>
3. <i>Results</i>	3.1. <i>Data Collection</i>
4. <i>Discussion</i>	4.1. <i>Conclusions</i>
5. <i>References</i>	

DRAWN: JT	CHECKED: MSB	REVIEWED: MM	APPROVED: BGS
DATE:		SCALE: 1 = 100	SIZE: A0

DATE:	DATE: 11-1-2000	CLASS: 70
REF N°:		

DRAWING No.:
MEC-10047-04-48-D1-XK-03-A-040



CONCEPT DRAWING

REV	DATE	DESCRIPTION	BY	CHK	REV	APP
REVISIONS						

CLIENT

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Comprehensive Detailed Project Report (DPR) for Establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh

CAR BODY INSPECTION AND TESTING FACILITY

 **MECON LIMITED**
BANGALORE

TITLE

ELEVATION

DRAWN	CHECKED	REVIEWED	APPROVED
DATE	DATE	DATE	DATE
SCALE: 1:400	SCALE: 1:400	SCALE: 1:400	SCALE: 1:400

DRAWING No. MEC-10047-01-48-01-00-02-A-01000



VIEW OF EXECUTIVE ENTRY



VIEW OF EXECUTIVE EMERGENCY EXIT



OVERALL VIEW OF CANTEEN BUILDING

CONCEPT DRAWING

REV	DATE	DESCRIPTION	BY	CHK	RW	APP
R02.0	26-11-25	FOR DPR SUBMISSION	MSB	MSB	MA	BGS
R01.0	13-11-25	SUBMITTED FOR APPROVAL	MSB	MSB	MA	BGS

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Bharat Electronics Limited

BEML
BANGALORE

Comprehensive Detailed Project Report (DPR) for Establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh

CANTEEN BUILDING

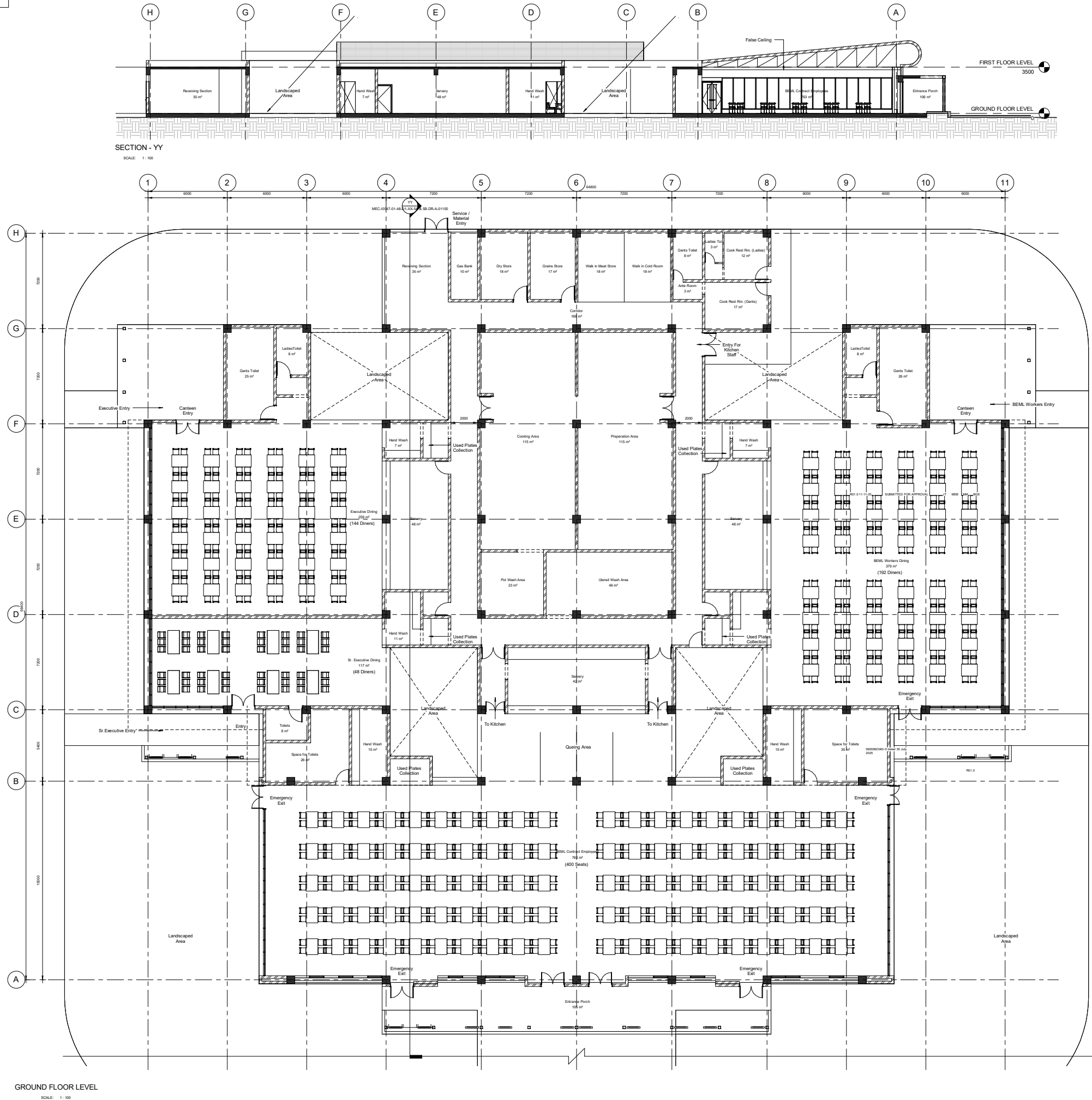


MECON LIMITED
BANGALORE

TITLE

3D - RENDER

DRAWN: MS BRUNO	CHECKED: MS BRUNO	REVIEWED: MALAYA	APPROVED: BG SAJJIT
DATE: 13-11-2025		SCALE: 1:1	SIZE: A1
REF No.: 5000062340/-0 dated 30 July 2025		PROJECT No.: 10047	
DRAWING No.: MEC-0047-01-48-D1-XX-5A & 5B-DR-A-01101			REVISION: R02.0



BUILT UP AREA SCHEDULE	
Name	Area(Sqm)
GROUND FLOOR	3015
TOTAL BUILT UP AREA	3015

CONCEPT DRAWING



Comprehensive Detailed Project Report (DPR) for Establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh

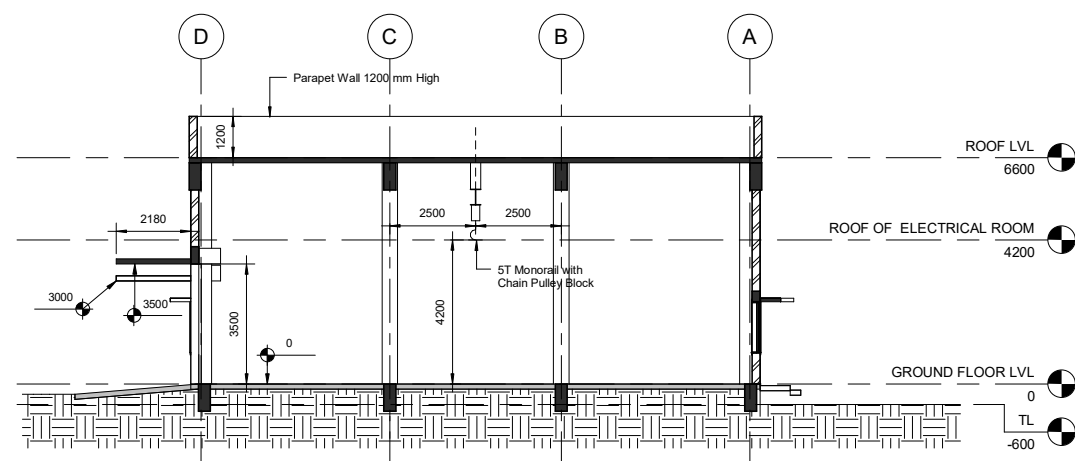
CANTEEN BUILDING



GROUND FLOOR PLAN AND SECTION

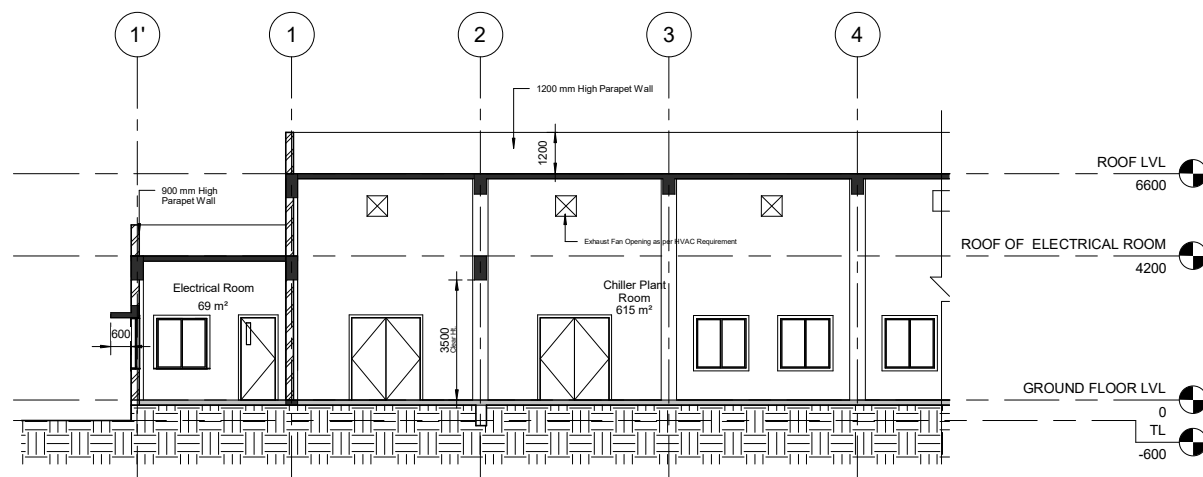
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DATE: 05-10-2022	SCALE: 1:100	DATE: 05-10-2022	SCALE: 1:100
REF No: 500052340-2 dated 30 July 2022	PROJECT No: 01/20/2787		

DRAWING No.: MEC-0047-01-4B-D1-XS-GA & SB-DRA-01100	REVISION: R02.0



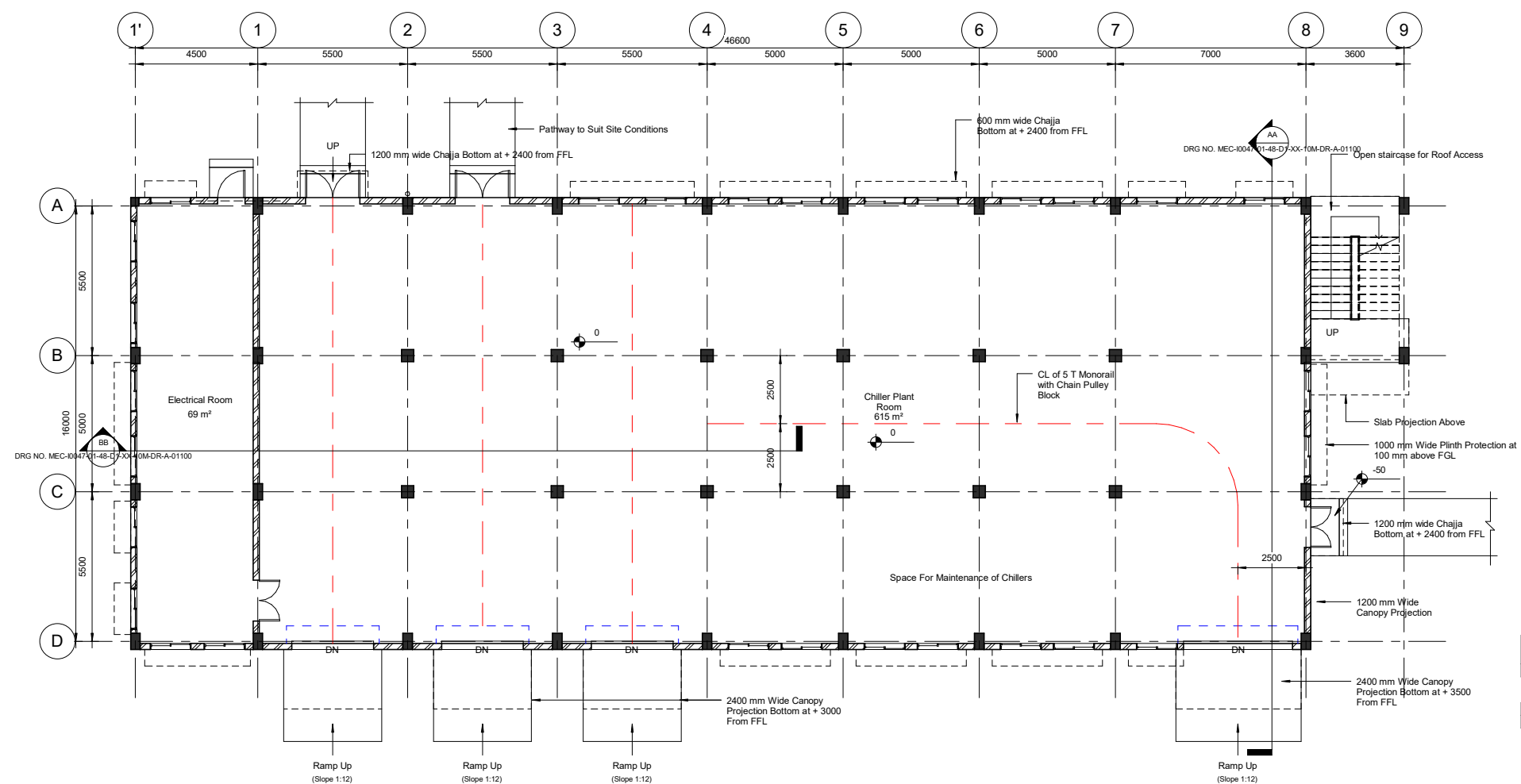
SECTION - AA

SCALE: 1:100



SECTION - BB

SCALE: 1 : 100



GROUND FLOOR PLAN

SCALE: 1:100

Area Schedule (Gross Building)		
Name	Level	Area
GROUND FLOOR LVL		
CHILLER PLANT	GROUND FLOOR LVL	720 m ²
STAIRCASE	GROUND FLOOR LVL	22 m ²
TOTAL BUILT UP AREA		742 m ²

CONCEPT DRAWING

R01.0	11-11-25	SUBMITTED FOR APPROVAL	JT	MSB	MM	BC
REV	DATE	DESCRIPTION	BY	CHK	R/VW	AP

CLIENT	



Comprehensive Detailed Project Report (DPR) for Establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh

COMMON CHILLER PLANT



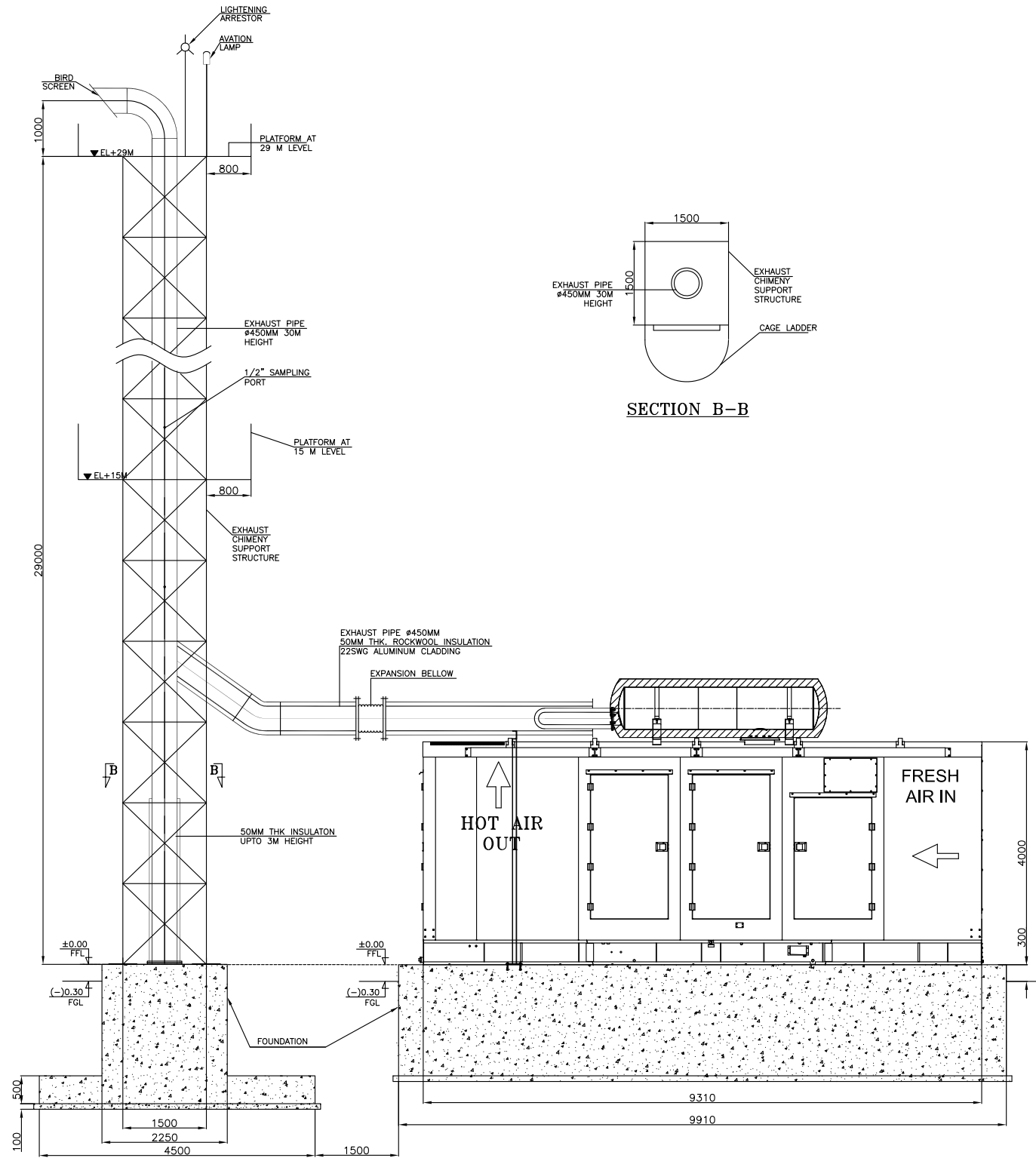
TITLE

GROUND FLOOR PLAN & SECTIONS

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DATE: 11-11-2025		SCALE: 1 : 100	SIZE: A1

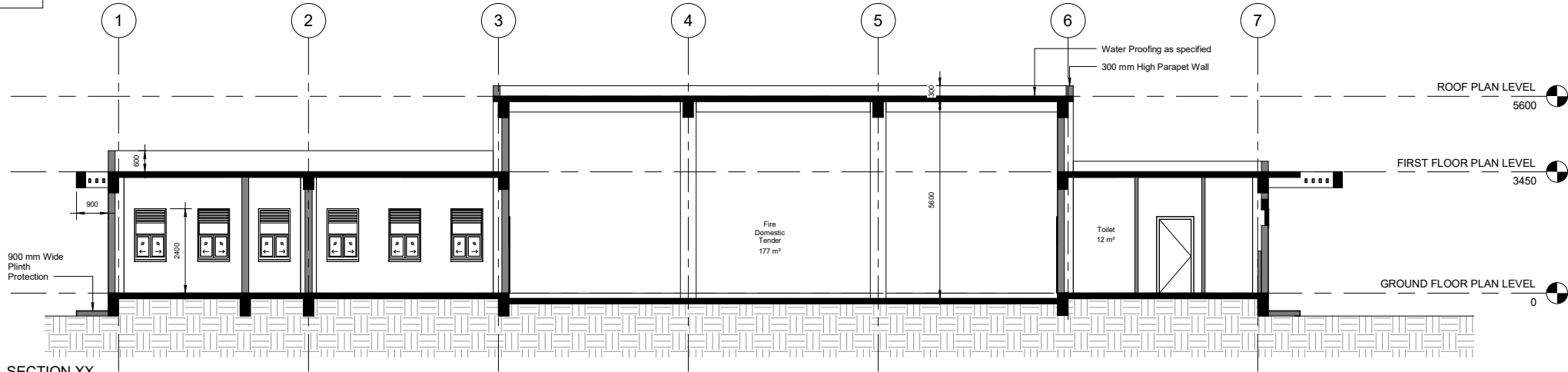
REF No.: 5900062340/-0 dated 30 July 2025	PROJECT No.: I/0047

DRAWING No.:	REVISION



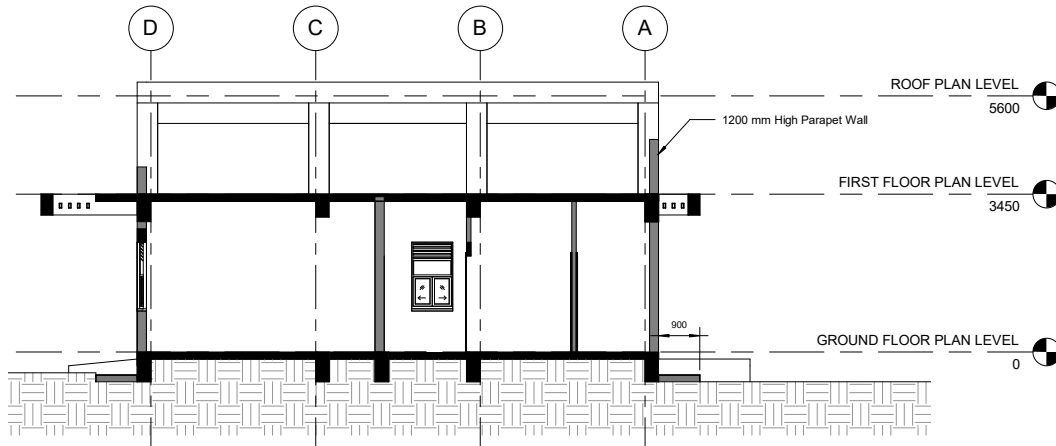
SECTION A-A
(CAGE LADDER NOT SHOWN FOR CLARITY)

NO.	27-10-25	FIRST SUBMISSION	SSA	SS	SS	SS			
REV.	DATE	DESCRIPTION	BY	CHECK	REVIEW	APPV			
			NEEDS/REVISION						
CLIENT									
			BHEL LIMITED BANGALORE						
COMPREHENSIVE DETAILED PROJECT REPORT (DPR) FOR ESTABLISHING A STATE-OF THE ART GREENFIELD ROLLING STOCK MANUFACTURING PLANT AT BHOPAL, MADHYA PRADESH									
CAR BODY FABRICATION & ASSEMBLY LINE FACILITY									
			MECON LIMITED BANGALORE						
TITLE									
LAYOUT & SECTIONS OF DG SETS FOR EMERGENCY POWER									
DRAWING NO.	CHECKED:	SS	REVIEWED:	SS	APPROVED:	SS			
DATE:	27-10-25		SCALE:	NTS		SIZE:	A3		
REF. NO.:	MEC/D047-01-40-BM/01 30 JEN 2025		PROJECT NO.:	E047					
DRAWING NO.:									
MEC/D047-01-40-DI-24-LR-D-03003							REV.		
							NO.		



SECTION XX

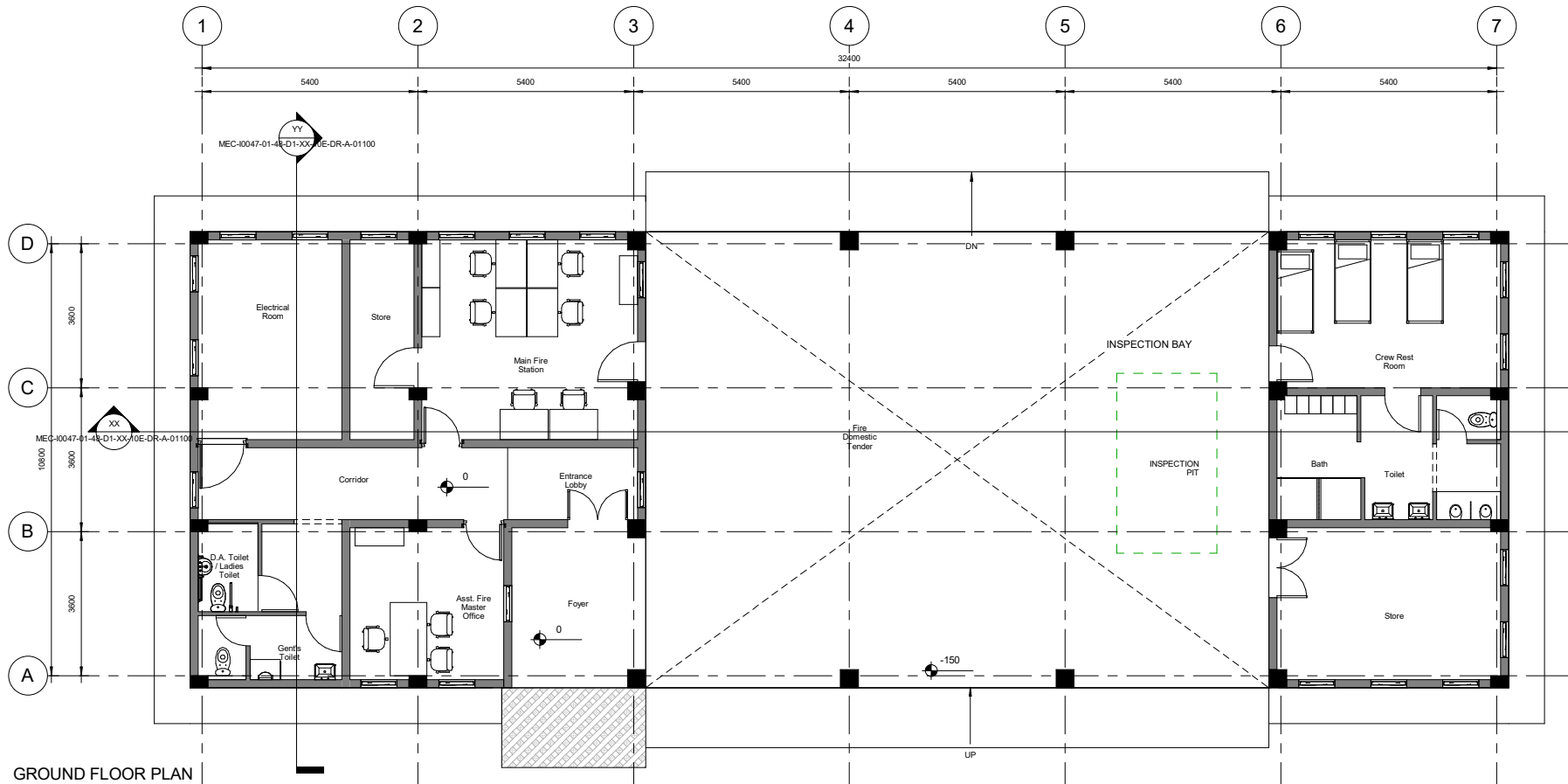
SCALE: 1 : 75



SECTION YY

SCALE: 1 : 75

BUILT UP AREA SCHEDULE	
Name	Area(Sqm)
GROUND FLOOR	376 m²
TOTAL BUILT UP AREA	376 m²



GROUND FLOOR PLAN

SCALE: 1 : 75

CONCEPT DRAWING



Comprehensive Detailed Project Report (DPR) for Establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh

FIRE STATION



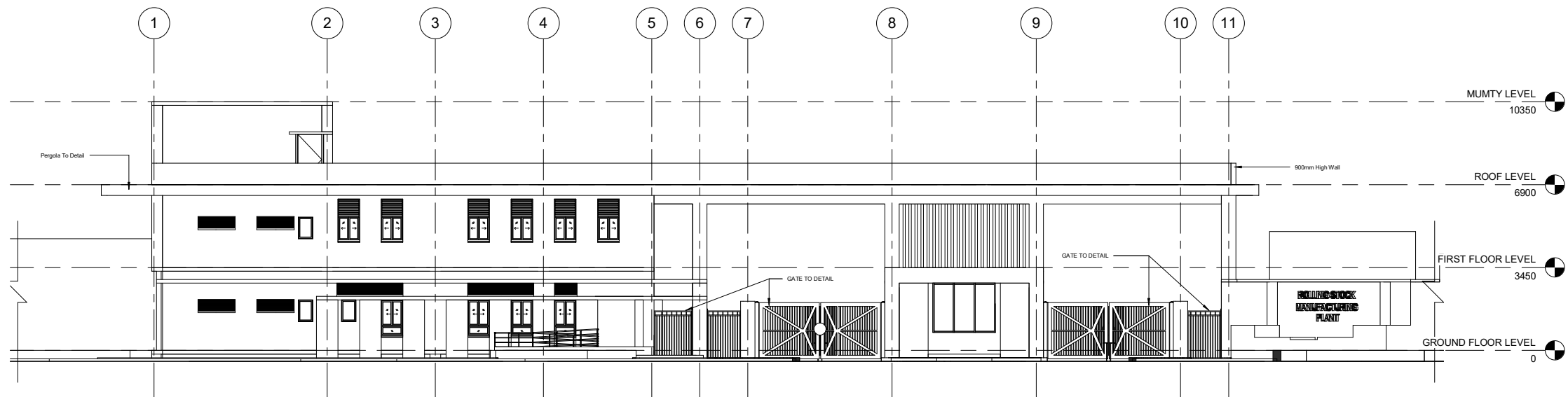
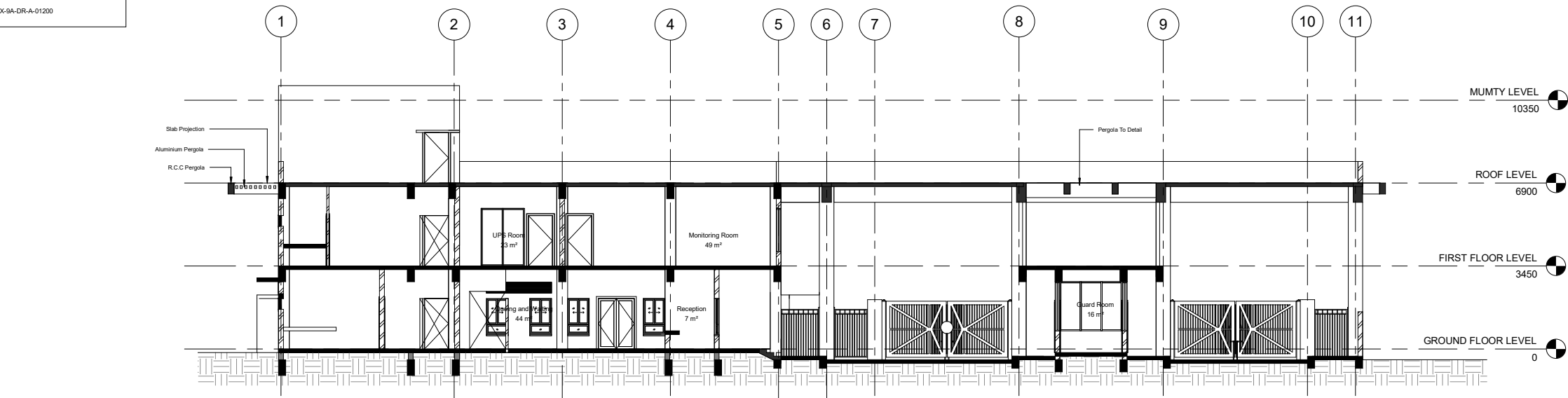
**MECON LIMITED
BANGALORE**

GROUND FLOOR PLAN AND SECTIONS

DRAWN: MS BRUNO
CHECKED: MS BRUNO
REVIEWED: MALAYA
APPROVED: BG SAJJIT
DATE: 21-10-2025
SCALE: 1 : 75
SIZE: A1

REF No.: 5900062340-0 dated 30 July 2025
PROJECT No.: 10047

DRAWING No.:
MEC-0047-01-48-D1-XX-10E-DR-A-01100
REVISION:
R01.0



CONCEPT DRAWING



VIEW OF MAIN GATE FROM VISITOR'S PARKING AREA



VIEW OF MAIN GATE FROM ACCESS ROAD

REV	DATE	DESCRIPTION	BY	CHK	RW	APP
01	06-10-25	SUBMITTED FOR APPROVAL	JT	MSB	MM	BGS

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Comprehensive Detailed Project Report (DPR) for Establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh

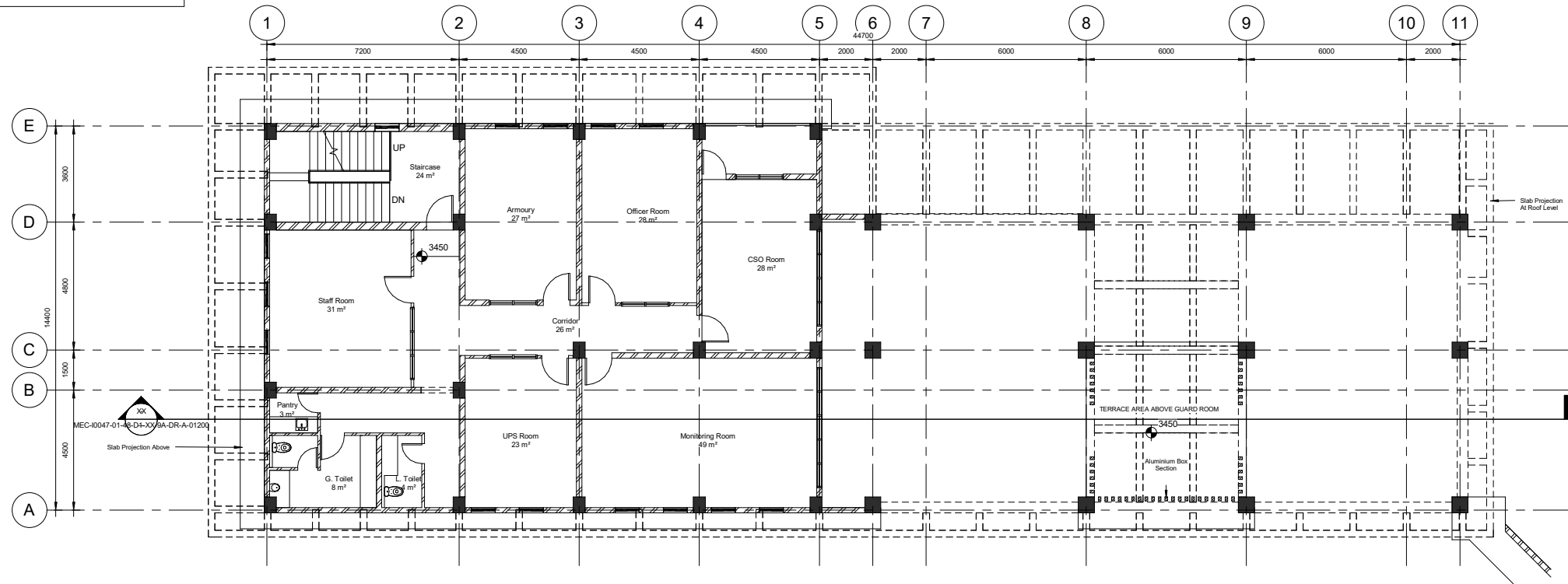
MAIN GATE COMPLEX WITH SECURITY OFFICE

MECON LIMITED
BANGALORE

SECTION, FRONT ELEVATION & VIEWS

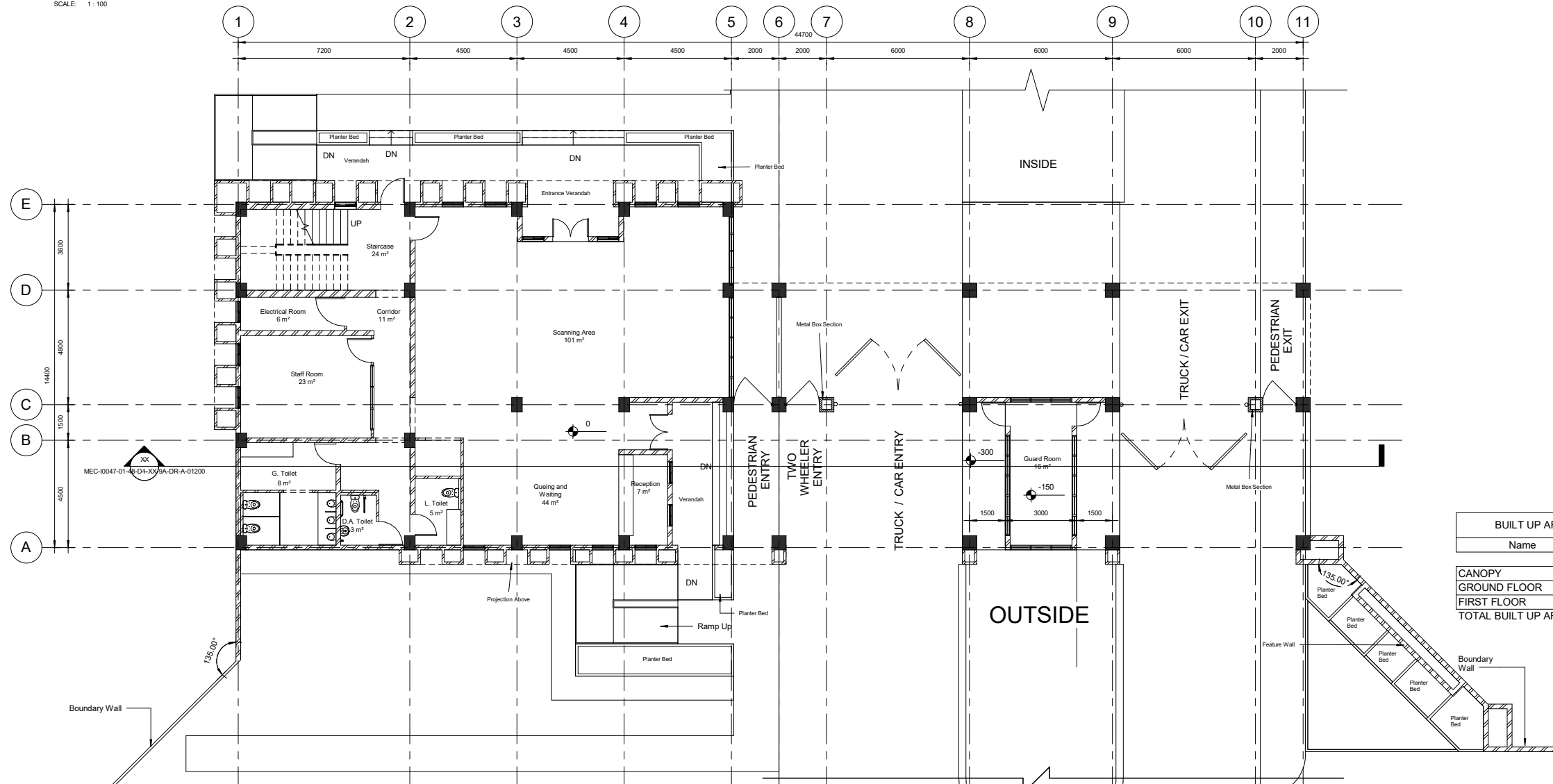
DRAWN: Author	CHECKED: Designer	REVIEWED: Designer	APPROVED: Approver
DATE: 11/04/25	SCALE: 1 : 100	SIZE: A1	

REF No.: 58000623401-0 dated 30 July 2025	PROJECT No.: 10047	REVISION: R01.0



FIRST FLOOR LEVEL

SCALE: 1 : 100



GROUND FLOOR LEVEL

SCALE: 1 : 100

CONCEPT DRAWING



Comprehensive Detailed Project Report (DPR) for Establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh

MAIN GATE COMPLEX WITH SECURITY OFFICE

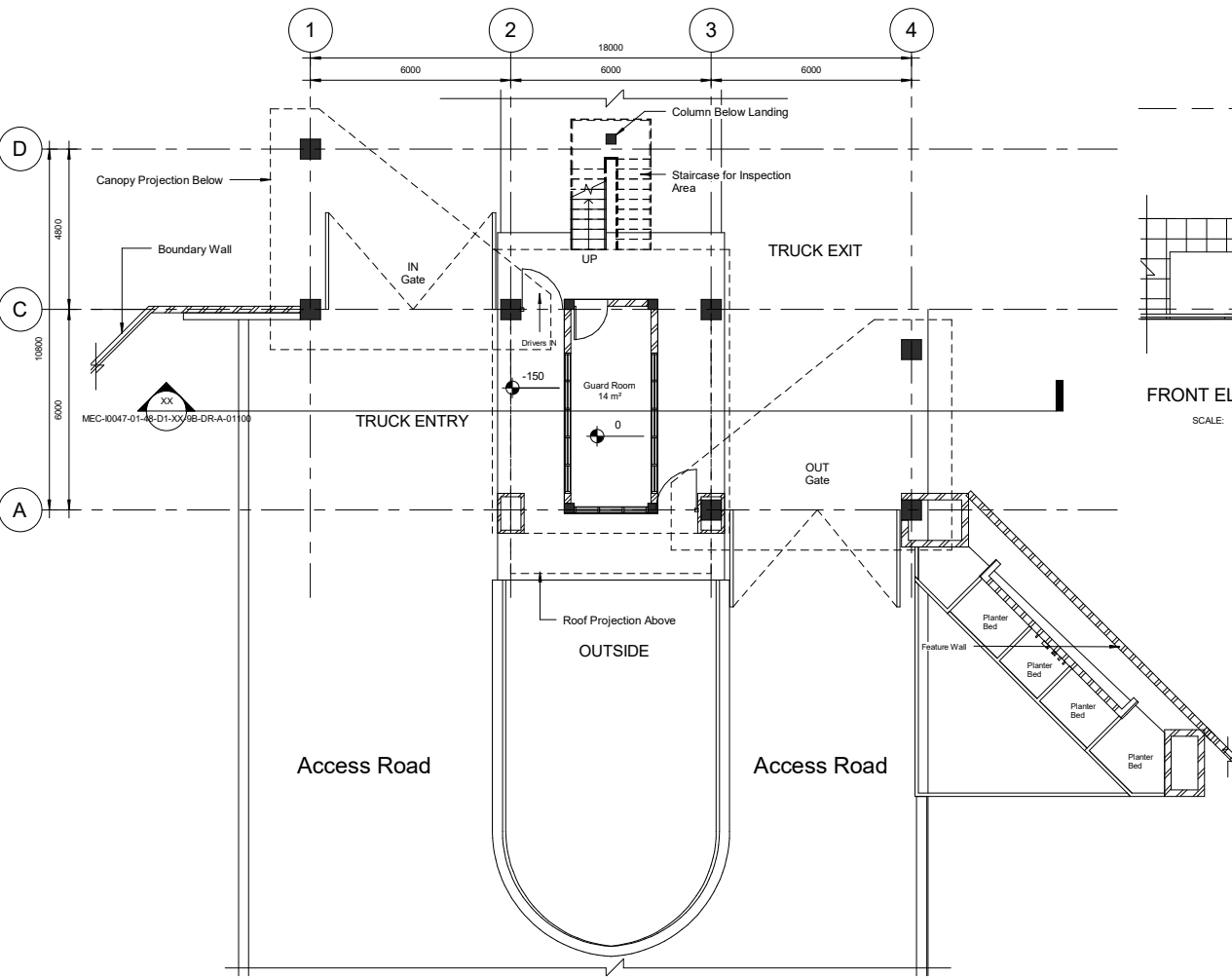


GROUND FLOOR PLAN AND FIRST FLOOR PLAN

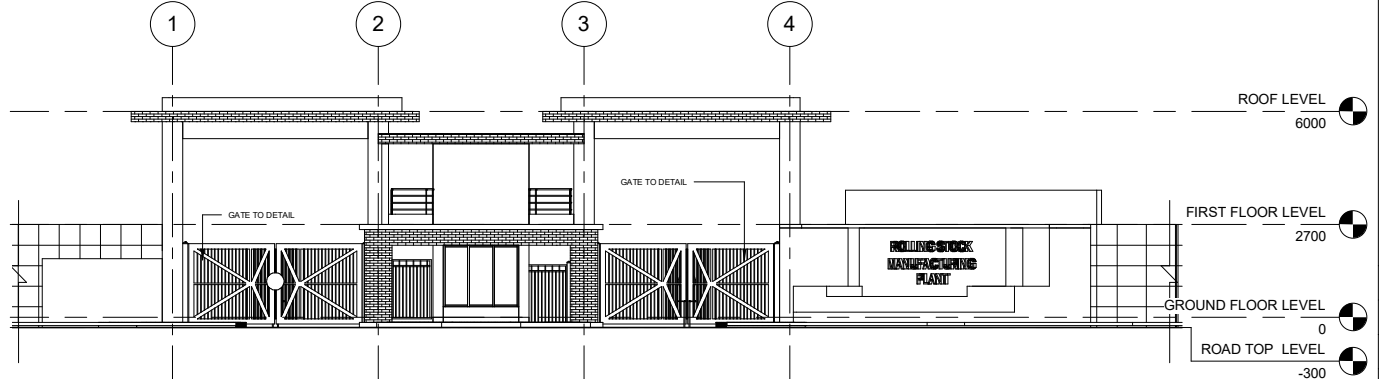
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DATE: 06-11-2025
CHECKED: MS BRUNO
REVIEWED: MALAYA
APPROVED: BG SAJJIT
SCALE: 1 : 100
SIZE: A1

REF No.: 58000623401-0 dated 30 July 2025
PROJECT No.: 10047

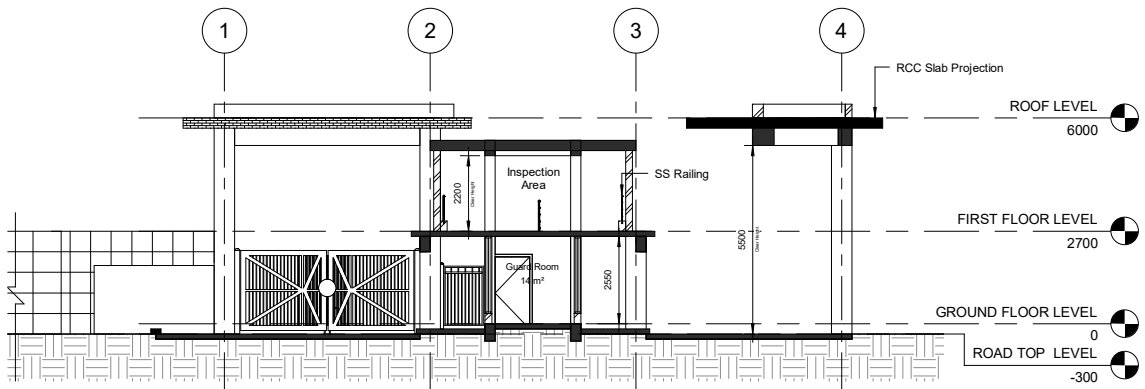
DRAWING No.: REVISION:



GROUND FLOOR LEVEL
SCALE: 1 : 100



FRONT ELEVATION
SCALE: 1 : 100



SECTION - XX
SCALE: 1 : 100

BUILT UP AREA SCHEDULE	
Name	Area(Sqm)
GROUND FLOOR	146
INSPECTION AREA	47
TOTAL BUILT UP AREA	193

CONCEPT DRAWING

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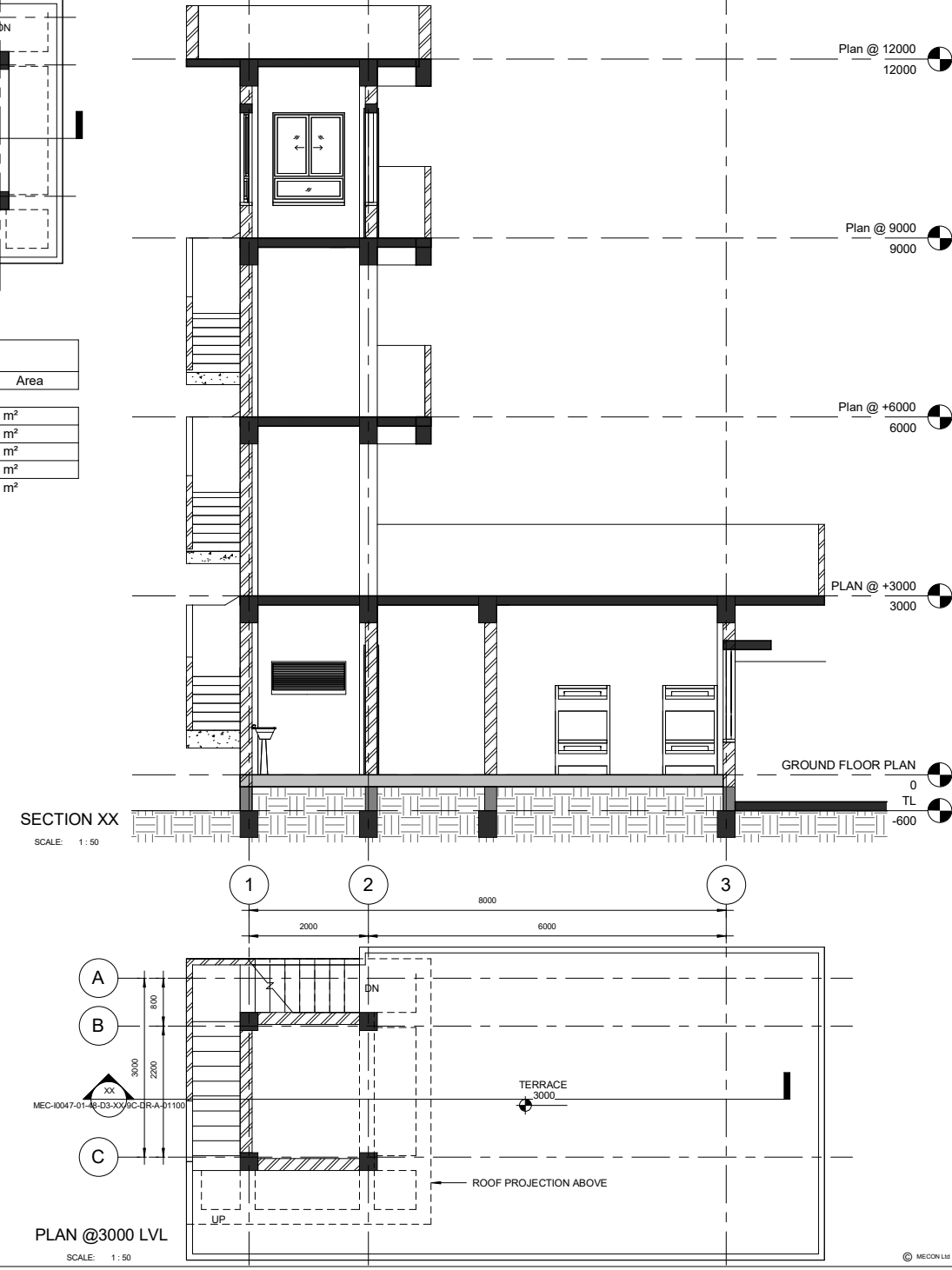
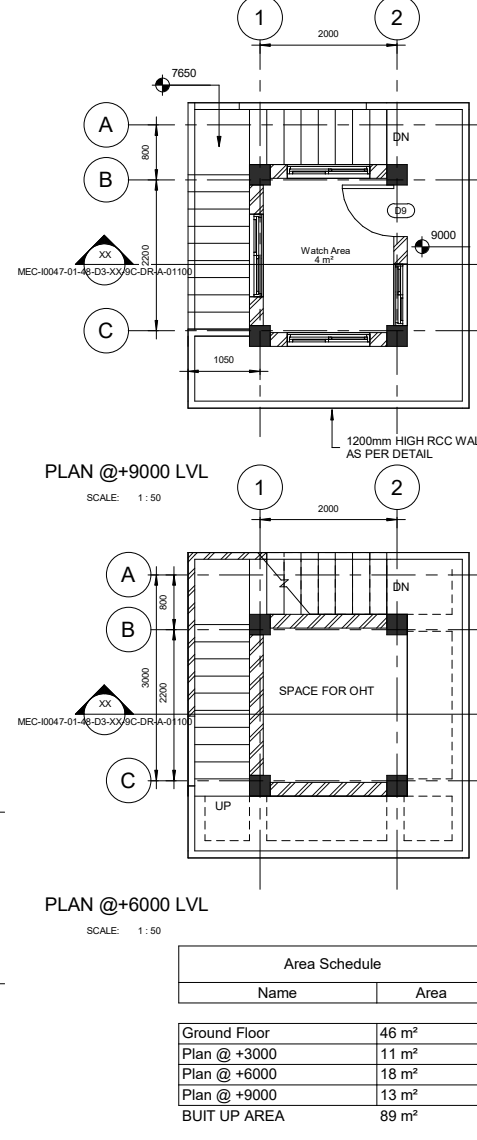
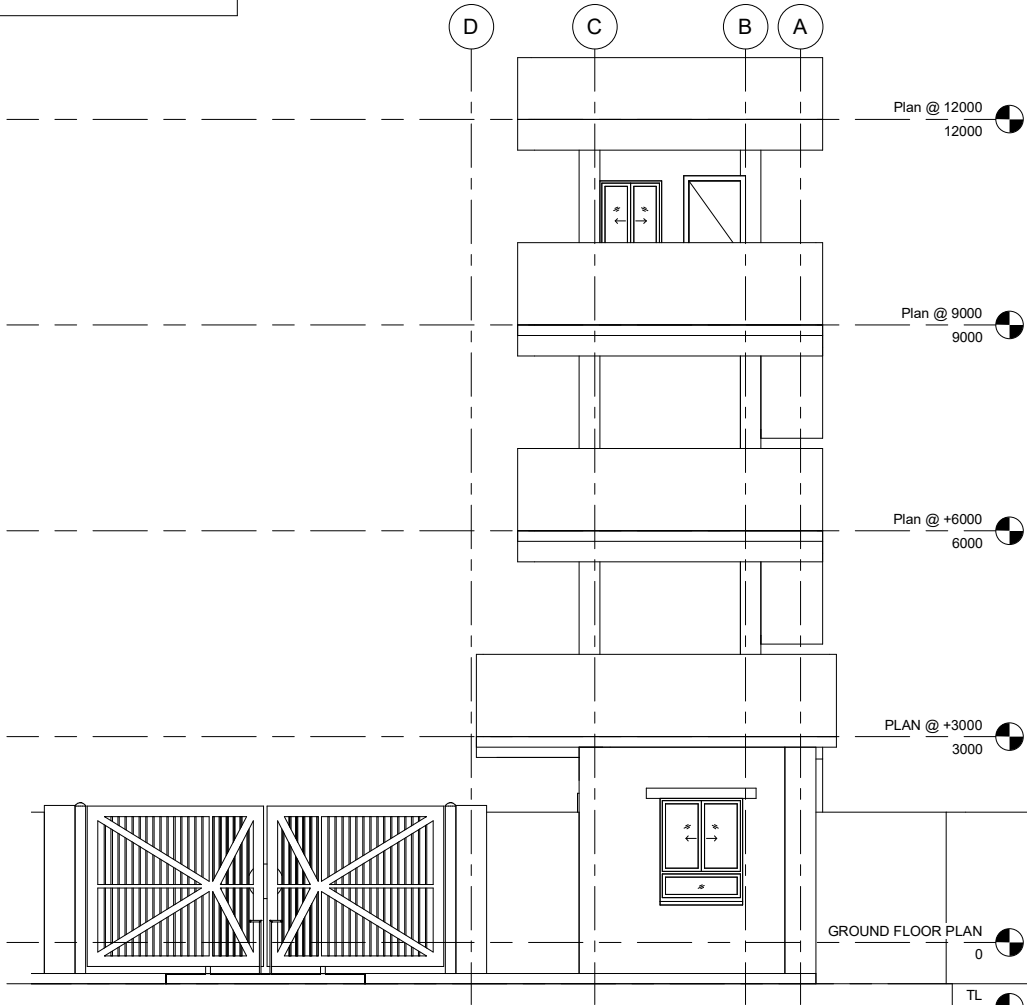
Comprehensive Detailed Project Report (DPR) for Establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh

GATE COMPLEX FOR TRUCK ENTRY / EXIT

MECON LIMITED
BANGALORE

GROUND FLOOR PLAN, SECTION, ELEVATION & VIEWS

DRAWN: THILAGAN	CHECKED: MS BRUNO	REVIEWED: MALAYA	APPROVED: BG SAJJIT
DATE: 06-11-2025		SCALE: 1 : 100	SIZE: A1
REF No.: 5900062340/-G dated 30 July 2025		PROJECT No.: 10047	
DRAWING No.: MEC-0047-01-48-D1-XX-9B-DR-A-01100			REVISION: R01.0



CONCEPT DRAWING



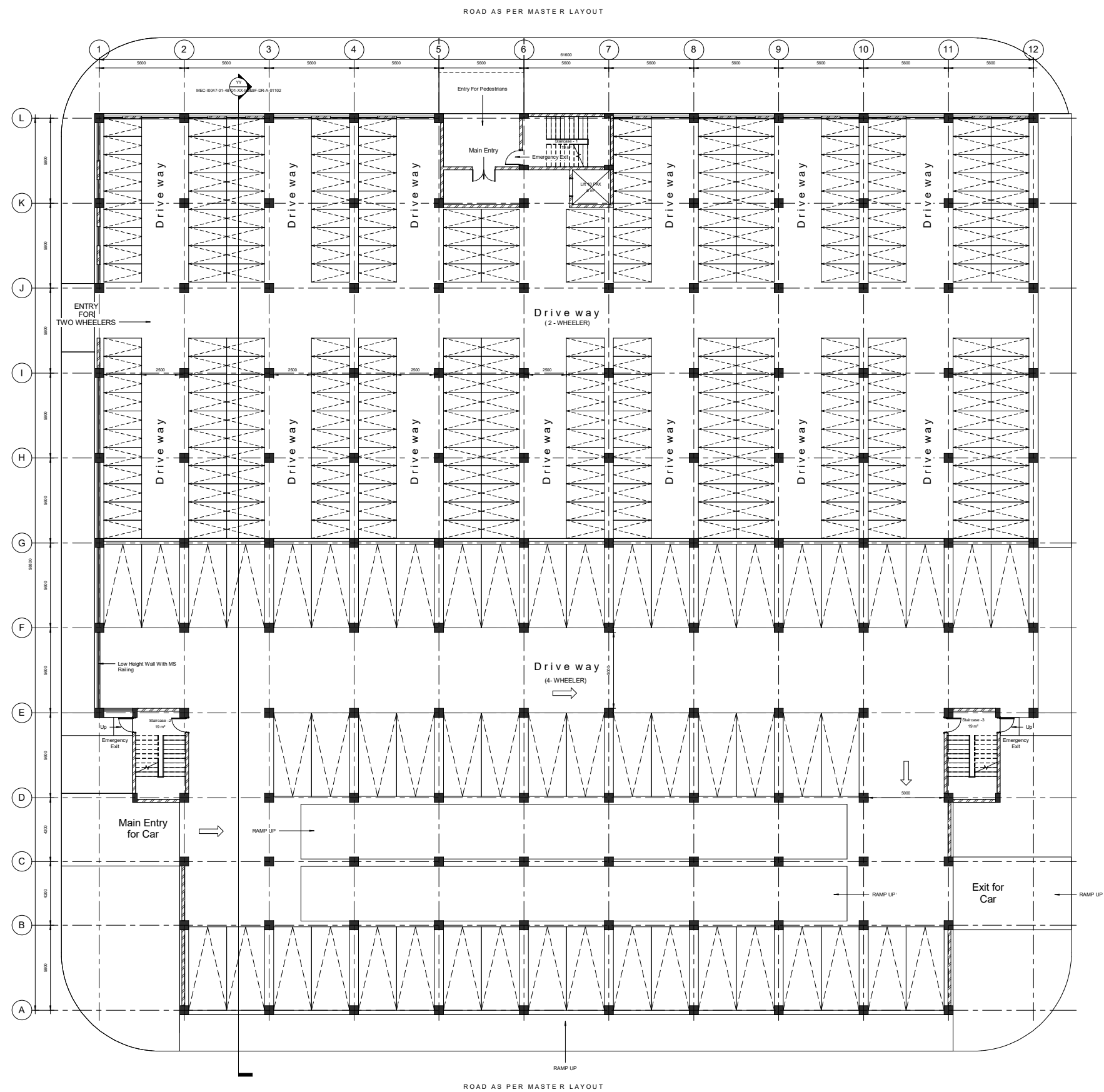
Comprehensive Detailed Project Report (DPR) for Establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh

GATE COMPLEX FOR RAILWAY SIDING



FLOOR PLANS, SECTION, ELEVATION AND 3-D RENDER

DRAWN: THILAGAN	CHECKED: MS BRUNO	REVIEWED: MALAYA	APPROVED: BG SAJIT
DATE: 06-11-2025		SCALE: 1 : 50	SIZE: A1
REF No.: 590062340/0 dated 30 th July 2025		PROJECT No.: 10047	
DRAWING No.: MEC-0047-01-48-D3-XX-9C-DR-A-01100		REVISION:	R01.0



Overall Summary:

Number of 4 Wheelers Planned - 243 Nos
Number of 2 Wheelers Planned - 285 Nos

Number of 4 Wheelers Planned - 54 Nos
Number of 2 Wheelers Planned - 285 Nos

GROUND FLOOR LEVEL

CONCEPT DRAWING

FD-1010-11-25	SUBMITTED FOR APPROVAL			JT	MSB	MM	EGS
REV	DATE	DESCRIPTION		BY	CHK	RVW	APP

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Comprehensive Detailed Project Report (DPR) for Establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh

MULTILEVEL CAR PARKING
(OPTION - 1)

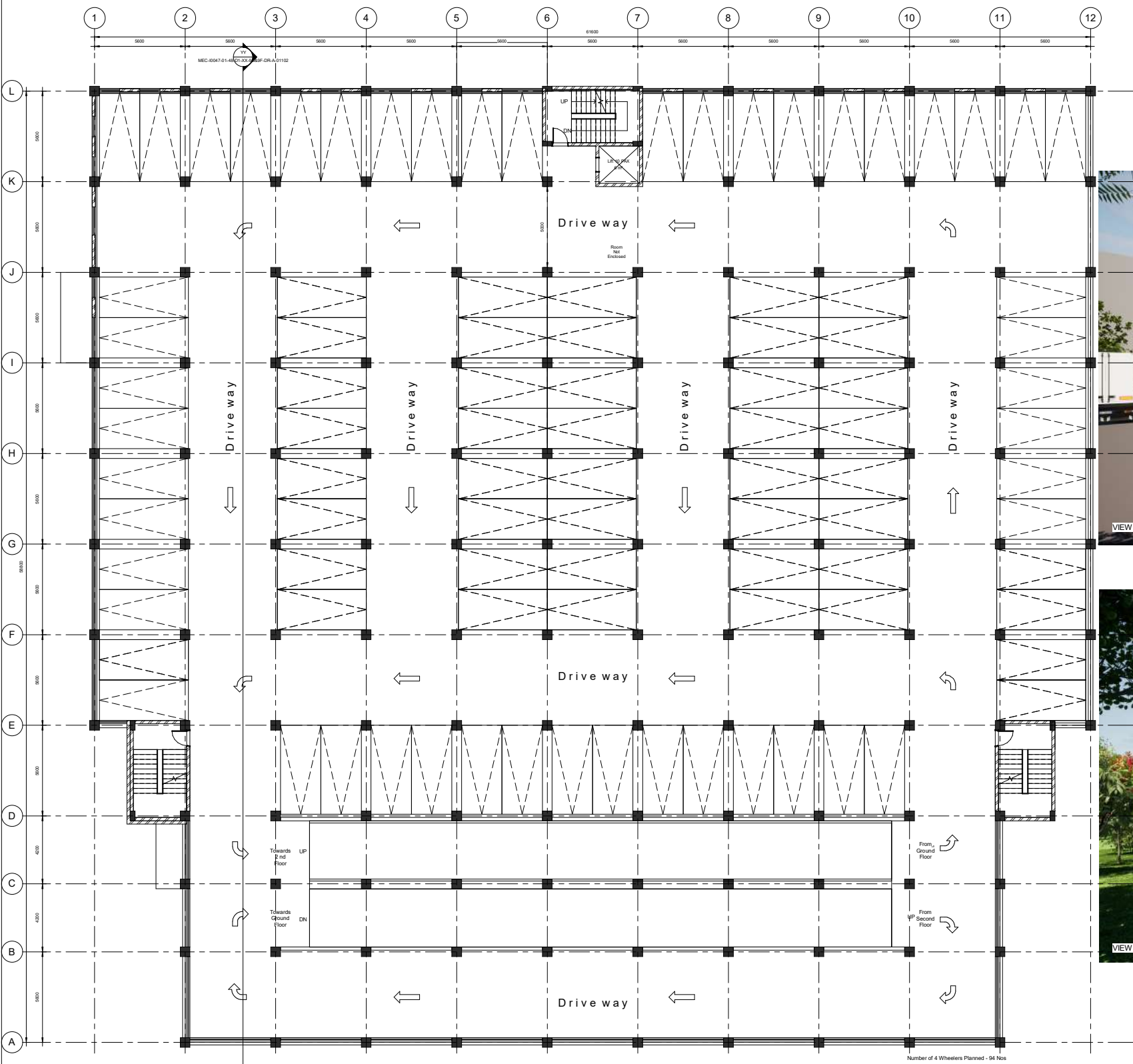


**MECON LIMITED
BANGALORE**

TITLE

GROUND FLOOR PLAN

DRAWN: MS BRUNO	CHECKED: MS BRUNO	REVIEWED: MALAYA	APPROVED: BG SAJIT
DATE: 10-11-2025	SCALE: 1 : 100		SIZE: A0
REF No.: 5900852340-0 dated 30 July 2025		PROJECT No.: DJ134/798T	
DRAWING No.: MEC-10047-01-48-D1-3X-50M5-DR-A-01100			REVISION: R01.0



FIRST FLOOR LEVEL
SCALE: 1:100



BUILT UP AREA SCHEDULE	
Name	Area(Sqm)
GROUND FLOOR	3510
FIRST FLOOR	3510
Area	3224
TOTAL BUILT UP AREA	10244

Number of 4 Wheelers Planned - 94 Nos

CONCEPT DRAWING

REV	DATE	DESCRIPTION	BY	CHK	REV	APP
01	10-11-20	SUBMITTED FOR APPROVAL	JT	MS	MM	BSG

REVISIONS

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Comprehensive Detailed Project Report (DPR) for Establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh

MULTILEVEL CAR PARKING
(OPTION - 1)

 **MECON LIMITED
BANGALORE**

TITLE
FIRST FLOOR PLAN & VIEWS

DRAWN THEAGAN	CHECKED MS BRUNO	REVIEWED MALAYA	APPROVED BO BALIT
DATE 10-11-2020	SCALE 1:100	DATE 10-11-2020	SCALE 1:100

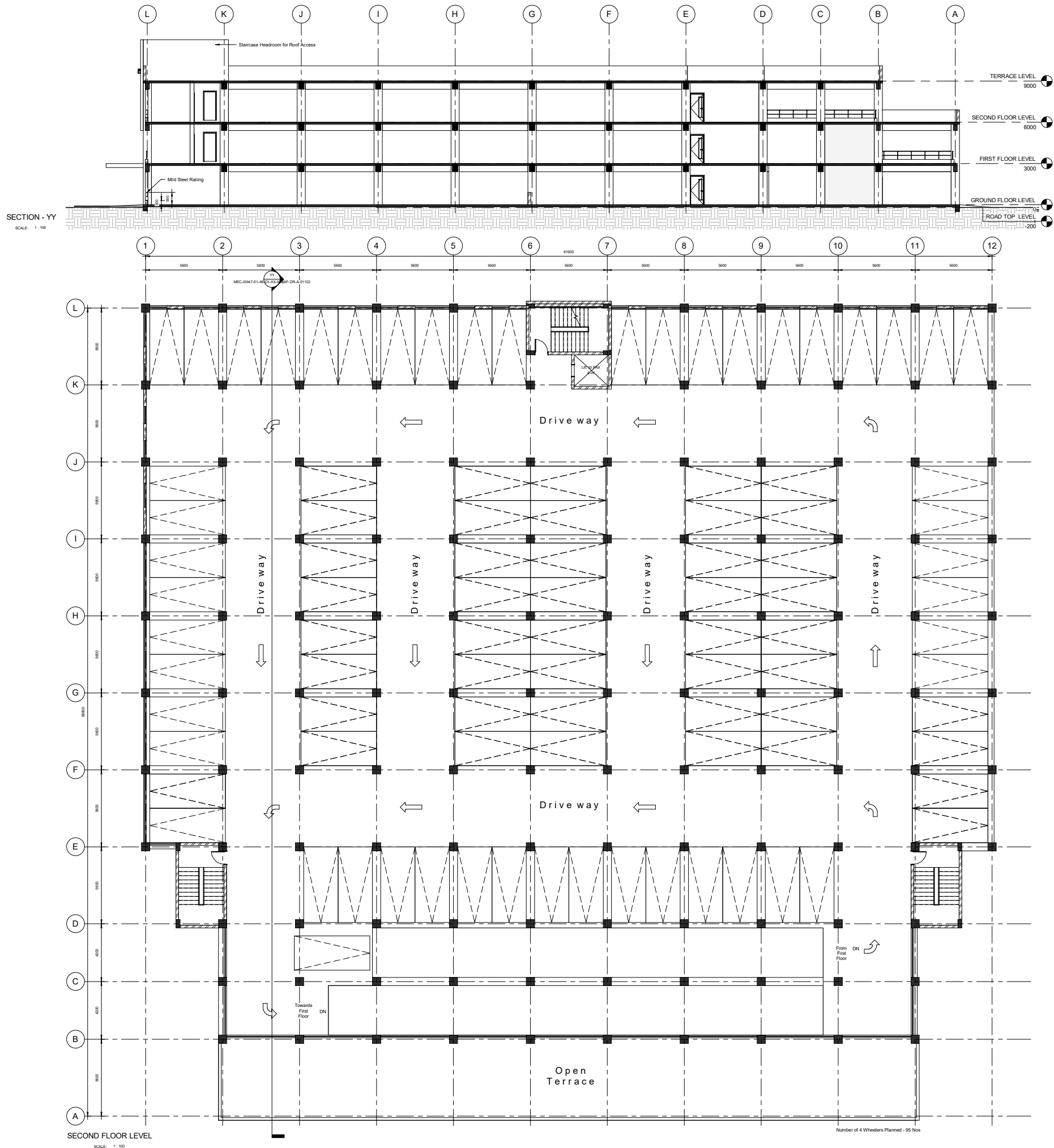
REF No. 00002440-2-0000-20-204
2020

PROJECT No. 01/04/7087

DRAWING No. MEC-0047-01-4B-D1-00-0000F-DRA-01101

REVISION

REV 0



CONCEPT DRAWING

REV	DATE	DESCRIPTION	BY	CHK	REV	APP
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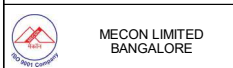
REVISIONS

CLIENT



Comprehensive Detailed Project Report (DPR) for Establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh

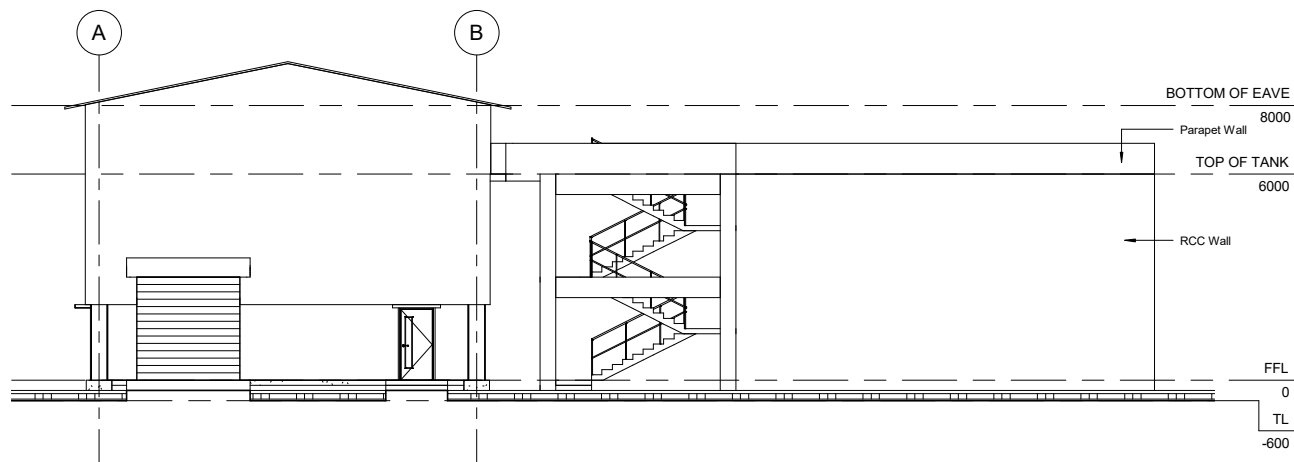
MULTILEVEL CAR PARKING
(OPTION - 1)



TITLE
SECOND FLOOR PLAN & SECTION

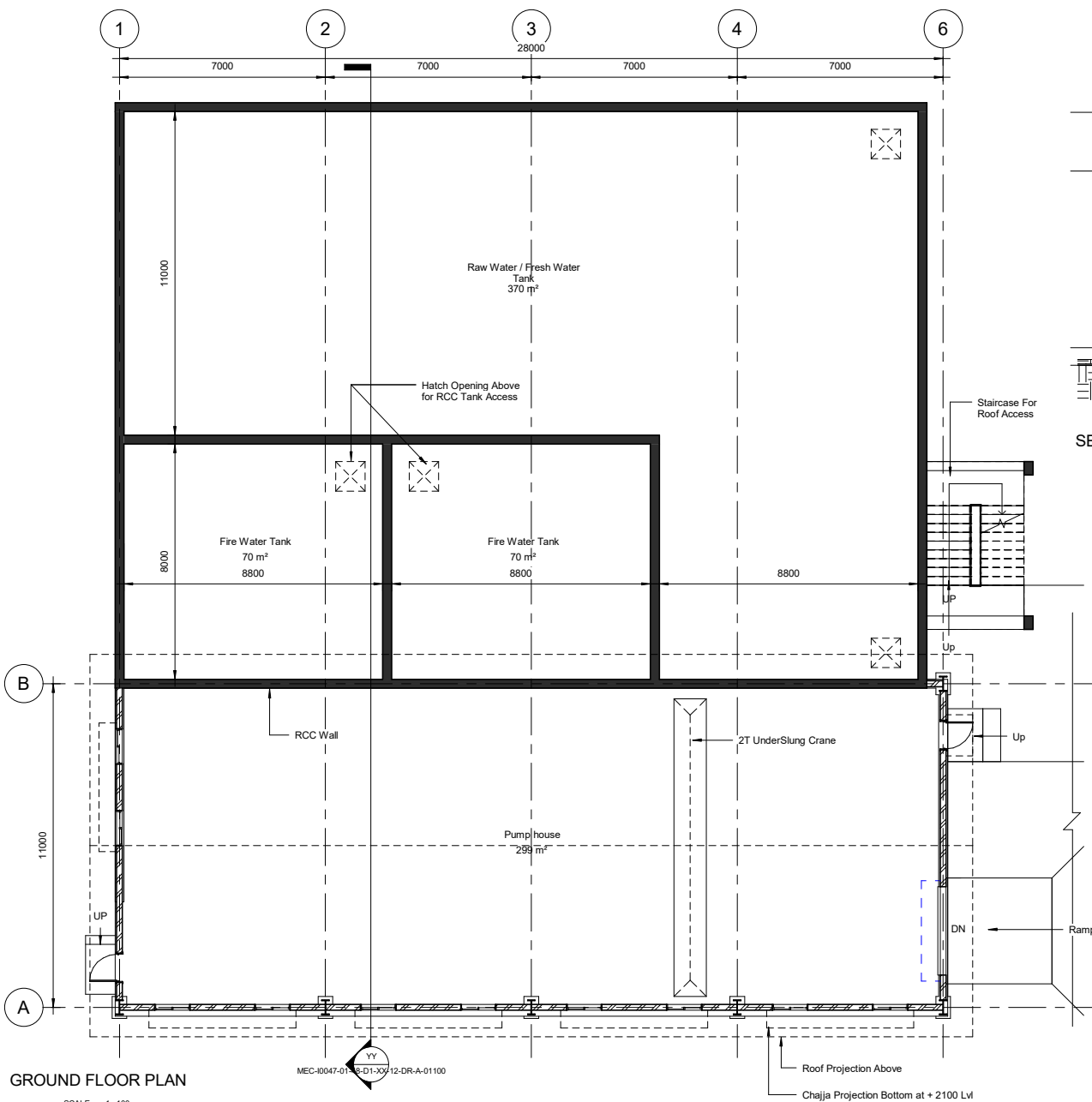
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DATE	10/11/2020	SCALE	1 : 100
REF No.	200002240-2 (and 3) 24/01/2020	PROJECT No.	01/04/7987

DRAWING No. MEC-10047-01-45-D1-00-0000F-DRA-01102



ELEVATION ALONG GRID 6

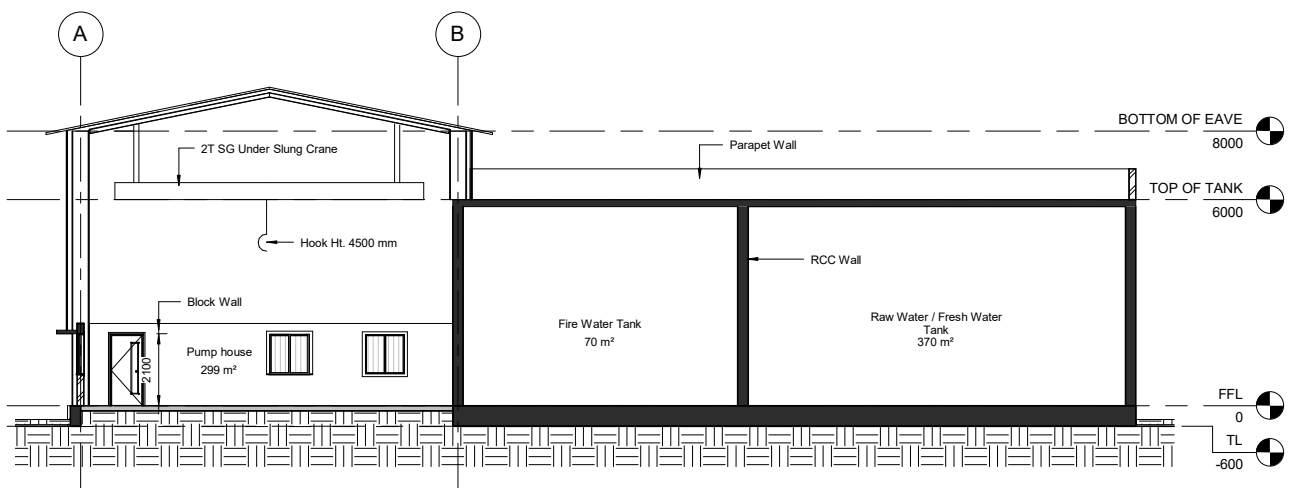
SCALE: 1 : 100



GROUND FLOOR PLAN

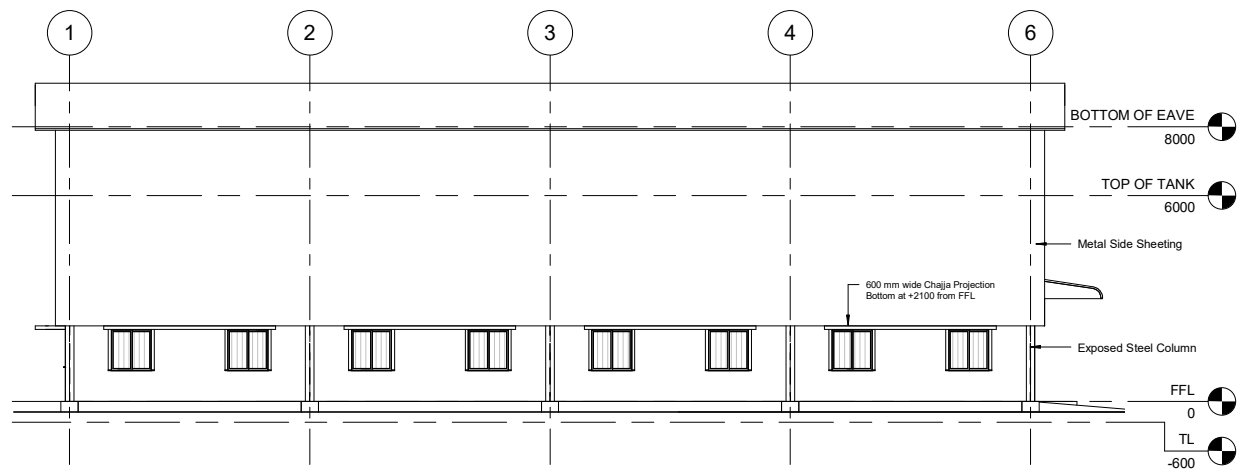
SCALE: 1 : 100

MEC-0047-01-48-D1-XX-12-DR-A-01100



SECTION - YY

SCALE: 1 : 100



ELEVATION ALONG GRID A

SCALE: 1 : 100

Area Schedule (Gross Building)	
Name	Area
FLOOR AREA	545 m²
TANK AREA	314 m²
TOTAL BUILT UP AREA	859 m²

CONCEPT DRAWING

REV	DATE	DESCRIPTION	BY	CHK	R/W	APP
REVISIONS						

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Comprehensive Detailed Project Report (DPR) for Establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh

DOMESTIC AND FIRE WATER
PUMP HOUSE AND SUMP
BUILDING



**GROUND FLOOR PLAN, ELEVATIONS,
SECTION & VIEW**

DRAWN: MS BRUNO	CHECKED: MS BRUNO	REVIEWED: MALAYA	APPROVED: BG SAJIT
DATE: 27/11/2025	SCALE: 1 : 100		SIZE: A1

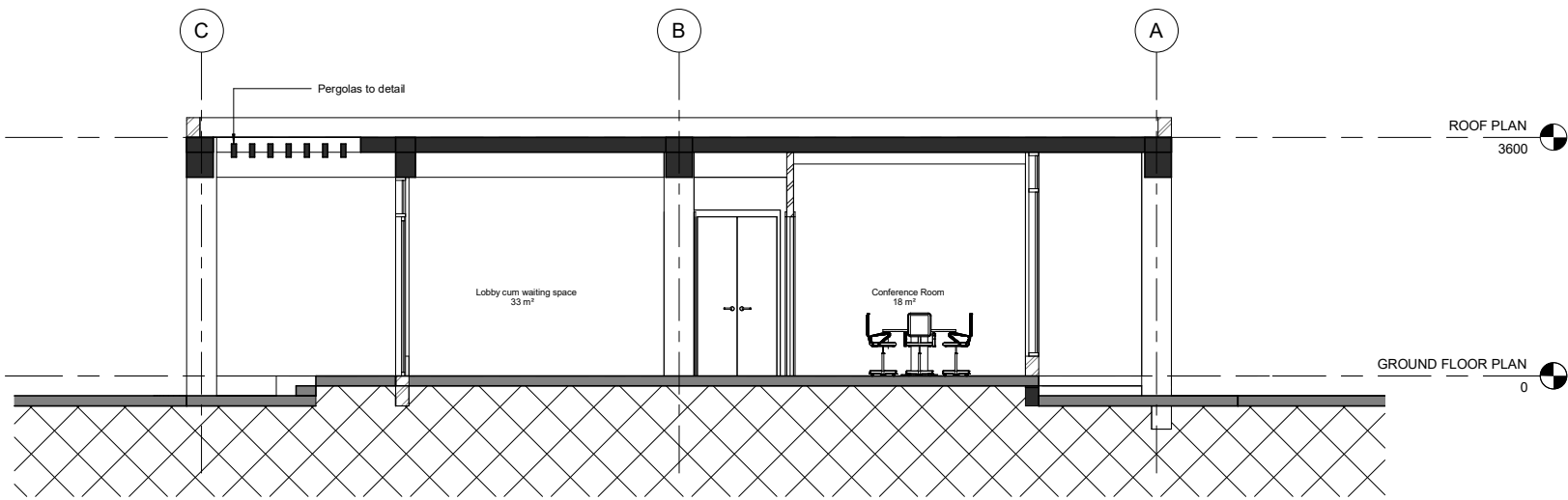
REF No.: 5900062340-0 dated 30 July 2025

PROJECT No.: 10047

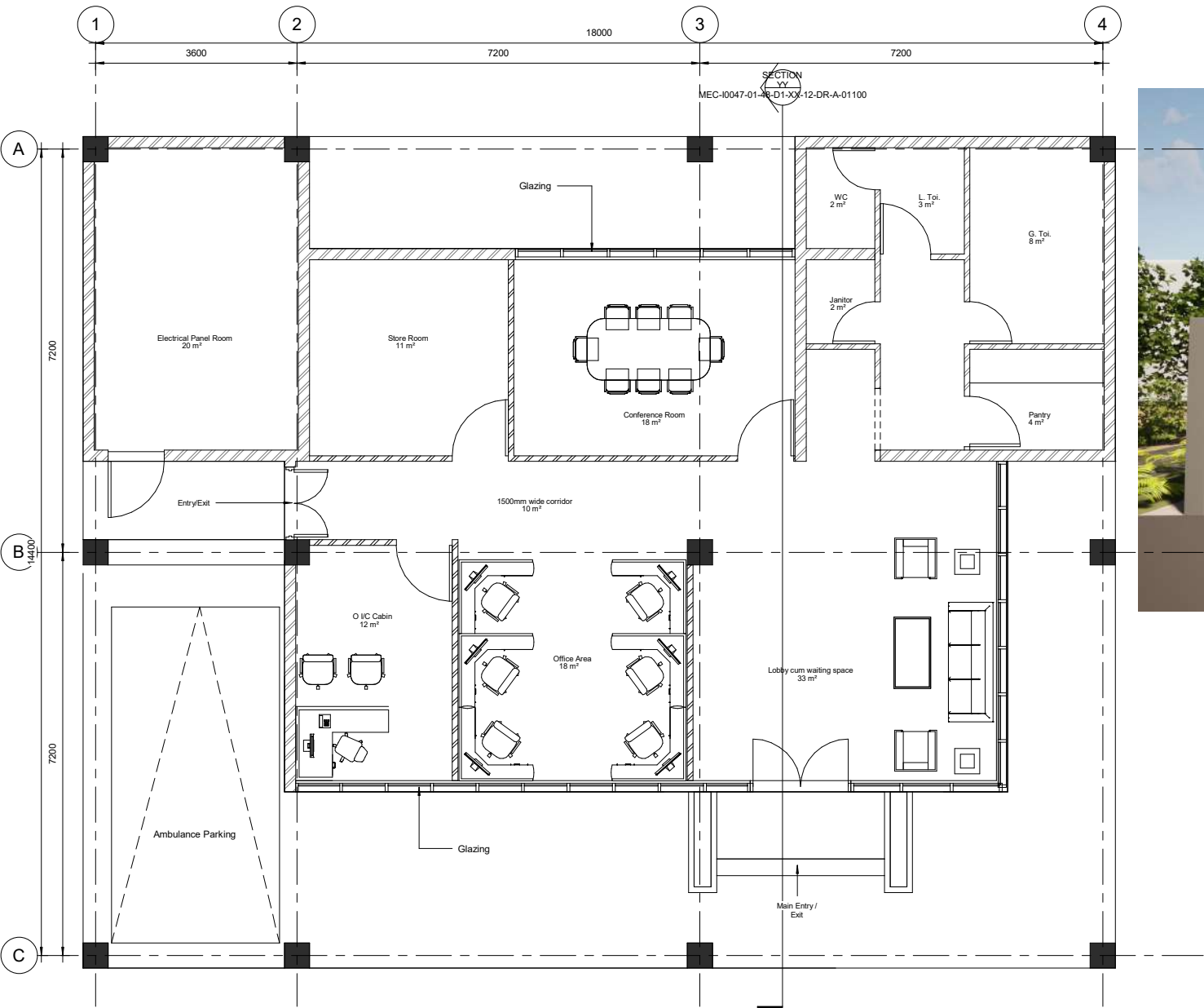
DRAWING No.: MEC-0047-01-48-D1-XX-12-DR-A-01100

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R01.0



SECTION YY
SCALE: 1 : 50



GROUND FLOOR PLAN
SCALE: 1 : 50



Area Schedule (Gross Building)	
Level	Area
GROUND FLOOR PLAN	274 m²
TOTAL BUILT UP AREA	274 m²

CONCEPT DRAWING

REV	DATE	DESCRIPTION	BY	CHK	R/W	APP

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Comprehensive Detailed Project Report (DPR) for Establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh

SAFETY OFFICE

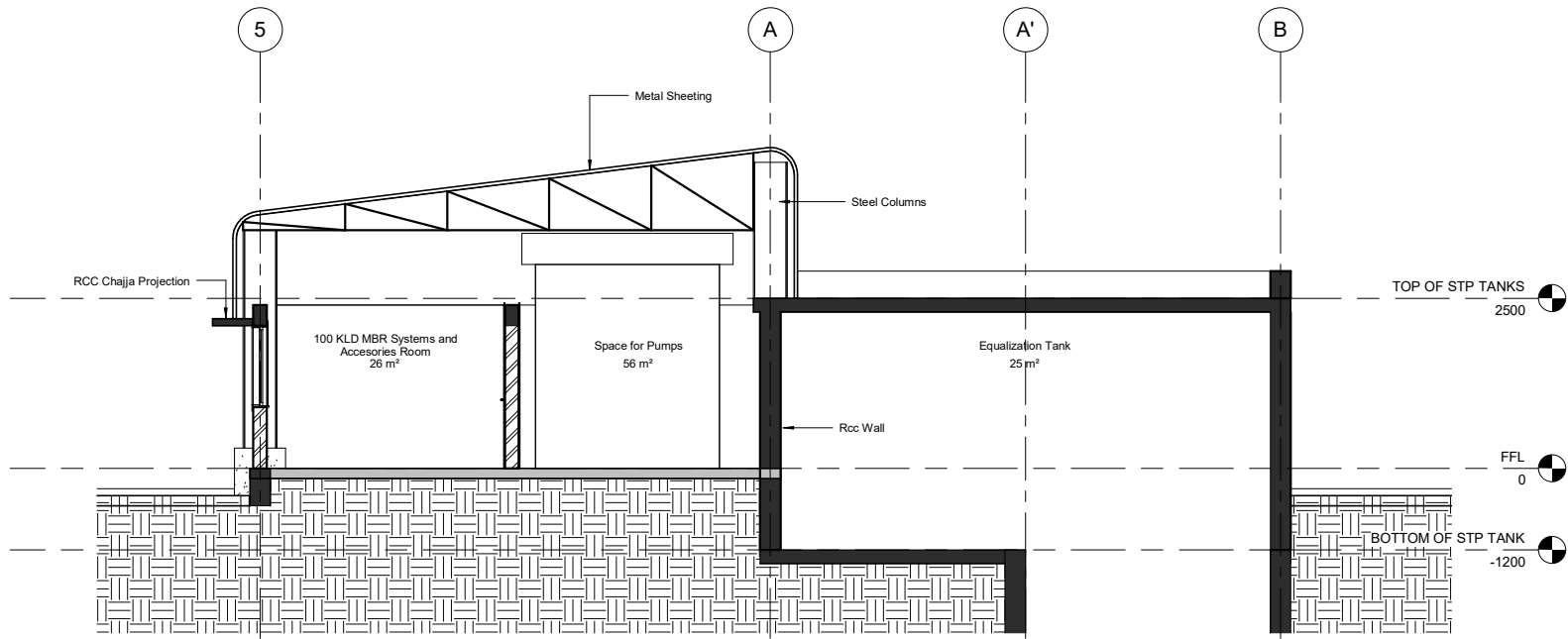
MECON LIMITED
BANGALORE

TITLE
GROUND FLOOR PLAN, SECTION & 3D RENDER

DRAWN: THILAGAN	CHECKED: MS BRUNO	REVIEWED: MALAYA	APPROVED: BG SAJJIT
DATE: 13-11-2025	SCALE: 1 : 50	SIZE: A1	

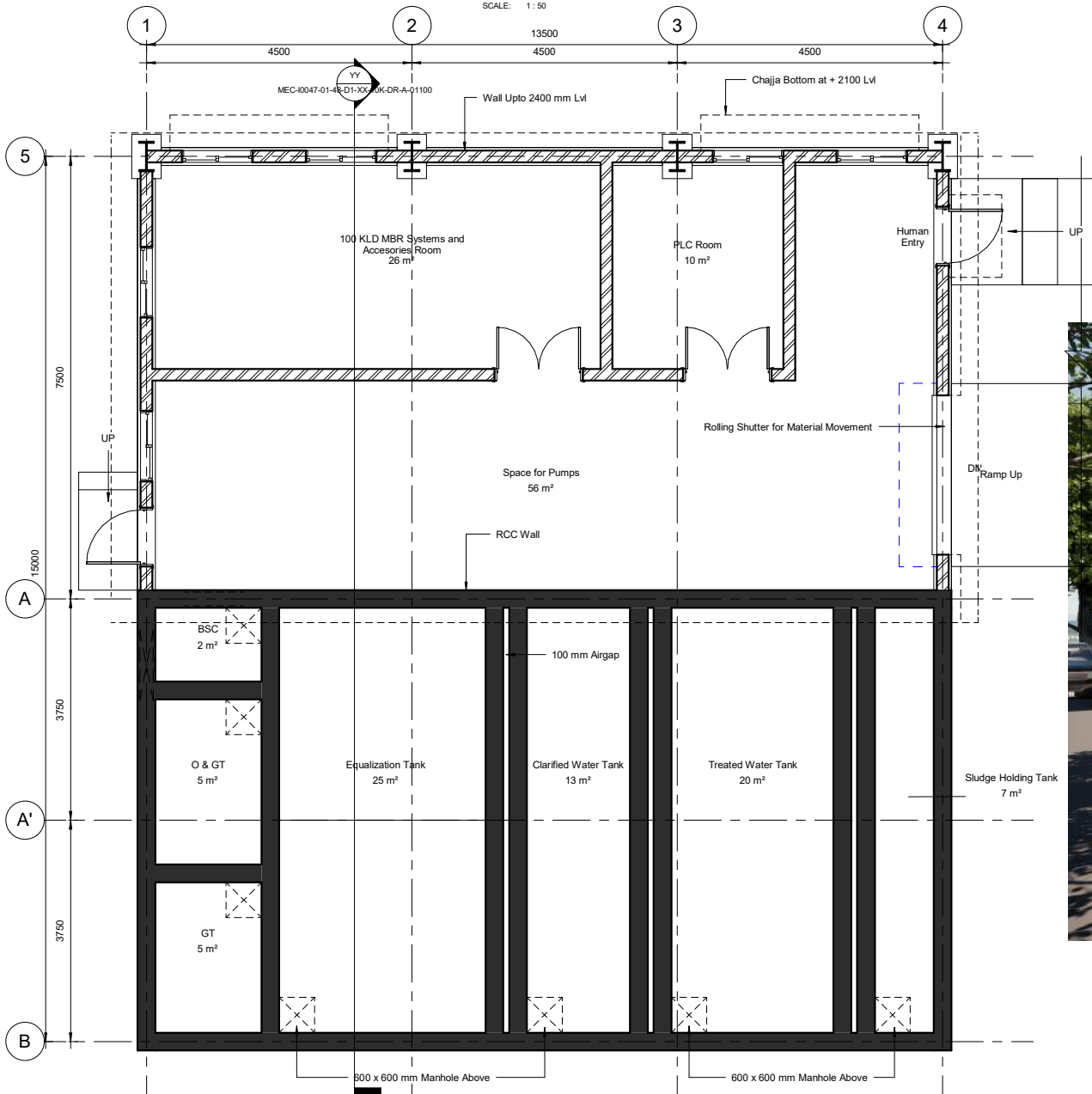
REF No.: 0000023401 dated 30 July 2020 PROJECT No.: DJ1034/798T

DRAWING No.: MEC-0047-01-48-D1-XX-12-DR-A-01100	REVISION: R01.0



SECTION - YY

SCALE: 1 : 50



GROUND FLOOR PLAN

SCALE: 1 : 50

Area Schedule (Gross Building)	
Name	Area
FLOOR AREA	104 m²
TANK AREA	108 m²
TOTAL BUILT UP AREA	211 m²



CONCEPT DRAWING

REV	DATE	DESCRIPTION	BY	CHK	R/W	APP

REV	DATE	DESCRIPTION	BY	CHK	R/W	APP

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Comprehensive Detailed Project Report (DPR) for Establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh

100 KLD MBR BASED STP BUILDING



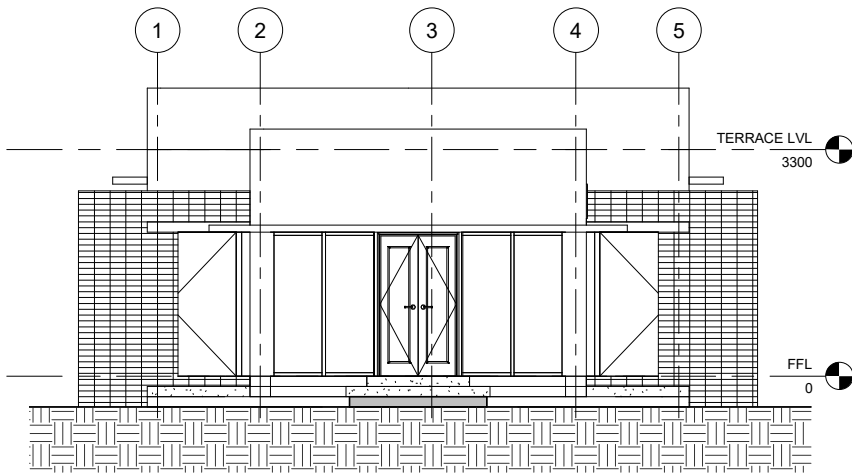
MECON LIMITED
BANGALORE

TITLE
GROUND FLOOR PLAN , SECTION & VIEW

DRAWN: MS BRUNO	CHECKED: MS BRUNO	REVIEWED: MALAYA	APPROVED: BG SAJJIT
DATE: 12/07/24	SCALE: 1 : 50	SIZE: A1	

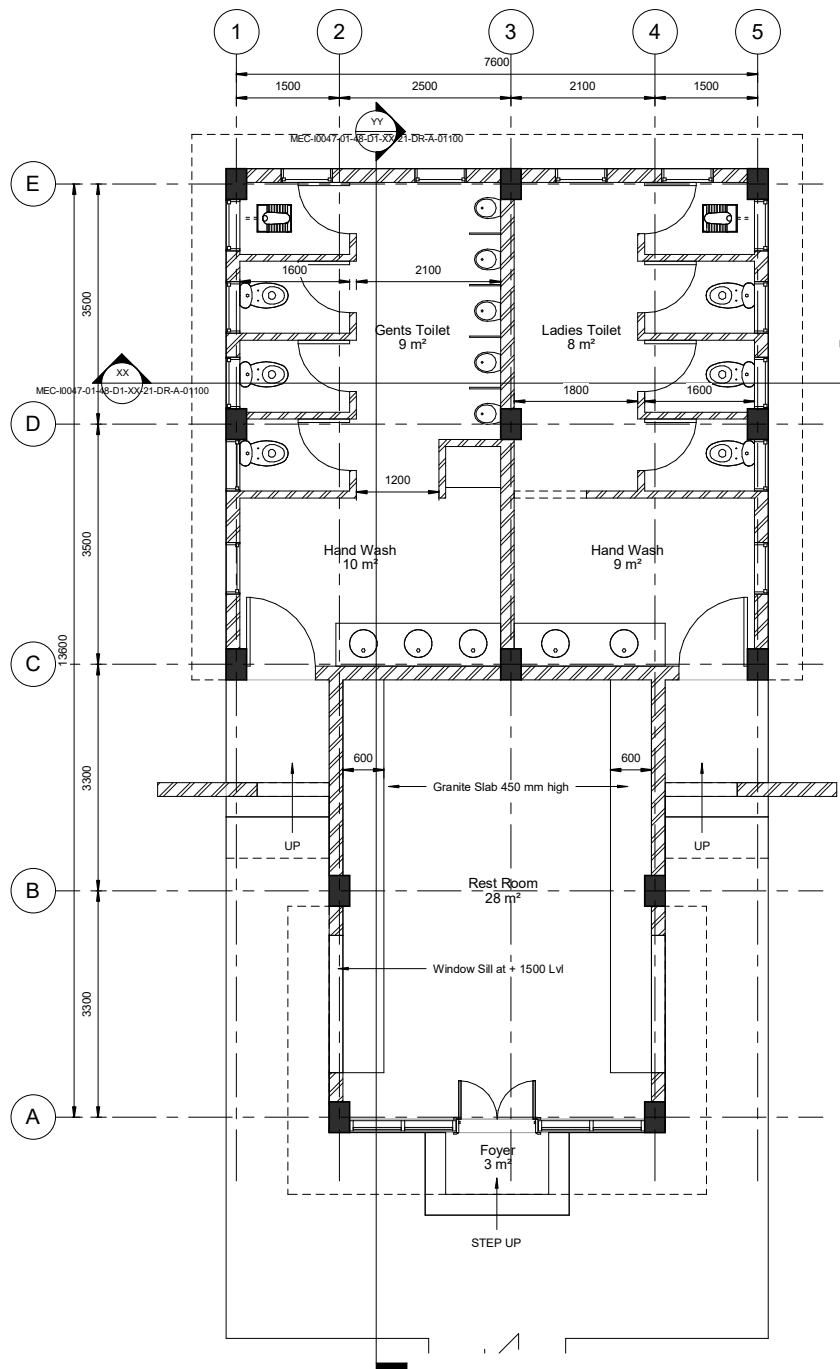
REF No.: 5900062340-0 dated 30 July 2025	PROJECT No.: 10047

DRAWING No.: MEC-0047-01-48-D1-XX-10K-DR-A-01100	REVISION:



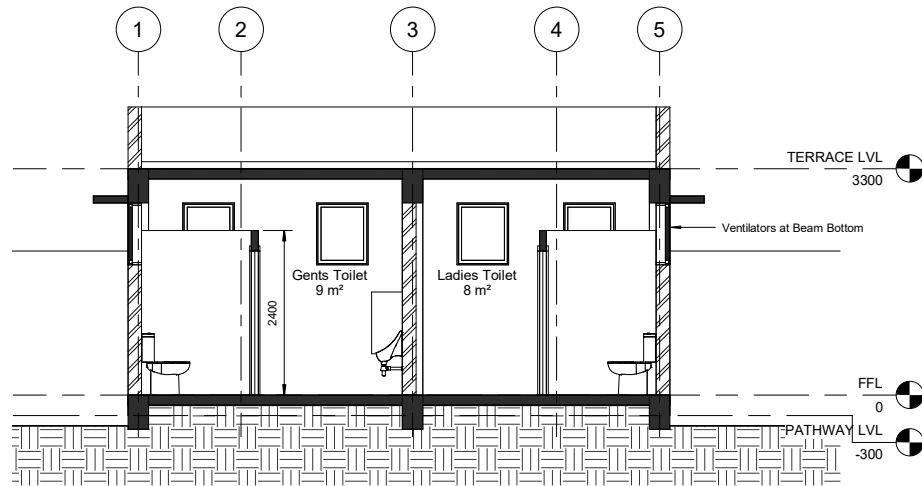
ELEVATION ALONG GRID - A

SCALE: 1 : 50



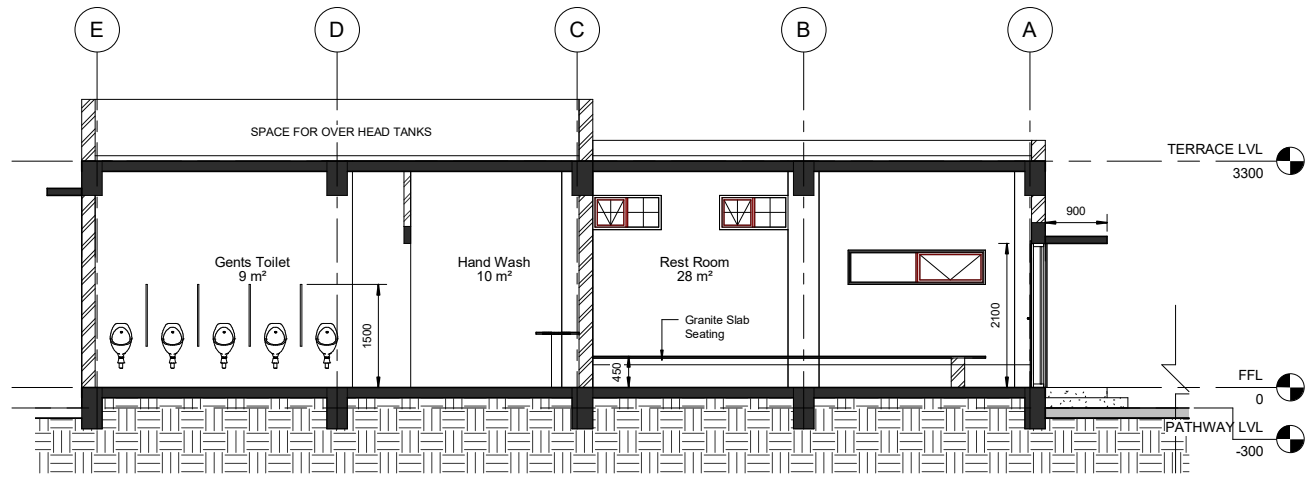
GROUND FLOOR PLAN

SCALE: 1 : 50



SECTION - XX

SCALE: 1 : 50



SECTION - YY

SCALE: 1 : 50

Area Schedule (Gross Building)	
Name	Area
FLOOR AREA	96 m²
TOTAL BUILT UP AREA	96 m²

CONCEPT DRAWING



Comprehensive Detailed Project Report (DPR) for Establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh

TOILET BLOCK AND RESTROOM AT PARKING AREA

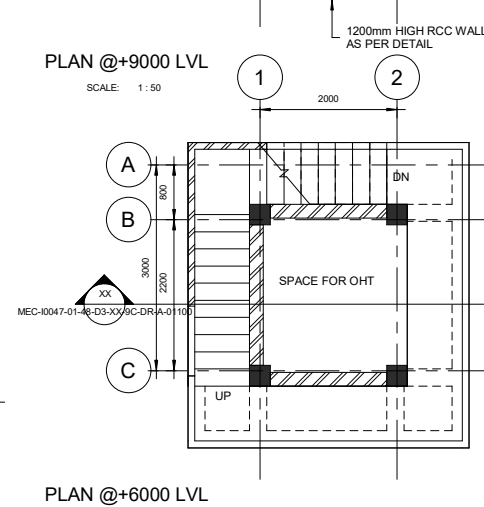
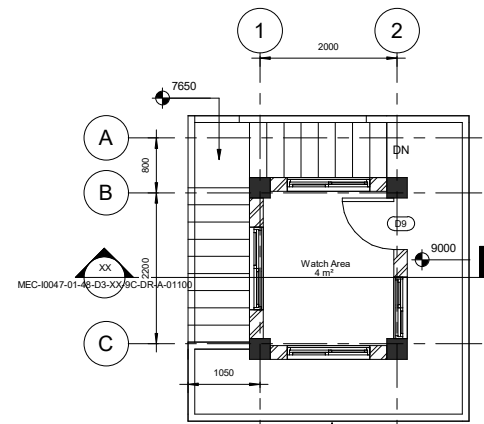
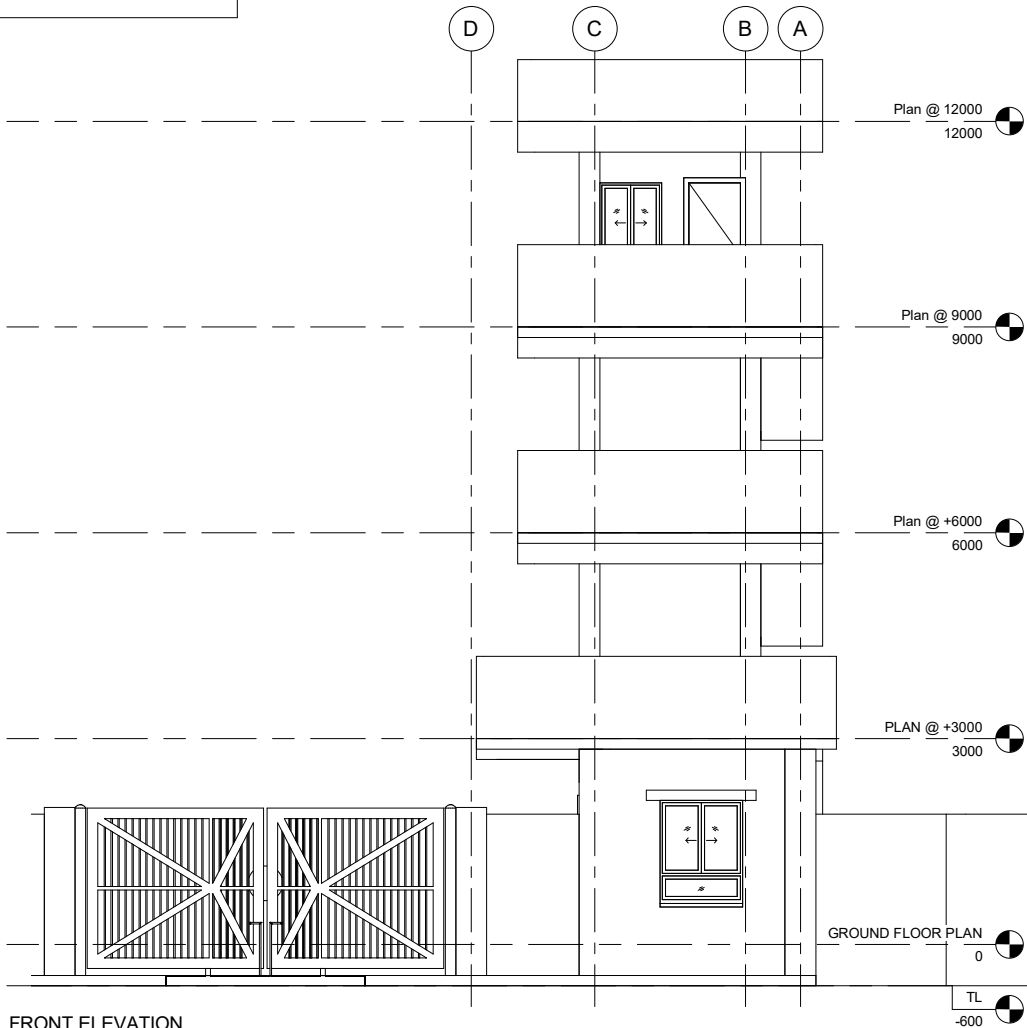


GROUND FLOOR PLAN, ELEVATION, SECTIONS AND VIEW

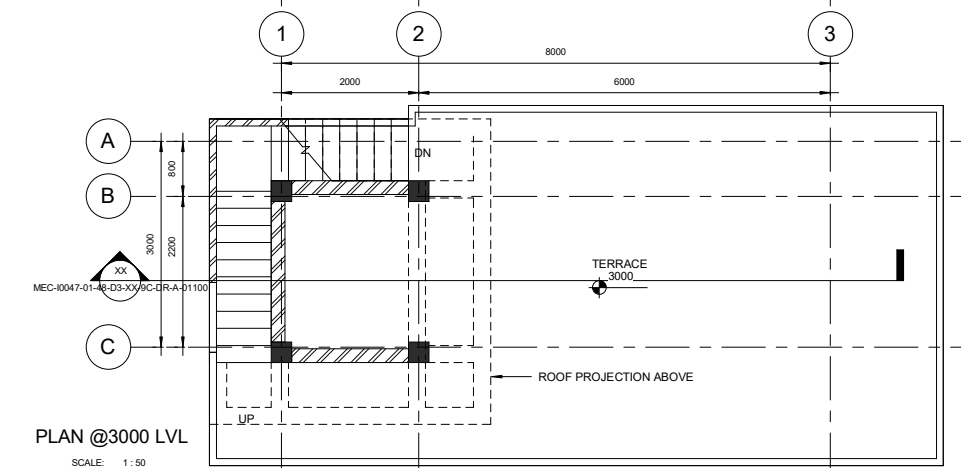
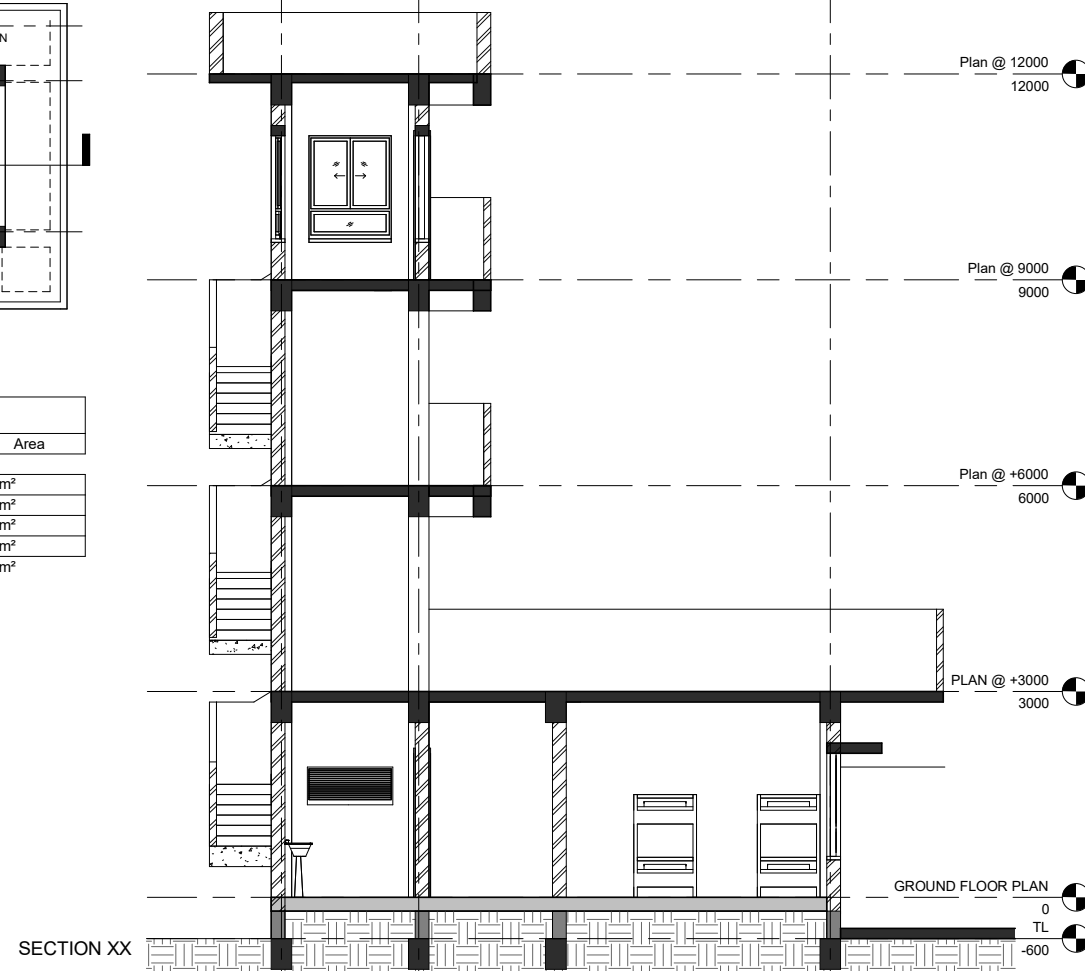
DRAWN: MS BRUNO	CHECKED: MS BRUNO	REVIEWED: MALAYA	APPROVED: BG SAJJIT
DATE: 10/04/25		SCALE: 1 : 50	SIZE: A1

REF No.: 5900062340-0 dated 30 July 2025

DRAWING No.: MEC-0047-01-48-D1-XX-21-DR-A-01100	REVISION:



Area Schedule	
Name	Area
Ground Floor	46 m ²
Plan @ +3000	11 m ²
Plan @ +6000	18 m ²
Plan @ +9000	13 m ²
BUILT UP AREA	89 m ²



CONCEPT DRAWING



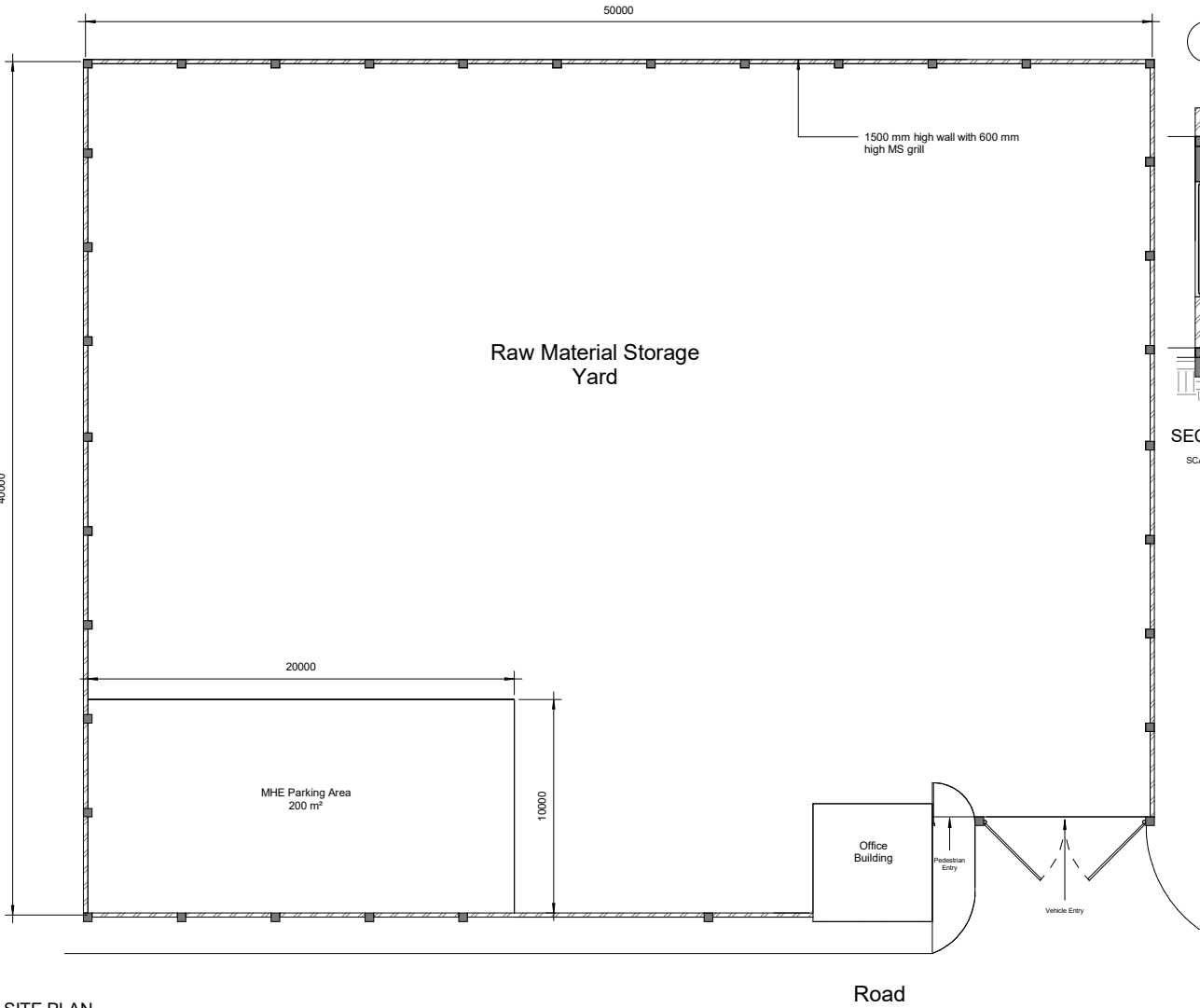
Comprehensive Detailed Project Report (DPR) for Establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh

GATE COMPLEX FOR RAILWAY SIDING



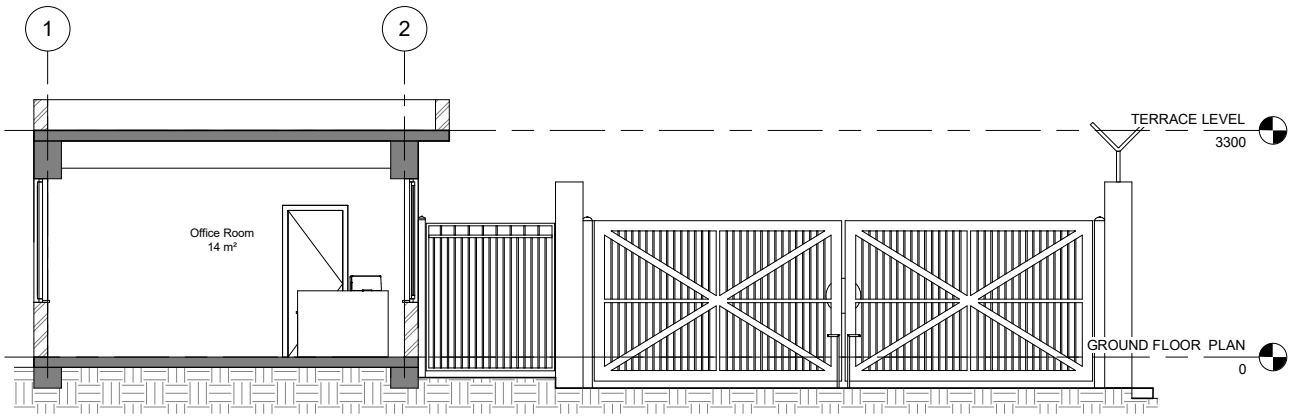
FLOOR PLANS, SECTION, ELEVATION AND 3-D RENDER

DRAWN: THILAGAN	CHECKED: MS BRUNO	REVIEWED: MALAYA	APPROVED: BG SAJIT
DATE: 06-11-2025	SCALE: 1 : 50	SIZE: A1	
REF No.: 590062340/G dated 30 th July 2025	PROJECT No.: 10047		
DRAWING No.: MEC-0047-01-48-D3-XX-9C-DR-A-01100	REVISION:		



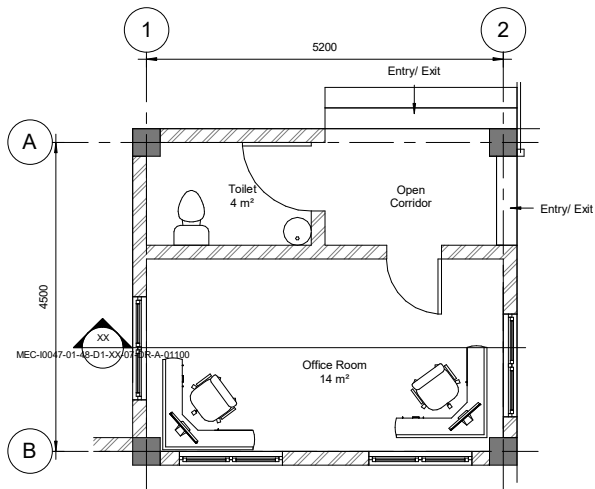
SITE PLAN

SCALE: 1:150



SECTION XX

SCALE: 1:50



FLOOR PLAN - OFFICE AREA

SCALE: 1:50

Area Schedule (Gross Building)	
Name	Area
OFFICE GROUND FLOOR	41 m ²

CONCEPT DRAWING

REV	DATE	DESCRIPTION	BY	CHK	R/W	APP
R02.0	27-11-2025	FOR DPR SUBMISSION	JT	MSB	MM	BOS
R01.0	15-11-2025	SUBMITTED FOR APPROVAL	JT	MSB	MM	BOS

REV	DATE	DESCRIPTION	BY	CHK	R/W	APP

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Comprehensive Detailed Project Report (DPR) for Establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh

RAW MATERIAL STORAGE YARD

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SITE PLAN, OFFICE FLOOR PLAN, SECTION & 3D RENDER

DRAWN: THILAGAN	CHECKED: MS BRUNO	REVIEWED: MALAYA	APPROVED: BG SAJIT
DATE: 15-11-2025	SCALE: As Indicated	SIZE: A1	

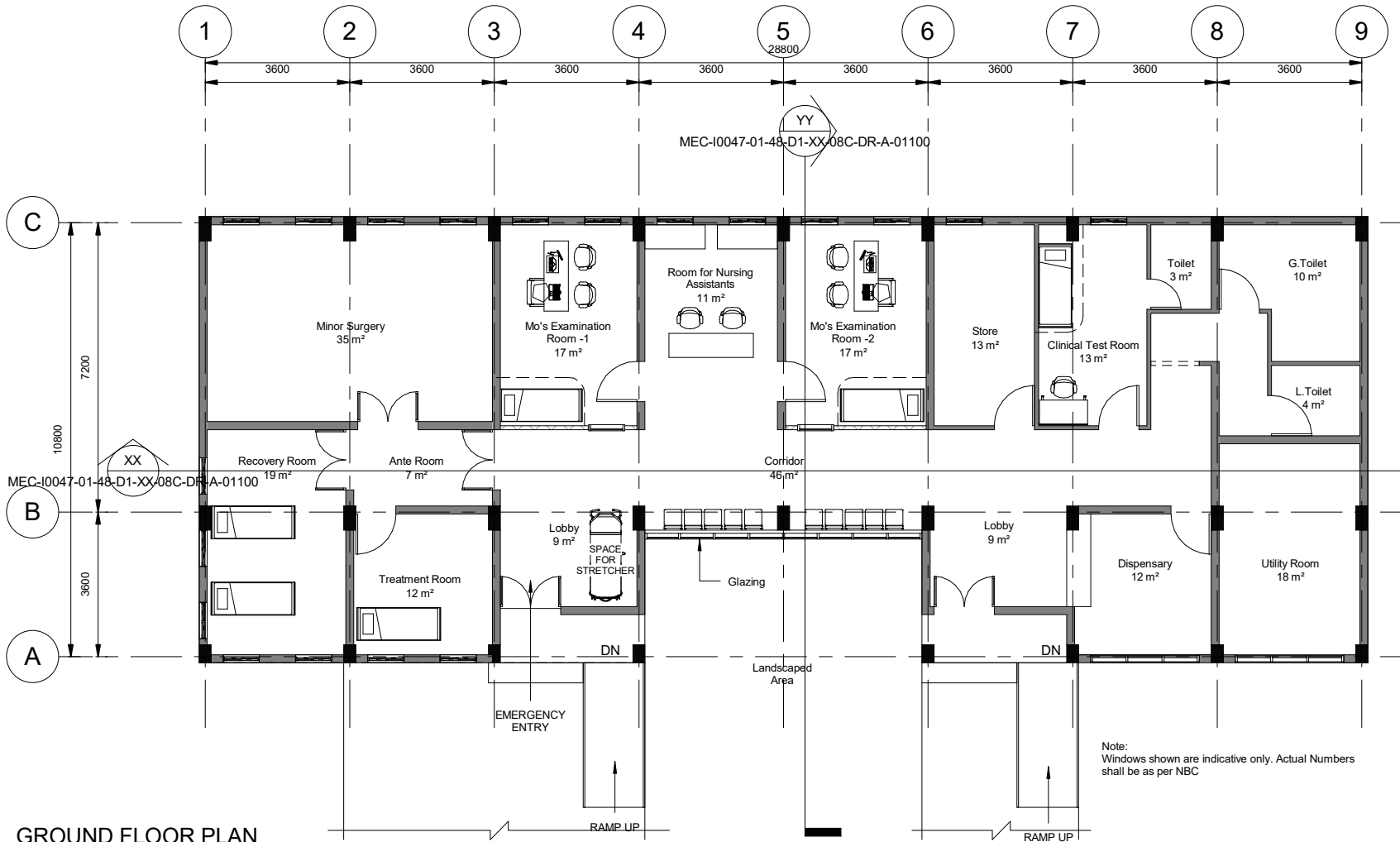
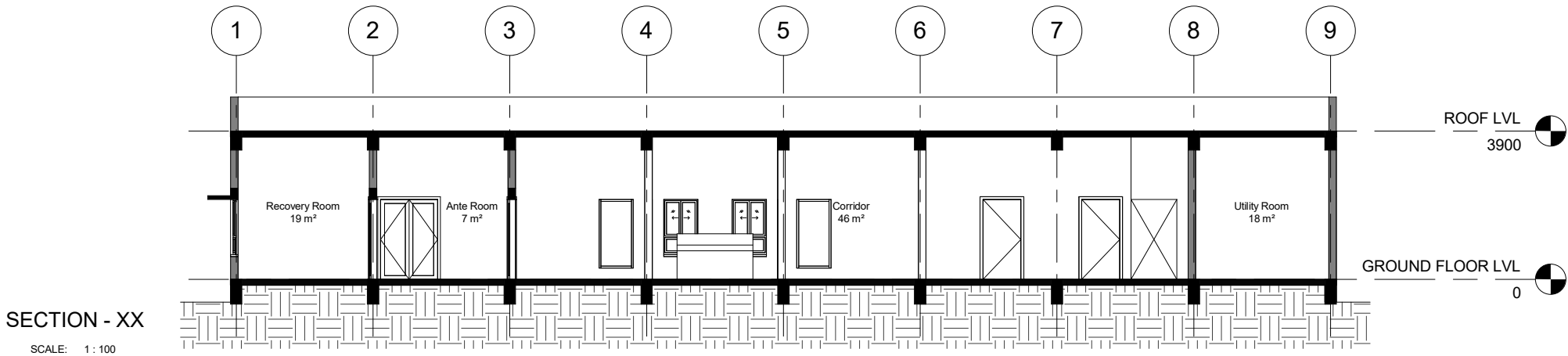
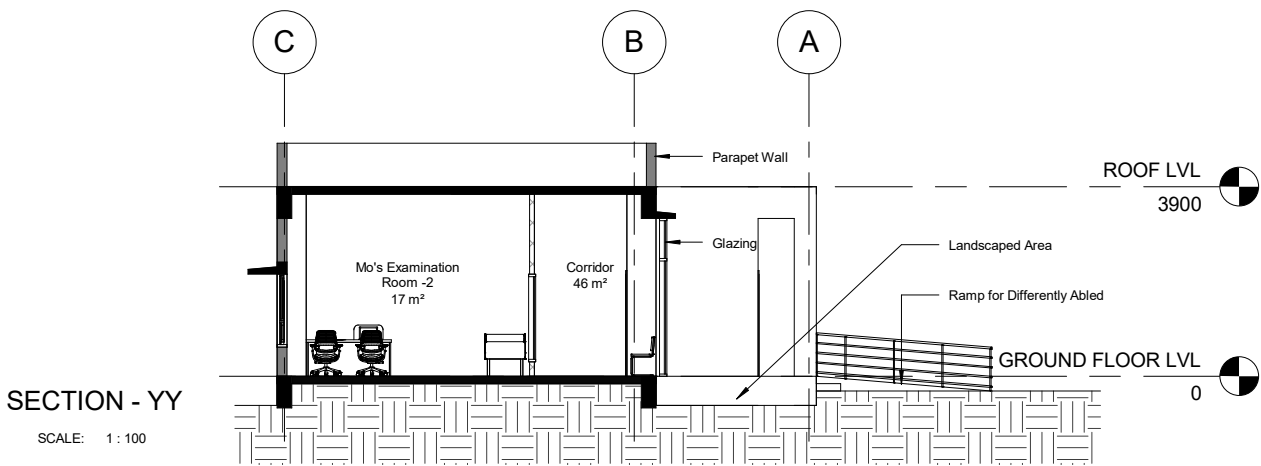
REF No.: 590062340/-0 dated 30 July 2025	PROJECT No.: DJ1034/798T
DRAWING No.: MEC-0047-01-48-D1-XX-07-DR-A-01100	REVISION: R02.0



FRONT VIEW OF OFFICE BUILDING



FRONT VIEW



Area Schedule	
Level	Area
GROUND FLOOR LVL	300 m²
TOTAL BUILTUP AREA	300 m²

Note:
Windows shown are indicative only. Actual Numbers
shall be as per NBC

CONCEPT DRAWING

REV	DATE	DESCRIPTION	BY	CHK	RWV	APP
R01.0	21-10-25	SUBMITTED FOR APPROVAL	MSB	MSB	MM	BGS

REVISIONS

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Comprehensive Detailed Project Report (DPR) for Establishing a State-of-the-Art Greenfield Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh

MEDICAL CENTRE

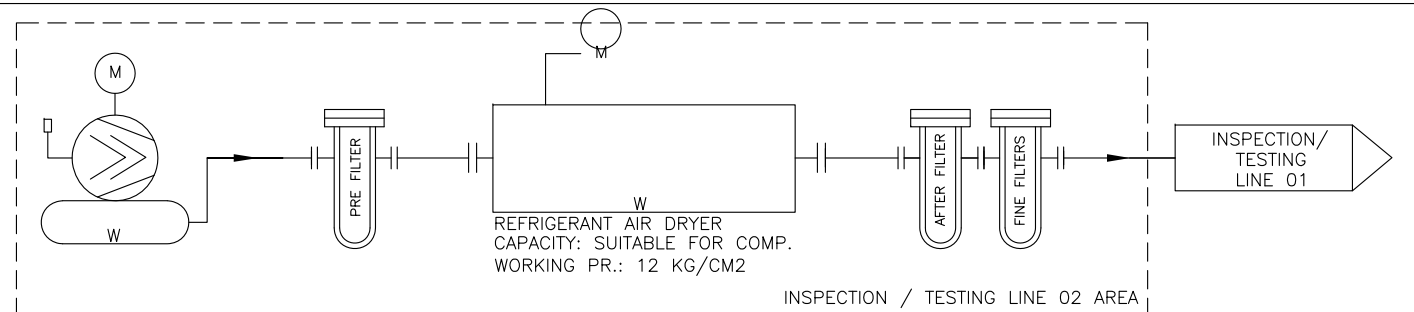
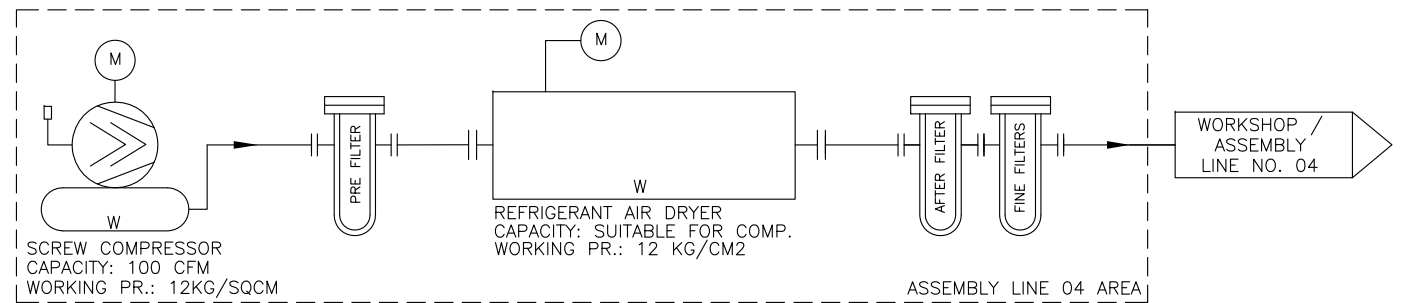
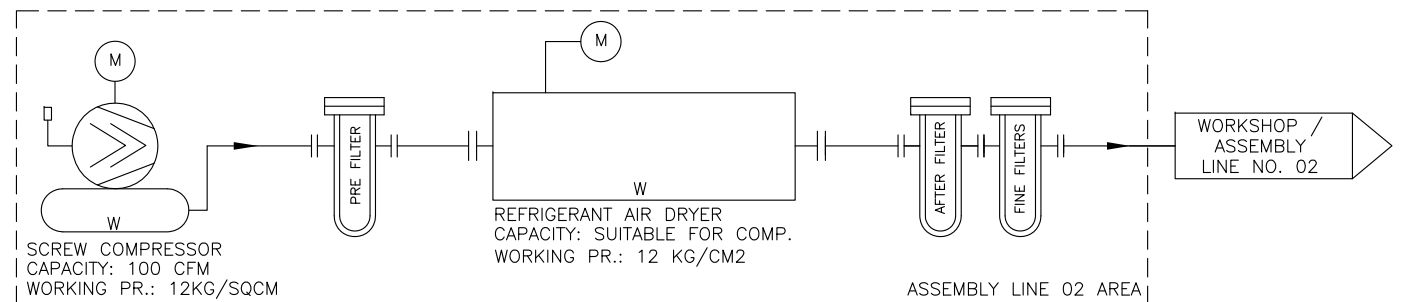


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TITLE

GROUND FLOOR PLAN AND SECTIONS

DRAWN: MS BRUNO	CHECKED: MALAYA	REVIEWED: MS BRUNO	APPROVED: BG SAJIT
DATE: 21-10-2025	SCALE : 1 : 100	SIZE: A2	
REF No.: 5900062340-I-0 dated 30 July 2025		PROJECT No.: I/0047	
DRAWING No.: MEC-I0047-01-48-D1-XX-08C-DR-A-01100			REVISION: R01.0





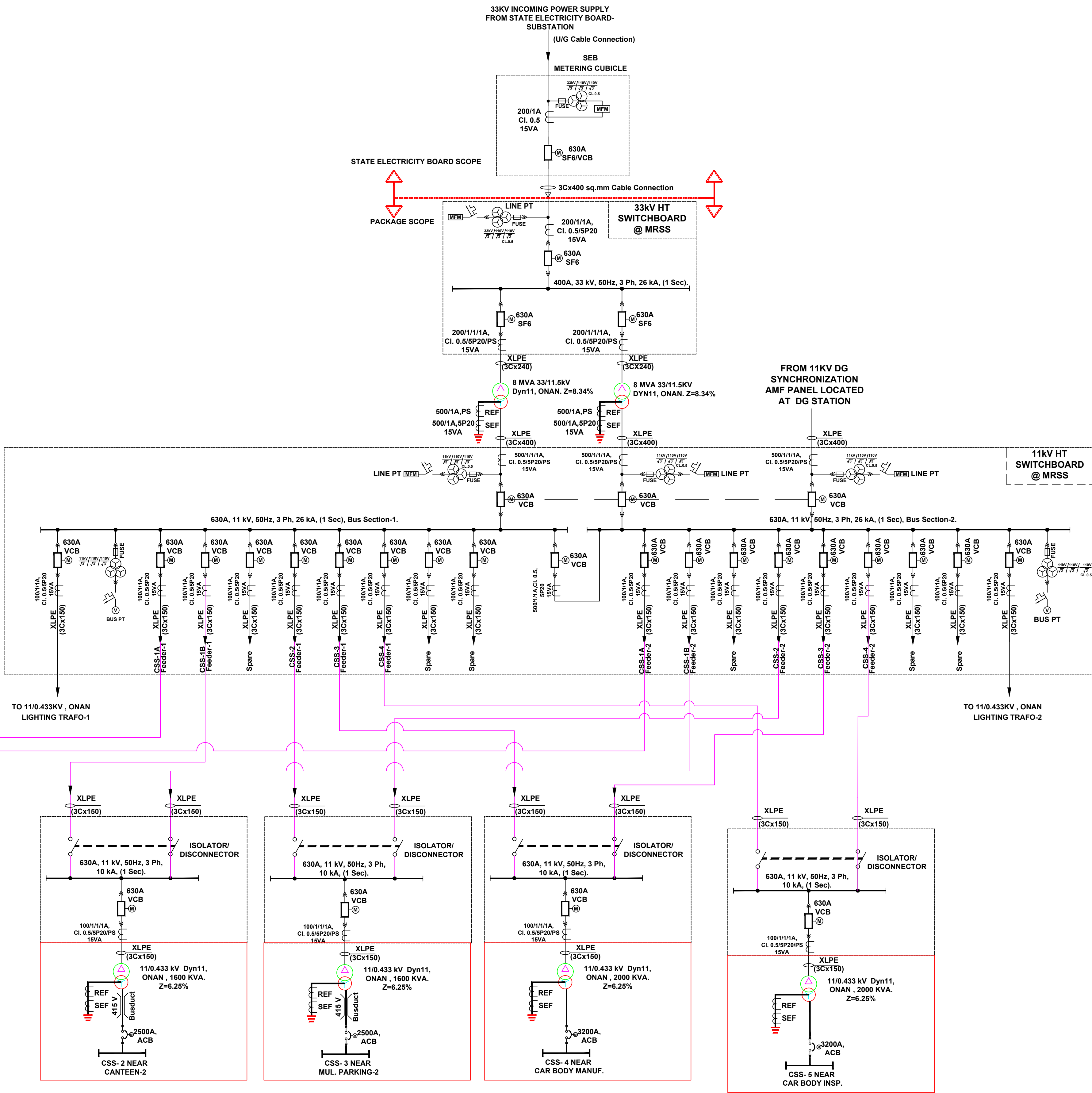
KEY PLAN

NOTE:

1. All dimensions are in MM unless otherwise mentioned.

LEGEND

	MOTORISED SF6/VACUUM CIRCUIT BREAKER - DRAW OUT TYPE
	11 kV ISOLATOR SWITCH
	MOTORISED AIR CIRCUIT BREAKER - DRAW OUT TYPE
	TWO WINDING POWER/DISTRIBUTION TRANSFORMER
	THREE WINDING POTENTIAL TRANSFORMER STAR - STAR WITH FUSE
	MICRO PROCESSOR BASED MULTI FUNCTION METER WITH FOLLOWING: AMMETER, VOLT METER, ACTIVE POWER (IMP & EMP), MEGAVAR (I & E), MEGAWATT AMPERE REACTIVE HOUR (I & E), FREQUENCY, PREDICTIVE LOAD MANAGEMENT, PF METER ETC.
	CURRENT TRANSFORMER
	MCB



OVERALL POWER DISTRIBUTION SCHEME

REV	DATE	DESCRIPTION	BY	CHK	REV	APP
1	27-11-2025	SUBMITTED FOR APPROVAL	YM	YM	YM	IRK

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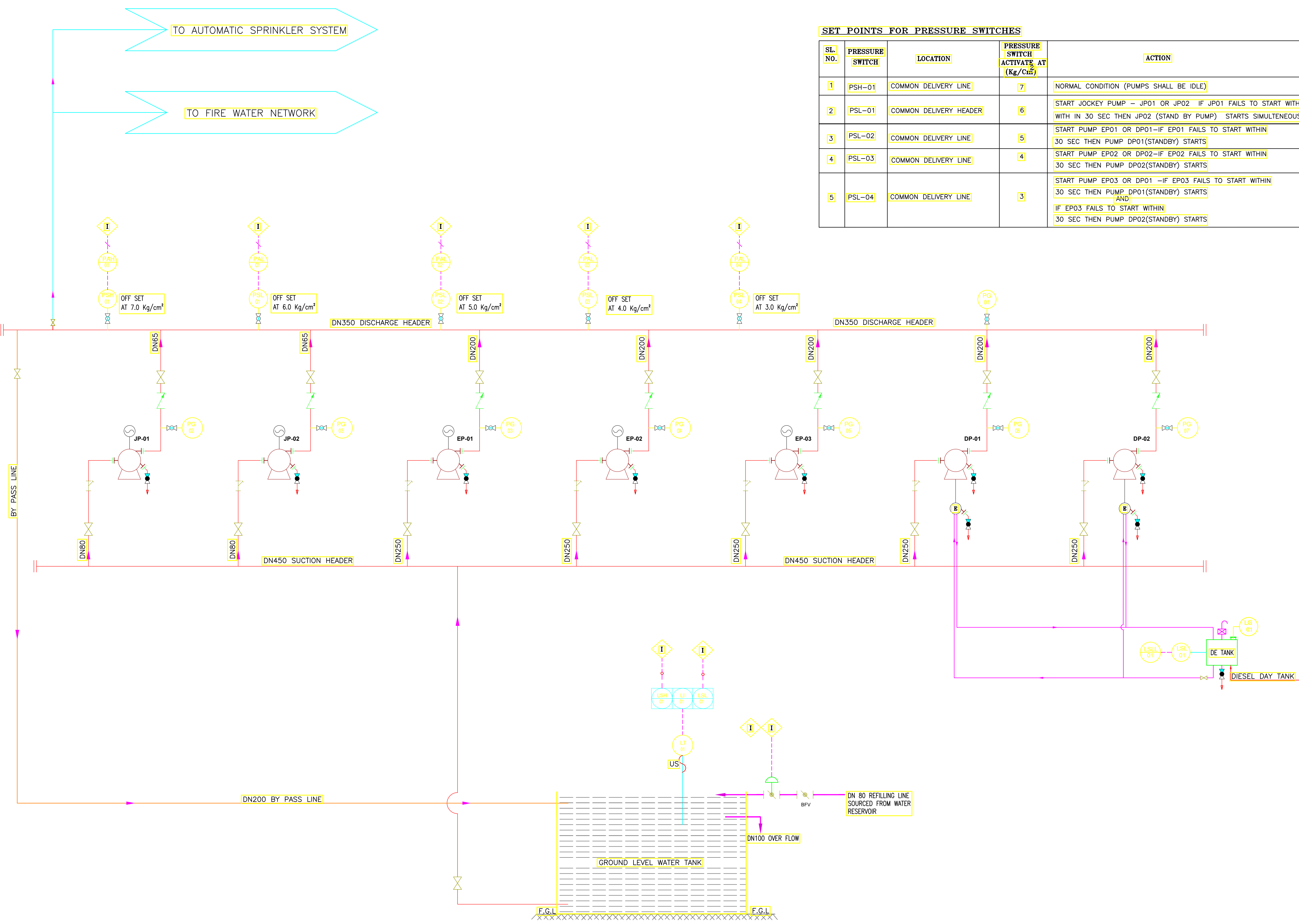
COMPREHENSIVE DETAILED PROJECT REPORT (DPR) FOR ESTABLISHING A STATE-OF-THE-ART GREENFIELD ROLLING STOCK MANUFACTURING PLANT AT BHOPAL, MADHYA PRADESH

CAR BODY FABRICATION & ASSEMBLY LINE FACILITY

MECON LIMITED BANGALORE

TITLE
SINGLE LINE DIAGRAM
KEY POWER DISTRIBUTION SCHEME

DRAWN: YM	REVIEWED: YM	APPROVED: IRK
DATE: 27-11-2025	SCALE: 1	SIZE: A0
REF No.: MEC-10047-01-E1-01-ZZ-ZZZ-DR-E-0720	PROJECT No.: 10047	
DRAWING No.: MEC-10047-01-E1-01-ZZ-ZZZ-DR-E-0720	REVISION:	REV 0



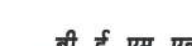
SET POINTS FOR PRESSURE SWITCHES				
SL. NO.	PRESSURE SWITCH	LOCATION	PRESSURE SWITCH ACTIVATE AT (Kg/Cm ²)	ACTION
1	PSH-01	COMMON DELIVERY LINE	7	NORMAL CONDITION (PUMPS SHALL BE IDLE)
2	PSL-01	COMMON DELIVERY HEADER	6	START JOCKEY PUMP – JP01 OR JP02 IF JP01 FAILS TO START WITHIN 30 SEC THEN JP02 (STAND BY PUMP) STARTS SIMULTANEOUSLY.
3	PSL-02	COMMON DELIVERY LINE	5	START PUMP EP01 OR DP01 –IF EP01 FAILS TO START WITHIN 30 SEC THEN PUMP DP01(STANDBY) STARTS
4	PSL-03	COMMON DELIVERY LINE	4	START PUMP EP02 OR DP02 –IF EP02 FAILS TO START WITHIN 30 SEC THEN PUMP DP02(STANDBY) STARTS
5	PSL-04	COMMON DELIVERY LINE	3	START PUMP EP03 OR DP01 –IF EP03 FAILS TO START WITHIN 30 SEC THEN PUMP DP01(STANDBY) STARTS AND IF EP03 FAILS TO START WITHIN 30 SEC THEN PUMP DP02(STANDBY) STARTS

LEGEND			
SYMBOL		SYMBOL	
	DESCRIPTION		DESCRIPTION
	CENTRIFUGAL PUMP	PG	PRESSURE GAUGE
	DIESEL ENGINE	PSH	PRESSURE SWITCH (HIGH)
	ELECTRIC MOTOR	PSL	PRESSURE SWITCH (LOW)
	BALL VALVE (NO)	PAL	PRESSURE ALARM (LOW)
	BALL VALVE (NC)	PAH	PRESSURE ALARM (HIGH)
	GATE VALVE	LSL	LEVEL SWITCH (LOW)
	NON-RETURN VALVE	LSL	LEVEL SWITCH (LOW,LOW)
	STRAINER	LG	LEVEL GAUGE
	FIELD MOUNT	LI	LEVEL INDICATOR
	INTERLOCK	LT	LEVEL TRANSMITTER
	BUTTERFLY VALVE		PANEL MOUNT IN PUMP HOUSE

- NOTES:**
1. ALL HYDRANT ARE PROVIDED CONSIDERING ROLLING STOCK MANUFACTURING FACILITIES PREMISES AN LIGHT HAZARD OCCUPANCY EXCEPT MLCOP BUILDINGS.
 2. FIRE FIGHTING SYSTEM SHALL BE DESIGNED BASED ON REQUIREMENT OF CFEES DELHI.
 3. ALL PUMPS SHALL HAVE MANUAL STARTING IN ADDITION TO AUTO START.
 4. THE FIRE HYDRANT NETWORK SHALL BE CONTINUOUSLY KEPT PRESSURISED AT 7.0 KG/CM.
 5. THE PUMPS OPERATION SHALL BE AS FOLLOWS:—
 - (A) THE JOCKEY PUMP SHALL KEEP THE NETWORK PRESSURISED AT 7 KG/CM². IN CASE THE NETWORK PRESSURE DROPS TO 6.0 KG/CM² IT SHALL START AUTOMATICALLY TILL THE PRESSURE BUILDS UPTO 7.0 KG/CM². AT 7.0 KG/CM² IT SHALL AUTOMATICALLY STOP.
 - (B) IN CASE PRESSURE CONTINUES TO FALL BELOW 6.0 KG/CM² THERE SHALL BE AN ALARM IN PUMP STATION. AT PRESSURE LESS THAN 5.0 KG/CM² THE MAIN PUMPS SHALL START AUTOMATICALLY.
 6. MAIN PUMPS SHALL BE STOPPED MANUALLY AFTER GETTING PROPER SIGNAL FROM LOCATION IN CHARGE.
 7. TOTAL NO. OF MAIN WORKING ELECTRICAL DRIVEN PUMP ARE 3 + 2 DIESEL ENGINE DRIVEN PUMP AS STANDBY.
 8. JOCKEY PUMP SHALL STOP AUTOMATICALLY ONCE THE MAIN PUMP STARTS.
 9. DIESEL DAY TANK TO BE LOCATED INSIDE THE FIRE WATER PUMP HOUSE.
 10. WATER FOR SPRINKLER SYSTEM SHALL BE SUPPLIED BY COMMON PUMPS INDICATED ABOVE.
 11. FIRE WATER SYSTEM IS AS PER BIS—13039:2014, BIS—15301:2003(RA 2018) AND NBC PART—4

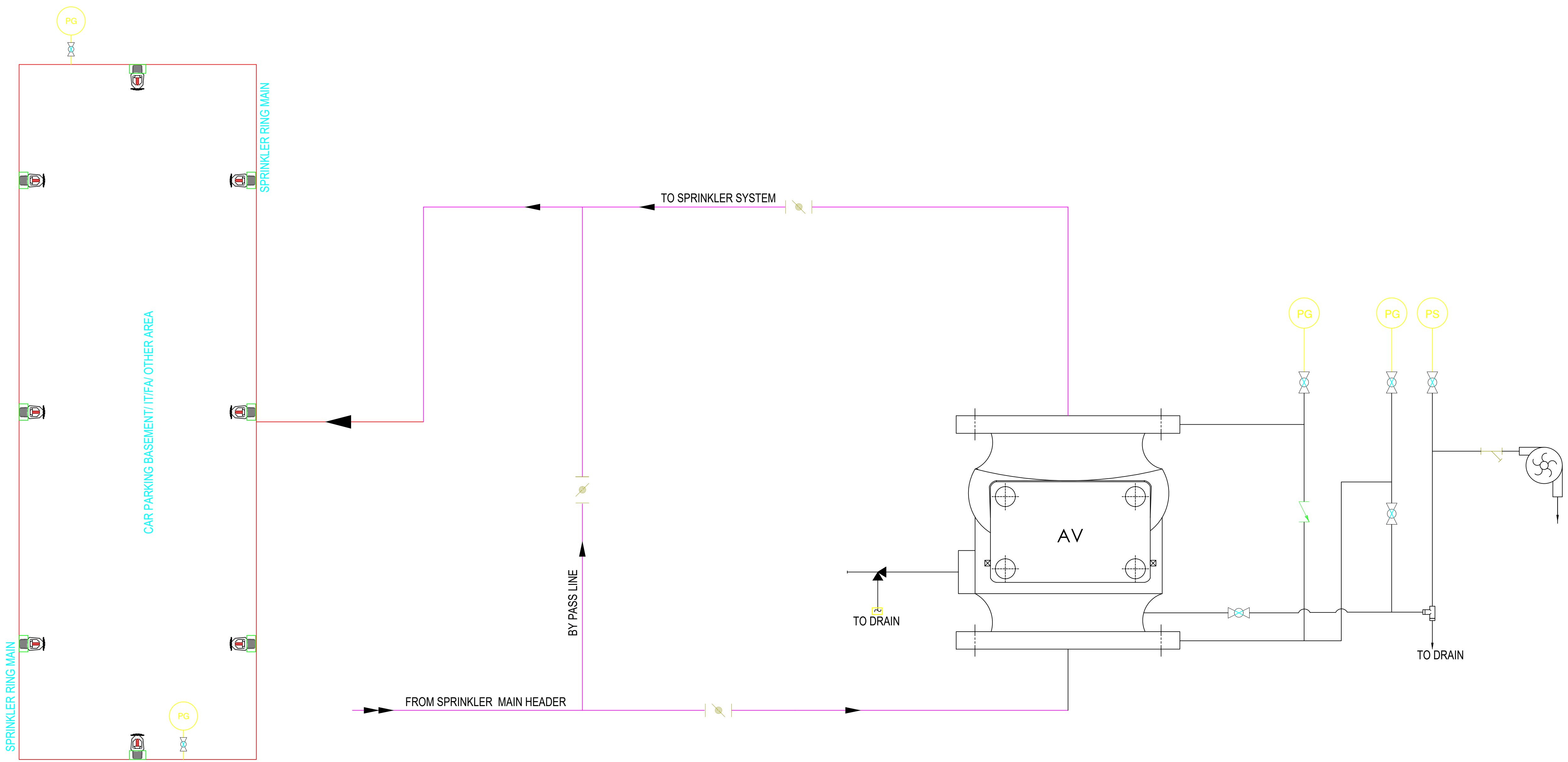
SL NO.	PUMP NO.	DESCRIPTION	CAPACITY m³/hr	HEAD MMC	DRIVE
1	JP-01	MAIN JOCKEY PUMP	18	88	ELECTRIC MOTOR
2	JP-02	STANDBY JOCKEY PUMP	18	88	ELECTRIC MOTOR
3	EP-01	MAIN FIRE WATER PUMP	171	88	ELECTRIC MOTOR
4	EP-02	MAIN FIRE WATER PUMP	171	88	ELECTRIC MOTOR
5	EP-03	MAIN FIRE WATER PUMP	171	88	ELECTRIC MOTOR
6	DP-01	STANDBY FIRE WATER PUMP	171	88	DIESEL ENGINE
7	DP-02	STANDBY FIRE WATER PUMP	171	88	DIESEL ENGINE

TANK/SUMP DETAILS				
SL NO	DESCRIPTION	(CU.M)	TANK SIZE(M)	Nos
1	FIRE WATER STORAGE TANK	513	20(L)X8.5(W)X3.2(H)	1

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SECTION	GL&T	ROLLING STOCK MANUFACTURING FACILITY AT BHOPAL, MADHYA PRADESH			
DESIGNED	S KARTHIK	FIRE FIGHTING SYSTEM			
CAD	S KARTHIK				
CHECKED & VERIFIED	K GOPALAN	P&I DIAGRAM FIRE WATER PUMPING SYSTEM			
APPROVED	SIG & DATE : 18-11-2025	SCALE NTS		SHEET	REV
	NAME: K. GOPALAN, GM	DRG NO.	MEC-10047-01-14-D1-ZZZ-DR-N-04001	1 OF 1	R0

[illegible]

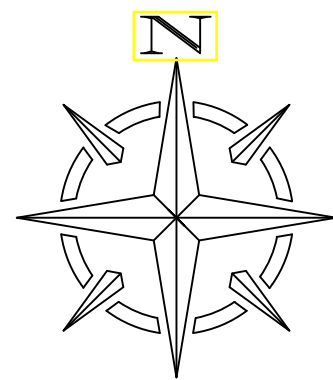


SYMBOL LEGEND

ALARM VALVE		GAUGE VALVE	
NON RETURN VALVE		STRAINER	
BUTTERFLY VALVE		ANGLE VALVE	
PRESSURE SWITCH		WATER MOTOR GONG	
PRESSURE GAUGE		QUARTZ BULB SPRINKLER	

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SECTION	GL&T	ROLLING STOCK MANUFACTURING FACILITY AT BHOPAL, MADHYA PRADESH	
DESIGNED	S KARTHIK	FIRE FIGHTING SYSTEM	
CAD	S KARTHIK	P&I DIAGRAM OF AUTOMATIC SPRINKLER SYSTEM	
CHECKED & VERIFIED	K GOPALAN		
APPROVED	SIG & DATE : 18-11-2025  NAME: K. GOPALAN, GM	SCALE NTS DRG NO. MC-10047-01-14-D1-ZZ-ZZZ-DR-N-04002	SHEET REV 1 OF 1 R0

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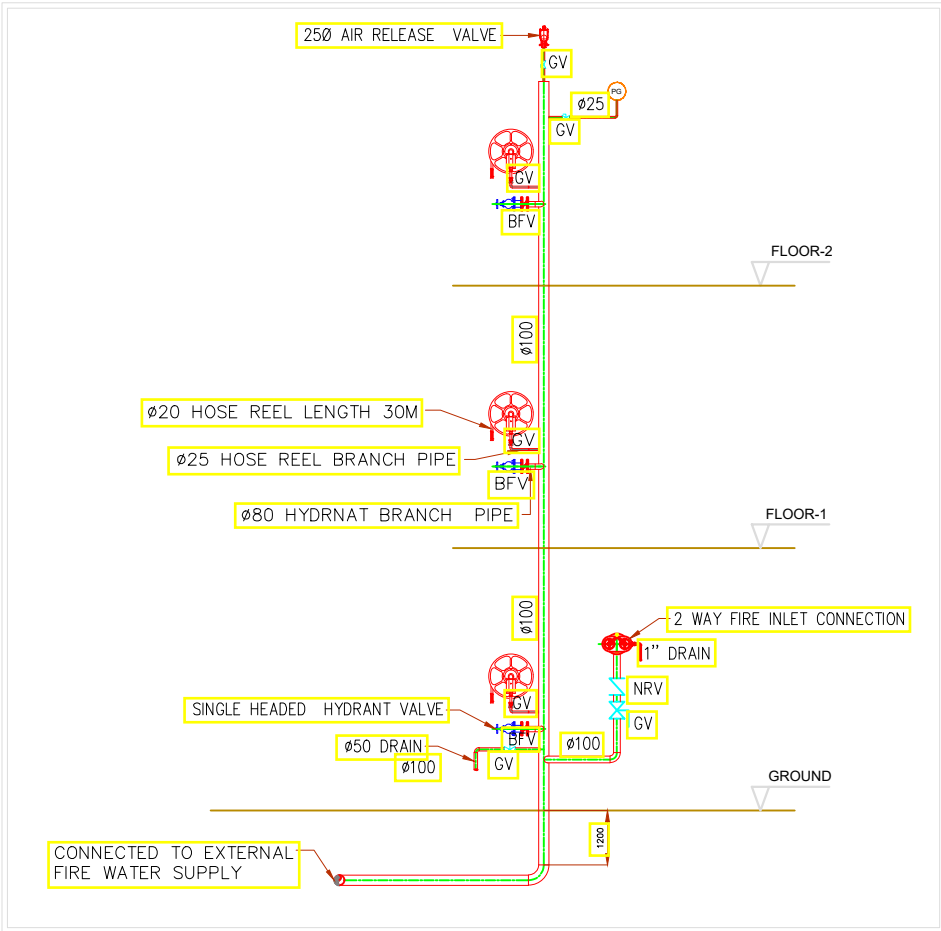


LEGENDS:-

FIRE HYDRANT PIPE	
SINGLE HEADED HYDRANT	
WATER MONITOR	
GATE VALVE WITH CHAMBER	
HOSE BOX	
PRESSURE GAUGE	

NOTES:-

- ALL HYDRANTS ARE PROVIDED CONSIDERING PLANT AS ARE LIGHT HAZARD OCCUPANCY
- THE SYSTEM NETWORK SHALL BE MAINTAINED AT 7.0 Kg/Cm. ^[2]
- INTERNAL HYDRANT (WET RISER) FOR INSIDE BUILDING SHALL BE ENVISAGED FOR VARIOUS BUILDING AS PER NBC (2016) PART-4 REQUIREMENT.
- INTERNAL HYDRANT (WET RISER) PROVIDED FOR HIGH RISE(MORE THAN 15M) BUILDING/STRUTURES AS PER NBC REQUIREMENT.
- HYDRANTS SHALL BE SPACED AT NOT MORE THAN 60M APART AND MONITORS AT STRATEGIC LOCATIONS.
- FIRE WATER LINES AT ROAD CROSSING SHALL BE LAID WITHIN HUME PIPE.
- TAPPING FOR WET RISER SYSTEM FOR INSIDE BUILDING SHALL BE TAKEN FROM MAIN HYDRANT NETWORK RUNNING NEAR BUILDINGS.
- FIRE HYDRANT SYSTEM NETWORK SHALL BE IS AS PER IS:-13039:2014 & TAC.
- INTERNAL FIRE HYDRANT (WET RISER) SYSTEM FOR THE BUILDING SHALL BE NETWORK SHALL BE AS PER IS : 3844, NBC PART-4 & TAC.
- HVWS SHALL BE PROVIDED FOR THE TRANSFORMER HAVING MORE THAN 10MVA OR 2000 LTRS OIL CAPACITY.
- WATER MONITOR SHALL BE PROVIDED NEAR TO THE BUILDING/STRUTURE OF HEIGHT MORE THAN 15M
- FIRE SERVICE INLET CONNECTION SHALL BE PROVIDED ON RISER OF BUILDING/STRUTURE.
- TAPPING FOR AUTOMATIC SPRINKLER SYSTEM SHALL BE TAKEN FROM HYDRANT HEADER.



TYPICAL ARRANGEMENT OF INTERNAL HYDRANT SYSTEM



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ROLLING STOCK MANUFACTURING FACILITY AT
BHOPAL, MADHYA PRADESH

FIRE FIGHTING SYSTEM

FIRE WATER PIPELINE NETWORK

SCALE NTS SHEET REV
DRG NO: MEC-10047-01-14-D1-ZZ-ZZZ-DR-N-04100 1 OF 1 R0

SECTION GL&T

DESIGNED S KARTHIK

CAD S KARTHIK

CHECKED & VERIFIED K GOPALAN

SIG & DATE: 18-11-2025

APPROVED NAME: K. GOPALAN, GM

REFERENCES

DRG NO.

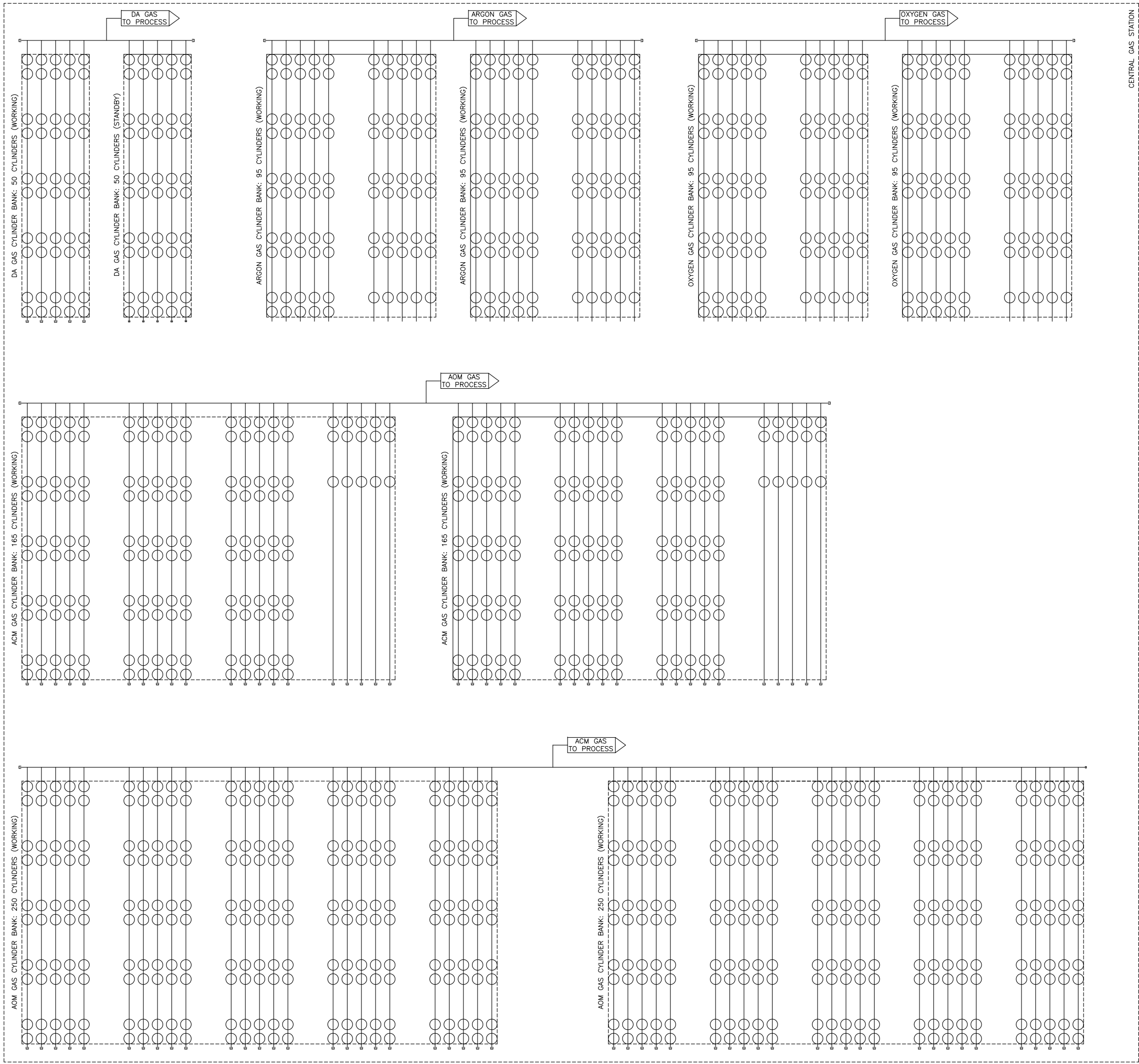
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REV NO. DATE ZONE DESCRIPTION BY VERIFIED

NOTES

CONCURRED BY



ROW	27-1-25	FIRST SUBMISSION	EDR	SS	SS	SS	
REV	DATE	DESCRIPTION	BY	CHK	RVW	APP	

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BEML LIMITED
BANGALORE

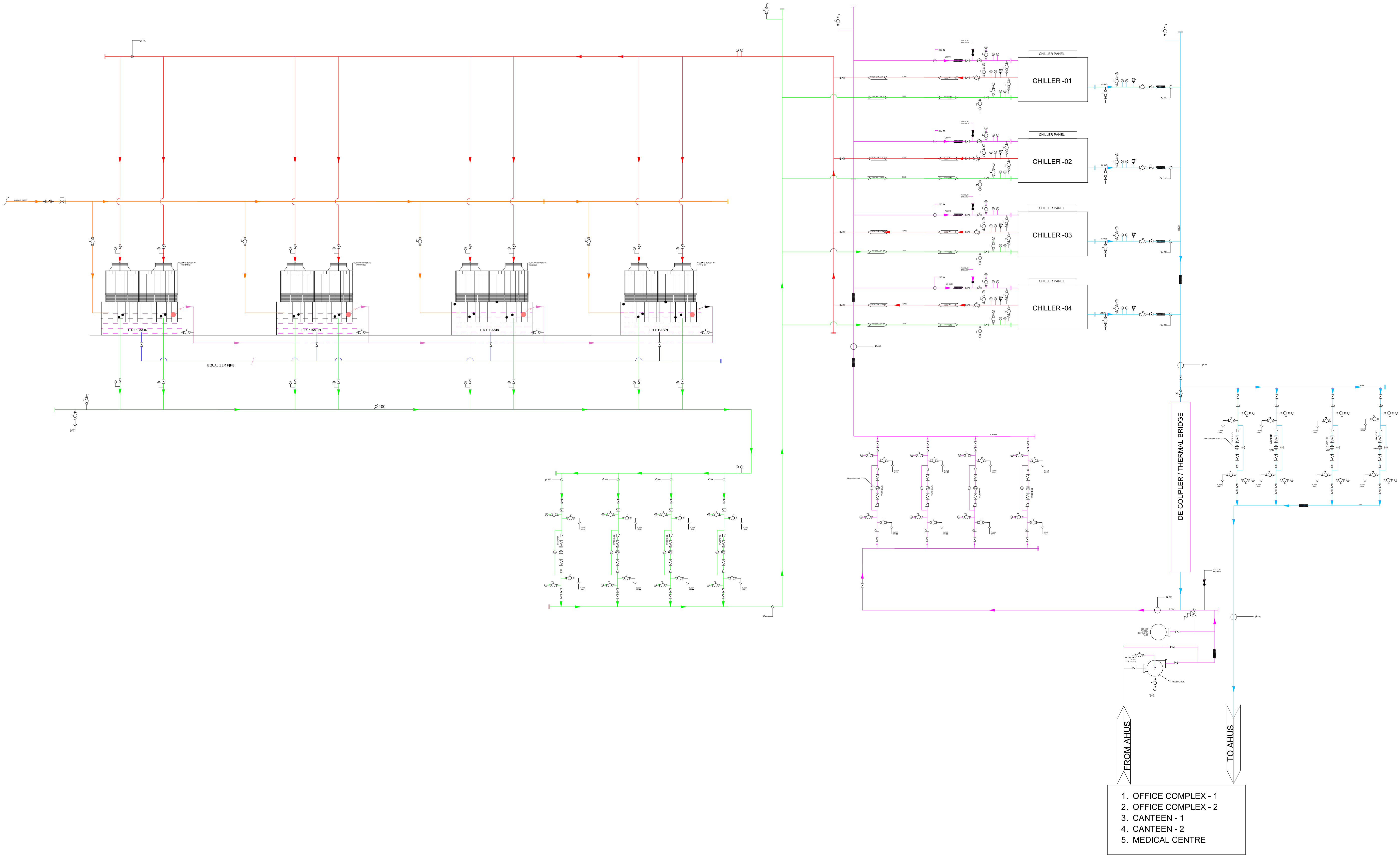
**COMPREHENSIVE DETAILED PROJECT
REPORT (DPR) FOR ESTABLISHING A
STATE-OF-THE-ART GREENFIELD
ROLLING STOCK MANUFACTURING
PLANT AT BHOPAL, MADHYA PRADESH**

CAR BODY FABRICATION &
ASSEMBLY LINE FACILITY



TITLE
PFD OF INDUSTRIAL GASES

DRAWN: EGN	CHECKED: SS	REVIEWED: SS	APPROVED: SS
DATE: 27-11-2025		SCALE: NTS	SIZE: A3
REF NO.: 5900062340/-0 dated 30 July 2025		PROJECT NO.: I0047	
DRAWING No.: MEC-I/0047-01-40-D1-ZZ-16-DR-N-03004			REVISION: R00



KEY PLAN

NOTES:

1. CHILLED WATER INLET & OUTLET TEMPERATURE = 7°C & 12°C
2. CONDENSER WATER INLET & OUTLET TEMPERATURE = 32°C & 37°C
3. VENTS ARE LOCATED AT THE HIGHEST POINT & DRAINING ARE LOCATED ON THE LOWEST POINTS OF THE PIPING SYSTEM.
4. ALL EQUIPMENT DRAIN SHALL BE CONNECTED TO NEAREST SURFACE DRAIN.
5. LEVEL SWITCHES SHALL BE INTERLOCKED WITH CONDENSER WATER PUMPS.
6. ALL DIMENSIONS IN MM UNLESS OTHERWISE MENTIONED.

SYMBOLS	DESCRIPTION
	AUTO PURGE
	SAFETY VALVE
	BUTTERFLY VALVE
	MOTORIZED BUTTERFLY VALVE
	BALL VALVE
	Y-STRAINER
	CONTROL VALVE
	MANUAL BALANCING VALVE
	FLOAT VALVE
	CONCENTRIC REDUCER
	ECCENTRIC REDUCER
	NON RETURN VALVE
	FLEXIBLE CONNECTOR
	DIFFERENTIAL PRESSURE SWITCH
	PRESSURE GAUGE
	TEMPERATURE GAUGE
	TEMPERATURE SENSER
	CHILLED WATER SUPPLY (CHWS)
	CHILLED WATER RETURN (CHWR)
	CONDENSER WATER RETURN (CWR)
	CONDENSER WATER SUPPLY (CWS)
	BLOW DOWN LINE
	MAKE WATER LINE
	DRAIN LINE

Not For
Construction

REV	DATE	DESCRIPTION	BY	CHK	RWV	APP

REVISIONS

CLIENT

**BEML LIMITED**
BANGALORE

COMPREHENSIVE DETAILED
PROJECT REPORT (DPR) FOR
ESTABLISHING A
STATE-OF-THE-ART
**GREENFIELD ROLLING STOCK
MANUFACTURING PLANT AT
BHOPAL, MADHYA PRADESH**

CAR BODY FABRICATION &
ASSEMBLY LINE FACILITY



MECON LIMITED
BANGALORE

TITLE
**CAR BODY FABRICATION & ASSEMBLY
LINE FACILITY**
**CHILLED WATER SYSTEM
P&ID**

DRAWING: KSK CHECKED: KSK REVIEWED: KSK APPROVED: KSK

DATE: 15-11-2025 SCALE: NTS SIZE: A0

REF No.: PROJECT No.: B0047

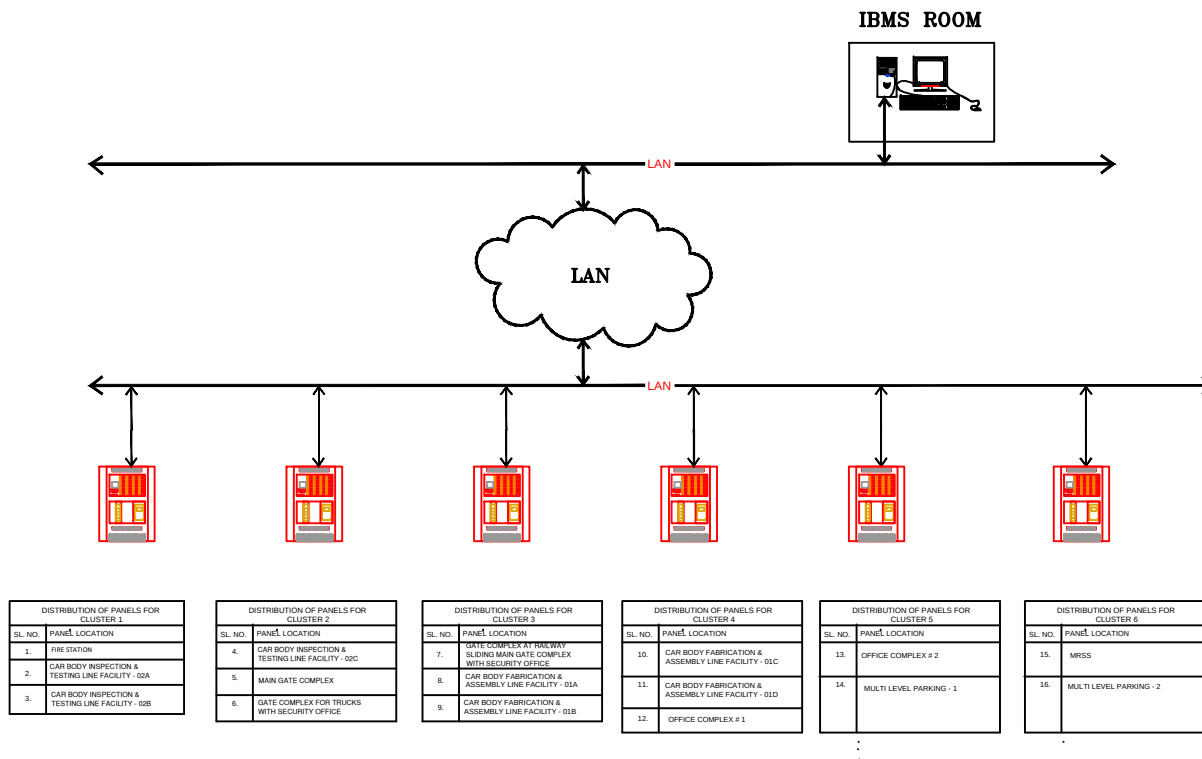
DRAWING No.: REVISION:



KEY PLAY

NOTE :-

1. All dimensions are in MM unless otherwise mentioned.



REV	DATE	DESCRIPTION	BY	CHK	APPV

YES/NO/NT

CONTENT



COMPREHENSIVE DETAILED
PROJECT REPORT (DPR) FOR
ESTABLISHING A
STATE-OF-THE-ART
GREENFIELD ROLLING STOCK
MANUFACTURING PLANT AT
BHOPAL, MADHYA PRADESH

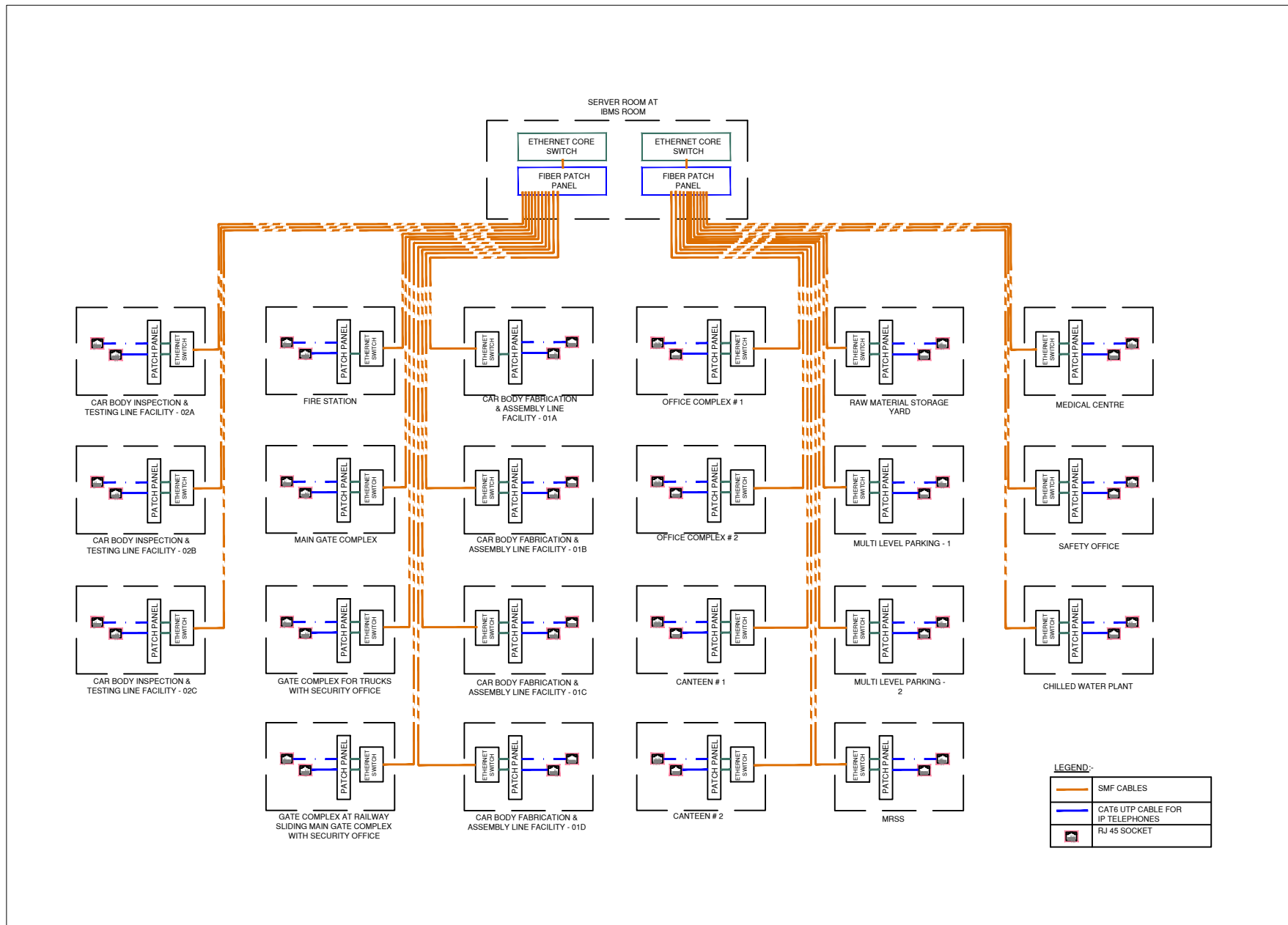
CAR BODY FABRICATION &
ASSEMBLY LINE FACILITY



1716 CAR BODY FABRICATION & ASSEMBLY
LINE FACILITY
SCHEMATIC
FDA SYSTEM

DRAWN: PG	CHECKED: PG	REVIEWED: PG	APPROVED:
DATE: 25-11-2025		SCALE:	SHEET: A3

REF No:	00-00000000	PROJECT No:	00000000
ORIGIN No:			
	00-00000000		



KEY PLAN

NOTE:
1. All dimensions are in MM unless otherwise mentioned.

REV	NO	DATE	DESCRIPTION	BY	CHK	APP
1	1					
2	2					
3	3					
4	4					
5	5					
6	6					
7	7					
8	8					
9	9					
10	10					

CLIENT: **BEML LIMITED BANGALORE**

COMPREHENSIVE DETAILED PROJECT REPORT (DPR) FOR ESTABLISHING A STATE-OF-THE-ART GREENFIELD ROLLING STOCK MANUFACTURING PLANT AT BHOPAL, MADHYA PRADESH

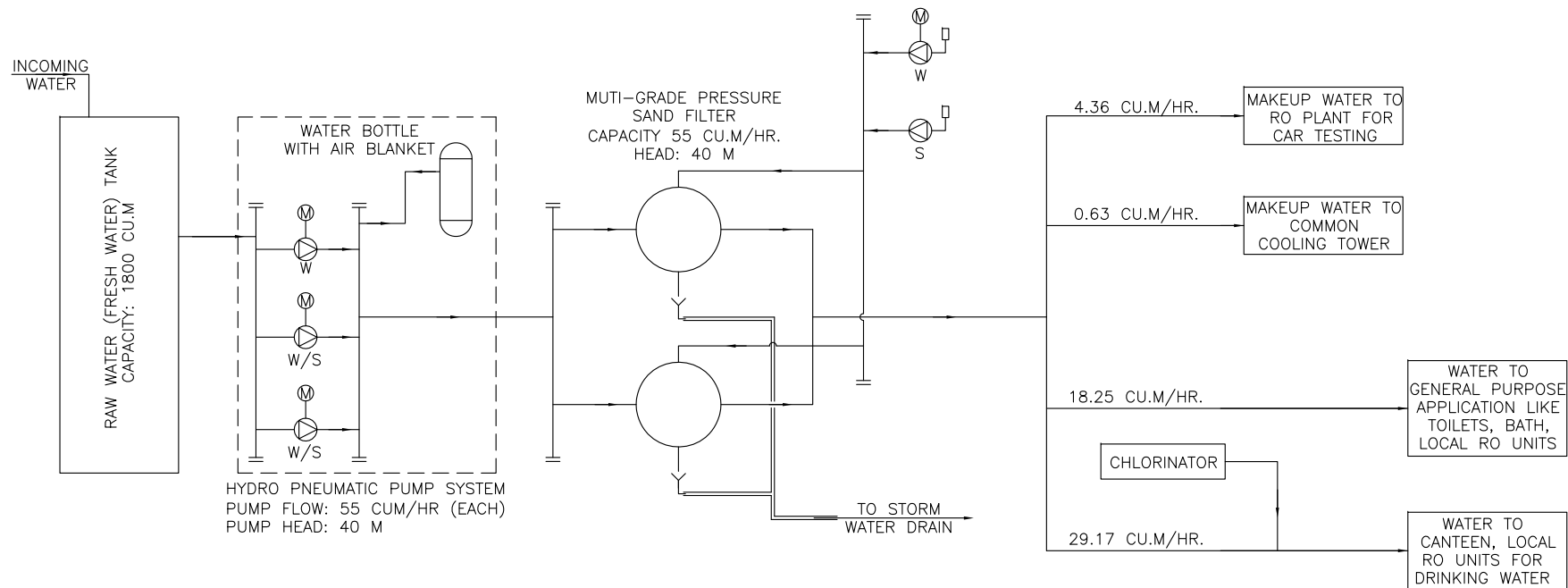
CAR BODY FABRICATION & ASSEMBLY LINE FACILITY

MECON LIMITED BANGALORE

S/C: CAR BODY FABRICATION & ASSEMBLY LINE FACILITY
SCHEMATIC LAN SYSTEM

DRAWN: PS	CHECKED: PS	REVIEWED: PS	APPROVED: PS
DATE: 03/10/2023	DATE: 03/10/2023	DATE: 03/10/2023	DATE: 03/10/2023
SHEET NO: 01	SHEET NO: 02	SHEET NO: 03	SHEET NO: 04

PROJECT NO: MEC /0087-03-ES-03-XR-03-04-00002	REVISION: 01



		BEML LIMITED BANGALORE	
COMPREHENSIVE DETAILED PROJECT REPORT (DPR) FOR ESTABLISHING A STATE-OF-THE-ART GREENFIELD ROLLING STOCK MANUFACTURING PLANT AT BHOPAL, MADH PRADESH			
CAR BODY FABRICATION & ASSEMBLY LINE FACILITY		MECON LIMITED BANGALORE	
			
FPO OF WATER SUPPLY FACILITIES			
DRAWING NO. _____ DATE: 24-04-2020	DESIGNED BY _____ SCALE: 1:1000	MODIFIED BY _____ SCALE: 1:1000	APPROVED BY _____ DATE: 24-04-2020
PROJECT NO. _____ MEC/(0047-01-40-01-22-12-08-0-03001)			NO. _____ DATE _____

BEML LIMITED

A Govt. of India Mini Ratna Company under Ministry of Defence

BEML Rail plant Bhopal

TITLE

ROLLING STOCK MANUFACTURING PLANT

Engineering, Procurement & Construction pertaining to establishment of Rail coach factory including Civil Construction of manufacturing blocks, testing bay, other utility buildings (Non factory buildings), Railway Track sidings, water supply and distribution System, Roads, Drainage and sewerage systems, General Electric works including regular and emergency power supply and distribution system, related installations & services (Fire, Gas, Compressed air, IT, BMS, etc.), MFA (Miscellaneous fixed assets) and other Land & Site development works including grading, levelling works in connection with setting up of a Rail Coach Factory hereinafter referred as BEML RAIL HUB FOR ADVANCE MANUFACTURING (BRAHMA) near Umaria village, Obaidullaganj, District- Raisen, Madhya Pradesh (India) PIN code 464993 on EPC Mode

DESCRIPTION OF BUILDING / FACILITIES & THEIR BROAD SPECIFICATION

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MEP systems described below has design basis considering one manufacturing block envisaged in near future after 03 years

List of Facilities/Utilities/Buildings, Rail Plant-Bhopal

SL. No.	Facilities / Utilities / Buildings	Dimension	Type of Structure
1.	Car body Fabrication Block	400m x 72 m	Steel Structure (Conventional) / (Hybrid-combination of conventional & PEB)
2.	Car body Inspection & testing Bay	852m x 24 m	Steel Structure (PEB)
3.	Office complex (G+5)	75.6m x 18.9m	RCC
4.	Canteen building (Single Storey)	64.8mx56.4m	RCC
5.	Medical centre	28.8mx10.8m	RCC
6.	Multi-level Parking	61.6mx64.4m	RCC
7.	100 ft road Weight bridge & office	70 Ton	Hard stand
8.	Main Gate complex with Security office	59.1mx14.4m	RCC
9.	Gate complex for trucks with security office	18mx10.8m	RCC
10.	Gate complex at railway siding main gate complex with security office	8mx4.8m	RCC
11.	Fire station	32.4mx10.8m	RCC
12.	Water supply pump house	28m x 11m	RCC
13.	Fire water pump house & sump		
14.	Sewage Treatment Plant (STP) (100 KLD)	15mx13.5m	RCC
15.	Main Receiving Sub Station (MRSS) (33 KVA)	40mx12.5m	RCC/OPEN
16.	Emergency Power Supply System (EPSS)(750x2)	30mx30m	RCC

17.	Compressed air system (12 bar)	20mx12m	RCC
18.	Centralised gas bank (Acetylene + Argon)	40mx16m	RCC
19.	Safety office	25.2mx14.4m	RCC
20.	RO plant (Container based)	15mx10m	RCC
21.	Chiller plant	46.6mx16m	RCC
22.	Railway yard (BG) with OHE	4000 m	
23.	Toilet block & Rest room at parking area	7.6 m X13.6 m	RCC
24.	Traversers (75 Ton)	240m x 32m	RCC
25.	Traversers (75 Ton)	160mx32m	RCC
25.	Raw material storage yard	50mx40m	(Hard Stand)

Note: Facilities' dimensions mentioned at SI No 1 & 2 are center to center whereas for all other facilities it is out to out.

For further Details Refer Drawing for Area, dimensions, Elevation & cross-section.

1. FUNCTIONAL DRAWINGS AND DETAILS

BEML intent to set up world class state of the Art Car body manufacturing facilities at Bhopal to meet the requirement of various types of Car/Coaches both in India as well as overseas.

The objective of this Assignment involves manufacturing of the following type of Car/Coaches to meet the requirement at present & Future:

- (a) Vande Bharat (Both sitting & Sleeper Coaches) & LHB coaches: 400 Coach per Annum
- (b) Metro Car: 400 Coach per Annum
- (c) High Speed Aluminium Coaches: 400 Coach per Annum

The aim of this assignment is to produce 1200 Coaches/Car per Annum.

In order to carry out the above mammoth requirement, the following major technological facility has been considered for the way forward:

- (a) Car Body Fabrication & Assembly line facility
- (b) Car Body Inspection & Testing line facility.
- (c) Inter plant Traverser

The above main technological facility has been planned in one zone which is designated as zone

1.1 BUILDING FUNCTIONAL DESIGN

1. General

Based on the Preliminary engineering undertaken at Bhopal Project site, the building functionality has been derived considering the optimum use of land to achieve the production target of 1200 coaches per Annum.

While designing the Building Functionality lean engineering concept has been introduced for the development of a World class manufacturing facility.

The entire Car body manufacturing area has been divided into 3 functional areas namely Car body Fabrication & Assembly line facility and Car body Inspection & Testing line facility and Inter Plant Traverser.

2. Starting Point for functional Design

2.1 Car Body Fabrication & Assembly line facility:

Considering the Production requirement for the next 10 years, it has been proposed to develop 1 Nos. Car Body Fabrication & Assembly line facility with a provision for 1 Nos. as Future. Each Manufacturing line will have dimension of 400m X 72 m. A road of 8-10m (will be finalised) has been proposed in between the Production line for the logistic support and to meeting the Fire safety norms.

The Plant offices for the above Manufacturing line has been attached as Annex building by the side of the Fire exit staircase for optimum utilisation of spaces.

Phase wise construction of Car Body Fabrication & Assembly line facility is as follows:

- Phase 1: 1 No. (Building Size: 400m X 72m)

2.2 Car Body Inspection & Testing line facility:

Considering the Production requirement, it has been proposed to develop 1 No. Car Body Inspection & Testing line facility having a dimension of 852m X 24m in phase-I with a provision to construct Car Body Inspection & Testing line facility as Future. A road of 10m has been proposed in between the Production line for the logistic support and to meeting the Fire safety norms.

Phase wise construction of Car Body Inspection & Testing line facility is as follows:

- Phase 1: 1 No. (Building Size: 852m X 24m)

3. Design Procedures Adopted

- While designing the building configuration lean engineering concept has been introduced for optimum utilization of space.
- Roof top solar panel has been proposed as a green building & sustainability measure.
- Sleek DG EOT cranes has been proposed for optimum utilization of spaces.
- Multi-layer production facility has been proposed for better efficiency and space utilisation.
- Extensive utilization of MHE for better logistic support.

1.2 BUILDING:

Building List.

S.No.	Name of facility	Zone	Facility Numbering
1)	Car body fabrication & Assembly line facility -01	01	01A
2)	Car body fabrication & Assembly line facility -02	01	01B
3)	Car body fabrication & Assembly line facility -03 (Future)	01	01C
4)	Car body fabrication & Assembly line facility -04 (Future)	01	01D
5)	Car body Inspection & Testing line facility-01	01	02A
6)	Car body Inspection & Testing line facility-02 (Future)	01	02B
7)	Car body Inspection & Testing line facility-03 (Future)	01	02C
8)	Inter plant Traverser	01	21

2. FUNCTIONAL DESIGN APPROACH

2.1 CAR BODY FABRICATION & ASSEMBLY LINE FACILITY:

This manufacturing line consists of 2-layer production facility. The 1st floor is designated for the fabrication and Assembly line facility for Car body. The following major activities has been envisaged in 1st floor:

❖ 1st floor Bay 1:

This is one of the crucial functional bays for the Car body manufacturing facility. Major highlights of this bay are:

- 1) This bay is having configuration of 400m X 24 m
- 2) This bay is envisaged with 10T/2T DG EOT crane with a clear height of lift as 12m.
- 3) An opening of 25m X 6m has been made in one of the bays ends (between column axis No. 1 & 3) for the lowering of the Car body shell to ground floor post assembly at first floor. A hydraulic lift has been envisaged for lifting and lowering of the car body shell.
- 4) This bay has been provided with centralised compressed air facility at regular interval between the column so that tapping can be made at any point to meet the compressed air requirement.
- 5) This bay has been provided with centralised gas line facility at regular interval between the column so that tapping can be made at any point to meet the gas requirement.

- The major functional area of this bay is as follows:

A. Under frame fabrication facility

1. Major functional areas under this segment are Underframe welding facility, Buffer storage for underframe, underframe skin welding facility, Underframe Assembly facility, underframe welding fixture facility, Underframe sub assembly storage facility.

2. Major functional equipment envisaged are standby idle jig, manual MIG/TIG welding, Wire feeder, seam welding machine, C-gun, welding controller with software, cooling unit, Robot gantry system, Jig fixture, grinding tools, Mechanic reverse table.

B. Roof fabrication facility

1. Major functional areas under this segment are Roof keystone seam welding facility, Roof Skeleton Composition (Dome+ Flat+ Cantrail) MIG Welding Cant Rail Sub Assembly, Roof Cantrail Sub Assembly Fixture Tack Welding, Roof Cantrail Skeleton Adjustment Stage, Roof Cantrail Spot Welding (skin+ skeleton, Flat Roof Skeleton, Flat Roof Adjustment, Flat Roof Spot Welding, Robot Gantry Spot Welding, Roof Assembly Spot Welding etc.
2. Major functional equipment envisaged are Seam welding, MIG welding, Tack welding, Roof preparation area, Spot welding etc.

C. Car body assembly welding facility

1. An area of 70m X 10m has been earmarked for the Car body assembly welding facility. There shall 2 arrangement station, out of which one will be at the welding position for the preparation of Car body shell and the other stations will be at preparatory position for welding. EOT cranes will be utilised for the lifting and lowering of the car body shell. Piped gas line and compressed air facility has been planned at columns and can be drawn to the consumer points.

D. Paint shop facility

1. An area of 30mX6m has been earmarked for the Paint shop facility along with Car body shell movement area of 25mX4m. This paint shop is semi-automatic containerised paint shop. A winch system shall be embedded with the Paint shop for the movement of car body shell inside the paint shop.

E. Water leakage testing/inspection facility

1. An area of 30mX6m has been earmarked for the Water leakage testing/inspection facility along with Car body shell movement area of 25mX4m. This facility is closed loop water supply system with RO water will be used for the water leakage testing. A winch system shall be embedded with this testing facility for the movement of car body shell inside the Water leakage testing/inspection facility.

• 1st floor Bay 2:

This bay is exclusive for warehouse facility specifically to store all the items pertaining to the Fabrication Bay. Major highlights of this bay are:

1. This bay is having configuration of 400m X 24 m.

2. This bay has been compartmentalised broadly in 2stage i.e., the heavy equipment will be stored on floor and the smaller equipment below 1 ton shall be stored in racks of various type such as heavy storage rack, medium storage rack and light weight storage rack.
3. The racking shall be both in the form of Pallet as well as in bin capability to store long items with length up to 6m.
4. No EOT crane has been envisaged in this bay. However, the material will be stacked by means of Articulating forklift.
5. An opening of 25m X 6m has been made in one of the bays ends (between column axis No. 1 & 3) for the lifting/lowering of the equipment to the first floor for storage.
6. This bay has been provided with different type of racking system for the storage of all the inventory required for the Fabrication activities.

- **1st floor Bay 3:**

This is also one of the crucial functional bays for the Car body manufacturing facility. Major highlights of this bay are:

1. This bay is having configuration of 400m X 24 m
2. This bay is envisaged with 10T/2T DG EOT crane with a clear height of lift as 12m.
3. An opening of 25m X 6m has been made in one of the bays ends (between column axis No. 1 & 3) for the lowering/lifting of the equipment to first floor by means of hydraulic lift.
4. This bay has been provided with centralised compressed air facility at regular interval between the column so that tapping can be made at any point to meet the compressed air requirement.
5. This bay has been provided with centralised gas line facility at regular interval between the column so that tapping can be made at any point to meet the gas requirement.

- The major functional area of this bay is as follows:

A. Side wall fabrication facility

1. Major functional areas under this segment are side wall skeleton welding fixture, side wall skeleton heat adjustment fixture, Side wall tack welding, Side wall spot welding, Side wall inspection, pass/fail status area,
2. Major functional equipment envisaged are side wall skeleton welding fixture etc.

B. End wall fabrication facility

1. Major functional areas under this segment are side End wall skeleton weld, skin welding & inspection, End wall spot welding.
2. Major functional equipment envisaged are skeleton welding, skin welding & inspection & spot welding.

C. Cabin fabrication facility

1. Major functional areas under this segment are Cabins structure welding, Cabin inspection, cabin overall welding.
2. Major functional equipment envisaged are Cabin structure welding & cabin overall welding.

The Ground floor is designated for the Furnishing line facility for Car body. The following major activities has been envisaged in Ground floor:

- **Ground floor Bay 1:**

This is one of the crucial functional bays for the Car body manufacturing facility. This bay is exclusive designated for Car body furnishing.

Major highlights of this bay are:

1. This bay is having configuration of 400m X 24 m
2. This bay is envisaged with 25T/5T DG EOT crane with a clear height of lift as 12m.
3. An area of 25m X 6m has been earmarked between column axis No. 1 & 3 for the positioning of Hydraulic lift required for lowering of the Car body shell to ground floor post fabrication & assembly at first floor.
4. This bay has been provided with centralised compressed air facility at regular interval between the column so that tapping can be made at any point to meet the compressed air requirement.
5. A high-pressure compressor (pressure 12 bar FAD 100 cfm) has also been proposed for the pipe pressure testing & for the braking system.
6. 2 in No. Combination track (both Broad gauge & standard gauge) of length of 50 m has been earmarked at the other end of Furnishing Bay for the buffer storage and to transport the Car body to inspection & testing bay via Traverser. A pit of 1.5 m clear height has been envisaged within the track bay. This has been earmarked for the Car body underframe fittings installation & inspection.

- The major functional area of this bay is as follows:

A. WATER TIGHTNESS TEST

1. Car body stage & fully furnished car stage Two Water Tightness Test Gantries with 240 water spraying nozzles to spray water at 2 bar pressures at discharge rate of 7.4 lit/min/nozzle as per IEC 61133 standard are available conduct Rain test and ensure cars are leak proof. RO water will be used to conduct this water tightness test. The water used to perform this test will be used again by means of closed loop recycle mode. Make up feed arrangement has been envisaged for the top up of RO water losses due to evaporation and other losses during operation.

B. Under frame fabrication facility

1. Major functional areas under this segment are Anti-drumming facility, Glass wool installation, Floor board installation, Cable cutting & Harnessing, Floor covering, Air duct

- installation, Window glass installation, Roof cable duct installation, Internal Electrics, Upholstery, Under gear equipment assembly, Bogie trucking & Roof equipment installation
2. Major functional equipment envisaged are Anti-drumming facility for underframe painting, cable harnessing equipment, Car Internal Electrics equipment, HVAC equipment, Upholstery equipment, Under gear assembly equipment etc.

C. BOGIE LOAD TESTING

1. A 40 Tons capacity Bogie Load testing facility used to measure various Bogie Design parameters under loaded condition.

• **Ground floor Bay 2:**

This bay is exclusive for warehouse facility specifically to store all the items pertaining to the Furnishing Bay. Major highlights of this bay are:

1. This bay is having configuration of 400m X24 m
2. This bay has been compartmentalised broadly in 2 stages i.e. the heavy equipment will be stored on floor and the smaller equipment below 1 ton shall be stored in racks of various type such as heavy storage rack, medium storage rack and light weight storage rack.
3. The racking shall be both in the form of Pallet as well as in bin capability to store long items with length up to 6m.
4. No EOT crane has been envisaged in this bay. However, the material will be stacked by means of Articulating forklift.
5. An area of 25m X 6m has been made in between column axis No. 1 & 3 for the lifting/lowering of the equipment to the first floor for storage by means of Hydraulic lift.
6. This bay has been provided with different type of racking system for the storage of all the inventory required for the Furnishing activities.

• **Ground floor Bay 3:**

The functionality of this bay is same as Ground floor Bay 1.

2.2 CAR BODY INSPECTION & TESTING LINE FACILITY:

This inspection cum testing bay is a ground floor structural building with Centre-to-Centre dimension as 852m(L)x 24m(W) with a clear height of 10 m. No EOT crane has been envisaged in this building. The entire inspection & testing bay is embedded with 2 nos. Combination track (i.e., combination of broad gauge and standard gauge) in the entire length of the bay for the movement of Metro car and other non-Metro car from Fabrication & Assembly line facility to the Car body inspection & testing line facility and from Car body inspection & testing line facility to the dispatch bay. Each track will have an inspection pit of clear size 1.4m(D)x3m(W).

A. STINGER BOX

A 750 V DC power supply Stinger box has been envisaged inside the Car body inspection bay for the testing facility for Metro car.

B. 25KV TESTING TRACK

A 25 kV AC power supply has been envisaged inside the Car body inspection bay for a distance of 210 m for the testing facility for Commuter rails.

C. INSULATION AND DIELECTRIC TEST

In order to check the Insulation resistance and high voltage withstanding capacity of the Insulation part of Cables. The said equipment checks the insulation resistance via insulation tester and passes the various high voltage for various class of cables as per the IEC standard for 60 Sec and the leakage current value to be within the range.

D. EARTH AND RETURN CONNECTION TEST

To ensure the Earthing system of all the sub systems and Individual car earthing and return path are as per standard.

E. VEHICLE CONTROL CIRCUIT TEST

This test is performed to check the following parameters:

1. The vehicle Control and Safety interlocks of train are as per the design via various Simulations.
2. Interlocks with Brake system, Converter Inverter, Horn, lighting system, Speed Control (Static), Pantograph, Static Inverter System, Door System, Signalling System, Shore Supply, Failure of APS via Simulation, Battery system, PAPIS systems, Coupler system, Rescue Operations etc.

F. HVAC TEST

This test is performed to check the following parameters:

1. To ensure the functionality of various modes of operation of HVAC viz Cool1, cool2, Emergency mode, External and Internal Smoke detection etc.
2. To check the quality of return air viz return air temperature, Humidity and airflow distribution in Saloon area.
3. To check the functionality of Dampers.
4. To check and record the Software Versions etc.

G. WHEEL FLANGE LUBRICATION TEST

The following parameter are checked under wheel flange lubrication test:

1. Oil Level in the tank.
2. Functionality of Wheel Flange and Top of Rail Lubricator System.
3. Spray time in Various Modes.
4. Alignment of Nozzles with the wheel flange and top the Rail.

H. CAR WEIGHING & KINEMATIC ENVELOP CLEARANCE TEST:

This test is performed considering the car Weighing System with 8 Load cells (One for each wheel of 2 Bogies) and 80 Ton capacity measures the total weight of the finished car with 10 Kg accuracy.

Exterior clearances of the car body are ensured in a Kinematic Envelope gauge installed on the track.

I. DOOR SYSTEM TEST

In order to check the functioning of the Door system, the following operations of Door system is checked:

1. Smooth opening and closing of doors.
2. Critical Door dimensions.
3. Closing and opening time.
4. Emergency egress and access.
5. Operation of Door Indicator lamps.
6. Opening and closing Time.
7. Pull Force Exerted on Door leaves while closing and opening.
8. Obstacle detection while door closing operation.
9. To check and record the Software versions etc.

J. PASSENGER ALARM AND PUBLIC INFORMATION TEST

This activity is performed using the following operation:

1. Public Announcement to Passengers.
2. Emergency Communication between passengers and Drivers.
3. To Check Various Displays Viz Dynamic Root map, Public Information Displays, Train Number Indicators, Destination indicator displays etc.
4. To Check the communication between Master Cab and Driver cab.
5. To check and record the Software Versions etc.

K. CCTV TEST

This activity is performed using the following operation:

1. Camera Displays on CCTV POE Screen.
2. Orientation of Cameras.
3. All Cameras Functioning Viz Saloon Camera, Roof Camera, Side Exterior Cameras, Obstacle detection camera, Front Camera, Track Camera etc.
4. To check the Data Recording System and retrieve the recorded video and Audio file.
5. Data Password protection in Data retrieving System.
6. To check and record the Software Versions Etc.

L. CONVERTOR INVERTER TEST

This activity is performed using the following operation:

1. To Check The fitness of the various internal Functional Cards of CI.

2. To Check the Input Supply and the required Output Supply with respect to various modes of operation.
3. Powering and Braking Commands available at Input and Output of CI.
4. To check the Load weight, signal available to CI.
5. To Check the output Signals with respect to PWM or Equivalent Signals.
6. Functioning of Protection System of CI.
7. To check and record the Software Versions Etc.

M. STATIC INVERTER TEST / APS TEST

This activity is performed using the following operation:

1. To Check the fitness of the various Internal Functional Cards of SIV.
2. To Check the Input Supply from Main Transformer and the required Output Supply to the corresponding various Circuits viz Three Phase AC, Single Phase AC, 110 V DC etc.
3. To check the Functionality of Battery charger.
4. Functioning of Protection System of Convertor Invertor.
5. To check and record the Software Versions Etc.

N. TRAIN CONTROL AND MONITORING SYSTEM (PCMS TEST)

This activity is performed using the following operation:

1. Input power Supply of various TCMS System viz RIO, Event Recorder, Control and Diagnostic Unit, POE Switches etc.
2. Software version checks of Various Sub Systems of TCMS.
3. Ethernet Communication within TCMS and Other Sub systems (viz. Propulsion, Door, brake etc.) of the Train.
4. Digital Inputs and Digital Outputs of TCMS System.

O. FIRE DETECTION TEST

This activity is performed using the following operation:

1. Fire and Smoke Sensor Functionality Via Simulation.
2. Functionality of Passive Linear Heat Detector Device.
3. Interlock with HVAC.
4. Availability of Smoke and Fire warning to TCMS system.
5. Addressing of the sensors Located at Various locations in the Train.
6. To check and record the Software Versions Etc.

P. WHEEL FLANGE LUBRICATO TEST

This activity is performed using the following operation:

1. Oil Level in the tank.
2. Functionality of Wheel Flange and Top of Rail Lubricator System.
3. Spray time in Various Modes.
4. Alignment of Nozzles with the wheel flange and top the Rail.

Q. BRAKE PNEUMATIC TEST

This activity is performed using the following operation:

1. Brake Piping and Valve Installations.
2. Compressor Operations.
3. Operation of Various Valves.
4. Operation of Safety Valves.
5. Operation of Pressure governors.
6. Operation of Anti-Skid Valves.
7. Pressure Values of Various Sub systems of brake system.
8. Application of Various Brakes Viz Service Brake, Emergency Brake, Parking Brake Etc.
9. Communication with TCMS System, BECU and Converter Inverter etc.

R. BRAKE ELECTRONICS TEST

This activity is performed using the following operation:

1. Communication within BECU systems
2. Communication with CI and Various Sub systems.
3. Pressure Values Viz MR pressure, BC Pressure, Load Pressure (T Pressure), CV pressure etc.
4. Various Braking Commands (Service Brake, Emergency brake, Dynamic Braking) Depending on the mode of Operation
5. BECU Major and Minor faults.
6. Dump Valve Operation.
7. BECU Bus communications.
8. Resistance Check of the Shields of Communication and Shield wirings etc.
9. Communication with TCMS systems.
10. Software Versions check. etc.

S. RUN TEST

This activity is performed using the following operation:

- a. Smooth rotation of wheels.
- b. Direction of rotation of wheels
- c. Current values of the traction motor, if available.
- d. Hustler mode operation, If available.
- e. Direction of operation (FWD & Rev).
- f. Various Door, obstacles detection, SCS switch, operation of Emergency Switches etc.
- g. Application of various Brakes during Dynamic operation of the train.

2.3 INTER BAY TRAVERSERS:

2-Nos. Traversers has been envisaged under this project.

- 1-No. 75-Ton capacity Traverser has been planned between Car body manufacturing & Assembly line facility. The traverser will have area of 240mX32 m.
- 1 No. 75-Ton capacity Traverser will have area of 160m X 32m has been planned within the Car body Inspection & testing bay for the transfer of car/coaches from bays to the dispatch bay.

There is 2-Mode of designated dispatch bay. The Vande Bharat & LHB coaches will be dispatch from the Northern side of the inspection & testing bay by means of railway track and Roads.

The Metro & High-speed AI coaches will be dispatch from the eastern side of the inspection & testing bay by means of surface transport. A goliath crane has been proposed for lifting and lowering of the car from the dispatch bay to the trailer. Laying of combination track(BG & SG) between two traverser for ease and smooth movement of goliath crane.

2.3.1 TRAVERSER

GENERAL

The scope covers design, supply, installation, testing and commissioning of electrically operated traverser along with standard accessories and items required to make traverser fully functional for traversing of rolling stock.

BROAD PARAMETERS

- a) Traverser should meet broad technical parameters detailed hereunder.
- b) Traverser Pit type, Capacity 75T
- c) VVVF drive: step less speed for all motions
- d) Class of Duty M6, for outdoor operation
- e) With hauling mechanism
- f) rail/ rectangular bar runway tracks
- g) Length of traverser and rail/ rectangular bar-24m excluding length of tongues. Length of tongue applicable in case of Surface Traverser. Traversing speed 0-40 m/min. Traverser controls from cabin and RRC.
- h) Rolling stock to be handled by traverser: coaches, Broad Gauge 1676 mm, Standard Gauge 1435 mm & cape gauge 1067mm, width 3660 mm maximum, height 4265 mm maximum from rail level, length 24000 mm maximum and weight 60T maximum.
- i) Top of traverser rail/ rectangular bar should be same as top of shop rail level (Applicable for hauling mechanism) Traction force required on winch to pull two rolling stocks at a time, rope speed 20-30 m/min, length of wire rope 125 m (Applicable for Pit traverser) Depth of pit from top of traverser rail to top of runway track 350 mm maximum.
- j) surface type traverser or any other design meeting functional requirement can also be proposed.

Standard mandatory spares shall also be supplied along with traverser list.

SCOPE

The scope covers traverser complete in all respect along with necessary accessories and items detailed hereunder to make traverser fully functional.

- a) Supply and fixing of rail/ rectangular bar runway tracks with check/ guard rails, fittings etc for movement of traverser for entire length as specified in layout drawing including civil foundation. Bidder should visit site to assess local conditions and incorporate any special requirement in design of traverser. Bidder should provide necessary foundation design for BEML approval and release of drawing for construction.
- b) Supply and fixing of DSL shrouded type complete with supporting masts, brackets, insulators main current collection gear, power-disconnecting switch immediately after

- the main current collection gear for entire length as specified in layout drawing.
- c) Bidder should provide complete earthing on traverser portion and DSL support masts with earthing connection as per IE rules.
 - d) Scope covers power supply, necessary spares, inspection and test certificates, installation and commissioning, documentation, training and warranty etc.
 - e) Supply of maintenance tools & tackles for each traverser: tool box containing all necessary tools like torque wrenches, portable hydraulic jacks of suitable capacity, hand grease gun, set of spanners, screw drivers, nose pliers, hammer, Allen keys of required sizes etc as required for the maintenance of traverser.
 - f) Portable skids- 4 numbers for each traverser
 - g) Hydraulic lifting jacks- 4 numbers for each traverser

CODES AND SPECIFICATIONS

Traverser should be designed, manufactured, erected, tested and commissioned in accordance with IS codes and specifications detailed hereunder or equivalent international standard like DIN.

- a) IS 3177-1999 (latest) Code of practice for EoT traversers and gantry traversers
- b) IS 807-2006 (or latest) Design, erection and testing (structural portion) of traversers and hoists
- c) IS 2266-2002 (or latest) Steel wire ropes for general engineering purposes
- d) IS 3938-1983 (or latest) Electric wire rope hoists
- e) IS 15560-2005 (or latest) Point hooks with shank up to 160T
- f) IS 2760-1980 (or latest) Steel chain slings.
- g) Traverser structure and parts of traverser mechanism should conform to class of duty specified as per IS 807-2006 (or latest)

If any condition mentioned in this specification is at variance with that of IS standard, technical specification hereunder shall prevail.

DESIGN FEATURES

Traverser should be designed as per codes and specifications (or equivalent international standard like DIN) and broad technical parameters, detailed herein above. Traverser should comply with relevant safety regulations under the Factories Act, Indian Electricity Rules and other statutory regulations as applicable. Traverser shall be manufactured and erected to tolerances:

- a) Span over LT wheels ± 6 mm
- b) Diagonal on wheels ± 5 mm
- c) LT wheel alignment ± 1 mm

Traverser should be simple and compact design with equipment and controls conveniently located to facilitate easy access and maintenance. Controls should be interlocked to prevent accidental movement. Electrical controls and motors should be protected from rain and water logging in pit. Suitable limit switches should be provided to stop over travel of traverser.

Suitable guards or enclosures should be provided to prevent inadvertent contact with DSL or other exposed electrical conductors and cables. Suitable isolation switches and stop buttons should be provided to isolate electric supply for maintenance and or in case of an emergency. Components and equipment provided below platform shall be accessible by opening hinged cover for maintenance.

Open gears should be avoided in wire rope handling area to prevent entangling of wire rope with moving parts. Electrical and mechanical equipment should be protected with weather proof covers, which could be easily removed. Electrical cables should be laid to prevent damage and could be easily inspected and maintained.

Suitable jacking pads should be provided on each four corners of bridge along with four hydraulic jacks of suitable capacity for jacking of traverser. Traverser bridge should be provided with safety stops to prevent traverser from falling more than 25 mm in case of breakage of track wheels or axle. These safety stops should not interfere during removal of wheels. Square/ rectangular bar/ rails should be provided on bridge platform for placement of rolling stock. Suitable skids should be supplied along with traverser to prevent rolling of rolling stock.

Traverser platform covered with chequered plate should have adequate clearances, minimum 600 mm, on all sides after placement of rolling stock. Spring-loaded buffers having contact surface not less than 125 mm diameter should be bolted on four corners of traverser and should have energy absorption capacity for stopping traverser in either direction travelling at speed of at least 40% of maximum rated speed with full load. Safety hand railing of tubular construction should be provided on bridge foot walk staircases, landing in cabin etc where access has been provided. Operator's cabin should have easy access and provide unobstructed view of movement of rolling stock. Cabin should accommodate electrical equipment. Cabin should be double walled construction for roof and side panels (except for glass panel) with thermal insulation. Operator should be able to operate traverser in sitting/ standing position. Cabin should have fan, lighting, fire extinguisher for electrical fire etc. Mirrors shall be provided to assist in viewing.

Scope covers supply of DSL and current collection gears shrouded and color-coded four bar DSL system of suitable rating. Current carrying shunts from collectors should avoid contact with adjacent collectors and ensure operation during rain. Current collectors should be provided with multi-strand 1.1 kV grade PVC insulated cables. Armoured weatherproof 1.1kV grade copper cable of adequate size shall carry current from junction box to isolating switch near current collector on control panel of traverser. Current collector shoe should be sintered copper graphite material. Current collector should have stainless steel arms and stainless-steel spring for pressurized contacts to withstand variation of +100 mm in vertical and horizontal plane. Shrouded bus bar system should be complete with all accessories like end caps, joint covers, power feed kit, jointing tool etc. Bus bar should be protected by galvanized MS hood on top to protect from rain. opposite side when rolling

stock is standing on bridge platform.

Monorail with hoist should be provided to facilitate dismantling / lifting of equipment for repair / maintenance. Alarm should be provided to caution workers. A continuous ringing alarm should be provided for LT motion. Controls should be interlocked to prevent accidental movement of traverser. Suitable limit switches for LT should be provided to stop and to prevent over-travel. A mushroom head type push button shall be provided in operator's cabin so that main incoming circuit breaker can be tripped in emergency condition by pressing operating head. Pilot lamp in control circuit shall glow when any switch is operated. AC variable frequency control (VVVF) for LT should be used by using independent variable voltage variable frequency drives. Common controller for both LT motors may be used. LED lighting should be provided in operator's cabin, staircase etc. Bulkhead fittings with dust proof covers should be used for above areas.

Traverser should be illuminated with LED lights for night operation. Traverser should be fitted with built-in inching device for LT and winch movement for accurate positioning of traverser for loading/unloading of rolling stock. Compact geared motors on LT should be provided with built in electromagnetic fail-safe disc brakes with braking torque not less than 100% of full load torque. Labels of a permanent nature should be provided on switches, fuses, contactors, relays, panels, controllers, resistors etc to facilitate identification of circuits. Earthing should be affected through fourth conductor of DSL and structure. Electrical equipment mounted should be connected to structure by means of electrical earthing links

Scope covers supply of portable push button type radio remote control along with two-step push button type transmitter, receiver, antenna & cable, two sets of rechargeable batteries, battery charger and other standard accessories and items for controlling all motions of traverser.

- a) Radio remote control shall be provided in addition to main control system through pendent/master controller.
- b) Transmitter of radio remote control should meet features like three stage audible and visual low power warning; audible and visual alarm; removable magnetic key (waterproof); shock resistant to 50G, password protection, narrow band FM, large mushroom E-stop switch, AA rechargeable batteries, internal antenna, programs receiver from ground through RE communication (no need to climb on traverser to change frequency or address), two dual axis joysticks, range 100 m, 16 strap for transmitter slinging etc.
- c) Receiver of radio remote control should meet features like power interruption protection, relay's contacted failure detection circuit, shock resistance mounting provision, impact durability up to 20G, external integrated antenna, enhanced watchdog circuit, FDDI (frequency deviation detection indicator) tracing circuit, signal alarm, light and E-stop button etc.

3. ARCHITECTURAL WORKS

3.1 INTENT OF THIS DOCUMENT

This chapter provides the Preliminary Concept plans of Technological and Non-technological buildings which are to be constructed in Greenfield Rolling Stock Manufacturing Plant of BEML at Bhopal.

This document also contains details of finishes such as painting, flooring, doors, windows, false ceilings, railings, partitions, toilet fixtures etc. which are to be followed in all the buildings (Technological and Non-Technological Buildings).

The write up of all buildings which describes the design considerations to be followed during design of building.

3.2 METHODOLOGY OF DESIGN

The following codes are to be followed in the design of the buildings

1. National Building Code 2016
2. Relevant IS Codes
3. Local Bye – laws
4. Aviation Department Rules
5. Fire Departments Standards / Regulations

4. LIST OF FACILITIES

The Following Facilities are being considered.

4.1 NON-TECHNOLOGICAL BUILDINGS:

1. Office Complex
2. Canteen Building
3. Medical Centre
4. Safety Office
5. Fire Station
6. Main Gate Complex with security Office
7. Gate complex for material movement with security office.
8. Gate complex for Railway Siding
9. Multilevel Parking

4.2 TECHNOLOGICAL AND UTILITY BUILDINGS / FACILITIES:

1. Car Body Fabrication & Assembly Line Facility
2. Car Body inspection and testing Bay
3. Water Supply and Fire water pump house
4. Electrical Substation+ EPSS
5. Centralised Gas Bank
6. Chiller Plant
7. Road Weigh bridge and office
8. STP
9. Raw Material Storage Yard
10. Traverser
11. Goliath Crane.

5. DESCRIPTION OF NON-TECHNOLOGICAL FACILITIES

5.1 BUILDING DESIGN CONCEPT

Occupant comfort in buildings is crucial for a positive living or working experience. Biophilic architecture has become a key design strategy in improving occupant comfort. The core idea behind biophilic design is to integrate natural elements into architectural spaces to create a stronger connection between people and the natural. This connection is known to enhance well-being, reduce stress, and improve productivity.

It is hence proposed to provide building designs with “BIOPHILIC ARCHITECTURE”

5.2 GREEN BUILDING

The need for Green Buildings arises from the requirement to create a sustainable built environment that minimizes environmental impact while enhancing human well-being.

5.2.1 ADVANTAGES OF GREEN BUILDINGS

- Lowering of Carbon foot Print
- Significant savings on energy and water.
- Low-VOC paints reduce health issues and increases occupant comfort
- Improves mental health, focus, and productivity due to presence of ample Natural lighting and ventilation.

5.2.2 GREEN RATING SYSTEM

In India, "Green Rating" refers to the evaluation and certification of buildings, companies, and industries based on their environmental sustainability practices. These ratings are awarded by various organizations to promote energy efficiency, resource conservation, and reduced ecological impact.

The following are the types of Rating system available in India

1. IGBC – Developed by CII (Confederation of Indian Industry)
2. GRIHA – Developed by MNRE and TERI
3. GRIHA 3-Star rating has been made mandatory for all new central government buildings and public sector undertakings (PSUs) in India. This requirement was announced in 2010 by the Ministry of New and Renewable Energy.

Hence, all non-technological buildings shall be planned and constructed as a GRIHA rate/certified building with minimum GRIHA 3-star rating.

The Designs are to be complied with all the standards such as orientation of building, building materials, energy usage etc. shall be as per GRIHA Manual.

6. SPECIFIC DESCRIPTION OF FACILITIES

6.1 OFFICE COMPLEX:

The building is a G+5 Configuration (RCC type) which can accommodate 170 occupants. Total Built up area is 5338 Sqm equipped with Fully centralised air-conditioning facility. This

building suite is BMS compliance building. Solar heater on the roof top has been provisioned for supply of hot water.

This building is conceived as an iconic structure and will serve as the face of the BEML's facility. It is designed to accommodate approximately 170 occupants. This facility shall be RCC Framed structure with Ground + 5 Floor configuration. It includes a variety of functional spaces such as:

- Canteen
- Covered parking for senior executives
- Discussion rooms
- Welfare facilities including indoor games, reading rooms, gym, and open gathering spaces.
- Office spaces for various departments (HR, Admin, Purchase, Accounts, Plant In-Charge, Director, CMD's Office cum Lounge).

The layout has been consciously designed with key areas such as the office spaces, canteen, and discussion rooms arranged around a central water body (Triplex), providing both visual appeal and functional connectivity.

The infill material shall be AAC (Auto-Cleaved Aerated Concrete) blocks. All the External walls shall be 200 mm thick AAC blocks. The overall size of building shall be 22m x 36m Approximately. The approximate plinth area shall be 750 Sqm. Overall height of each floor shall be 3900 mm.

OFFICE SPACE DESIGN GUIDELINES:

- **CABINS:**

The Cabins shall be provided with 100 mm thick gypsum dry wall partitions as per requirement to provide flexibility in design. All cabins shall be provided with false ceiling. The area of each cabin shall be a minimum of 17 SQM. The minimum width of cabins shall be 3000 mm The depth of cabin shall be Minimum 4500 mm.

- **CORRIDORS:**

Corridors in office spaces shall be minimum of 1500 mm. All rooms shall be provided with adequate lighting and ventilation as per NBC.

- **BUILDING FAÇADE:**

The facade of the building has to be aesthetically designed. Under no circumstances the utility pipes shall be visible on the main façade.

Grooves in plaster shall be planned at the intersection of RCC elements with masonry work. (Beam wall junctions and wall column junctions). Facade is to be aesthetically appealing and combination of different treatment such as dry-stone cladding, ACP (aluminium composite panel), Rustic textured paint, Exterior grade acrylic emulsion paint. Etc., should be planned in consultation with BEML before execution.

All the beams in Balconies shall have seamless soffit. There shall not be any undulations / variations in the depth of beams planned.

6.2 MEDICAL CENTRE

This facility shall be RCC Framed single storeyed structure. The infill material used shall be AAC blocks. The Overall size of the building shall be 29 m x 10.8m approximately. The approximate plinth area shall be 300 Sqm. The Overall floor height shall be 3900 mm. The building shall have the following minimum facilities.

- Lobby
- Waiting Area
- Consultation Room -2 Nos
- Clinical Test Room
- Treatment Room
- Minor OT
- Recovery rooms
- Toilets
- Utility Rooms

6.3 CANTEEN BUILDING:

Canteen Building has been proposed in strategic locations for the breakfast, lunch, evening snacks & dinner for the personnel / workers working inside the plant premises.

This facility shall be RCC Framed single storeyed structure.

The size of the building shall be 65m x 56 m.

The approximate plinth area shall be 3015 Sqm. Equipped with Fully centralised air conditioning facility. which can accommodate the spaces such as Dining area for 800 occupants, (200) BEML Executives, (200) BEML Workers & (400) Contract workers, cooking area, separate preparation area, cooking area, storage for grains, washing area, hand wash area with toilets etc. adequate cooking equipment's is to be planned / procured. Kitchen Equipment's is a specialized subject, hence the cost of the same is not considered in this document.

This building shall be planned with adequate number of toilets and Shower as per NBC Guidelines.

6.4 SAFETY OFFICE

The functionality of the safety office is to provide a general training on the safety inside the manufacturing plant. The overall building is a ground floor RCC building of size 18m X 15m. The building accommodates the following facilities:

- Office area
- Conference hall
- Waiting area

6.5 FIRE STATION:

This facility shall be RCC Framed single storeyed structure. The infill material used shall be AAC blocks. The Overall size of the building shall be 27m x 12m approximately.

The building shall be planned for accommodating 2 no of fire tender with one bay for inspection. The Overall height of Building for Main fire station part shall be 3900 mm (10.8x12m) and for Fire Brigade area (Parking and inspection area) the same shall be 6000mm (16.2x12m).

The building shall have the following minimum facilities.

- Foyer
- Main Fire Station
- Fire Tender Parking Bay – 2 No
- Inspection Bay – 1 No
- Crew Rest Room
- Toilet

6.5.1 FIRE FIGHTING SYSTEM:

GENERAL

Firefighting shall be installed as per requirement of National Building Code -2016 (NBC). All the buildings shall be classified according to the use or nature of hazard occupancy in following groups.

- Group G Industrial

The specifications for Fire Fighting system elaborated in different chapters are generally based on NBC (latest) / TAC codes (India) / NFPA codes and BIS specification as applicable.

DESIGN BASIS

Considering the above building occupancy, the hazard classifications (Light, Medium, and High) of buildings / area are derived from the standards mentioned below.

- NBC-2016, part-4.
- BIS: 13039: 2014
- TAC – Fire Protection Manual

As per BIS norms, the various Buildings of Rolling Stock Manufacturing Plant Area Comes under “Engineering work shop, godowns and water pump house.” As per this classification, the degree of Hazard of Rolling Stock Manufacturing Plant premises is “**Light Hazard Occupancies**”.

As per TAC, Clause no.7.2, the various Buildings of Rolling Stock Manufacturing Plant area comes under “Electric substation/distribution station, Engineering work shop, godowns and water pump house.” As per classification, the degree of Hazard of Rolling Stock Manufacturing Plant premises is “**Light Hazard Occupancies**”.

As per NBC-2016, Annex-B of Part-IV, the various Buildings of Rolling Stock Manufacturing Plant area comes under “Engineering work shop, godowns and water pump house.” industrial Occupancies. As per classification, the degree of Hazard of Rolling Stock Manufacturing Plant premises is “**Light Hazard Occupancies**”.

From the above, it is concluded that the Rolling Stock Manufacturing Plant premises is categorised under Light Hazard for providing the Fire Fighting and Safety system to protect the area/premises.

6.5.2 FIRE FIGHTING SYSTEM REQUIREMENT

The starting Point for design and provision of Firefighting protection system is based on the hazard classification of buildings, type of building occupancy, fire risk Involved etc. The requirement of firefighting system has been designed based on the following Codes and standards.

- NBC-2016, part-4.
- National Fire Protection Association (NFPA) standards 13, 14, 72, 2001.
- BIS: 13039
- BIS: 3844
- Tariff Advisory committee (TAC) FP Manual & Rules on Sprinkler

In order to combat any occurrence of fire in various areas/units of the Rolling stock Manufacturing Facilities, an elaborate system of firefighting facilities have been provided as per above standards/norms.

- Fire Water pumping system
- Yard Hydrant system
- Wet Riser system
- Hose reel system
- Fire Brigade Connection
- Automatic Sprinkler system
- Fire Tenders
- Portable Fire Extinguishers
- Fire Detection & Fire Alarm System

6.5.3 FIRE WATER PUMPS & ACCESSORIES

General

The Rolling stock Manufacturing plant, premises shall be provided with Fire Water pumping systems comprising mainly of the following and details as follows:

Fire Water Pumps

One number of firefighting pump house is envisaged for catering to fire water needs of the proposed. The following electrical driven firefighting pump, diesel engine driven pump and Jockey pumps are envisaged.

Sl NO	Description	Capacity (cum/Hr)	Head (mWC)	Qty
1	Electric Driven pump	171	88	3
2	Diesel Driven pump	171	88	2

3	Jockey pump	18	88	2

Reference of Drawings

The P&ID Diagram of Fire Water Pumping System are shown in the Drawing No. MEC-I0047-01-14-D1-ZZ-ZZZ-DR-N-04001 (Refer Enclosed Drawing).

Description Fire Water Pumping System

The fire hydrant system and Spray system have been provided considering fully automatic operation of pumps and control systems. Normally, both systems shall be kept pressurized at a pressure of 7.0 Kg/cm². To take care of minor leakages from the systems two number jockey pumps common for Fire hydrant system have been provided. When there is leakage of water from either system, first jockey pump shall start automatically so that system pressure is maintained at 7.0 Kg/cm².

In case of fire, when any landing valve / yard hydrant is opened, the water pressure in the respective network shall drop resulting in automatic starting of main electric pumps for respective system at the present low pressure in headers. If the main electric pumps for hydrant fail to start or trip, the diesel engine driven pumps shall start automatically. Whenever the Main fire pumps are working, the jockey pumps shall not work. Also when the header pressure drops beyond a present value, the Diesel Engine pumps shall start even with main pumps (motor driven) running.

Complete system shall be provided with Auto as well as local mode of operation. The local mode of operation shall override the Auto mode. Individual selector switches (Local / Auto / off) shall be provided for drives of Pumps. For jockey pumps, the selector switches shall also have a selection for reserve pump.

Static water tank of 513 Cum useful volume with compartment for Fire Water system shall be provided. The pump suction header shall be connected with common header. The common header connected with sump with two inlets.

Broad Technical Parameters of Static Water Tanks and FWPH

- The static water sumps shall be provided with RCC Construction and Shape is rectangular.
- To facilitate cleaning dewatering pit shall be provided in both static water tanks.
- The pipe network and valves within the pump house shall be adequately supported so as to avoid undue stress on the equipment.
- Suitable toe drain, connected to garland drain shall be provided in the pump house to drain out any spillage of water from the glands etc.

Fire Fighting Pumps

The Horizontal centrifugal pumps shall conform to the following codes, standards regulations wherever applicable:

S. No.	Codes	Description
1	IS-12469-1978 (R.A 2011)	Specification for Pumps for Fire Fighting System
2	IS-5120-1977(R.A 2001)	Technical requirement for Roto-dynamic special purpose pumps
3	IS-9137-1978(R.A 2002)	Code of acceptance for centrifugal, mixed flow and axial flow pumps - Class 'C'
4	BS-5316, Part-I-1977	Acceptance tests for Centrifugal (ISO-3555-1977) mixed flow and axial flow pumps - Class 'C' tests
5	BS-5316, Part-II-1977	Acceptance tests for centrifugal (ISO-3555-1977), mixed flow and axial flow pumps – Class 'B' tests
6	Hydraulic Institute standards of U.S.A (Latest Edition)	
7.	PTC 8.2 – 1965	Power Test Code – Centrifugal pumps

The horizontal centrifugal pumps along with their auxiliary equipment shall be suitable for the required duty conditions and shall be designed and manufactured for continuous duty at full load.

The motor rating shall be of continuous; rating type and its rating shall be equivalent to the horse power required to drive the pump at 150% of its rated discharge.

Capacity Vs discharge pressure curved for each pump shall be continuously drooping from the shut-off point to the rated operating point and be suitable for parallel operation. The pump shall be designed to avoid cavitation at any of the operating points. The characteristic of the pump shall be non-over loading type.

The required duty range for a pump shall be on stable portion of its head capacity curve close to the best efficiency point. The head developed at the best efficiency point shall be close to the required differential pressure so that throttling is not required at pump discharge. Pumps shall be capable of supplying not less than 150% of rated capacity at a head of not less than 65% of rated head. The shut off head shall not exceed 120% of rated head.

The equipment design shall incorporate provisions for reduction in noise level. For Diesel engine driven pumps, Noise level shall not exceed 110dBA at 1 metre from the equipment and for other equipment, it shall not exceed 85 dBA at 1 m distance from equipment.

Casing

The casing shall be designed for a pressure not less than the shut-off pressure at the highest operating speed or the maximum pressure that may be encountered at the pump inlet. Jack screws, lifting lugs, eyebolts or equivalent horizontal positioning screws and guide dowels etc. shall be provided in the casing to facilitate alignment disassembly and reassembly. When

jack screws are furnished as means of parting contacting faces, the catching face shall be counter bored to receive the jackscrew.

Running clearance between wearing rings and other moving parts shall be such as to prevent seizure under the operating conditions of temperature, suction conditions, characteristics of the fluid handled and the expansion characteristics of the wearing ring material.

Impellers

Impellers shall be statically and dynamically balanced. Dynamic balancing shall be at the operating speed of the pump.

The impeller shall be securely locked and keyed to the shaft in a way such that it is not loosened due to reverse rotation of the pump.

Shafts

The shafts of all the pumps and drive motors shall be designed for combined critical speed. The ratio of critical speed to speed of shaft shall be not less than 1.2.

Shafts shall be easily accessible throughout their lengths. All steel shafting 150mm or less in diameter shall be hot rolled and turned, forged and turned, cold rolled or cold drawn. All shafting above 150mm in diameter shall be forged and machined to size.

The deflection in line shaft shall not exceed 0.1 mm per meter length. All shafts above 150mm diameter shall be ultrasonically tested. Shafts shall be checked for endurance and strength. Change of sections in shafts if considered shall be made with due allowance for stress concentration. Shafts shall be machined to close tolerance for mounting on impeller bearings, shaft seal, shaft sleeve, shall not exceed 50 microns.

Coupling and coupling guard

The pumps shall have flexible coupling with motor. Removable coupling guards shall be supplied and mounted. Guards shall be sufficiently heavy and rigid to provide adequate safety to personnel.

Shaft sealing

Shaft seals shall be provided to prevent leakage out of, or into, a pump over the range of specified operating conditions including reverse rotation of the pump. The seals shall be suitable for variations in inlet conditions that may prevail during start-up and shut down. They shall be accessible for inspection and replacement without disturbing any part of the installation.

Packed glands with supply of sealing liquid shall generally be used. Packed glands shall be sufficiently deep to accommodate at least five packing rings and shall not require separate lubrication. A lantern ring sandwiched between rows of packing shall be provided for packed glands subject to vacuum split type lantern ring shall be used so that the same can be taken out easily. Throat bush or collar ring is to be provided with the casing to support the packing inside the gland. Provision shall be made for tightening the pump glands during running of the pumps.

Sealing connection to the lantern ring shall be taken from the pump discharge while handling clear and non-aggressive liquids.

Bearings

Bearings shall be manufacturer's standard design and of water lubricated sleeve type. Suitable thrust bearings shall be provided in the pump to take total thrust of the pump including hydraulic thrust. Thrust bearings shall be oil lubricated type with suitable cooling arrangement. Suitable tapped holes shall be provided for refilling of oil in the bearing housing.

Bearing oil temperature shall not exceed 72⁰ C based on continuous operation for anti-friction bearings and 62⁰C for white metal bearings under specified operating conditions. Bearings may be water or air cooled to maintain oil temperature within the limitations. Where water cooling is required, either water jackets formed by cored castings or cooling coils may be used. Cooling jackets shall not offer possibilities of leakages of coolant into the bearings.

Bearing housing shall be of such design as to exclude entry of water, dust and other contaminations. When the housing serves as an oil reservoir, an oil level indicator shall be furnished.

Oil lubricated bearings shall be equipped with constant level oilers with the recommended oil level clearly indicated by permanent marks.

The bearing housing used with grease lubricated bearing shall be constructed as to require the grease to pass through the bearing when being forced from the inlet fitting to the vent or drain plug.

Companion Flanges Bolts, Nuts & Gaskets

Plate flanges having raised face shall be provided at delivery side of pumps and they shall be of mild steel and conform to the relevant table of IS: 6392 -1972 (R.A. 1988)

SS bolts and nuts conforming to IS: 1363 shall be provided for the companion flanges and column pipe connections.

The MOC of the parts shall be as follows:

Hardware in contact with water: SS 304.

Hardware not in contact with water: IS 1367 – Class 4.6

Heavy Hex. Nuts Cs: IS1367 / ASTM A 194 GR 2H IS 1364 CL4. Rubber gaskets conforming to IS:638 shall be provided for the companion flanges.

Broad Specifications of Fire Water Pumps

A)	Fire water pumps	:	• 171 m³/h, Electrical driven = 3 Nos. • 171 m³/h, Diesel Engine driven = 2Nos.

6.5.4 FIRE TENDERS

DCP fire tenders

S. N	SCOPE OF WORK / SUPPLY
1	GENERAL: DCP tender contains 4000kg of dry power in 2 vessels (2000kg each). The DCP tender fabricated on tata LPT 2518 / 48 or Ashoka chassis 2516 or Volvo or Mahinda AMW or EICHER. The DCP unit itself will have independent expellant gas assembly to discharge powder through two hose reels fitted with triggered type pistol grip nozzle from each vessel
2	CHASSIS: Modal: TATA LPT 2518 2518 / 48 or Ashoka chassis 2516 or volvo or Mahinda AMW or Eicher. Along with 1-sparer wheel / stepney
3	DCP Tank: 2-Nos
3.1	Material: 2- cylindrical tanks fabricated as per ASME code VIII Div-1 with 10 percent radiography of seams and 100percent radiography of T-joints. Tank hydraulically tested to 35kg/sqcm test certificate also shall be furnished at the time of inspection
3.2	Anti-corrosive treatment: sand blasting / tin coating from inside/ outside synthetic enamel PO-red in colour
3.3	Capacity: 2000kgX2Nos
3.4	Sheet: SA 515 Grade 60/70 or SA 516 GR 60/70
3.5	Shape: cylindrical
3.6	Design pressure: 20 kg/ sqcms
4	Safety disc: 1-no with each vessel
5	Safety valve: burst disc on tank calibrated to 21kg/sqcm
6	Free fluidity of DCP: Perfect fluidisation achieved through a set of diffuser nozzle
7	Working pressure of system: 14kg/sqcm
8.1	Nitrogen cylinders: Each tank mounted on the unit-8 Nos
8.2	Total 16 Nos end to cylinders
8.3	Capacity 56/60 litre (only one capacity to be in tender)
9	Expansion shock device: Independently provide each vessel to ensure that fluidity of dry powder is constantly maintained
10	Hose reel:
10.1	Quantity 2nos for each tank
10.2	Hose size 25mm X 30m long
10.3	Nozzle: trigger type piston grip nozzle
10.4	Discharge rate: 5kg/sec at a pressure of 14kg/sqcm
11	Monitor: 1-having 14kg/sec, 25kg/sec and 15kg/sec discharge rates at 3-position, the throw being approximately 45meter, 30 meter and 20meter respectively. Monitor traversing through 360 degrees in horizontal and +70 degree and -15deg in vertical plain
12	Driver cab
12.1	Type: -Close type with single compartment
12.2	Material: MS square tube 30X30X2mm structure, externally panelled with al sheet 16 SWG, internal panelling al sheet 16SWG
12.3	Seat: 2no plus one full six crew seat
12.4	Flooring: Al chequered plate 16SWG
12.5	Doors and lockers: 2-nos (1 on each side)
13	Controlled panel
14	Aluminium extension ladders 10.5m (IS:4571)—1 NO
15	Shovel (as per IS:274)- 1 NO

16	Pick axe small as per IS:550-1 NO
17	Fire man Access:(IS 926) -2 NO
18	Pick axe large as per IS:550-1NO
19	Accessories
19.1	Electric siren-1NO
19.2	Fog lamps-2NO
19.3	Reversing light-1NO
19.3	Traficators-1 set
19.5	Trafficators blinker type-1-set
19.6	Wind screen wipers 1-no
19.7	Tools for normal routine maintenance
19.8	Search light with 30meters cable
19.9	Adjustable spotlight
19.10	Inspection lamp
19.11	PA-system suitable for outdoor duty and capacity 1-No
19.12	Tool box for general maintenance kit-1-set
19.13	First aid box-1 no
19.14	Mud guard-1-set
19.15	Hydraulic jack 25-ton capacity-1-no
19.16	Spark and surge arrester: CCE approved spark and surge arrester along with original certificate to be handed over to BEML with supply 1-No
20	Finish 2-coats of primer NC based fire red (PO-red) in middle, inside cabin cream colour
21	Painting: name of department: BEML ltd in Hindi, and English must be painted on both the side
22	Acceptance tests: The acceptance test mentioned below to be given to complete satisfaction of inspecting officer
22.1	Stability: No overturning of fully Ladden and equipped vehicle at a horizontal angle of 27 degree from horizontal plane
22.2	Gradient: To be tested at an angle of 1:4 as per BIS
22.3	Articulation: to be tested for articulation and should not show any sign of stress during the test the clearance of the wheel wells to be checked for tolerance
22.4	Shower test: after completion of fabrication, the vehicle to be subjected to shower test as per the norms lead down under BIS the plan should not show any sign of leakges during test
22.5	Road Test: Road test to be carried out as per the parameters for breaking acceleration top speed etc...
23	Performance guarantee: manufacturer guarantee for design material workmanship and the performance of the complete unit for the period of 12-months from the date of commissioning of completed vehicle. Any mechanical defect, faulty workmanship or operational defects found during this period to be rectified by the vendor at BEML premises within reasonable time without any extra cost of BEML. The tank to be warranted against leakage for a period of 5-years after supply in writing.
24	Training: After supply of vehicle, vendor will provide training on operation and maintenance including chassis at BEML's site & charge for the same to be included in the price. Additional free training to be given at BEML's site within warranty period & when desired by BEML.
25	Approvals:
25.1	All equipment being quoted by vendor shall confirm to the latest version of relevant Indian standard.
25.2	Vendor shall mention the relevant standard reference, against each item governed by the

	Indian / overseas
25.3	vendor shall agree to provide certificates in original of all necessary or mandatory approvals in respect of the fire tender before dispatch to BEML Bhopal.
25.4	On placement of order, Fire tender is to delivered at BEML Bhopal. Transit insurance shall be included in vendors scope.
25.5	After supply, vendor shall provide training in operation of their systems free of cost to BEML/CISF personnel.
25.6	On final supply, operation and maintenance manual, any electrical system manual etc., shall be handed over to BEML. All guarantee certificated for any/All accessories installed on the fire tender, shall be handed over to BEML.
25.7	Along with Techno-commercial offer, vendor shall submit a separate sheet listing all items (Installed on DCP Tender)
26	INSPECTION: -
26.1	All the inspection shall be carried out against relevant IS & Tender technical specification of BEML Jointly
26.2	Vendor shall agree to offer stage inspection of the fire tender in three stages. a) 1 st inspection for Tank & Allied Accessories. b) 2 nd inspection for body work on chassis. c) 3 rd inspection shall be final Pre- dispatch inspection 3 rd inspection will be done by CISF & BEML jointly.
27.	ERECTION & COMMISSIONING: Since the item is ready to use type and shall be delivered in ready to use condition in BEML, Bhopal. However, supplier's representative shall come & will make all the system fully ready to use again & demonstrate use of all items. And shall import training to our working personnel (Training period 7-days). Defect free & uninterrupted demonstration shall be contributed as successful commissioning. Further, Guarantee period will start after successful commissioning. Fuel required during the demonstration at BEML works shall be arranged by the vendor.
28	Registration at Bhopal: BEML shall arrange registration at Bhopal and annual insurance for vehicle.
29	Transit insurance as applicable for automobiles as per Govt. rules from the point of delivery to BEML CRX shall have to be arranged by vendor.
30	For Delivery: Vendor has to deliver the vehicle at the works of BEML, Bhopal & shall have to arrange driver / fuel / insurance, any other applicable documents etc., and other leviable Govt. Duties from various states where vehicle is passing. All bills' challans, receipts etc in respect of vehicle shall be handed over to BEML by vendor at the time of Delivery.

Water Bowser

1	Chassis: - (included in vendors Scope) capacity = 25T, 280 BHP, type= MAN CLA or TATA or VOLVO or Mahindra or Eicher or Benz or Ashok Leyland along with one spare wheel / stepney. Drag Hook or eye of adequate strength and design to be provided at the rear & front of chasis by vendor
	PUMPING SYSTEM: -
	Type – centrifugal
	Make – Firefly or go-Vida or Rosenbauer
2	Discharge capacity – minimum 6000LPM at 8 kg/sqcm

	Material of construction: The pump body, casing, impeller and delivery outlet to be made of gun metal / bronze / stainless steel only. The pump should not have any aluminium parts. The impeller shaft to be of stainless steel and to be carried in anti-friction bearing as per the manufacturers standard design. Bearing housing to be of CI drain valve to be made of stainless steel.
	Pump suction inlet: The suction inlet of the pump should be capable of being connected either directly to hydrant discharge outlets through header or to the water tanks of the vehicle. Size of inlet should not be less than 140mm or 2X 100mm. The connection from the water tank to the pump to be suitably sized (min 150mm).
3	Pump discharge outlets: there to be 6 outlets of 63mm each of standard size 63 mm with screw down type gun metal (LTB GR.2 of IS 318). Delivery valves having female couplings.
	Pump mounting: the pump to be rear mounted. Pump will have at least 4-mounting points, the mounting to be done on heavy "C" channels / plates only.
	Shaft sealing: self adjusting type.
	Pump control panel: the entire system of control panel to be of open architecture type which will ensure that both the scheduled operation as well as preventive maintenance is affected easily. The control panel will have the following: - Pump to delivery outlets - Pump to monitor pump to colling line - Tank to pump suction - Outside source to pump suction - Water level indicator The above-mentioned connections are the min. requirements. Other connections / controls as maybe required can be provided by the manufacturer. The "pump engaged" indicator LED type will also be provided in the driving compartment along with the one mentioned on the control panel above to indicate that the pump shift has been successfully completed to the driver as well as the operator.
	Pump priming system Type: twin piston reciprocating or water – ring or exhaust ejector type Make: firefly or GO-Vida or Rosenbauer or equivalent make Capacity: priming system must be capable of lifting water from 7-meters depth within 24 seconds.
	HP- pump The HP pump to be fully imported, CE certified / UL listed, separate unit driven by the side PTO of the Chassis. The capacity to be 150 LPM @ 100kg/sqcm pressure. The pump will have six plungers & positive displacements, working to its optimum capacity at not more than 1000RPM. Indigenous three piston / diaphragm pumps will not be accepted. The pump to be guaranteed for a min life of 5000HRs of operation.
5	HOSE REEL Two hose reels (High- pressure type) to be provided for the auxiliary pump. The hose used would be minimum R1 type & rated for 130 bar working pressure. Two high pressure fog guns capable of discharging 75 LPM @ 100kg.sqcm pressure in jet or fog patterns to be provided at the end of the reel. The jet range to be minimum 25mtrs.
6	POWER TAKE OFF (P.T.O): The P.T.O of heavy-duty type of a suitable ratio for the rated output of the pump & torque of the vehicle to be provided. The lever / switch for engaging the P.T.O to be provided in driver cabin. Necessary supports for PTO units, propeller shaft coupling, universal joints etc for power inputs to and output from PTO units will have to be provided by vendor. MAKE: WEBSTER 4128 or SYALL or VAS.
7	COOLING SYSTEM: in addition to the radiator cooling. An indirect cooling system of the

	open circuit type to be provided to keep the engine from overheating during extended use in tropical climates & when ambient temperature is over 50degree Celsius. A flexible pipe, atleast 5-meters long to be provided as spare, so that waste cooling water can be discharged away from vehicle. The pipe will have threaded end connectors.
8	Water Tank: the water tank to be of minimum 10000lts. Capacity & to be suitable mounted on the chassis in such way that the weight distribution is optimised. In addition, a 2% expansion space to be made in the tank over & above the water capacity. The tank to be fabricated out of MS plates min 5mm thick (externally epoxy painted & internally FRP Lined) all around except the top and baffle plates which to be of 4mm. the tank to be welded construction & to be die – pressed on all side to prevent distortion & to ensure torsional rigidity. Due care to be taken to ensure that butt-welded joints are minimized. Wherever butt-joints are unavailable, the soundness of weld-joints complete welding to be done using Mig welding process only. The tank to be hydraulically tested at 0.5kg/sqcm pressure to find out if there are any leakages. All the joints to be flanged type and will have O-ring sealing. Rubber gaskets will not be used anywhere in the plumbing. All the outlets and inlets from the tank to be taken by installing nozzles of suitable length and reinforcements pads.
8a	BAFFLES: thickness of baffle plate to be minimum 4mm and should be bolted type, the baffle to be designed that they do not distort / buckle under any circumstance during braking & cornering.
8b	MOUNTING: the tank to be mounted on rigid mountings which will prevent distortion due to chassis flexion. Suitable hooks / lifting eyes. To be provided on top of the tank to enable it to be lifted off the vehicle for maintenance / repairs.
8c	CONNECTION FOR FILLING: the tank to be filling orifice of 250mm & an inspection & maintenance manhole of 450mm at the top. The cover for this port to be hinged or threaded type apart from the above two more filling connection to be provided on the sides of the tank terminating in filling connection of 63mm male instantaneous couplings made of GM or SS material incorporated with a strainer. Valve to be of NRV / Ball / Butterfly type.
8d	DRAINING, CLEANING & REPAIRS: A 50 mm dia drain line with a ball / butterfly valve to be provided to drain the tank for maintenance/ cleaning / repairs etc. A cleaning hoe of 250mm to be provided at the bottom of the tank & to be taken down to a point below the chassis without reducing the effective ground clearance.
8e	OVERFLOW: one overflow pipe of suitable diameter to be fitted to the tank. The diameter of the overflow pipe to be determined as per the filling connections provided. However, it should not be less than 100mm diameter in any case to ensure the tank does not get pressurized. The overflow pipe to be taken up to 2-inches higher than the top of the vehicle.
8f	LEVEL INDICATOR: A water level indicator to be provided near the control panel. The level indicator to be of graduated glass tube, clear acrylic or electronic type as per the manufacturer's standards.
9	FOAM PROPORTIONER: The foam proportioner should provide with the selector valve will have four settings. Each upward setting will result into an equal increase in the foam compound flow rate. The linkages of this purpose to be as simple as possible to avoid distortion due to chassis flexion.
10	MONITOR: the water monitors to be provided at a suitable location on the top of the vehicle the monitor to be of 4500LPM@10Kg/sqcm pressure. It should have provision for jet as well as spray patterns.
10a	MONITOR PERFORMANCE: the monitor to be capable of traversing through 360 degrees in horizontal plane, +75 deg & 15deg in vertical plane with discharge range of at least 65-meters in still air with water. The fog curtain to be 160 deg & the friction loss will be less than 10 psi through the monitor. The monitor to be designed for a continuous working pressure of 8-10kg/sqcm.
10b	MONITOR MATERIAL CONSTRUCTION: the material for the monitor & waterways to be chosen with a view that there will be prolonged use with brackish water & hence corroding materials will not be permitted.

10c	MONITOR COATING / PAINTINGS: Painting of monitor to be done using a good quality paint system. The paint used to be poly urethane only for enhancing fade resistance. The paint will be guaranteed for minimum 5-years against peeling, chipping, cracking and fading
11	PIPING & VALVES: complete pipeline circuit on the vehicle including water lines & fittings will be of SS 316 material only, including all water lines. All valves up to 2" size to be lever operated SS 316 ball valves & all valves above 2" size will be normal ball / butterfly valves but made of SS316. The valves to be of 3-piece design to ensure easy maintenance & repairs. Seats of the valves to be easily replaceable, readily available & at least 2-sets of spare seals to be provided for each size of valves. All sockets welded lines to be dry penetration tested and all the butt-welded joints to be radiographically tested. A flow chart and schematic diagram to be made and submitted with the technical bid
12	BODYWORK: enclosed accommodation for driver, officer in charge & four crew members to be provided in a double compartments drivers cabin as per the below given specs:
12a	INTERIORS OF THE CABIN: the cabin to be internally lined with a good quality PVC Coated aluminium sheets. Alternatively other systems of interiors will be accepted provided the same is on PAR with the latest tender in the latest trends in the international markets & as per newr norms the entire floor of the crew cabin to be provided with a good quality anti-skid type vinyl matting. A first aid box to be provided in the cabin.
12b	STRUCTURE: The entire structure to be of welded construction made from MS pressed section & square tubes of Min 2mm thickness duly treated for corrosion resistance by zinc plating & two other pack epoxy treatment. Angles & channels used for the structure will be min. 3mm thick runners and cross members (wherever used) will be of minimum 6mm thickness.
12c	PANELLING: the outer panelling to be done from 3mm aluminium sheets and the internal panelling to be done from 2mm aluminium sheets treated for anti-slippage or with chequered sheets. The doors will be fitted with winding / sliding safety glasses. Sheets of outer panelling will be glued to the framework. Riveting / bolting / screws of any kind will not be permitted.
12d	SEATING: All the seats would have foam cushions & to be covered with good quality Rexene. The crew seat will have individual seating for the crew fitted with brackets for placements of breathing apparatus in an upright position. The seats to be of the wear and walk away type so that when the crew disembarks from the vehicle the BA sets should easily come off the seats with them. The seat bottom will be theatre type, which will automatically flip-up when the fireman gets up, thereby freeing up the space for easy embarking and disembarking.
12e	LOCKERS: Sufficient lockers to be provided to accommodate all the equipment / accessories accessible manner.
12f	ROLLER SHUTTERS: for easy operation of fire tender MCD (FRANCE) or Fierco (ITALY) make roller-shutters to be installed on both sides of the appliances. These shutters will be rooted inward underneath the roof giving unobstructed access to the equipment's lockers & the equipment accessories fitted in the vehicle. Roller shutters to be made of hollow rectangular shaped aluminium links which should be inter connected with the help of plastic / rubber profiles, sealings the roller shutter water tight when closed. They should be powdering terrain and slopes. a spring mechanism to be fitted so that the shutters are held-up at any point of opening. It would be easy to operate & will ensure that the shutters cab ne easily pulled down. The sections of the shutter to be powder coated / anodized to a smooth finish and aesthetic look. Guide rails should support the shutters over the entire length on both sides & make them torsion free the shutter should have a sturdy locking mechanism which will prevent accidental opening during movement of the vehicle. A master switch for isolating locker lighting circuit should also be fitted in the driver's cabin
12g	STORAGE OF EQUIPMENTS: for all watering fittings like branch pipes etc quick release type couplings on snaps clamps of spring steel (as per the manufacturers standards) to be provided which will be enable the operator to locate the desired equipment instantly & save valuable time.

12h	OTHER WORKS: The door of the cabin to be fitted with safety glasses. The driver to be provided with rear view mirror, the cabin to be ergonomically designed for long and comfortable run.
13	Electrical system: all the wiring to be properly fixed and to be protected against heat, oil and physical injury. To the extent possible all wiring will pass through conduits. All wires to be stranded copper or copper alloy conductors of a gauge rated to carry at least 125 percent of the maximum current for which the circuit is protected wiring to be uniquely identified at least every 2ft by colour coding or permanent marking
14	LADDER & LADDER GALLOWS: Ladder gallows with ladder to be provided for carrying 10.5 metres aluminium trussed type double extension ladder. The design to be such that the ladder can be released without difficulty from a reasonably position & will embody rollers to permit easily withdrawal by one man.
15	FITTINGS AND ACCESSORIES: the following accessories to be provided on the appliance 1. Spot light in front – 2Nos 2. Fog lamps -2Nos 3. Blinker type traffic indicator -4Nos 4. Search light with 30mtrs cable and tripod stand- 1Nos 5. LED light bar (minimum 75-100 watts) makes grand or equivalent. - 1Nos
16	WORKMANSHIP & FINISH: The GVW of appliance should not exceed the rated GVW of the chassis manufacturer with all equipment's & crew the weight distribution diagram should not be submitted along with the offer.
17	PAINTING AND MARKING: priming the finished material with a zinc rich primer & then finally coated with a two-pack epoxy-based paint.
18	SURFACE PREPARATION: once the panelling is completed, all the outside surfaces should be surface treated & painted with a good quality paint system, like Du-Pont, PPG, sandbox etc, the paint to be polyurethane (PU) finished paint each coat of 50 microns DFT. Water lines to be painted red in colour & foam lines will be painted yellow in colour.
19	VEHICLE EXTERIOR PAINT: The vehicle and monitor should be painted with at least 2-coats of zinc phosphate epoxy primer each of 50-microns DFT and two coats of polyurethane finish paint each coat 50-microns DFT.
20	WATER AND FOAM LINE PAINT: water & foam lines should be painted with zinc phosphate epoxy primer each of microns DFT and two coats of polyurethane finished paint each coat of 50-microns DFT. Waterlines to be painted red in colour & foam lines will be painted yellow in colour.
21	DETAILS REQUIRED: the bidder should give the details of entire painting and process & also the details f in house painting facilities like paint booth etc., the colour for outside tube as per the latest international and Indian norms for the fire brigade vehicles. The user's name to be written on both sides with yellow colour
22	Reflective strips: Reflective stripes to be affixed to the perimeter of the apparatus
23	MARKING / NAME PLATES: shall be provided with stainless steel
24	OWNERS EMBLEM: Owner's emblem in original colour together with name (in HINDI and ENGLISH) to be written in golden yellow/ reflective white stickers / paint on both sides of the vehicle. "BEML Ltd, Bhopal"
25	Acceptance tests: The acceptance test mentioned below to be given to complete satisfaction of inspecting officer. Vendor will ensure that design of tender should not affect chassis parameters such as speed, turning circle, acceleration, endurance test, priming test, hydraulic testing etc all inspections & tests to be carried out by the vendor to the complete satisfaction of BEML representative. All testing parameters should be carried out at manufacturers premises & details of infrastructure to be provided at time of techno- commercial bid.
25.1	Stability: No overturning of fully Ladden and equipped vehicle at a horizontal angle of 27 degree from horizontal plane

25.2	Gradient: To be tested at an angle of 1:4 as per BIS
25.3	Articulation: Vehicle to be tested for articulation and should not show any sign of stress during the test the clearance of the wheel wells to be checked for tolerance
25.4	Shower test: after completion of fabrication, the vehicle to be subjected to shower test as per the norms lead down under BIS the plan should not show any sign of leakages during test
26.5	Road Test: Road test to be carried out as per the parameters for breaking acceleration top speed etc...
26.6	Performance guarantee: manufacturer guarantee for design material workmanship and the performance of the complete unit for the period of 12-months from the date of commissioning of completed vehicle. Any mechanical defect, faulty workmanship or operational defects found during this period to be rectified by the vendor at BEML premises within reasonable time without any extra cost of BEML. The tank to be warranted against leakage for a period of 5-years after supply in writing.
26.7	Training: After supply of vehicle, vendor will provide training on operation and maintenance including chassis at BEML's site & charge for the same to be included in the price. Additional free training to be given at BEML's site within warranty period & when desired by BEML.
27	Approvals:
	All equipment being quoted by vendor shall confirm to the latest version of relevant Indian standard.
	Vendor shall mention the relevant standard reference, against each item governed by the indian / overseas
	vendor shall agree to provide certificates in original of all necessary or mandatory approvals in respect of the fire tender before dispatch to BEML Bhopal.
	On placement of order, Fire tender is to delivered at BEML Bhopal. Transit insurance shall be included in vendors scope.
	After supply, vendor shall provide training in operation of their systems free of cost to BEML/CISF personnel.
	On final supply, operation and maintenance manual, any electrical system manual etc., shall be handed over to BEML. All guarantee certificated for any/All accessories installed on the fire tender, shall be handed over to BEML.
	Along with Techno-commercial offer, vendor shall submit a separate sheet listing all items (Installed on water bowser Tender)
28	INSPECTION: -
	All the inspection shall be carried out against relevant IS & Tender technical specification of BEML Jointly
	Vendor shall agree to offer stage inspection of the fire tender in three stages. d) 1 st inspection for Tank & Allied Accessories. e) 2 nd inspection for body work on chassis. 3 rd inspection shall be final Pre- dispatch inspection 3 rd inspection will be done by CISF & BEML jointly.
29	ERECTION & COMMISSIONING: Since the item is ready to use type and shall be delivered in ready to use condition in BEML, Bhopal. However, supplier's representative shall come & will make all the system fully ready to use again & demonstrate use of all items. And shall import training to our working personnel (Training period 7-days). Defect free & uninterrupted demonstration shall be contributed as successful commissioning. Further, Guarantee period will start after successful commissioning. Fuel required during the demonstration at BEML works shall be arranged by the vendor.
30	Registration at Bhopal: BEML shall arrange registration at Bhopal and annual insurance for vehicle.
31	Transit insurance as applicable for automobiles as per Govt. rules from the point of delivery

	to BEML CRX shall have to be arranged by vendor.
32	For Delivery: Vendor has to deliver the vehicle at the works of BEML, Bhopal & shall have to arrange driver / fuel / insurance, any other applicable documents etc., and other leviable Govt. Duties from various states where vehicle is passing. All bills' challans, receipts etc in respect of vehicle shall be handed over to BEML by vendor at the time of Delivery.
33	Accessories
	Aluminium extension ladder-10.5-metre-long trussed type-1no's
	Heavy duty PVC suction hose with round thread couplings- 2.5 metre long-4no's
	Synthetic jacketed delivery hose as per BIS type 'B' 63mm, 22.5 metre with couplings-10no's
	Suction strainer of gun-metal LTB Gr 2 of IS 318-2no's
	Basket strains for above GM suction strainer-2no's
	Suction wrenches for above GM suction strainer-1pair
	Dividing breaching Gun metal LTB Gr of IS 318-20no's
	Collecting breaching Gun metal LTB GR 2 of IS 318- 2no's
	Hand controlled branch pipe gun metal LTB Gr 2 of IS 318-1no's
	Long line terylene 50 mm circumference 30m long-2no's
	Short line terylene 50 mm circumference 15m long-2no's
	Hose bandages rubberized-12no's
	Hose clamps-6no's
	Branch pipe gun metal LTC Gr 2 of IS 318-4no's
	Nozzle for branch pipe of various sizes gun metal LTB Gr 2 of IS 318-10 no's
	Adaptor double female instantaneous pattern gun metal LTB Gr 2 of IS 318-2no's
	Adaptor double male instantaneous pattern gun metal LTB Gr 2 of IS 318-2no's
	Nozzle spanner gun metal LTB Gr 2 of IS 318-2 no's
	Rubber gloves- 6 pairs
	Light bar installed outside on front top of cabin (Halogen strobe – LED) of red-white -blue colour-1nos
	Electrically operated wailing siren of high pitch to be provided-1no's
34	Spark and surge arrester: CCE approved spark and surge arrester along with original certificate to be handed over to BEML with supply 1-No 1. Taparia / Jhalani make tool kit- 1 no's 2. Hydraulic jack of 25T capacity- 1no's 3. First Aid Box- 1no's

6.6 MAIN GATE COMPLEX WITH SECURITY OFFICE:

There are two entry and exit control points for the plant site, one is the main entry for man and material movement, whereas the other is only for the material movement. The main entry shall also be used for the movement of VIP.

The Main gate complex building is integrated with Security office. This is RCC structure building. This is Ground +1 building structure.

Total Built up area is 863 Sq. m This building has a provision for entry / exit for all employees with access control system.

This Gate will provide access to main security building from employee entry.

The main gate complex is an RCC structure of G+1 floor with gate pass, scanning and security monitoring area.

The building shall have the following facilities:

- Reception and waiting area
- Scanning area
- Staff room
- Monitoring room
- Chief security room

Being the main entrance to the factory, the facia and facade of the gate complex have to be aesthetically beautiful, facade is to be aesthetically appealing and combination of different treatment such as dry-stone cladding, ACP (aluminium composite panel), Rustic textured paint, Exterior grade acrylic emulsion paint. Etc., should be planned in consultation with BEML before execution

The area of parking at entrance gate should be provided with heavy duty paver blocks of approved colour combination and shade

6.7 GATE COMPLEX FOR MATERIAL MOVEMENT WITH SECURITY OFFICE:

This gate complex building is integrated with Security office. This is a Ground +1 building structure. This is RCC structure building.

Total Built up area is 193 Sq. This Gate shall be used exclusively for the Truck entry/exit with a clear width and height of 6 m for Truck/trailer movement.

6.8 GATE COMPLEX AT RAILWAY SIDING MAIN GATE COMPLEX WITH SECURITY OFFICE:

This gate complex building is integrated with Security office. This is a Ground+3 building structure. This is RCC structure building. Total Built up area is 89 Sqm. This Gate shall be used exclusively for the LHB/Vande Bharat coach's entry/exit.

6.9 PARKING FACILITY

The following are the type of parking facility provided for the plant:

- 20 no of covered parking in ground floor of the Main office complex for senior executives.
- 15 no Truck parking near the main gate
- One multi-level parking area with provisions for the following:
 1. Two-wheeler – 285
 2. Four-wheeler – 360
 3. Bus – 09

6.10 CAR BODY MANUFACTURING CUM STORAGE BAY

The Workshops are the most important facilities in Rolling Stock Manufacturing Plant. The proposed Workshop Building is designed as a functional, efficient, and flexible space that

supports hands-on activities, fabrication processes, and training needs while ensuring safety, durability, and user comfort. The architecture emphasizes clarity of circulation, unobstructed work zones, and seamless integration of services, creating an environment that enhances productivity and operational workflow.

The overall built form adopts a simple, rectilinear geometry to maximize usable floor space. The structural grid is optimized to create large column-free spans, supporting overhead movement of materials and machinery. The building envelope consists of durable, low-maintenance materials—such as insulated metal panels, structural steel framing, and high-performance glazing—selected to withstand industrial use and provide long-term resilience.

Natural lighting and ventilation are key design drivers. Continuous clerestory windows and high-level translucent sheets & louvres ensure diffused daylight across the workshop floor while reducing dependence on artificial lighting. Mechanical ventilation systems supplement natural airflow to maintain indoor air quality and temperature control in zones with heat-generating equipment.

The internal planning separates noisy, heavy-duty work areas from cleaner, precision-based tasks. Service cores containing electrical rooms, tool storage, washrooms, and utility shafts are placed along the rear edge, allowing the main hall to remain unobstructed. Safe circulation is maintained through clearly defined pedestrian pathways, dedicated equipment movement aisles, and emergency exits positioned as per NBC guidelines.

Sustainable design principles are incorporated through energy-efficient lighting, rainwater harvesting provisions, solar-ready roofing, and the use of recyclable materials. Exterior landscaping and permeable paving help manage storm-water runoff and reduce heat island effects.

Overall, the workshop building is conceived as a robust and adaptable facility that prioritizes user safety, operational efficiency, and long-term performance, while maintaining a clean, contemporary architectural character.

The workshop is designed as 3-bay structure with each bay of width 24m c/c & a length of 400 m. The workshop is further a two storied workshop having functional relations in both the floors. The structure is designed to take heavy loads considering the functionality. Each workshop is attached with office spaces on one side lengthwise along with the fire escape staircases integrated to it.

The office building annexed to manufacturing bay on the outer side of bays along their length shall have G+5 floors with only Ground floor and Top floor opening into Shop Floors located at ground and First floor of manufacturing block. Each manufacturing shall have 2- such annexe building with approach via lift as well as staircase and 5th floor office opening into shop floor at First Floor. Only Ground and 5th floor (Top floor) shall be used for Housing offices for officials whereas G+2 floor (2nd floor) shall be used for discussion rooms and conference Hall other floors will not have any occupancy, the façade of outer face shall be seen as that of manufacturing block, so that it merges with the side facia of the block. This building will cover an area of 120mx4m on each floor including area of the bay between the columns of

manufacturing bay in the entire width of column. The annexe building will have two passengers' lifts and a central staircase with access to each floor. This building will also have a Service lift to be used for material movements by shop floors. Passenger lift shall have a capacity of 15 persons (Specification shall be followed/ referred with the Elevator specification mentioned at S.No. 19, in accordance to the requirement) and service lift will have a capacity of 1.5 tonne. This annexe building shall have toilet units on both ends. However, size of these toilet units will be based on number of users. Accordingly, the capacity of Ground and top floor toilets shall be much bigger than toilets at intermediate floor to take care of personnel working on these shop floors.

G+2 (third floor) shall be used exclusively for meeting and conferences which shall be provided with 1-no big size conference room to accommodate at least 60-70 persons and two small meeting rooms each having a capacity of 8-10 persons. Same specification as that of Office Building Complex is applicable here. However, the frame can be made up of structural steel.

Note: Lift proposed in this Annexe building is not in the scope of EPC contractor. However, only cabin shaft (Hoist way) is to be constructed by the contractor

Solar panels are also planned on the roof so as to generate renewable energy. Though supply of panels is not forming part of the scope of EPC contractor, he shall make suitable provision while doing roofing for ease of mounting of solar panels at a later date. The contractor has to discuss this aspect with BEML and finalise the provision before proceeding with roofing work design/construction.

During design and construction, the EPC contractor shall make a provision in manufacturing block for easy, safe and convenient access / approach to roof top with weather resistant safety railings around the facility.

Permanent lifeline system shall be provided along the designated movement paths on the roof to ensure safe working at height during solar panel installation and maintenance.

The system shall allow attachment of safety harnesses for multiple users simultaneously.

The lifeline system shall consist of:

- The lifeline should have a safe working load of 15KN, with adequate factor of safety.
- End anchors and intermediate supports, Stainless steel wire rope (minimum 8 mm dia), Energy absorbers / shock absorbers, Turnbuckles and tensioning devices, Anchor fasteners and base plates, Compatible full-body harness connection points.
- All components shall be corrosion-resistant and suitable for outdoor industrial use.
- System shall comply with relevant IS / EN / OSHA standards for fall protection.
- Fixing to roof structure shall not compromise the structural integrity or watertightness of the shed.
- All penetrations through roof sheets shall be minimized, wherever fixing is required, EPDM washers, sealants and flashing shall be provided to prevent leakage.

Structural supports shall be fixed to primary or secondary structural members only, not directly on thin roof sheeting.

While designing and constructing the manufacturing block, the contractor shall ensure that adequate and safe access / approach is provided to the roof top for maintenance purpose. Safety railing (corrosion) around the edges of the roof shall be designed and installed. Any damaged roof sheets during execution shall be repaired or replaced at contractor's cost. All steel components shall be hot-dip galvanized (minimum 80 microns coating). Fasteners shall be stainless steel or galvanized high-tensile bolts. Touch-up painting shall be done at all cut edges and welded joints.

7. UTILITY BUILDINGS

7.1 WATER SUPPLY AND FIRE WATER PUMP HOUSE

The Water Supply and Fire Water Pump House are designed to accommodate raw water and fire-fighting water systems within a compact yet accessible layout. The building adopts a single-storey industrial form with adequate internal clear heights for pump installation, maintenance, and overhead piping. This combined pump house is a RCC structure with a height of 6m & pump house of height 8m. Water reservoir is RCC type above ground structure, Pump house is RCC column with brick wall type structure.

The building is RCC structure building with total Built up area is 850 Sq. m.

Ventilation is ensured through louvered openings and mechanical exhaust fans to dissipate heat generated by motors. The pump floor is planned to allow clear access for alignment, routine maintenance, and equipment replacement, with large service doors provided for loading/unloading. The structure is designed as a durable steel framed enclosure with anti-vibration flooring and corrosion-resistant finishes suited for high moisture environments.

Fire pump rooms comply with NBC and NFPA norms, incorporating dedicated separation walls, minimum clearances, and protected cable routing.

Provisions for underground tanks, yard hydrants, and control panels are integrated with the external fire water network. A combined Drinking water & Fire water pump house has been proposed for this Project.

Pump configuration for the combined pump house is as follows:

1. 11 KW x 3 nos. (3w+1s) for VFD motor of hydro pneumatic pumps.
2. 11 KW x 2 nos. (2w+1s) for star delta / DOL motor of air scouring blowers.

7.2 MRSS:

The MRSS is strategically positioned to ensure safe power distribution while maintaining required statutory distances from occupied buildings. The architecture emphasizes safety zoning, with segregation of HT switchgear, LT switchgear, transformer bays, and control rooms.

The building typically adopts a partially RCC / partially steel structure with fire-rated partitions, spill containment pits for transformers, and adequate ventilation through natural louvres and forced-air systems. Cable trenches are laid out for ease of maintenance and

minimize crossing of power circuits.

Service areas such as battery rooms, control rooms, and metering rooms are acoustically treated where required and provided with climate control for equipment integrity. The MRSS façade employs simple industrial finishes—such as metal cladding or textured paint—for long-term durability and low maintenance.

MRSS is a RCC structure building with total Built up area is 300 Sq. m. A Separate 33/11kV transformer area of size 12m X 6 m has been considered. A Satellite office building is also integrated with this MRSS building.

A dedicated 33 kV HT cable will reach to Project site by MP State Electricity Board under deposit basis work. The 33 kV HT line will be terminated at the metering cubicle inside the project area.

33 kV Cable from metering cubicle to the MRSS shall be laid through suitable cable routing by the Construction contracts.

7.3 COMPRESSED AIR SYSTEM

Compressed air system shall be distributed type each manufacturing bay will be equipped with 1-no. oil free screw type compressor of 100CFM rating with delivery pressure of 12-bar. Inspection & testing bay shall also be having 1-no identical compressor.

The pipelines will be routed overhead along the building columns / walls. Isolating valves condensate drains and compensators, Pressure gauges & pressure reducing valves will be provided in pipeline network as per the process requirements. Platforms, access ladders, etc. will be provided for operation and maintenance of valves, instruments & controls and gauges provided in the compressed air pipeline network. Piping layout will follow good engineering practices. Distribution pipeline & fittings will be MS / CS, Valves shall be CS with SS internals. At Every alternate column of the manufacturing bay tap point for compressed air shall be provided. The tap point shall have automatic quick couples.

During detail design stage positioning of these compressors within manufacturing block / Inspection Bay, pipeline routing along with technical requirements & BOM will be finalised. Pressure drop throughout the distribution network should not be more than 0.5 bar.

No separate building is envisaged for this system.

7.4 CENTRALISED GAS BANK

The Centralised Gas Bank is designed in accordance with applicable gas safety codes, PESO guidelines, and fire safety regulations. The architecture adheres to an open or semi-open shed typology with natural ventilation as the principal safety feature.

Cylinder storage areas are segregated by gas type and arranged with safe clearances, bollards, and explosion-relief openings. The floor is finished with anti-spark material, and piping manifolds are mounted for clear visibility and maintenance.

Safety features include gas detection, earthing pits, fire extinguishers, and emergency access routes. The gas bank site layout provides unhindered circulation for cylinder loading/unloading and emergency response, maintaining adequate separation from other buildings

Various Industrial gases like Acetylene, Oxygen, Argon, AOM gas & ACM gas are required in the plant. In view of this, a Centralised gas bank has been proposed for fulfilling the requirement.

The said industrial gases are required for the following purposes:

- a) Acetylene & Oxygen gas are required for cutting operation.
- b) Argon gas, AOM gas (98 % Argon + 2% Oxygen) & ACM gas (80 % Argon +20% Co2) are required for automatic & manual welding operation

8. COMMON DRIVEWAYS / LANDSCAPING AROUND THE FACILITIES

Adequate drains shall be planned around the building and is to be connected to main drain.

Edge Kerb shall be of pre cast / cast in site of approved design and shall be minimum 100 mm above the drive way.

The level of landscaping shall be 100 mm above driveway level with edge kerb all around.

Landscaping with Shrubs / trees / lawns / ground covers shall be planned around building as per approval.

Decorative water fountains in external area (location to be decided while planning landscaping) shall be provided (2-Nos) with waterproofing treatment, designed for low maintenance and safe operation which is suitable for industrial outdoor conditions in accordance with the BEML.

For landscaping/ Green belt development suitable provision to be made for watering/ Irrigation of green belt development, its maintenance and also installation of “BEML” Logo/signage of appropriate size at the entrance of the plant and other various locations inside the plant and offices.

9. GENERAL SPECIFICATION OF FACILITIES

9.1 DOORS AND WINDOWS:

The Flush doors proposed in buildings shall be provided with frame of approved shade of minimum 30-35 mm thickness. All doors shall be provided with Stainless steel hardware's of SS 304 grade from approved make. All the doors except for WC area in toilet shall be provided with door closure. The Utility Rooms, record rooms shall be provided with multipurpose metal doors of approved make.

The Metal fire doors shall be of 2 hours fire rated with heavy duty type. The hardware's to be used shall be of SS 304 grade. The metal fire doors shall be provided with RCC Pilaster on all sides of metal door frame All the windows to be planned shall be heavy duty aluminium windows of approved shade and shall be provided with 5 mm thick glass as per approval.

9.2 PARAPET WALL:

Height of Parapet Wall shall be minimum of 1050-1200 mm from the Finished Floor Level, depending upon the required constructed buildings.

9.3 STAIRCASE:

The width of staircase shall be as per Part - 4 of NBC 2016 (minimum 1500 mm Wide as per type of building) The riser shall be maximum of 150 mm and tread shall be minimum of 300mm. The design of staircase shall be as per NBC guidelines Railing shall be of 1100 mm high of SS 304 grade matte finish.

9.4 RAMPS:

In order to facilitate access of Differently Abled people inside building and to make the building barrier free, differently abled ramps to be provided as per NBC guidelines

9.5 PLINTH PROTECTION:

The buildings shall have plinth protection all-around the building of width 900 mm. The finish shall be concrete finish. Kota stone finish shall be provided for Office buildings. The level of plinth protection shall be 100 mm above finished ground level or landscape level.

9.6 CHAJJA & CANOPY:

All Windows and external doors shall be provided with chajjas and Canopies. The minimum depth of Chajja in windows shall be 600 mm and for External doors canopy depth shall be 1200 mm unless specified.

For manufacturing block and inspection bay the canopy depth shall be 2m.

9.7 SHAFTS FOR UTILITY:

All the services such as Electrical, Communication cables (ELV), Fire hydrants, Plumbing Lines, Rain water down comers etc. are to be routed inside designated shafts. The shaft doors shall be metal fire door with 2 hrs. fire rating. All shaft doors are to be provided with 300 mm high sill with 18 mm thick granite stone coping on top. The shafts shall be accessible from common areas of building.

9.8 PLUMBING FITTINGS AND FIXTURES:

The following shall be provided

- Each offices / Buildings should be provided with suitable capacity HDPE overhead fresh water tank as per the occupancy level of the building. In addition, an additional tank of adequate capacity for storage of treated effluent shall also be provided for flushing.
- Each Water closet area shall be provided with a Health faucet, angle cock as required. All fixtures shall be chrome plated.
- Pantry shall be provided with sink cock / mixture for sink and one water purifier point.
- All fixtures such as sink cock / mixtures, bib cocks, pillar cocks, Angle cocks, Health Faucets etc. shall be of approved make.
- Water Closet shall be a single unit wall hung type of approved make and colour
- Under Counter wash basins shall be provided with 20 mm thick granite counter of approved shade and texture.

- Urinals in gent's toilet shall be of flat back type. 20 mm thick Granite stone divider of size 500 mm x 900 mm shall be provided in between two urinals. The granite divider shall be polished on both sides and shall be fixed with top at +1500 level.
- Pantry shall be provided with stainless steel 304 grade sink with drain board of approved make.

Each Toilet shall have the following Toilet accessories of approved make.

1. Mirror of full width of Granite counter with height of 900 mm with bevelled edges.
2. Chrome finish Soap dispenser, 600 mm long SS Towel ring near wash basin.
3. SS Coat hook in all Water closet room.

All toilet accessories shall be of SS 304 Grade only.

9.9 LIGHTING AND VENTILATION:

The lighting and ventilation inside the building should be properly planned. This shall be as per NBC 2016-chapter Lighting and Ventilation and Part - III.

S. No.	Particulars	Requirement
1	Height of Octagonal Pole (In meters)	9
2	Type of bracket for suitable fitment of luminaire on the octagonal pole	Single Arm/Double Arm/triple arm (As per the design given in the Pole drawing)
3	Each Bracket length	1500
4	No. of LED luminaires can be fitted in the bracket of each octagonal pole (in No's)	01 for single arm 02 for dual arm 03 for triple arm
5	On site warranty (in Months)	60
Pole Construction		
1	Material of Octagonal pole	Grade ISH:430LA as per IS: 5986:2017 latest
2	No. of sections	1
3	Cross section of octagonal pole (no of sides)	8
4	Internal distance between parallel faces at the base of pole (in mm)	150-155
5	Internal distance between parallel faces at the top of pole (in mm)	70-75
6	Longitudinal Welds	Only 1
7	Octagonal pole sheet thickness (in mm)	≥ 3
8	No. of stiffeners per pole	4 (Min)
9	Metal protection treatment of fabricated mast section	Hot dip Galvanized, as per IS:4759 latest:
10	Luminaire carriage / brackets	Fabricated suitably and hot dip galvanized for fixing and holding required no. of light fixtures

11	Door opening on base of the pole	Door opening: 500 mm height from base plate, Size: 100 mm x 500 mm with Gasket
12	Type of locking arrangement for door	Pad lock with key
13	Provision of finial on the pole top	Yes
Earthing		
1	Each Pole earthing shall be made with supply of materials, using copper coil of 10 SWG bare copper wire of 2.0 meter in length.	Yes
Base Plate		
1	Base plate material	Grade: E250, Quality (as per IS: 2062:2011 latest)
2	Base plate size - (Length in mm x Width in mm x Thickness in mm)	250X250X16
3	Necessary accessories on each pole	Suitable foundation Bolts - 4 nos. (min)
4	Foundation Bolt type	J
5	Bolt size	M20x700
6	Conformity of specification for bolts and Nuts	as per IS:1367 (Part 2), Grade B
7	Galvanization of foundation bolts and nuts and octagonal pole shall be galvanized	As per IS:4759 latest
8	Earthing terminals on the base of the pole, for lightning and electrical protection	Using 12 mm Dia SS Bolts of suitable length
Junction Box		

1	Junction box location	on the Carriage Assembly as required, from which the interconnections for the designed number of the light fixtures on the carriages
2	Material of Junction Box	Polycarbonate
3	Ingress protection class of Junction Box	IP-65
4	Cable (ISI Marked Cable) connections from the top junction box to the individual luminaries of each pole	3CX2.5 Sqmm Flexible Copper Cable
5	Terminal Box with Circuit breakers and backlite sheet for cable termination at door opening (Base compartment) for each pole	MCB, 6A, 1P, 240V, AC
6	No. of MCB per Junction Box (in Nos.)	1
Pre Dispatch Inspection		
1	Inspection	Pre dispatch inspection will be carried out at vendor's work with no extra cost. All the acceptance tests as per IS shall be witnessed during the inspection. Vendor shall not dispatch the material without prior dispatch clearance from BEML Official.

Generic	S. No	Particular	Requirement
	1	Each pole shall be supplied with suitable foundation bolts, nuts and washers, Instruction manuals	Yes
High Mast System			
	1	Cross section of mast (no of sides)	20-sided polygon

	2	Top diameter (in mm) - Minimum	150
	3	Plate Thickness for Top (in mm)- Minimum	4
	4	Provision for Cable Termination	MCB Isolator
Lighting Finial			
	1	Heavy duty hot dip galvanized lightning finial shall be provided for each mast (in Nos). It shall be solidly bolted to the head frame to get a direct conducting path to the center of the earth through the mast. The lightning finial shall not be provided on the lantern carriage under any circumstances in view of the safety of the system	Yes
Aviation Obstruction Lights			
	1	Vertical Stand Led Type Aviation obstruction lights shall be provided on top of each mast (in Nos)	Yes
Wind Loading			
	1	Wind loadings as per	IS 875:1987 part 3 or latest
Lantern Carriage			
	1	The Lantern Carriage shall be of steel tube construction, the tubes acting as conduits for wire, with holes fully protected by grommets	Yes
	2	The entire lantern carriage shall be hot dip galvanized after fabrication	Yes
	3	The inner lining of the carriage shall be provided with protective PVC arrangement, so that no damage is caused to the surface of	Yes

		the mast during raising and lowering operation of the carriage	
Junction Box			
	1	IP of the Junction Box	IP 65
		Junction Box Material	Cast Aluminium
Winch			
	1	Minimum working load of winch (in Kg)	750
	2	Motor capacity - Minimum (in HP)	1.5
	3	Suitable rating and connecting copper cable also shall be provided for the motor	Yes
Stainless Steel Wire Rope			
	1	The suspension system shall essentially be without any intermediate joint. The steel wire ropes shall be of suitable construction, the central core being of the same	Yes
	2	Overall Diameter of the Rope	≥ 6 mm
LED Luminaire			

	1	LED luminaire shall be provided with protection against Short Circuit, Overload, Over Voltage, reverse Polarity.	Yes
	2	The Luminaires casing/housing (single piece housing) shall be pressure die casted aluminium alloy with higher thermal conductivity	Yes
	3	The luminaire body must be corrosion resistant epoxy powder coated	Yes
	4	Light Source	SMD LED Chip as per LM80/IS 16106
	5	Test Reports to be submitted (Minimum Life of the LED chip must not be below 50000 burning hours while ensuring at least 70 % efficacy)	LM 79, LM 80 & TM 21,
Earthing			
	1	The digging of Earth Pit, Supply of Earthing Material and all incidental work shall be in the scope of the Vendor. Lightning arrester and the High Mast shall be earthed separately.	Yes

Railway Siding:

Railway siding is to be developed for running test of rakes, stabling & dispatch of coaches in line with Master Plan Layout. The total length of track (broad-gauge) is estimated as 4000m which is envisaged with OHE as of now. The top level of track in different stretches is to be maintained as specified. The development of siding shall include formation work to the required level, supply of all materials viz. ballast, Rail (60 Kg/m), PSC sleeper, switches, fishplates and all other accessories required for laying of rail track including providing & laying of OHE complete. All materials used and workmanship shall conform to relevant BIS and IRC standard.

10. SPECIFIC SCHEDULE FOR FINISHES:

The Non-Technological Infra Buildings shall have the following Finishes:

S. No	Description of work	Finishing Material
1	Internal Wall – All Locations	2 Coats of Premium Acrylic Emulsion paint over white cement-based putty of average thickness 1mm of approved make
2	External Wall – All Locations	Weather coat Acrylic External Emulsion paint of approved shade
3	Flooring and Skirting except for Toilets / balcony, Drinking water Point and pantry	Vitrified tiles Glossy Finish (Tile size shall be 600 x 1200 mm) of approved Shade
4	Staircase	18 mm thick Granite stone slab flooring of approved Texture and shade
5	Flooring for Toilets / Drinking water point, Balcony etc.	1200 x 600 mm anti-skid vitrified tile of approved shade and make
6	Dado for Toilets and DW area	1200 x 600 mm vitrified tile dado up to 2400 mm from FFL. Exposed Corners shall be provided with PVC inner corner tile beading of approved make
7	Dado for Pantry	600 mm high Glazed Ceramic tiles of approved shade along wall of granite counter
8	Sill of Windows, Fixed Glazing's, Ventilators and Parapet along internal corridors and all balconies	18 mm thick Granite slab (15 mm projected from edge of wall)
9	Windows, Ventilators and fixed Glazing	Powder Coated Aluminium Windows of approved Extrusions
10	False ceiling	As mentioned in the building description

The Technological Infra Buildings shall have the following Finishes:

S. No	Description of work	Finishing Material
1	Internal Walls and ceilings – All office spaces such as cabins, corridors of office area, workstation area, conference halls, lobby, waiting area, Control rooms, console rooms,	2 Coats of Premium Acrylic Emulsion paint over white cement-based putty of average thickness 1mm of approved make

	VFD Room, Scada room, Record room	
2	Internal Walls and ceiling – All Locations other than mentioned in Sr.no 1	2 Coats of Acrylic oil bound washable distemper of approved shade over white cement-based putty of average thickness 1mm of approved make
3	External Wall – All Locations	Weather coat Acrylic External Emulsion paint of approved shade
4	Flooring of Battery rooms	20 mm thick Acid resistance tiles of approved Make
5	Flooring and Skirting of all locations as per Sr.no -1	Vitrified tiles Glossy Finish (Tile size shall be 1200 x 600 mm) of approved make
6	Staircase flooring and skirting	25 mm thick Kota stone slab
7	Flooring of Cable cellar room, Panel Room, Ventilation room / HVAC Room, MCC Room etc.	52 mm thick cement concrete flooring with concrete hardener
8	Store rooms / Record Rooms	600 x 600 mm 20 mm thick pre polished Kota stone
9	Flooring in toilets, Pantry, Drinking Water Area	300 x 300 mm Non-Skid Ceramic tile of approved make
10	Dado for Toilets	300 x 600 mm Glazed ceramic tile of approved shade up to lintel bottom on all sides of wall. Exposed Corners to be provided with PVC inner corner tile beading of approved make.
11	Dado for Pantry	600 mm high Glazed Ceramic tiles of approved make along wall of granite counter
12	Dado in Battery Room	1800 mm high dado with 20 mm thick Acid-resistant tiles
13	Parapet along internal corridors and all balconies other than terrace area	25 mm thick Kota slab (15 mm projected from edge of wall)
14	Windows, Ventilators and fixed Glazing	Powder coated Aluminium of approved shade

15	False ceiling for Cabins, control rooms, conference halls, console rooms, VFD Room, Scada room	Combination of Gypsum seamless and grid type ceiling

FLOORINGS

Providing and fixing removable raised/false access flooring with system and its components of approved make for different plenum height with possible height adjustment up to 50 mm, comprising of modular load bearing floor panels supported on G.I. rectangular stinger frame work and G.I. Pedestal etc. all complete, as per the architectural drawings, as specified and as directed by Engineer-in-charge consisting of:

Providing at required spacing to form modular framework, pedestals made out of GI tube of thickness minimum 2 mm and 25 mm outer diameter, fully welded on to the G.I. Base plate of size 100mm x 100mm x 3mm at the bottom of the pedestal tube, G.I. pedestal head of size 75mmx75mmx3.5 mm welded with GI fully threaded stud 16mm outer diameter with two GI Check nuts screwed on the stud for level adjustment up to 50mm, locking and stabilizing the pedestal head in position at the required level. The pedestals shall be fixed to the subfloor (base) through base plate using epoxy-based adhesive of approved make or the machine screw with raw plug.

Vinyl Flooring: P/I of flexible homogeneous, calendared compacted vinyl flooring, suitable for heavy traffic area, of thickness 2mm and with PUR surface treatment and group P wear rating having fungi static & bacteriostatic properties.

Sports Flooring (Indoor games - Room): P/I of vinyl flooring, commercial grade of thickness 5-6.5 mm and wear layer thickness of 0.65mm and weight 2975g/sqm with group T as per EN-651 and with impact sound installation of 19dB and with Protesol surface treatment and Sano sol fungi static/bacteriostatic treatment.

Wooden flooring (applicable to CMD and Director rooms) - Providing & laying of 15mm thick made in India Engineered wood flooring with Plank width of 135mm and length of 1800mm with top layer of 3mm wood over 2mm thick Mikasa VA protect underlay (Combination of PE film and extruded foam). Surface of top layer is pre finished with several layers of UV hardened acrylic lacquer, free from formaldehyde and solvents. Flooring plank shall be interlocked using Plankton system. Average moisture content shall be approximately 7-9%. Engineered wood planks shall be a composition of 3 layers of board with directions of each layer oriented at right angle to the adjacent layer. Bevelled in length and width as specified by the manufacturer including fixing in position, levelling and finishing complete as per manufacturers specifications and direction of Engineer in charge.

SPECIFICATION OF FALSE CEILING

1. FALSE CEILING - Providing and fixing false ceiling at all height including providing and fixing of frame work made of special sections, power pressed from M.S. sheets and galvanized with zinc coating of 120 gms/sqm (both side inclusive) as per IS : 277 and consisting of angle cleats of size 25 mm wide x 1.6 mm thick with flanges of 27 mm and 37mm, at 1200 mm centre to centre, one flange fixed to the ceiling with dash fastener 12.5 mm dia x 50mm long with 6mm dia bolts, other flange of cleat fixed to the angle hangers of 25x10x0.50 mm of required length with nuts & bolts of required size and other end of angle hanger fixed with intermediate G.I. channels 45x15x0.9 mm running at the spacing of 1200 mm centre to centre, to which the ceiling section 0.5 mm thick bottom wedge of 80 mm with tapered flanges of 26 mm each having lips of 10.5 mm, at 450 mm centre to centre, shall be fixed in a direction perpendicular to G.I. intermediate channel with connecting clips made out of 2.64 mm dia x 230 mm long G.I. wire at every junction, including fixing perimeter channels 0.5 mm thick 27 mm high having flanges of 20 mm and 30 mm long, the perimeter of ceiling fixed to wall/partition with the help of raw plugs at 450 mm centre, with 25mm long dry wall screws @ 230 mm interval, including fixing of gypsum board to ceiling section and perimeter channel with the help of dry wall screws of size 3.5 x 25 mm at 230 mm c/c, including jointing and finishing to a flush finish of tapered and square edges of the board with recommended jointing compound, jointing tapes, finishing with jointing compound in 3 layers covering upto 150 mm on both sides of joint and two coats of primer suitable for board, all as per manufacturer's specification and also including the cost of making openings for light fittings, grills, diffusers, cut-outs made with frame of perimeter channels suitably fixed, all complete as per drawings, specification and direction of the Engineer in Charge but excluding the cost of painting with : 12.5mm thick tapered edge gypsum plain board conforming to IS: 2095- part I.
2. Grid Ceiling: -Providing & fixing of metal works lay-in system of white/ silver grey 9006. The grid to be superfine xl 15mm (micro look 8) (Superfine exposed Tee grid system. The tiles are to be of aluminium (standard weight for 600 x 600 is 2.08 Kg/ sqm) with 1.8 mm dia holes (20% open area diagonal pitch) with black acoustic fleece with minimum 0.7 NRC. All as per approved typical shop drawings with a 10-year limited warranty.
 - 2.1.1 Tile Size: 600 X 600mm
 - 2.1.2 Tile Size: 1200 X 300mm
3. Gypsum Board Cove including paint: P/f Cove light pelmet/ trough: 150mm high, 200mm wide in ceiling made of Laggy board with GI framing complete as per design. (Note:- Cove to be complete from inner side as well) & also including the cost of plastic emulsion paint with required finish of 2 or 3 coats as per satisfaction of engineer.

NOTE: Samples of all finishing material are to be got approved from M/s BEML ltd before using in works. The contractor shall produce samples of all materials and shall obtain approval of EIC in writing before he places bulk order for the material for incorporation in the works. In respect of the material for which samples are not kept to detailed specification or not given herein after, such materials shall comply with latest relevant Indian standard specifications.

The contractor shall on demand produce original receipted vouchers/ invoices in respect of material supplied by them.

Though the condition above has been written for finishing items, the same shall be applicable mutatis mutandis for all materials to be incorporated in works

11. CIVIL WORKS

11.1 General

The project site is located at Umariya Village near Obaidullaganj town in Raisen district, approximately 30 km south-east of Bhopal City, in Raisen District, Madhya Pradesh. The site is strategically positioned along National Highway 46, with good accessibility.

11.2 Descriptions of civil works

The civil engineering works shall comprise of:

Land And Site Development Works

- **Grading and levelling works**

1. Grading and levelling works is to be carried out in accordance with formation level provided for various zones of project site.
2. Rock obtained from cutting can be used in project construction for following purposes:
 - Stone pitching / Construction of toe wall, retaining wall (wherever required) by converting into stone block of sizes suitable for CR/RR-Masonry
 - Sub-base & Base course in road construction.
 - Base / Lean / filling & levelling concrete.
 - Rail track ballasts.
 - Landscaping.
 - For Back filling/bulk filling / levelling low lying area crushed stone can be used. The Size should be chosen such that it compacts well & drains adequately and does not create voids for this well graded crushed stone with maximum size 20mm with adequate fines to fill the voids will serve the purpose.
 - The above application is subject to conversion of quarried rock into usable aggregate of required size as specified under relevant code (IS/ IRC / MoRTH). For this purpose, the contractor at his own expense will install mobile crusher at site.
 - It shall be the sole responsibility if the contractor to dispose the surplus rock.
 - For filling purpose, the contractor can also use good earth mixed with fly-ash and aggregate in permitted size made out of rock obtained from cutting in accordance with relevant IS code and CPWD specification
 - Filling with good earth only or good earth mixed with stone aggregate of allowable size in permitted percentage as per relevant IS Code / CPWD Specification may be adopted in case the contractor has to bring earth from outside for bridging the gap of filling and cutting.
3. For excavation in rock the contractor maybe required to resort to blasting. Utmost care is required to be taken during blasting operations. All rules and regulations are to be

strictly adhered to, including obtaining required licenses and deployment of qualified personnel. Special care needs to be taken when doing blasting near to village area.

4. looking into the huge quantum of cutting and filling envisaged adequate number of required plans and machineries are to be deployed and round the clock working to be ensure for meeting the project timeline open foundation system as per requirement of sub soil condition observed in the adjacent site. Construction of RCC buildings, Steel structural buildings, Roads, Drains and associated facilities etc., including all finishing works, as per technological schemes shall be considered.

11.3 Civil design criteria

The structures will be designed conforming to latest relevant Bureau of Indian standard codes of practices and safety regulations. The rules and regulations stipulated in Factory Act; Electricity Act and any other statutory regulations will be followed. In absence of suitable Bureau of Indian Standard codes and specifications, other international standards and codes shall be used.

All Structures, building foundations, Machines/equipment foundations, Water retaining structures, Trenches, Pits etc. will be designed as per latest relevant Bureau of Indian standard codes.

In general, construction will follow provisions and guidelines of IS: 456 / IS: 800 and IS: 3370 for water retaining structures. All structures will be designed for the most critical combinations of dead loads, imposed loads, equipment loads, crane loads, piping loads, wind loads, seismic loads and any other loading conditions which can occur during the design life of the structure.

11.4 Loads & load combinations

The following basic load cases will be considered for the civil design:

- a. Dead load
- b. Imposed load
- c. Earth pressure
- d. Wind load
- e. Seismic load
- f. Equipment load
- g. Crane/ monorail load
- h. Hydro static pressure
- i. Temperature load
- j. Surcharge load
- k. Other loads
- l. Load combinations

a. Dead Loads

Dead loads Consist of the weights of the complete structure with finishes, fixtures, partitions, wall Panels and all equipment, tanks, roofing, piping, cable trays etc. Loads given in IS: 875 (part-1) will be considered for computation of dead loads.

b. Imposed Loads

Imposed Loads in different areas will include live loads, minor equipment loads, erection loads, operational / maintenance loads, etc. The loads considered will not be less than that specified in IS: 875 (Part II). The loads list here under are the minimum loads for the areas involved. Floors and supporting members which may be subjected to heavy equipment loads will be designed on the basis of weight of equipment.

The specific minimum floor live loads are listed below:

Building roofs:

1) Flat Roof:

- 1.5 kN/m² for accessible roofs
- 0.75 kN/m² for non-accessible roofs

2) Electrical Building:

- Control room: 10 kN/m²
- MCC Room: 15 kN/m²
- Switchgear room: 15 kN/m²

3) Technological units

Live load and Equipment loads will be considered as per Technological requirement.

4) Other Areas:

- ✓ RCC Floors: 5 kN/m² for offices, laboratories, conference rooms and general floors
- ✓ Stairs and balconies : 5 kN/m²
- ✓ Chequered plate/gratings : 5 kN/m²
- ✓ Walkways : 3 kN/m²
- ✓ Toilet rooms : 2 kN/m²

Live load reduction will be in accordance with the provisions of IS: 875 and IS: 1893.

c. Earth Pressure

Earth pressure for all underground structures will be calculated using 0.5 as coefficients of earth Pressure at rest. For retaining wall design, the active earth pressure coefficient will be 0.3. For design of Substructure of pump houses and underground liquid storage tanks earth pressure at rest will be used. For other structures Coefficient of active or passive earth pressure will be used as applicable. Surcharge load will be considered for the design of all underground structures including channels, sumps, cable and pipe trenches, etc. to take into account the vehicular traffic in the vicinity of the structure.

D. Wind Load

Wind load on structures will be calculated as per provisions of IS: 875 (part 3). Structures will

be designed for Basic wind speed (V_b) of 39 m/sec. The return period of 50 years to be considered. The wind will be assumed to blow in any direction and most unfavorable condition will be considered for design. Terrain Category 1 shall be considered.

E. Seismic load

Seismic load shall be considered as per zone-II of latest IS Code, i.e, IS:1893-Part 4. The importance factor of relevant Industrial Buildings and structures shall be considered as per the above code unless specifically mentioned.

F. Equipment Load

Static and dynamic loads of major equipment will be based on the manufacturer's data of the specified equipment and will be considered in design in addition to the live load. However, where the uniform floor live load adequately accounts for the equipment moving weight, the weight of such equipment as a dead load is not to be considered e.g., switchgear and control room floors are usually designed for a live load that includes the equipment weight.

Foundations and fixing arrangements for Equipment which generates vibration, shall be designed to prevent transfer of such vibrations to the adjoining structures.

G. Crane and Monorail load

Crane girders and supporting columns will be designed for vertical and horizontal forces (including impact forces) as per crane vendor's data. All crane loads and monorail loads will have their design loads increased by impact factor as given in IS:875.

H. Hydrostatic pressure

Design and Construction of liquid storage structures shall comply with the requirements of IS 3370 (Part-1): 2009. All structures required to retain liquids shall be Designed for both the Full and Empty conditions, and the assumptions regarding the arrangements of loading shall be such as to cause the most critical effects.

I. Temperature Load

Expansion joints will be provided at every 45 m for concrete buildings/ structures as per IS: 456 which take care of the temperature loads. Where expansion joint is not possible to provide, the building will be designed for temperature loads.

J. Surcharge Load

All underground structures will be designed for a surcharge load of 2 t/sqm. Earth pressure at rest shall be considered in the design of underground structures while calculating lateral earth pressure.

K. Other Loads

Stresses imparted to structures due to differential settlements, Variation of water table, erection and maintenance loads, creep and shrinkage shall also be considered in design of all structures.

L. Load Combinations

The individual members of the frame will be designed for the worst combination of forces. Permissible stresses for different load combinations will be taken as per IS: 875 (Part-V) and other relevant IS codes. Wind and seismic forces will not be considered to act simultaneously. Load factors will be based on the factors given in the relevant codes of practice. Crane / monorail load will not be considered during seismic condition.

The structure/building shall be designed for various combination of loads to ensure safety and economy in the design.

Combination of loads shall be as per IS:875 (Part-5)-1987 and IS:1983(Part-4)-2016.

Limit state of Collapse & Limit state of serviceability load combinations shall be as per IS: 456-2000.

Crane load combination shall be as per IS:875(Part-2)-1987.

11.5 DESIGN METHODOLOGY FOR RCC STRUCTURES

11.5.1 General

All designs of RCC structures will be carried out by limit state method as per IS: 456 except for water retaining structures, which will be carried out by working stress method as per IS: 3370.

Design strength of materials and design loads will be calculated using appropriate partial safety factors over characteristic strength and characteristic loads as per relevant IS Codes. Reinforcement detailing will be as per IS: 5525 and SP: 34.

11.5.2 Foundations

Moderately weathered (Grade III) to slightly weathered (Grade II) fine- to medium-grained quartzite (Layer-IA) is encountered from the existing ground surface. Therefore, shallow foundations may be adopted at depths of 0.6 m to 1.0 m within Layer-IA to safely support the superstructure loads.

Field data and laboratory test results from all borehole locations indicate that the strength of the rock underlying the proposed foundation level is very high and well above typical design requirements. Accordingly, a safe bearing pressure of 40 t/m² may be considered for footings of various sizes placed at depths of 0.6 m to 1.0 m below the existing ground level.

As no groundwater table was encountered in the explored boreholes, foundations resting on the rocky stratum are less susceptible to chemical attack. Chemical analysis of a water sample collected from approximately 90 m depth from a nearby submersible pump indicates that the water is non-aggressive. Hence, no special cement or concrete treatment is required.

11.5.3 Liquid Retaining Structures

RCC water retaining structures will be designed as un-cracked section in accordance with IS:3370 (Part I to IV) by working stress method.

Substructure of pump houses, water channels etc. will be designed as cracked section in accordance with as per IS: 3370 (Part I to IV) by working stress method.

All water retaining / storage structures will be designed assuming liquid up to the height of wall irrespective of provision of any over flow arrangement.

11.5.4 Machine Foundations

The design of machine/equipment foundation will be as per IS 456 and IS 2974. All machine/equipment foundations and structures subject to vibrations will be suitably proportioned so that amplitude and frequency of the foundation /structures are within permissible limits. Dynamic analysis will be carried out to calculate natural frequencies in all modes including coupled modes and to calculate vibration amplitudes. Frequency and amplitude criteria as laid down by the relevant codes or machine manufacturers will be satisfied. Minimum reinforcement will be governed by IS: 2974 and IS:456.

If equipment is to be supported on building structures, floors, etc. suitable vibration isolation will be provided by means of springs, isolation pads, etc. and such vibration isolation system will be designed suitably. Pumps will be supported on conventional framed / block type RCC foundations.

All such foundations will be separated from adjoining parts of building and other foundations. Joints at floor / slab will be suitably sealed.

11.6 Increase in Stresses

Where stresses due to wind (or seismic) are combined with those due to other loads, the allowable stresses in concrete and reinforcement steel will be increased as per IS code provisions. Bearing capacity of the soil will be increased by 25% under seismic wind load condition.

11.7 Stability of Structures

Design will be checked against buoyancy due to the ground water during construction and maintenance stages for structures like underground storage tanks, pits, trenches etc. Minimum factor of safety of 1.2 against buoyancy will be ensured considering empty condition inside and ignoring superimposed loading. For purpose of calculating downward load due to any over burden, only the mass located vertically above the projected area of the base slab will be taken into consideration.

All building sub-structures will be checked for sliding and overturning stability during both construction and operating conditions for various combination of loads, Factor of safety for these cases will be taken as mentioned in IS: 456 and other latest relevant IS codes. However, following minimum factor of safety will be followed:

- a) Factor of safety against overturning due to wind, seismic or another lateral load will be 1.4 minimum
- b) Factor of safety against sliding will be 1.4 minimum.
- c) Factor of safety against uplift due to hydrostatic forces will be 1.2 and due to any other loads will be 1.5.

Stability of the structure will also be investigated for loading conditions during construction,

repair or other temporary measures. Lower factor of safety will be used for such loading conditions as per relevant IS codes. In cases where dead load provides the restoring force, only 0.90 times characteristic dead load will be considered. Imposed loads will not be considered as restoring force.

11.8 Fire

A Structure or Structural element required to have fire resistance should be designed to possess an appropriate degree of resistance to flame penetrations, Heat transmission and failure. Minimum requirements of concrete cover and member dimensions for normal-weight aggregate concrete members have to ensure a fire resistance of 2.0 hours as per IS 456-2000. The General requirements for Fire resistance of a Structures shall be as per provisions given in IS:1642-2013

11.9 Durability

The buildings/structures are situated in Bhopal, Madhya Pradesh. The region, experiences a moderate climate with relatively less exposure to severe environmental conditions compared to coastal areas, the environmental exposure condition for the RCC can be considered as "Moderate" (as per Cl. 8.2.2, IS: 456-2000). According to Table 5 of IS: 456:2000, the minimum grade of concrete in such conditions is M20, with a minimum cement content of 300 kg/m³ and a maximum water-cement ratio of 0.50. However, the grade of concrete adopted shall be M25, except for Trenches/Drains/Channels, which will be constructed using M20 grade RCC. Adequate concrete cover to reinforcement shall be provided as per the requirements in Table 16 of IS 456:2000, ensuring proper compaction and workmanship throughout the construction process.

11.10 CONCRETE MIX

The cement used for below ground structures (including foundations) and above ground structures in contact with deleterious material, will be Portland Slag cement conforming to IS:455. For above ground structures not in contact with deleterious material, the cement will be Portland Pozzolana Cement conforming to IS 1489: Part-1: 2015. Or OPC (ordinary Portland cement) 43-grade conforming to IS 8112-1989 mixed with fly ash in allowable percentage meeting required properties in accordance with relevant IS codes.

The proportion for nominal mix of concrete will be as per Table 9 of IS: 456:2000. Nominal mix in concrete will be allowed for grades up to M 15 only and all other grades of concrete will be with Design Mix concrete in accordance to IS 456:2000 and SP 23.

The concrete grade used for different structures will be as follows:

M- 5	Fill concrete
M- 7.5	Levelling course below foundations, trenches and underground structures
M- 10	Foundation below concrete block wall, RR masonry walls

M-20	- Base plate encasement, encasement of structural steel work, block area paving, screed concrete, Non- structural Flooring etc. - Pavement around buildings including plinth protection work, damp proof course below concrete block work etc.
M-25	Reinforced concrete work for foundations, Structural flooring, framed structure (Except Equipment foundations, Water retaining structure, etc.)
M-30	Reinforced concrete work for Equipment foundations, Water retaining structure, Roads, etc.

Minimum cement content, maximum water cement ratio and minimum grade of concrete will be considered as per IS: 456.

11.11 REINFORCEMENT

Reinforcing bars for concrete will be “TMT bars with strength requirements conforming to IS: 1786-1985” of Grade Fe 500D.

11.12 AGGREGATE

These shall conform to IS: 383 Specification for Coarse and Fine Aggregates from Natural Resources including M-sand. Unless specified, 20 mm and downgraded aggregates will be used for all structural concrete works. However, for levelling and base concrete (lean concrete) up to M-15 grade, downgraded aggregate of nominal size 25mm or above maybe used as permissible under provisions of relevant IS code.

11.13 GROUTING

Crushing strength of the grout will generally be one grade higher than the base concrete. Minimum grade of grout will be M 30. Nominal thickness of grouting will be at least 50mm for columns and pedestals of major equipment. For secondary posts, stair and ladder base, etc. grouting will not be less than 25mm thick.

For machine foundations the grout will be ready mix flow able, non-shrinkable grout.

11.14 WATERPROOFING TREATMENT

All the buildings RCC roof structure shall receive polyurethane (PU) waterproofing treatment as per manufacturer’s specification. Integral waterproofing compound as per manufacturer’s specification shall be used in the screed concrete.

11.15 FOUNDATION BOLTS AND INSERT PLATES

Anchor bolts will be designed for working stress, in tension and shear and for required embedded length in concrete. Shear and crushing strength of concrete will also be checked. Increase in allowable stress for loading including seismic and wind loads will not be permitted in design of anchor bolts.

Insert plates will be designed/checked for shear and bending moment. All lugs will be checked for tension. Bond strength of concrete will also be checked. Lugs using steel bars will preferably be fillet welded to the plate to transfer full strength of the lug.

Steel templates will be used for fixing bolts in position in all types of foundations. Foundation bolts and pockets will be pre-fabricated before placing them in position.

Tolerance for formed and concrete dimension will be as per IS: 456:2000.

11.16 PCC PAVING

PCC paving of grade M20, 100mm thick laid over 150mm thick compacted soling/Hard core/sand or murrum filling will be provided around all building as plinth protection to a width of 1000 mm.

11.17 ROADS AND DRAINS.

The road shall be designed as per IRC/MORTH recommendations and as per the CBR specified in the soil investigation report.

Internal roads will be RCC roads (M30), laid over a layer of PCC laid over a layer of Wet Mix Macadam laid over a layer of Granular Sub Base. 7.0 M wide Internal roads and approach roads & 4.0M wide peripheral roads are.

- **Roads & Drains**

1. Plant roads are to be invariably designed and constructed as rigid pavement with suitable expansion joints, camber and slope.
2. The width of the internal roads is envisaged as 7m and peripheral road of 4m has been considered with 1.0m wide berm and drains on either side are considered of the road.
3. Street lights of referred specifications are to be provided along the road to maintain proper illumination. In addition, high mast / flood lights are to be placed at road junctions and strategic locations for proper illumination.
4. In-between the manufacturing blocks 8m wide RCC pavement has been considered.
5. The drainage of RCC / Masonry (CR-Masonry) is envisaged, the contractor is required carry out the detailed hydrological and drainage study for design and construction of drainage system which should also account for envisaged future expansion.

- **RCC Trench**

1. RCC storm water drains are considered, however the same shall be reviewed based on site/design requirement.
2. RCC covered trench of adequate width and depth is required to be constructed for routing of power cables, control cables, instrument cables, communication cables and various pipes (Gas, water, treated waste water etc.)
3. Proper slope & drainage provision to be made in design and construction of these trenches for easy evacuation of storm water.

11.18 CODES AND STANDARDS

The following Indian Codes and Standards shall be generally used for design of civil and structural works. In all cases, the latest revisions with amendments, if any, shall be followed.

For work not covered by Indian standards, other International Standards, as applicable shall be followed. In case where either Indian or International standards, are not applicable, good engineering practice, as approved by the Owner shall be followed.

11.19 LIST OF IS CODES & STANDARDS

a) Concrete	
IS 456: 2000 (Reaffirmed 2021)	Plain and Reinforced Concrete - Code of Practice.
IS 3370 (Part 1): 2021	Code of Practice for Concrete Structures for the Storage of Liquids – General Requirements.
IS 3370 (Part 2): 2021	Code of Practice for Concrete Structures for the Storage of Liquids – Reinforced Concrete structures.
IS 3370 (Part 4): 2021	Code of Practice for Concrete Structures for the Storage of Liquids – Design Tables.
IS:875 (Part 1) – 1987 (Reaffirmed 2018)	Code of Practice for Design Loads (Other than EQ) for Buildings and Structures – Dead Loads.
IS:875 (Part 2) – 1987	Code of Practice for Design Loads (Other than EQ) for Buildings and Structures – Imposed Loads.
IS:875 (Part 3) – 2015 (Reaffirmed 2020)	Code of Practice for Design Loads (Other than EQ) for Buildings and Structures – Wind Loads.
IS:1893 (Part 1) – 2025	Criteria for Earthquake Resistant Design of Structures – General Provisions and Buildings.
IS:1893 (Part 2) – 2014 (Reaffirmed 2019)	Criteria for Earthquake Resistant Design of Structures – Liquid retaining Tanks.
IS :4326 – 2013 (Reaffirmed 2018)	Code of Practice for Earthquake Resistant Design and Construction of Buildings.
IS: 13920: 2016 (Reaffirmed 2021)	Ductile Detailing of Reinforced Concrete Structures subjected to Seismic Forces – Code of Practice.
Standard Publications & Hand books	
SP: 22 - 1982	Explanatory Handbook on Codes for Earthquake Engineering.
SP: 24 - 1983	Explanatory Handbook on IS 456 – 1978.

SP: 16 - 1983	Design Aids for Reinforced Concrete to IS 456 – 1978.
SP: 34 - 1987	Hand book on Concrete Reinforcement and Detailing.
SP: 6 (Part 1 to 7)-1964	Hand book for Structural Engineers.
SP: 7	National Building Code of India.
C) Foundations	
IS: 1080 – 1985 (Reaffirmed 2021)	Code of Practice for Design and Construction of Shallow Foundations in Soils (Other than Raft, Ring and Shell).
IS: 2974- 1982 (Part 1) (Reaffirmed 2018) IS: 2974- 1982 (Part 2) (Reaffirmed 2018) IS: 2974- 1982 (Part 3) (Reaffirmed 2020) IS: 2974- 1982 (Part 4) (Reaffirmed 2020) IS: 2974- 1982 (Part 5) (Reaffirmed 2018)	Code of Practice for Design and Construction of Machine Foundations.
IS: 6403 – 1981 (Reaffirmed 2021)	Code of Practice for Determination of Bearing Capacity of Shallow Foundations.
IS: 11089 – 1984 (Reaffirmed 2021)	Code of Practice for Design and Construction of Ring Foundation.

12 STRUCTURAL WORKS

12.1 GENERAL DESCRIPTION

- Steel structures will be designed to meet the technological requirements along with the functional, strength and serviceability requirements for all the units considered for design.
- The sheeting for roof shall be double skin sandwich panel and side cladding shall be of Color coated GALVALUME sheets
- Adequate louvers and translucent sheeting will be provided in the building as per the technological and functional requirement.
- The thickness of structural elements will not be less than 8mm (except for webs of rolled sections and the gutter). An allowance for corrosion is kept for structures exposed to outside atmosphere. In case of load bearing welds the thickness of fillet welds shall be as per codal provision or as mutually agreed as per the design requirement.
- All staircases will have a minimum width of 800 mm formed from chequered plates or Open grid panels. The slope of staircases will be preferably within 36 to 40 degrees. Handrails of platforms will be of tubes. The top rail will be 1.1 m above platforms level. The top rail, knee rail & the posts will be tubes and toe guards will be of steel plates or 4mm thick (i.e.: skelp plate).

12.2 DESIGN BASIS

- The Design of all the Structural members shall be as per the stipulations set out herein, with due consideration given to all local and state regulations governing such as works including stipulations of Indian Standards and Codes of practice.\
- The method of design shall be based on limit state concept. The structure shall be designed to safely withstand all loads liable to act on it. It shall also satisfy serviceability requirements such as limitations on deflection.
- All relevant limit states shall be considered in design to ensure adequate degree of safety & serviceability. In general, the structure shall be designed on the basis of most critical limit state and shall be checked for other limit states.

12.3 CODES AND THE STANDARDS

- The following (Indian) Codes and Standards shall be in generally used for design of structural works.

12.4 List of Codes & Standards

Steel structures		
	IS: 875 (Part 1)- 1987	Code of Practice for Design Loads (Other than EQ) for Buildings and Structures – Dead Loads
	IS: 875 (Part 2)- 1987	Code of Practice for Design Loads (Other than EQ) for Buildings and Structures – Imposed Loads
	IS: 875 (Part 3)- 2015	Code of Practice for Design Loads (Other than EQ) for Buildings and Structures – Wind Loads
	IS: 1893 (Part 1)- 2016	Criteria for Earthquake Resistant Design of Structures –General Provisions and Buildings
	IS: 1893 (Part 2)- 2014	Criteria for Earthquake Resistant Design of Structures –Liquid retaining Tanks
	SP: 6 (Part 1 to 7)-1964	Hand book for Structural Engineers
	IS: 800 - 2007	General construction in steel – code of practice
	IS: 808	Dimension for hot Rolled steel beam , column, channel and angle sections
	IS: 812	Glossary of terms relating to cutting and welding of metals
	IS: 813	Scheme of symbols for welding
	IS: 814	Covered electrodes for manual metal arc welding of carbon and carbon manganese steel specifications
	IS: 815	Covered electrodes for metal arc welding in mild steel and high strength low alloy steel
	IS: 816	Use of metal arc welding for general construction in mild steel
	IS: 9595	Metal Arc welding of Carbon and Carbon Manganese steels – recommendations
	IS: 2062	Structural steel (standard quality)
	IS: 3502	Steel chequered plates
	IS: 822	Inspection of welds
	IS: 7215	Tolerance of fabricated steel structures
	IS: 7743	Magnetic flaw detection of welds
	IS: 9172	Recommended design practice for corrosion prevention of steel structures

Note: Latest editions of IS Codes shall be followed

12.5 DESIGN LIFE

The intended Design life of all the Structures including foundations considered shall be:50 years.

12.6 DESIGN APPROACH

The fundamental principle of controlling the Design and Construction of the buildings shall be to ensure that functional performance is maintained at all times throughout the entire design life of the structure.

It is recognized that for the following scenario's the 'functional performance criterion' is not the main design criterion:

Severe earthquakes, for which the non-collapse criterion in the event of the Maximum Considered Earthquake (MCE) is adopted;

Temperature loads, for the change of axial elongation & the effect of the temperature is considered in the load combinations.

This shall be achieved through a combination of using the best quality control standards for materials and workmanship during Construction and adequate detailing during design.

12.7 SEISMIC DESIGN

The seismic design of the buildings shall be as per general provisions given in the IS: 1893-2016. The design approach adopted in this code is to ensure that structures possess at least a minimum strength to withstand minor earthquakes without damage; to resist moderate earthquakes without significant structural damage though some non-structural damage may occur; a aims structures withstand a major earthquake without collapse.

12.8 WIND DESIGN

The Effect of Wind on the structure as a whole shall be determined by the combined action of external and internal pressures and friction acting upon it. The design of the Buildings, Structures and their Components related to wind loads, shall be as per provisions given in the IS: 875 (Part-3) - 2015.

The following are the parameters considered for wind intensity calculation:

K1 = Risk Coefficient for All general buildings & Structures as per Table-1

K2 = Terrain factor with respect to height of building as per Table-2

K3 = Topography Factor as per Cl 6.3.3.1

K4 = Importance Factor for Cyclonic Region as per Cl 6.3.4

Kd = Wind directionality Factor for Cyclone affected Area as per Cl 7.2.1

Ka = Area Averaging Factor as per Table-4

Kc = Combination Factor as per Cl 7.3.3.13

Design Wind Speed (V_z) = $K1 \cdot K2 \cdot K3 \cdot K4 \cdot \text{Basic Wind Speed}$

$$P_z = 0.6 V_z^2$$

Design Wind Pressure (P_d) = $K_d \cdot K_a \cdot K_c \cdot P_z$

External Pressure as per clause 7.3.3.(Table 5 & 6)

Internal Pressure as per clause 7.3.2

12.9 DYNAMIC EFFECTS OF WIND

The importance of the Wind induced Oscillations or Excitations along wind and across wind direction shall be investigated in the flexible slender steel structures or steel members. Therefore, the following guidelines shall be adopted to examine the problem of the induced oscillations in such type of structures.

Buildings and closed structures with a height to minimum lateral dimension ratio of more than about 5.0

And

Buildings and closed structures whose natural frequency in the first mode is less than 1.0Hz.

Buildings or Structures which satisfy either of the above two criteria should be examined for dynamics effects of wind.

Increase in Allowable Bearing Pressure

When Wind forces are included, the allowable Bearing pressure in soil shall be increased as per Indian Standard.

12.10 DESIGN FOR LOADS DURING CONSTRUCTION

The structures shall not be specifically designed for loads during construction, such as crane loads and storage of masonry on building floors. It is the responsibility of the contractor to ensure that the structure shall not be overloaded during construction, for example by using temporary supports.

12.11 DESIGN FOR CRANE/MONORAIL LOADS

Crane/Monorail load shall be considered for the structures as per the technological requirement. No horizontal surge will be considered for monorails. In load combinations, Monorail load shall be considered as Live load. Actual loads and deflection criteria from crane/ monorail system shall be calculated by the suppliers and submitted in close relation to the design of the main load bearing structure before the detail design of both is undertaken. Fatigue shall be taken into account.

12.12 EQUIPMENT LOADING

Equipment and other systems, which are supported at floor or at roof, shall be considered as Equivalent Static point load and applied as lumped masses for earthquake conditions. Foundations and fixing arrangements for Equipment which generates vibration, shall be designed to prevent, or at least sufficiently limit, transfer of such vibrations to the adjoining structures.

Structures supporting vibratory/reciprocating equipment's shall be designed so as to obviate occurrence of resonance. The ratio of applied frequency to natural frequency shall be beyond the limits of 0.7 to 1.5.

12.13 DURABILITY

For durability, a design life of 50 years has been considered

Durability of steel structures

The following factors affect the durability of steel structures.

- a) Environment
- b) Degree of exposure
- c) Shape of the member and Structural detail
- d) Protective measures
- e) Ease of maintenance.

The structural durability factors mentioned above shall be dealt with in line with the provisions of Section-15 of IS: 800-2007.

12.14 DESIGN LIMIT STATES STEEL STRUCTURES

The steel structures are designed by limit state method under the following classification:

- a) Limit state of strength;
- b) Limit state of serviceability;
- c) Limit state of stability.

12.15 LIMIT STATE OF STRENGTH

The Design for strength should be based on characteristic values of material strengths and applied loads. The Design values are obtained by dividing the characteristic values by appropriate partial safety factors.

The load factors for strength design shall be obtained from the Indian Standard.

12.16 LIMIT STATE OF SERVICEABILITY

The Design for serviceability should be based on characteristic values of material strength and applied loads.

The load factors for serviceability design shall be equal to 1.0.

Deflection is the main serviceability design criterion. The Indian Standard gives separate deflection criteria for concrete and steel elements.

12.17 Control of Deflection for steel buildings

The deflection of various steel structural members shall be limited in line with Table 6 of IS: 800- 2007 so as not to impair the smooth working of the building units.

Type of Building	Deflection	Design Load	Member	Supporting	Maximum Deflection
(1)	(2)	(3)	(4)	(5)	(6)
Industrial Buildings	Vertical	Live load/ Wind load	Purlins and Girts	Elastic cladding	Span/150
				Brittle cladding	Span/180
		Live load	Simple span	Elastic cladding	Span/240
				Brittle cladding	Span/300
		Live load	Cantilever span	Elastic cladding	Span/120
				Brittle cladding	Span/150
		Live load/ Wind load	Rafter supporting	Profiled Metal Sheeting	Span/180
				Plastered Sheeting	Span/240
	Lateral	Crane load (Manual operation)	Gantry	Crane	Span/500
		Crane load (Electric operation up to 50 t)	Gantry	Crane	Span/750
		Crane load (Electric operation over 50 t)	Gantry	Crane	Span/1 000
		No cranes	Column	Elastic cladding	Height/150
				Masonry/Brittle cladding	Height/240
				Crane (absolute)	Span/400
		Crane + wind	Gantry (lateral)	Relative displacement between rails supporting crane	10 mm
		Crane+ wind	Column/frame	Gantry (Elastic cladding; pendent operated)	Height/200
				Gantry (Brittle cladding; cab operated)	Height/400
Other Buildings	Vertical	Live load	Floor and Roof	Elements not susceptible to cracking	Span/300
				Elements susceptible to cracking	Span/360
		Live load	Cantilever	Elements not susceptible to cracking	Span/150
				Elements susceptible to cracking	Span/180
	Lateral	Wind	Building	Elastic cladding	Height/300
		Wind	Inter storey drift	Brittle cladding	Height/500
				—	Storey height/300

12.18 LIMIT STATE OF STABILITY

Stability of the structures against overturning, sliding and floatation will be carried out for the serviceability load combinations.

For factor of safety for steel structures will be as per Table-4 of IS: 800- 2007.

12.13 LOAD COMBINATIONS

LOAD COMBINATIONS FOR STRUCTURAL STEEL STRUCTURES

For structural steel structures the load combination shall be as per the Table 4 of IS: 800-2007. The most unfavourable load combination arising from combined action of dead load, live load, equipment load, wind load, Crane load, Earth quake loads and installation loads will be considered for the design.

12.14 General

All the values for loads and factors/assembly of load combinations that shall be considered in the structural design are as per requirements of IS: 875 & IS: 1893. These values to be seen as a minimum, more stringent requirements might be applicable and will as a result be specified herein.

12.15 Dead Loads (DL)

Dead loads shall include the self- weight of all structural, weight of floor/roof, including all other likely dead loads from equipment of a permanent or semi-permanent nature including tanks, wall panels, partitions, roofing, piping, drains, bus-ducts etc. Self-weight of materials shall be calculated on the basis of unit weights given in IS: 875 (Part-1) -1987.

12.16 Live Loads (LL)

The Imposed loads applied in the design shall not be less than the equivalent minimum load specified in Table 1 of IS: 875 (Part 2) -1987. It shall be applied as Static Uniformly Distributed Load over the entire floor area.

12.17 Uniformly Distributed Load

Static uniform live loads are unit loads, which are sufficient to provide for movable and transitory loads, such as the weight of people, portable equipment and tools, equipment, or parts, which may be moved over or placed on floors during maintenance operations. These uniform live loads shall not be considered on floor area, which are permanently covered with equipment.

12.18 Live Loads on Roof

The Imposed loads on various types of roofs shall be as per Table 2 of IS: 875 (Part 2) -1987. It shall be applied as Static Uniformly Distributed Load over the entire Roof area.

12.19 Wind Loads

The Maximum Basic Wind speed shall be 39 m/s. Basic wind speed is based on peak gust velocity averaged over a short time interval of about 3 seconds and corresponds to mean heights above ground level in an open terrain (Category 2), and has been worked out for 50 years return period. Terrain Category 2 shall be used for Design.

Design wind speed & Design wind pressure at any height above mean ground level shall be obtained as per formulae given in Cl. 5.3 & Cl. 5.4 of IS: 875 (Part 3)-2015.

Calculating load along wind or drag load shall be done as per method given in Cl. 8.0 of IS: 875 (Part 3) -2015.

12.20 EARTHQUAKE LOAD

To determine the Seismic forces in the Structure, Seismic Zone-II shall be considered, as the project site falls in Zone-II. The Zone factor (Z), which is considered a reasonable estimate of the effective peak ground acceleration at any specific location, of 0.1 will be adopted.

The Response reduction factor (R), which is a measure for the amount of energy dissipated by the structure during an earthquake and depends on the amount of ductility present in the structure, will be considered as 5.0 for special moment resisting frame (with ductile detailing) and 3.0 for ordinary moment resisting frames (non-ductile detailing). For ductile detailing, references from IS: 13920- 2016 will be followed.

The Importance factor (I), which depends on the functional use of the structure and is characterized by hazardous consequences of its failure, post-earthquake functional needs, historical value or economic importance, shall be considered as 1.0 for administration-, canteen-, gate and gate house-, laboratory- and workshop buildings. For all other buildings, Importance factor value of 1.5 to 2.0 shall be considered.

12.21 DESIGN HORIZONTAL SPECTRUM

For the purpose of calculating seismic forces, the design value for horizontal seismic coefficient A_h for a structure shall be determined by the following expression as per Cl. 6.4.2 of IS: 1893 (Part-I) – 2016.

$$A_h = [z / 2 * I / R * S_a / g]$$

Where, Z, I, R and S_a/g are given below as per IS: 1893 (Part I) – 2016

Z	Zone factor given in Table 2, (Z=0.1 for zone II)
I	Importance factor, I = 1 to 2, given in Table 6 of IS: 1893 (Part 1) & Table 2 of IS: 1893 (Part 4).
R	Response reduction factor given in Table 7. R=5 for Steel Structure moment resisting frame as per SP6 R=4 for steel frame with concentric bracings.
S_a/g	Spectral acceleration coefficient for different soil types as per Fig.2. Type of the soil is as per the soil data. Damping value = 0.05 for Steel structures

12.22 INCREASE IN ALLOWABLE BEARING PRESSURE

When earthquake forces are included, the allowable bearing pressure in soil shall be increased as per Table 1 of IS: 1893 (Part 1) - 2016, depending upon type of foundation of the structure and the type of soil.

The design force shall be considered in each of the three principal horizontal directions (2 horizontal + 1 vertical) of the structure

12.23 DESIGN DEAD AND LIVE LOADS

The earthquake loads shall be calculated for the Full Dead load plus the Reduced percentage of live loads given below as per Table 8 of IS: 1893 (Part I) - 2016.

Live load Classes	Percentage of Live load
UDL of Above 3 kN/m ²	50
UDL of up-to and including 3 kN/m ²	25
UDL on Roof	Not to be considered

12.24 DESIGN LATERAL FORCE

The total lateral force or Design seismic base shear, VB along any principal direction shall be determined below:

$$VB = A_h W$$

Where,

A_h = Design horizontal seismic co-efficient (refer Cl. 4.4.1.2 of this document)

W = Seismic weight of the building calculated according to Cl. 7.4.2 of IS: 1893 (Part 1)

The masses considered in the structure, generating the loads are calculated from: Self-weight of the structure and super imposed dead loads (Equipment load) 50% of Live load and 0% of roof live load.

12.25 DESIGN HORIZONTAL EARTHQUAKE LOAD

The structures shall be designed for the effects due to full Designed earthquake load in one Design Vertical EQ Load, unless the IS provides a clause where this requirement can be excluded.

The effects due to vertical earthquake loads shall be calculated by considering two-thirds of the Design Horizontal Acceleration Spectrum.

12.26 SUPER IMPOSED DEAD LOADS (SIDL)

Equipment loads are calculated loads based upon the actual weight and size of the equipment. Loadings (both static and dynamic) of major equipment will be obtained from the manufactures

certified drawings of the specified equipment to be furnished. Loadings imposed by equipment shall be specifically determined or estimated before detailed structural design. Estimated loadings shall be noted as such in hand calculations or computer input and verified before detail design.

Each member in the floor which carry these loads shall be designed for the heaviest unit or units of equipment arranged in the most critical position. The impact factor for light weight machinery shall not be less than 20 percent. Loading effect due to Impact and vibration of Equipment shall be as per Cl. 6.0 of IS: 875 (Part 2) -1987.

12.27 MATERIALS FOR CONSTRUCTION

The materials for steel structures shall generally be as follows:

- a) All rolled steel sections and plates shall conform to IS:2062 – 2011.
- b) Covered electrodes for metal arc welding of structural steel shall conform to IS:814-2004.
- c) Crane Rails shall be as per IS:3443-1980.
- d) Steel chequered plates shall be as per IS 3502- 2009.

12.28 METHOD OF CONSTRUCTION

- a) Fabrication and erection of steel structures shall be in accordance with IS: 800 – 2007 and relevant standards mentioned there in.
- b) Steel structures shall generally be of welded construction. Site connections shall be either by permanent bolts or by erection bolts followed by site welding.

13. PRE-ENGINEERED BUILDING (PEB)

13.1 GENERAL

The scope covers proof checked design, fabrication, inspection, supply, erection and commissioning of Pre-Engineered Building (PEB) shed complete in all respects as per GADs of sheds enclosed in bid document.

Scope covers all components required to construct primary and secondary framing (wind bents, wall and roof purlins), wall and roof cladding, catwalk with hand rail, staircase, sliding door with frame and all necessary hardware needed for completing building/ shed.

General features of PEB covered in scope are detailed hereunder.

13.2 DESIGN SPECIFICATIONS

DESIGN LOADS (LIVE/ WIND)

Building should be designed and analysed for all possible combinations of live load, dead loads, gravity loads, earthquake loads, crane loads if any, wind loads etc for mean probable life of structure for 50 years.

1. Live load: 0.75 kN/m² as per IS 875-2-1987 Code of practice for design loads (other than earthquake) for buildings and structures, Part 2: imposed loads
2. Wind load: Basic wind speed as per IS 875-3-1987 Code of practice for design loads (other than earthquake) for buildings and structures, Part 3: wind loads
Probability factor k_1 as per codal provision.
Terrain height & structure size factor k_2 as per codal provision
Topography factor k_3 as per codal provision.
3. Seismic Zone: As per IS 1893-2002 (or latest)
4. Crane load Capacity of crane mentioned in Bid Document. Effect of two cranes working under full load in different combination, i.e., same, adjacent and different bays should be considered for vertical loads, lateral surge, tractive effort etc.
5. Dead load All possible weight of building components, electrical cables, pneumatic pipelines, gas pipelines, water pipelines, machinery, equipment, fittings etc should be considered.
6. Load combination All possible load combinations should be considered, i.e., dead load, imposed load, wind load, seismic load, temperature load etc as per relevant IS codes.

13.3 DEFLECTIONS

Main frame as per IS 800-2007 (or latest)

Vertical $L/180$ as per IS 800-2007 (or latest)

Lateral $L/150$ as per IS 800-2007 (or latest)

Purlins $L/180$ as per IS 800-2007 (or latest)

13.4 APPLICABLE CODES

Relevant BIS Codes with latest revision should be used. Wherever other than BIS codes/ manuals are mentioned equivalent BIS Codes may also be used.

- a) IS 875-1987 (or latest) Design loads (other than earthquake) for buildings and structures.
- b) IS 1893-2002 (or latest): Criteria for earthquake resistant design of structures
- c) IS 800-2007 (or latest) General construction in steel
- d) IS 801-1975 (or latest) Cold formed light gauge steel structure members in general building construction
- e) IS 12843-1989 (or latest) Tolerances for erection of steel structures
- f) Manual of Steel Construction, 9th Edition, American Institute of Steel Construction (AISC).
- g) Cold-formed Steel Design manual, 1996 Edition, American Iron and steel Institute (AISI)
- h) American Welding Society (AWS D 1.1.2008), Structural Welding Code– Steel

13.5 COLUMN DESIGN

Column design should be such that crane gantry load is vertically transferred directly to ground. Design of gantry girder on brackets fixed on column is permitted for EOT crane capacity.

13.6 SCOPE OF WORKS

Scope covers execution of complete PEB as per GAD of shed enclosed and specifications detailed in Bid Document and comprising items mentioned hereunder. However, the list is not exhaustive and may require some more items, which are not included in the list but are essentially required for completion of the work.

- a. Rigid frame structural for column, rafters with end plates, purlin, girt, bracing preferably piped bracing.
- b. Roof and wall cladding sheet, day light panel, flashing, trim, gutter, downspout Structural hardware, sheeting, fastener, end lap sealant, Anchor bolts and template.
- c. Crane girders/ beams, bracket, catwalk with hand rails at gantry level and
- d. staircase/ ladder to gantry, Framed opening, sliding doors, gravent, louver, turbo vent
- e. Structural members with one coat of factory applied
- f. primer and paint, final painting
- g. False ceiling panel, door, window, ventilator, rolling shutter, masonry brick wall, partition wall etc

13.7 STANDARD MATERIAL SPECIFICATIONS

Relevant BIS Codes latest revision should be used. Wherever other than BIS codes/ manuals are mentioned equivalent BIS Codes may also be used.

13.8 STRUCTURAL

Built-up sections should be fabricated from hot rolled plates conforming to ASTM A572 Gr50 (345MPa)/ IS 2062 E350 MPa steel. Sections should be fabricated from plates joined by continuous automatic submerged arc welding process. Hot rolled sections except beams should be mill sections complying with IS 2062 (240 MPa) steel. ERW pipes, sections and crane beams should be mill formed sections conforming IS 2062 (240 MPa) steel. Pre galvanized Z purlin as per ASTM A653M of thickness 1.6 mm, 2 mm and 2.5 mm of Gr50 (345 MPa) steel should be used. Bracing rods and sag rods should be made of steel bars conforming to IS 2062 (240 MPa).

13.9 FASTENERS

Primary structural connections should be made with electro galvanized (silver) high strength bolts Gr8.8 steel conforming to IS 3757. Purlins and girts should be connected to supporting members by machine bolts Gr4.6 steel conforming to IS 1363 electro-galvanized (yellow). Anchor bolts should be made from rods conforming to ASTM F1554 with a minimum yield strength of 250 MPa. Roof and wall panels should be fastened by No12 carbon steel self-drilling screws hot-dip galvanized with polymer- coated finish with an integral washer head to which an EDPM elastomer layer is bonded.

13.10 PAINTING

Scope covers painting of structural members. Primary steel should be shot blasted and cleaned thoroughly before applying primer coat. One primer coat of red oxide zinc chromate as per IS 2074 should be applied in shop after fabrication with an average dry film thickness (DFT) of 35 microns. Painting covers one shop primer coat and two coats of synthetic enamel paint (RAL 5010) of total DFT thickness of 100 microns on all structural members.

13.11 SHEETING

Scope covers supply and erection of 0.60 mm thick zincalume/ galvalume steel trapezoidal sheeting from reputed manufacturer with nominal 28 mm deep ribs. End ribs should be designed for anti-capillary action to avoid seepage of water through lateral overlap. Feed material of profiled sheet should be zincalume/ galvalume steel with base metal thickness (BMT) of 0.55 mm and total coated thickness of 0.60 mm.

Base metal should be high strength steel of 550 MPa yield strength with hot dip metallic coating of aluminium zinc alloy (55% Al, 43.4% Zn & 1.6% Si) as per ASTM A792M/ AS1397 & AZ150 of 150 gm/m² total on both sides with super durable polyester quality paint coat conforming to AS/ NZS 2728 Type- 4.

Painting should have total coating thickness of nominal 35 micron comprising nominal primer coat of 5 micron on both surfaces, external coat of nominal 20 micron on top surface (RAL 5012) and reverse coat of nominal 5 micron on back surface (RAL 9002). Colour shade for roof and wall cladding sheets should be selected from standard colour shade with approval of the employer.

Paint for exposed coat should be super durable polyester with inorganic pigment and free of lead. Conversion coating should be applied on both surfaces of metallic coating before application of paint as per AS-2728. Sheets should have marking details on backside of sheet at regular intervals indicating steel manufacturers name and product details.

Sheeting should be fastened with nominal 40-micron zinc coated or nominal 25-micron zinc-tin alloy coated Hex head self-drilling screw as per AS3566 2002 Class-3 fasteners of approved make with EDPM washer as per requirement considering profile shape and design load. Fastener size should be selected as per design/ manufacturers recommendations.

13.12 DAY LIGHT PANEL

Scope covers supply and fixing of UV protected polycarbonate day light panel minimum 2 mm thick conforming to classification 14443 PCISP LH49 2521 as per IS 14443 1997 with all flashings, trim closures, caps etc from reputed manufacturer. Profile of day light panel should match roof and wall sheeting panel. Closure strips should match sheeting profile.

13.13 LOUVER

Scope covers supply and fixing of louvers as per GAD of shed with fixed louver blades and border flashings manufactured from same sheeting material with outer side (RAL 9002) and inner side (RAL 5012) as per colour scheme approved by the employer.

13.14 TURBO VENT

Scope covers supply and fixing of gravity flow ridge type turbo roof vents with 600 mm throat and manufactured from same sheeting material. Turbo vents should be lightweight wind driven turbine-based roof vents manufactured from light weight, rust resistant aluminium alloy suitable to wind speed up to 200 km/hr.

Light weight roof vent structure should also assist in producing a low starting torque to initiate ventilation function. Double row ball bearings should be sealed and prepacked for maintenance free operation. Throat diameter of ventilation should be 600 mm with base plate of aluminium alloy. Colour of turbo vents should match with colour of roof sheeting (RAL 5012). Turbo roof vent should cover warranty for a period of 10 years guarantying ventilator turbine to spin when subjected to direct wind under normal conditions.

13.15 ROOF EXTENSION

Sidewalk roof extension should be 900 mm cantilevered roof members located at eave and sloped at same pitch as main structure roof slope. End wall roof extension should be 900 mm cantilevered C and Z sections which are continuous span extensions of main building end bay purlins and eave struts. Roof extension structural members (except rafters) should be concealed completely when soffit panel is specified.

13.16 STRUCTURAL CANOPY

Sidewall canopy should be 1500-2000 mm cantilevered rafter attached at eave or any point below eave supporting 200-250 mm deep Z purlins. Soffit panel should conceal canopy purlins leaving rafters exposed unless otherwise specified.

13.17 FASCIA AND PARAPET

Vertical and curve line fascia should be bracketing mounted type. Vertical fascia should consist of hot rolled I section or cold formed C section fascia post supported by hot rolled section bracket that is cantilevered from rigid frames columns at side walls and from end wall posts at end walls with cold formed 200-250 mm deep Z and C sections as top and bottom grits respectively. An intermediate C grit oriented vertically should support valley gutter when required.

Vertical fascia should project 600 mm from steel line. Height of fascia shall vary depending on actual requirement. Fascia cladding should be 0.60 mm thick TCT pre-painted Hi-Rib panels. Soffit panels and backside panels should be provided, if required. Curve line fascia is of same construction as vertical fascia but supplied with curved steel panel having same corrugation profile as Hi-Rib panel.

Parapet should be made from same construction as vertical fascia but without cantilever. Wall sheeting should continue to top of parapet.

13.18 ACCESSORIES (Trims, Flashings, Gutter, Downspouts, Ridge, Capping And Liner Panel)

Scope covers supply and fixing of accessories like louver blades, flashings, gutters, down take pipes, trims, ridges, capping, liner panels etc fabricated from same sheeting material used for roof and wall cladding application. Accessories should be fixed properly with roof and wall sheeting to ensure weather tight PEB shed. Down-take pipes/ downspout should be fabricated in square section (equivalent to 6" diameter pipe) from same sheeting material. Gutter and

down-take pipe system should ensure no water accumulation and stagnation at gutter level. Colour on outer side of accessories should be RAL 9002.

NOTE:

It is up to the bidder to assess the feasibility of adopting PEB technology for design and construction of manufacturing block OR to adopt a combination of both conventional fabrication as well as PEB. (maybe GF can be done using conventional & first floor using PEB).

However, inspection and testing bay has to be necessarily designed and constructed with PEB technology.

The intent of BEML is to get the project completed in time with quality. Bidders are requested to quote in consideration to above aspects.

14 PRESERVATIONS

All carried out works are to be preserved till its final completion to avoid re-work and time-loss

14.1 Inspection

All steel structures shall be subjected to inspection for acceptance by the purchaser.

14.2 Erection

Erection of steel structures shall be carried out in accordance with IS:800- 2007 and other relevant IS codes.

14.3 Painting

The recommended paint systems for general service requirement of internal and external steel structures covering surface preparation, application of primer coats, intermediate coats and final coats to develop the required minimum dry film thickness on steel surface is as below.

Surface preparation: Sa2½ according to Swedish Standard SIS055900.

For specific small items like walkway gratings and stair steps galvanization shall be recommended. Painting system shall be as per the Technical Specification.

The paint scheme enclosed in Annexure should be followed invariably, Paints shall be free from VOC / lead free paints.

NOTE: All civil construction works are to be executed in accordance with referred specifications in the absence of specifications provided in the tender, relevant IS Code and CPWD specifications. maybe followed

If IS code or CPWD specification is not available for any work, specifications available elsewhere with best engineering practices shall be followed.

For maintaining quality approved FQP (field quality plan) to be invariably followed. FQP to be got approved before commencement of work.

15 ELECTRICAL WORKS:

15.1 Introduction:

Major electrical loads of facilities can be broadly classified into the following:

- Process & Testing Equipment.
- Utility system (Lifts, STP/firefighting pumps, Water supply facilities etc.,)
- Instrumentation & control loads (LAN, PA, FDA, EPBAX etc.,)
- HVAC systems
- Lighting Load
- UPS for Admin building & Critical Lighting
- Illumination for roads, open areas etc.

UPS are planned for Critical Lighting (for entry, fire exit, staircase etc.,) of Office Typology building during Critical situations and Emergency Evacuation.

15.2 Design considerations:

The design of Power Distribution System and Selection of Equipment shall be based on the main consideration of simplicity, safety and reliability, ease of operation & maintenance.

The Equipment shall conform to relevant IS/IEC specifications and codes of practice to meet the operational requirements and to ensure reliable and safe operation. Generally, all electrical equipment shall be of Type Tested design in line with IS / IEC standards.

15.3 Statutory compliance:

Indian Electricity Rules as enforced by State Electricity Authority shall be complied with and adhered to. Safety Standards as per relevant codes/norms/practices shall be applicable.

15.4 Incoming power supply:

33kV incoming Power Supply shall be made available inside the Plant boundary at the Metering cubicle by State electricity Board. Incoming Power transmission lines and metering cubicle shall be made available by Client through SEB.

15.5 Scope of work and battery limits

Battery limits /scope of work shall start from the 33kV metering cubicle and goes downstream up to user end. 33kV incoming power supply shall be stepped down to 11kV through 33/11kV, ONAN Power transformers and further downstream to 415V through 11/0.433 kV ONAN Distribution transformers. Adequate quantity of Compact secondary substations (CSS) is considered for catering to LT loads of various facilities from MRSS building.

15.6 Design parameters:

STANDARD VOLTAGE LEVEL:

S.N.	Description	Data
1.	HT AC	33 kV, 3 phase, 50 Hz, effectively earthed. 11 kV, 3 phase, 50 Hz, effectively earthed.
2.	Control voltage for HT switchgear	110 V DC
3	LT AC	415V, 3Phase, 50 Hz, effectively earthed.

SYMMETRICAL SHORT CIRCUIT RATING:

S.N.	Description	Short Circuit Rating
1.	33kV and 6.6 kV switchgear	26 kA for 3 sec .
2	415V switchgear	50kA for 1 Sec.

PERMISSIBLE VARIATIONS IN POWER SUPPLY:

The system/unit/plant/equipment shall be designed so as to be suitable for the following variations in incoming voltage and frequency unless specifically indicated otherwise in the technical specification:

S.N.	Description	Voltage	Frequency
1.	For HT & LT system	+/-10%	+/- 3%
2.	For Control voltage DC	+/-10%	NA

In case of sensitive equipment which require more stringent quality of power supply with lesser variations to achieve the desired performance, the supplier shall provide the necessary regulator/stabilizer required before such equipment.

Equipment selection and de-rating will generally be based on ambient temp of +50 Deg C

15.7 EQUIPMENT SPECIFICATION:

A. POWER TRANSFORMER:

The Power transformer is envisaged to step down the 33kV incoming supply voltage to 11kV voltage at MRSS. The transformers will be suitable for outdoor installation and will be oil immersed and designed for ONAN cooling

S. No	Description	
1	3 Phase power supply system in which transformer is to be used	
a)	HV side Max. Voltage	33 KV
b)	LV side Max. Voltage	11.5 KV
2	Transformer application	Power Transformer
3	Rated no load voltage	
	- HV Winding	33 kV
	- LV Winding	11 kV
4	Method of cooling	ONAN
5	Rated MVA at no load voltage & principle tap (ONAN rating)	
	ONAN	As per SLD.
6	Percentage impedance voltage at rated current, frequency, principle tap and 75°C	12.5%
7	Winding data	
	a) No. Of windings	Two
	c) Winding connection (HV / LV winding)	Delta/Star
	d) Vector groups HV-LV	DNyn
8	<u>Bushing current transformers (LV Neutral side)</u>	Shall be accessible without removing tank cover and active parts
	a) Location	LV neutral
	- Application	Core 1-REF Core 2-SEF
	- No. of cores on the CT (Quantity)	2
	- Type	Ring
	- Ratio	Core 1 As Required

	Core 2	As Required
9	CT for winding Temperature compensation	
	-Type	As Required
	-Ratio	As Required
	-Class	Metering
	-Burden	As Required
10	Transformer mounted on:	
	i) Rollers/flanged wheels	Flanged wheels
	ii) Flanged wheels (removable)	Removable
	iii) Rail gauge (in both axis)	1676mm Rail gauge

B. 11/0.433 kV DISTRIBUTION TRANSFORMER:

HT power supply is stepped down to 415V at each CSS using 11/0.433kV, three phase ONAN, oil filled, outdoor type copper wound distribution transformers.

1	3 Phase power supply system in which transformer is to be used	
a)	Primary side (HV) max. Voltage	11 kV
b)	System earthing Primary side (HV) Secondary side (LV)	Solidly grounded
2	Direction of power flow	Uni directional
3	Transformer application Applicable standards	Distribution transformer IS 1180
4	Transformer type Indoor/ outdoor Dry type/ liquid filled Core type/ shell type	As per requirement Mineral oil filled Core type

5	Auto wound / two winding/ three winding	Two winding
7	Number of phases	Three
8	Rated frequency	50 Hz., $\pm 5\%$
9	Rated no load voltage HV winding LV winding	11 0.433 kV
10	Cooling Method of cooling Cooling liquid	ONAN Mineral oil
11	Rated MVA at no load voltage & principle tap (ONAN rating) ONAN	As per IS/IEC.
12	Overloading as per IS 6600	Required
13	Max. Temp. rise at rated MVA & principal tap Top oil by thermometer method over design ambient temp. Any winding (HV&LV) by resistance method over design ambient temp. of 45 ⁰ C Hot spot temp. based on the design ambient of 45 ⁰ C	40 ⁰ C over 45 ⁰ C 40 ⁰ C over 45 ⁰ C 105 ⁰ C
14	Percentage impedance voltage at rated current, frequency, principle tap and 75 ⁰ C Between HV-LV	As per IS
15	Tapping's Off-circuit/ ON load Manual /automatic No. of steps Percentage variation /step	Off Circuit Manual 4

	Winding in which tapping's are required	2.5 (Equal), -5% to +5% HV	
16	External terminal Short circuit withstand capability of transformer on any tapping for 3 phase and line to ground faults across LV winding	Not less than 2 sec.	
17	Insulation		
	PF withstand kV (RMS)	Impulse with standard kVP	Switching Impulse withstand
	HV winding 20KV LV Winding 2.5KV	60kV -	NA
18	Winding insulation category a) HV-uniform /non-uniform b) LV-uniform/ non-uniform	Full Insulation Full Insulation	
19	Winding data No. of windings Winding material Winding connection (HV \ LV winding) Vector groups HV-LV1	Two Copper Delta / star Dyn11	
20	Core laminations Type Material	CRGO SILICON STEEL	
21	Noise level in DB scale when measured 4 ft. from the transformer edge at a height of 5 ft. above the floor at rated voltage and load	As per IS	
22	Bushing current transformers:		

	Location No. of cores on the CT Type Ratio Protection class Knee point voltage CT sec. Resistance at 75 ⁰ C Short time rating for 2 sec Magnetising current at Vk/2 Accessibility		1 HV neutral NA Not applicable Not applicable - - : : : : : : :	2 LV neutral Inside Neutral terminal box 2 cores Indoor As required Class PS, 5P15, 15VA 500 Volts Less than 5 ohms As per trafo Not more than 20mA Shall be accessible without removing tank cover/active parts	
23	Bushings	Line bushings		Neutral bushings	
		HV	LV	HV	LV
	Type	Porcelain	Porcelain	Not applicable	Porcelain 2 nos.
	Voltage class	12 kV	1.1 kV		1.1 kV
	Current rating in Amps. Minimum	As per Requirements & Trafo rating			
	Creepage distance	Not less than 31 MM per kV of rated voltage of the bushing			
	Short time rating & insulation level	As per trafo			
	24	Terminal arrangement			
	High voltage		Bottom entry, Cable box with Air insulated Disconnect chamber		

	Secondary	Bottom entry, Cable box with Air insulated Disconnect chamber
25	Radiators	Detachable
26	Transformer mounted on:	
i)	Rollers/ flanged wheels	Bi-directional rollers

C. LIGHTING TRANSFORMER:

To cater to illumination need of the plant, required no. of 11/0.433kV and 415/433V Lighting transformers of suitable capacity has been considered as applicable.

The transformer design shall ensure that the efficiency of transformers is compliant with CBIP Guidelines for energy efficient transformers.

Sl. No.	Particulars	
1.	Specification	IS 2026, IS 11171 – 1985
2.	Type	Three phase, core type, cast resin dry type
3.	Duty	Indoor, installed in room
4.	Degree of Protection of Enclosure	IP32 for indoor and IP42 for outdoor.
5.	Voltage HV/LV	11/0.433 kV 415/ 433V
6.	Frequency	50 Hz
7.	No. of phase	3
8.	Continuous rating	As per requirement
9.	Conductor	Copper
10.	Insulation class	Class F
11.	Cooling	AN
12.	Winding connection	Delta / Star
13.	Vector group	Dyn 11
14.	Neutral grounding	Effectively earthed

Sl. No.	Particulars	
15.	System earthing	HV -Resistance earthed LV-Effectively earthed
16.	Percentage impedance	As per IS
17.	Termination	Cable end box suitable for termination of XLPE aluminium cables, with air insulated disconnecting chamber Suitable for Cable termination
18.	Temperature rise over 50°C ambient temp	In winding (measured by Resistance method) – 70°C Core and other adjacent parts of winding - 70°C
19.	Bushing mounted CT's	
	CT in LV Neutral bushing for standby E/F protection	Ratio: as required Class: as required
20.	Off circuit tap changer Range Total tap positions Taps above nominal voltage Taps below nominal voltage Voltage per step variation Tap change controls	Bolted Link type ±5% 5 2 2 2.5 % Manual
21.	Impulse test withstand voltage	As per IS 2026, Part III – 1981
22.	One minute dry and wet power frequency withstand voltage	- do -
23.	Short circuit level on Primary side	50kA
24.	Time duration to withstand 3 phase short circuit at secondary terminals, without any injury.	1 Sec.
25.	Auxiliary supply voltage	240 V AC
26.	Parallel operation	Suitable for parallel operation with transformers of similar ratings

Sl. No.	Particulars	
27.	Overload capacity	As per IS 6600

D. HT SWITCHGEAR:

The HT switchgear envisaged shall be indoor type sheet metal clad, draw out type with VCB circuit breakers and shall be provided with necessary protection, control gear, metering and audio-visual alarm annunciation system. The circuit breaker mechanism shall be mechanically and electrically trip free. The circuit breakers shall be electrically operated, stored energy type and shall be operated on 110V DC / 220V DC control power supply.

The switchgear shall be equipped with microprocessor based numeric relays, energy monitoring devices like multifunction meters etc.

A separate dummy / cable chamber panel shall be provided for the feeders where more than two nos. cables are terminated.

Sl. No.	Particulars	11 kV
1.	Type	VCB
2.	Service	Indoor
3.	Enclosure	IP4X
4.	Nominal System Voltage	11 kV
5.	Highest System Voltage	12kV
6.	No. of phases and frequency	3ph. 50 Hz
7.	Busbar material	Copper/ Aluminium
8.	Bus Colour code	RYB
9.	System Earthing	Solidly Earthed
10	Continuous Current Rating at 50 deg C(I/C)	As per SLD
11.	Short Circuit Rating	26.2 kA
12.	Short Circuit duration	3 Sec
13.	Rated making Current	100 kA
14.	Busbar Rating	As per SLD
15.	Power Frequency Withstand voltage (RMS)	28kV for 1 minute

Sl. No.	Particulars	11 kV
16.	Impulse withstands Voltage (1.2/50 micro sec) peak	75 kV
17.	Control Voltage	110 V DC / 220V DC
18.	Spring charge motor voltage	240 V AC
19.	CT Ratio	As per SLD
20.	Bus PT and Line PT	As per SLD
21.	Aux. Contacts	6 NO + 6 NC
22.	Termination	
22.1	Incomers	Armoured XLPE, FRLS Al Cable
22.2	Outgoings	Armoured XLPE, FRLS Al Cable
23.	Clearance in air Phase to phase (mm) Phase to earth (mm)	As per IEC

The switchgear shall be equipped with Microprocessor based Numeric Relays, Energy Monitoring devices like multifunction meters etc.

A separate dummy / cable chamber panel shall be provided for the feeders where more than two nos. cables are terminated.

All major relays and multifunction meter shall be microprocessor based numerical and communicable type.

The multifunction meter shall have the following minimum features.

- Ammeter
- Voltmeter
- Frequency meter

- Power Factor meter
- kW meter
- kWH meter
- kVA meter
- kVAR meter with lead & lag facility
- Maximum Demand meter & controller (as per requirement)

E. CONTROL SUPPLY:

Control supply buses shall run throughout the switchgear.

Two DC feeders shall be taken in each board controlled by MCCB's.

In each panel for controlling of its DC supply MCCB (DC duty) shall be used. DC Auto Changeover and Manual Changeover facility shall be provided. Failure of each DC supply shall be monitored in the switchboard as well as at remote.

110V / 220V DC supply shall be taken from a station aux. board.

Each section shall have separate feed with automatic changeover scheme.

Each panel shall have one MCB for controlling its AC supply.

Sub circuits shall be protected with HRC fuses in each panel for indication lamps, closing and tripping circuits.

Control circuit should be protected, preferably with MCBs, alternatively HRC link type fuses conforming to IS 9224-1979.

F. LT POWER FACTOR COMPENSATION EQUIPMENT

The Capacitor Bank shall be provided to improve Power factor from 0.8 to minimum 0.95 lag at CSS. The HT capacitor bank unit of MRSS shall comprise incoming side Isolators, Lightning Arrestors, Series Reactor, Discharge PT's, Capacitor banks, Neutral unbalance protection CTs, bus work, supporting structures, etc. as required to make the installation complete in all respects.

The selection of Power Factor Compensation (Capacitors with Reactors) and associated Equipment shall be finalized as per system requirements.

Sl. No.	Description	415V
1	Type of connection	Delta Connection
2	Bank rating in kVAR	refer SLD
3	Bank rating in capacitance	As required
4	Method of mounting	In CSS

Sl. No.	Description	415V
5	Type of steel	Galvanised steel with minimum galvanization of 900 gm/ sq.m
6	Bank formation	By copper bus bars taped to full insulation level
7	Insulation level	As per IS (impulse and power frequency)
8	Bus bar insulators	As per IS (Clearance)
9	Installation	Indoor

G. COMPACT SECONDARY SUBSTATIONS (CSS):

Designed in accordance with IEC 61330 standards, the CSS shall be prefabricated secondary substation with type-tested equipment and consists of VCB along with CT & PT, distribution transformer, and associated equipment in a compact unit. The CSS shall be designed to achieve high levels of personnel safety and aesthetics.

The Compact Substations, Non- Walkable type shall be factory assembled unit consisting the following major equipment.

- 11kV RMU with earth switch
- 11 kV Vacuum Circuit Breaker.
- Up to 2500 kVA 11/0.433 kV, ONAN/ AN Transformer
- 415 V LT bus bar
- LT Distribution Board
- HV Surge arrestor
- 11kV Current & Potential Transformers

All components are housed in an enclosure, which protects the equipment against environmental hazards and unauthorised access. The enclosure is typically divided into two sections or compartments as follows:

- Vacuum Circuit Breaker (VCB)
- Distribution Transformer

H. LT POWER /MOTOR CONTROL CENTRE (PMCC/MCC):

The 415V switchboards shall comprise of Air Circuit Breakers/MCCB, in Draw Out design and multi-tier formation. The switchboard shall have two bus sections and a bus coupler breaker with provision for auto changeover in the event of loss of power on any one bus section.

The circuit breakers shall be electrically operated and equipped with Microprocessor /Static type direct acting releases for over load and short circuit as well as earth fault protection.

All Motor Control Centres (MCCs), large drives starter panel (rating 55 kW to 160kW) and Power Distribution Boards (PDBs) shall be supplied power from the LT PMCC (415V switchboard). The 415V switchgear shall confirm to IS-8623 and IS 13947.

Description	Particulars
Nominal system voltage	415 V
System Earthing	Neutral solidly earthed
Short time rating	50 KA for 1 Sec.
Making capacity	105 kA
Control supply	240V AC
Configuration	As per IS
Colour code	RYB
Busbar rating	As Per Incomer Rating
Enclosure	IP-4X or better
Circuit Breakers	
Symmetrical breaking current	50 kA
Making capacity	105 kA
Short time rating (for 1 second)	50 kA
Rating for incomers	As per SLD
Rating for outgoing	As per Single Line Diagram Or requirement during engineering stage.
Closing mechanism	
I) Incomer & bus sectionalizer	Motor operated spring charged stored energy type
II) Outgoing	Independent manual
Spare	20 % of feeder or minimum 2
Tripping mechanism	Shunt trip
Control supply	240 AC
No. of auxiliary contacts	6 NO + 6 NC for future use

Termination	
a) Incomer	Bus duct (top entry)
b) Outgoing	Armoured aluminium cable

I. AC DISTRIBUTION BOARD (PDB/ACDB)

415V, 3 phase, 4 wire, 25 KA short time rating for 1 second (for ACDB) indoor type. Board shall be single front, metal clad, front matched, dust and vermin proof, fully compartmentalized and extensible on both sides, IP5X type enclosure. DB Shall have base channel of size ISMC75.

DB Shall have isolated busbar chamber for main busbar at the top, running throughout the length of the board. Chamber shall have removable cover.

Cable alley shall have sufficient space for Aluminium power cables and bottom cable chamber shall be left free completely isolated from the vertical busbars.

Busbars shall have same cross section throughout the length. Rating of the neutral bus bar shall be 50% of the main bus bar. Earth bus bar shall run in bottom chamber throughout the length of the panel.

DB shall have Moulded Case Circuit Breaker (MCCB) triple pole, air brake type with independent manual quick make and break type. MCCB shall be capable of breaking rated current at 0.3 PF at the rated voltage.

MCCB shall withstand the fault current envisaged for 415V system. All feeders shall have ON/OFF lamps and 96 sq.mm size ammeter.

Incomer & Bus-coupler shall have manual operated ACBs with Microprocessor based O/c, short circuit, earth fault & shunt trip releases and outgoing shall be MCCBs.

J. Battery, Battery charger and DC distribution board (PLANTE)

Adequate capacity of 110V DC or 220V DC Plante type Battery along with Battery charger & DCDB shall be provided for catering 110V DC / 220V DC control supply to 11KV HT switchboards.

The system shall include:

Two Battery system (1 W+ 1 S) each comprising with

- DC Battery set
- Two identical automatic float-cum-boost chargers
- DC distribution board

K. HT / LT CABLES:

Power inside the plant shall be distributed through cables to various premises.

HT & LT Cables shall be laid through Underground Cable Service corridors. HDPE Pipes shall be used at road crossings and paved area.

Inside the substations and covered premises, the cables shall be laid in cable cellar, Cable basement or in concrete channels (over cable supporting structures) or on columns and other available structures. Power cables shall be laid on ladder type GI cable trays, whereas control cable shall be laid on perforated cable trays.

11kV cables shall be heavy duty, FRLS, XLPE insulated, PVC sheathed multi core, aluminium/copper conductor steel wire double armoured, FRLS type.

Cables for 415 V system shall be heavy duty, 1.1kV grade, PVC /XLPE insulated PVC sheathed aluminium conductor, double armoured type FRLS type.

The control cables shall be multi strand copper conductor, PVC insulated and PVC sheathed with minimum cross section of 2.5 sqmm for control voltage circuit and 4.0 sqmm for power circuit. Copper Cable shall be provided for rating up to 3.7kW.

The HT cables shall conform to IS-7098 –1988, whereas LT power and control cable shall confirm to IS-1554-1988. All HT and LT power and control cables shall be double armoured type.

Cable cellar shall be envisaged in LT substation. Also, cable cellar shall be considered in Main receiving substation. All cable trays shall be galvanized and ladder type for power cables.

Cable shall be laid separately for HT and LT feeders. All cable entry points shall be sealed with Fire retardant paints and material and all cable shall be painted with fire retardant paint.

Ventilation system shall be considered dry ventilation system. Split AC shall be considered for control room, office room, conference room, VVVF room etc.

L. 415V POWER DISTRIBUTION BOARDS:

Power distribution boards (PDB) will be feeding power to cranes, hoist and utility sockets. All incoming and outgoing MCCBs/ACBs shall have electronic/microprocessor-based releases with adjustable LSIG protection.

LT Switchboard	
Nominal system voltage	415 V
System earthing	Neutral solidly earthed
Short time rating	50kA for 1 Sec.
Making capacity	105kA
Control supply	240V AC
Busbar rating	AS per SLD
Enclosure	IP-4X or better

Circuit Breakers	
Symmetrical breaking current	50 kA
Making capacity	105 kA
Short time rating (for 1 second)	50 kA
Rating for incomers and buscouplers	AS per SLD
Rating for outgoing (ACBs)	AS per SLD
Incomers & bus couplers	Motor operated spring charged stored energy type.
Outgoing feeders	Motor operated spring charged stored energy type.
Tripping mechanism	Shunt trip
Control supply	240V AC as applicable
Incomer	Bus duct (top entry)
Outgoing	Armoured aluminium cable
Feeder Arrangement	
Incomer (Mounted in single tier arrangement)	Air circuit breakers
Outgoings (Mounted in Double tier arrangement)	Air circuit breakers

M. LT MOTOR CONTROL CENTRE (LT MCC)

Motor Control Centres (MCCs) shall be Draw-out type, Single front in IP-54 enclosure with single incomer for control of drives of rating equal to or less than 90kW. MCCs will be draw out, single front, modular construction.

General		
1.0	Type	Metal clad. draw out
2.0	Construction	Modular construction. Fully compartmentalized with metal / insulating material partition.
3.0	Enclosure class	IP54.
4.0	Type of execution	Single front.
5.0	Mounting	Floor mounting. Free standing with ISMC 75.

6.0	Installation	Indoor.
Busbars		
(i) Main horizontal & vertical busbars		
1.0	Arrangement	Three phase & neutral. Bus Bar chamber on the top.
2.0	Material	High conductivity electrolytic aluminium alloy confirming to grade E91E as per IS-5082 -1981.
D. Insulation level		
1.0	Rated insulation voltage	1100 V
2.0	Impulse withstand voltage	4 kV as per IS-13947 (Part I) 1993
3.0	One minute power frequency withstand voltage	2.5 kV for power circuit & 500 V for control circuit
E. Pollution Degree		
1.0	Pollution Degree	Pollution Degree 3 As per IS-13947 (Part-1): 1993; unless otherwise stated

N. MOTOR CONTROL PANELS (MCP)/SOFT STARTER:

For LT motors of rating greater than 55kW and up to 160kW shall be provided with independent Motor Control Panel (MCPs) which shall be directly fed from LTSS/PCC. MCPs shall be conventional type, Single front, non-draw out type with IP-54 enclosure class of protection. Power devices like MCCB, Contactor, Electronic type Over Current relay (EOCR) with combine protection & display, Control transformer etc. shall be located in MCPs.

Soft Starter shall be provided for drive rating in range of 90kW to 180kW where full torque load starting is not required (like fans, pumps etc.). Separate panel to be provided for the same.

O. Main Lighting Distribution Boards (MLDB):

Main Lighting Distribution Boards (MLDB) with two incomers and bus coupler for Power supply to various Lighting Distribution Boards (LDB). MLDB shall have 415/415V isolation transformers in Incomers. capacity.

Main Lighting Distribution Board (EMLDB) will be provided for power supply of all light fittings One incomer will be from MLDB and second incomer will be fed from Emergency source.

P. VARIABLE FREQUENCY DRIVES (VFD)

VVVF converters will be provided for drives having requirement of speed control or any other equipment where process requirement calls for variable speed application. De-rating on account of ambient temperature of 50 deg.C shall be done while calculating the continuous current rating of VFDs.

Rating Selection of Variable Frequency AC Drives:

For constant torque load, continuous current of AC drives will be 150% of motor full load rated current (as indicated in motor data sheet/name plate).

- For motion control drives, belt weigh feeders, Vibrating feeders and intermittent duty drives – 125% of motor full load current (as indicated in motor data sheet/name plate).
- For continuous duty drives like pumps, fans etc. – 115% of motor full load rated current (as indicated in motor data sheet/name plate).
- Current rating of AC drive will be calculated after de-rating to specified ambient temperature.
- Line reactor will be provided in incoming side of VFD. Suitable output chokes/terminator will be provided in output side of the VFD considering limitations of cable distance as per manufacturer's recommendation.
- Continuous current rating of VFDs will be selected for heavy duty rating.

Q. UN-INTERRUPTED POWER SUPPLY (UPS)

Dual parallel redundant system with provision of bypass line with static bypass switch and stabilizer. Each UPS set shall be rated for full capacity and in normal condition both the UPS shall be sharing the total load and in case of failure of any one UPS, other healthy UPS shall take the full load.

Each UPS set shall consist of common battery bank for 30 minutes back up (for lighting) and 1 hour backup (for workstation) in case of power failure.

UPS system with UPS Power distribution board, sub-distribution boards for distribution of power to Automation system equipment, Instrumentation system equipment, Weighing system, CCTV system, FDA system, Telecommunication system, LAN & any other equipment as per requirements.

R. HT/LT MOTORS

Low Voltage Squirrel Cage Induction Motor

Sl. No.	Parameters	Description
1	Motor body	Grey iron casting.
2	Motor Feet	Integrally cast with the stator.
3	Protection for Motor & Bearing	IP – 55

4	Shaft ends & Extension	Cylindrical.
5	Bearings	Motor of rating up to 7.5kW, ball bearings will be used for both DE & NDE end. Motor ratings above 7.5 kW, DE will be provided with roller bearing and NDE will be provided with ball bearing.
6	Terminal box	
I	Location	RHS viewed from DE/on Top.
7	Cooling	- TEFC (IC-411)
8	Electrical design	
I	Power Supply	415V
II	Starting Torque	$\geq 160\%$ Rated Torque.
III	Breakdown or pullout torque	Minimum 200 % of the rated torque.
IV	Starting current	As per latest edition of IS 12615.
V	Max speed permissible	120% over speed for 2 minutes.
VI	Overload capacity	Capable of withstanding 160% Overload for 15 sec.
VII	Efficiency	All continuous duty motors shall be complied to IE4 efficiency class and shall confirm to IS 12615.
VIII	Insulation	Class 'F'.
IX	Permissible temperature rise	Limited to class 'B' (120 deg. absolute).
X	Space Heater	Outdoor motors above 45 kW. Indoor Motors above 110 kW.

High Voltage Squirrel Cage Induction Motor

Sl. No.	Parameters	Description
1	Stator Frame	Fabricated Steel/ High grade cast Iron.
2	Stator Core	Laminated sheets of high-grade low loss silicon steel.

3	Motor body	Grey iron casting.
4	Casing Feet	Integral with the motor frame.
5	Protection for Motor & Bearing	IP – 55
6	Bearings (below 5000kW)	Anti-friction bearing with re-greasing facility and with grease quantity controllers.
7	Vibration monitor	Will be provided at the DE of motor bearing for rating 1000kW and above.
8	Bearings insulation	Against circulating shaft currents.
9	RTD & BTM (PT100 type)	- All motors will be provided with PT100 type (duplex) 6 nos. or (simplex 12 numbers) stator winding temperature detectors & 2 nos. Bearing (DE & NDE) temperature detectors (duplex) for monitoring alarm and trip conditions. - For HT motor temperature alarm, tripping & monitoring, RTDs (for winding/bearing) will be wired to motor protection relay in HTMCC as well as to PLC RIO as automation system inputs. Limit value contacts for alarm and tripping will be generated in the automation system along with the display of winding and bearing temperature. - Local Dial Gauge to be provided for DE & NDE Bearing temperature indication for Motors rated 1000kW and above.
10	Vibration monitoring	Vibration monitoring (online) will be provided at the DE of motor bearing for motors of ratings 1000 kW and above (or as specified in CTS) and it should be connected to plant automation system inputs for online monitoring.
11	Terminal box	
(i)	Protection	IP – 55
(ii)	Type	Main TB - Phase segregated Neutral TB- Non-Phase Segregated.
(iii)	No. of terminal boxes	Separate TBs for Space heaters, RTDs/BTDs, Vibration monitor etc.

12	Cooling	TEFC/ CACA/ CACW
(i)	Efficiency	High efficiency design of 95% or higher at full load.
(ii)	Direction of Rotation	Direction of Rotation – Bidirectional.
(iii)	Starting current	<= 600% Rated current
(iv)	Max speed permissible	120 % rated for 2 minutes.
(v)	Differential protection	Required for 1000 kW & above.
(vi)	Insulation	Class 'F' & confirming to IEC 34 - 15/1990.
(vii)	Insulation Material	Cast resin rich/Poor.
(viii)	Permissible temperature rise	Limited to class 'B' (120 deg. absolute).
(ix)	Space Heater	Required & automatically off during RUN.

LT Inverter Duty Motor

Sl. No.	Parameters	Description
1	Motor body	Cast iron.
2	Motor Feet	Integrally cast with the stator.
3	Protection- Motor & Bearing	IP - 55
4	Shaft ends & Extension	- Cylindrical. - Shaft will be extended for encoder/tach mounting.
5	Bearing	- Insulated bearing will be provided at NDE for motors rating 75kW and above. - For loads exerting high cantilever forces at drive ends, roller bearings to be provided for motors of frame size 225 and above in DE.
6	Terminal box	
(i)	Location	RHS viewed from DE/ on Top.
7	Cooling	- TEFC, Effective bi-directional

		- Motor with 20:1 speed range or higher shall have external fan. - External fan motor will be 3 phase, 415 V AC.
8	Service factor	- 1.0 for VFD power. - 1.15 for sine wave power.
9	Peak transient voltage	3.16 times rated voltage for Motors
10	Minimum rise time	0.1 microsecond
11	Locked Rotor Torque	- 70 to 250% of motor rated torque for applications which requires to start at low starting torque e.g. fans, blowers, centrifugal pumps etc. - 200 to 250% of motor rated torque for applications which requires to start on load e.g. conveyors, crushers, stirring machines, agitators, reciprocating pumps and compressors etc. - 275% of motor rated torque for applications which requires to start at high torque e.g., elevators, cranes, winches, hoists etc.
12	Overload capability	150% of the rated current for 2 minutes at rated voltage and rated frequency.
13	Max speed permissible	120% rated for 2 minutes.
14	Insulation	- Class 'H' temperature rise limited to 'F'.
15	Space Heater	- Outdoor motors above 45 kW - Indoor Motors above 110 kW
16	Thermistors	- Will be provided in the windings. - For motors 45 KW and above, thermistor will be with 6 PTC @ 2 nos. per phase winding.

AC squirrel cage induction motors (SCIM) of ratings up to 160kW will be fed at 415V, 3 phase 4 wire 50 Hz.

AC squirrel cage induction motors (SQIM) of ratings above 160kW will be connected to the HT power supply system.

AC squirrel cage induction motors require speed control will be from VFD and motor rating of ratings up to 200 kW will be fed by 415V VFD panel.

For motors rated & above 200 kW up to 1000 kW shall be fed by VFD rated 690V.

For motors above 1000 kW, the Motors shall be fed from MV VFD of 11 kV through dedicated converter duty transformer.

S. LOCAL CONTROL STATIONS

Each drive motor shall be provided with one Local Control Station (LCS) for testing and maintenance purpose.

The LCS shall be provided with Local-Remote selector switch, Start/stop or open/close push buttons and one emergency stop push button (mushroom headed push button press to lock turn to release type).

15.8 ILLUMINATION:

The lighting system inside and outside plant units will be designed based on the desired minimum illumination levels specified below and practices followed in industries, architectural arrangement, building dimensions including mounting height, environmental considerations, Ease of maintenance and reliability of the lighting distribution network.

Lighting Power Density (LPD i.e., Watts per Sqm) is limited as per ECBC norms and Effective lux level is achieved as per lighting Design calculations. As per IS 3646, Type of LED fixture envisaged and Minimum Average Illuminance (lux) level to be achieved for enclosed spaces are listed below:

Area/ Application	Avg. Lux Level (Minimum) required	Type of Luminaire considered
Office Area	300	Recessed (2x2) LED Tile type fixture suitable for 600x600 mm ceiling
Store Rooms/ Food Stores/ bulk storage/ record room	150	Surface mounted (2x2) LED Square type fixture suitable 600x600 mm ceiling
Lunch Hall / Laundries	200	Surface mounted (1x4) LED type fixture
Dining Area / cafeteria (AC)/ canteen	200	Recessed (2x2) LED Tile type suitable for 600x600 mm ceiling.
Entrance / Waiting Area/Lobby	150	Round recessed LED flat panel fixture
Corridor	100	
Toilets/ Rest Room	100	

Food Preparation/ Cooking Area	200	Surface mounted (1x4) LED type fixture
Gas Manifold, Battery rooms	100	Surface mounted (1x2) LED flame proof luminaire fixture
Electrical Rooms	200	Recessed/Surface mounted as suitable (1x4) LED type fixture
Dormitory / change room/ Locker room/ Pantry	200	Surface mounted (1x4) LED type fixture or Surface mounted (2x2) LED Square type fixture suitable for 300x300mm / 600x600 mm ceiling as applicable.
Reading Room / Library/ Discussion room / Laboratory	300	Recessed (2x2) LED Tile type fixture
Dockyard Workshop / Loading -unloading bay	300	LED High Bay Fixture
Hospital- Reception/ Waiting Lobby	150	Recessed (2x2) LED Tile type fixture
Hospital Wards-General	100	
Hospital Wards- Beds	150	
Hospital -Operation Theatre	300	
Hospital- Lab	300	
Hospital -Radiology Department	100	
Hospital-Casualty/ OPD	150	
Hospital Dispensaries	300	

HFFR wires shall be used for building electrification. Minimum 1.5 sq. mm. Cu wires for lighting circuits and 2.5 sq.mm. Cu wires for plug circuits.

The voltage drops from LDB and any fixture shall not exceed 3%.

For lighting circuits, the load is restricted to a maximum of 1 kW and for plug circuits it is restricted to 3 kW.

Individual control in office buildings shall be through single pole decorative modular grid mounting snap on type switches 10 Amperes. For high bay fittings where group controls are required, MCBs shall be provided

A. LIGHTING POWER DISTRIBUTION

The distribution of lighting power supply for the individual areas will be done at 415V, 3 phase, 4 wire bus system through Main Lighting Distribution Boards (MLDB) for the area. Each incomer of MLDB will be fed through separate lighting transformers.

The outgoing feeders of the MLDB shall feed the required numbers of Sub Lighting Distribution Boards (SLDB) for lighting. Each SLDB shall receive power at 415V AC, 3 phase, 4 wire and distribute it into 240V, 1 phase circuits for connection to the lighting fixtures and 240V receptacles. The SLDBs will be located in the rooms, bays, shop units etc. preferably near entry/exit.

15.9 VENTILATION & AIR CONDITIONING REQUIREMENTS:

Electrical rooms of the plant will be provided with ventilation and air conditioning facilities as indicated below:

HT/LT substation room, switch gear room and MCC room, PDB/MLDB room etc. which do not house any electronic equipment but contain only electrical equipment, will be provided ventilation system. Toilet will be provided with exhaust ventilation.

Electrical room housing electronic equipment like VFDs, PLC, Remote I/O, computers, Servers, UPS, Office rooms, Conference room etc. will be provided with air-conditioned environment.

15.10 CABLE CARRIER SYSTEM:

Laying of all power cables, control cables, communication cable, FDA system cable, Telephone cable etc. from MRSS to various LT CSS, MCC room, HT Motors, Inter-facility cable route shall be through Underground Cable trench / service corridors.

Power cables will be laid on ladder type cable trays & control/ signal cables will be laid on perforated trays. Tray shall be GI Prefabricated.

Ladder type cable trays will be selected from sizes 300mm, 450mm and 600mm. Tray sizes of 200mm, 100mm, 50mm will be perforated type.

15.11 GI OCTAGONAL STREET LIGHT POLES

The Octagonal Poles will be designed to withstand the maximum wind speed as per IS 875 and should have height of 7m approx. in general. The top area i.e. area of pole itself and weight of brackets & fixtures will have to be considered to calculate maximum deflection of the poles and will meet the requirement of BS 5649 Part VI 1982.

The Pole shaft will have octagonal cross section and will be continuously tapered with single longitudinal welding; there will not be any circumferential welding. The welding of Poles shaft will be done by submerged Arc Welding process.

All Octagonal pole shafts will be provided with rigid flange plate of suitable thickness with provision for fixing minimum 4 foundation bolts. This base plate will be fillet welded to the pole shaft. Foundation bolts will also be supplied.

The Octagonal Poles will have door of approximate 500mm length at elevation of 500mm from base plate. The door will be dust & weather proof & water tight. The door will be flush with exterior surface and will have suitable locking arrangement. There will also be suitable arrangement for the purpose of earthing. The pole will be adequately strengthened at the location of door to compensate the loss in section. Inside door, suitable Power Terminal Box for looping incoming 415V power cables 4CX16Sq. MM & DP MCB (C-Curve) with 3x2.5sq.mm wires will be provided for power supply to light fittings. Street light pole with two arms will have two MCBs inside the JB.

15.12 HIGH MAST LIGHTING TOWER

The mast will be high and designed in such a manner that it is capable of withstanding external forces exerted by wind pressure as per IS: 875 (Part 3)-1992 and should have 20m height along with load of the lantern carriage assembly.

Mast Construction

The mast will be fabricated from special steel plates conforming to BS 4360/BS- EN10025 S-355 cut and folded to form number of polygonal sections, giving a continuous tapered profile for stability and aesthetics, Silicon content in steel should not exceed 03% for good quality galvanization. Bottom section will be provided with plate welded to it for anchoring the mast to a reinforced concrete foundation block. To increase the strength, gussets will be provided.

The bottom section will be accommodating winch, electric drive etc. and for the safety of the same a vandal resistant and weather proof door will be provided with locking arrangement.

The fabricated and welded mast sections as detailed above will be hot dip galvanized with a minimum thickness of coating 90 microns conforming to IS 4759-1996, IS: 2629-1990 & IS: 2633-1992, both internally and externally.

After the delivery of the mast at site, these will be joined by slip stressed fit method with necessary stressing equipment. No site welding or bolted joints will be accepted. Earthing terminal will be provided on the mast base and feeder pillar-box as per relevant ISS.

The mast will be provided with suitable LED aviation obstruction lamp.

15.13 LIGHT FITTINGS

LED Light fittings shall be considered for Internal and external lighting.

All the luminaires will be designed, manufactured and tested in accordance with the Indian Standards as far as they are applicable.

All the luminaires will be industrial type. All the lighting fixtures will be complete with all parts along with lamps/tubes, control gears and accessories for installation and efficient performance whether specifically mentioned in the schedule of items or not.

Individual LED light fittings will be provided with suitable gland arrangements for 3x2.5 sq.mm Armoured copper cable entry unless otherwise specified. Terminals of all fittings will be suitable for taking 3x2.5 sq.mm, copper conductor PVC insulated and PVC sheathed cable.

All fittings will be supplied with all interconnections made and fully wired up to the terminal block.

All live parts will be provided with suitable sleeves to prevent accidental contacts. The earthing terminal in the fitting will effectively earth the body of the entire luminaire.

Dust and vapour tight fittings will have the enclosures suitably designed to withstand the heating effect.

The fixing arrangement of various components and lamps will be in such a way that the maintenance and replacement jobs can be easily carried out.

15.14 STREET LIGHT FITTING

LED LUMINAIRE FOR ROAD LIGHTING

Street light fitting will be LED based, minimum 150-Watt, energy efficient type with minimum burning time of 50,000 hours at minimum 70% light efficiency with no toxic content and Street light fittings, suitable for outdoor duty in weatherproof enclosure class with IP65 protection, integral starting/control gear complete with controls/starter pre-wired to a terminal block. Power factor will be more than 0.9 and efficiency more than 86%. LED fixture housing will be made up of high-grade pressure die cast aluminium with powder coating to provide excellent resistant to corrosion. The fittings will be provided with heat resistant & toughened glass cover. Junction Temperature will be kept as low as possible so as to increase performance and life time of LED and ensure that the luminaires are as heat efficient as possible. Hinging arrangement for glass cover to be provided for maintenance. The fittings will be suitable for direct mounting on poles having extended arm. LED Light fittings will be suitable for operation at an ambient temperature of 50 Deg. C and suitable for outdoor installation. Heat sink temperature rise above ambient will be limited as per relevant IS/IEC as available.

Colour Rendering Index will be greater than 70. LED Luminaire will have built in surge protection. Luminaire will have efficacy higher than 85 lumens/watt.

LED will be provided with secondary lens optics to achieve effective light intensity distribution.

Make & Model Number of Luminaries will be embossed/ engraved on the luminaire The Test Reports as per IS-16105, IS-16106 & IS-10322 will be from NABL/ IESNA/GOI certified labs or lab of the manufacturer with NABL accreditation. Design of LED fittings should be for minimum glare.

15.15 FLOOD LIGHT FITTING

Weather proof Flood light non-integral luminaire suitable for 240V, LED lamp, high pressure die-cast aluminium housing powder coated in black, Electro chemically brightened pre anodized asymmetrical aluminium reflector with heat resistant toughened glass cover, IP 65. Lamps and lighting fixture will be of the same make.

15.16 EARTHING PROTECTION:

Entire system shall be earthed in accordance with the provisions of the relevant IEEE/ IEC recommendations/ IS code of practice IS 3043-2001 and Indian Electricity Rules, so that the values of the step and contact potentials in case of faults are kept within safe permissible limits.

Parts of all electrical equipment and machinery not intended to be alive shall have two separate and distinct earth connections each to conform to the stipulation of the Indian Electricity Rules and apparatus rated 240V and below may have single earth connections.

All shops and buildings as well as the electrical sub-stations and electrical rooms shall be provided with a ring main earthing system each. Individual ring main earthing systems shall again be interconnected as a network.

The ring earthing system around each building shall be laid at a distance of approximately 1.5 M from the building and at a depth of approximately 0.8m. The earth ring shall further be connected at intervals to deep earthing electrodes to achieve a combined earth resistance of less than one ohm.

Electronic earthing shall be provided as per requirement.

15.17 LIGHTNING PROTECTION

All buildings and factory structures vulnerable to lightning strokes owing to their height or exposed situation shall be protected against atmospheric flash-over and lightning strokes in such a manner as to eliminate any danger to the personnel employed therein. Stipulations of IEC: 62305 shall be followed. All electrical equipment shall have double earthing.

A 'Faraday Cage' made of hot galvanized strip steel connected to all buried pipes and steel structures crossing this cage ring shall be laid around each main building or factory unit as earthing device.

This shall be separate from the electrical equipment earthing ring main. All lightning arrestor earth leads of the buildings and factory units shall be connected to this cage ring. Air termination network should cover all salient points of the structure. Down conductors shall follow the most direct path possible between air termination and earth termination avoiding sharp bends. Down conductor shall have a testing point adjacent to the earth electrode. Each conductor shall have an independent earth termination. All earth terminations shall be interconnected.

Earthing connection to equipment subject to movement, vibration and shocks, shall be through flexible stranded conductors.

15.18 EXTERNAL INFRASTRUCTURE/ MANAGEMENT SYSTEM:

This shall cover the complete electrical system to feed the internal building electrification Viz. Overall Cable Network, Overall Earth Network, and services / road.

Cable network:

Cable Network under external electrification may be defined mainly in two parts.

- HT Cable Network

- LT Power Cable Network

LT Power Cable network:

LT Power cable Network for LT Power cable distribution to individual building shall be provided. LT Power Cable Network for shall be formed along with the road network.

LT Power Cable network May further be divided in two three parts

- Main LT Power cable network along the road network
- Road crossing through Hume pipe/Conduits.
- Sub Cable Network to connect to main network to individual building. For this connectivity Cable ducts / conduits shall be considered.

Buried Cable trench:

Construction of buried cable trench shall include excavation, preparation of sieved sand bedding riddled soil cover, supply and installation of brick or concrete protective covers, back filling, compacting, supply and installation of route markers and joint markers.

LT Power Cable

- LV power cables will be 1.1 KV Grade heavy duty, PVC/ XLPE insulated, flat strip Armoured, aluminium Conductor.
- Minimum size of aluminium cable will be 10 mm². For any requirement of below 10 mm², copper cables will be used.
- No. of Cores and cross section area of the cables shall be as per requirements.
- Inner sheath shall be of PVC type ST2 and shall be applied by extrusion.

LT Power cable shall confirm to following IS:8130, IS:5831, IS:3975, IS:3961, IS:7098

LT Control Cable

- LV control cable will be unarmoured, PVC insulated, copper conductor.
- Control cables spare core philosophy shall be as per TS.
- Specification of control cable shall be as per TS.

Earthing network:

Entire system shall be earthed in accordance with the provisions of the relevant IEC recommendations / IS code of practice IS: 3043 - 1987 and Indian Electricity Rules.

Earthing system shall be designed to achieve earth resistance of value not exceeding 1 ohm.

The LV side neutrals of the distribution transformers shall each be connected to two separate earthing electrodes. They shall also be connected with the neutral bus of the corresponding switchgear and the switchgear neutral bus shall be connected to the earthing ring at two different and distinct points. 50x6 MM GI earth strip shall run along the cable network and necessary additional route as required to make a complete ring.

For Building Earthing, Buildings Energy Meter Cum Distribution Board shall be connected to nearest earth grid at minimum two Points.

Earthing of Individual Sub Unit of building shall be done through Cu wire.

15.19 INTERNAL WIRING:

Wiring within the building is classified in the following parts:

- **Mains Wiring:** Mains wiring shall mean wiring from buildings MLDB/ Energy Meter cum Distribution Board to LDB/ELDB.
- **Sub main Wiring:** Sub Main wiring shall mean the wiring from LDB to Switch Board or Switch Board to another Switch Board / Switch Socket Outlet.
- **Point Wiring:** Point Wiring shall mean wiring from the switch board's Switch to electrical equipment fitting i.e. (lighting / fan / exhaust fan / call bell point etc.)

Point Wiring

All Wiring shall be done in concealed conduits. Concealed conduits shall be laid before casting. Looping in on the phase side shall be at the switches and on the neutral side at the ceiling roses. Every light point, fan point and plug point shall have individual control switch unless stated otherwise. Earthing shall be provided for all the points according to the statutory requirement wherever necessary.

The number of points per circuit, generally, shall not exceed 10 or 800 Watts. However, same shall be finalized during engineering.

The point wiring consists of wiring from the switch board in conduit with its ancillary work, such as inspection bends, junction boxes and FRLS wires up to the fixed terminals of ceiling roses, connectors, batten holders, etc. depending upon the type of point. All the conduits entering and leaving Switch Boards shall be bonded together with bare aluminium / copper wire and earth clips.

Light Point

Point wiring for light points shall commence at the distribution board terminals and shall terminate at the ceiling rose/connector in ceiling box/lamp holder via the control switch.

Ceiling Fan Points

Point wiring for ceiling fan points shall be same as for light points in Para above and shall, in addition, include recessed fan hook, ceiling outlet box.

Exhaust Fan Point

Point wiring for exhaust fan points shall be same as for light points in Para above and shall in addition include socket outlet near the exhaust fan and control switch with regular at a convenient location complete as required.

Call Bell Point

Point wiring for call bell points shall be same as for light point in Para above.

Minimum Wire Size shall be as follows:

Sl No.	Description	Phase & Neutral Wire	Earth Wire
1	Point Wiring	1.5 Sq. mm	1.5 Sq. mm
2	Sub Main Wiring 6A / 5A	2.5 Sq. mm	2.5 Sq. mm
3	Sub Main Wiring 16A / 15A	4.0 Sq. mm	4.0 Sq. mm

Bunching of wires :

Wires carrying current shall be so bunched in conduits that the outgoing and return wires are drawn into the same conduit. Wires originating from two different phases shall not be run in the same conduit. Lighting & Power Circuits shall be separate. All wires shall have ferules for identification.

Rigid PVC Conduits:

These shall be rigid PVC Type, threaded type having perfectly circular tubing. The minimum wall thickness of Rigid PVC Conduits permitted for concealed conduits shall be 1.8 mm. MMS conduits to be used for conducting in slab and walls Conduit & Accessories shall conform to relevant Indian standards. The tubing must perfectly circular, without any burrs or kinks. The conduits shall be of such type, so as to be capable of making tight fitting joints. The minimum size of Rigid PVC Conduits allowed in open / concealed work shall be 20 mm and above.

The number of wires in each conduit shall not exceed as specified in the table of conduit capacity. All the conduits shall be supported using M.S. Spacers and G.I. Saddles and fixed using GI screws.

Wherever straight runs exceed 3 m, additional pull boxes or junction boxes shall be provided.

Energy Meter cum Distribution Board:

Energy Meter cum Distribution Board shall be made of high quality Polycarbonate (shock proof, rust free, corrosion free, acid and chemical resistant, fire retardant, having high impact, made of halogen and silica free recyclable material), UV resistant, having high grade gasket made of Polyurethane, should withstand glow wire test at 960°C in accordance with IEC 60 695-2-11 UL subject 94, should be flame retardant, the Junction box should have test certificate in accordance with IEC 60 439-1 (IS8623), IEC 60 439-2 and IEC 60 364-7-712

Switch Boxes:

Switch Box shall be made of GI/MS with Minimum thickness of 1.2 mm. Switch boxes shall be suitable to house modular type switches of required ratings, unless otherwise stated, and fan regulators as required shall be provided.

These will be so designed that accessories are mounted on a grid plate with tapped holes for brass machine screws leaving ample space at the back and on the sides for accommodating conductors and check nuts at conduit entries. The grid plates and M.S. boxes shall be fitted

with a brass earth terminal. Boxes shall be attached to conduits by means of check nuts on either side of their walls.

MS boxes shall be completely embedded leaving edges flush with finished wall surface.

The system shall be extremely easy to assemble and modules can be individually changed without re-wiring of complete assembly by removal of front plate and simply clipping in or out as required.

Moulded front covers made from high impact resistant, flame retardant and ultraviolet stabilized engineering plastics shall be fixed by means of counter sunk chromium plated brass machine screws. No timber shall be used for any supports.

Socket Outlets

6/16 amps socket outlets shall be of modular flush mounting type, unless otherwise stated, and shall be switched, and fitted with automatic linear safety shutters to ensure safety from prying fingers. 6A Sockets shall have three Pins, however 16A Sockets shall have 3/5 Pin to make it suitable for 6A and 16A plug both.

Socket outlets shall be made from high impact resistant, flame retarding and ultraviolet stabilized engineering plastic material.

An earth wire shall be provided along the wires feeding socket outlets for electrical appliances. The earth wire shall be connected to the earthing terminal of the socket and shall be connected to the earth terminal provided inside the box.

Switches

All 6- and 16-amps switches shall be of the modular flush mounting type, unless otherwise stated, 240 Volt AC of best quality and standard. The switch moving and fixed contacts shall be of silver nickel and silver graphite alloy and contact tips coated with silver. Housing of switches shall be made from high impact.

Flush Plates

Switches, receptacles and telephone system outlets in wall shall be provided with Moulded cover plates, unless otherwise stated, of approved colour, shape and size made from high impact resistant, flame retarding and ultra violet stabilized engineering plastic material, and secured to the box with counter sunk /round head chromium plated brass screws.

Fan Hook Boxes

Ceiling boxes for fan hooks shall be made out of sheet steel not less than 14 SWG and hexagonal in shape with one 'U' shaped 15mm dia. rod inside secured tightly with the top reinforcement of the roof. 3 mm thick Perspex / Hylam sheet cover of matching colour shall be provided.

Draw Boxes

16 SWG mild steel draw boxes of ample dimensions shall be provided at convenient locations to facilitate drawing of long runs of conductors. These shall be mounted flush with wall / ceiling surface as required and shall have screwed covers of 3 mm thick Perspex / hylam sheet.

Inspection Boxes

Inspection boxes of 16 SWG mild steel and steel and having smooth external and internal finish shall be provided to permit inspection and maintenance. These shall be mounted flush with wall / ceiling surface as required and shall have screwed cover of 3mm thick Perspex / Hylam sheet.

Ceiling Fan

Electric ceiling fans shall be capacitor type, with double ball bearing complete with capacitor, 300 mm down rod, canopies, three number blades made of aluminium alloy, with suitable speed regulator, suitable for operation on single phase, AC 230 Volt, 50Hz supply and shall conform to class 1 of IS: 374 / 1979 (Reaffirmed 2005).

16 INSTRUMENTATION & PROCESS CONTROL

16.1 FIRE DETECTION AND ALARM SYSTEM

I. GENERAL

The Fire Detection and Alarm System (FDAS) shall be an addressable, microprocessor-based system designed in accordance with the latest editions of:

- NFPA 72 (2022) – National Fire Alarm and Signalling Code
- NFPA 70 – National Electrical Code
- UL 864 – Control Units and Accessories for Fire Alarm Systems
- Detectors – UL 268 / 521
- Local Fire Authority / NBC India (Part IV), wherever applicable

All components (detectors, control panels, modules, and notification appliances) shall be UL listed and/or FM approved.

II. SYSTEM COMPONENTS

The FDAS shall comprise of the following major components:

- a) Microprocessor-based Main Fire Alarm Control Panel (FACP) with CPU, loop modules, control modules, and integral power supply. All the major buildings will have a dedicated Microprocessor based FDA panel. All the FDA panels shall be looped together and information from each panel shall be available in the IBMS room.
- b) Human–Machine Interface (HMI) or Graphical Monitoring Station (UL listed software).
- c) Addressable detectors – multi-sensor smoke/heat detectors on ceilings, and where required, under raised floors or above suspended ceilings.
- d) Beam Detectors for Workshop areas.
- e) Manual Call Points (MCPs) at exits and along escape routes.
- f) Audible and Visual Notification Appliances (sounder–strobe units) in all occupied areas.
- g) Addressable control/relay modules for interfacing with HVAC, lifts, PA system, access control, and fire pumps.

- h) Class A wiring using FRLS fire alarm cables in raceways, shafts.
- i) Short-circuit isolator modules provided for every 20 devices.

III. SYSTEM PHILOSOPHY

- a) The Fire Alarm Control Panel shall be located in the IBMS Room at Office Complex / entry area of each building. Repeater panel shall be provided in Fire stations, Main gate complex.
- b) Each floor or fire area shall constitute an independent detection zone; loop distribution shall ensure no single fault disables more than one floor.
- c) The Graphical Monitoring Station shall display all alarms, troubles, and supervisory conditions, allowing operator control through a secure, password-protected interface.
- d) Upon fire detection, the system shall display the exact device address and location on the FACP and GUI, and initiate corresponding cause-and-effect actions.
- e) Selective evacuation shall be adopted: alarm notification shall activate on the affected floor, one floor above, and one floor below.
- f) System operation shall revert to normal upon acknowledgment and manual reset of the panel after the fire condition clears.

IV. CAUSE & EFFECT MATRIX

- a) In the event of confirmed fire detection:
- b) Sounder–strobe units on affected and adjacent floors shall activate.
- c) The activated device address and location shall appear on the main FACP and graphical workstation.
- d) A pre-recorded voice message shall broadcast through the Public Address System.
- e) All AHUs and ventilation systems in the affected area shall shut down.
- f) Access-controlled doors shall unlock to permit evacuation.
- g) Fire-fighting interface relays shall trip power to non-essential systems as programmed.
- h) All actions shall automatically reset when the fire panel is manually reset after clearance.

16.2 DETECTOR INSTALLATION AND SPACING

16.2.1 Multi Sensor Detector

- a) Under flat ceilings, the horizontal distance between any point in a protected area and the detector nearest to that point shall not exceed 7.0 m.
- b) The detector shall be envisaged to cover entire room.
- c) In case of a sloping roof or pitched ceiling (where the distance between the top of apex and bottom of the roof exceeds 600 mm), spacing of detectors at or in the vicinity of apex shall be spaced between 7.5 m and 8.5 m or as recommended by manufacturer.
- d) Detectors shall not be mounted within 500 mm of any wall.
- e) Detectors shall be located at least 1 m away from air conditioning units.
- f) An obstacle e.g. beam shall be very well taken care of during designing of FDAS system. For multi sensor detectors, ceiling with beam depth of 200mm shall be considered as smooth ceiling however if it exceeds 200mm the spacing between detectors should be reduced to twice the depth of obstruction. If the beam projects more

than 450mm below and are more than 2.5m on centres, each bay formed should be treated as separate area.

- g) A detector shall be placed on the ceiling 1.5m from any door, window or any opening in the wall partition.
- h) All stairwells, lift shafts etc. shall have a detector at the top.
- i) The detector shall also be provided in the cable tunnels, ducts, false floors, AC and AHU room.
- j) Every enclosure (room or cabin) shall have a detector at ceiling level and also under false ceiling, false flooring, if provided.

16.2.2 Heat Detector

- a) Heat detectors shall be installed to ensure sensing element is not less than 50 mm and not more than 150 mm below the ceiling/roof level, except as necessary by site test during designing.
- b) For heat detector mounted on ceiling with beam projection height of 100mm, the beam construction shall be treated as smooth ceiling but for ceiling projected more than 100mm the spacing of heat detectors at right angle to the direction of the beam travel should not be more than two thirds of smooth ceiling spacing. If the beam projects more than 450mm below and are more than 2.5m on centres, each bay formed should be treated as separate area.
- c) Other guidelines for spacing of heat detectors remain the same as that of multi sensor detectors, which has already been covered above.

16.3 TECHNICAL REQUIREMENTS

16.3.1 Addressable Fire Alarm Control Panel (FACP)

- a) UL 864-listed, microprocessor-based, modular panel with LCD/LED colour display.
- b) Enclosure: NEMA Type 1 (indoor).
- c) Power Supply: Integral, supervised PSU with automatic battery charging.
- d) Standby Power: Minimum 24 hours standby + 5 minutes alarm (or 15 minutes for voice system).
- e) Loop Capacity: 3 loops + 1 spare loops.
- f) Event history stored in non-volatile memory with date/time stamp.
- g) Shall provide dry contacts (NO/NC) for common fire, fault, and supervisory signals.
- h) Communication with Building Management System (IBMS) via standard protocol (e.g., Modbus, BACnet).
- i) Self-diagnostic features: loop open/short, ground fault, power fail, CPU fault, module failure.
- j) All communications to external agencies shall use listed fire alarm communicators—no direct autodial via public telephone network.

16.3.2 Detectors

- a) Intelligent, addressable, UL-listed type.
- b) Equipped with dual LEDs for communication and alarm.

- c) Sensitivity automatically compensating for drift; programmable day/night sensitivity levels.
- d) Multi-sensor detectors used where false alarms are probable (e.g., kitchens, workshops).
- e) Addressing by soft-address protocol (no manual DIP-switch addressing).

16.3.3 Manual Call Points (MCP)

- a) UL listed, break-glass or resettable type, installed such that the travel distance to the nearest MCP does not exceed 22.5M.
- b) Mounting height: 1.2 m – 1.5 m above finished floor.
- c) Located adjacent to each exit and at each floor level.
- d) Activation shall generate both local alarm and indication at FACP and graphical workstation.

16.3.4 Notification Appliances

- a) Audible and visible appliances shall be synchronized, UL listed, and compatible with the FACP.
- b) Minimum sound level: 15 dB above ambient or 5 dB above maximum noise lasting >60 sec, whichever is greater.
- c) Visual notification shall be provided wherever ambient noise exceeds 105 dBA.
- d) Evacuation tones shall be of uniform pattern throughout the building.

16.3.5 Remote Response Indicators

- a) Provided for detectors installed in concealed areas (false ceilings, false floorings, shafts, etc.) to aid in alarm localization.

16.3.6 Power Supply

- a) FDAS shall derive power from an exclusive 230 VAC single-phase circuit, protected, labelled “FIRE ALARM – DO NOT SWITCH OFF”.
- b) Battery type: VRLA / sealed lead acid, capacity calculated as per IEEE 485.
- c) Automatic switchover to battery supply upon mains failure; automatic charging on restoration.

16.3.7 Cabling and Wiring

- a) All field wiring shall be supervised, Class A, using FRLS fire alarm cables in conduits or raceways.
- b) Splices only in listed junction boxes with terminal blocks.
- c) Shielded cables shall be used for analogue signals.
- d) All circuits shall be labelled at both ends and tagged for identification.

16.4 VERY EARLY SMOKE DETECTION ASPIRATION (VESDA) SYSTEM

16.4.1 SYSTEM DESCRIPTION

The VESDA System (Very Early Smoke Detection Apparatus) is a high-sensitivity aspirating smoke detection system designed to provide early warning of incipient fire conditions by continuously sampling the air through a network of pipes installed throughout the protected area.

The system shall be fully integrated with the addressable Fire Detection and Alarm System (FDAS) and shall comply with the requirements of NFPA 72 (Chapter 17 – Initiating Devices) and UL 268A / UL 2904 listings.

Each VESDA detector shall incorporate:

- a) Air sampling chamber with high-efficiency filter.
- b) Laser or LED-based optical detection chamber.
- c) High-sensitivity smoke measurement (0.01% obscuration/m).
- d) Programmable alarm thresholds (Alert, Action, Fire 1, Fire 2).
- e) Integral aspirator (fan) with monitored airflow.
- f) Supervised inputs and outputs for interface with Fire Alarm Control Panel (FACP).

16.4.2 SYSTEM APPLICATION

VESDA detectors shall be provided in critical or high-value areas where early detection is essential, such as:

- a) Server Rooms.

16.4.3 SYSTEM OPERATION

- a) The aspirating fan shall draw air continuously from the protected area through the sampling holes in the pipe network.
- b) The air is passed through a filter and into the detection chamber where a laser or LED-based optical sensor analyses the smoke content.
- c) On detection of smoke above programmed thresholds, the VESDA unit shall generate graded alarms:
 - ✓ Alert Level: Early indication, annunciates only to monitoring staff.
 - ✓ Action Level: Maintenance or investigation alert.
 - ✓ Fire 1 Level: Initiates visible and audible alarm on the FACP.
 - ✓ Fire 2 Level: Triggers full evacuation and interfacing actions (HVAC shutdown, access release).
- d) The VESDA unit shall continuously monitor airflow in each pipe to detect blockages or leaks. Any deviation shall generate a fault signal to the FACP.

16.4.4 TECHNICAL REQUIREMENTS

Feature	Specification / Requirement
Detector Type	Laser or LED-based, aspirating type, UL-listed VESDA or equivalent
Sensitivity Range	0.01% obscuration/m

Alarm Levels	Alert, Action, Fire 1, Fire 2 (programmable)
Interface	Addressable via relay or communication module to FACP
Pipe Material	Flame-retardant ABS or HDPE, red colour
Sampling Holes	Size and spacing as per design software output and NFPA 72 cl. No.17.7.3
Flow Supervision	Each pipe monitored for blockage and break
Power Supply	24 VDC from FACP or dedicated PSU with 24h standby + 5 min alarm backup
Integration	All alarms and faults transmitted to FDAS for annunciation and event logging & IBMS
Compliance	NFPA 72, UL 268, UL 2904, FM Approved

16.5 VIDEO CONFERENCE SYSTEM

This Design Basis Document defines the:

- **Technical requirements,**
- **system design philosophy,**
- and
- **configuration methodology.**

To be deployed across various meeting spaces within the facility.

The scope includes **Discussion rooms, Board rooms, and large conference halls**, each configured to meet the functional, operational, and user-experience requirements of the respective space.

The system design emphasizes **integrated audio-visual collaboration, cross-platform interoperability, and ease of use**, supporting **modern hybrid work patterns and remote collaboration workflows**. The architecture ensures consistent performance, reliability, and intuitive operation across all room types.

16.5.1 Design Objectives

The Video Conference System shall:

- a) Enable seamless real-time collaboration between on-site and remote participants.
- b) Deliver **high-quality audio and video** with low latency and stable connectivity.
- c) Support **multiple conferencing platforms** (e.g., Microsoft Teams, Zoom, Webex, Google Meet).
- d) Provide **user-friendly interfaces** for simplified operation and minimal support dependency.
- e) Ensure **energy efficiency, aesthetic integration, and scalable expansion** for future requirements.

16.5.2 SYSTEM CONFIGURATION

Core System Architecture

All room types are designed on a **common architectural foundation**, customized to specific functional and spatial requirements, **core components include:**

- a) **Video Conference Codec / Endpoint:** Provides connectivity to collaboration platforms, encodes and decodes AV streams, and manages meeting functions.
- b) **Display Systems:** 96” / 108” for Conference Halls and Board Rooms, supporting content sharing and remote participant visibility.
- c) **Audio Systems:** Includes microphones, speakers, and DSP processors to ensure echo-free, clear, bidirectional communication.
- d) **Control Interfaces:** Enables intuitive operation via touch panels, wireless controllers, or voice-enabled interfaces.
- e) **Network Infrastructure:** Configured with adequate bandwidth and Quality of Service (QoS) prioritization for stable HD video performance.
- f) **Power Management:** Integrated with room scheduling for automated start up and shutdown, ensuring energy efficiency and operational readiness.

Discussion Room Configuration

4-seater discussion rooms utilize compact all-in-one VC units combining camera, microphones, speakers, and codec in a single enclosure.

Key features:

- a) **Single display system** with wireless presentation capability for both conferencing and local sharing.
- b) **Minimalist control interface** with one-touch meeting joins options or small touch panels supporting multiple platforms.
- c) **Simplified cable management** using a single USB-C or HDMI connection for both audio and video.
- d) **Power over Ethernet (PoE)** enabled components to reduce cabling clutter and eliminate local adapters.

Board Room Configuration

Board rooms employ a distributed AV architecture featuring high-quality, flexible components for executive-level communication.

Key components:

- a) **High-definition PTZ or auto-tracking cameras** providing adjustable framing and superior image clarity.
- b) **Ceiling-mounted microphone arrays** for uniform pickup and noise reduction.
- c) **High-fidelity loudspeakers** optimized for natural voice reproduction.
- d) **Rack-mounted DSPs, codecs, and control processors.**

- e) **Multiple display systems** supporting simultaneous remote video and content sharing with dynamic routing options.

Conference Hall Configuration

Conference halls are equipped with professional-grade AV systems offering scalability, redundancy, and versatility for various event types.

Key features:

- a) Large-format LED displays or projection systems for wide audience visibility.
- b) Distributed loudspeaker arrays for uniform sound coverage and assistive listening systems for accessibility compliance.
- c) Wireless microphones and presenter reinforcement systems for clarity in large spaces.
- d) Centralized control system supporting both automated presets and manual operator control modes.

16.5.3 DATA COMMUNICATION SYSTEM

This Design Basis Document defines the overall design philosophy, system architecture, and implementation framework for the Data Communication System to be deployed across the facility.

The data communication network forms the digital backbone of all IT and low-voltage systems, enabling secure, high-speed, and reliable connectivity between enterprise applications, user endpoints, and integrated IP-based building systems. The design encompasses intranet, internet, Wi-Fi, and Local Area Network (LAN) infrastructure supporting both wired and wireless connectivity requirements.

The system is engineered to facilitate seamless communication across all functional areas, ensuring redundancy, scalability, and operational continuity. It also provides a unified network foundation for ERP, CCTV, Access Control System (ACS), IP-PBX, VoIP phones, Video Conference (VC) systems, Public Address (PA) system, and Integrated Building Management System (IBMS).

The proposed Data Communication System provides a secure, scalable, and resilient network infrastructure that serves as the central nervous system of the facility. Through its redundant architecture, structured design, and integrated approach, it ensures reliable connectivity for enterprise users and mission-critical IP systems alike.

The design shall align with industry best practices, supports future technological evolution, and ensures continuous, efficient, and secure operation of all connected systems.

DESIGN OBJECTIVES

The Data Communication System shall:

- a) Establish a robust and secure IT infrastructure supporting all enterprise and building automation functions.
- b) Provide seamless connectivity for intranet and internet access, and wireless connectivity (Wi-Fi) for users and devices.

- c) Enable integration of IP-enabled utilities (CCTV, ACS, IP-PBX, VoIP, VC system, PA system, IBMS & ERP) into a converged network backbone.
- d) Ensure network segmentation and isolation between critical systems to enhance security and manageability.
- e) Incorporate redundant paths, equipment, and power sources to achieve high availability and fault tolerance.
- f) Support scalable bandwidth growth and seamless integration of future technologies.
- g) Facilitate centralized management with real-time monitoring and performance analytics.
- h) Maintain compliance with industry standards, information security policies, and local IT governance requirements.
- i) Comply with applicable national regulatory standards and governance frameworks, including the DoT guidelines for M2M/IoT service provisioning and use of WPAN/WLAN connectivity.

APPLICABLE STANDARDS AND GOVERNMENT GUIDELINES

Beyond international and industry standards for structured cabling, network design and AV/IT convergence, the system shall align with the following recent regulatory guidance:

- a) The DoT has issued a Direction (D.O. No. 3-28/2021-IoT/TEC-pt, dated 15 July 2025) stating that M2M/IoT services must be availed only through DoT-registered M2M Service Providers (M2MSPs) and WPAN/WLAN connectivity providers, and must comply with prescribed standards.
- b) Under this guideline, any wireless connectivity (including WPAN/WLAN) used for M2M/IoT must be via a provider registered with DoT; and the M2M service provisioning must be through a registered service provider.
- c) These regulations affect the way IoT/M2M devices (for example sensors in IBMS, AV system endpoints, access control sensors) are connected, monitored and managed inside the facility network.
- d) The network design must incorporate the ability to segregate IoT/M2M traffic, interoperate with registered service providers, maintain audit trails, and ensure compliance with the DoT's device-connectivity and service registration regime.

SYSTEM ARCHITECTURE OVERVIEW

The facility's network architecture adopts a hierarchical structured design comprising Core, Distribution, and Access layers, ensuring efficient traffic management, flexibility, and ease of maintenance.

a) Core Network:

- Serves as the high-speed backbone interconnecting all major data and communication systems.
- Connects the enterprise LAN, data centre, and gateway routers to external internet and intranet links.
- Designed for non-blocking throughput with redundant switches, dual links, and failover routing.

b) Distribution Layer:

- Aggregates traffic from access switches serving different departments, floors, and utilities.
- Provides policy-based routing, VLAN management, and inter-subnet communication.
- Incorporates firewalls and network access control mechanisms to enforce security boundaries.

c) Access Layer:

- Provides wired and wireless connectivity to user endpoints and field devices.
- Includes Ethernet access switches, wireless access points, and PoE infrastructure supporting IP-based systems.
- Configured with port-level security, VLAN tagging, and Quality of Service (QoS) prioritization for time-sensitive applications such as voice and video.

16.6 NETWORK COMPONENTS AND SUBSYSTEMS

16.6.1 LOCAL AREA NETWORK (LAN)

The LAN interconnects all building areas through structured cabling and intelligent switching infrastructure, supporting both data and IP-based building services. The design incorporates dual backbone Fiber routes for redundancy and high throughput.

Key functions include:

- High-speed data transport for corporate applications.
- Integration of all IP-based systems including CCTV, ACS, IP-PBX, VoIP, PA, VC, and IBMS.
- Segregation into logical VLANs based on function (e.g., IT, security, voice, building automation) for performance and security.
- Dual uplinks to redundant core switches ensuring zero single point of failure.

16.6.2 INTRANET AND INTERNET CONNECTIVITY

The network provides secure and scalable access to internal enterprise applications and external internet resources.

- The **intranet** segment connects internal systems such as ERP, mail, storage, and database servers hosted within the facility or private data centre.
- The **internet gateway** connects through redundant ISP links ensuring continuous connectivity.
- Unified Threat Management (UTM) firewalls protect against cyber threats and manage access policies, web filtering, and VPN connections for remote access.
- Network Address Translation (NAT) and routing policies are configured to separate internal and external traffic while maintaining data security.

16.6.3 WIRELESS NETWORK (WI-FI)

The Wi-Fi system provides secure and high-speed wireless access across office, meeting, and public areas.

- Dual-band access points connected to PoE switches ensure seamless coverage and mobility.
- Wireless controllers manage SSIDs, authentication, and bandwidth policies for users and guests.
- Wi-Fi is integrated with the intranet for internal users and with internet gateway firewalls for guest access through captive portals.
- RF design ensures uniform signal distribution and minimal interference, supporting roaming and high-density user environments.

16.6.4 REDUNDANCY AND HIGH AVAILABILITY

The data communication network is designed for continuous operation with redundant architecture at all critical layers.

- a) Dual core switches/routers in active-standby or active-active configuration.
- b) Dual fibre backbone paths between communication rooms, providing path diversity.
- c) Dual power feeds and UPS/backup power for critical network devices.
- d) Dual ISP links for internet/intranet access with automatic failover.
- e) Redundancy for network servers, gateways and service provider links (including for M2M/IoT service path).
- f) Failover mechanisms to maintain operation without manual intervention during hardware or link failure.

16.6.5 NETWORK FOR IP-BASED SYSTEMS

The communication backbone supports multiple converged IP systems, each operating within logically segmented networks:

System	Network Integration Approach
CCTV System	Dedicated VLAN for video traffic ensuring recording continuity without impacting corporate traffic.
Access Control System (ACS)	Connected through secure LAN segment with central server authentication and monitoring.
IP-PBX and VoIP Phones	QoS-enabled voice VLAN ensuring clear audio quality and low latency.
Video Conference System (VC)	Prioritized traffic routing and bandwidth allocation for HD video and collaboration sessions.
Public Address (PA) System	Network-enabled controllers integrated through PoE switches and IP-based amplifiers.

IBMS (Integrated Building Management System)	Separate VLAN for monitoring HVAC, lighting, energy, and safety systems through BACnet/IP or Modbus TCP.
ERP network	For Clients ERP system

All IP-based systems utilize the same structured cabling and switching infrastructure, maintaining logical separation through VLANs and firewall rules while sharing the physical medium efficiently.

SYSTEM SIZING & DESIGN CRITERIA

- Network sized for current and projected device populations, including workstations, wireless clients, IP-systems and IoT/M2M endpoints with a growth allowance of 20–25%.
- Minimum two network drops per workstation and dual network connections for critical systems.
- Fibre backbone between communication rooms and data centre sized for high-throughput (10 Gb/s or higher) with headroom.
- Access switch capacity and PoE budget sized to support all IP-devices with growth.
- Wi-Fi AP density planned for both user access and device connectivity; ensure overlapping coverage and seamless roaming.
- Bandwidth and QoS provisioning to support voice, video, data and IoT traffic; ensure separate VLANs and priority settings to avoid congestion.
- IoT/M2M service traffic routed via dedicated VLANs and service provider links with monitoring and audit trail compliance to DoT guidelines.

System design ensures sufficient switching capacity, structured cabling bandwidth, and backbone throughput to meet peak load conditions with headroom for future scalability.

16.7 VOICE COMMUNICATION SYSTEM

This Design Basis Document defines the design philosophy, functional requirements, and configuration framework for the Voice Communication System for the facility. The system enables reliable, high-quality voice connectivity across all operational, administrative, and utility areas through a combination of IP-based (VoIP) and analog telephone infrastructure.

The design ensures seamless internal and external communication, integration with the facilities data network, and compatibility with unified communication platforms. The voice system shall support inter-departmental connectivity, emergency communication, public-address integration, and remote collaboration, forming an essential part of the facility's ICT backbone.

The voice communication network is designed as an integrated, scalable, and redundant system built around a central IP-PBX platform, interconnected with local and remote extensions via structured cabling and Power-over-Ethernet (PoE) infrastructure.

DESIGN OBJECTIVES

The primary objectives of the voice communication system are to:

- Provide reliable and high-quality voice communication across all areas of the facility.

- b) Integrate IP-PBX systems, VoIP phones, and analogue endpoints into a unified communication platform.
- c) Ensure redundancy and resilience in call handling and power supply.
- d) Enable interoperability with external PSTN/ISDN/SIP trunks as applicable.
- e) Support scalability for future expansion in user base and additional communication services.
- f) Provide ease of management through centralized administration and monitoring tools.
- g) Maintain network security and QoS prioritization to ensure uninterrupted voice service.
- h) Comply with local telecommunication regulations and structured cabling standards.

SYSTEM ARCHITECTURE OVERVIEW

The overall voice communication architecture adopts a hybrid IP-based topology integrating digital, analogue, and IP endpoints into a unified voice network. The system consists of three primary layers:

- a) Core Layer: IP-PBX server(s), gateways, and centralized management platform.
- b) Distribution Layer: Intermediate Distribution Frames (IDFs), PoE network switches, and VoIP integration points.
- c) Access Layer: IP phones, analogue phones, soft clients, and telephone junction boxes distributed across the facility.

All voice components connect via the structured cabling system with Cat 6 (or higher) copper cabling and Fiber uplinks, providing a unified network backbone for voice and data convergence.

SYSTEM COMPONENTS

IP-PBX SYSTEM

The IP-PBX forms the core switching platform for all internal and external voice communication. It manages call routing, signalling, user registration, and integration with voicemail, conferencing, and IVR services. The IP-PBX shall interconnect with external trunks (SIP/PSTN) through gateways and support redundancy to ensure uninterrupted operation.

VOIP PHONES

VoIP phones (Session Initiation Protocol) serve as the primary user interface for voice communication within office and utility spaces. They connect through PoE switches and receive both data and power over the same network cable.

ANALOG PHONES

Analog phones are retained in selective areas such as workstations, security rooms, lift lobbies, maintenance zones, and service areas. These connect through analog ports of the IP-PBX or analogue gateways located in communication racks.

MAIN DISTRIBUTION FRAME (MDF)

The MDF acts as the central termination and cross-connect point for all voice circuits. It houses the IP-PBX, trunk interfaces, network gateways, and primary patch panels connecting to

distribution-level IDFs. The MDF provides interconnection between internal extensions and external telecom lines.

INTERMEDIATE DISTRIBUTION FRAME (IDF)

Each floor or zone includes an IDF housing PoE network switches and analog extension termination points. IDFs provide localized connectivity to endpoints, reducing cable lengths and simplifying maintenance. Fiber uplinks from MDF to IDFs ensure high-speed and fault-tolerant connectivity.

TELEPHONE JUNCTION BOXES (TJBS)

Telephone Junction Boxes are provided at convenient wall or floor locations. Each TJB terminates the horizontal cabling from IDFs and allows flexible patching for IP or analog telephone sets.

POE NETWORK SWITCHES

PoE switches provide data connectivity and power to VoIP endpoints, IP-PBX gateways, and related network devices. The PoE feature eliminates local adapters and improves cable management. Switches are installed within IDF racks with redundancy and managed under the network control system.

CABLING INFRASTRUCTURE

The voice communication system uses structured cabling aligned with the overall network. Category 6 /CAT6 copper cables are deployed for VoIP endpoints, while multi-pair telephone cables serve analogue extensions. Fiber links connect the MDF to IDFs ensuring scalability and future integration.

DESIGN CRITERIA

The system design is governed by the following key principles:

- a) **Unified Network Integration:** Voice and data share a common structured cabling and switching infrastructure with logical segmentation (VLANs) for performance and security.
- b) **Reliability and Redundancy:** Dual network paths, redundant PoE switches, and failover IP-PBX configurations ensure continuous service availability.
- c) **Scalability:** Capacity provisioned for 20–25% future growth in the number of users, extensions, and IP endpoints.
- d) **Quality of Service (QoS):** Network configured to prioritize voice packets, minimizing latency and jitter.
- e) **Power Continuity:** PoE switches backed by UPS ensure uninterrupted operation during power disturbances.
- f) **Ease of Maintenance:** Centralized management with detailed labelling, patching schedules, and documented routing between MDF–IDF–TJBs.
- g) **Compliance:** Adherence to structured cabling standards (TIA/EIA-568), data centre guidelines (TIA-942), and local telecom regulations.

SYSTEM SIZING PARAMETERS

The sizing of the voice communication system has been determined based on the following considerations:

- a) User Base: Total number of staff, departments, and functional areas requiring internal/external voice connectivity.
- b) Extension Count: Allocation of extensions per workstation, conference room, and common area.
- c) IP Endpoints: Number of VoIP phones, IP conference units, and gateways.
- d) Analog Extensions: Quantity of analogue phones for critical and utility areas.
- e) Network Infrastructure: Number of PoE ports, switch capacity, and uplink redundancy.
- f) Distribution Framework: Number and location of MDF and IDF racks based on building layout and cable length limitations.
- g) Cable Sizing: Horizontal copper cable runs limited to 90 m per channel; multi-pair voice cables sized for analogue distribution; Fiber sizing between MDF and IDF for future scalability.

16.8 IP-BASED PUBLIC ADDRESS (PA) SYSTEM

This Design Basis Document defines the system design approach, configuration philosophy, and functional requirements for the IP-based Public Address (PA) system to be deployed across the facility.

The system provides voice announcements, emergency notifications, and background music capability to enhance communication, safety, and operational efficiency within the premises.

The PA system will be fully network-based, utilizing the structured cabling and LAN infrastructure to ensure centralized management, scalability, and reliability. It integrates with other building systems such as Fire Alarm, IBMS, and Security systems for automated emergency announcements.

The design ensures compliance with the latest government communication and safety standards, following guidelines issued by the Bureau of Indian Standards (BIS), Ministry of Electronics and Information Technology (MeitY), and National Building Code (NBC Part 4 – Fire and Life Safety) for emergency audio announcements.

DESIGN OBJECTIVES

The design of the IP-based PA system aims to:

- a) Deliver clear and intelligible voice announcements across all areas of the facility.
- b) Allow zoned and selective paging for operational flexibility.
- c) Enable integration with Fire Alarm and IBMS systems for automatic emergency messaging.
- d) Support background music (BGM) and scheduled announcements during normal operation.
- e) Provide redundant network paths and servers to ensure continuous operation during power or link failure.

- f) Facilitate centralized control and remote monitoring through the PA management software.
- g) Include provisions for future expansion to accommodate additional zones or new facilities.

SYSTEM ARCHITECTURE

The IP-based PA system adopts a distributed, server-controlled architecture consisting of digital audio nodes connected via the facility's Ethernet network.

Core system components include:

a) **Central PA Server / Controller:**

Manages audio routing, priority logic, scheduling, and system diagnostics. Integrates with IBMS, Fire Alarm, and security systems for coordinated emergency responses.

b) **Paging Call Stations:**

Installed at IBMS rooms, reception areas, and key administrative locations to enable live announcements, zone selection, and recorded message playback.

c) **Network Amplifiers:**

Distributed across equipment rooms to drive local speaker circuits in each zone. Each amplifier connects to the network via PoE or Ethernet link and receives digital audio streams from the central server.

d) **Speakers:**

Ceiling, wall-mount, and outdoor horn-type speakers provide audio coverage in offices, corridors, stairwells, public areas, and outdoor spaces. Speaker types and mounting positions are selected based on acoustic requirements and area usage.

e) **Cabling Infrastructure:**

Utilizes Cat 6 structured cabling for IP connectivity between network devices and speaker cabling (two-core shielded copper) from amplifiers to loudspeakers.

All devices are connected through managed PoE switches integrated within the data communication network.

Design Criteria

The PA system is designed based on the following criteria:

a. **Coverage:**

100% coverage of all occupied spaces, circulation zones, and emergency areas. Speakers are spaced to maintain uniform sound pressure levels and speech intelligibility (STI > 0.5).

b. **Zoning:**

Facility divided into functional zones (e.g., office, corridors, lobbies, parking, utilities) to allow area-specific announcements.

Each zone shall be independently controllable for volume, source selection, and priority.

c. Integration:

- Interface with Fire Alarm System for emergency evacuation messages.
- Interface with Building Management System (BMS) for automated or scheduled announcements.
- Integration with IP telephony or security systems (optional) for all-call paging.

d. Scalability:

System sized to accommodate 20–25% future expansion in number of speakers, amplifiers, and network ports without major hardware modification.

System Sizing

System sizing is determined based on:

- **Total floor area and acoustic zones** within the facility.
- **Number of speakers per zone**, derived from coverage and intelligibility requirements.
- **Amplifier capacity**, calculated from total speaker load with 20% headroom for expansion.
- **Network bandwidth** allocation for audio streaming between PA server and amplifiers.
- **Power provisioning** through PoE switches and dedicated UPS backup for continuous operation.
- **Server capacity** designed to support all active zones, paging consoles, and scheduled announcements concurrently.

Central and local equipment racks (MDF/IDF) will house network switches, amplifiers, and junction boxes. Structured cabling routes are shared with ICT pathways, complying with data and electrical separation norms.

16.9 IP-BASED ACCESS CONTROL SYSTEM (ACS)

This Design Basis Document establishes the design approach, configuration principles, and operational framework for the IP-based Access Control System (ACS) to be implemented across the facility. The system provides secured entry and exits management for personnel, ensuring only authorized individuals access restricted zones.

The ACS integrates with other IP-based building systems — such as CCTV, IBMS, and Fire Alarm — to enhance overall safety, security, and operational efficiency. It employs biometric and RFID-based identification combined with centralized server management for flexible control, monitoring, and reporting.

The design aligns with the latest Government of India guidelines for security systems, including MeitY's cybersecurity framework for IP-based equipment, and conforms to the National Building Code (NBC – Part 4) and Information Technology Act, 2000 regarding digital identity management.

DESIGN OBJECTIVES

The Access Control System is designed to:

- a) Restrict unauthorized entry to secured areas and sensitive facilities.
- b) Maintain digital records of personnel movement for audit and reporting.
- c) Enable multi-factor authentication using biometric and RFID credentials.
- d) Support remote monitoring, configuration, and central management via IP network.
- e) Integrate with fire alarm and emergency systems to unlock all doors during evacuation events.
- f) Ensure high availability, redundancy, and scalability for future expansion.

SYSTEM ARCHITECTURE OVERVIEW

The IP-based ACS uses a **distributed controller architecture** with centralized supervision. Each access point (door) is equipped with field devices that communicate with door controllers over the network, while the main server handles authentication, event logging, and user management.

The architecture includes:

- a) **Access Control Server:** Centralized software-based system managing users, credentials, time zones, door permissions, and event logs. It interfaces with CCTV and IBMS platforms for unified monitoring.
- b) **Door Controllers:** Intelligent networked controllers managing one or multiple doors. They operate in standalone mode during network failure, maintaining local authentication data.
- c) **Biometric and RFID Readers (Mi fare):** Installed at entry and exit points for user identification through fingerprint or card credentials.
- d) **Exit Push Buttons and Emergency Release Units:** Facilitate safe egress; emergency units override door locks during fire or emergency conditions.
- e) **Locking Devices:** Electromagnetic locks ensuring secure physical control at each door, powered through the controller.
- f) **Local Security Adapter (LSA):** Provides secure interface between field devices and controllers, ensuring localized connectivity and fail-safe operation.
- g) **Cabling Infrastructure:** Cat 6 structured cabling for IP connectivity between readers, controllers, and servers; shielded power cables for door locks and auxiliary components.
- h) **Integration with Other Systems:** Interface with fire alarm system for automatic unlocking during emergency; linkage to CCTV for video verification of access events.

The network backbone provides **connectivity** between field controllers and central servers, supported by UPS power backup and dedicated VLAN segmentation for enhanced cybersecurity.

DESIGN CRITERIA

The design of the Access Control System follows these guiding principles:

- **Coverage:** All restricted areas, main entry points, and critical rooms (e.g., VSAT room, classified OPS Room, electrical room, UPS & Battery room, and IBMS room) shall be covered by access control.
- **Scalability:** Designed for a 20–25% growth in user base, door points, and credential capacity without major infrastructure modification.
- **Safety Compliance:** All access points connected to the Fire Alarm system to automatically unlock doors during emergency evacuation.
- **Integration:** Seamless interoperability with CCTV, IBMS, for automated credential synchronization and event verification.
- **Power and Network Reliability:** Controllers and readers powered through PoE or redundant power supply, supported by UPS.

SYSTEM SIZING

System sizing is determined based on the total number of access-controlled doors and user population:

- **Access Points:** entry / exit to classified areas shall be configured with entry reader, exit reader or push button, electromagnetic lock, and controller interface.
- **Controllers:** Sized based on the number of connected doors, with additional capacity for 25% expansion.
- **Server Capacity:** Designed to handle total concurrent access events, data storage for logs, and system backups.
- **Network Bandwidth:** Calculated for real-time event updates and integration with monitoring systems without latency.
- **Power Requirements:** Each controller and reader connected to UPS-backed circuits ensuring continued operation during outages.
- **Cabling:** Cat 6 network cabling for IP data; shielded copper for power/lock control. Route segregation maintained as per electrical safety standards.

Central and floor-level communication racks host door controllers, LSAs, and PoE switches, interconnected to the main ACS server over a LAN backbone.

FULL-HEIGHT TURNSTILES

- **Purpose:** Prevent tailgating and unauthorized entry at pedestrian gates.
- **Operation:** Electro-mechanical or motorized drive mechanism, bidirectional control, card/biometric access.
- **Duty Cycle:** 24/7 continuous operation.
- **Construction:** Heavy-gauge SS 304/316; IP54/IP65 for outdoor units.
- **Clear Passage:** ~650–700 mm.
- **Fail-Safe/Fail-Lock:** Configurable based on security policy.

- Integration: Access Control System (ACS), Fire Alarm (for free-rotation on alarm), and central monitoring.

16.11 X-Ray Baggage Scanners

- Purpose: Non-intrusive inspection of bags for explosives, weapons, contraband.
- Tunnel Size: As per site requirement (e.g., 620×420 mm / 1000×1000 mm).
- Imaging: Dual-energy X-ray, organic/inorganic material discrimination, threat image projection (TIP).
- Safety: AERB compliance, leakage <1 µSv/hr, emergency stop, lead shielding.
- Throughput: ≥550 bags/hour (model dependent).
- Connectivity: Networked for image storage, operator console, central security room.

16.11 Boom Barriers

- Purpose: Regulate vehicular entry and exit at gate perimeters.
- Arm Length: 3–6 m depending on lane width.
- Operation Speed: 1–3 seconds adjustable.
- Mechanism: Electromechanical or servo-type with heavy-duty cycle.
- Features: Loop detector integration, traffic light support, manual override.
- Integration: RFID/ANPR system, guard console, gate control panel.

DESIGN CRITERIA & FUNCTIONAL REQUIREMENTS

- **Access Control Integration:** All turnstiles and boom barriers shall integrate with facility ACS, including RFID, biometric, and visitor management.
- **Central Monitoring:** Systems shall feed real-time status to Security Control Room (SCR) via network or dry contacts.
- **Fail-Safe Operation:**
 - Turnstiles: Free-rotation / open on fire alarm input.
 - Boom Barriers: Auto-raise/manual release during emergency.
- **Environmental Conditions:**
 - Temperature: 0–50°C (indoor/outdoor specific).
 - Humidity: 10–90% RH.
 - Dust/Ingress: Minimum IP54 for outdoor units.
- **Electrical:**
 - Power Supply: 230V AC ±10%, 50 Hz or per OEM.
 - UPS-backed for critical units (30–60 min).

- Surge protection for outdoor installations.

16.12 INTEGRATED BUILDING MANAGEMENT SYSTEM (IBMS)

The Integrated Building Management System (IBMS) is envisaged as a unified, intelligent control and monitoring platform to enhance building performance, energy efficiency, operational reliability and occupant comfort. The system integrates and supervises key building services such as Heating, Ventilation & Air Conditioning (HVAC), Lighting, Access Control System (ACS), Closed-Circuit Television (CCTV), Fire Detection & Alarm System (FDA), Power Monitoring & Electrical Distribution, Water/Utility Management and other electromechanical equipment.

The IBMS will provide centralized visibility of the entire building's mechanical and electrical systems through a single command-and-control interface, enabling real-time monitoring, alarm/event handling, trend analysis, automation routines, and maintenance support.

The system is designed for 24×7 operation, high availability, scalability and conformity to relevant national guidelines for safety, energy management and security.

SYSTEM OBJECTIVES

The IBMS is designed to achieve the following objectives:

- a) Integrated Monitoring & Control: A unified platform to control HVAC, lighting, security systems, fire safety, power management and utility services.
- b) Energy Optimization: Automated scheduling, adaptive control logic, occupancy-based automation and demand-based equipment operation.
- c) Operational Efficiency: Minimize downtime through continuous monitoring, predictive alerts and real-time diagnostics.
- d) Safety & Security: Coordination with FDA, ACS, CCTV and emergency systems for enhanced occupant safety.
- e) Data-Driven Decision Making: Historical trends, analytical dashboards and reports for facility management and optimization.
- f) Scalability & Flexibility: Modular hardware and software supporting future growth, additional services and technology upgrades.
- g) Compliance: Adherence to government safety guidelines, energy norms, and smart building standards.

SCOPE OF IBMS

The IBMS covers automation, integration and monitoring of the following building services:

- a. HVAC System – AHUs, FAHUs, VRV/VRF, chillers, pumps, cooling towers, ventilation fans, dampers
- b. Lighting Control System – interior/exterior lighting, occupancy sensors, daylight-based dimming
- c. Access Control System (ACS) – biometric/RFID readers, door controllers, emergency release

- d. CCTV / Video Surveillance System (VSS) – IP cameras, VMS/NVR integration, monitoring
- e. Fire Detection & Alarm System (FDA) – smoke/heat detectors, panels, alarms, notification devices
- f. Power Monitoring System (PMS) – DG sets, UPS, panels, energy meters, load management
- g. Electrical Equipment Control – capacitor banks, transformers, LT panels, motor control
- h. Water & Utility Management – plumbing pumps, STP/ETP, overhead/underground tank levels
- i. Environmental & Safety Monitoring – temperature, humidity, CO₂, gas leak detection
- j. IT & Communication Integration – data network interfaces, alarms to command centre
- k. Central Monitoring Workstations & Server Infrastructure – IBMS server, database, operator consoles
- l. Cabling Infrastructure – control cables, communication cables and structured cabling for IP-based systems.

DESIGN CRITERIA

General Design Philosophy

- a. Create a centralized, redundant, high-availability automation environment.
- b. Use open communication protocols for interoperability.
- c. Provide separate VLANs or dedicated networks for IBMS traffic to ensure security and performance.
- d. Ensure that the system supports remote access, centralized reporting, and integration through the IBMS server.
- e. Allow 20–25% spare capacity in processors, I/O modules, switch ports and server resources for expansion.
- f. Ensure compliance with government norms on building safety, energy conservation, fire regulations and security system integration.

Security System Integration (CCTV & ACS)

- a. High-level integration for event-driven automation (e.g., door-forced alerts trigger CCTV pop-ups).
- b. Access logs captured and archived on IBMS server.
- c. Central monitoring of credential status, alarms, door status and controller health.

HVAC Integration Criteria

- a. Monitor and control all major HVAC equipment such as AHUs, chillers, pumps, fans and valves.

- b. Real-time temperature, humidity and airflow monitoring.
- c. Demand-based and schedule-based automation for energy efficiency.
- d. Fault, status and operating hours logging for predictive maintenance.

Lighting Control Criteria

- a. Zonal lighting control based on occupancy and time-of-day schedules.
- b. Manual override capability on site.
- c. Exterior lighting automation based on astronomical clock or sensors.
- d. Integration with emergency lighting status.

Fire Safety Integration

- a. High-level integration with FDA for alarm/event visibility on the IBMS console.
- b. Fire signals override HVAC operation (e.g., AHU shutdown, damper closure).
- c. Real-time alarm display with audio-visual indicators at the IBMS workstation.

Power & Utility Management Criteria

- a. Integration with energy meters, UPS, DG sets, LT panels and feeders.
- b. Monitoring of voltage, current, power factor, energy consumption and load profiles.
- c. Alarm generation for abnormal electrical conditions.

SYSTEM ARCHITECTURE

Overall Architecture

The IBMS architecture consists of:

- a) **Field Level Devices:** Sensors, actuators, detectors, controllers, relays, power/energy meters, dampers, VFDs, pumps and lighting control devices.
- b) **Controller/Automation Level:** Distributed control panels housing DDC controllers, I/O modules, communication modules, and power supplies. These panels interface with field devices and communicate with the IBMS server.
- c) **Network Layer:** Redundant IP-based communication backbone using structured cabling and PoE switches where required.
- d) **Server & Application Layer:** Central IBMS server, database server, historian, redundancy server and application engine.
- e) **Monitoring & Control Layer:** Operator workstations, large display screens, mobile/tablet interfaces and reporting consoles.

Field Devices & Sensors

- a) Temperature, humidity, pressure, airflow sensors
- b) CO₂ sensors
- c) Lighting sensors, occupancy sensors

- d) Water level sensors, flow meters
- e) Electrical power meters, breaker status monitoring
- f) Damper actuators, valve actuators
- g) Pushbuttons, relays, interface modules

Controllers & Panels

- a) DDC controllers for HVAC equipment
- b) Lighting control modules
- c) IO modules for discrete/analogue signals
- d) System integration panels
- e) Emergency override and fire integration modules

Server Infrastructure

- a) IBMS application server
- b) Redundant server setup (active/standby)
- c) Storage for real-time and historical data
- d) Workstations and operator consoles
- e) Unified graphical interface for monitoring and control

Communication & Cabling

- a) UTP Cat 6/Cat 6A structured cabling for IP devices
- b) RS-485 or similar cables for legacy system integration
- c) Fiber optic backbone between technical rooms
- d) Patch panels, racks, cable management accessories

17 HEATING, VENTILATION AND AIR CONDITIONING (HVAC) SYSTEM:

17.1 GENERAL

- a) Air conditioning and Ventilation systems (ACVS) are provided for proper working conditions necessary to maintain environment compatible with human hygienic requirements and to maintain conditions necessary for proper storage of materials and working of plant and equipment in the premises such as Electrical rooms, Control rooms, Offices, etc.
- b) Air conditioning & Ventilation systems are designed based on the climatic conditions prevailing in the region. The ACVS plant rooms will be integral with and adjacent to the served premises and will be located based on the convenience of routing of ducts, availability of fresh uncontaminated air and creating least disturbance to adjacent premises in terms of vibration and noise. ACVS will be provided with adequate measures for safety.

17.2 DESIGN BASIS

1. Air Conditioning Systems

- Air-conditioning facilities are envisaged for Control rooms, PLC Rooms, VFD Rooms, Office areas etc. to remove heat generated from panels & / or to maintain efficient environment for the working personnel.
- The following inside design conditions are considered for estimating the Air-conditioning System capacities: -

Table-1

S. No.	Room name	Room Inside conditions	
		Temperature	RH
1	Control Rooms, Server room, PLC rooms, UPS Rooms, VFD Rooms cum IMCC panel rooms & any other room where electronic panel / equipment is located	$23 \pm 2^{\circ}\text{C}$	$55 \pm 5\%$
2	Office rooms, Conference rooms, etc.	$24 \pm 2^{\circ}\text{C}$	$<70\%$

- Outside design Condition: As per the Meteorological data of site.
- The capacity of Air conditioning system shall be arrived based on room sizes, Temperature, RH, Occupancy, solar loads, internal equipment heat loads, lighting loads etc. as per ISHRAE / ASHRAE standards. 20% factor of safety (for de-rating of equipment / air leakages in ducts etc.) shall be considered on the capacity of the equipment.
- A minimum of 50% standby capacity is provided for the air conditioning systems proposed and a minimum of one no. unit / equipment shall be provided as standby for the premises provided with Split type Air conditioner units.
- Premises to be Air conditioned & System Description

Table-2

S. No	Room/Area / Premises	Equipment / System Proposed	Equipment Capacity
1	Office complex	Central chilled water-based system comprising of chillers, pumps, cooling towers, piping, valves, AHUs, ducting, dampers, diffusers etc.	a) Water cooled screw Chillers - 280 TR x 4 Nos (3W+1S)

2	Canteen		b) Chilled water pumps (120 m ³ /hr) - 2 Nos. (1W+1S) c) Condenser water pumps (140 m ³ /hr) - 2 Nos. (1W+1S) d) FRP Cooling towers (~225 TR) - 2 Nos. (1W+1S) e) Air handling units i) AHUs - 30 TR x 12 Nos. Office complex - (Main Admin Building) ii) AHUs - 35 TR x 4 Nos. (Canteen) iii) AHUs - 20 TR x 2 Nos. (Medical Centre) iv) AHU 20 TR (02) - Safety Office
3	Medical Centre.		
4	Safety Office		
5	Main security Complex	Air Cooled VRF Type System	40 TR (60 HP) outdoor unit & suitable capacity Indoor units to various rooms
6	Annexe Building	Air Cooled VRF Type System	50-No's

Note: The Capacity of equipment indicate in above table are indicative and for reference only. The system is to be designed to arrive at desired capacity of each equipment. The bidder to consider this aspect and quote accordingly.

17.3 Ventilation systems

- Ventilation facilities shall be envisaged for the premises as per the relevant standards for creating efficient environment for the working personnel & equipment.
- The capacity of Ventilation system will be arrived based on Area, solar loads, internal equipment heat loads, lighting loads etc. OR based on minimum air-changes as per NBC / ASHRAE / ISHRAE, whichever is higher with 20% factor of safety considering de-rating (wear & tear) of equipment / air leakages in ducts etc.
- For the premises where only Natural ventilation is considered, roof mounted turbo-ventilators are considered & provision shall be kept for installation of Ceiling fans / industrial air circulators. In manufacturing blocks for proper ventilation for both the

floors (Ground and First) adequate number of wall mounted propeller / axial flow fans of suitable capacity with cowl and Bird screen to be provided.

- d) HT Panel room shall be provided with pressurized plenum ventilation systems. This shall include centrifugal fan, dry panel filters, air washing units, ducting, adjustable louver grilles for air supply, volume control dampers, supports, electrics, instrumentation and controls, etc. The premises shall be pressurized to 2-3 mm WC to prevent dust ingress. Ventilation equipment for plenum ventilation shall be located in separate rooms adjacent to the served premises
- e) General Exhaust Ventilation shall be considered for Cable cellar, Pump houses, Battery rooms, Stores, Toilets, etc. The supply of fresh air will be through Louvers / open able windows & exhaust will be through wall mounted propeller / axial flow fans of suitable capacity with cowl and Bird screen. The Battery room will be provided with wall mounted flameproof exhaust fans with minimum of 6 air changes per hour.
- f) Salient Design Features
 - Standard, proven and commercially available systems equipment will be used.
 - Standby provisions will be made for supply and exhaust ventilation systems components to ensure the continuous operation of the ventilation system.
- g) Fan Static Pressure
 - The Fan static pressure will be estimated considering maximum allowable pressure drop in the louvers / filters / Air washing unit / dampers / plenums / Fan unit and frictional pressure drop in ducts.
- h) Ducting (common to Air conditioning & ventilation systems): The velocities in the duct shall be as follows:

Table-3

Description	Air velocity	
	Ventilation system	Air Conditioning system
Main Duct	8 – 10 m/sec	6 – 8 m/sc
Branch Ducts	6 – 8 m/sec	4 – 5 m /sec
Diffusers / grilles	4 - 6 m/sec	3 - 4 m/sec

- The ducting shall be designed as per latest editions of SMACNA and manufacturer standards / data.

17.4 List of Codes & Standards

All equipment, systems and works for air conditioning & Ventilation facilities shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment shall be installed and the following publications, norms/guidelines, standards, acts and rules shall be followed.

- ✓ Publications of Bureau of Indian Standards (BIS).
- ✓ American / Indian Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE / ISHRAE).
- ✓ VDI stipulation for vibration level.
- ✓ Sheet Metal & Air-conditioning Contractors National Association (SMACNA).
- ✓ National Building Code – India (NBC).
- ✓ ACGIH - Industrial Ventilation

The system is designed primarily based on the guidelines of codes/ standards, as listed below:

Table-4

Standard	Particulars
IS 655 & IS 277	Metal air ducts
IS 7613	Method of testing panel type air filters
IS 2062	Steel for general Structural purposes
IS 3069	Glossary of terms, symbols and units relating to thermal insulation materials
IS 3144	Fire resistance Testing of acoustic insulation
ISO1940 & VDI 2060	Dynamic balancing
IS:4029	Guide for testing 3 Phase Induction Motors
ISO 1940-1	Mechanical vibration – Balance quality requirements of rigid rotors. Part 1 – Determination of permissible residual unbalance
ISO 10816-1	Mechanical vibration–Evaluation of machine vibration by measurements on non-rotating parts. Part 1– General guidelines.
IS 4691	Motors
IS 4894	Specification for Centrifugal fans
IS 3588	Specification for Tube Axial fans

Standard	Particulars
IS:1391	Specification for Split Air-conditioners
IS: 8148	Specification for Package Air-conditioners
IS: 1239 (Part-I)	Piping
AMCA-201	Design of centrifugal fans and classification
AMCA 210-07	Laboratory Methods of Testing Fans for Rating
AMCA 204-05	Balance Quality & Vibration Levels for Fans
AMCA 300-08	Reverberant Room Method for Sound Testing of Fans.
AMCA 99-2404-03	Drive Arrangements for Centrifugal Fans
AMCA 99-2406-03	Designation for Rotation & Discharge of Centrifugal Fans
AMCA 99-2407-03	Motor Positions for Belt or Chain Drive Centrifugal Fans
AMCA 99-2408-69	Operating Limits for Centrifugal Fans
AMCA 99-2412-03	Impeller Diameters & Outlet Areas for Centrifugal Fans
SMACNA-2005	HVAC Duct Construction Standards - Metal and Flexible
ASHRAE- 52.1 / 52.2	Gravimetric & Dust Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation For Removing particulate matter / MERV Reporting Values testing

17.5 Technical Specification of the equipment

17.5.1 Water Chilling Package

The chilling package shall include the following major components: -

- Semi-hermetic Twin-Screw Compressors
- Shell & tube Flooded type evaporator
- Shell & tube water-cooled Condenser
- Associated refrigerant piping, valves, fittings, accessories and controls
- Condenser water pumps & Chilled water pumps
- GS-FRP-fill ID Cooling towers
- Expansion tank
- Inter-connecting piping network
- Electrics & controls

17.5.2 Screw Compressor

- a) The compressor shall be of multi-circuit twin screw, semi - hermetic screw compressor type suitable for HFC -134a / Env. friendly refrigerant and should offer economical part load operation.
- b) The motor should be cooled by independent refrigerant supply to ensure it always runs at the ideal temperature. Mixture of oil and liquid refrigerant shall be injected in the compressor in order to get high COP at high condensing pressure.
- c) The unit should be provided with an integral oil separator and it shall be of high efficiency, augmented gas impingement type to maximize oil extraction. The compressor shall have an in-built oil separator for oil separation before the refrigerant enters the condenser.
- d) The unit should be with electronic expansion device for optimized refrigerant metering to the evaporator - ensuring maximum utilization of heat exchange surface.
- e) The unit shall use the latest microprocessor-based control technology – which constantly monitors all machine parameters and precisely manages the operation of Compressors & expansion devices for optimum energy efficiency. The control system shall offer chiller protection during fault conditions arising from high condensing temperature.
- f) The unit shall have automatic capacity control through regulation of slide valve in the compressor based on requirements of the cooling capacity thus ensuring proper control on leaving chilled water temperature.
- g) The refrigerant shall be environment friendly with zero ozone depletion potential and minimum global warming potential. Refrigerant containing chlorine CFC and HCFC shall not be acceptable.

17.5.3 Shell & Tube Chiller

- a) The units shall be supplied with shell and tube Flooded type evaporator. Replaceable tubes shall be fabricated from integral finned copper and mechanically bonded to steel tube sheet. Waterside working pressure should be designed for 10.5 bar. Pressure relief valve shall be mounted on the suction side of the refrigerant circuit. Evaporator shall be insulated as specified elsewhere.
- b) The chiller shall be designed, manufactured & tested as per the ASHRAE / ARI standards.
- c) The tubes shall be of copper of min. dia. $\frac{3}{4}$ " having minimum wall thickness of 0.63 mm.
- d) The chiller shall be designed / selected with an adequate overloading factor to account for scale formation on the waterside.
- e) The chiller assembly shall be tested hydraulically for strength & pneumatically for leakage pressures as per code of unfired pressure vessels.
- f) Suction line and chiller insulation complete as required Suction line & Chillers shall be adequately insulated with minimum 19mm thick polyvinyl Nitrile rubber insulation finished with 0.63mm thick G.S.S cladding or equivalent insulation material as per standard procedures.
- g) Chiller shall be equipped with the following controls / accessories / safety devices:
 - Cooling & anti-freeze thermostats

- Water inlet / outlet connections with flanges & shut-off valves
 - Vent connections with valves
 - Pressure & temperature gauges at all the water inlets / outlets
 - Relief valve, purge valve, drain valve, and shut off valve
 - Refrigerant charging connection with valve
 - Pressure & temperature gauges at the refrigerant inlet / outlet
 - Flow meters & switches on the water lines
- h) A liquid level sight glass or view port shall be provided on the side of the chiller to determine proper refrigerant charge. Fouling factor of $0.0001 \text{ ft}^2 \cdot \text{hr.}^\circ \text{F} / \text{BTU}$ may be considered for selection / sizing of Chiller. Pressure drop of water across the cooler shall be limited to 0.5 kg/cm^2 .

17.5.4 Condenser

- a) The condenser shall be of water-cooled horizontal shell & tube type construction with water flowing inside the tubes and the refrigerant gas condensing outside the tubes. A discharge gas baffle shall be incorporated to prevent direct impingement on the tubes. This baffle shall be designed so as to distribute refrigerant gas properly for most efficient heat transfer.
- b) The condenser shall be equipped with integral finned type, solid drawn, seamless copper tubes. Minimum tube thickness shall be 0.63 mm with internal turbulator. (Minimum number of fins shall be 25 per inch).
- c) The condenser shall be of water-cooled horizontal shell & tube with refrigerant & water connections, integrally finned copper tubes with adequate surface area to provide sub-cooling at 2°C (min.) being imparted to refrigerant liquid within the condenser shell only. Temperature raise across condenser shall not be more than 5°C . Pressure drop of water across condenser shall be limited to 0.9 kg/cm^2 . Fouling factor of $0.00025 \text{ ft}^2 \cdot \text{hr.}^\circ \text{F} / \text{BTU}$ may be considered for selection / sizing of Condenser.
- d) Multi-pass construction is desirable for the condenser. It shall be designed for proper number of passes to give optimum water velocity; efficient heat transfer & allowable pressure drop. Adequate baffling arrangement shall be used in the condenser to improve heat transfer. Condenser tubes shall be adequately supported to prevent sagging & vibration. A purge connection shall be located in the condenser for efficient elimination of non- condensable.
- e) The condenser shall be equipped with the following accessories / safety devices:
 - Purge valve
 - Charging valve
 - Relief valve / fusible plug
 - Liquid level indicator
 - Hot gas inlet / liquid outlet connections on the shell with flanges
 - Water inlet / outlet connections with flanges
 - Hand shut-off valve for water inlet & outlet

- Flow switches for the condenser water
 - Pressure & temperature gauges for water inlet & outlet / refrigerant gas inlet & liquid outlet
 - Vent valves, drain valves
 - Charging valves
- f) Condenser assembly should be tested hydrostatically for strength and pneumatically for leakages at pressures as per latest codes of unfired pressure vessels.

17.5.5 Micro-Processor based Control Panel

- a) Each unit shall be provided with a Micro-processor-based control Panel, factory mounted, wired and tested. The control panel shall include alphanumeric display showing all system parameters in English language with numeric data in English (FPS) units.
- b) All safety and cycling shutdowns shall be annunciated through the alphanumeric display and consist of day, time, cause of shutdown, and type of restart required.
- c) Safety shutdowns shall include: - high compressor discharge temperature, low evaporator pressure, motor controller fault and sensor malfunctions, Loss of chilled water flow, loss of condenser water flow.
- d) Cycling shutdowns shall include: - low water temperature, low oil temperature, chiller/condenser water flow interruption, power fault, internal time clock and entire cycle.
- e) Control panel shall be able to interface with the Centralized Monitoring System to monitor operating parameters of chiller and status messages indicating chiller is ready to start, chiller is operating, chiller is shutdown on a safety requiring reset.
- f) Security access shall be provided to prevent unauthorized change of set points to allow local or remote control of the chiller and to allow manual operation of the oil pump.
- g) The microprocessor shall ensure even compressor loading and optimal energy efficiency through microprocessor controls.
- h) The display shall have operating parameters like: -
 - Entering and leaving chilled water temperature.
 - Entering and leaving condenser water temperature.
 - Refrigerant Suction Pressure.
 - Refrigerant Discharge Pressure.
 - System Voltage.
 - Actual current drawn by compressors.
 - Loading / unloading status.
 - Compressor running hours.
 - Other display / functions which are essential for operation and safety of Chiller.

17.5.7 Inter-connecting refrigerant piping, fittings & valves

- a) Refrigerant piping is required to interconnect the compressor, condenser & the chiller into a closed network.
- b) Suction line shall be thermally insulated with polyurethane of 50 mm thick. The piping design shall be carried out in conformity with the (ANSI – B-31.5-1962) codes applicable & sound engineering practice. Heavy-duty seamless steel pipe shall be used for pipe network. While seamless solid drawn copper tubes shall be used for refrigerant liquid line.
- c) The piping network shall be adequately supported to ensure rigidity, strength & isolated by means of suitable isolators.
- d) The tenderer shall furnish complete piping & instrumentation diagrams showing the arrangement of piping inclusive of all materials, instruments & controls proposed to be included in the bid. The entire piping network shall be pressure-tested, leak tested, dried, evacuated & charged with the refrigerant after erection.
- e) All bolts & nuts shall be of black hexagonal carbon steel type as per IS: 1363 (1992) & with the material & other requirements as per IS: 1367- 1992.
- f) Velocity in the discharge & Suction pipe of the refrigerant shall be such that no undue vibration & noise are generated.
- g) The piping network shall incorporate loops in the circuit to efficiently separate oil and liquid refrigerant from hot gas and suction vapor respectively.
- h) All horizontal lines shall be pitched to 12 mm for every 3.0 m in the direction of refrigerant flow. All necessary loops and bends shall be provided to ensure proper return of oil to the compressor.
- i) Each refrigerant circuit shall be suitable for operation on HFC-134a and shall include the following items:
 - Electronic expansion valve
 - Removable liquid line drier / strainer
 - Liquid line sight glass with moisture indicator.
 - Hand shut off valves
 - Liquid to suction heat exchanger

17.6 Water pumps (Chilled water & Condenser water re-circulation)

- 17.6.7** The pumps shall be designed, manufactured and tested as per latest editions of IS 5120, IS 9137, IS 6595: part 2 or as per other international standards acceptable to the Purchaser and shall be suitable for the duty conditions and capacities as indicated in this specification.
- 17.6.8** The Horizontal / Vertical Split Casing type centrifugal pumps along with their auxiliary equipment shall be designed and manufactured for continuous duty at full load.
- 17.6.9** Pump head capacity characteristic shall be gradually rising from operating to shut-off point without any zone of instability. The pump BHP - flow characteristic shall preferably be non-overloading type beyond rated capacity point. Pumps shall be rated for continuous operation.

- 17.6.10** Pumps shall be capable of developing the required head at rated capacity for continuous operation. The pumps shall operate satisfactory at any point on the H-Q characteristic curve over a range of 70% to 130% capacity corresponding to 75% of the total head whichever is lower.
- 17.6.11** Capacity vs discharge pressure curve for each pump shall preferably be continuously drooping from the shut-off point to the rated operation point and be suitable for parallel operation. The pumps shall be designed to avoid cavitation at any of the operating points.
- 17.6.12** The required duty range for a pump shall be on stable portion of its head-capacity curve close to the best efficiency point. The head developed at the best efficiency point shall be close to the required differential pressure so that throttling is not required at pump discharge.
- 17.6.13** The equipment and auxiliaries shall be designed for quick and economical maintenance. The equipment shall be easily dismantle-able without disturbing the suction, delivery pipe connections and motor.
- 17.6.14** Operating speed of the pumps shall not be more than 1500 rpm & the equipment design shall incorporate provisions for reduction in noise level.
- 17.6.15** The required NPSH at duty point shall be at least 1.0 m lesser than the available NPSH.
- 17.6.16** The power rating of the pump motor shall be larger of the following
- ✓ 110% of the power required at the duty point.
 - ✓ For parallel operation, motor rating should be sufficient enough for running of single pump also.
- 17.6.17** All moving parts and items of the equipment, which can conceivably cause injury to the operator or otherwise authorized personnel within the vicinity of working area, shall be adequately guarded.
- 17.6.18** The equipment shall be designed for continuous duty to run 24 hours a day & 365 days a year.
- 17.6.19** The common base frame for pump and motor shall be in one piece with suitable holes for grouting. Adequate space shall be provided between pump drain connections and base plate for installation of minimum 15mm drain piping. Pumps shall be supplied with suitable drain pans or drain rim type base plates with valved drain connections.
- 17.6.20** Coupling guard, made of expanded metal and bolted to the base plate shall be supplied for all pumps.
- 17.6.21** Standard hydrostatic test shall be conducted on the pump casing with water at 1.5 times the maximum discharge head or twice the rated discharge head whichever is higher. The hydrostatic tests on the casing shall be conducted for a minimum duration of 30 minutes.

17.7 Casing

- ✓ The casing shall be of cast iron and shall be designed for a pressure not less than the shut-off pressure at the highest operating speed plus the maximum pressure that may

be encountered at the pump inlet. In addition, CI casing shall have corrosion allowance of not lower than 3 mm.

17.8 Impellers

- a) Impeller shall be of bronze/SS. Impellers and balancing drums (if provided) shall be statically and dynamically balanced. Dynamic balancing shall be at the operating speed of the pump. For multi stage pumps, all the impellers shall be assembled together for balancing. Provision shall be made for adjusting the clearance between the impeller and the casing to compensate for wear.
- b) The impeller shall be keyed or screwed on to the shaft in such a way that it does not come-out due to reverse rotation of the pump.

17.9 Shaft

The shaft shall be of AISI-410 and shall be designed for critical speed. The ratio of critical speed to speed of shaft shall be not less than 1.2 for solid shafts.

17.10 Shaft sealing

Mechanical type Shaft seals shall be provided to prevent leakage out of, or into, a pump over the range of specified operating conditions. The seals shall be suitable for variations in inlet conditions that may prevail during start-up and shut down. They shall be accessible for inspection and replacement without disturbing any part of the installation.

17.11 Bearing

Two bearing assemblies shall be provided, one within the frame to carry radial load only and the other to carry both radial and axial thrust. Bearings shall be of manufacturer's standard design, antifriction type, oil / grease lubricated. Suitable thrust bearings shall be provided in the pump to take total thrust of the pump including hydraulic thrust. Thrust bearings shall be of oil lubricated type with suitable cooling arrangement. Motor thrust bearing shall be designed without water cooling arrangement. Suitable tapped holes shall be provided for refilling of oil in the bearing housing.

17.12 Base plate

All pumps shall be supplied with sturdy base plates, as per manufacturer's standard, common to pump and drive. Base plates and pump supports shall be constructed so rigidly and the unit so mounted as to minimize misalignment due to piping strain, internal differential thermal expansion, etc. Base plates shall be fabricated from MS channels.

17.13 Companion flanges, bolts, nuts & gaskets

- a) Plate flanges having raised face shall be provided at suction and delivery side of pumps and they shall be of mild steel and conform to table 17 of IS 6392:1971 (RA1998). Slip

on raised face flanges to 150 Lbs. class conforming to ANSI B16.5 shall also be acceptable.

- b) Black bolts and nuts conforming to relevant part of IS 1367 shall be provided for the companion flanges.
- c) CAF gaskets of 1.5 mm thickness conforming to IS 2712:1998 (RA 1999) shall be provided for the companion flanges.

17.14 Materials of the pump shall preferably be as follows: -

Casing	:	Cast iron
Impeller	:	Bronze / SS
Impeller ring	:	White metal
Shaft	:	EN8
Shaft sleeve	:	Bronze
Bearing	:	Heavy-duty ball / Roller bearing
Stuffing box bushes	:	White metal.
Base plate	:	Cast iron / fabricated MS
Gland	:	Cast iron
Flanges	:	IS: 1536
Coupling	:	Flexible
Packing	:	Mechanical seals

Each pump shall be complete with pressure gauge at the suction & discharge complete with Flow control valves, isolating valve, non-return valves & Y-Strainer. All inte-

gral piping required for sealing, cooling etc. should be supplied with the pump.

Dial type pressure & temperature gauges should be provided for suction & discharge sides.

Each pump set shall be tested for mechanical running for at least 4 hours at site.

To protect from any condensation, chilled water pump (casing) should be thermally insulated with minimum 25 mm thick polyvinyl closed cell Nitrile rubber insulation & finished with 0.63mm thick G.S.S cladding or equivalent insulation material as per standard procedures.

17.15 Cooling Tower

- a) Induced draft, Cross flow type, Factory assembled, GS FRP-fill cooling tower shall be provided for the cooling of condenser water with 4 deg. C approach temperature.
- b) Cooling tower shall be designed, manufactured, performance tested as per CTI codes & CTI certified. The Cooling towers shall comply with Energy efficiency requirements as per ASHRAE std. 90.1.
- c) The cooling towers shall be provided with FRP cold water basin, with internal partition for each cell of the cooling tower. The make-up water to be tapped from the make-up water tank located on the roof of the Chilled water plant. The construction should be such

as to eliminate the danger of drawing air into the pump when operating with minimum water in the basin.

- d) The cold-water basin shall have accessories & connections for makeup, quick fill, drain & overflow. Ball & float valve is to be provided for makeup water line. The makeup water supply pipe shall be positioned at least 2 meters above the maximum level in the basin. Pressure reducing valve (6.0 bar to 0.5 bar) may be provided to reduce the pressure of make-up water.
- e) The cooling towers shall be mounted on masonry pillars / Stools on the terrace of Chilled water Plant.
- f) The filling shall be of PVC. Thickness of PVC fills shall not be less than 0.2mm. These shall be of such construction as to provide low air resistance, large wetted surface for a high heat transfer efficiency, and easy replace ability.
- g) The water distribution system shall be either open basin with gravity feed nozzles or pipe system with nozzles requiring not more than 0.5 kg / cm² water pressure at rated capacity. The nozzles shall be spaced to give even distribution of water. The nozzles shall be self-draining, non-clogging and designed for flexible operation & ready accessibility. Suitable measuring orifices shall be provided. All main piping connections shall be brought out & shall end in flanges to facilitate connections.
- h) Drift eliminators of PVC shall be provided for maximum removal of entrained water droplets. The spacers and tie rods used shall be of plastic material. Eliminators shall be provided in removable sections & installed in the cell of the tower. The number of deflections in the eliminators shall be so arranged as to limit the drift loss to 0.2 % of the water circulated.
- i) All the fasteners shall be of stainless steel. Rubber / Neoprene gaskets must be used on all bolted joints as a seal against water leakage.
- j) Motors of induced draft fan shall be of weatherproof construction. The fan motor shall be totally enclosed air over (TEAO), reversible, squirrel cage, ball bearing type designed specifically for cooling tower duty. The motors shall be furnished with special moisture protection on windings, ball bearings & shafts and labeled appropriately for cooling tower service.
- k) Fans shall be of heavy duty, multi blade, axial flow, Aluminium alloy blades. Fans & shafts shall be supported by heavy duty, self-aligning, grease packed ball bearings with moisture proof seals and integral slinger collars.
- l) The cooling tower shall be complete with ladder, access platform for maintenance & service requirements.

17.16 Chilled Water / Condenser water Piping with Accessories

- a) MS Medium Class piping is to be used as per IS: 1239 Part - I for interconnecting chilled water - piping network. Pipes above 150 mm diameter shall conform to IS: 3589 & shall have minimum 5 mm thickness.
- b) Velocity of water in pump suction line and delivery line will be within 1.2 and 2.0 m/sec respectively. Velocity in pipes shall be maximum 2.0 m/sec.

- c) Y-Strainer / Pot strainer to be provided in suction line of pump and gate valve and non-return valve to be provided in the delivery side of pump.
- d) Gate valve will be provided in water pipeline for Shutoff & Partial flow control and Globe valves for flow regulation purposes.
- e) Pipe fittings like bends, elbows, flanges, sockets, nipples, etc. will be as per relevant IS/BIS standards.
- f) Matching flanges shall be as per IS: 6392. All bolts & nuts shall be black hexagonal carbon steel type conforming to IS: 1363 for material & other requirement as per IS: 1367.
- g) Drain piping network is to be included as required for condensate drain, with isolation valves at proper places.
- h) Pipe supports will be steel, adjustable for height and coated with rust preventive primer and finish coated with aluminium paint. Where pipe and clamp are of dissimilar material a gasket will be provided in between.
- i) Spacing of pipe supports will not exceed the following:

Pipe (mm)	Spacing (Metres.)
3 to 12	1.25
19 to 25	1.85
32 to 150	2.50
150 and above	3.00

- j) All piping shall be tested to hydrostatic test pressure of at least one & half times the maximum of operating pressure but not less than 7 kg/ cm² for a period of not less than 24 hours. System may be tested in sections & such section shall be securely capped. No insulation shall be applied to piping until the completion of pressure testing to the satisfaction of the owner.
- k) The Tenderer will provide all materials, tools, equipment, instruments, services and labour required to perform test and remove water resulting from cleaning and/after testing.
- l) Pressure gauge dial dia. will not be less than 150mm. The pressure gauge will be with appropriate working range and be complete with shut off gauge cocks, etc. duly calibrated before installation.
- m) Gunmetal gate & globe valves are to be used up to pipe sizes 50 mm & butterfly valves are to be used above these pipe sizes. Gunmetal valves shall be as per IS: 778 Class - I with screwed ends.
- n) Chilled water piping laid indoor shall be as follows: -

Pipe size	Material	Joints / Fittings	Sealing material
Up to 65 mm	M.S tube Medium IS-1239 Part –1	a) Welded fittings b) Unions c) Slip on flanges d) Welded joints	a) Non-hardening b) Lubricant c) 3 mm - 3 ply Rubber insertion d) -----
75 to 200 mm	---- do ----	a) Welded b) Slip on flanges c) Screwed GI flanges for GI pipes	a) ----- b) 3 mm - 3 ply rubber insertion c) -----

17.17 Thermal Insulation of Chilled water pipes

- Clean the pipe surface with wire brush and apply a coat of bituminous primer.
- Apply a thick coat of bituminous cold adhesive over the surface.
- Fix pre-formed pipe sections (Polyurethane / phenolic foam of min. 32 kg/m³ density) minimum 50 mm thickness / 75 mm thk (outdoor / exposed / buried piping) secured in position by means of aluminum band of size 20 mm x 24 swg at 300 mm center to center.
- Wrapping the pipe with Aluminum foil laminated Kraft paper as vapor barrier over the insulation with proper overlaps and joints sealed by means of self-adhesive Aluminum foil tape.
- Provide the surface with Aluminum band of size 20 mm x 24 swg at 400 mm center to center.
- Fix plain Aluminum sheet 0.5 mm thick with self-tapping screws to the floating rings made of MS flat 25 x 3 mm at 400 mm center to center. The sheet joint shall be sealed with suitable sealant.
- For pipes buried in ground outer protective insulation jacket shall be seamless, extruded, black, UV resistant, high-density polyethylene (HDPE).

17.18 Thermal insulation for GI class B piping for drain

- Clean the pipe with wire brush and apply a coat of bituminous primer.
- Apply thick coat of adhesive.
- Insert the preformed pipe sections of Aluminum foil faced Nitrile rubber 25 mm thick on the surface.
- Cover the joint with 50mm Aluminum Adhesive tapes at all places circumferential and longitudinal.

17.19 Valve & Accessories

- Balancing Valve

The balancing valve shall be fitted in to the pipeline system for balancing, control and shut off. These shall have in-built flow measuring port to measure flow and pressure drop for proper

balancing and control of water. The body shall be made up of Gun metal / cast iron body that is corrosion resistant with EPDM coated disc with long pitch with protected out pipe insulation. Pressure rating of valve shall be PN16.

b. Butterfly Valve

The Butterfly valve shall comprise of a standard one-piece body casted out of graded Cast iron, the disc shall be made out of casted stainless steel/ Bronze, seat made out of Nitrile rubber for proper isolation/ seal. The coating on the body and disc shall be either epoxy or PTFE material. Pressure rating of valve shall be PN16. Butterfly valve shall perform the function of isolating valves. All Butterfly valves shall be provided with locking devices.

c. Globe Valve

The Globe valve shall have a forged casted brass or bronze body, the packing and the seat shall be made out of Teflon material for valve seat tightness. The valve shall have a large flow chamber to enable minimum pressure drop and maximum flow. The seals for the body and bonnet shall be of fully retained gasket. Pressure rating of valve shall be PN16.

d. Ball Valve

The ball valve shall have a forged casted brass or bronze body, PTFE Disc & packing along with MS nut and handle. Pressure rating of valve shall be PN20.

e. Non-return (check) valves

It shall be provided conforming to BIS 778 and IS 5312 (Part I) and in accordance with the following specifications.

Size	Construction	Ends
50 mm to 150 mm	Cast iron/Gun Metal plate	Flanged
200 mm to 450 mm	Body cast iron, plate carbon steel with 13% chrome overlay	Flanged

The spring and hinge / stop pin shall be SS 304 and bearing fine material. Non-return valves shall be disc type. Swing check valves shall normally be used in all water services. Lift type valves may be used in horizontal runs. Valves shall be suitable for not less than 15 kg per Sq.cm gauge working pressure.

f. Three-way modulating valves

These shall be provided in chilled water lines as diverting valves at each air-handling unit and shall be actuated by a space thermostat. Space conditions shall be maintained by continuous proportional modulation of the chilled water through the coil. The valve shall revert to fully

bypass position when fan is shut off. Maximum pressure drop across valve shall not exceed 0.85 kg/ sq.cm.

g. Thermostats

- Thermostats shall be electric fixed differential type as indicated below, with sensing element located in the return air stream.
- All thermostats shall be supplied with the standard mounting boxes as recommended by the manufacturer. The profile, mounting arrangement and exact location of the thermostat shall be such as to suit the site.
- Proportional control thermostats shall be provided for actuating the three way modulating valve at each air handling unit. Thermostat shall provide manual switching (heat-off-cool-in heating-cooling system).
- Thermostat shall have temperature adjustments "Warm-Normal-Cool" settings and fan switch. Switching off must break fan circuit.
- Air-stat shall be provided within air handling unit containing electric heating or reheat coils to prevent heaters from energizing unless the air flow is established.

h. Strainers

- Strainers shall be of 'Y' type or pot type.
 - 'Y' strainers shall be provided on the inlet side of each air-handling units and pumps in chilled water and condenser water circuit.
 - Pot strainers, shall be provided in return water header, for chilled water and condenser water.
 - The strainers shall be designed to the test pressure specified for the gate valves.
 - Filtration area of Y-strainer shall be minimum four times the connecting pipe size.
 - Strainers shall have a removable bronze/ stainless steel minimum 1mm thick screen with 3 mm perforations and permanent magnet.
 - Strainers shall be provided with flanges or threaded sockets as required. They shall be designed so as to enable blowing out accumulated dirt and facilitate removal and replacement of screen without disconnection of the main pipe.
 - Strainers shall be provided with equal size isolating gate valves on either side so that the strainers may be cleaned without draining the system.
- i. Balancing valve, Butterfly valves, globe valve, Ball valve conforming to the following specifications shall be provided-

Size	Construction	Ends
15 To 40 mm	Gun Metal	Screwed
50 mm and above	Body cast iron spindle and valve seat of Bronze or Gun metal or Nitrile rubber (in case of butterfly Valve)	Flanged

- j. All valves shall be heavy duty conforming to BIS 780, BIS 5152, and BIS 5155. Valves shall have non rising spindles unless otherwise specified and shall be suitable for not less than 15 Kg per sq.cm gauge working pressure. Valves above 250 mm dia. shall be gear driven.
- k. Flanges shall be of slip on raised face type. The supply of flanges shall also include supply of bolts and nuts and suitable non-asbestos / fiber rubber insertion gaskets (minimum 3 mm thick).
- l. Auto Air vent / drain valve of suitable size shall be provided in the chilled water piping at highest point and at lowest points in the risers respectively.
- m. The automatic air vent valve used for venting of air from water distribution piping to avoid damage due to corrosion, cavitation and loss of efficiency in air conditioning system. When there is air in the pipe line / valve, the float weight acts on the lever which is integral with the plug moves down and allows the air to vent outside. As soon as, the trapped air discharged, the water pushes the float up and lever moves the plug against the seat ensuring tight sealing of the system.
- n. The valve maximum operating pressure shall be 16 bar. MOC of Valve body & cover shall be of brass, Float: High density expanded Polyethylene, Spring: SS and Seal: Nitrile rubber.
- o. Water flow switch / differential pressure switch

The water flow switch/ differential pressure switch along with the pressure difference scale will be suitable for installing in the condenser and chilled water lines across the condenser and evaporator respectively, with the necessary interlocking mechanism.

17.20 Air-handling Units (AHU)

17.20.7 General

- a) Chilled water based, floor Mounted Horizontal AHUs are to be provided for the Air conditioning facilities.
- b) The Air Handling units shall be of factory built thermal break double skin construction of approved make comprising of Pre-filter & Fine-Filter Section, Chilled water Coil Section, stainless steel drain pan, Fan Section with Centrifugal fans. The complete unit shall be installed on spring / vibration isolators / mountings for eliminating vibration to the civil structures. The total units shall be AHRI / Euro vent certified. The description of the units is as follows:

17.20.8 Casing

- a) The casing shall be of sandwich panels fixed on modular frame design. The frame shall be made of non-corrosive extruded Aluminium channels fitted with extruded Aluminum / PVC (Polyamide) corner pieces and insulated with 50 mm PUF injected having Min. density of 40 Kg/m³ insulation.
- b) The structure shall be having thermal break for total unit. Panels shall be 50 mm thick sandwich type with injected polyurethane foam insulation for rigid non-vibrating construction. The insulation shall not absorb moisture and should be rot resistant.
- c) The panels shall be flush mounted to the casing with no sharp edges/corners. They shall be rapid access type fitted from inside with Allen screws to have flush finish from outside. The sealing of frame to panel shall be by means of non-hygroscopic seal compressed between the panel and the Aluminium frame channels to prevent cold tracking and air leakage between panel & frame.
- d) The panels shall be mounted using SS screws onto 1.6 mm thick extruded Aluminium-alloy box section/channel frame or Galvanised steel frame with suitable height legs for adequate U-trap for the AHU static pressure rating.
- e) The inner / outer sheet 0.8 mm thickness wall shall be of galvanized 120 gm/m² sheet chemically treated, having scratch free, pre-plasticized coating and plain GI inner sheet.
- f) Suitable compression glands for cable entry and nozzles for pressure measurement / filter testing shall be provided with closure for unused nozzles.
- g) The AHU shall be provided with electrical power / control junction box on external side of the unit conveniently mounted for cable connections.

17.20.9 Condensate Pan

Sandwich insulated Condensate drain pan shall be fabricated from minimum 18G stainless steel sheet (SS 304) with all corners welded with uniform slope from all side s leading to drain point ensuring no stagnation of condensate water. Drain point/pipe coming out from AHUs should be also of SS 304. It should be isolated from bottom floor panels through 25 mm heavy duty TF expanded polystyrene or polyurethane foam. Drain plug shall be provided in the bottom of the coil section.

17.20.10 Fan Section

- a) Fan shall be draw-through type, high efficiency, dynamically balanced, centrifugal, forward / Backward curved type. Fan Casing shall be made of galvanized steel sheet. Fan wheels shall be made of galvanized steel. Fan shaft shall be of ground C40 carbon steel and supported in pre-greased ball bearings operating at less than 75% of the first critical speed. Fan wheels and pulleys shall be individually tested and precision balanced dynamically.
- b) Fans shall be VFD driven forward / back ward curved as required for stable operation. The blades shall be made of heavy gauge of steel treated and painted after manufacturing.

- c) The fans shall be statically and dynamically balanced at the factory as complete fan assembly should have AMCA approval. The fans shall be equipped with self-aligning bearings. The static efficiency of fan shall not be less than 70%.
- d) Fan / motor assembly shall be mounted on a common framework entirely isolated from the unit by cushy foot/spring isolators to avoid transmission of vibration.
- e) The fan discharge shall be isolated from the casing by a vibration absorbing connection.
- f) The fan section shall have outlet dampers as deemed fit for connecting the supply ducts.
- g) The Critical speed of the fan shall be minimum 125% of the operating speed.
- h) The fan outlet velocity shall be within 10 m/s & Fan RPM shall be limited to 1450.
- i) Fan motor shall be selected for 25% margin on fan shaft power. Fan motors shall be VFD driven and suitable for 415V $\pm$ 10%, 50 Hz, 3 phase, AC supply. It shall be squirrel cage, totally enclosed fan cooled, motors with efficiency class of IE2 with class F insulation and IP-55 protection.
- j) Motors shall be specially designed for quiet operation and motor speed shall not exceed 1450 RPM.
- k) Fan motors shall be mounted inside the AHU on spring mounts with belt drive facility with easy belt tensioning. Drive arrangement shall be with dynamically balanced, constant pitch pulleys and oil-resistant belts, with the drive selected at 110% of motor horsepower. Drive motor shall be flaming proof & corrosion protection with standby arrangement (as per requirement).
- l) Drive to fan for backward curved shall be provided through belt-drive with a standard belt guard housing the bolt and adjustable motor sheave.
- m) Belts shall be of the oil-resistant type. The frame for mounting the fan and motor shall be isolated from the double skin casing with spring isolators.
- n) Interlocking arrangement shall be provided to stop the fan motor when the access doors in the fan section or adjoining sections are opened, with a manual overriding provision.

17.20.11 Coil Section

The coil boxes housing cooling coils shall be of the same construction as of the AHU casing.

17.20.12 Cooling Coils

- a) Chilled water coils shall have 12.7mm dia. Copper tubes with thickness as per OEM standards, with Aluminium fins firmly bonded to copper tubes assembled in zinc coated steel frame.
- b) Face and surface areas shall be such as to ensure rated capacity from each unit and such that the air velocity across each coil shall not exceed 500 FPM.
- c) The coil shall be pitched in the unit casing for proper drainage.
- d) Each coil shall be factory tested at 21 Kg/Sq.cm, air pressure while submerged in water.
- e) Tubes shall be hydraulically expanded for minimum thermal contact resistance with the fins.
- f) Fin spacing shall be 13 fins per inch. (4-5 Fins/CM.). The coil shall be minimum 6 Rows for the Cooling coil.

- g) Additional cooling coil may be provided in fresh air chamber for pre-cooling of fresh air to meet high latent load requirement.

17.20.13 Filter Section

- a) The filter section shall be same as that of casing and panels of AHU but with an access door for withdrawal / fixing of filters.
- b) Each unit shall be provided with a factory assembled pre-filter & fine filter section containing min. 50mm / 150mm / 300mm thick washable synthetic type air filters assembled in anodized aluminium / SS frame. The media shall be supported with HDP mesh on one side and aluminium / SS mesh on other side. Filter banks shall be easily accessible and designed for easy withdrawal and replacement of filters. Filter framework shall be fully sealed and constructed from aluminium alloy.
- c) The Filter section shall be 2 stage one is Pre filters of capacity 90% down to 10 Micron (MERV-7) and other is fine filter 90% down to 3 Micron Filters (MERV-13).
- d) The maximum velocity of air across the pre-filter and the fine filter shall not exceed 500 FPM.

17.20.14 Isolator

The complete assembled AHU shall be floor mounted on spring isolators to avoid transmission of vibration to the floor.

17.20.15 Performance Data

- a) Air handling units shall be selected for the lowest noise level (<60 dBA) of the equipment.
- b) Fan performance rating and power consumption data with operating points clearly indicated shall be submitted for review and the same shall be verified at the time of testing and commissioning.

17.21 Air-cooled Package Unit

- a) The Air-cooled packaged units shall conform to IS 8148: 2003. These shall have standard features such as air-cooled condensers, refrigerant compressors, interconnecting refrigerant piping, condensate drain connections, thermostats, controls etc. to make the system complete & give trouble free and satisfactory operation.
- b) The units shall be suitable for working under industrial environment and suitable for continuous duty. The unit shall have one evaporator unit and one condensing unit. The evaporator unit shall be detachable type. The condensing unit shall be installed on the space outside the conditioned area.
- c) The refrigerant compressor shall be hermetically sealed scroll type operating on Low GHG / Very low / zero ODP refrigerant (R407C, R410A) The Compressor shall have an Energy Efficiency Ratio (EER) of not less than 10.0 under design operating conditions. It shall be capable of operating continuously in an industrial atmosphere.

- d) The condenser shall be air-cooled copper coil of minimum 3 rows, 12-14 fins/inch Aluminium fins with ample condensing surface. Tubes shall be arranged in a staggering manner for better efficiency.
- e) The evaporator coil shall be of direct expansion type with copper tubes of minimum 4 rows and mechanically bonded aluminum fins of min 15-16 fins per inch. It shall be sufficiently deep and well-proportioned to match the airflow and ensure perfect cooling. Tubes shall be arranged in staggered design for best air contact giving low by-pass.
- f) Centrifugal (evaporator) fans shall be provided to handle the conditioned air. The fan shall be dynamically balanced and its operation shall be smooth and quiet. Fan shall be complete with direct drive motor. The bearings shall be self-lubricating type. A selector switch with “RESET” position shall be provided for running the fan alone without cooling as and when required.
- g) Propeller type fan shall be provided to cool the condenser coil. The fan shall be dynamically balanced and its operation shall be smooth and quiet. It shall be complete with direct drive motor. The bearings shall be self-lubricating type.
- h) Air filter shall be provided for the fresh air as well as total air. The air filter shall be dry panel type. It shall have large surface area & good dust holding capacity. The filter shall be capable of handling air with dust concentration 10 mg/m³ of air. The cleaning efficiency of the filter shall be more than 90% down to 10 microns. The filter shall be easily replaceable type. Velocity of air across the filter shall be in the range of 2.0 - 2.5 m / sec. Filter panel shall be cleanable and washable type for reuse. U-Tube manometer shall be provided for measuring pressure drop across the filter. All leakage areas shall be sealed with suitable sealing compound.
- i) Electronic Thermostat shall be provided for control of temperature as per the designed inside conditions.
- j) Inline humidifiers & strip heaters of appropriate capacity forming either as an integral part of Package unit or externally mounted shall be envisaged for the areas requiring RH control (55 ± 5%). Humidifiers can be of Pan / Bottle or Steam generating type. The operation of Humidifier & Strip heaters shall be based on inputs signals from Humidistat & Return air parameters. The system shall be fully automatic with fool proof interlocks to prevent operation of the system in case of any accidental malfunctioning of Heaters or Humidifiers. Also, suitable (selector) on / off switches / knobs shall be provided to disengage the Humidistat / strip heaters circuit and permit operation of PAC unit as required.
- k) The refrigerant circuit between outdoor unit and indoor unit shall be carried out as per site conditions. The circuit shall include thermostatic expansion valve, filter drier and liquid line shut off valve. It will be protected by Hi-Lo pressure start.
- l) The cabinets of the evaporator and condensing unit shall be constructed of heavy gauge steel, finished with electro deposition paint and synthetic resin baked enamel, weather proof with an attractive appearance. Removable panels shall be provided for convenient service access to interior of the cabinet. The evaporator unit shall have elegant cabinet with all controls discretely concealed to make appearance impressive.
- m) Insulation of suction and liquid line shall be carried out with pipe section - flexible, closed cell elastomeric, nitrile rubber insulation covered with aluminium foil. The complete

refrigerant piping shall be insulated and provided with weather protection. The drain pipe shall also be insulated with nitrile rubber to avoid condensation.

n) Control & Instrumentation

- The Package AC system shall be provided with controls/ contactors / thermostats suitable for sequential starting / stopping i.e. the compressor shall start in the last and shall shut off first.
- All necessary operational controls, regulating controls, automation, measuring & monitoring required to cope with the equipment duty are to be so designed & arranged such that operation of the plant can be fully automatic or if required, fully manual.
- All necessary interlocking & alarm circuits shall be arranged so as to eliminate any possible damage to the plant due to malfunctioning of instruments or any probable operational mistakes.

17.22 Multi-Split (VRF / VRV) AC Units

a. Overview

- i. The AC units shall conform to IS: 1391 – 1992, Part – II. These shall have standard features such as Air-cooled Condensers, Refrigerant Compressors, interconnecting refrigerant Piping, Condensate drain connections, thermostat etc., to make the system complete & give trouble free and satisfactory operation. The units shall be suitable for working under industrial environment and suitable for continuous duty.
- ii. The Outdoor Units shall be of modular construction connected with VRF / VRV (wall mounted type / duct-able / ceiling suspended / Floor mounted type) multiple Indoor units.
- iii. Each of the modular outdoor units can be equipped with inverter compressors for higher reliability, improved life, better backup and duty cycling purpose. The system shall be capable of changing the rotating speed of inverter compressor by inverter controller to follow variations in cooling and heating load.
- iv. Outdoor Units shall be suitable for mix match connection of all type of indoor units.
- v. The refrigerant piping between indoor units and outdoor unit shall be possible to extend up to 100.0 m with maximum 20.0 m level difference without any oil traps.
- vi. Both indoor units and outdoor units shall be factory assembled, tested and filled with first charge of refrigerant before delivering at site. The major components of the Multi –Split Air conditioning system shall comprise the following: -
 - Compressors
 - Air-cooled Condenser
 - Condenser fan
 - Evaporator
 - Evaporator fan
 - Filter
 - Controls

- Refrigerant Circuit
- Electrics
- Touch panel controller with minimum 64 units.

b. Equipment Description -Outdoor Units (ODUs)

- i. The outdoor unit shall be factory assembled, with weather proof casing constructed from heavy gauge mild steel panels and coated with baked enamel finish. The unit should be completely factory wired tested with all necessary controls. It should also be provided with duty cycling for multiple compressors switching starting sequence for better stability and prolonged equipment life.
- ii. The outdoor unit shall be modular in design and should be allowed for side-by-side installation.
- iii. The unit shall be provided with its own microprocessor control panel.
- iv. The outdoor units shall be coated with anti-corrosion paint & shall be mounted on Gal barium steel base plate.
- v. The machine must have a sub-cool feature to use coil surface more effectively through proper circuit / bridge so that it prevents the flushing of refrigerant from long piping due to this effect thereby achieving energy savings.
- vi. The outdoor unit should be fitted with low noise, aero spiral design fan with aero fitting grille for spiral discharge airflow to reduce pressure loss and should be fitted with an inverter type DC fan motor for better efficiency.
- vii. The condensing unit shall be designed to operate safely when connected to multiple indoor units.
- viii. The Unit should allow for backup operation to facilitate uninterrupted cooling. Auto backup required during compressor failure, sensor failure, ODU fan / motor failure.
- ix. Compressor
 - The compressor shall be highly efficient Rotary / Scroll type and capable of inverter control. The inverter compressor shall change the speed in accordance to the variation in cooling or heating load requirement.
 - The Compressor shall be capable of operating continuously.
 - All parts of compressor shall be sufficiently lubricated. Oil heater shall be provided in the compressor casing.
- x. Heat Exchanger
 - The heat exchanger shall be constructed with copper tubes mechanically bonded to aluminium fins to form a cross fin coil. Tubes shall be arranged in staggered design for best air contact giving low by-pass.
 - The aluminium fins shall be covered by anti-corrosion resin film.
 - The unit should be with e-pass heat exchanger to optimize the path of heat exchanger and for better efficiency of condenser.
 - The unit shall be provided with necessary number of direct driven low noise level propeller type fans arranged for vertical discharge. Each fan shall have a safety guard.

xi. Refrigerant Circuit

- The refrigerant circuit shall include liquid & gas shut-off valves and a solenoid valve at condenser end. The equipment must have in built refrigerant stabilization control for proper refrigerant distribution. All necessary safety devices shall be provided to ensure the safely operation of the system.
- Refrigerant should be R410A Only.

xii. Safety Devices

All necessary safety devices shall be provided to ensure safe operation of the system. Following safety devices shall be part of outdoor unit: -

- High pressure switch,
- Fuse
- Fan drive overload protector
- Fusible plug
- Over load relay
- Overload protection for inverter compressor

xiii. Oil recovery system

Unit shall be equipped with an oil recovery system to ensure stable operation with long refrigeration piping lengths. The system must be provided with oil balancing circuit to avoid poor lubrication.

c. Indoor Units (IDUs)

- i. Each indoor unit shall have electronic expansion valve which senses the temperature based on variation of the room load and conveys the same for the outdoor modules to respond accordingly.
- ii. The Indoor units shall be ceiling mounted cassette type/ wall mounted type.
- iii. The address of the indoor unit shall be set automatically for individual and group control. For centralized control, it shall be set by a remote controller (with an LCD display panel).
- iv. The fan shall be dual suction, aerodynamically designed turbo, multi blade type, statically & dynamically balanced to ensure low noise and vibration free operation of the system. The fan shall be direct driven type, mounted directly on motor shaft having supported from housing.
- v. The cooling coil shall be made out of seamless copper tubes and have continuous aluminium fins. The fins shall be spaced by collars forming an integral part. The tubes shall be staggered in the direction of airflow. The tubes shall be hydraulically / mechanically expanded for minimum thermal contact resistance with fins. Each coil shall be factory tested at 21 kg/m² air pressure under water.
- vi. Unit shall have cleanable type filter fixed to an integrally moulded Plastic / Aluminium frame. The filter shall be easily serviceable.

- vii. Each indoor unit shall have computerized PID control for maintaining design room temperature. Each unit shall be provided with microprocessor thermostat for cooling or cooling and heating.
- viii. Each unit shall be with wireless LCD type remote controller. The remote controller shall memorize the latest malfunction code for easy maintenance. The controller shall have self-diagnostic features for easy and quick maintenance and service. The controller shall be able to change fan speed and angle of swing flap individually as per requirement.
- ix. The units shall comprise of following features: -
 - Four (4) way directional flow decorative grille.
 - Each unit complete with Low noise (below 50db inside conditioned area), multi-blade centrifugal fan.
 - Each unit shall have two (2) rows of deep chilled water-cooling coil.
 - Each unit shall have Cleanable filters.
 - Insulated condensate drains pan with drain pump assembly
 - Drain pump failure alarm
 - Decorative panel as per architectural layout.
 - Infra-red remote control one for each unit.
 - LCD display on the unit
 - Four (4) speed motor or as per OEM.
 - Auto swing louver.
 - Condensation drains connections.
 - All units shall be suitable for 220 +/- 10% Volts, 50 Hertz, single phase power supply etc. complete.
 - The Remote temperature control / thermostat shall have memory back up for set point re-store in case of power failure and re-start.
 - Four hanger rods with required anchoring fasteners, hooks, washers etc. for ceiling suspension and a pair of power supply cable of about five metres length shall also be supplied along with the cassette units.

17.23 Air cooled Split type Air Conditioners

The Split AC units shall conform to latest standard of IS 1391, Part – II. The model offered shall have BEE Star Rating of not less than 4 Star. These shall have standard features such as air-cooled condensers, refrigerant compressors, interconnecting refrigerant piping, condensate & drain connections, thermostat etc., to make the system complete & give trouble free satisfactory operation.

The units shall be suitable for working under industrial environment and suitable for continuous duty. Each split-type air conditioner shall have one outdoor unit and one indoor unit. The indoor unit shall be of High wall / Floor mounted type. The outdoor units shall be installed on the roof / terrace. The detailed specifications of individual component / parts shall be as described in the following paragraphs: -

- a. The refrigerant compressor shall be hermetically sealed scroll type operating on Low ODP refrigerant preferably R32 / R410A / R407c. It shall be capable of operating continuously in an industrial atmosphere.
- b. The condenser shall be air- cooled copper coil of minimum 10 mm OD with Aluminium fins having ample condensing surface. Tubes shall be arranged in a staggering manner for better efficiency.
- c. The evaporator coil shall be of direct expansion type with copper tubes of minimum 10 mm OD and mechanically bonded aluminium fins. It shall be sufficiently deep and well-proportioned to match the airflow and ensure perfect cooling. Tubes shall be arranged in staggered design for best air contact giving low by-pass.
- d. Single Centrifugal evaporator fan shall be provided to handle the conditioned air. The fans shall be dynamically balanced and its operation shall be smooth and quiet. Fans shall be complete with direct drive motor. The bearings shall be self-lubricating type. A selector switch with “RESET” position shall be provided for running the fans alone without cooling as and when required.
- e. Propeller fan shall be provided to cool the condenser coil. The fan shall be dynamically balanced and its operation shall be smooth and quiet. It shall be complete with direct drive motor. The bearings shall be self-lubricating type.
- f. The air filter in the indoor unit shall be of dry type. It shall have large surface area and good dust holding capacity. The cleaning efficiency of the filter shall be more than 90 % down to 20 microns. The filter shall be of easily replaceable and washable type.
- g. Electronic Thermostat shall be provided for control of temperature as per the designed inside conditions.
- h. The refrigerant circuit between outdoor unit and indoor unit shall be carried out as per site conditions. The circuit shall include thermostatic expansion valve, filter drier and liquid line shut off valve. It will be protected by Hi-Lo pressure start.
- i. Indoor unit shall have elegant cabinet with all controls discretely concealed to make appearance impressive. Outdoor unit cabinet shall be powder coated so that it is able to withstand corrosive atmosphere.
- j. Insulation of suction and liquid line shall be carried out with pipe section flexible, closed cell elastomeric, nitrile rubber insulation. The complete refrigerant piping shall be insulated and provided with weather protection. The drain pipe shall also be insulated to avoid condensation.

17.24 Air-washer Unit (AWU)

- a. The Air-washer Unit shall be of Double skin type made out of 16-gauge GI casing and shall be of injection filled with PUF / PHENOTHERM / Rockwool slab / rolls (48 kg/m³ density) of 50 mm thick Insulation between the two galvanized metal sheets.
- b. The Air-washer unit shall enclose mono-block self-priming pump assembly for water distribution on the Celdek media.

c. The Air-washer unit shall comprise of following sections: -

i) Filter panel section

- Air filter bank shall comprise of panel type Pre-filters with mounting frame
- Pre-filter shall be of 3 ply HDPE panel type with efficiency of 90% down to 10 microns.
- Velocity of air across the filters shall be in the range of 2 to 2.5 m / sec.
- Filter panel shall be cleanable and washable type for reuse.
- U – tube manometer shall be provided for measuring pressure drop across the filter.
- Cleaning efficiency of the Pre-filter element shall be 90% down to 10 micron size of dust particles.
- Filter material shall be enclosed in a sheet metal framework. Filter frame shall be fabricated from 16 G M.S sheet in welded construction. All leakage areas shall be sealed with suitable sealing compound.

ii) Evaporative section

- The evaporative section shall be complete with CELdek media, water distributing section, water collection trough, droplet separator, pump, interconnecting water piping, valves, strainers, make up, drain, overflow, quick fill, float, mounting frames etc.
- The evaporative section shall be constructed out of Aluminium alloy / folded galvanized sheet.
- The cooling media shall consist of min. 300 mm thick CELdek cooling pads designed for min. 90 % saturation at < 2.5 m/s. Suitable regulating valve shall be envisaged on the piping network for manual control of humidity.
- Mist eliminator shall be provided after CELdek media to separate the water droplets from the air stream.
- The section shall be of bolted construction with min. 100 mm wide FRP lining on the joints in the water tank.

iii) Centrifugal Fan for Air-washer

- The fan is to work at an ambient temperature of maximum + 50 °C and minimum +2 °C.
- Centrifugal fans shall conform to IS: 4894.
- Centrifugal fan shall be forward / backward curved multi-blade DIDW / SISW inlet type depending upon construction of Air-washer.
- Fan and motor assembly shall be mounted on a common vibration proof base frame & the assembly shall be mounted on anti-vibration spring isolators.
- The fan shall be of rugged steel construction with proper painting and suitable for heavy-duty operations.
- Impeller and shaft assembly of Fan shall be statically and dynamically balanced on precision electronic dynamic balancing machines.

- The specifications for fan have been indicated for standard air.
 - Fan shall be fitted with drilled inlet and outlet flanges for fastening ducts with bolts and nuts.
 - The air handled by fan shall be clean.
 - The fan shall be of limit load design only.
 - Speed of the fan shall be preferably within 1000 rpm and outlet velocity shall be within 12 m / sec.
 - The fan shall be provided with outlet damper for control of capacity.
 - Critical speed of fan shall be minimum 125% of the operating speed.
 - Fan shall be provided with airflow switch indicator.
 - Fan shall be either connected to motor directly with flexible coupling or shall be connected to motor by V-belt drive with slide rails, pulley blocks, belts & tensioning device, etc.
 - The Fan inlet shall be covered with coarse wire mesh guard for safety.
- d. Suitable air tight doors, marine lamps, etc are to be provided at Fan section / filter sections for maintenance.
- e. The Air-washer unit shall be placed on vibration isolation pads to minimize vibrations.

17.25 Centrifugal Fan

- a. The fan is to work at an ambient temperature of maximum +50 °C and minimum +10 °C.
- b. All Centrifugal fans shall conform to IS: 4894 - 1987 (Reaffirmed – 1994).
- c. Centrifugal fan shall be forward / backward curved multi-blade single / double width single / double inlet type.
- d. Fan and motor assembly shall be mounted on a common vibration proof base frame & the assembly shall be mounted on anti-vibration spring isolators.
- e. The fan shall be of rugged steel construction with proper painting and suitable for heavy-duty operations.
- f. Impeller and shaft assembly of Fan shall be statically and dynamically balanced on precision electronic dynamic balancing machines.
- g. The specifications for fan have been indicated for standard air.
- h. Fan shall be fitted with drilled inlet and outlet flanges for fastening ducts with bolts and nuts.
- i. The air handled by fan shall be clean.
- j. The fan shall be of limit load design only.
- k. Speed of the fan shall be preferably within the 1000 rpm and outlet velocity shall be within 12 m / sec.
- l. The fan shall be provided with outlet damper for control of capacity.
- m. Critical speed of fan shall be minimum 125% of the operating speed.
- n. Fan shall be provided with airflow switch indicator.

- o. Fan shall be either connected to motor directly with flexible coupling or shall be connected to motor by V-belt drive with slide rails, pulley blocks, belts & tensioning device, etc.
- p. The Fan inlet shall be covered with coarse wire mesh guard for safety.
- q. The capacity of fan motor shall not be less than 125% of the BkW.
- r. The fan shall have followed minimum thickness of materials for different parts:
 - Capacity below 20,000 m³/hr:
 - Casing: 2.5 mm
 - Back plate: 3.15 mm
 - Impeller: 3.15 mm
 - Capacity above 20,000 m³/hr and below 50,000 m³/hr
 - Casing: 3.15 mm
 - Back plate: 4 mm
 - Impeller: 4 mm
 - Capacity above 50,000 m³/hr
 - Casing: 6 mm
 - Back plate: 8 mm
 - Impeller: 6 mm

17.26 Pre-Filters

- a. Pre-filters shall be provided at the inlet of Centrifugal Fan.
- b. Size of Pre-filters shall be of standard size 610x610x150 mm thick.
- c. Velocity of air across the filter shall be in the range of 2 m/sec.
- d. Filter panel shall be cleanable and washable type for reuse.
- e. Magnahelic gauge shall be provided for measuring pressure drop across the filter.
- f. Cleaning efficiency of the Pre-filter element shall be 90% down to 10-microns size of dust particles.
- g. Filter material shall be enclosed in a sheet metal framework. Filter frame shall be fabricated from 16G M.S sheet in welded construction. All leakage areas shall be sealed with suitable sealing compound.
- h. Proper sealing shall be ensured to prevent leakage of air between mounting frame and filter panels.

17.27 Air Intake Louvers

Air intake Louvres are envisaged as first stage separators of air borne sand, dust & objects at each ventilation chambers. The Air intake louvers can be of FRP / 3.0 mm thk MS / high quality GI or extruded Aluminium alloy mounted on suitable frame work. The Louvre frame work shall squarely fit into the wall openings having 50 x 50 x 6 edge angle inserts.

17.28 Tube Axial (TA) Fan / Propeller Fan

- a. The TA / Propeller fans shall be suitable for wall mounting.
- b. The fans are to work at an ambient temperature of + 50 ° C during summer & + 10 ° C during winter & shall conform to IS : 3588 (TA Fan) / IS : 2312 (Propeller fan).
- c. Fans shall be fitted with drilled flanges for fastening with inserts embedded plates at the wall opening.
- d. The specifications for fan have been indicated for standard air.
- e. All fans shall be of rugged steel construction with proper painting, suitable for wall mounting & continuous operation.
- f. The fans shall handle ambient air for providing fresh air supply / exhaust.
- g. The impeller shall be directly mounted on the motor shaft & motor shall be in the air stream.
- h. Fans shall have suitable cowl & bird screen with provision for mounting on the wall opening.
- i. Fans are to be provided with two coats of anti-corrosive finishing paint over two coats of red oxide primer.

17.29 Wind Turbine / turbo Ventilator

The Wind Turbine Ventilators shall be specially designed and manufactured as per industrial specification and standards and rigorously tested to ensure durability and performance in extreme temperatures and high wind conditions. The Ventilators shall be able to discharge / exhaust required volume at a wind velocity of 10.0 MPH. The vanes shall be of double curved for maximum weather durability, maximum wind driven efficiency and rain spill deflection. MOC of vanes shall be bright hi grade (A1100 / 19000 gr.). The vane assembly shall rotate effortlessly on SS 304 Ball & pin with self-lubricating guiding bush mechanism.

The Turbine ventilator shall be designed to withstand the load of maximum wind velocity at the site of installation.

The turbine ventilator vanes shall be provided with Electro zinc plated center shaft, SS mounting (bottom / neck) rings, top cover, metal / FRP base duct (transition piece), sleeves, support and accessories – nut & bolts, rivets, weather proofing etc.

17.30 Sheet Metal Ducting

i. Ducting (Site fabricated)

- a. The scope of this section comprises supply fabrication, installation and testing of all sheet metal ducts. It may be noted, the specification for Site fabricated ducting & Factory fabricated ducting are though separate, they shall be considered complimentary to each other w.r.t. Quality / good engineering practices.

- b. Ducts shall be of Galvanised Iron 20/22/24 gauge and min.18 gauge for plenum box as per IS: 655 and Galvanised Iron coating thickness shall be as per latest editions of IS: 277.
- c. All ducting work shall be strictly reinforced to prevent sagging buckling & vibration, as per IS: 655 or better.
- d. All joints shall be flanged.
- e. For proper air distribution in the premises, supply air grilles & diffusers shall be provided with volume control dampers.
- f. Backflow dampers shall also be provided wherever necessary on the discharge side to prevent back-flow.
- g. All the ducting shall be properly supported to the building structures.
- h. Thickness of the GI sheets for supply air diffusers and dampers shall be min. 20/22 G.
- i. Straight ducts shall be fabricated in segments of maximum 3 m length. The ducts shall have flanged ends & shall have drilled holes for connecting up by bolts.
- j. Bolt holes shall be drilled at a linear distance of 100 to 150 mm centre to centre.
- k. Rubber gaskets of minimum 3 mm thickness shall be used to join the duct segments.
- l. All joints shall be airtight.
- m. Bends & elbows shall have a bend turning radius not less than 1 to 1.5 times depth of rectangular duct.
- n. Angle bends of 30, 45 & 60 degree shall be used as far as possible.
- o. Ducts shall be suitably supported from wall / ceiling by brackets / hanger rods, using grip bolts or from structural beams / members. Maximum unsupported length of duct shall not be more than 3.0 meters.

The velocities in the duct shall be as follows:

Description	Air velocity for Ventilation systems	Air velocity for Air Conditioning systems
Main Duct	8 – 10 m/sec	6 – 8 m/sc
Branch Ducts	6 – 8 m/sec	4 – 5 m /sec
Diffusers / grilles	4 - 6 m/sec	3 - 4 m/sec

- p. Measuring hatch shall be provided after the fan in the ducting network at convenient locations for measurement of air quantity.
- q. The design of the ducting for supplying, conditioned air to different premises shall be a balanced one. Balancing shall be achieved by providing suitable volume control dampers in the Main & branch supply air / return air ducts.

ii. **Ducting (Factory fabricated)**

a. **Governing Standards**

The construction, erection, testing and performance of the ducting system shall conform to the SMACNA-1995 standards (“HVAC Duct Construction Standards – Metal and Flexible – Second Edition – 1995”-SMACNA).

b. **Ducting – Raw material**

- (i) All ducting shall be fabricated of LFQ (Lock Forming Quality) grade prime G.I. raw material furnished with accompanying Mill Test Certificates.
- (ii) Galvanising shall be as per IS:277. The samples of raw material shall be selected at random & subject to approval and tested for thickness and zinc coating.
- (iii) The G.I. raw material should be used in coil-form (instead of sheets) so as to limit the longitudinal joints at the edges only irrespective of cross-section dimensions.

c. **Duct Connectors and Accessories**

All transverse duct connectors (flanges/cleats) and accessories/related hardware are such as support systems, shall be zinc-coated (galvanized).

d. **Fabrication Standards**

All ductwork including straight sections, tapers, elbows, branches, show pieces, collars, terminal boxes and other transformation pieces must be factory-fabricated or equivalent Technology. Equivalency will require fabrication by utilizing the following machines and processes to provide the requisite quality of ducts and speed of supply:

- (i) Coil lines to ensure location of longitudinal seams at corners/folded edges only to obtain the required duct rigidity and low leakage characteristics. No longitudinal seams permitted along any face side of the duct.
- (ii) All ducts, transformation pieces and fittings to be made on CNC profile cutters for required accuracy of dimensions, location and dimensions of notches at the folding lines.
- (iii) All edges to be machine treated using lock formers, flangers and roller for turning up edges.
- (iv) Sealant dispensing equipment for applying built-in sealant in Pittsburgh lock where sealing of longitudinal joints is specified / required.

e. **Selection of GI gauge and Transverse Connectors**

- (i) Duct Construction shall be in compliance with 1” (250 Pa) w.g. static norms as per SMACNA
- (ii) All transverse connectors shall be the branded 4-bolt slip-on flange system (supplied by OEM) with built-in sealant.
- (iii) The specific class of transverse connector and duct gauge for a given duct dimensions shall be as per SMACNA - Sheet Metal and Air conditioning Contractors’ National Association Inc- “HVAC Duct Construction Standards- Metal and Flexible”-1995, U.S.A.

- (iv) Non-toxic, AC-applications grade P.E. or PVC Gasketing is required between all mating branded flanged joints. Gasket sizes should conform to flange manufacturer's specification.

f. Duct Construction

- (i) The fabricated duct dimensions should be as per approved drawings and all connecting sections are dimensionally matched to avoid any gaps.
- (ii) Dimensional Tolerances: All fabricated dimensions will be within $\pm 1.0\text{mm}$ of specified dimension. To obtain required perpendicularity, permissible diagonal tolerances shall be $\pm 1.0\text{ mm}$ per metre.
- (iii) Each and every duct pieces should be identified by color-coded sticker, which shows specific part numbers, job name, drawing number, duct sizes and gauge.
- (iv) Ducts shall be straight and smooth on the inside. Longitudinal seams shall be airtight and at corners only, which shall be either Pittsburgh or Snap Button Punch as per SMACNA practice, to ensure air tightness
- (v) Changes in dimensions and shape of ducts shall be gradual (between 1:4 and 1:7). Turning vanes or air splitters shall be installed in all bends and duct collars designed to permit the air to make the turn without appreciable turbulence.
- (vi) Plenums shall be shop/factory fabricated panel type and assembled at site.
- (vii) The deflection of transverse joints should be within specified limit for rectangular duct deflection as given in SMACNA.
- (viii) Reinforcement of ducts shall be achieved by either cross breaking or straight beading depending on length of ducts as per SMACNA.

iii. Support system

- A completely galvanized system consisting of fully threaded rods, slotted angles or double-L bottom brackets (made out of 3.0 mm M.S. sheet) nuts, washers and anchor bolts generally conforming to SMACNA standards should be used.
- Support for Horizontal - Rectangular duct

S. No.	Max. Duct Size (mm)	Hanger Rod Diameter	Interval (mm)
1	Upto - 700	6 mm	2400
2	701 - 1200	8 mm	2400
3	1201 - 2000	10 mm	2400
4	Above 2000	12 mm	2400

- As an alternative, slotted galvanized brackets attached to the top two bolts of may also be used as appropriate for the site condition.
- To provide the required thermal brake effect, Neoprene or equivalent material of suitable thickness shall be used between duct supports and duct profiles in all supply air ducts not enclosed by return air plenums.

iv. Installation -Tools and tackles for site work

The duct installation shall conform to SMACNA norms. For duct assembly and installation the use of suitable tools and tackles should be used to give the required duct quality and speed of installation including (but not restricted to)

- Electric Pittsburgh Seamer – used for closing Pittsburgh joints
- Electric Slitting shear – to make cut-outs
- Drilling machine with drill bits – for drilling holes in sheet metal work
- Hammer drill machine with drill bits – for drilling holes in building structures for anchors
- Hoisting system – for lifting the duct assembly upto mounting heights

v. Testing

After duct installation, a part of duct section (approximately 5 % of total ductwork) may be selected at random and tested for leakage. The procedure for leak testing should be followed as per SMACNA - “HVAC Air Duct Leakage Test Manual” (First Edition)

17.31 Supply Grilles / Diffusers (with VCD)

- a. Supply air grilles along with volume control dampers (VCD) shall be used for distribution of air into the premises and shall be mounted on duct collars.
- b. GI sheet not less than duct thickness shall be used for the manufacture of grills. All grills shall be true to shape and shall be checked with level gauge before being secured in position. No distortion or wrapping is permitted.
- c. Supply air grills shall be fitted with built-in louvers as per manufacturer’s standard design. The grill shall be operated with an easily accessible lever to direct and control the air (to fully closed position also). The volume and direction control dampers shall be designed for smooth operation.
- d. Air distribution grills / diffusers shall be preferably of square - Anodised aluminium, powder coated of size 300 / 400 / 500 mm.
- e. All duct mounted grills shall be complete with rubber gaskets and flanged holding frames of suitable design for the intended installation. They shall be mounted on collar extending from the duct. No part of grills shall project into the main duct. Wall / vertical mounted supply grills shall have one set of adjustable louvers. The front of louvers shall be of horizontal type to adjust vertical deflection.
- f. Air distribution diffusers / grilles shall offer a pleasing appearance and be of Anodised aluminium, Powder coated to match the F/C & internals. The diffusers shall also be provided with adjustable dampers. Return air can be collected above the false ceiling through - return air linear grills at the perimeter of premises.

17.32 Volume Control Dampers

- a) Volume control damper shall be provided to regulate the airflow in duct branches.
- b) The volume control damper for rectangular duct shall be multi-leaf, opposed acting, aerofoil blade type with external operating link and operating mechanism.
- c) Size of the volume control damper shall be as per duct sizes.
- d) Volume control damper shall have flanges at both ends to connect – up with the ducts.

17.33 Fresh Air Filter at Package AC / AHU Room

- b. Fresh Air filter shall comprise of Pre-filters with damper, cowl, bird screen & mounting frame.
- c. Size of filter panel shall be preferably of standard size - 610 x 610 x 50 / 150 mm thick for Pre filter.
- d. Pre-filter shall be of 3 ply HDPE panel type with efficiency of 90% down to 10 microns.
- e. Velocity of air across the filter shall be in the range of 2.0 - 2.5 m / sec.
- f. Filter panel shall be cleanable and washable type for reuse.
- g. Cleaning efficiency of the Pre filter element shall be 90% down to 10-micron size of dust particles.
- h. Filter material shall be enclosed in a sheet metal framework. Filter frame shall be fabricated from 16 G M.S sheet in welded construction. All leakage areas shall be sealed with suitable sealing compound.
- i. Proper sealing shall be ensured to prevent leakage of air between mounting frame and filter panels.

17.34 Solenoid / Motor Operated Fire Damper

These dampers shall be provided on the supply air duct & on return air path / duct to isolate the served premises in case of fire. Operation of these Dampers as well as the Fan Motors is to be interlinked with the Plant's Fire / smoke detection system - to switch off in case of Fire.

17.35 Thermal Insulation of Duct

Thermal insulation of supply & return air ducts shall be provided with fire retardant quality Closed cell Nitrile Rubber (class 'O') or closed cell Polyolefin foam of thickness not less than 19 mm & 32.0 mm for return and supply air ducting respectively. The insulation material density shall not be less than 25 kg/m³ and the same shall be factory fabricated pre-laminated with Al. foil on one side and seal the joints by means of aluminium foil self-adhesive tape. Calculation for arriving at the thickness of insulation shall be provided for reference.

17.36 Acoustic Insulation of Duct

The acoustic insulation for plenums & 5.0 m from initial portion for ducts shall be carried out with open cell nitrile rubber / open cell polyolefin foam thickness not less than 25 mm and

density not less than 25 kg/m³ and should be fixed inside the ducts as per manufacture instruction.

17.37 Under-Deck Insulation of Exposed Roof

Under deck insulation shall be provided for the exposed roof of Air-conditioning premises.

The Under-deck insulation shall be carried out as per the following description: -

- b. Fix MS cleat made out of 50 x 50 x 3mm MS flat to the underside of the slab at 600 mm centre to centre using MS dash fasteners of size M6 x 40 mm long.
- c. Fix cross linked polyethylene foam (XLPE) of density 35 kg/m³ TF quality PUF / 48 kg/m³, 50 mm thick with aluminium foil 0.03 mm laminated on one side on to the open bed made out of 22 SWG GI wire with aluminium foil lamination facing the floor.
- d. Fix GI wire netting of size ½” x 22 SWG on to the MS cleats ensuring proper contact of insulation with ceiling.

17.38 Acoustic Insulation of AC / PAC room walls

Suitable acoustic insulation shall be carried out for PAC / Fan / AHU Rooms which are located near to Office / conference Rooms. Details of acoustic treatment of such premises shall be discussed and finalized at the detailed design of the system during the execution.

17.39 List of Preferred Makes

Sl. No.	Item Description	Preferred Makes
1.	Water Cooled Packaged Screw chiller	Blue star, Carrier, Trane, York, Voltas, Kirloskar, Duham-bush, Hitachi. Daikin, Climaveneta, LG
2.	Centrifugal Pumps	Armstrong, Beacon weir, Grundfos, Mather & Platt, KSB, Kirloskar, Sulzer, Ebara, Flow serve, Crawley & Ray, Johnson, Maxflow, Voltas, Xylem, Wilo, Sintech Precision products, Bareja Pumps, Viraj Electricals, Process Pumps, Flow more
3.	Cooling Towers	Paharpur, Mihir, Himgiri, Advance, Gammon India, Southern Cooling Tower, Shri Ram Tower Tech, Bell, Roos Tempkool
4.	Centrifugal fans for Ventilation	CB Doctor, EFE, Flow Link, Rieco, Howden, Reitz, Accel, Dustven, Patel Airflow, NADI, Pasko Engg. Pvt. Ltd., Scintillant Projects, Soil & Enviro Industries, FMI, Aerocon Corp, TLT, Laxmi Engg., S.K. Systems, Suvidha Air Engineers, FMI, Max flow fans, Flakt, S H Engineering, Advance Ventilation, Witt India, Kruger, System air

Sl. No.	Item Description	Preferred Makes
		<u>FOR AHU FANS:</u> Nicotra, Kruger, COMFERÉ, Ruskin Titus, Flakt Group
5.	Tube axial fans / Propeller Fans / Cabinet fan	CB Doctor, Flow Link, Almonard, Accel, Khaitan, Aerovent, ISEL, Marathon, LM Engg., Suburban Industrial works, Patel airflow, Pasko Engg. Pvt. Ltd., Scintillant Projects, Turboflow, Indvent fans, Aerocon Corp, Laxmi Engg., SH Engineering, Air Technikon, C. Doctor, Dustven, NADI, Flakt, EFE, SK System, Advance Ventilation, FMI, Witt India, Andrew Yule, System air, Kruger, Marut Air
6.	Panel filter for air (Pre-filter / Fine-filter)	FMI, Cadillac, Filtec (India), AAF, Spectrum Filtration, Anfilco, APC Air Systems, Andrew Yule, Dyna, C.B Doctor, SK System, EFE, Puromatic, Camfil, Trijama, Thema dyne, Klenzaid, Aerosol
7.	Split Type Air conditioner	Blue Star, Carrier, Hitachi, Voltas, Zamil, Daikin, LG, Samsung, Aircon
8.	Air handling units	Voltas, Blue Star, Suvidha, Carrier, Caryaire, Zeco, Airflow, Edgetech, ETA Engg. pvt. Ltd., Zamil, Ethos, Flakt Group, VTS, Citizen, DRI
9.	Duct Thermal & Acoustic insulation / AHU Rooms acoustic insulation, under-deck insulation	U.P.Twiga, Rockwool India, Lloyds, Owens Corning, Bakelite, Hylam, Beardshell, Malanpur Entech, ALP Aeroflex, Armacell, K-Flex, Polybond Insulation, Thermobreak, Paramount
10.	MS Pipes	Tata, GST, ITC, Jindal, The Indian Seamless and Metal Tubes, Maharashtra Seamless Ltd., SAIL Rourkela, Kalyani Seamless, Zenith, Zeco or Equivalent
11.	Pipe Insulation	Beardshell, Lloyds, Bakelite, Hylam, Paramount, Armacell, K-Flex, Superlon, Malanpur Entech, Polybond Insulation, FGP, UP Twigs, Rockwool India, Jayashree Insulators, ALP Aeroflex, Armaflex, Zenith, Zeco or Equivalent
12.	PVC Pipe & Fittings	Finolex, Oriplast, Bharat pipe & fittings, Supreme Industry, EPP Composites, Astral
13.	Coupling	Bibby (Wellman), Fenner, GBM
14.	Bearing	SKF, FAG, TATA
15.	GI / SS Sheets for duct	Jindal, SAIL, TATA, Bhushan, Ispat or Equivalent
16.	Vibration isolators	DUNLOP, EMERALD, GERB, GETZNER
17.	Grilles / Diffusers / Fire (Motorized) Dampers / VCD / Louvers	Ravistar, Dynacraft, Cosmos, Airflow, Caryaire, Airmaster, System Air, Ruskin Titus, Greenheck, Southern Cogen, Aquaflex, Vedha, Entech or equivalent
18.	Actuators	Siemens, Belimo, Honeywell, Johnson Control

Sl. No.	Item Description	Preferred Makes
19.	Fabricated Duct	Rolastar, Camduct, Ductmaster, Western Air Duct, ZECO, Vedha Entech, Radiant, Nutech, Spiro, Saiductfab, Ravistar, Ruskin Titus
20.	Strip Heater / Pan Humidifier	Alco Heating, Das Pass, Rapid Control
21.	3 way / 2-way Control Valve / Differential Pressure Control valve	Honeywell, Johnson Controls, Siemens, Advance, Sauter, Belimo, Danfoss, Flowcon, or Equivalent
22.	Globe / Gate / Ball / Check Valves	L&T, Audco, IVC, Intervolve, KBL, Advance, Fouress, BDK, Honeywell or Equivalent
23.	Butterfly Valves	Fouress, BDK, Intervolve, Audco, Advance, L&T, Honeywell or Equivalent
24.	Balancing Valve	Honeywell, Advance, Castle, FlowCon, Audco or Equivalent
25.	Float Valve	Leader Engineering, IVC, Levcon, Shiva Durga
26.	Automatic Air Vent	Anergy, Rapid Control or equivalent
27.	Y – Strainers / Pot Strainer	Honeywell, Emerald, Leader, Sant
28.	AHU Controller and associated instruments with interfacing	Johnson & Control, Honeywell, Siemens, Race, Schneider, Danfoss, Trane, Sauter or Equivalent
29.	Temperature / Pressure gauges	Ashcroft, Tedington, A. N. Instruments, Mass, Warea
30.	Expansion Bellow	Flexican, Flexatherm, SUR Ind., GBM Mfg., TI Flexible Tube, Madras Hydraulics, Lonestar, Anup industries, Indo Thai flexible tubes, Cori, Easy flex
31.	LT Panels (MCC / VVFD / HVAC Panels)	ABB, Siemens, Schneider, L&T, C&S, BCH
32.	Motors	ABB, Siemens, CGL, Bharat Bijlee, Kirloskar
33.	Local Push Button Station	BLEP/Flexpro/Flameproof Equipment / Pushtion / L&T / ABB / SIEMENS
34.	1.1 kV PVC/XLPE Cable (Power & Control)	Universal / Polycab / Finecab / Crystal / KEI / KEC / GEMSCAB
35.	Cable Trays & supports	Advance Power Product, India Electricals Syndicate, Rabi Engg. Works, Ratan Project & Engg. Co, Tecno Fab Manufacturing, Unitech Fabricator & Engineering, Mahavir Engg, GS Engineers

18. ELEVATORS

1. SCOPE

The scope of work covers Design supply, installation, testing, commissioning and handing over of the elevators meeting the intents of the tender specifications. Elevators may be with a machine room or without it.

The scope of work shall also cover the responsibility to obtain necessary approvals and License to operate from the appropriate local authority.

2. CODES & STANDARDS

Design of elevator components, their installation and operation shall meet with:

- IS 1860 :1968 Code of practice for installation, operation and maintenance of electric passenger and goods lifts.
- IS 4666:1980 Specification for electric passenger and goods lifts.
- Indian Electricity Act 1910 and Indian Electricity Rules 1956.

All codes and standards referred herein mean the latest and any work to alternate codes or practice shall be specifically stipulated by the tenderer citing the variations for acceptance by BEML.

3. HOISTWAY

A clear hoist way with gate openings or holes will be provided. No additional structural supports, members shall be provided in the hoist way for mounting of the traction motor in the case of machine room less elevators. The contractor shall use shear-type fasteners of adequate size to derive supports for all his requirements. During construction, to ensure verticality, straightness and dimensional accuracy of the hoist way, Mivan shuttering to be used. The visit of supplier during construction of the hoist way is desired on intermittent basis to ensure hassle free installation of elevator.

In the case of elevators without machine room, the traction motor shall be mounted within the hoist way with necessary mounting frame.

Car and counter weight buffers shall be of spring type for speed up to 1.6mps and hydraulic for higher speeds, with necessary supporting channels and struts. The buffers shall be capable of with-standing twice the fully-loaded car and two times the counter weight at contract speed + 15% and the fully compressed buffer top shall be not less than 1.2 metre. from the bottom.

Car and counter weight guides shall be machine rolled mild steel T-section with smooth, sliding, tongued and grooved joints. The guide rails shall be continuous throughout the travel. The brackets for fixing the guide rails shall be of steel and spaced so that the deflection shall not exceed 5mm under normal operation. Brackets shall be designed to suit the clear hoist way with necessary supporting structures.

Counter weight shall be made up of cast iron enclosed in a steel frame. Counterweight shall be car-weight plus 40% of contract load or any other value providing smooth and economic operation. Counterweights shall be provided with necessary guards at the bottom of the hoist way for at least 1.8 m.

All hoist way materials shall be non-flammable and Traveling cables shall be rendered flame resistant with suitable cladding.

4. ELEVATOR ENTRANCES

Entrances shall be centre opening or two speed with jamb openings. Entrances shall be complete with necessary frames, doors, sills, fascia, toe guards, dust covers, headers, hanger tracks, cover plates and all other hardware.

Doors for elevators shall consist of hollow metal panels pressed out sheet stainless steel adequately reinforced to form a rigid assembly and acoustically treated, so that noise transmission to corridors is not more than 20 dB on all octave bands. Doors shall have safety retracting shoes. Doors shall be of stainless steel.

Each door shall have integral hangers with balanced point of suspension. Main and up-thrust rollers shall have neoprene or any other suitable tyres and be mounted on factory lubricated ball bearings for smooth and noiseless operation. Roller tracks shall preferably be integral with the header assembly. Each door leaf shall be fitted with bottom Teflon/nylon stabilizers.

Frames, fascia, hanger and dust covers and toe guards shall be of not less than 12 mm sheet steel. Sills shall be of extruded aluminium with necessary non-slip grooves. The entire door assembly shall be fire-resistant for not less than 1.5 hrs.

Frames and other exposed parts shall have a baked enamel finish of approved colour. All sheet steel members shall receive a suitable treatment for rust inhibition before receiving the after-coats of primer, filler and paint. Unexposed structural members shall be provided with necessary shop coats and one field coat of paint. Final colour and finish selection for the car rests with the BHEL and no work shall be carried out until written instructions are issued.

5. CAR

Car frame supporting the car platform and enclosure shall be made of structural steel with isolating rubber cushion. Platform deflection shall not exceed 3 mm under maximum loading conditions. Car shall be complete with:

1. Wiring for lighting up to 1000 watts incandescent/fluorescent/LED.
2. Centrifugal Blower fan selected specially for noiseless operation.
3. Stainless steel car operating panel
4. Non-slip extruded aluminium threshold plate.
5. Interphone with an ear set microphone and speaker and the trailing cables shall be included.
 - a) 4 pair 14/0076 music cable.
 - b) 4 pair 0.5 Dia Cat.3 cable

All pairs shall be twisted

6. Emergency lighting & alarm with necessary battery for 30 minutes complete with battery, charger etc.
7. An overload gauge feature which defeats the operating circuit when the car load reaches 110% of contract load.

All wiring for (5) (6) & (7) shall be provided as part of the traveling cables.

Car size shall be as per the relevant IS standards.

The car interior shall be according to the Interior design and the car shall be designed to take a marble or granite flooring.

The car operating panel shall have the following devices:

- i. Hall buttons corresponding to the landings serviced.
- ii. Up and down direction indicators
- iii. Emergency stop switch
- iv. Alarm button connected to an alarm bell situated on the ground floor complete with wiring.
- v. Key-operated selector switch for 'Attendant' and 'Automatic' operation.
- vi. Door 'open' and 'close' buttons
- vii. Fan switches
- viii. Key operated non-stop emergency switch
- ix. Handrail all around the car cabin
- x. P A System Mic.

All buttons shall be pushing self-illuminating type.

An alpha-numeric car position indicator shall be provided in each car. This should be digital type with announcement of floor.

Car doors shall be Centre opening hollow metal doors. Door construction, suspension etc. shall be as specified for entrance doors.

A key operated switch with up-down buttons and a 100W lamp shall be provided for testing on top of the car.

6. DOOR OPERATOR FOR AUTOMATIC DOORS

Door operator shall be electric driven and shall work through a low-speed gear reducer. Operator shall provide smooth, quiet and positive operation of the car and hoist way doors simultaneously driving them to fully opened or fully closed positions. Doors shall be smoothly brought to rest at the end of travel by a rotary type hydraulic cushioning device. An adjustable timing device shall hold the door open for a set time interval after a stop is made except when the ultra-red monitor over-rides. An Infrared monitor shall be incorporated to initiate door closing 2 seconds after last beam interruption. This is over and above the mechanical retracting shoes.

Door operator shall have the following safety interlocks:

- i. Only the door at the landing where the car is stopping can be opened and no other hoist way door.
- ii. Car cannot move when the car or hoist way door is open.
- iii. During emergencies, car and hoist way doors shall be capable of being opened from outside.

For other safety devices refer section on 'Safety Devices.'

7. SIGNALS

Hall buttons shall have car direction lights which will remain illuminated when the call is registered and shall remain so, until the call is answered.

Car position indicator at each landing shall be incorporated for each elevator. These should be alpha-numeric electronic display with up-down arrows and a gong. Also lift location Panel on all floors.

All fixtures shall be of stainless steel and shall be approved by the Project Manager.

8. ROPES & SHEAVES

The suspension ropes shall be of special acid proof quality steel or high-grade traction steel of

suitable size, construction and number specially designed for lift duty, having a factor of safety at least equal to that specified in IS: 2365: 1977 or approved equivalent standard. Approved means of attaching the ropes to the car and counterweight shall be provided for each rope and all ropes anchored to a winding drum shall have not less than one complete turn of the ropes on the winding drum when extreme limits of travel are reached.

Governor ropes shall be of steel.

Tests shall be carried out at the manufacturer's works to ascertain that the ropes comply with the appropriate code or standard and test certificates shall be submitted for approval prior to shipment.

The traction sheave shall be made from close grained cast iron of the proper hardness accurately grooved for the proper number and size of hoisting ropes and shall be designed to give constant traction and long rope life. All deflector sheaves necessary to obtain proper lead of the ropes shall be provided and shall have similar construction to the traction sheaves.

A guard extending below the machine level shall be provided underneath the deflector and secondary sheaves.

9. ELEVATOR MACHINE

Machine shall be gearless traction type with necessary drive A.C motor, brake assembly, shaft sheave, all mounted on a common base. Motor shall be heavy duty, reversible type particularly designed for elevator service. Drive motors shall be selected for high starting torque and low starting current. All drive motors shall be rated for not less than 150 starts per hour.

The drive system shall operate on electronically computed acceleration and deceleration references through a microprocessor for achieving maximum inter floor speeds while providing consistently smooth ride and accurate stopping. The starting current shall be not more than 2.5 times the normal current. The processor shall control the drive motor speed through pre-calculated acceleration and deceleration references for achieving smooth rides. Levelling shall be through distance dependent speed reference to achieve the specified levelling criteria. The controller should achieve maximum interfloor speeds.

A spring applied and electrically released brake assembly with non-asbestos lining shall be provided on the drive shaft. A cranking device for manual operation of elevator car shall also be provided to meet emergencies together with manual break release. The manual break release and cranking device upon application shall automatically interrupt power supply. Wherever specified, a battery-operated emergency landing facility shall be provided.

A micro-levelling feature shall be incorporated. Micro levelling shall correct for over- travel, under travel and rope stretch, within its zone independently of the operating device. Car levelling at each landing shall not exceed ± 4 mm with or without load and down or upward travel.

In the case of elevators without machine rooms, the traction machine shall be fitted within the hoist way and the break-release mechanism shall be operable from the last landing without entering into the hoist way.

10. CONTROLLER

The lift controller shall be vertical, totally enclosed cubicle constructed of sheet steel with hinged doors on the front and screwed panels or hinged doors on the back, giving easy access to all components inside the controller. The cubicle enclosure shall be minimum of IP 22.

The controller shall have a microprocessor with solid state switching devices sequenced and interlocked. All operations shall be software controlled with facility for interfacing with the building Fire Alarm System and Building Management System. Necessary protocols shall be made available for integration into the Building Management System. The controller shall operate within the supply voltage fluctuations specified and shall incorporate necessary input voltage stabilizers. The system shall have proven reliability.

In the case of machine room less elevators, the controller should be located such that it can be easily accessed from the last landing and shall be key locked and vandal proof.

The controller shall provide protection against the following:

- a) No-voltage or sustained under voltage
- b) Over current in any component
- c) Phase reversal of the power supply
- d) Overload
- e) Single phasing

The controller shall be arranged to cut-off the power supply, apply the brake and bring the car to rest at the nearest landing in the event any of the above failures occur.

Remote car position indicating panel shall be provided on each floor.

Latest version of controller and its software shall have to be provided.

11. SAFETY DEVICES

An automatic stopping device shall stop the car at the terminal landing independent of the regular operating device. In the event, the car travels beyond the zone of the above stopping device, the final limit switches in the hoist way should arrange to stop the car and also prevent normal operation until reset.

A mechanical safety shall be mounted on the car frame and should actuate the fly ball governor gear which shall cause the following:

- a) Disconnect power to elevator machine
- b) Apply the main brake
- c) Apply the guide rail safety jaws

The safety gear shall be manually reset.

Retractable safety shoes shall be provided on the car & hoist way doors together with an infra-red scanner. (Curtain full ht.)

An emergency stop switch in the elevator pit shall be provided to stop the car.

A battery-operated emergency landing facility shall be provided. This facility shall bring each elevator to the nearest landing and keep the car and hoist way doors open. In the case of

multiple elevators, the batteries shall be adequately powered to bring all the elevators to the nearest landing in an orderly sequence (Auto Rescue device).

SN	PARTICULARS	ELEVATORS		
		Passenger	Passenger	Service
1	No. of Elevators	4	1	1
2	Capacity	20 Passenger	15 Passenger	1.5 Tonnes
3	Speed	1.5 m/sec	1.5 m/sec	0.5 m/sec
4	Drive	A.C. VVVF	A.C. VVVF	A.C. VVVF
5	Location of M/c room	Machine room less	Machine room less	Machine room less
6	Travel	Approx. 21 metres	Approx. 21-metre	Approx. 21-metre
7	Serving	G+5	G+5	G+5
8	No. of stops	5	5	5
9	Power supply	415V, 3 Phase 50 Cycles AC	415V, 3 Phase 50 Cycles AC	415V, 3 Phase 50 Cycles AC
10	Auxiliary	Single Phase 220V 50 Cycles AC	Single Phase 220V 50 Cycles AC	Single Phase 220V 50 Cycles AC
11	Available car area	As per relevant IS standards	As per relevant IS standards	As per relevant IS standards
12	Available pit depth	1.8 metres	1.8 metres	1.8 metres
13	Available overhead	4.8 metres	4.8 metres	4.8 metres
14	Available Hoist way size	2450 x 2550 mm	3050 x 1850 mm	2450 x 2550 mm
15	Car Enclosures			
a	Car ceiling	Stainless steel 304	Stainless steel 304	MS painted finish
b	Car panels	Stainless steel 304 (1mm Thickness)	Stainless steel 304 (1mm Thickness)	MS painted finish (1mm Thickness)
c	Car flooring	25 mm Recess in Platform with Italian flooring	25 mm Recess in Platform with Italian flooring	25 mm Recess in Platform with Granite flooring
d	Lighting	LED	LED	LED
16	No. of entrances	Single entrance	Single entrance	Single entrance
17	Car entrance	Automatic Centre Opening Power Doors in SS 304	Automatic Centre Opening Power Doors in SS 304	Automatic Centre Opening Power Doors in MS painted finish
18	Door safety	Full Screen Infra-Red Protection	Full Screen Infra-Red Protection	Full Screen Infra-Red Protection

19	Landing entrance	Automatic Centre Opening Power Doors in SS 304	Automatic Centre Opening Power Doors in SS 304	Automatic Centre Opening Power Doors in MS painted finish
20	Clear opening	1.0 mt (W) x 2.1 mt (H)	1.0 mt (W) x 2.1 mt (H)	1.1 mt (W) x 2.1 mt (H)
21	Control system	Microprocessor Based Duplex selective collective control operation with or without attendant	Microprocessor Based Duplex selective collective control operation with or without attendant	Microprocessor Based Simplex control operation with or without attendant

22	Operating & signal fixtures			
a		Motion Hall Button with Led Illumination at All Floors	Motion Hall Button with Led Illumination at All Floors	Motion Hall Button with Led Illumination at All Floors
b		Digital Hall Position at all Floors	Digital Hall Position at all Floors	Digital Hall Position at all Floors
c		Car Operating Panel with Motion Led Illuminated Floor Buttons with Built in Digital Car Position Indicator	Car Operating Panel with Motion Led Illuminated Floor Buttons with Built in Digital Car Position Indicator	Car Operating Panel with Motion Led Illuminated Floor Buttons with Built in Digital Car Position Indicator
d		Intercommunication	Intercommunication	Intercommunication
e		Extra Leeds in Traveling Cables for Music System	Extra Leeds in Traveling Cables for Music System	Extra Leeds in Traveling Cables for Music System
f		Fireman's Switch at The Main Lobby	Fireman's Switch at The Main Lobby	Fireman's Switch at The Main Lobby
23	Control specifications			
a	Door operator	Automatic with Power Operated Door	Automatic with Power Operated Door	Automatic with Power Operated Door
b	Operating Device	Single Call Push Button at each level, Floor Buttons, Door Open / Close Buttons, Emergency Stop Control, Integral Interphone, Fire Man's Switch	Single Call Push Button at each level, Floor Buttons, Door Open / Close Buttons, Emergency Stop Control, Integral Interphone, Fire Man's Switch	Single Call Push Button at each level, Floor Buttons, Door Open / Close Buttons, Emergency Stop Control, Integral Interphone, Fire Man's Switch

c	Indicator	Digital Car Position Indicator and Illuminated Direction Arrows in Car and all landings, Pre-Announcing Gong at all Landings.	Digital Car Position Indicator and Illuminated Direction Arrows in Car and all landings, Pre-Announcing Gong at all Landings.	Digital Car Position Indicator and Illuminated Direction Arrows in Car and all landings, Pre-Announcing Gong at all Landings.
d	Alarm Bell	Battery Operated Alarm Bell and Emergency Light	Battery Operated Alarm Bell and Emergency Light	Battery Operated Alarm Bell and Emergency Light
e	Indicator	Overload Warning Indicator	Overload Warning Indicator	Overload Warning Indicator
f	Others	Automatic Rescue Device, Variable Door Time, Auto fan off, Voltage stabilizer for controller, Car Door Lock, Braille Buttons, Manual Rescue Device	Automatic Rescue Device, Variable Door Time, Auto fan off, Voltage stabilizer for controller, Car Door Lock, Braille Buttons, Manual Rescue Device	Automatic Rescue Device, Variable Door Time, Auto fan off, Voltage stabilizer for controller, Car Door Lock, Braille Buttons, Manual Rescue Device

20. SEWAGE TREATMENT PLANT

Design, engineering, construction, supply, installation, testing and commissioning of 100 KLD STP based on MBR technology complete with electro-mechanical works necessary equipment, interconnecting piping network etc.

SECTION-1: - PREAMBLE

General

The main source of wastewater to be treated shall be resulting from factory floor washing, cleaning and leakage test of coaches, kitchen waste water and waste water coming out from washrooms/Toilets. The scope of work includes design, engineering, preparation of drawings, getting approvals from statutory bodies, construction, erection, commissioning, trial run and obtaining test results of completely below ground sewage treatment plant with electrical, mechanical, piping and controls along with operation and maintenance for one year. The treated effluent should be fit to reuse for Flushing and Landscaping etc. The work is required to be carried out on a turnkey basis covering a guarantee of satisfactory performance as per the standards laid for a minimum period of One year.

BASIC DATA ON INFLUENT RAW WASTE WATER (SEWAGE): -

Following shall be the Parameters for design of Sewage Treatment Plant.

<u>TABLE-1</u>	
Parameters	Values
Daily Average Flow	100 M3 / Day
pH	6.0 - 8.5
BOD5	250 - 350 Mg/L
Total Suspended Solids	250 - 450 Mg/L
COD	500 - 700 Mg/L
Oil & Grease	up to 50 Mg/L
Inflow time	8 hrs.
Peak factor	3
Temperature	Ambient

Standards of the Sewerage Discharge after treatment shall be as follows:

As stipulated by State Pollution Control Board (PCB), the treated effluent quality shall be within the following values for various parameters.

Waste water after treatment below shall be suitable for recycling in flushing and landscaping.

<u>TABLE-2</u>	
<u>Parameters</u>	<u>Values</u>
Turbidity (NTU)	< 2
Total Suspended Solids	Less than 10 mg/L
pH	6.5 – 8.5
Temperature °C	Ambient
Oil & Grease	< 10 mg/L
Total Kjeldahl Nitrogen as N	10 mg/L
NH4-N	5 mg/L
BOD5	Less than 6 mg/L
COD	Less than 50 mg/L

Dissolved Phosphorous as TP	1 mg/L
Nitrate Nitrogen as N	10 mg/L
Faecal Coliform in 100 ml	Nil
Colour	Colourless
Odor	Aseptic which means not septic and no foul odour
TDS	2000

DESIGN CRITERIA: -

- The STP is designed on the basis of wastewater flow and quality parameters as mentioned above in Tables 1 & 2 Where the contractor to submit an offer for STP, these values shall form the design criteria for designs.
- The plant shall function in aerobic condition only. Formation of any anaerobic / septic condition in the bio-reactor shall not be allowed.
- The “Manual on sewerage and sewage treatment”, “Manual on water supply and treatment” and other relevant BIS / PCB / Ministry of environment publications shall be followed.

STATUTORY APPROVALS: -

On award of the work, contractor shall submit and obtain approval and permission from State Pollution control Board and any other statutory approval may be required for the installation and operation of the sewage treatment plant for the proposed process and disposal arrangement. The contractor shall make presentation and all submittals required by the authority.

On satisfactory completion of the works and commissioning of the plant and getting desired effluent results the contractor shall obtain the No Objection Certificate (NOC) from the authorities.

SECTION II: SCOPE OF WORK

The Scope of work includes Design, Engineering, Construction, Supply, Installation, Testing, Commissioning, trial run and handing over of Sewage Treatment Plant (STP), to give treated effluent quality as specified and in accordance with norms of central / State Pollution Control Board. The successful bidder is also to undertake operation & maintenance of the facility for a period of 5-years (1+4) from the date of signing of the handing over document of the facility through OEM after successful trial run and handing over of the plant out of which one year shall be covered under DLP and further four years shall be under AMC (Annual maintenance charge). Nothing shall be payable additionally on this account. The bidder is to take into account this aspect and quote accordingly. The EPC contractor would be required to deploy at least one operator per shift in all three shifts to take care of operation and maintenance of the

facility for a period of five years(5-years) as stated above. A separate and fresh performance BG of the amount equivalent to 10% of this line item (as per price break-up) is required to be submitted by the contractor after DLP and before start of AMC with validity of 4.5-years. During the period of DLMP (defect liability & maintenance period), cost incurred on consumables and replacement of defective parts, components etc., shall be the responsibility of the bidder for which no-additional payment will be made shall undertake day to day maintenance of the facility, consumables during this period shall be provided by the contractor at no additional cost.

The contractor will be solely responsible for smooth running of the sewage treatment plant and overall functioning of STP. In case it is found in the later stage that some additional fixtures / equipment is required to be added in order to achieve desired quality, the contractor would be liable to provide without any extra charges.

Following items are within the scope of contract. The basic flow diagram is attached herewith. The capacity of different tanks / units is indicative and for reference only. The successful contractor will be required to carry out detail design and submit the detailed Process and shop drawings incorporating various civil and equipment's details. These detailed drawings shall be vetted by BEML and approved drawings shall be released for construction submitted to the Client / Consultant for their comments & approval.

Vendor has to submit all the technical details for equipment's used for operation of plant for approval. All the works shall be carried out as per approved construction drawing only.

Vendor's scope includes Engineering of the System along with the detailed hydraulic calculations, chemical dosage calculations, including preparation of detailed equipment drawings, piping, electrical & instrumentation, and other items of work required for installation and commissioning of the plant.

- Complete civil works.
- Complete interconnecting piping between various units including supply of all materials like pipes, fittings, all valves, gaskets, flanges, nuts and bolts including all materials required for necessary pipe supports and associated civil works, etc., complete.
- Supply, erection and commissioning of all the equipment's required for the sewage treatment plant as per the 'individual equipment specification and details given.
- All electrical works including all electrical motors for the various equipment, cabling, LT panel, starters, etc., will be provided by the contractor The scope of work includes all civil works like construction of panel foundations, cable trenches, cable supports, lighting of entire plant as per drawing etc., complete Commissioning of all the equipment.
- The contractor has to mention in his offer, the details of electrical power requirements of the various equipment, total installed load and operational load.
- All temporary sheds, office, godowns, etc. required for storage of materials and for contractors' supervisory personnel at site.
- Scope of contract for piping includes construction of necessary masonry valve chambers wherever necessary, removable type MS painted covers and extension spindles for valves.
- The entire STP is proposed to construct below ground level. The contractor has to mention the minimum plant area required and total depth.

- Preparing shop drawings for the civil works / units related to the wastewater treatment plant for the work within the plant terminal points, the civil works will be constructed by another agency nominated by the Owner.
- Make of all piping/Equipment's/Motors/Cables and Pumps shall be clearly stated in the offer shall be got approved by the Client / Consultant before Supply & Installation. The decision of consultant in this regard shall be final and binding on the successful Contractor.
- All equipment GA drawings shall be submitted to the Client / Consultant for approval prior to fabrication/ ordering. The fabricated and brought-out equipment's shall be inspected at Contractor/Manufacturers workplace by the Client/Consultant at the cost of contractor and shall be dispatched to site only after obtaining clear dispatch instructions in writing from Client/Consultant.
- It is obligatory on the part of the intending bidder to visit the site of work prior to submitting the offer and familiarize himself with local / site / soil conditions, availability of men, Materials and Machinery for successful and timely execution of the works. No extra shall be paid in case Contractor fails to ascertain correct site conditions before submitting the offer.
- Any other item not specifically / mentioned in this tender but is essential for proper and successful completion commissioning and running of the STP for its commercial utilization is also to be included in the scope of contract.
- Main contractor has to ensure proper coordination between various groups working under them for establishing and running the plant successfully.
- Five years operation and maintenance (DLMP) will be included in the contract after trial run.
- Obtain No Objection Certificate (NOC) that the plant is meeting the State Pollution Board requirements

TEST / COMMISSIONING AND TRIAL RUNNING OF INDIVIDUAL COMPONENT

The Contractor shall have to test each equipment used for the plant for at least 72 hours continuous running with designed load and to the full satisfaction of the Client / Consultant. Any defects found, has to be rectified by the contractor at his own cost immediately and within reasonable time to be decided by client.

Necessary Instruments, Gauges, labour / Supervisory Staff, Laboratory analysis etc., are to be furnished / provided by the Contractor free of cost to client. Vendor has to specify the value-added services in his offer letter.

TESTS (SAMPLING & ANALYSIS OF TREATED WATER)

EPC contractor shall ensure deputation of OEM's plant operator in all three shifts to take care of operation and maintenance of plant meeting the desired parameter. During the DLMP period, the contractor has to undertake sampling of effluent on monthly basis and get it tested for specified parameters from NABL accredited lab. In case Laboratory Test Report do not reflect desired result, all necessary action followed by laboratory testing till satisfactory result will be the responsibility of the contractor.

Moreover pH, TSS & COD parameters should be checked & logged by the Vendor on daily basis.

COMMISSIONING AND TRIAL RUN OF PLANT AND HANDING OVER

After successful commissioning of the plant, the contractor shall trial run it for a period of one month. During trial runs as described above, the Contractor shall satisfy the Client / Consultant in all respects regarding the satisfactory quality of effluent, quality of materials, equipment's and workmanship used in the plant. Only after satisfying itself/ himself regarding the above points, client will take over the plant and such date of taking over shall be deemed as date of completion for all purposes, like guarantees, and payment terms mentioned elsewhere in this tender. The guarantee period described elsewhere in the tender shall start from the date of completion.

TRAINING OF OPERATOR

Vendor shall provide necessary training for operators nominated by BEML during commissioning & trial run period. After completion of training to the operators as nominated, the Vendor shall certify the operator's performance to carry over the plant maintenance and operation efficiently. The Contractor to provide 3 operators (1-in each shift) during commissioning stage as well for training purpose.

GUARANTEE

The under mentioned clauses shall govern in case of any contrary provisions given elsewhere in the document.

Manufacturer's Guarantees

The manufacturer's guarantee for design, workmanship and performance for all bought out items shall be made available to BEML and shall be valid at least for the entire defect's liability period.

In the event of failure of any particular equipment, which fails more than three times during the guarantee period as mentioned in clause below, the contractor shall replace at his own cost that equipment. Manufacturer's/Contractor's guarantee, as mentioned in clause above, for such replaced equipment shall also be made available to the Owner and should be kept at least for 'one year from the date of last replacement.

Performance Guarantee

The Contractor shall give guarantee for a period of one year from the date of successful commissioning and trial run of the treatment plant against design, defective materials, workmanship, performance and guaranteed effluent quality. In the event the commissioning of the plant is not possible due to non-availability of influent, contractor shall be issued mechanical completion certificate by client provided each equipment is tested satisfactorily as directed. However, the contractor shall have to maintain the plant at his own cost. In such a case for a period for three months beyond which period, if he is required to maintain further, he will be paid extra at mutually agreeable rate. However, the Contractor shall carry out testing, commissioning and trial run of the plant during the Defects Liability Period. Any defects found

in the workmanship, materials or performance of the plant shall be made good by the Contractor at his own expense within the time specified by client.

The contractor, if directed by the Client, shall at his own cost prove the Oxygenation capacity guaranteed by him for the diffusers provided by conducting Oxygenation capacity tests on the unit by any standard and internationally recognized method to be approved by the Consultants.

SECTION III: TECHNICAL SPECIFICATION

TREATMENT SCHEME: -

The treatment scheme shall be based on Membrane Bioreactor based Biological Treatment followed by UV System. The STP will consist of following stages:

1st Stage – Primary Treatment, which comprises of screening, oil and grease trap.

2nd Stage – Secondary or biological treatment, which comprises of Anoxic & Aeration Tank, MBR Tank equipped with submerged membrane.

3rd Stage – Disinfection, which comprises of UV System

4th Stage – Sludge Treatment, which comprises of Screw Pumps and Filter Press.

TREATMENT UNITS: -

Above Treatment Scheme shall comprises of the following units –

- 1) Bar Screen Chamber with Screen
- 2) Oil & Grease Chamber with Oil & Grease Separator
- 3) Equalization Tank
- 4) Air Blowers
- 5) Fine Screen
- 6) Anoxic Tank
- 7) MBR Module equipped with hollow fiber membranes
- 8) Permeate Suction Pump
- 9) Backwash Pump
- 10) Raw Sewage Transfer Pumps
- 11) Sludge Recycling Pumps
- 12) UV System
- 13) Treated Water Tank
- 14) Sludge Holding Tank
- 15) Screw Pumps with Filter Press

- 16) Piping & Cabling
- 17) Electrical Panel

PROCESS DESCRIPTION: -

Screening

The Sewage is led into a Bar Screen Chamber provided with SS Bar Screen. Bar screen shall be provided at inlet point in the bar screen chamber. Screen with openings generally of uniform size having 10 mm opening to remove suspended or floating matters in sewage to be provided. The velocity shall be maintained so as to avoid settling of grit or organic matter. Bar screen shall be so designed that it can be cleaned manually from outside of tank.

Oil & Grease Chamber

The raw sewage after passing through Bar Screen shall be taken into an oil & grease trap for removal of oil and grease from the effluent. Oil & Grease Separator also to be provided to separate oil & grease from the trap.

Equalization Tank

The Equalization Tank is provided to balance fluctuating flow and engineered to deliver a constant rate of flow to the treatment system. Aeration of Equalization Tank will be kept with adequate numbers of coarse air bubble air diffusers to avoid any smell and sedimentation problems. The raw sewage is pumped using submersible non-clog pumps of suitable capacity.

Anoxic Tank

The Anoxic Reactor will reduce the ammoniacal nitrogen by completing the de-nitrification reaction. The process involves the de-nitrification of waste streams through the use of bacteria which breaks down the nitrate in the waste to use as an oxygen source. This breakdown of nitrate from the waste stream release oxygen and nitrogen gas. The oxygen is consumed by the bacteria and the nitrogen gas releases to the atmosphere. The waste stream then has acceptable nitrogen levels as per the environment requirement.

MBR tank with submerged membrane bioreactor

The Sewage will be pumped to aeration tank which comprises fine pore diffusers and PVDF hollow Fiber submerged membrane. The efficiency of BOD removal is considered as between 90 – 97% in this bioreactor.

The MBR tank contains highly concentrated biomass, so called activated sludge, which transforms the organic matter of the wastewater into carbon dioxide, water and biomass. The activated sludge is kept in aerobic conditions at all times by continuous aeration.

The membranes come in stacks called cassettes. The cassettes are mounted on to a skid with an easy removal mechanism. The skid with the cassette construction ensures that the replacement costs for the membrane are kept to the minimum.

The filtrate from the MBR will be removed by MBR filtrate pumps. The suction of the pump is connected to the MBR filtrate headers in the skid. Return activated sludge pumps are provided in the MBR chamber to maintain the continuous circulation of the mixed liquor between the aeration tank and the MBR Chamber.

Permeate of membrane is further treated with UV System and stored in Treated Water Tank.

The excess sludge from the aeration tank will be taken out at regular intervals from the recirculation line. The sludge will be stored in sludge holding tank and then pumped through screw pump to filter press and solid cakes formed are carted out. Sludge cake should be stored in proper place as per the norms and guidelines.

DETAILS OF ELECTRICAL WORKS: -

GENERAL SPECIFICATION OF EQUIPMENT

- I. 1 NO. LT Panel, cubicle type suitable for floor mounting and comprising incoming power Control switch, Ammeters, Voltmeter, Phase Indicating Lamps MCBs and Starters for the feeders all complete. Also, to be provided are Automatic Level Controller for actuating the Raw Effluent / Treated effluent. Necessary Auto manual Selector Switches shall also be provided.
- II. Local push button starters shall also be provided near the Aerator equipment's and mounted in weatherproof enclosures.
- III. Necessary power wiring by armoured PVC Cables or by PVC insulated wire in conduit from LT Panel to equipment motors shall be provided with necessary tray/ support etc complete and internal lighting of entire DSTP Plant as shown in the drawing.
- IV. Necessary earthing as per I.E., rules.
- V. Lighting shall be as per IS requirements and fixtures shall be Philips make and the make and size of cables used should be approved from the Client / Consultant.
- VI. Energy meter (approved make) should be provided in the panel.
- VII. The switchboard shall be metal clad, totally enclosed, rigid, compartmentalized design, floor mounting, air insulated, extensible cubicle type for use on medium voltage power, 3 phases 4 wire 50 cycles system.
- VIII. The equipment shall be designed for operation in high ambient temperature and high humidity tropical atmospheric conditions. Means shall be provided to facilitate ease of inspection, cleaning and repairs for use in installations where continuity of operation is of prime importance.

STANDARDS

Following equipment's shall conform to the requirements of:

- a) Moulded Case Circuit Breaker (MCCB) - IS 13947 - 1, 2 / IEC 60947 - 1 & 2
- b) Miniature Circuit Breaker (MCB) - IS 8828 – 1996 / IEC 898 - 1995
- c) Contactors - IS 13947 - 1, 4
- d) Indicating Instrument - IS 1248

- e) Residual Current Circuit Breaker (RCCB) - IS 12640 - 1988 / IEC 1008
- f) HRC fuse link - IS 9224 and BS 8: 8
- g) Current Transformer - IS 2705 and IEC 185
- h) Potential Transformer - IS 3156
- i) Relay - IS 3231 & IS 8686 (For Static Relays)

CONSTRUCTION

1. The switchboard shall be-

- a) CRCA Sheet steel enclosed, indoor floor mounted freestanding cubicle type.
- b) Made up of the requisite vertical sections modular type which when coupled together shall form continuous switchboards.
- c) Dust, vermin and damp proof and enclosure protection not less than IP 52
- d) Each feeder / instrument compartment shall be provided with a hinged door interlocked with MCCB/SFU inside the compartment such that door can only be opened when MCCB/SFU in off position.
- e) Readily extendable as required by the addition of vertical sections after removal of the end covers.
- f) Switchboards shall have access to the feeders, bus bars, cable termination, cable alley, etc. as required.

2. Each vertical section shall comprise-

- a) A front-framed structure of rolled/folded CRCA sheet steel. angle section of minimum 3 mm thickness rigidly bolted together. This structure shall house the components contributing to the major weight of the equipment such as circuit breaker cassettes, fuse switch units, main horizontal bus bars, vertical risers and other front mounted accessories.
- b) The structure shall be mounted on a rigid base frame of folded CRCA sheet steel of minimum 6 mm thickness and 75 mm height. The design shall ensure that the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation.
- c) A cable chamber housing the cable end connections and power/control cable terminations. The design shall ensure generous availability of space for ease of installation and maintenance of cabling and adequate safety for working in one vertical/horizontal section without coming into accidental contact with live parts of the adjacent section.
- d) A cover plate at the top of the vertical section, provided with a ventilating hood where necessary. Any aperture for ventilation shall be covered with a perforated sheet having less than 1 mm diameter perforations to prevent entry of vermin.
- e) Front and rear doors fitted with dust excluding neoprene gaskets with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors generous overlap shall be ensured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

3. The total height of the panel shall not be more than 2300 mm unless otherwise specified and maximum height of switch operating handle shall not be more than 1800mm from FFL. The total depth of the panel shall be adequate to cater for proper cabling space.
4. Doors shall be of minimum 14-gauge sheet steel and covers/partitions of 16-gauge sheet steel. All sheet steel work forming the exterior of switchboards shall be smoothly finished, levelled and free from flaws. The corners should be rounded.
5. The Components in the switchboards shall be so arranged as to facilitate ease of operation and maintenance and at the same time to ensure necessary degree of safety.
6. Components forming part of the switchboards shall have the following minimum clearances:
Between phases - 32mm
Between phases and neutral - 26mm
Between phases and earth - 26mm
Between neutral and earth - 26mm
When, for any reason, the above clearances are not available, suitable insulation barrier / shielding shall be provided. Clearances shall be maintained during normal service conditions.
Creepage distances shall comply to those specified in relevant standards.
7. All insulating material used in the construction of the equipment shall be of non-hygroscopic material treated to withstand the effects of high humidity, high temperature and tropical ambient service conditions.
8. Functional units such as circuit breakers, fuse switches, MCCBs, etc. shall be arranged in multi-tier formation except that not more than two air circuit breakers shall be housed in a single vertical section.
9. Metallic/insulated shrouding shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with:
10. Main bus bars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories.
11. Fault withstand capacity of Panel including Bus Bar / MCCB / ACB shall be as specified in BOQ.
12. Cable terminations of one functional unit, when working on those of adjacent unit/units.
13. All covers providing access to live power equipment/circuits shall be provided with tool operated fasteners to prevent unauthorized access.
14. Provision shall be made for permanently earthing the frames and other metal parts of the switchgear by two independent distinct connections.
15. Only CRCA steel sheets shall be used for fabricating the cubicle.

16. Thickness tolerance for sheets shall be as applicable in relevant IS.

17. Metal Treatment and Finish: -

The panel shall have nine tank pretreatment process comprising of degreasing, rinsing, dedusting, rinsing, phosphatizing, rinsing, and passivation followed by powder coat painting having a paint thickness of 60 micron or as specified of approved shade of siemens grey (Shade RAL 7032). The powder paint will be subjected to oven heated process.

Note:

- Provide detailed specification with guarantee details of the equipment's.
- Provide efficiency curves and catalogues for the equipment's used.
- Provide GA drawings and shop drawings before start of the work.
- Provide as built drawing after completion of project.
- Vendor to furnish the manual for operation and maintenance with trouble shooting by his experience.
- Vendor to furnish the list of spare parts, which are frequently required for trouble free operation.

SECTION IV: LIST OF APPROVED MAKES

Pumps	
Equipment / Material /Component	Manufacturers Name
Centrifugal Pumps	Kirloskar / Grundfos / Xylem / Ebara
Centrifugal	Grundfos / Xylem / Ebara
Screw Pumps	Roto / Positive / Tushaco / Rotomac
Submersible Pumps	Grundfos / Xylem / KSB / Ebara
Dosing Pumps	Asia LMI / Emec Italy / Toshcon
Dewatering Pumps	Grundfos / Xylem / KSB / Ebara
Sludge Pumps	Kirloskar / Tushaco

Piping	
Equipment / Material /Component	Manufacturers Name
GI / MS Pipes	Jindal / Prakash Surya

GI Pipes Fittings	Unik / UNCO / R Brand
HDPE Pipes	Reliance / Duraline / Supreme / Jain
PVC Sch 40 & 80 Water Supply Pipes & fittings	Supreme / Astral / Finolex / Ashirwad
CI / Cast Steel / Bronze Gate construction of Butterfly / Globe / Butterfly / NRV	IVC / Venus / Audco / Advance / SKS / AIP / Kirloskar / Sant
Strainer	CIM / Audco / Advance / AIP

Mechanical Equipment	
Equipment / Material /Component	Manufacturers Name
Blowers	Everest / Usha / Kay / Beta
Diffused Aeration	EDI / Thermax / Geo Miller / Micro / ITT System / Envirotech / Norton / Rehau / MM Aqua
Tube Settler media / Media for Bio	MM Aqua / Thermax / Geo Miller / Cooldeck
Reactor	
U V Sterilizer	Creative / Alfa
Filter Press	Sachin Filtech / Pharmatech
Membrane Module	GE / Siemens / Huber
Mechanical Step Screen	Jash / Wastech / Ecologix

Instrumentation	
Equipment / Material /Component	Manufacturers Name
Pressure Indicator	Manometer India/ H Guru Instruments/ General Instruments/AN Instruments/ Forbes Marshall / Bells / Emerald / Jepson / Waree Instruments
Level Sensor & Indicator	Toshniwal Bros./ABB/ Bells Controls / Forbes Marshal / Pune Techtrol / Level tech / Elegant / Cirrus

Flow Instrument System	Resemount (I) Pvt. Ltd/ABB/ E&H/ Forbes Marshall / SB Electromech /Waree Instruments/ Level tech Systems
Gas Meter	Fluid Components/ MKS Instruments/ Kurtz Instruments /Forbes Marshall/ABB
pH meters	A-LMI/ Rosemont / Toshniwal /E&H/ Forbes Marshal / Ultra line
Analyser- Conductivity	Fobes Marshall /. A- LMI / Rosemont / Forbes Marshall / Kent
Bulk Water Meter	Aquamet / Kaycee / Kent
Electro-magnetic type Flow Meter	Forbes Marshall / ABB
DO Sensor	Forbes Marshall / Hach / Electronet

Instrumentation	
Equipment / Material /Component	Manufacturers Name
MCB / RCCB / RCBO / DB	L&T / Hager / ABB / Legrand / Schneider
Industrial outlet	L&T / Hager / ABB / Legrand / Schneider
Electrical Control Panel	Advance / Adlect / Ambit / Trico lite / Milestone / Vidyut control / RST / Dynamic
Switchgear & Accessories	ABB / Schnieder / L&T / Siemens
MCCB (Microprocessor)	ABB (T max) / L & T (D sine) / Schneider (Compact NXS / NS) / Siemens (3VL) / Legrand (DPX)
Switch Fuse Unit with HRC Fuses	L & T / ABB / Schnieder / Siemens / GE
Contactors / Relays	L & T / Siemens / ABB / Schneider
Ammeters / Voltmeters and metering equipment's	L & T / Siemens / Automatic Electric / Neptune / Enercon
Selector Switches	Kaycee / Salzar / L&T
LED lights	L&T / Vaishno / Siemens
PVC Insulated Copper Conductor Wires	Finolex / Polycab / Skystone / RR

PVC / XLPE Insulated 11 KV / 1.1 KV Cables	Finolex / Polycab / sky tone / RR
Lugs	Dowell's / 3D / C.C.I. / 3 M / Comet / Hex
Cable Glands	Siemens / Comet / Grippwel
MS Conduits and Accessories	B.E.C. / AKG / MK
Fluorescent Tube Fitting	PHILIPS / WIPRO / Bajaj
Ceiling Fans / Exhaust Fans / Air Circulators	Crompton / Bajaj / Usha

21. ELECTRIC OVERHEAD TRAVELLING (EOT) CRANE

21.1 GENERAL

The scope covers design, manufacture, supply, erection, testing and commissioning of electric overhead travelling (EOT) crane along standard accessories and items required to make crane fully functional.

21.2 SCOPE

Scope covers supply of EOT crane complete in all respect along with necessary accessories and items detailed hereunder to make EOT fully functional.

- Electrical cables for power supply from distribution control panel in shed to DSL up to 10m length as per GAD of shed.
- Supply and fixing of gantry rail/ square or rectangular bar on crane girder along the entire length of shed as indicated in GAD of sheds. Bidder should ensure proper fixing and alignment of crane gantry rail/ bar before erection of crane.
- Supply and fixing of shrouded type DSL along the entire length of shed as indicated in GAD of sheds.
- Pendant push button control for long travel, cross travel and hoist motions with necessary flexible multi-core cable of sufficient length for operation of crane from floor level.
- Portable radio remote control along with accessories and items required controlling all motions of crane including synchronous operation of two cranes.
- Supply of power supply arrangement (clause #2.14), necessary spares, consumables, tools and tackles (clause #3), inspection and test certificates (clause #4), installation and commissioning (clause #5), documentation (clause #6), training (clause #7) and warranty (clause #8) as per General Terms and Conditions applicable for Bill #13 for each crane.
- Supply of maintenance tools for each crane: a tool box containing D/E Spanners of required sizes- 1 set, grease gun-1 No, oil can-1 No, screw driver of required sizes- 1 set,

nose pliers- 1 No, Insulated pliers- 1 No, hammer 2 lb.- 1 No, Allen key of required sizes- 1 set, hydraulic jack- 1 No.

- h) Supply of operation and maintenance spares including the following for each crane:
- ✓ Fixed & moving contact tips for contactors- 1 number of each size
 - ✓ Contactors coils- 1 set consisting of 3 numbers of each size
 - ✓ Limit switches- 1 set of MH, 1 set of CT, 1 set of LT
 - ✓ Current collectors- 1 set
 - ✓ Fuse links- 1 set of each size
 - ✓ Thrusters- 1 of each size
 - ✓ Brake Liners with rivets- 1 pair of each size
 - ✓ Main spring for thruster brakes- 1 of each size
 - ✓ Brakes shoes complete with lining- 1 pair of each size
 - ✓ Oil seals for gear cases- 1 for each size of gearbox and geared coupling.
 - ✓ VVVF drive module- 1 no of each type
 - ✓ long travel and Cross travel wheel duly machined without axle and bearings- one number of each type.
 - ✓ Supply of lifting tackles, wire ropes, chains, hooks etc along with crane as detailed hereunder.

21.3 DESIGN FEATURES

- a) Crane should be designed as per codes and specifications (or equivalent international standard like DIN and broad technical parameters, detailed hereinabove. Crane should comply with relevant safety regulations under the Factories Act, Indian Electricity Rules and other statutory regulations as applicable.
- b) Crane should be manufactured and erected to tolerances specified hereunder.
- ✓ Span over LT wheels +6mm
 - ✓ Diagonal on wheels +5 mm
 - ✓ Long travel wheel alignment +1mm
 - ✓ Tilt of wheels or Balance Axle +1mm/1000mm (Horizontal & Vertical)
 - ✓ Trolley wheel gauge +3mm.
 - ✓ Trolley track gauge +3mm
 - ✓ Difference in height between trolley rails(H) for different trolley track gauge(S) shall be within following limits: (S) up to 2500 mm- (H) 4mm, (S) from 2500 to 4500mm- (H) 6mm and (S) above 4500mm – (H) 8mm
 - ✓ Speed at full notch with rated load, voltage and frequency shall be (a) Travelling & Traversing +10% / -5% of specified speed (b) Hoisting +10% / -5% of specified speed (c) Lowering +25% / -5% of specified speed.

- c) Operator's cabin should be located at one end opposite DSL side. Closed accessible cabin should have sliding side windows, toughened glass 6mm thick to have unobstructed view of load and surrounding. Layout of controls should enable crane operation from a seated position. Cabin should have adjustable padded seat, rubber matting, fan, lighting and fire extinguisher for electrical fire etc.
- d) AC variable frequency control (VVVF) for MH, AH, CT & LT should be used by using independent variable voltage variable frequency drives. Common controller for both LT motors may be used.
- e) LED lighting should be provided in operator's cabin, staircase etc. Bulkhead fittings with dust proof covers should be used for above areas. Four numbers underslung LED lamps with shock absorbing and anti-swing suspension arrangement should be provided for uniform shed floor illumination. Minimum one socket outlet for hand lamp 24V should be provided in cabin, long travel side and in areas where control panel, resistors and transformers are installed.
- f) Labels of permanent nature shall be provided on supports of all switches, fuses, contactors, relays etc to facilitate identification of circuits and replacement. Panels, controllers, resistors etc should be properly marked for each motion. Equipment terminals shall also to be marked likewise.
- g) Earthing to crane should be done through fourth conductor of DSL. Electrical equipment mounted on crane should be connected to crane structure by means of earthing links. Inverter should be suitable for crane application for all motion.
- h) Dead man's handle should be provided in cabin-operated crane, which will stop crane movement in case operator neglects proper handling. A foot-operated alarm should be provided to caution workers. A continuous ringing alarm should be provided for long travel motion of crane.
- i) Crane controls should be interlocked to prevent accidental movement of crane. Suitable limit switches, one each for LT and CT, and two each for MH and AH, should be provided to stop and to prevent over- travel. Electrical interlocks should be provided for simultaneous operations of traversing and traveling but during hoisting it is not possible to undertake either traversing or traveling.
- j) All hoist motions should be provided with limit switches (rotary/ gravity) to prevent crane from over hoisting and over lowering. Two limit switches should be provided for proper back up protection.
 - ✓ First limit switch shall act in case of over hoisting and over lowering.
 - ✓ Second, one shall be gravity limit switch and will operate only for hoisting.
- k) Safety switches of sustained contact type shall be provided at each end of crane- bridge so that in any emergency conditions, by operating any switch incoming circuit breaker is tripped to cut power to all motions. A mushroom head type push button shall be provided in operator's cabin so that main incoming circuit breaker could be tripped in emergency condition by pressing operating head. Pilot lamp in control circuit shall glow when any switch is operated.
- l) Suitable guard or enclosure should be provided on crane to prevent inadvertent contact with DSL or any other exposed electrical conductor and cable. Suitable isolation switches and stop buttons should be provided to isolate electric supply for maintenance and in case

of an emergency. Safety hand railing of tubular construction should be provided on bridge foot walks, end carriages, staircases, landing in cabin, trolley and other places where access has been provided.

- m) Scope covers pendant push button control for LT, CT, MH and AH motions. Supply voltage to pendant control shall be 110V AC obtained through a suitable transformer. Necessary flexible multi-core cable of sufficient length should be supplied to operate crane from floor level. Pendant should be moving type and movement of pendant will be independent of trolley. Pendant control with double key lock system should have spring loaded push buttons to return to off position to stop crane movement as soon as operator releases thumb pressure on button.
- n) Scope covers supply of portable push button type radio remote control along with two-step push button type transmitter, receiver, antenna & cable, two sets of rechargeable batteries, battery charger and other standard accessories and items for controlling all motions of crane.
 - ✓ Radio remote control shall be provided in addition to main control system through pendant/ master controller.
 - ✓ Transmitter of radio remote control should meet features like three stage audible and visual low power warning; audible and visual alarm; removable magnetic key (waterproof); shock resistant to 50G, password protection, narrow band FM, large mushroom E-stop switch, AA rechargeable batteries, internal antenna, programs receiver from ground through RE communication (no need to climb on crane to change frequency or address), two dual axis joysticks, range 100 m, 16 strap for transmitter slinging etc.
 - ✓ Receiver of radio remote control should meet features like power interruption protection, relay's contacted failure detection circuit, shock resistance mounting.

21.4 BROAD TECHNICAL PARAMETERS

Bidder shall ensure that crane dimensions like span, gantry height and crane clearances are compatible and suitable to GAD of shed. Crane should meet broad technical parameters detailed hereunder.

S. No	Location	Ground floor	First Floor
1	Capacity (T) (M/A)	25/5	10/2
2	Span (m)	22	22
3	LT travel (m)	390 (Min)	390 (Min)
4	CT travel (m)	20 (Min)	20 (Min)
5	TOR in (m)	13.8	32.5
6	Height of Lift (m)	12	12
7	Hoist Speed (m/min)	3/3	3/3
8	CT speed (m/min)	20	20

9	LT Speed (m/min)	50	50
10	No. of cranes (Qty-Nos.)	4	4

21.4.1 EOT CRANE 25T

- Double Girder, Capacity MH 25T and AH 5T, Span $\approx$ 22 m.
- Class of Duty M6, for indoor operation.
- VVVF drive, step less speed for all motions.
- Speed in m/minute: MH-3, AH-3, LT-50 and CT-20.
- Crane controls by RRC (Radio Remote Control).
- Lift of MH hook above floor level (FL) & drop of hook below FL 10.5 m & nil
- Lift of AH hook above floor level (FL) & drop of hook below FL 10.5 m and 1
- Type of MH hook: C type, Type of AH hook: C type
- Head room (crane height from gantry rail level) 2200 mm maximum
- Overhang (crane end projection from rail canter) 200 mm maximum
- Centre distance between hooks MH & AH $\approx$ 1 m

21.4.2 EOT CRANE 10T

- Double Girder, Capacity MH 10T and AH 3T, Span $\approx$ 22m.
- Class of Duty M6, for indoor operation.
- VVVF drive, step less speed for all motions.
- Speed in m/minute: MH 3, AH 3, LT 45 and CT 20
- Crane controls from moving pendant RRC.
- Lift of MH hook above floor level (FL) & drop of hook below FL 10.5 m and nil.
- Lift of AH hook above floor level (FL) and drop of hook below FL 10.5 m and 1m.
- Type of MH hook: C type, Type of AH hook: C type
- Head room (crane height from gantry rail level) 2000 mm maximum.
- Overhang (crane end projection from rail centre) 200 mm maximum.
- Centre distance between hooks MH & AH $\approx$ 800 m

22 WATER SUPPLY FACILITIES

22.1 General

The water requirement for the proposed rolling stock commuter Rail and Metro Cars manufacturing plant is predominantly for CAR testing, fire-fighting, drinking purpose, general purposes like bathing & canteen application with a small part of the requirement being for cooling purpose & direct process needs like washing etc. To minimize the fresh water drawn

from the source, cooling water, CAR testing water recirculation systems have been envisaged with required makeup.

Treated effluent from STP meeting required norms shall be used for flushing in washrooms and general horticulture purpose.

22.2 Requirement of water

The fresh water requirement of the plant is estimated at 53 m³/h (650 cum/day approx.).

Recirculation systems have been envisaged only in cooling towers & car testing facility & remaining major water consumption in the plant is once through type.

Table Showing Break - Up of Recirculation and Fresh Makeup Water Requirement

Sl. no.	Description	Existing BEML with 400 car per Annum (cum)	Proposed BEML with 1200 car per Annum (cum)	Makeup water per day (cum)	Makeup water (cum) per hour	Remarks
	A	B	C	D	E	F
1	Water consumption FOR CAR body & bottom plate water testing.	335.00	1005 (Re-circulation)	40.2	3.35	Process loss considered is 3% to 5%. 4 % circulation is considered
2	RO reject water for makeup RO water at 2D is	-	-	12.06	1.01	1D & 2D are the RO feed water

3	Cooling water recirculation	-	750 (Re-circulation)	7.5	0.63	Makeup water considered is 1%
4	Water requirement Considering No. of People around 1000	45.00	225.00 (Once through)	225.00	18.75	Water requirement for 5000 people
5	Water requirement considering Kitchen 3 Nos. for working complete day for breakfast, lunch, snacks & dinner	70.00	350.00 (Once through)	350.00	29.17	Water requirement for 5000 people
	Total			634.76 Say-635	52.90	55 cu.m say i.e. 12hours working per day or 6 hours each shift
	Number of days storage (Days)			3		
	Volume of the storage considering 10 %			2095		

	additional volume (Cu.M)					

22.3 Source of water

The source of water for the proposed plant will be from the municipal fresh water supply pipeline (i.e. drinking water pipeline from Narmada River to Bhopal city) passing near the plant site, from where, raw water / fresh water will be supplied to the storage reservoir to be constructed in the plant. The plant storage reservoir of 2095 Cum will cater for 3 days storage requirement. It is considered that the water is made available at the storage reservoir in the plant.

22.4 Proposed facilities

To cater to the water requirements of the plant, the following facilities are envisaged which are explained below.

22.5 Raw water treatment plant

Incoming fresh water / raw water will be stored in the RCC reservoir. The fresh water / raw water drawn from the plant storage reservoir will be filtered in multi grade pressure sand filters and this water will be used as make-up for the various recirculation systems & once through system. chlorination is done for supplying water to canteen & RO units for drinking water.

As consumption of water for various purposes in the plant is not constant & varies in wide range, for pumping purposes hydro pneumatic pump along with air bottle with diaphragm, VFD motor (for all pumps) are envisaged. Here no recirculation system & over-head tank are envisaged for the pumps. This hydro pneumatic pumping system makes pumps trouble free operation & power saving & prevent frequent on & off of recirculation control valve. (As control valve is not there in this case).

Pump will operate based on the line pressure. On demand, flow of water will occur & pr. reduces, at pre-set pressure, pumps will start & supply water. One pump for supplying process water & drinking water to the plant continuously, other two pumps will normally not be working continuously, however operates during pressure filter cleaning operation (i.e., during high water demand for pressure filters cleaning purpose) for short duration of time (20 to 30 minutes, approx.). Therefore, normally two pumps will be stand-by for most of the time.

Refer Drg. no.: MEC-/I0047-01-04-D1-ZZ-12-DR-N-03001, PFD of water system.

22.6 Firefighting facilities

Refer separate writeup for Firefighting facilities.

22.7 Cooling Water Recirculation systems

The requirement of water in the chillers & compressed Air Station is only for indirect cooling of the compressors. Cooling water will be pumped to the chillers & compressors and will be cooled in the Cooling towers before reuse. Only process water makeup is envisaged.

For Cooling tower & re-circulation cooling water details refer AC & Ventilation chapter.

22.8 Water distribution

MS / CS / DI/ Galv. pipes & fittings are envisaged for water supply based on the requirement. The pipelines will be routed overhead along the building columns / walls. Ball valve / Gate valve / butterfly valves / control valves of suitable diameter & pressure gauges will be provided as per requirement & at tapping points. Water hammer arresters & air release valve are envisaged in the distribution network considering sudden surge during operation. Platforms, access ladders, etc. will be provided for operation and maintenance of valves, instruments & controls and gauges provided in the pipeline network.

Pressure reducing valves (PRV) will be provided as per requirement to regulate the pressure. PRV's to be easily accessible for repair.

Pipe sizing and pressure drop Calculation is carried out using sing Hazen William's formula as given below (Reference: NBC 2016 PART -9 ANNEX c Clause 4.7)

Hazen-Williams equation for pipe flow

- ✓ Headloss in pipes(water supply network)
- ✓ Empirical
- ✓ Named after Allen Hazen and Gardner Stewart Williams.
- H= head loss(m)
- Q= flow rate(m³/ sec)
- L= length of pipe(m)
- d= diameter(m)
- C= Hazen William's coefficient

$$H = 10.65 \frac{Q^{1.85} L}{C^{1.85} d^{4.87}}$$

Piping layout will follow good engineering practices.

22.9 Reference codes & standards

Sl. No.	Design standard	Standard	Description

1.	BIS	IS: 1520	Horizontal centrifugal pumps for clear, cold & fresh water
2.	BIS	IS: 5120	Technical requirement for roto-dynamic special purpose pumps
3.	BIS	IS: 9137	Code of acceptance tests for centrifugal, mixed flow and axial pumps
4.	BIS	IS: 1710	Pumps - Vertical Turbine Mixed and Axial Flow, for Clear Cold Water
5.	BIS	IS: 10553	General guidelines chlorination plant, including handling, storage and safety of chlorine cylinders and drums
6.	ANSI	ANSI B 31.3	Process piping code
7.	BIS	IS: 1239 (Part-I)	Steel tubes, tubulars and other wrought steel fittings - Specification
8.	BIS	IS: 1239 (Part-II)	Steel tubes, tubulars and other wrought steel fittings - Specification
9.	BIS	IS: 3589	Electrically welded steel pipes for water, and sewerage (168.3 to 2540 2000).
10.	BIS	IS: 5504	Spiral welded pipes
11.	ASTM	ASTM A 106 Gr. B	ERW & Seamless CS pipe specification
12.	ASTM	ASTM A 53	MS pipe specification
13.	ANSI	ANSI B 36.1	Welded & seamless wrought steel pipe dimensions
14.	ANSI	ANSI B 36.19	Stainless Steel pipes dimensions
15.	ANSI	ANSI B 16.9	Butt welding pipe fittings dimensional standard.
16.	ANSI	ANSI B 16.11	Forged steel fittings: Socket welded & threaded

17.	BIS	IS: 6392	Steel pipe flanges.
18.	ANSI	ANSI B 16.5	CS pipe flanges & flanged fittings
19.	BIS	IS:13095	Butterfly valves for general purpose.
20.	IPSS	IPSS-1-06- 012	Steel industry OPSS specification of Butterfly valves
21.	BS	BS EN: 593	Industrial valves: metallic butterfly valves for general purposes
22.	ANSI	ANSI/AW WA C504	Rubber seated butterfly valves
23.	BIS	IS: 5312	Swing check type reflux (non-return) valves for water works purposes — specification
24.	BS	BS: 5153	Specification for cast iron check valves for general purposes
25.	BIS	IS: 778	Copper alloy gate, globe and check valves for waterworks purposes
26.	BIS	IS: 3042	Specification for single faced sluice gates (200 to 1200 mm size.)
27.	BIS	IS: 13349	Cast iron single faced thimble mounted sluice gates - Specification
28.	BIS	IS: 14846	Sluice valve for water works purposes (50 to 1 200 mm size) — specification
29.	BIS	IS: 14845	Resilient seated cast iron air relief valves for water works purposes — specification
30.	ISO	ISO:17192	Metal ball valves for petroleum, petrochemical and allied industries
31.	BIS	IS: 1703	Water fittings — copper alloy float yalves (horizontal plunger type) — specification
32.	BIS	IS: 2906	Indian standard specification for sluice valves for water works purposes (35-1200mm size).
33.	BIS	IS: 4038	Specification for foot valves for water works purposes.

34.	BIS	IS: 5312	Swing check type reflux (non-return) valves for water works purposes — specification
35.	BS	BS: 5155	CI & carbon steel butterfly valve for general purpose
36.	BS	BS: 5158	CI & carbon steel plug valve for general purpose
37.	BIS	IS 14845	Air release valves.
38.	IPSS	IPSS-1-06-001	Foot valves standard.
39.	API	API: 602	Steel gate, globe & check valves for sizes pns 4 (ND100) and smaller for the petroleum and natural gas industries.
40.	BS	BS: 5352	Steel wedge gate, globe and check valves 50 mm and smaller for the petroleum, petrochemical and allied industries.
41.	API	API: 600	Gate valves for petroleum & natural gas.
42.	BS	BS: 1414	Specification for steel wedge gate valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries
43.	BS	BS: 1873	Specification for steel globe and globe stop and check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries
44.	BS	BS: 1868	Specification for steel check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries.
45.	API	API: 599	Metal plug valves - Flanged, threaded, and welding ends
46.	API	API 598	Valve inspection & testing.
47.	BIS	IS: 2002	Steel plate for pressure vessel for intermediate and high temperature service including boilers.
48.	BIS	IS:2062	Hot rolled medium and high tensile structural steel – Specification.
49.	BIS	IS: 5822	Code of Practice for Laying of Electrically Welded Steel Pipes for Water Supply.

50.	BIS	IS: 3114	Code of practice for laying of cast iron pipes.
51.	BIS	IS: 12288	Code of Practice for Use and Laying of Ductile Iron Pipes.
52.	BIS	IS: 1387	General requirements for the supply of metallurgical materials.
53.	BIS	IS: 7307	<u>Fusion welding of steel.</u>
54.	BIS	IS: 7310	Approval Tests for Welders Working to Approved Welding Procedures.
55.	API	API: 1104	Welding of Pipelines and Related Facilities.
56.	ASTM	ASTM Sec. 5	Non-Destructive examination.
57.	ASME	ASME Sec 9	ASME boiler & pressure vessel code.
58.	BIS	IS: 1447	Code of practice for painting of ferrous metals in buildings.
59.	BIS	IS: 5	Colours for Ready Mixed Paints and Enamels.
60.	-	-	Indian Petroleum rules.

23 COMPRESSED AIR FACILITIES

23.1 General

To cater the plant air & instrument air requirement of the proposed Rolling stock commuter Rail and Metro Cars Manufacturing plant air compressors are proposed. These air compressors will supply single quality dry air to technological equipment's, pneumatic instruments, pneumatic equipment's, pneumatic operated valves, general purpose application like for cleaning etc.in the plant.

In order to meet the air demand for testing of the pipelines & braking system of car, high pressure air compressors are proposed. These compressors will be decentralized & are installed in the respective works shops, inspection & testing bay.

Proposed equipment's

To meet the high pressure compressed air requirement following are envisaged.

SL. No.	Equipment Description	No of units
4.	Lubricated screw compressor of capacity 100 CFM with delivery pressure of 12 kg/cm ² (g). mounted on 500 liters horizontal air receiver.	5-Nos. (5W+0S)
5.	Refrigerant air dryer of matching capacity	5-Nos. (5W+0S)

Refer Drg. no.: MEC-/I0047-01-04-D1-ZZ-15-DR-N-03002, PFD of air compressor facility enclosed with report.

23.2 Description Of Equipment

1. Air Compressor.

All air compressor will be air-cooled, single/multistage, oil free, fixed speed, rotary screw type: each capable of delivering continuously rate volume of airflow at rated delivery pressure these shall be supplied with all accessories etc. for smooth and trouble-free operation.

Screw compressors will generally be confirmed to API 619.

Each compressor unit will be complete in all respect with electric motor drive mounted on common skid, coupling, replaceable coupling guard, etc. Driving motor capacity will have 10% margin over the required shaft power including all shaft driven auxiliaries at maximum capacity of compressor.

The working of compressor (load & unload) will be controlled based on the system pressure.

Each type of compressors will be identical in design, construction and performance and all the components will be inter changeable. Compressor will be designed for continuous duty and parallel operation. All the compressor parts/sub-assemblies will be duly accessible for maintenance. Unbalanced forces and moments of the rotating parts will be minimum to ensure least vibration and noise.

The thickness of screw compressor casing will be sufficient to withstand maximum pressure and temperature.

The rotor will be made of forged steel suitable for operating parameters and suitable lubrication system for moving parts will be provided.

Compressors will have built-in micro-processor panel controlling the operation of the compressors automatically. Necessary instrumentation and control will be as per manufacturer's standard & system requirement.

Each compressor unit will be provided with suction filter.

Each compressor will be provided with oil tank, oil filter, oil cooler, oil separator, oil pump & after cooler, moisture separator with auto condensate trap, air flow & air pressure control system, acoustic hood, heat exchangers, base frame, casing cooling system, lubrication system, solenoid valves, pressure / temp/ flow switches, NRV, safety valves, integral pipings, etc. Oil separator will be complete with necessary fittings & mounting like safety valve, etc. The design / fabrication of the intercooler / after cooler will conform to IS: 4503-1991 or equivalent foreign standards. In case of 100 CFM compressors entire compressor unit will be mounted on the horizontal air receiver.

Suitable acoustic enclosure will be provided to keep the noise level within 85 dB (A) at source. The acoustic hood frame work will be made of rolled steel section.

Direct drive will be employed between compressor & motor

2. Refrigerant air dryers.

Suitable capacity refrigerant air dryer with each compressor unit will be provided to supply continuously dry air with a pressure dew point of (+) 3 deg. C. The air-drying unit will be refrigerant type with automatic mode of operation. Design consideration of the drying unit will be as per manufacturing standards available with Approved vendor list of MECON. One air dryer will be provided for each of the compressor installed.

Selection of dryers will be such that performance of the same will not be affected at different loads of the system. The dryers will be installed adjacent to the compressor. The system will be designed such that under no circumstances the dry air supply will be stopped. Selection of refrigerant will be environmentally acceptable. Pressure drop across dryer will not exceed 0.2 kg/sq.cm.

The dryer will be supplied along with all necessary auxiliaries. The operation and controls of the dryers will be fully automatic. The dryer will be complete with following as the minimum requirement.

- ✓ Air inlet connection
- ✓ Air outlet connection
- ✓ Air inlet strainer
- ✓ Condensate separator
- ✓ Digital pressure dew point indicator
- ✓ Air drying unit insulating block housing air to air heat exchanger, air to refrigerant heat exchanger / evaporator, condensate separator, liquid separator, refrigerant distributor, refrigerant injection restrictor.
- ✓ Condensate trap with automatic discharge
- ✓ Manual condensate drain valve.
- ✓ Air cooled condenser.
- ✓ Hermetic / semi hermetic refrigerant compressor.
- ✓ Liquid refrigerant dryer
- ✓ Liquid shut-off valve
- ✓ Liquid refrigerant receiver

- ✓ Sight glass with moisture indicator
- ✓ Refrigerant expansion valve
- ✓ Refrigerant circuit access connection
- ✓ Capacity bypass
- ✓ Temperature and pressure indicators / switches

The dryers will have built-in control panel with auto/manual operation.

3. Air Receivers

Air receiver will be vertical type & horizontal type i(n case of 100 CFM compressor) conforming to IS: 2825 (Class 2) or ASME Sec. VIII in all respects of design, manufacture, fabrication, welding, testing, mountings, radiography materials, etc. It will be suitable for maximum compressor working pressure with supporting base legs and necessary fittings like safety valves, pressure indicator, manhole (devit type), inspection hole, draining arrangement with auto drain traps with strainer & manual bypass isolation valves, nozzles and access / platform for maintenance etc. The receiver will be fabricated from carbon steel plates conforming to IS: 2002 (latest revision), Gr-2A or equivalent material.

4. Filters

Suitable air filters will be provided at downstream of air receiver. Selection of fine filters will conform to ISO 8573 class meeting the process requirement.

5. Pre filter

Each stream will be provided with one no. of pre filter. These filters will be surface filter renewable / replaceable type with the following parameters:

1. Material of construction:
 - a) Body: Carbon steel
 - b) Filtering element: Sintered bronze / borosilicate fiber type.
2. Capacity: 3200 cum/hr. (FAD). & 100 CFM
3. Pressure: Air compressor delivery pressure (Max)
4. Particle size: 1 micron
5. Diff. Pr. gauge: Yes

6. Fine filter

Each stream will be provided with one no. of fine filters at the outlet of air receiver to ensure fine air availability. Fine filter will be replaceable type.

1. Material of construction:
 - a) Body: Carbon steel
 - b) Filtering element: Borosilicate fiber / equivalent
2. Capacity: 3200 cum/hr. (FAD) & 100 CFM.

3. Pressure: Air compressor delivery pressure (Max)
4. Dust / oil Particle size: 0.01 microns
5. Diff. Pr. gauge: Yes

Quality of compressed air in both the compressors will conform to ISO8573. Compressed air quality will be as per table given below:

Description	Particle size (microns)	Dew point temp. (Deg. C).	Oil (mg/cum)
Dry compressed air (Class: 1-4-1)	0.1	(+) 3 PDP	0.01

7. **Compressed air distribution:**

Medium pressure & high pressure compressed air will be supplied to individual consumer or individual requirement through network of pipelines. The pipelines will be routed overhead along the building columns / walls. Isolating valves condensate drains and compensators, Pressure gauges will be provided in pipeline network as per the process requirements. Platforms, access ladders, etc. will be provided for operation and maintenance of valves, instruments & controls and gauges provided in the compressed air pipeline network. Piping layout will follow good engineering practices. Distribution pipeline & fittings will be MS / CS, Valves shall be CS with SS internals.

Pressure loss in the pipeline is calculated by logarithmic charts.

8. **Reference codes & standards**

Sl. No.	Design standard	Standard	Description
1.	API	API: 619	Rotary – Type displacement compressors for petroleum m chemical & gas industry services
2.	API	API: 618	Reciprocating Compressors for Petroleum, Chemical, and Gas Industry Services.
3.	BIS	IS: 2825	Code for unfired pressure vessels

4.	ASME	ASME Sec 8	Rules for Construction of Pressure Vessels.
5.	BIS	IS:7938	Air receiver for compressed air installations
6.	ISO	ISO: 8573.1	Air Quality standards
7.	ISO	ISO: 12500	Filters for compressed air
8.	ISO	ISO: 7183:2007	Compressed-air dryers
9.	IS	IS: 8183	Bonded mineral wool specification.
10.	ANSI	ANSI B 31.1	Power piping code
11.	ANSI	ANSI B 31.3	Process piping code
12.	BIS	IS: 1239 (Part-I)	Steel tubes, tubulars and other wrought steel fittings - Specification
13.	BIS	IS: 1239 (Part-II)	Steel tubes, tubulars and other wrought steel fittings - Specification
14.	BIS	IS: 3589	Electrically welded steel pipes for water, and sewerage (168.3 to 2540 2000).
15.	BIS	IS: 5504	Spiral welded pipes
16.	ASTM	ASTM A 106 Gr. B	ERW & Seamless CS pipe specification
17.	ASTM	ASTM A 53	MS pipe specification
18.	ANSI	ANSI B 36.1	Welded & seamless wrought steel pipe dimensions
19.	ANSI	ANSI B 36.19	Stainless Steel pipes dimensions
20.	ANSI	ANSI B 16.9	Butt welding pipe fittings dimensional standard.
21.	ANSI	ANSI B 16.11	Forged steel fittings: Socket welded & threaded
22.	BIS	IS: 6392	Steel pipe flanges.

23.	ANSI	ANSI B 16.5	CS pipe flanges & flanged fittings
	BIS	IS:13095	Butterfly valves for general purpose.
24.	IPSS	IPSS-1-06-012	Steel industry OPSS specification of Butterfly valves
25.	BS	BS EN: 593	Industrial valves: metallic butterfly valves for general purposes
26.	ANSI	ANSI/AW WA C504	Rubber seated butterfly valves
27.	BIS	IS: 5312	Swing check type reflux (non-return) valves for water works purposes — specification
28.	BS	BS: 5153	Specification for cast iron check valves for general purposes
29.	BIS	IS: 778	Copper alloy gate, globe and check valves for waterworks purposes
30.	BIS	IS: 3042	Specification for single faced sluice gates (200 to 1200 mm size.)
31.	BIS	IS: 13349	Cast iron single faced thimble mounted sluice gates - Specification
32.	BIS	IS: 14846	Sluice valve for water works purposes (50 to 1 200 mm size) — specification
33.	BIS	IS: 14845	Resilient seated cast iron air relief valves for water works purposes — specification
34.	ISO	ISO:17192	Metal ball valves for petroleum, petrochemical and allied industries
35	BIS	IS: 1703	Water fittings — copper alloy float valves (horizontal plunger type) — specification
36	BIS	IS: 2906	Indian standard specification for sluice valves for water works purposes (35-1200mm size).
37	BIS	IS: 5312	Swing check type reflux (non-return) valves for water works purposes — specification
38	BS	BS: 5155	CI & carbon steel butterfly valve for general purpose

39	BS	BS: 5158	CI & carbon steel plug valve for general purpose
40	API	API: 602	Steel gate, globe & check valves for sizes pns 4 (ND100) and smaller for the petroleum and natural gas industries.
41	BS	BS: 5352	Steel wedge gate, globe and check valves 50 mm and smaller for the petroleum, petrochemical and allied industries.
42	API	API: 600	Gate valves for petroleum & natural gas.
43	BS	BS: 1414	Specification for steel wedge gate valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries.
44	BS	BS: 1873	Specification for steel globe and globe stop and check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries
45	BS	BS: 1868	Specification for steel check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries.
46	API	API: 599	Metal plug valves - Flanged, threaded, and welding ends
47	API	API 598	Valve inspection & testing.
48	BIS	IS: 2002	Steel plate for pressure vessel for intermediate and high temperature service including boilers.
49	BIS	IS:2062	Hot rolled medium and high tensile structural steel – Specification.
50	BIS	IS: 7307	Fusion welding of steel.
51	BIS	IS: 7310	Approval Tests for Welders Working to Approved Welding Procedures.
52	API	API: 1104	Welding of Pipelines and Related Facilities.
53	ASTM	ASTM Sec. 5	Non-Destructive examination.

54	ASME	ASME Sec 9	ASME boiler & pressure vessel code.
55	BIS	IS: 1447	Code of practice for painting of ferrous metals in buildings.
56	BIS	IS: 5	Colours for Ready Mixed Paints and Enamels.
57	-	-	Central Pollution Control Board standards.

24 EPSS: EMERGENCY DIESEL GENERATOR SETS.

24.1 General

BEML Limited intends to construct green field project for construction of Rolling Stock Manufacturing Plant at Bhopal, Madhya Pradesh for Commuter Rail and Metro Cars.

This chapter enumerates the details of emergency DG sets planned for supplying the power during grid power outage in the proposed Manufacturing Plant.

The dimensions shown in the layout of DG sets and Chimney for exhaust here under are just for reference and understanding purpose. The EPC vendor would be required to design, construct, supply, install and commission the facility as per rating and numbers of DG sets envisaged and in accordance with applicable code and statutory requirements.

The total emergency load estimated for the proposed manufacturing plant is 3000 KVA (2400 KW). Emergency load is estimated about 50 % of the total electrical load demand of the plant.

To cater the above emergency / critical load, 11 KVA, 3 Nos x 750 KVA capacity HSD fired (2 W+1 S), Diesel Generator sets are envisaged along with associated accessories & panels. Emergency DG sets & accessories will be installed out door near to MRSS. All 3 DG sets will be working.

24.2 Site Conditions.

DG set foundation shall be designed to the site conditions specified under respective chapter.

24.3 Standards And Regulations

DG set & accessories shall meet the requirements laid down in relevant ISO 8528 & ISO 3046., BS, IEC and other reputed national / international standards as applicable. It shall comply with statutory requirement of Indian Electricity rules, factory inspectorate, CPCB, PESO Government of India and Government of Madhya Pradesh, Indian petroleum act, Indian explosives act.

Emergency power supply of all other units including chiller plant & Pump Houses are planned from Centralized DG system near to MRSS building.

3Nos. 750 kVA, 11kV, DG sets has been considered and the same is located near to MRSS. Containerised type DG set has been considered with a provision for Day tank to feed the DG set. An area of approx.70 Sq. m has been considered for the facility.

24.4 Technical Details of Diesel Generator Set.

Diesel engine shall be of four strokes, turbocharged, radiator-cooled, prime power type and shall be complete with internal combusting engine, fuel oil system, exhaust system along with exhaust silencer, chimney, lube oil system, battery starting system, governing system, alternator and capable of driving continuously the generator to give required output at its alternator terminals without any de-aeration.

All the DG sets (along with enclosure / hoods) will be installed outdoor. All DG sets shall have independent stack as per CPCB norms with minimum stipulated.

Refer Drg. no.: MEC-/I0047-01-40-D1-ZZ-14-DR-N-03003, layout & sections of DG sets for emergency power enclosed with report.

24.5 TECHNICAL PARTICULARS OF DG SETS

Sl. No.	Description	Unit	Value
1.	Number of DG sets	Nos.	3 (2 Working + 1 standby)
2.	Rated power at the alternator terminals	KVA	750
3.	Power rating classification	KVA	Prime power with varying load required during power outage.
4.	Fuel	-	High Speed Diesel
5.	DG sets Cooling system	-	Radiator-cooled.
6.	Engine speed	rpm	1500 rpm
7.	Lubrication system	-	Forced lubrication
8.	DG sets Starting system	-	Battery start.
9.	Frequency	Hz	50 Hz
10.	Voltage	KV	11 KV

DG set/s output shall be suitable for emergency application and prime power type & shall be in accordance with ISO 8528 & ISO 3046.

24.6 COMBUSTION AIR SYSTEM

Combustion air to the engine shall be clean air and it will be supplied through exhaust gas driven turbo charger from atmosphere through dry type suction filter. Suction filter & Turbo

charger shall be mounted on the engine / base frame. Differential pressure gauge or mechanical clogging indicator to be provided across suction filter.

24.7 ENGINE GOVERNING

The diesel engine shall run steady at any load up to full load. Engine shall be provided with electronic governor with 110% over speed protection. Engine governor shall be capable of maintaining speed within the specified limit as per BS 3046 part 4 classes A1.

24.8 LUBRICATING OIL SYSTEM

The diesel engine shall be forced lubricated; the lubrication system shall be self-contained & not limited to the following equipment.

- a) Sump: To store sufficient lube oil for circulation, sump of sufficient capacity for continuous operation. Sump shall also be provided with level gauge or dip stick required for monitoring. Lube oil sump shall be integral part of DG set base frame.
- b) Pump: Shaft driven main oil pump, electric motor driven auxiliary oil pump & oil tank mounted hand pump (as required for priming during start-ups, oil change etc.) shall be provided in the DG lubrication system. A timer-based control (with manual over ride) shall be provided to start the auxiliary oil pump once in 6 hours and run for half an hour and flush the lube oil in the system.
- c) At the inlet of pumps Strainers to be provided. Necessary differential pressure gauge or mechanical clogging indicator to be provided across lube oil filter.
- d) Lubricating oil cooler with thermal valve or thermostat for Automatic lube oil temperature control to be provided.
- e) Interconnecting piping, valves & fittings.
- f) Breather / suitable oil vapour extraction system shall be provided to remove the oil vapour collected in the lube oil tank. In-case of forced oil vapour extractor, automatic electrical type is preferred over air ejector type vapour extractor.

24.9 ENGINE EXHAUST SYSTEM

The engine exhaust gases shall be let-off through exhaust system. All the hot parts at the working level shall be insulated. The exhaust system shall include:

- a) Suitable size exhausts duct connecting to engine exhaust manifold and silencer & chimney to be provided to expel the exhaust gases. MOC of exhaust duct & silencer shall be CS.
- b) Exhaust manifold shall be air cooled type – incoming combustion air.
- c) **Silencer:** After turbocharger turbine, the exhaust gases shall be let off through silencer. Exhaust muffler/silencer shall be for minimum insertion loss of 25 db (A). However maximum level of shall not exceed 85 dB (A) at 1 m from the DG set. Silencer shall be residential type.
- d) **Expansion bellows:** Expansion bellows shall be provided on the exhaust duct near the engine exhaust manifold & near chimney connection on the exhaust pipe to absorb the thermal expansion and reduce the thermal loads on engine & chimney respectively.

- e) **Exhaust chimney / duct:** 30 m height exhaust chimney with a cowl (at the top) shall be provided to expel the hot exhaust gases. Chimney shall be structurally supported type & shall be provided with insulation up to 3 m height from ground. Two numbers of always switch on Automatic timer-based Aviation lamps with manual on & off option to be provided at the top of chimney. Chimney shall have sampling ports with proper platforms & approach. Landing platforms & approach ladder shall also be provided to reach chimney top. In general, design of chimney shall conform to IS 6533. Exhaust duct, exhaust manifold, silencer & chimney and other hot parts which are at lower levels & approachable for normal human height shall be provided with thermal insulation with cladding. Thermal insulation shall conform to IS 8183; thickness of insulation shall be selected such that the skin temperature will not exceed 62 Deg C. Also, hot mineral wool insulation shall be wrapped with chicken mesh and 22 SWG aluminium cladding.

23.10 COOLING SYSTEM

Shall have radiator type cooler (includes engine jacket water & cooling water) along with cooling air fan. The air to water / coolant cooler shall be of high efficiency type and the capacity of cooling coils shall be more than required for the DG sets at 110 % operation.

23.11 HOOD

Complete DG Set shall be provided with weather proof enclosure & Acoustic enclosure cum silencing hood. Enclosure shall be provided with acoustic insulation to limit the sound level. The acoustic enclosures have minimum 25 dB (A) insertion loss. However maximum level of sound at 1 meter from hood shall not exceed 85 dB (A).

Hood shall have suitable ventilation fans to expel the heat generated inside the enclosure. For the ease of erection & dismantling during maintenance the enclosure/panel shall be open able from any side of DG sets. Enclosure shall be provided with the following

- a) Lockable inspection doors.
- b) Sealed glass window for inspection & MP panel vision.
- c) Fresh air inlet acoustic louvers & fresh air chamber as required.
- d) Hot air exhaust chamber & exhaust acoustic louvers as required.
- e) Lighting inside hood.
- f) Hood panel shall be CRCA sheeting with 1.6 mm (minimum) thickness with rock wool insulation & perforated GI or aluminium sheets as lining material. Weather proof powder coating shall be provided on the outside surface of the hood.
- g) The dimensions of the hood shall be such that there will be sufficient space inside the hood for the maintenance.

23.12 FUEL OIL SYSTEM

Each DG set shall be provided with 990 Liters Day tank. Day tank shall be provided with flanged fuel inlet, outlet, high- and low-level switches, float valve etc. The day tank shall be provided with level gauge calibrated in liters for easy filling in of fuel. Fuel outlet of day tank to be connected to the fuel supply / feed line of DG set. Fuel return line from the DG set shall be connected back to the day tank. Drain cock shall be provided. The oil tanks shall be mounted on a self-supported steel structure frame.

The fuel oil tanks shall be per IS: 803, 1976 & shall be provided with reinforcement plates (not less than 3mm) inlet & outlet nozzles, hand hole, Vents, drains, earthing etc. Except vent, interconnection and overflow nozzles.

Suitable fuel oil filters (preferably dual filters) to supply clean fuel oil to engine shall be provided in DG set/s. Necessary differential pressure measurement & mechanical clogging indicator to be provided across fuel filter.

A float valve between high level switch & tank overflow in day tank shall be provided so that in case of high-level switch malfunction, the tank will be isolated from incoming fuel oil to avoid over flow. Fuel oil system shall be complete with oil pipelines (including pipeline from day tanks to engine), fittings, valves, flow meters etc. HSD pipe lines shall conform to ASTM A106 grade B, Sch. 40, ANSI B 36.1 & fittings shall confirm to ASTM A105 / A216, ANSI B16.11 & B16.9 thickness matching to the pipe thickness.

23.13 COUPLING & BASE FRAME

Coupling of diesel engine & alternator shall be flexible type. The coupling shall be efficient type with minimum loss of power & minimum vibration transmitted during operation due to possible misalignment and unbalances. Anti-vibration pads shall be provided to reduce the vibration to the floor/ foundation & other equipment's.

23.14 CONTROLS & INSTRUMENTATION

DG set shall have Auto Mains Failure feature & can start automatically during power outage. DG set will be provided with Skid mounted control panel controlling the operation & functions of the DG sets. The D.G. shall be self-sufficient W.R.T system control. DG set/s shall be provided with mounted microprocessor-based control panel. Sufficient measurements, interlocks and controls shall be provided for efficient operation as well as for safety of equipment and operating personnel set/s & accessories shall be provided with all instruments necessary to check the DG sets system parameters & check its performance continuously.

23.15 BRIEF TECHNICAL DETAILS OF ELECTRICAL EQUIPMENT

1. Generator

The main parameters of generator would be as follows: -

- i) Power factor - 0.8 (lagging)
- ii) Rated voltage - 11 kV+ 10%, 3 phases, 50Hz, +3%.

The generators shall be driven by the diesel engine as described above. The generators shall also conform to IEC-34/IS-4722 or equivalent.

Generator shall be capable of carrying an unbalanced load of 20% without injurious heating of any part provided rated current is not exceeded.

The generator shall withstand without mechanical injury an over speed of twenty (20) percent for a period of two (2) minutes. The generator stator and rotor windings shall have Class-F insulation meeting the temperature rise limitations for Class-B.

2. Generator Excitation System

A complete generator excitation and voltage regulation system shall be provided with the generator. The excitation shall be of static type or brushless type.

3. Terminal Box

Suitable Alternator Terminal Box duly painted shall be provided towards power output side as well as towards neutral side.

4. Control & Relay Panel

The emergency diesel generator shall be driven from the control panel of the D.G. set to facilitate automatic and manual starting of the set. A composite relay and metering panel housing composite Microprocessor based Numerical generator management relays and meter in equipment as well as synchronization arrangement and a separate control cum battery charging panel shall be provided individually for the DG set. Including the NGR panels located in the MRSS building.

The proposed emergency power system envisaged will conform to latest norms, as applicable.

HT/LT cables: 11 kV (UE) cables shall be heavy duty, XLPE insulated, PVC sheathed multi core, aluminium conductor.

5. steel wire/strip armoured type.

Power Cables for kV system shall be heavy duty, 1.1 kV grade, XLPE insulated PVC sheathed aluminium conductor, armoured / unarmoured as required. The control cables shall be multi strand copper conductor, PVC insulated and PVC sheathed with minimum cross section of 2.5 sq.mm for control circuit and 4.0sq.mm for power circuit. Five to ten core cables will have one spare core, and cables above 10 cores will have minimum 20% spare cores.

6. Earthing & Lightning Protection.

The lightning protection system of the DG station will be designed based on IS 2309:1969. The Earthing system of the DG station shall be designed based on IS 3043:1987. illumination inside DG enclosure is proposed using LED type lighting fixtures. Wherever applicable, weather proof outdoor type fixtures, flame proof fittings, flame proof junction boxes, switches etc., are envisaged.

25 Illumination

Illumination inside DG enclosure is proposed using LED type lighting fixtures. Wherever applicable, weather proof outdoor type fixtures, flame proof fittings, flame proof junction boxes, switches etc., are envisaged.

25.1 Reference codes & standards

Sl. No.	Design standard	Standard	Description
1.	ISO	ISO: 8528	Reciprocating internal combustion engine driven alternating current generating sets
2.	ISO	ISO: 3046	Reciprocating internal combustion engines
3.	IS	IS: 8183	Bonded mineral wool specification.
4.	BIS	IS: 10987	Code of practice for design, testing and installation of under-ground/above-ground horizontal cylindrical steel storage tanks for petroleum products
5.	BIS	IS: 803	Code of Practice for Design Fabrication and Erection of Vertical Mild Steel Cylindrical Welded Oil Storage Tanks
6.	API	API 650	Welded steel tanks for oil storage
7.	ANSI	ANSI B 31.1	Power piping code
8.	ANSI	ANSI B 31.3	Process piping code
9.	BIS	IS: 1239 (Part-I)	Steel tubes, tubulars and other wrought steel fittings - Specification
10.	BIS	IS: 1239 (Part-II)	Steel tubes, tubulars and other wrought steel fittings - Specification
11.	BIS	IS: 3589	Electrically welded steel pipes for water, and sewerage (168.3 to 2540 2000).
12.	BIS	IS: 5504	Spiral welded pipes
13.	ASTM	ASTM A 106 Gr. B	ERW & Seamless CS pipe specification
14.	ASTM	ASTM A 53	MS pipe specification
15.	ANSI	ANSI B 36.1	Welded & seamless wrought steel pipe dimensions
16.	ANSI	ANSI B 36.19	Stainless Steel pipes dimensions

17.	ANSI	ANSI B 16.9	Butt welding pipe fittings dimensional standard.
18.	ANSI	ANSI B 16.11	Forged steel fittings: Socket welded & threaded
19.	BIS	IS: 6392	Steel pipe flanges.
20.	ANSI	ANSI B 16.5	CS pipe flanges & flanged fittings
21.	ISO	ISO:17192	Metal ball valves for petroleum, petrochemical and allied industries
22.	BS	BS: 5155	CI & carbon steel butterfly valve for general purpose
23.	BS	BS: 5158	CI & carbon steel plug valve for general purpose
24.	API	API: 602	Steel gate, globe & check valves for sizes pns 4 (ND100) and smaller for the petroleum and natural gas industries.
25.	BS	BS: 5352	Steel wedge gate, globe and check valves 50 mm and smaller for the petroleum, petrochemical and allied industries.
26.	API	API: 600	Gate valves f or petroleum & natural gas.
27.	BS	BS: 1414	Specification for steel wedge gate valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries
28.	BS	BS: 1873	Specification for steel globe and globe stop and check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries
29.	BS	BS: 1868	Specification for steel check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries.
30.	API	API: 599	Metal plug valves - Flanged, threaded, and welding ends
31.	API	API 598	Valve inspection & testing.
32.	BIS	IS: 2002	Steel plate for pressure vessel for intermediate and high temperature service including boilers.
33.	BIS	IS:2062	Hot rolled medium and high tensile structural steel – Specification.
34.	BIS	IS: 1387	General requirements for the supply of metallurgical materials.
35.	BIS	IS: 7307	Fusion welding of steel.

36.	BIS	IS: 7310	Approval Tests for Welders Working to Approved Welding Procedures.
37.	API	API: 1104	Welding of Pipelines and Related Facilities.
38.	ASTM	ASTM Sec. 5	Non-Destructive examination.
39.	ASME	ASME Sec 9	ASME boiler & pressure vessel code.
40.	BIS	IS: 1447	Code of practice for painting of ferrous metals in buildings.
41.	BIS	IS: 5	Colours for Ready Mixed Paints and Enamels.
42.	-	-	Indian Petroleum rules.
43.	-	-	Central Pollution Control Board standards.

The BEML plant for rolling stock manufacturing will consist of industrial units, administrative blocks, utilities and service facilities. The campus is designed to promote sustainability by utilizing green building concepts through

- a) Minimum disturbance to landscape and site conditions with better storm water management facilities. Proper care for preventing soil erosion during construction activities shall be taken as well as to protect natural drainage
- b) Avoid, reduce and control environmental pollution arising from the plant. As such air pollution is not emanated from the plant. The DG sets employed will conform to CPCB standards.
- c) Waste water recycling in STP. The recycled water will be used for green belt development and other activities thus decreasing the dependency on fresh water.
- d) In this site the green belt is planned with native species of the region as they will survive easily in the environment. With the use of native species, the ecosystem is also maintained. Treated water shall be used in arboriculture so as to reduce the consumption of portable water.
- e) Rain water harvesting, reuse of treated water and conservation of potable water.
- f) Energy efficient and eco-friendly illumination like usage of LED, efficient air condition system with controls.
- g) Solar panels are proposed over shop building to harness solar energy in a bid to utilise renewable energy
- h) Building orientation to take advantage of solar access, shading and natural lighting and effects of micro climate on building.
- i) Environmentally friendly building materials for construction like fly ash-based cement, low VOC paints, bamboo based/ engineered wood instead of virgin wood.
- j) Efficient solid waste management system by minimize landfill by employing reuse, recycling and energy recovery technologies. Some of the practices to be employed are segregation of wastes at source, proper handling and management of hazardous waste, treatment of organic waste. Construction waste management strategy will be developed

to reduce construction waste to either reuse them at site for handed over to authorized agencies for recycling.

26. FURNITURE SPECIFICATION

26.1 L- Shape workstation (L1800/1500 x D600 x H750mm) + Metal Pedestal Unit: as per below specs. (warranty- 5 years) For Executives in Grade 4-5.

Partition based workstation with hollow partition of 69-75mm thickness. Partition is Tile based Aluminium Frames of 69-75mm thickness of height 1200mm-1230mm made of 1.2 - 1.25 mm thick Aluminium Profiles epoxy powder coating including skirting of 100-150mm high with leveller and have 45-50mm clear space between two tiles for wire management facilities. Aluminium parts shall have epoxy powder coating min 45microns. Cover Section (Raceways) coming above/below the worktop 85-100mm height made up of 0.7-1.0mm thick zincd /CRCA powder coated steel and the Worktop 1800x1500mm in one piece is made of 25 mm thick E 1-Grade / Green prelaminated particleboard of approved shade supported by 1.2mm-2mm. thick, epoxy powder coated steel brackets. All flat edges shall be finished with hot melt PVC edge banding of 2mm Thickness on User Side and 0.8mm thick on other sides. Fabric tiles along with One Glass Marker and One magnetic pinup Tile shall be provided for each user above the work surface and Metal Powder Coated Tiles below the worktops. All worktops are closed with 25 mm thick E 1-Grade / Green prelaminated particleboard gable end of approved shade supported by 1.2mm-2mm. thick, epoxy powder coated steel brackets on both sides. Trims: Extruded aluminium, epoxy powder coated colour of min 45microns thickness. Each Workstation has a 3 Drawer (2 Drawer + 1 Filing) Mobile pedestal (Metal) unit of size 450 Width. Height 640-680mm and Depth 500mm, lockable with keys. Front and Body: 0.7 /0.8mm. Powder coated steel. Castors: 2 Front Lockable Castors & 2 Std Castors. Metal Key Board Tray powder Coated and Floor CPU Trolley on Castors is included in each workstation. Workstations should be as per cluster drawings attached with the tender.

26.2 L- Shape workstation (L1500/1500 x D600 x H750mm) + Metal Pedestal Unit: - as per below specs. (warranty- 5 years) For Executives in Grade 1-3 and supervisory personnel

Partition based workstation with hollow partition of 69-75mm thickness. Partition is Tile based Aluminium Frames of 69-75mm thickness of height 1200mm-1230mm made of 1.2 - 1.25 mm thick Aluminium Profiles epoxy powder coating including skirting of 100-150mm high with leveller and have 45-50mm clear space between two tiles for wire management facilities. Aluminium parts shall have epoxy powder coating min 45microns. Cover Section (Raceways) coming above/below the worktop 85-100mm height made up of 0.7-1.0mm thick zincd /CRCA powder coated steel and the Worktop 1500x1500mm in one piece is made of 25 mm thick E 1-Grade / Green prelaminated particleboard of approved shade supported by 1.2mm-

2mm. thick, epoxy powder coated steel brackets. All flat edges shall be finished with hot melt PVC edge banding of 2mm Thickness on User Side and 0.8mm thick on other sides. Fabric tiles along with One Glass Marker and One magnetic pinup Tile shall be provided for each user above the work surface and Metal Powder Coated Tiles below the worktops. All worktops are closed with 25 mm thick E 1-Grade / Green prelaminated particleboard gable end of approved shade supported by 1.2mm-2mm. thick, epoxy powder coated steel brackets on both sides. Trims: Extruded aluminium, epoxy powder coated colour of min 45microns thickness. Each Workstation has a 3 Drawer (2 Drawer + 1 Filing) Mobile pedestal (Metal) unit of size 450 Width. Height 640-680mm and Depth 500mm, lockable with keys. Front and Body: 0.7 /0.8mm. Powder coated steel. Castors: 2 Front Lockable Castors & 2 Std Castors. Item is inclusive of keyboard tray & CPU trolley; sizes will be as per drawing.

26.3 Linear workstation (L1200 x D600 x H750mm) + Metal Pedestal Unit: - as per below specs. (warranty- 5 years) For Workmen/Technicians

Partition based workstation with hollow partition of 69-75mm thickness. Partition is Tile based Aluminium Frames of 69-75mm thickness of height 1200mm-1230mm made of 1.2-1.25 mm thick Aluminium Profiles epoxy powder coating including skirting of 100-150mm high with leveller and have 45-50mm clear space between two tiles for wire management facilities. Aluminium parts shall have epoxy powder coating min 45microns. Cover Section (Raceways) coming above/below the worktop 85-100mm height made up of 0.7-1.0mm thick zinc /CRCA powder coated steel and the Worktop 1200x600mm in one piece is made of 25 mm thick E 1-Grade / Green prelaminated particleboard of approved shade supported by 1.2mm-2mm. thick, epoxy powder coated steel brackets. All flat edges shall be finished with hot melt PVC edge banding of 2mm Thickness on User Side and 0.8mm thick on other sides. Fabric tiles along with One Marker and One magnetic pinup Tile shall be provided for each user above the work surface and Metal Powder Coated Tiles below the worktops. All worktops are closed with 25 mm thick E 1-Grade / Green prelaminated particleboard gable end of approved shade supported by 1.2mm-2mm. thick, epoxy powder coated steel brackets on both sides. Trims: Extruded aluminium, epoxy powder coated colour of min 45microns thickness. Each Workstation has a 3 Drawer (2 Drawer + 1 Filing) Mobile pedestal (Metal) unit of size 450 Width. Height 640-680mm and Depth 500mm, lockable with keys. Front and Body: 0.7 /0.8mm. Powder coated steel. Castors: 2 Front Lockable Castors & 2 Std Castors. Item is inclusive of keyboard tray & CPU trolley; sizes will be as per drawing.

26.4 AGM/DGM Workstation - as per below given sizes & Metal Pedestal unit.

Main Table (750 mm high & 750mm wide): Top: 25 mm. thick particle board (E1-Grade) clad with 0.6mm thick post formed laminate with flat edge duly sealed with 2mm thick PVC

Edge-banding: 2 mm. PVC edge-banding

Modesty: 18mm thick Particle Board (E-1 Grade / Green). Gable: 25 mm. thick pre-laminate particle board (E1-Grade / Green). Edge-banding 2 mm PVC edge-banding. Height adjustable levellers in Gable end.

Side Table (750mm high & 500mm wide) :25 mm. thick particle board (E1-Grade / Green) clad with 0.6mm thick post formed laminate with 0.4mm backing laminate with flat edge duly sealed with 2mm thick PVC Edge-banding. Main Table and Side Table Joint are Male /Female Joint for Neat finishing without any gap at Joining of 2 Post formed Worktops.

Back Console (750mm high & 400mm wide) :25 mm. thick particle board (E1-Grade / Green) clad with 0.6mm thick post formed laminate with 0.4mm backing laminate with flat edge duly sealed with 2mm thick PVC Edge-banding. Side Table and back Console Joint are Male /Female Joint for Neat finishing without any gap at Joining of 2 Post formed Worktops. Back Console shall be inclusive of storage shelves and shutters (Prelaminated) with necessary edge banding in 18mm thk. & supporting hardware. (handles & Hinges)

Mobile Pedestal: 3 Drawer (2 Drawer + 1 Filing) Mobile pedestal (Metal) unit of size 450 Width. Height 640-680mm and Depth 500mm, lockable with keys. Front and Body: 0.7 /0.8mm. Powder coated steel. Castors: 2 Front Lockable Castors & 2 Std Castors. Item is inclusive of front table, side table, back console, keyboard tray & CPU trolley; sizes will be as per drawing.

(warranty- 5 years)

Length - M.T.1650 mm, S.T.1000 mm, B.C.1500mm

26.5 GM/Cabin Table: Manufacturing, providing and placing in position machine made factory assembled Table,(as per finally approved sample by department) of following dimensions with the following specifications. (warranty- 5 years)

Cabin Table top and under structure should be made of minimum 25mm. thick Particle Board (E-1 Grade), melamine finishes with matched 2 mm PVC edge-banding. E1 grade laminate with zero urea formaldehyde emissions ($\leq 8\text{mg}/100\text{ g}$ oven dry board-perforated method) for better in-house quality. This should comply with (EN 120-1992). The height of table top shall be 740-760 mm from ground level. The particle board should be E-1 Grade with pvc edge banding. Understructure :Melamine legs made of minimum 25mm thick particle board. The exposed edge of worktop shall be secured with 1.5 mm-2 mm thick PVC edge banding tape of approved colour. The modesty panel should be provided with 19 mm thick made of Particle board wood Grade E-1 (Environmental Friendly) thickness 25 mm. ,cover with Melamine. The height of Modesty panel should be 600mm. Each table should have 3 drawer pedestal made of 25mm. thick Particle Board (E-1 Grade), melamine finishes with matched 2 mm PVC edge-banding. E1 grade laminate with zero urea formaldehyde emissions ($\leq 8\text{mg}/100\text{ g}$ oven dry board-perforated method) for better in-house quality. This should comply with (EN 120-1992). All hardware shall be of approved make. Wiremanagement : wire management through flat top matching with table top finish.

Providing and fixing Low Height Storages , Body (top, side & back) of storages should be made out of 19 mm thick E1 grade particle board with 2mm thick pvc edge banding & only top thickness is 25mm thick, Shelf of storages should be made out of 16 mm e1 grade particle board with 2mm thick pvc edge banding and able to withstand with UDL of 45 kgs. Doors made out 16 mm thick Particle Board (E-1 Grade), melamine finishes with 2 mm PVC edge-banding

fitted with extruded aluminium handle, as per requirement. Storages should be provided with adjustable levellers. Door Lock should be of three-way lock mechanism, the hinged doors can be locked at once. Door should be provided with Hinge-damping mechanism to enable soft closing of doors . E1 grade laminate to be used which provide no urea formaldehyde emission and formaldehyde should be phenol base with emission of not more than ($\leq 8\text{mg}/100\text{ g}$ oven dry board-perforated method) for better in-house quality. This should comply with (EN 120-1992). Item is inclusive of front table, side table, back console, keyboard tray & CPU trolley; sizes will be as per drawing.

Cabin Table of size: Main Table- 2100 x 900 mm; Side table- 1200 x 600 mm; Back console 2100 x 550 mm; 740-760 H mm

26.6 CGM/Executive Director desk

ED Cabin Table: Manufacturing, providing and placing in position machine made factory assembled Table,(as per finally approved sample by department) of following dimensions with the following specifications. (warranty- 5 years).

Cabin Table top and under structure should be made of minimum 38mm. thick Particle Board (E-1 Grade), melamine finishes with matched 2 mm PVC edge-banding. E1 grade laminate with zero urea formaldehyde emissions ($\leq 8\text{mg}/100\text{ g}$ oven dry board-perforated method) for better in-house quality. This should comply with (EN 120-1992). The height of table top shall be 740-760 mm from ground level. The particle board should be E-1 Grade with pvc edge banding. Understructure : Melamine legs made of minimum 38mm thick particle board. The exposed edge of worktop shall be secured with 1.5 mm-2 mm thick PVC edge banding tape of approved colour. The modesty panel should be provided with 19 mm thick made of Particle board wood Grade E-1 (Environmentally Friendly) thickness 25 mm., cover with Melamine. The height of Modesty panel should be 600mm. Each table should have 3 drawer pedestal made of 25mm. thick Particle Board (E-1 Grade), melamine finishes with matched 2 mm PVC edge-banding. E1 grade laminate with zero urea formaldehyde emissions ($\leq 8\text{mg}/100\text{ g}$ oven dry board-perforated method) for better in-house quality. This should comply with (EN 120-1992). All hardware shall be of approved make. Wiremanagement : wire management through flattop matching with table top finish.

Providing and fixing Low Height Storages , Body (top, side & back) of storages should be made out of 19 mm thick E1 grade particle board with 2mm thick pvc edge banding & only top thickness is 25mm thick, Shelf of storages should be made out of 16 mm e1 grade particle board with 2mm thick pvc edge banding and able to withstand with UDL of 45 kgs. Doors made out 16 mm thick Particle Board (E-1 Grade), melamine finishes with 2 mm PVC edge-banding fitted with extruded aluminium handle, as per requirement. Storages should be provided with adjustable levellers. Door Lock should be of three-way lock mechanism, the hinged doors can be locked at once. Door should be provided with Hinge-damping mechanism to enable soft closing of doors . E1 grade laminate to be used which provide no urea formaldehyde emission and formaldehyde should be phenol base with emission of not more than ($\leq 8\text{mg}/100\text{ g}$ oven dry board-perforated method) for better in-house quality. This should comply with (EN 120-

1992). Item is inclusive of front table, side table, back console, keyboard tray & CPU trolley; sizes will be as per drawing.

26.7 ED Cabin Table of size: Main Table- 3000 x 900 mm; Side table- 1250 x 600 mm; Back console 3300 x 550 mm; 740-760 H mm

26.8 SA Cabin Table : Manufacturing, providing and placing in position machine made factory assembled Table,(as per finally approved sample by department) of following dimensions with the following specifications. (warranty- 5 years)

Cabin Table top and under structure should be made of minimum 25mm. thick Particle Board (E-1 Grade), melamine finishes with matched 2 mm PVC edge-banding. E1 grade laminate with zero urea formaldehyde emissions ($\leq 8\text{mg}/100\text{ g}$ oven dry board-perforated method) for better in-house quality. This should comply with (EN 120-1992). The height of table top shall be 740-760 mm from ground level. The particle board should be E-1 Grade with pvc edge banding. Understructure : Melamine legs made of minimum 25mm thick particle board. The exposed edge of worktop shall be secured with 1.5 mm-2 mm thick PVC edge banding tape of approved colour. The modesty panel should be provided with 19 mm thick made of Particle board wood Grade E-1 (Environmentally Friendly) thickness 25 mm. ,cover with Melamine. The height of Modesty panel should be 600mm. Each table should have 3 drawer pedestal made of 25mm. thick Particle Board (E-1 Grade), melamine finishes with matched 2 mm PVC edge-banding. E1 grade laminate with zero urea formaldehyde emissions ($\leq 8\text{mg}/100\text{ g}$ oven dry board-perforated method) for better in-house quality. This should comply with (EN 120-1992). All hardware shall be of approved make. Wire management : wire management through flattop matching with table top finish. Item is inclusive of front table, side table, back console, keyboard tray & CPU trolley; sizes will be as per drawing.

Providing and fixing Low Height Storages , Body (top, side & back) of storages should be made out of 19 mm thick E1 grade particle board with 2mm thick pvc edge banding & only top thickness is 25mm thick, Shelf of storages should be made out of 16 mm e1 grade particle board with 2mm thick pvc edge banding and able to withstand with UDL of 45 kgs. Doors made out 16 mm thick Particle Board (E-1 Grade), melamine finishes with 2 mm PVC edge-banding fitted with extruded aluminium handle, as per requirement. Storages should be provided with adjustable levellers. Door Lock should be of three-way lock mechanism, the hinged doors can be locked at once. Door should be provided with Hinge-damping mechanism to enable soft closing of doors . E1 grade laminate to be used which provide no urea formaldehyde emission and formaldehyde should be phenol base with emission of not more than ($\leq 8\text{mg}/100\text{ g}$ oven dry board-perforated method) for better in-house quality. This should comply with (EN 120-1992).

SA Cabin Table of size: Main Table- 1650 x 750 mm; Side table- 1000 x 500 mm; Back console 1650 x 400 mm; 740-760 H mm

26.9 CMD desk

Manufacturing, providing and placing in position machine made factory assembled Table,(as per finally approved sample by department) of following dimensions with the following specifications. (warranty- 8 years)

Cabin Table top and under structure should be made of minimum 38mm. thick Particle Board (E-1 Grade), melamine finishes with matched 2 mm PVC edge-banding.E1 grade laminate with zero urea formaldehyde emissions ($\leq 8\text{mg}/100\text{ g}$ oven dry board-perforated method) for better in-house quality. This should comply with (EN 120-1992). The height of table top shall be 740-760 mm from ground level. The particle board should be E-1 Grade with pvc edge banding.Understructure :Melamine legs made of minimum 38mm thick particle board. The exposed edge of worktop shall be secured with 1.5 mm-2 mm thick PVC edge banding tape of approved colour. The modesty panel should be provided with 19 mm thick made of Particle board wood Grade E-1 (Environmental Friendly) thickness 25 mm. ,cover with Melamine. The height of Modesty panel should be 600mm. Each table should have 3 drawer pedestal made of 25mm. thick Particle Board (E-1 Grade), melamine finishes with matched 2 mm PVC edge-banding.E1 grade laminate with zero urea formaldehyde emissions ($\leq 8\text{mg}/100\text{ g}$ oven dry board-perforated method) for better in-house quality. This should comply with (EN 120-1992). All hardware shall be of approved make. Wiremanagement : wire management through flattop matching with table top finish.

Providing and fixing Low Height Storages , Body (top, side & back) of storages should be made out of 19 mm thick E1 grade particle board with 2mm thick pvc edge banding & only top thickness is 25mm thick, Shelf of storages should be made out of 16 mm e1 grade particle board with 2mm thick pvc edge banding and able to withstand with UDL of 45 kgs.Doors made out 16 mm thick Particle Board (E-1 Grade), melamine finishes with 2 mm PVC edge-banding fitted with extruded aluminium handle, as per requirement. Storages should be provided with adjustable levellers. Door Lock should be of three-way lock mechanism, the hinged doors can be locked at once. Door should be provided with Hinge-damping mechanism to enable soft closing of doors . E1 grade laminate to be used which provide no urea formaldehyde emission and formaldehyde should be phenol base with emission of not more than ($\leq 8\text{mg}/100\text{ g}$ oven dry board-perforated method) for better in-house quality. This should comply with (EN 120-1992). Item is inclusive of front table, side table, back console, keyboard tray & CPU trolley; sizes will be as per drawing.

CMD Cabin Table of size: Main Table (3300 X 900) Side Table (1250 X 600) 740-760Hmm , Back storage of size: 3900+3300 mm X 550mm 740-760Hmm

26.10 Director desk

DIRECTOR & ED Cabin Table : Manufacturing, providing and placing in position machine made factory assembled Table,(as per finally approved sample by department) of following dimensions with the following specifications. (Warranty -8 years)

Cabin Table top and under structure should be made of minimum 38mm. thick Particle Board (E-1 Grade), melamine finishes with matched 2 mm PVC edge-banding.E1 grade laminate with zero urea formaldehyde emissions ($\leq 8\text{mg}/100\text{ g}$ oven dry board-perforated method) for

better in-house quality. This should comply with (EN 120-1992). The height of table top shall be 740-760 mm from ground level. The particle board should be E-1 Grade with pvc edge banding. Understructure : Melamine legs made of minimum 38mm thick particle board. The exposed edge of worktop shall be secured with 1.5 mm-2 mm thick PVC edge banding tape of approved colour. The modesty panel should be provided with 19 mm thick made of Particle board wood Grade E-1 (Environmental Friendly) thickness 25 mm. ,cover with Melamine. The height of Modesty panel should be 600mm. Each table should have 3 drawer pedestal made of 25mm. thick Particle Board (E-1 Grade), melamine finishes with matched 2 mm PVC edge-banding. E1 grade laminate with zero urea formaldehyde emissions ($\leq 8\text{mg}/100\text{ g oven dry board-perforated method}$) for better in-house quality. This should comply with (EN 120-1992). All hardware shall be of approved make. Wire management : wire management through flattop matching with table top finish.

Providing and fixing Low Height Storages , Body (top, side & back) of storages should be made out of 19 mm thick E1 grade particle board with 2mm thick pvc edge banding & only top thickness is 25mm thick, Shelf of storages should be made out of 16 mm e1 grade particle board with 2mm thick pvc edge banding and able to withstand with UDL of 45 kgs. Doors made out 16 mm thick Particle Board (E-1 Grade), melamine finishes with 2 mm PVC edge-banding fitted with extruded aluminium handle, as per requirement. Storages should be provided with adjustable levellers. Door Lock should be of three-way lock mechanism, the hinged doors can be locked at once. Door should be provided with Hinge-damping mechanism to enable soft closing of doors . E1 grade laminate to be used which provide no urea formaldehyde emission and formaldehyde should be phenol base with emission of not more than ($\leq 8\text{mg}/100\text{ g oven dry board-perforated method}$) for better in-house quality. This should comply with (EN 120-1992). Item is inclusive of front table, side table, back console, keyboard tray & CPU trolley; sizes will be as per drawing.

26.11 Director Cabin Table of size: 3300mm x 900mm Front Table, 1250mm x 600mm Side Table & 2700mm (900+1800) x 600mm Back Storage with all table Height as 740-760mm

26.12 PS Tables

PA Cabin Table: Manufacturing, providing and placing in position machine made factory assembled Table, (as per finally approved sample by department) of following dimensions with the following specifications. (warranty- 5 years)

Cabin Table top and under structure should be made of minimum 25mm. thick Particle Board (E-1 Grade), melamine finishes with matched 2 mm PVC edge-banding. E1 grade laminate with zero urea formaldehyde emissions ($\leq 8\text{mg}/100\text{ g oven dry board-perforated method}$) for better in-house quality. This should comply with (EN 120-1992). The height of table top shall be 740-760 mm from ground level. The particle board should be E-1 Grade with pvc edge banding. Under structure: Melamine legs made of minimum 25mm thick particle board. The exposed edge of worktop shall be secured with 1.5 mm-2 mm thick PVC edge banding tape of approved colour. The modesty panel should be provided with 19 mm thick made of Particle board wood Grade E-1 (Environmentally Friendly) thickness 25 mm., cover with Melamine. The height of Modesty panel should be 600mm. Each table should have 3 drawer pedestals

made of 25mm. thick Particle Board (E-1 Grade), melamine finishes with matched 2 mm PVC edge-banding. E1 grade laminate with zero urea formaldehyde emissions ($\leq 8\text{mg}/100\text{ g}$ oven dry board-perforated method) for better in-house quality. This should comply with (EN 120-1992). All hardware shall be of reputed make/brand as per sample finally approved by the department. Micromanagement : wire management through flattop matching with table top finish.

Providing and fixing Low Height Storages , Body (top, side & back) of storages should be made out of 19 mm thick E1 grade particle board with 2mm thick pvc edge banding & only top thickness is 25mm thick, Shelf of storages should be made out of 16 mm e1 grade particle board with 2mm thick pvc edge banding and able to withstand with UDL of 45 kgs. Doors made out 16 mm thick Particle Board (E-1 Grade), melamine finishes with 2 mm PVC edge-banding fitted with extruded aluminium handle, as per requirement. Storages should be provided with adjustable levellers. Door Lock should be of three-way lock mechanism, the hinged doors can be locked at once. Door should be provided with Hinge-damping mechanism to enable soft closing of doors . E1 grade laminate to be used which provide no urea formaldehyde emission and formaldehyde should be phenol base with emission of not more than ($\leq 8\text{mg}/100\text{ g}$ oven dry board-perforated method) for better in-house quality. This should comply with (EN 120-1992). Item is inclusive of front table, side table, back console, keyboard tray & CPU trolley; sizes will be as per drawing.

PA Cabin Table of size: Front Table 2100 x 900mm; Side Table 1200 x 600mm; Back storage of size: 2550 x 550mm; Height 740-760 mm PA Cabin Table of size: Front Table 1950 x 900mm; Side Table 1200 x 600mm; Back storage of size: 3000 x 550mm; Height 740-760 mm

26.13 MEETING ROOM TABLES

The under structure should be self-supported/installed first without the Table Tops enabling all wiring and installation of receptacles. Table Top shall be made of 25mm thick made up of Melamine/Veneer as required, E1 grade as per approved colour and texture with matching edge PVC binding in ergonomic profile without cut-out. Di Cast Aluminium /GI, powder coated metal under structure with metal Supporting Legs. The System will have an under counter vertical riser cum table support with service shutters in powder coated metal. These will terminate under the table top. All cable management tray under each desk supported with cable snake. Flip top cover in powder coated finish with soft close hinges. The openable edge to have provision for a brush edge or appropriate bevelled edge of table edge cut profile inside, to facilitate easy cable movement and access. It should be sufficiently sized for adequate and proper access of the above-mentioned data and power provisions. Straight Metal Supporting Legs (powder coated). (warranty- 8 years)

2800mm L x 1200 mm W (08/10 PAX) Conference Room - 1 no. access flap + Box + Switch Mounting Plate of size 450mm L 5250mm L x 1350 mm W (14/16 PAX) Conference Room - 2 No. access flap + Box + Switch Mounting Plate of size 450mm L 1000mm DIA (MT Room- 4 PAX)

26.14 Auditorium / Conference Room Table

The under structure should be self-supported/installed first without the Table Tops enabling all wiring and installation of receptacles. Table Top shall be made of 25mm thick made up of Melamine/Veneer as required, E1 grade as per approved colour and texture with matching edge PVC binding in ergonomic profile without cut-out. Di Cast Aluminium /GI, powder coated metal under structure with metal Supporting Legs. The System will have an under counter vertical riser cum table support with service shutters in powder coated metal. These will terminate under the table top. All cable management tray under each desk supported with cable snake. Flip top cover in powder coated finish with soft close hinges. The openable edge to have provision for a brush edge or appropriate bevelled edge of table edge cut profile inside, to facilitate easy cable movement and access. It should be sufficiently sized for adequate and proper access of the above-mentioned data and power provisions. Straight Metal Supporting Legs (powder coated). (warranty- 8 years)

Size: 10800mm x 600mm LINEAR SHAPE

26.15 Storage (warranty- 5 years)

Providing and fixing Medium Height Storages of Size 750mm W x 450mm D x 1200mm H, Body (top, side & back) of storages should be made out of 19 mm thick E1 grade particle board with 2mm thick pvc edge banding, Shelf of storages should be made out of 19mm thick E1 grade particle board with 2mm thick pvc edge banding and able to withstand with UDL of 45 kgs. Powder coating should be scratch resistance (cross hatch test 6x6 grid method). Doors made out 25 mm thick Particle Board (E-1 Grade), melamine finishes with 2 mm PVC edge-banding. E1 grade laminate to be used which provide no urea formaldehyde emission and formaldehyde should be phenol base with emission of not more than ($\leq 8\text{mg}/100\text{ g oven dry board-perforated method}$) for better in-house quality. This should comply with (EN 120-1992). Front of low height Storages should be made out of metal or 16 mm. thick Particle Board (E-1 Grade), melamine finishes with 2 mm. PVC edge-banding fitted with extruded aluminium handle, as per requirement. Storages should be provided with adjustable levellers. Door Lock should be of three-way lock mechanism, the hinged doors can be locked at once. Door should be provided with Hinge-damping mechanism to enable soft closing of doors

Storage of size: 750W x450D 1200Hmm

Providing and placing Prelaminated Particle Board (E-1 Grade / Green) **Overhead storage** with openable doors of 600 mm(ht), made up of 18mm thick prelaminated particle board with PVC edge banding and locking arrangement. Storage body is made of 18mm thick pre laminated particle Board conforming to IS : 12823 Interior Grade, The back of the unit is made from 18mm prelaminated board. All the exposed edges are with 2mm PVC edge Imported banding & sealed edges are with 0.8mm thick PVC Imported edge banding. The top, side and hinged shutters are sealed with 2mm thick PVC edge banding. The shelves are height Adjustable . The units are assembled by knock down fittings such as Minifix & Dowels. All the hardware and Hinges are from Hettich/Ebco. Storage has Brushed SS finish handles and lock . Prelam storage unit of 600mm ht and 450mm depth (SQMT) RO . Units in standard width of 600mm / 750mm / 900mm.

26.16 Under Counter Storages 850 mm high and 600 mm deep:- Providing & fixing Under counter storages for pantry & basin as per drawing . The overall Structure made in 19mm thick BWP ply and approved colour Granite slab on top. Storages finished in 1 mm thick laminate from everywhere except outer back side of storages and also including all SS snap hinges, handles, locks etc & all necessary hardware as required. PVC lipping on all edges with matching shade, including laminated skirting in approved shade with all hardware, magnetic catchers, tower bolts, etc complete as per detailed drawings. cost include of Granite Top with half round edge polish as approved (Basic cost of Granite Rate Rs. 180/- per sft).

Electrical Panel cabinet made with laminate clad 18 mm MDF /ply, comprising of textured laminated carcass 40mm thick, with laminated shutters including air transfer grill of size 150 x 300 mm-2 nos., hardware- 300mm high SS pull handle, hinges, magnetic catchers .The back of the cabinet to have 12mm thick bison board.

26.17 On Site Furniture

Reception table made as per detail drawing & made in 19 mm thick. Commercial board and finished in 1mm thick laminate from inside as per approved & outer surface will be 18mm thk. Italian marble clad as per approval, complete with drawer units, shutter and all hardware complete. Size : 3600 mm l X 750 mm W X 1050 mm H (Base rate rs. 450 / sqft.)

Reception table made as per detail drawing & made in 19 mm thick. Commercial board and finished in 1mm thick laminate from inside as per approved & outer surface will be 18mm thk. Italian marble clad as per approval, complete with drawer units, shutter and all hardware complete.

Size : 2400 mm l X 750 mm W X 1050 mm H (Base rate rs. 450 / sqft.)

Librarian table made as per detail drawing & made in 19 mm thick. Commercial board and finished in 1mm thick laminate as per approved & 12mm thick corion cladding complete with drawer unit, shutter and all hardware complete. Size : 1800 mm long

Library reading table made as per detail drawing & made in 19 mm thick. Commercial board and finished in 1mm thick laminate as per approved with drawer unit, shutter and all hardware complete. Size : 1800 mm long.

26.17 CHAIRS (WARRANTY-8 YEARS)

WORKSTATION - Providing medium back revolving chairs for Workstations . Chair seat made up of insert moulded Polyurethane Foam upholstered with foam laminated mesh fabric, insert moulded foam assembled over a load bearing plastic seat cover, back is made up of two piece injection moulded frame, inner frame upholstered with mesh fabric and mounted on the main assembly, back adjustable lumbar support for achieving comfortable seating posture. Armrests should be adjustable with 120-160 mm adjustability with PU padded. Base: Black nylon base with 5 nos. nylon castors. Chair should be of 360 degree swivel Posture Control with multi pointer locking and synchro tilt mechanism and hydraulic gas lift gas lift to allows 90-100 mm. of height adjustment. Seat size 440 - 550 mm depth, Seat width of 530-550 mm Seat Height of 420-510mm with hydraulic height adjustability of 90-100mm. Sub assembly

back size 550 - 620 mm height. Effective back height from Seat - 570mm, polyurethane foam for seat having density 65-70 kg/m³. Pedestal made of nylon base fitted with 5 nos. twin wheel castors (castor wheel dia. 60-70 cm), base pedestal dia 60-70 mm and pitch centre dia. 700-720mm with castors, twin wheel castors injection moulded in Nylon etc. all complete as per manufacturers specification, approved sample and direction of Engineer-in-Charge. Chair should be SGS Gold BIFMA Certified product.

AGM/DGM CHAIR - Providing High back revolving chairs for DGM cabins. Chair seat made up of insert moulded Polyurethane Foam upholstered with foam laminated mesh fabric, insert moulded foam assembled over a load bearing plastic seat cover, back is made up of two piece injection moulded frame, inner frame upholstered with mesh fabric and mounted on the main assembly, back adjustable lumbar support for achieving comfortable seating posture. Armrests should be adjustable with 120-160 mm adjustability with PU padded. Base: Black nylon base with 5 nos. nylon castors. Chair should be of 360 degree swivel Posture Control with multi pointer locking and synchro tilt mechanism and hydraulic gas lift gas lift to allows 90-100 mm. of height adjustment. Seat size 440 - 550 mm depth, Seat width of 530-550 mm Seat Height of 420-510mm with hydraulic height adjustability of 90-100mm. Sub assembly back size 550 - 620 mm height. Effective back height from Seat - 570mm, polyurethane foam for seat having density 65-70 kg/m³. Pedestal made of nylon base fitted with 5 nos. twin wheel castors (castor wheel dia. 60-70 cm), base pedestal dia 60-70 mm and pitch centre dia. 700-720mm with castors, twin wheel castors injection moulded in Nylon etc. all complete as per manufacturers specification, approved sample and direction of Engineer-in-Charge. Chair should be SGS Gold BIFMA Certified product.

AGM/DGM VISITOR CHAIR -Providing medium back revolving chairs for Visitors in DGM/AGM Visitors Room . Chair seat made up of insert moulded Polyurethane Foam upholstered with foam laminated mesh fabric, insert moulded foam assembled over a load bearing plastic seat cover, back is made up of two piece injection moulded frame, inner frame upholstered with mesh fabric and mounted on the main assembly, back adjustable lumbar support for achieving comfortable seating posture. Armrests should be adjustable with 120-160 mm adjustability with PU padded. Base: Black nylon base with 5 nos. nylon castors. Chair should be of 360 degree swivel Posture Control with multi pointer locking and synchro tilt mechanism and hydraulic gas lift gas lift to allows 90-100 mm. of height adjustment. Seat size 440 - 550 mm depth, Seat width of 530-550 mm Seat Height of 420-510mm with hydraulic height adjustability of 90-100mm. Sub assembly back size 550 - 620 mm height. Effective back height from Seat - 570mm, polyurethane foam for seat having density 65-70 kg/m³. Pedestal made of nylon base fitted with 5 nos. twin wheel castors (castor wheel dia. 60-70 cm), base pedestal dia 60-70 mm and pitch centre dia. 700-720mm with castors, twin wheel castors injection moulded in Nylon etc. all complete as per manufacturers specification, approved sample and direction of Engineer-in-Charge. Chair should be SGS Gold BIFMA Certified product.

GM/CGM & ED CHAIR - Providing and placing high back chair for GM's & ED's Cabins room in leather of Reef High Back whose seat is made of medium density foam,molded plywood and upholstered with leatherite in front and back. Overall dimension: 750 mmD X

750 mmW X 1180mm H. Seat Dimension: 520mmW X 480mmD X 520mm H. The backrest is made from molded plywood and leatherite in front and back. The armrest are made of aluminium with PU padded and adjustable at 70mm. It has aluminium polished base with black nylon castors. It has knee tilt mechanism, 360 degree swivel and back tilt with multiple locking position. Gas lift allows 10mm of height adjustment. Complete as per the direction of Engineer-in-charge. Product should be BIFMA gold rated SCS global certified for in-house air quality.

GM/CGM & ED VISITOR CHAIR - Providing and placing high back chair for GM's & ED's Visitors room in leather of Reef Mid Back whose seat is made of medium density foam, molded plywood and upholstered with leatherite in front and back. Overall dimension: 750 mmD X 750 mmW X 1020mm H. Seat Dimension: 520mmW X 480mmD X 520mm H. The backrest is made from molded plywood and leatherite in front and back. The armrest are made of aluminium with PU padded and adjustable at 70mm. It has aluminium polished base with black nylon castors. It has knee tilt mechanism, 360 degree swivel and back tilt with multiple locking position. Gas lift allows 10mm of height adjustment. Complete as per the direction of Engineer-in-charge. Product should be BIFMA gold rated SCS global certified for in-house air quality.

CMD & DIRECTOR CHAIR- Providing & placing Medium Chair Size with Standard Height Range having Tilt Limiter with Fully Adjustable Arms along with Standard Arm pads having Posture Fit Support in Graphite Frame Finish and Graphite Chassis Finish with Graphite Base Finish. 2.5-inch Standard Carpet Casters Black Armpad Finish Graphite 8Z Pellicle Suspension Material (Seat and Back) **CMD & DIRECTOR VISITOR CHAIR-** Providing and placing high back chair for CMD & Director Cabins room in leather of Medium Back whose seat is made of medium density foam, molded plywood and upholstered with leatherite in front and back. Overall dimension: 750 mmD X 750 mmW X 1180mm H. Seat Dimension: 520mmW X 480mmD X 520mm H. The backrest is made from molded plywood and leatherite in front and back. The armrest are made of aluminium with PU padded and adjustable at 70mm. It has aluminium polished base with black nylon castors. It has knee tilt mechanism, 360 degree swivel and back tilt with multiple locking position. Gas lift allows 10mm of height adjustment. Complete as per the direction of Engineer-in-charge. Product should be BIFMA gold rated SCS global certified for in-house air quality.

Conference Chair - Providing & placing Task Chair with 5 star base in Polished Aluminium finish with Seat/Back in Mesh with Synchronised Tilt having 1 back Lock with 1 Directional Arms, Fixed Seat Depth, Adjustable Lumbar Support, finish in all Black Color with Backrest finish in Mesh.

Providing & placing CHAIRS for Library and Dining area as per approved design. Total Length shall be 500. Total Width shall be 450. Total Height shall be 900. Understructure shall be made of hollow Stainless Steel.

Providing & placing Chairs as per approved design. Understructure and Back are made of wood, Seat shall be having Fabric Upholstery. Size: (W)460*(D)525*(H)920mm.

26.18 SOFAS

Reception/Waiting: Supplying and Placing Leatherite sofa. The seat should be made of PU foam with Density 32 ± 2 kg/cu.mtr having an additional top layer of J PU foam with Density 28 ± 2 kg/cu. Seat should be upholstered with fabric or leatherette. 2) BACK FOAM: The back should be made of PU foam with Density 28 ± 2 kg/cu. mtr with two additional top layer of super soft foam of density 23 ± 2 kg/cu. mtr, upholstered with fabric or leatherette. Under structure should be made up of 1.2 $\pm$ 0.1 cm. thick hot pressed plywood OCP-QLTA-PL14-18 4. Dia 4mm zigzag spring assembly should be mounted in under structure for support and additional cushioning purpose .t should be a welded assembly made in Stainless steel (grade SS 202) tube & plate.

SIZE : 88.0cm (W), 92.0cm (D), 82.0cm(H), 45.0cm(SH).

Basic Rate of Leatherite/Fabric: Rs.600

Guest Room: Supplying and Placing Leatherite sofa. The seat should be made of PU foam with Density 32 ± 2 kg/cu.mtr having an additional top layer of J PU foam with Density 28 ± 2 kg/cu. Seat should be upholstered with fabric or leatherette. 2) BACK FOAM: The back should be made of PU foam with Density 28 ± 2 kg/cu. mtr with two additional top layer of super soft foam of density 23 ± 2 kg/cu. mtr, upholstered with fabric or leatherette. Under structure should be made up of 1.2 $\pm$ 0.1 cm. thick hot pressed plywood OCP-QLTA-PL14-18 4. Dia 4mm zigzag spring assembly should be mounted in under structure for support and additional cushioning purpose .t should be a welded assembly made in Stainless steel (grade SS 202) tube & plate.

SIZE : 88.0cm (W), 92.0cm (D), 82.0cm(H), 45.0cm(SH).

Basic Rate of Leatherite/Fabric: Rs.600

ED Cabin: Supplying and Placing Leather sofa. SIZE:- 920mm (W) x 920mm (D) x 890mm (H). Seat height 470mm. THREAD : Nylon

Material Handling Data Sheet (MSDS) for Glue

Standard of Plywood used: IS 303 Commercial Plywood

Thickness 12mm

Basic Rate of Leather: Rs.2500

Providing & installing Two Seater Sofa .-

1)Reception/Waiting: The seat should be made of PU foam with Density 32 ± 2 kg/cu.mtr having an additional top layer of J PU foam with Density 28 ± 2 kg/cu. Seat should be upholstered with fabric or leatherette.

2) BACK FOAM: The back should be made of PU foam with Density 28 ± 2 kg/cu. mtr with two additional top layer of super soft foam of density 23 ± 2 kg/cu. mtr, upholstered with fabric or leatherette. Under structure should be made up of 1.2 $\pm$ 0.1 cm. thick hot pressed plywood OCP-QLTA-PL14-18 4. Dia 4mm zigzag spring assembly should be mounted in under

structure for support and additional cushioning purpose .It should be a welded assembly made in Stainless steel (grade SS 202) tube & plate.

SIZE : 146.0cm (W), 92.0cm (D), 82.0cm(H), 45.0cm(SH).

Basic Rate of Leatherite/Fabric: Rs.600

Guest Room: The seat should be made of PU foam with Density 32 ± 2 kg/cu.mtr having an additional top layer of J PU foam with Density 28 ± 2 kg/cu. Seat should be upholstered with fabric or leatherette. 2 BACK FOAM: The back should be made of PU foam with Density 28 ± 2 kg/cu. mtr with two additional top layer of super soft foam of density 23 ± 2 kg/cu. mtr, upholstered with fabric or leatherette. Under structure should be made up of 1.2 ± 0.1 cm. thick hot pressed plywood OCP-QLTA-PL14-18 4. Dia 4mm zigzag spring assembly should be mounted in under structure for support and additional cushioning purpose .t should be a welded assembly made in Stainless steel (grade SS 202) tube & plate.

SIZE: 146.0cm (W), 92.0cm (D), 82.0cm(H), 45.0cm(SH).

Basic Rate of Leatherette/Fabric: Rs.600

AGM Cabin: Overall size of the sofa shall be 144cm(w)*83cm(d)*86.5cm(h)*46cm(sh).Upholstery Material shall be 1 mm thick Fabric

•Breaking Load (N) : Warp 1327 Weft 1228

•Elongation at break (%) : Warp 27.5Weft Material shall be the Combination of 12mm (moisture resistance and termite free) thick plywood and pine Wood

•Pinewood cross section (without knots)-22x64 mm-34x64 mm-16x35 mm

•Moisture content shall be 10 -12 %. Seat Material shall be Slab stock foam with density Base of 28 kg/m³ and super soft 32 kg/m³ at top.Back Material shall be Slab stock foam with density of Super soft 32 kg/m³ with a layer of siliconized conjugated polyester fiber of 200 gsm.

Basic Rate of Fabric: Rs.600

Providing & installing Three Seater Sofa .-

18.1 Reception/Waiting: The seat is made of PU foam with Density 28 ± 2 kg/cu.mtr having an additional top layer of super soft PU foam in Density 32 ± 2 kg/cu. upholstered with fabric or leatherette. BACK FOAM: The back is made of PU foam with Density 28 ± 2 kg/cu. mtr with two additional top layer of super soft foam of density 32 ± 2 kg/cu. mtr, upholstered with fabric or leatherette .Under structure is made up of 1.2 ± 0.1 cm. thick hot pressed plywood (moisture resistance & termite proof as per IS: 303) & pinewood of cross section devoid of major knots & surface defects 6 nos. per seat & 3.8 mm Dia zigzag spring assembly is mounted over under structure for cushioning purpose 6 nos. per seat & 3.8 mm Dia zigzag spring assembly is mounted over under structure for cushioning purpose. LEG ASSEMBLY: It is a welded assembly made in Stainless steel (grade SS 202) tube & plate with plastic endcap. (W) 205.5* (D) 90.5(H) 85.5 cm seat (H) 45.0 cm. Basic Rate of Leatherite/Fabric: Rs.600

CMD / Director cabin size: Supplying and Placing Leather sofa. Total Length and Height shall be -1990*885.Total Width -935.Seating Area Length - 1450.Seating Area Width - 500.Seating Area Height from Ground - 485.Arm Height and Length - 625*610.Back Height from Arm - 260.Back Width - 335.Arm Width - 300.Leg

Height - 70. Length between Legs - 1645.Width between legs - 800. STITCHING shall be done from nylon thread. LEATHER/PVC/FABRIC: (PU/PVC/Cotton/ Polyester/ Composite)- Thickness (mm): 0.75mm. Weight (GSM): - 500 MIN. Tensile Strength {wrap/weft} (Kg/cm): - 4.0/2.8. Bursting Strength (Kg/cm²): 5.5 MIN. Adhesion (PVC/PU Backing) (Kg/cm): 0.6/0.4. Colour Fastness to Rubbing {Dry /Wet} (Scale 1-5): 3-4. FRAME MATERIAL used shall be 12%. Thick Plywood. Standard of Plywood used: {Required Standard: IS 303 Commercial Plywood} Commercial Grade. SEAT FOAM: (DENSITY, TYPE). Poly in Lumber Partition Back Cushion: 0.8 Kg +0.8 Kgs+ 0.8 Kg. Poly in Upper Partition Back Cushion: 1.7Kg + 1.45Kg + 1.7Kg. ARMREST FOAM: (DENSITY, TYPE)- Poly in Each Arms: 900 grams. LEG MATERIAL: * Fixing of Leg shall be: (Self Tapping Screw / Insert with metric threading). Material of leg shall be Teak Wood. * Bush for Leg bottom shall be: (PVC bush / Felt Pad)

ED Cabin: Supplying and Placing Leather sofa. (L)1820*(H)890*(W)920

THREAD: Nylon

Material Handling Data Sheet (MSDS) for Glue

Standard of Plywood used: IS 303 Commercial Plywood

Thickness 12mm

Basic Rate of Leather: Rs.2500

P/I Five-Seater Sofa. -

Supplying & placing in position modular 4-seater Shape sofa consisting of 1 no One seater sofa and 1 no three-seater along with armrests at both the terminals Seat & Body- Under structure: Under structure is made of combination of plywood & pinewood members. Plywood is 12±1mm thk. [moisture resistance & termite proof as per IS:303] & pinewood are cross section [22x25, 22x40, 25x75 & 25x100mm] are without major knots & defects on the surface. 3mm MDF is stapled on the seat front bottom vertical surface to get the surface to stick the foam. Dia. 3.8mm zigzag spring asly. is mounted on the seat structure with spring mounting plastic bracket for support & additional cushioning purpose. Elastic belt of 2" width is used above the spring asly. to give good sagging effect. Non-woven fabric is stapled on the seat structure frame above the spring asly. to avoid the tearing of seat foam with the surface contact of metal spring. Back vertical surface is stapled with non-woven cloth to get surface to stick the foam. Complete under structure is made by gluing & stapling. • Foam: Seat is made of PU foam with density 28 kg/m³ having an additional top layer of super soft PU foam with density 18 kg/m³. Recron sheet of 230GSM is used above this foam. Seat front bottom vertical surface & back vertical surface is glued with the PU foam with density 22 kg/m³. Side vertical surface, body front taper vertical & top horizontal surface is glued with PU foam with density 16 kg/m³. •

Upholstery: Seat & body upholstery is made in the dual tone colour with fabric / fabric option & fabric / leatherite option. Back Top Cushion- Under structure: Under structure is made of combination 12±1mm & 6±1mm thk. plywood [for 2 Seater, 3 Seater & Chaise Lounge] & combination 12±1mm, 4±1mm thk. plywood & 3mm MDF [for Small Corner & Big Corner] with gluing & stapling. • Foam: It is made with super soft PU foam with density 18 kg/m³. • Upholstery: It is upholstered with fabric.

Basic Rate of Fabric: Rs.600

Providing & installing Centre Table: -

Supply and placing centre table in position with top made of 19mm thick stone top supported on SS legs under structure. The work shall be carried out as per the instructions received from engineer-incharge. Refer image attached. (Base Rate of stone rs.450/sft.)

LXWXH – 1200X600X450 mm

LXWXH – 1800X600X450 mm

Providing & installing Side Table: -

Supply and placing centre table in position with top made of 19mm thick stone top supported on SS legs under structure. The work shall be carried out as per the instructions received from engineer-in charge. Refer image attached. (Base Rate of stone rs.450/sft.)

LXWXH - 400X400X450 mm

Providing and installing 8 mm thk. Table top glass (Float Type) on all furniture including edge grinding, polishing, labour charge for placing glass tops on designated table/ workstations/ back unit/ side unit at various floors including cartages

Supply of Study Table; Size 1200L x 550W x 750H mm Made of 19mm particle board, finished in laminate as per approval.

Laminate color to be matched with the bed color.

Supply of Queen Size Bed & bedside tables (78x60 inches)

Supply of Queen size Mattress (78x60x10 inches)

Supply of Modular Wardrobe cum Dressing Table as per provided drawing.

Size: 3000L x 600W x 2400H; Made of 19mm Particle Board, finished in laminate as per approval of BEML.

Providing & placing Guest Room Chairs as per approved design. Under structure and Back are made of wood, Seat shall be having Fabric Upholstery. Size: (W)460*(D)525*(H)920mm.

CAFÉ FURNITURE

Café Chair: Providing & installing Product: Tango Single Moulded Polypropylene cafeteria stackable chair with ss legs available in red, green, black, white, orange, grey colour.

Café Table: Providing & installing

PRODUCT - CAFETERIA TABLE (PERFORM) (6PAX)

Size: 1800 x 800 x 750HT

Specification: Table top - PLB 25mm thick pre-lam particle board finished with 2mm PVC edge banding.

Under-structure - Supported on powder coated Ms sq. 50x50 legs & supporting Ms cross beam 40x20.

PRODUCT - CAFETERIA TABLE (4 PAX)

Size: 1200 x 800 x 750H

Specification: Table top - PLB 25mm thick pre-lam particle board finished with 2mm PVC edge banding.

Under-structure - Supported on Powder coated BALL base.

Café Table of 900mm Dia with metallic powder coated under structure of approved shade & 25mm the melamine top as per BEML approval (Executive Dining).

The table to have 25mm x 2mm Rehau edge banding of matching shade.

NOTE: All furniture to be supplied by EPC contractor to be BIFMA/ ANSI APPROVED. The List of furniture to be supplied annexed to the tender to be read in conjunction with referred specification. In the list against an official of a particular rank only table would have been mentioned however it shall mean all associated things such as side table, console etc complete as provided in the specification.

In pantry overhead and undercounter storage in required length is to be provided as per referred specification while architectural planning the qty of same is to assessed and to be included in price break-up.

SPECIFICATION FOR ELECTRO MECHANICAL (MOTORIZED) BED

SL NO	DESCRIPTION	BID PARAMETERS	GOLDEN PARAMETER
1	BRAND	GODREJ INTERIO/PARAMOUNT BEDS/JANAK HEALTHCARE/HILL-ROM	YES
2	TYPE OF ICU BED ACTUATOR	ELECTRO MECHANICAL MOTORIZED	YES
3	TYPE OF MECHANISM FOR FUNCTIONING OR CONTROLLING ANGULAR MOTION OF BED PART	ELECTRO MECHANICAL(MOTORIZED)/SUPER SMOOTH CRANK SCREW MECHANISM/ HYDRAULIC MECHANISM(MOTORIZED)	NO

		ELECTRO MECHANICAL(MOTORIZED)/SUPER SMOOTH CRANK SCREW MECHANISM/HYDRAULIC MECHANISM(MOTORIZED)/COUNTER WEIGHT MECHANISM	
4	TYPE OF MECHANISM FOR FUNCTIONING OR CONTROLLING HEIGHT OF BED		NO
5	MAXIMUM REVERSE TRENDLENBURG ANGLE IN DEGREE (TOLERANCE +_ 2 DEGREE)	15/20	NO
6	MAXIMUM TRENDLENBURG ANGLE IN DEGREE (TOLERANCE + 2 DEGREE)	15/20	NO
7	MAXIMUM ADJUSTABLE KNEE REST ANGLE IN DEGREE	0-40	NO
8	MAXIMUM ADJUSTABLE BACK REST ANGLE IN DEGREE	0-70	NO
9	MATERIAL FOR IV ROD WITH CHROMIUM PLATED	SS	YES
10	MATERIAL FOR WHEELS	SS/POLYESTER	NO
11	MATERIAL FOR BED TOP SECTION	SS/MS/ABS PLASTIC	NO
12	CLEARANCE BETWEEN BED BASE FRAME AND FLOOR SURFACE IN MM	150	YES
13	TYPE OF SIDE PANEL	SWING UP DOWN TYPE/DETACHABLE TYPE	NO
14	NUMBER OF SIDE PANEL	2/4	NO
15	NUMBER OF HOOKS PROVIDED IN IV ROD	2/4	NO
16	DEGREE ANGLE AND HEIGHT INDICATOR SHALL BE PROVIDED AR BOTH FOOT AND HEAD SIDE	SHOULD BE PRESENT	YES
17	POWER OF MOTOR IN HP	05 /0.8 / OR HIGHER	NO
18	ICU MATTRESS	IT SHOULD BE X RAY TRANSLUCENT	YES
19	MATTRESS	SHOULD BE PROVIDED	YES
20	MATTRESS SHOULD BE MADE OF HIGH RESILIENT AND BIO DENSITY FOAM	SHOULD BE PROVIDED	YES
21	MATTRESS SHOULD BE TRANSLUCENT TO ALLOW RADIOGRAPHY USING PORTABLE X RAY	SHOULD BE PROVIDED	YES
22	MATTRESS SHOULD BE MADE OF CUBE CUT DESIGN AND INDEPENDENT CUBE TO PROMOTE AIR FLOW TO REDUCE MOISTURE	SHOULD BE PROVIDED	YES
23	MATERIAL FOR ICU BED MATTRESS	PU FOAM	YES
24	THERAPEUTIC WEIGHT LIMIT FOR MATTRESS IN KG	150/175	NO
25	POWER SUPPLY	230 V SINGLE PHASE 50 HZ	YES
26	MATERIAL FOR FRAME OF BED	MS	YES

27	MATERIAL FOR SIDE RAILING: SIDE SAFETY GUARD	MS/ABS PLASTIC	NO
28	MATERIAL FOR HEAD AND FOOT PANEL: BOARD	MS/ABS PLASTIC	NO
29	LENGTH OF BED IN MM	2100-2200	NO
30	WIDTH OF BED IN MM	950-1000/1000-1050	NO
31	ELECTRIC SHOCK PROTECTION LEVEL CLASS B: CLASS 1	SHOULD BE PROVIDED	YES
32	SAFE WORKING LOAD CAPACITY OF THE ICU BED IN KG	200/250	NO
33	CONFIRMITY TO STANDARD FOR SAFETY AND ELECTROMAGNETIC COMPATIBILITY	IEC-60601-1-2:2001 STANDARD OR IS- 13450	YES
34	BED SHOULD HAVE RADIO TRANSLUCENT TOP (X RAY TRANSLUCENT)	SHOULD BE PROVIDED	YES
35	WARRANTY	3 YEARS OF MORE	NO
36	CERTIFICATION OF PRODUCT	EUROPEAN CE	YES

27. TECHNICAL SPECIFICATION OF GOLIATH CRANE

1. INTRODUCTION

The Gantry crane with lifting beam / girder of suitable dimension and capacity is required to be supplied installed tested and commissioned. The facility is meant for loading of finished and tested coaches on lorry for dispatch. This crane shall be reliable, trouble free and maintainable. The facility is to be installed in dispatch area year marked for metro coaches in between the two traversers. The combined track consisting of Standard gauge and broad gauge shall be laid of length 420meters between the two traversers.

The technical requirements of crane are indicated in the table below.

2. TECHNICAL REQUIREMENTS FOR 60 T GANTRY CRANE

2.1. General:

Sr. No.	Item	Parameter
1.	Type of Crane	Double girder Gantry crane (Goliath Type)
2.	Duty Class of Crane	Class M6 as per latest IS: 3177
3.	Type of Service	out-door
4.	Hoisting Capacity a. Main Hoist (MH)	60 T
5.	Atmospheric Condition	Normal atmosphere

6.	Weight Details a) Crane Weight b) Crab Weight	(To be furnished by supplier) (To be furnished by supplier)
Operating Speed (at rated load)		
7.	Long Travel Motion (L.T.)	5 & 0.5 m/min
8.	Cross Travel Motion (C.T.)	5 & 0.5 m/min
9.	Hoisting Speed (MH)	3 m/min Hoist motion shall also be provided with two slow speeds i.e. 10%, 50% of normal speed using VVVF (Variable Voltage Variable Frequency) controlled drives
Crane Performance and Structural Details		
10.	Span	8m
11.	Bay Length	60m
12.	Required lifting height (above floor)	10m
13.		

17.	Cross Travel approach for Hoist from L.T. rail (C1)	1000 mm
18.	Cross Travel approach for Hoist from L.T. rail (other side) (C2)	1200 mm
19.	Longitudinal Approach for hoists from wall (L1)	1000mm
20.	Longitudinal Approach for hoists from wall (other side) (L2)	1000mm
21.	Distance between rail brackets	8m (max)
22.	Operation of gantry crane	Through push button pendent operating from floor & Hand-Held Radio Remote Control.

3. CODES AND STANDARDS

The crane shall comply with all currently applicable statutes, regulation and safety codes relating to the design, construction and operation of cranes in the locality where the crane will be installed. No part of these specifications shall be construed to relieve the vendor of his responsibility to supply a functionally adequate crane. The crane supplied shall comply with the latest applicable Indian / International standards. Other national standards are acceptable if they are established to be equal or superior to the referred standards.

In the event of any conflict between codes, standards referred below and this specification, the requirements of this specification shall govern.

Some applicable codes are listed below;

Table 2

i.	IS : 3177 (2020)	Code of Practice for Design of E.O.T. and Gantry Cranes other than steel works Crane
ii.	IS : 807 (2014)	Code of Practice for Design, Manufacture, Erection & Testing (Structural portion) of Cranes and Hoists.
iii.	IS : 2266 (2002)	Steel Wires for Ropes for General Engineering Purposes. Hoisting rope
iv.	IS : 325 (1996)	Three Phase Induction Motors
v.	IS : 15560	Point hooks with shank up to 160 Tonne
vi.	ISO : 12488	Cranes-Tolerance for wheels and travel and traversing tracks
vii.	IS : 800 (2007)	General Construction in Steel – Code of Practice
viii.	IS 3938	Specification Electric Wire Rope Hoists [MED 14: Cranes, Lifting Chains and Related Equipment]
ix.	IS : 4460 (1995)	Gears – Spur and Helical Gears – Calculation of Load Capacity
x.	IS : 3443 (1980)	Crane Rail Section
xi.	IS : 4029	Guide for Testing Three Phase Induction Motors
xii.	IS : 694 (2010) or IS 7098 (part1)	Electric Cables. (PVC or XLPE)
xiii.	ASME Section V & IX	For non-destructive testing and welding

xiv.	IS : 961 (1975)	Structural Steel (High Tensile)
xv.	IS : 816 (1969)	Code of Practice for use of Metal Arc Welding for General Construction in Mild steel
xvi.	IS : 823 (1964)	Code of Practice for use of Metal Arc Welding of Mild steel
xvii.	IS/IEC: 60034-1(2004)	Rotating electrical Machines

MATERIAL OF CONSTRUCTION

All materials used shall be of industrially proven and sound quality. It shall conform to latest relevant standards as given below;

Table 3

i.	Steel Plates	IS-2062 Gr- E250 and quality BR
ii.	High Tensile Bolts	BS-970 (EN-24) or IS equivalent,
iii.	Hooks and Clevises	20Mn2 & IPSS or IS-1875 Class 3A
iv.	Steel Pinions / gears	BS-970 (EN-24 / En 19) or IS equivalent
v.	Steel Shafts and Axles	BS-970 (EN-8 or 9) or IS equivalent
vi.	Pins and Screws	BS-970 (EN-8) or IS equivalent
vii.	Steel Castings	IS-1030 (Gr-II)
viii.	Steel Forgings	IS-2004, Class III
ix.	Hoisting rope	IS-2266
x.	Runway track for L.T. & C. T	IS-2062 Gr- E250 and quality BR (<i>hardness of shall not be less than 200HB</i>)
xi.	Wheels	BS-970 (En-9) forged
xii.	Seamless pipe	ASTM A- 53 / 106 Grade B
xiii.	Rope drum	ASTM 106Gr-B

Purchaser may ask for additional tests, if necessary, to confirm the quality of material at vendor's cost. Manufacturer can, however, use alternative material which is superior for the intended service. But in all cases, they are required to obtain prior concurrence of the purchaser after furnishing chemical and physical properties of the offered material, and any other information that may be asked by the purchaser.

Lifting girder of commensurate length and capacity to be supplied along with goliath crane.

28. INDUSTRIAL GASES

• Introduction

BEML has proposed Rolling stock commuter Rail and Metro Cars Manufacturing plant (green field) at Bhopal, Madhya Pradesh. Industrial gases like Acetylene, Oxygen, Argon, AOM gas & ACM gas are required in the plant. The said industrial gases are required for the following purposes:

- Acetylene & Oxygen gas are required for cutting operation.
- Argon gas, AOM gas (98 % Argon + 2% Oxygen) & ACM gas (80 % Argon +20% Co2) are required for automatic & manual welding operation.

This writeup specifies the storage handling & distribution of the above industrial gases. The system description will be explained as under:

• Requirement Of the Industrial Gases:

The requirement of said industrial gases is indicated below:

TABLE SHOWING REQUIREMENT OF INDUSTRIAL GASES

Number of Days-320

<u>Description</u>	<u>Unit</u>	<u>Total Quantity Required (per annum)</u>	<u>Per day consumption (320 working days)</u>	<u>Consumption in each shift (Considering 2 shifts)</u>	<u>Consumption per hour, with each shift of 8 hours</u>	<u>No. of cylinders required for 3-days (47 L cylinder holds 7 m3 of gas @150 bar)</u>	
<u>Dissolved Acetylene Gas (DAGas)</u>	<u>Cu.M</u>	<u>36471.00</u>	<u>113.97</u>	<u>56.99</u>	<u>7.12</u>	<u>48.8</u>	<u>50</u>
<u>Compressed Oxygen Gas</u>	<u>Cu.M</u>	<u>70995.00</u>	<u>221.86</u>	<u>110.93</u>	<u>13.87</u>	<u>95.1</u>	<u>95</u>
<u>Argon Gas</u>	<u>Cu.M</u>	<u>69048.00</u>	<u>215.78</u>	<u>107.89</u>	<u>13.49</u>	<u>92.5</u>	<u>95</u>
<u>98%Argon+ 2%Oxygen (AOM Gas)</u>	<u>Cu.M</u>	<u>189627.0</u>	<u>592.58</u>	<u>296.29</u>	<u>37.04</u>	<u>254.0</u>	<u>255</u>

<u>80%Argon+</u> <u>20%Co2 (ACM</u> <u>Gas)</u>	<u>Cu.M</u>	<u>122544.0</u>	<u>382.95</u>	<u>191.48</u>	<u>23.93</u>	<u>164.1</u>	<u>165</u>

Gas storage is planned for three days i.e. If gas is continuously consumed stored gas will last for three days. In case if gas is used intermittently the gas storage will be for more than three days depending upon the consumption factor.

Refer Drg. no.: MEC-/I0047-01-04-D1-ZZ-16-DR-N-03004, PFD of industrial gas, enclosed with report.

- **Source of gas**

In the proposed plant, gas generation is not envisaged, however gas is supplied from outside in the portable receptacles / cylinders. In order to increase the gas storage volume, the pressure of the storage is considered at 150 bar & water volume of the cylinder is considered as 47 liters.

- **Proposed facilities**

Various industrial Gas requirements viz. Acetylene, Oxygen, Argon, AOM and ACM gases required for the plant will be met by the gas cylinders to be procured from any reputed vendors. Separate cylinder-manifolds-storage for each gas will be provided. These cylinders & manifolds will be installed in the central / common gas station. Gas will be supplied to various plant consumers from this common gas station.

For a given type of gas, cylinders will be connected to a common Manifold and will be operated Semi- Automatically or manually depending on the needs from the users. The manifold will house the primary regulator, which will bring down the gas pressure from the cylinder pressure to 10 to 12 bar depending on the type of gases. The outlet of the primary regulator will be connected to the gas service pipelines.

The gas regulator as mentioned earlier will be operated as Semi-Automatically and will be operated as continuous source of gas to service side. The Cylinder manifold will have gas cylinders connected on both left and right side of the primary regulator. At any given instance either left or right side of the connected cylinders will supply the gas to service side and will be termed as 'supply mode'. On depletion of the gas from the connected supply cylinders, the supply source will shift and start the flow from the other side of the connected cylinders which where-in standby and termed as 'standby mode'. The change-over of the supply from one side to another side is automatic by means of pressure difference in case of semi-automatic type.

In Semi-Auto Change over mode of operation, the side that gets gas exhausted in the cylinder will be removed from the manifold after depressurizing the side by closing supply Isolation valve and opening the purge valve on the manifold system. The empty cylinders will be removed and gets replaced with the filled cylinders and the gas line will be flushed for any entrapped gas in the manifold system during the cylinder change sequence. The system will be now ready for supply by opening the supply isolation valve. Now the cylinders changed &

filled side will be termed as ‘standby mode’. Thus, the change-over will be in tandem with either side delivering the gas un-interrupted on to the service side if the system is semi-automatic.

For Auto-change over type manifold, the change-over alarm and the signal will be provided to BMS. The manifold system will house the primary regulator having knob to set the outlet pressure, the

change-over unit, the gauges (both inlet and outlet) safety relief valves, vent / purge ports, isolation valves for bank isolation and also for cylinder isolations, pig-tails / flexible hose, filters, non-return valves, excess flow valve and other safety devices for flammable gases (viz. vent for Regulator failure conditions, flash back arrestor). The relief and vent outlets of flammable gases shall be terminated at-least 3 metres. above top most point of the building. For inert gases the vent outlets will be left above the gas bank level.

The gas having pressure of 10 to 12 bars at the outlet of the primary regulator will be conveyed inside the lab building in a pipeline and is termed as main header. The main header will be piped from gas bank to the plant buildings at various locations. The consumer / group of consumers which needs specified gas will get tapped from this main header and forms as branch header.

The branch header will have a regulator connected, which in-turn will bring down the header pressure from 10 to 12 bars on the upstream to user / user group required pressure at the regulator downstream as per the user / user’s needs and this regulator will be termed as ‘secondary regulator’, which will have a built-in pressure gauge indicating the downstream pressure.

The line outlet from the secondary regulator will get piped and gets finally connected / branched to the respective equipment’s which need the specified gas service. If any equipment requires dedicated pressure control using gas regulator, where-in the user required pressure need to be set for the outlet. Then, such line will be taken separately from the main branch header and routed inside the plant building dropped near to the equipment with dedicated gas regulator and isolation needle valve will be provided.

Piping for all the gas bank carrying gases, the MOC of the pipes, fittings & valves will be SS316 tubes for size ranging from ¼” OD to 1” OD and above 1” OD the pipes, fittings & valves will CS type SS internals for valves. For pipeline up to 1” OD The end joints for non-flammable gases will be by means of double compression type and for all the flammable gases the joints will be carried out by Orbital weld (Automatic TIG Weld) joint and thread / compression joints used as needed only. For piping above 1” OD all end joints for all non-flammable gases will be threaded type & all end joints for all flammable gases will be by Orbital weld (Automatic TIG Weld) joint.

b. General guidelines and safety norms for gas transportation in pipeline Safety precautions for non-flammable gases & flammable gases

- a. The SS tubes & fittings & CS pipes, fittings provided for the non-flammable gas will be procured from the reputed brands. For all toxic and flammable gases viz. Acetylene precautions will be taken care while design of the pipe routing, installation, testing and commissioning. The entire routing of toxic and flammable line needs to be Orbitally (Automatic TIG welding) welded for all joints.
- b. The relief and vent outlet for flammable gases will be piped from the gas manifold outlet and left 3 mtrs. above the building top as per PCB (Pollution Control Board) standard.
- c. All flammable gas pipelines will be installed to the exterior of the building and will enter the building as close to the requirement as possible and the lines will be installed below the false ceiling (as needed / required). All inert gas lines including oxygen will be installed above false ceiling as needed / required).
- d. Gas detectors will be installed for toxic and flammable gases at gas bank, at use point locations and along the pipe routing (in confined areas). The detector outlet will be connected to control panel where-in the unit receives input from detectors and trigger an alarm during the event of leakage. The controller also triggers a signal to close the auto-shut of valves installed at gas bank in the gas pipelines for immediate shut-off of gas supply into the building.
- e. The gas detectors will be considered for all flammable and toxic gases. The gas sensors for all thin gases viz. Acetylene will be installed by mounting the sensors on the false ceiling or true ceiling or at heights as may be the cases. In case of any heavy gases viz. Argon, Oxygen, AOM, ACM the sensors will be installed at 400mm above the FFL on the wall or bench.
- f. The sensors will be connected to the gas detector panel which senses the input from sensors and trigger an alarm and also shuts off the automatic shut-off valve positioned just outside the gas bank. The sensors will be calibrated for 40% of LEL of any given gases as the point for alarm trigger.

c. Gas bank and Gas Management system

The central gas will be segregated as “Inert” and “Flammable” banks. In the inert bank all non-flammable gases like Argon, AOM, ACM & oxygen gas will be kept. In the flammable gas bank, all flammable and toxic gases like Acetylene will be kept. The two types of banks will be in the common gas bank & no wall between various gases proposed. Only acetylene gas bank will be kept 6 m away from oxygen gas bank.

The gas bank will have all the safety features in terms of manifold units, the ventilation and the exhaust of the gases. The guidelines that will be applicable for gas storage as per gas cylinder storage rule 2004 will be incorporated to this gas banks also as needed.

Codes & standards

Sl. No.	Design standard	Standard	Description
35.	ANSI	ANSI B 31.1	Power piping code
36.	ANSI	ANSI B 31.3	Process piping code
37.	BIS	IS: 1239 (Part-I)	Steel tubes, tubulars and other wrought steel fittings - Specification
38.	BIS	IS: 1239 (Part-II)	Steel tubes, tubulars and other wrought steel fittings - Specification
39.	BIS	IS: 3589	Electrically welded steel pipes for water, and sewerage (168.3 to 2540 2000).
40.	BIS	IS: 5504	Spiral welded pipes
41.	ASTM	ASTM A 106 Gr. B	ERW & Seamless CS pipe specification
42.	ASTM	ASTM A 312	Standard specification for austenitic stainless-steel pipe intended for high-temperature and corrosive service
43.	ASTM	ASTM A269	Standard specification for seamless and welded austenitic stainless-steel tubing used in general corrosion-resisting and low- or high-temperature service
44.	ASTM	ASTM B75	Copper Tubes
45.	ASME	ASME G93	Oxy cleaning
46.	ASTM	ASTM A 53	MS pipe specification
47.	ANSI	ANSI B 36.1	Welded & seamless wrought steel pipe dimensions
48.	ANSI	ANSI B 36.19	Stainless Steel pipes dimensions
49.	ANSI	ANSI B 16.9	Butt welding pipe fittings dimensional standard.
50.	ANSI	ANSI B 16.11	Forged steel fittings: Socket welded & threaded
51.	BIS	IS: 6392	Steel pipe flanges.
52.	ANSI	ANSI B 16.5	CS pipe flanges & flanged fittings
53.	ISO	ISO:17192	Metal ball valves for petroleum, petrochemical and allied industries

54.	API	API: 602	Steel gate, globe & check valves for sizes pns 4 (ND100) and smaller for the petroleum and natural gas industries.
55.	BS	BS: 5352	Steel wedge gate, globe and check valves 50 mm and smaller for the petroleum, petrochemical and allied industries.
56.	API	API: 600	Gate valves for petroleum & natural gas.
57.	BS	BS: 1414	Specification for steel wedge gate valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries
58.	BS	BS: 1873	Specification for steel globe and globe stop and check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries
59.	BS	BS: 1868	Specification for steel check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries.
60.	API	API: 599	Metal plug valves - Flanged, threaded, and welding ends
61.	API	API 598	Valve inspection & testing.
	BIS	IS: 2002	Steel plate for pressure vessel for intermediate and high temperature service including boilers.
62.	BIS	IS:2062	Hot rolled medium and high tensile structural steel – Specification.
63.	BIS	IS: 7310	Approval Tests for Welders Working to Approved Welding Procedures.
64.	API	API: 1104	Welding of Pipelines and Related Facilities.
65.	ASTM	ASTM Sec. 5	Non-Destructive examination.
66.	ASME	ASME Sec 9	ASME boiler & pressure vessel code.
67.	BIS	IS: 1447	Code of practice for painting of ferrous metals in buildings.
68.	BIS	IS: 5	Colours for Ready Mixed Paints and Enamels.
69.	BIS	IS-2379: 1990(R2006), (R2007-05)	Colour Code for identification of pipeline.

70.	Indian std.	-	Central Pollution Control Board standards.
71.	Indian std.	Gas Cylinder Rules	Gas cylinder rules
72.	Indian std.	-	Petroleum & Natural Gas Regulatory Board.
73.	BS and International Std.	BS-EN 50073:1999 And IEC60079-292 Ed1.0: Explosive atmospheres	Gas Detectors and Detector Panels selection, positioning, installation, commissioning, testing and maintenance.

The BEML plant for rolling stock manufacturing will consist of industrial units, administrative blocks, utilities and service facilities. The campus is designed to promote sustainability by utilizing green building concepts through

1. Minimum disturbance to landscape and site conditions with better storm water management facilities. Proper care for preventing soil erosion during construction activities shall be taken as well as to protect natural drainage
2. Avoid, reduce and control environmental pollution arising from the plant. As such air pollution is not emanated from the plant. The DG sets employed will conform to CPCB standards
3. Waste water recycling in STP. The recycled water will be used for green belt development and other activities thus decreasing the dependency on fresh water
4. In this site the green belt is planned with native species of the region as they will survive easily in the environment. With the use of native species, the ecosystem is also maintained. Treated water shall be used in arboriculture so as to reduce the consumption of portable water.
5. Rain water harvesting, reuse of treated water and conservation of potable water.
6. Energy efficient and eco-friendly illumination like usage of LED, efficient air condition system with controls.
7. Solar panels are proposed over shop building to harness solar energy in a bid to utilise renewable energy
8. Building orientation to take advantage of solar access, shading and natural lighting and effects of micro climate on building

9. Environmentally friendly building materials for construction like fly ash-based cement, low VOC paints, bamboo based/ engineered wood instead of virgin wood.
10. Efficient solid waste management system by minimize landfill by employing reuse, recycling and energy recovery technologies. Some of the practices to be employed are segregation of wastes at source, proper handling and management of hazardous waste, treatment of organic waste. Construction waste management strategy will be developed to reduce construction waste to either reuse them at site for handed over to authorized agencies for recycling.

APPROVED MAKES

S.N	ITEMS	MAKE
1.	Cement	ACC, JK, Ultra Tech.
2.	Chlorpyriphos	DE-NOCIL, Cyanamide, Bayer India Ltd, Bhagiradha Chemicals Ltd.
3.	Structural Steel	SAIL, TATA, RINL, JSW, JSPL
5.	Reinforcement steel	TISCO, SAIL, RINL, JSW
6.	M.S. Pipe, Tubes, Bar, Flats, angle, Tee Sections	SAIL, TATA, TISCO, JINDAL
7.	Concrete admixture	Fosroc, MC-Bauchemie, BASF, Sika; Choksey Chemical
8.	Ready Mix cement concrete	ACC Concrete, UltraTech concrete, L&T concrete or equivalent
9.	Polysulphide sealant	Pidilite, Chemetall-Rai, Thio flex 600 FOSROC, CHOKSEY CHEMICAL; DOW CORNING
10.	Bitumen Impregnated Board	Shalitex, Sika or approved equivalent
11.	Polyethylene back up rod	Supreme Ind. Ltd. or approved equivalent
12.	PVC water stops	Fixopan, Sintex or equivalent
13.	White Cement	Birla, J. K
14.	Water proofing compound	Fosroc, MC-Bauchemie, BASF, Sika, CICO Technologies Limited
15.	White washing lime	Dehradun (Source) or equivalent
16.	Paints	Asian Paints, Nerolac, AkzoNobel, Berger
17.	Fire Retardant paint	Viper or approved equivalent
18.	Epoxy	Fosroc, BASF, SIKKA, MC-Beauchemin
19.	Waterproof Ply	Green, Century, Duro, Marino
20.	AAC Blocks.	BILT, JK, KJS
21.	APP Polymeric Polyethylene Felt-	BITUMAT, Techno Nicol, or equivalent
22.	Expanded Polystyrene (Thermocole)	Beardshell, BASF or approved equivalent
23.	Extruded Polystyrene	Iso board ND, BASF or approved equivalent
24.	Commercial Quality White Glazed Ceramic Tiles	Kajaria, Somany, Jhonson
25.	PVC strips	Fixopan, Fair Polymers or approved equivalent
26.	Welding rod	ADVANI or approved equivalent
27.	Micro Concrete	PIDILITE, FOSROC, SIKKA, BUILTECH
28.	R.C.C. pipes	Indian Hume Pipe, Pragati, Paradise, Vikas pipes
29.	Water proofing cement paint	Super Snowcem paint, J.K, Birla, Acrocem
30.	Chemical Grout	Endure Bal-grout, Leticrete, Fosroc, star coating
31.	Dash Fasteners	Fischer, Hilti or equivalent
32.	Granite Stone	as per approved sample
33.	Metal Deck	Pennar, TATA
34.	Hydraulic door closers	DORMA, HAFLE, or equivalent
35.	Aluminium Sections	Hindalco, Jindal/approved equivalent
36.	Glazing	Modi glass, AIS glass, Saint Gobain
37.	Silicon sealants	Dow corning
38.	Wall putty	Birla putty, JK putty, Asian putty
39.	Spider fittings	Dorma, Nexus, Hafle

40	Floor springs	Dorma, Hafle
41	LOW VOC paints	Asian Paints, Nerolac paints, Alco noble (ICI)
42	Aluminium Powder coating	AkzoNobel, Jotun.
43	Structural Sealant	Wacker, Dow Corning, GE

List of Approved Makes

The following is the list of approved make/ brand of materials (Refer materials, whichever are applicable for the scope of work) for proposed work.

Sl. No	Name of materials	Approved Make
Civil works		
1	Cement (PPC/OPC)	ACC/ Ultra Tech/ RAMCO / Dalmia / Chettinad Cements
2	Reinforcement Steel (HYSD/ TMT)	TATA/ SAIL/VIZAG/ JINDAL/ JSW
3	White Cement/ Wall putty	Birla wall care/JK White/ Berge/Asian Paints/ShieldmaxX
4	Vitrified Floor Tile	Kajaria/Johnson/ Nitco/ Somany (all first quality).
5	PVC drain Pipe, CPVC pipes	Supreme/Prince/ Finolex / Ashirvad
6	G.I. Pipes	Jindal/ Tata /Apollo/ Prakash surya
7	C.I. pipe & fitting	KAPILASH/NECO/BENGAL IRON CO./RIF
8	Aluminium Sections	Jindal, Hindalco, Indalco, Nalco
9	Float glass	Modi Guard/ Saint Gobain / HNGIL/ AIS
10	Toughened Glass	Modi Guard/ Saint Gobain / HNGIL// AIS
11	Frameless Glass fitting	Ozone / Dorma
12	Pre-laminated board	Greenlam/ Merino /Kitply/Century
13	POP punning	Sakarni/ Shri Ram/ JK/ Birla
14	All type of Primers / Synthetic Enamel paint	Asian/ ICI (Dulux)/ Nerolac/ Berger
15	Interior Emulsion & Texture paints	Asian Paints (Royale)/ Berger (Silk Glamour)/ Nerolac (Impressions HD)/ Dulux(velvet touch)

16	Exterior Emulsion all buildings	Asian Paints (Ultima)/ Berger (Silk Glamour)/ Nerolac (Excel Anti peel)/ Dulux(Weather shield max)
17	S.S Stair case railings	Jindal Stainless Steel/ SAIL/ ESSAR/ ICICH Industries
18	CI Manhole	NECO/ Kapilansh /SKF/RPMF
19	Stainless Steel Bolts/ Washers & Nuts	Kundan/ Puja/ Atul
20	Chequered Precast Concrete Tile	Hindustan Tiles/ Ultra/ Swastik Tiles
21	UPVC Windows	Fenesta/ Prominance/ Rehau/Torfenster/ Alupast / NCL Veka LTD
22	Admixture	Fosroc/ Sika.
23	Water Proofing Compound	Tapcrete/ Cico/ Accoproof/ Impermo/ Fosroc.
24	Adhesive	Pidilite/ Dunlop/ Sika/ Fosroc/ Endura/ Laticrete
25	Epoxy Mortar	Fosroc/ Sika/ Pidilite/ MYK
26	Structural & Weather Silicon	Dow Corning/Wacker.
27	Epoxy/PU Flooring & other specialised floorings.	Berger/ Fosroc/ Pidilite/Sika/MYK/ Ardex Endura/ STP.
28	Flush Door shutters	Duro/ Kitply (Swastik)/ Century/ Durian/ Greenply/ Merino/ Green Panel/ A1 teak/ / JENA
29	Fire rated door	Signum Fire Protection/ Shakti Metdoor/ NAVAIR/ Sukri/ Promat/ Godrej/
30	Acoustic Door	Ica Acoustics/ Oceanz Acoustics/ Acoustical Solution Inc.
31	Flush Door Shutters (Decorative/ Non-Decorative).	Swastic/ Corbett/ Century/ Green/ Archid/Jena
32	Glass FRP Door Shutters	Polyline/ Duroplast/ Cactus.
33	Hydraulic Door Closer/ Floor Spring	Hardwyn/ Godrej/ Dorma
34	S.S. Staircase Railing	Connect Architectural Products Pvt.Ltd/ Jindal Stainless Steel Ltd./ Icich Industries, Essar

35	Door Coordinator	UL Listed/ Monarch/ Dorma.
36	Anodised Aluminum Hardware (Heavy Duty)	Hardima/Everite/ Sigma (ISI Marked).
37	Tempered / Clear / Float / Toughened Glass	Pilkinton/Saint Gobain/ Asahi.
38	Door Locks	Godrej/Europa/Ozone/Dorset
39	Rolling Shutter Motor	CAME/AUTOZON/ GEAPL
40	Floor spring & Door closure	Godrej/ Dorma/Dorset/ Kich
41	Water proofing chemical	DrFixit /SIKA/ ARDEX/BERGER /FOSROC
42	Tile Adhesive	Lacticrete/ Ardex Endure/ Pidilite/ Sika/ Asian Paints/ Fosroc.
43	Acoustic Treatment: Wall Panelling	Armstrong / Anutone / Himalaya / Credenze
44	Heavy Duty Paver Tiles	Johnson-(Endura)/Somany-(Dura Stone)/Pevit,
43	Poly-Sulphide Sealant	Pidilite/ Tuffseal/Sika/ Fosroc.
44	Damp Proof Material	Impermo/Duraseal/ Acco-Proof.
45	Hardware's Door & Windows	Hettich/ Everite/Dorma/ Godrej/Iron mongery
46	PVC casing pipe	Kissan (Agro)/ Appollo/Supreme
PEB/Structural Works		
1	Structural Steel	TATA/ SAIL/ Jindal/ Vizag/JSW
2	Structural Steel- MS pipes only	TATA/ SAIL/ Jindal/ Vizag/ APL Apollo/JSW
3	HR plates for Built-Up Sections	VIZAG/ SAIL/ ESSAR/ TATA/ JSW/JINDAL
4	Hot Rolled Steel: Beams /Channels / Angles/ Rods / Plates	VIZAG/ SAIL/ ESSAR/ TATA/ JSW/JINDAL
5	Hot Rolled Steel: Circular/Square/Rectangular Tube Sections	VIZAG/ SAIL/ ESSAR/ TATA/ JSW/ APPOLLO/JINDAL
6	Pre Galvanised Cold Rolled Coils:- Purlins /Girts	SAIL/ ESSAR/ JSW/TATA/ JINDAL

7	Galvalume Roof Sheeting / Galvalume Wall Cladding/ Flashing/ Gutter/ and Downspout	TATA BLUE SCOPE/ JSW/ META COLOUR/ LLOYD INSULATIONS/ INTERARCH
8	Tube sections	VIZAG/ SAIL/ ESSAR/ TATA/ JSW/ JINDAL
9	High Strength Bolts	Deepak/ Atul/ Panchsheel/ TVS & Pooja
10	Secondary Connections	Deepak/ Atul/ Panchsheel/ TVS /Pooja
11	Sheeting/cladding Fasteners	Fisher/ Hilti/ Corroshield
12	Paint -Epoxy and primer	Asian/ Berger/Dulux/Dupont
13	Welding Rods	Advani Orikon / ESAB INDIA/ EWAC ALLOYS/ HONAWAR ELECTRODES/ D & H Welding Electrodes
14	Life Line System at Roof	3M India Ltd/ Sure safety (Ind) Ltd/ M/s Eklavya Safety LLP/Karam/ (CE certified system).
15	Skylight	VELUX or equivalent
16	Polycarbonate sheet	LLOYD INSULATIONS/ TUFLITE / GE PLASTIC/LEXAN/BAYERS
17	Self-drilling/ tapping Zinc plated screws size 5.5x55mm for Galvalume sheets	TATA/JINDAL/JSW/ HILTI/
18	XLPE Sheet	Supreme/ Green Insu/ Aerolam
19	PUF sandwich Panel	AlFa/Karthik/ Lloyd/Kirby/ Metecno/ TATA Bluescope
Electrical, Data & Voice Networking Works		
1	HT switch gears (VCBs, panels, relays etc)/ RMU	L&T/Schneider/Crompton/Megawin
2	LT switch gears ACBs, relays	L&T(U power)/ Legrand (DMX3)/ Siemens (3WL)/ Schneider (Easypact HVS)
3	HT & LT armoured cables	Finolex/ Polycab/ Havells/KEI/ RR KABEL
4	HT/ LT Electrical Panels	CPRI Approved Manufacturers for approved voltage
5	HT/LT cable joint kits	M-Seal/Raychem/3M

6	MCBs/RCCBs/RCBOs/ DBs & accessories	Legrand (DX3)/ L&T (Exora)/Schneider (Acti9)/ABB-(S200M)/Hager-(H3)
7	MCCBs/SFU/Contactors/Panel board mounting switches/ Single Phase Preventer /Timer	ABB/ Schneider/L&T/Legrand
8	Power Capacitors	EPCOS / Siemens / L & T / Schneider/ Legrand
9	FRLS and PVC insulated stranded flexible copper wires as per IS 694	Finolex/ Polycab/ Havells/ KEI/ RR KABEL
10	PVC rigid conduit heavy duty	Finolex/Precision/Avon Plast/ BEC/AKG/ Vasavi Minimum thickness 2.0mm up to 25mm and 2.5 mm for above 25mm
11	M.S. Conduit pipe and accessories	AKG/BEC/RMCON/NIC with ISI marking
12	Modular type Switches, Socket, Fan Regulator, including Modular Boxes and Plates and accessories	Legrand (Mossaic/Myrise)/ Crabtree (Picadly)/ Schneider (Zencello)
13	Indication lamps / push buttons / selector switch	L&T/Siemens/Schneider/AE/Kaycee/Tecknic/BC H/ IMP
14	LED light Fittings, lamps & accessories	Philips/Havells/Bajaj/CGL
15	Street Light/High Bay light	Philips/Havells/Bajaj/CGL
16	Multifunction meter	El measure/ Schneider/L&T
17	Ceiling Fans	Havells/Usha/CGL/Bajaj/Orient (5 star BEE rated BLDC with regulator shall be used)
18	Exhaust fans/Wall fans	CGL/Bajaj/Havells /Almonard
19	CT/PT	Kalpa/Kappa/L&T/AE/ INDCOIL/Pragati
20	Variable Frequency Drives (VFDs)	Yaskawa/Fuji Electric/Schneider/Danfoss
21	HDPE Pipe	Duraline /Rex Polyextrusion / Plato / Tijaria / Tirupati Plastomatics / AJAPLAS
22	Terminals	Connectwell/ CHHABI/ Cab seal / Wago / Elmex
23	Cable lugs & glands	Dowells/ Jainsons / Asian / Commet/ Wago/ Gripwel / Johnsons/ Smi

24	Cable Tray	RICO/PILCO/VENUS/Profab / Indmark Formtech / UCIC / Kanade Anand / VATCO/ RM Con
25	Rubber Insulation Mat (ISI marked mats only to be used)	Syntex/Jyoti/Tata/Vardhman/Zenith/ Kiran/Raychem/Elstomer.
26	UPS/Inverter	Numeric/Fuji Electric/Emerson/ Liebert
27	Battery	Exide/Amaron (Batteries with 3 years warranty only to be used.)
28	Bus Bar Trunking- Sandwiched	Schneider/L&T/C&S/Siemens/Legrand
29	Sensors for lighting	Havells/Crompton/Philips/Honeywell/Legrand/ Schneider.
30	Split type Air conditioner	Daikin / Blue Star /Voltas / LG/ Carrier / Mitsubishi / Godrej / (5 star BEE rated Inverter ACs shall be used)
31	Voltage stabilizers	Godrej/ V-Guard/ Microtek/ Voltas
32	Industrial Insulated sockets & Plugs	Schneider/ Legrand/ CAPE/Mennekes
33	ABS enclosure for Industrial sockets	Hensel/Mennekes/CAPE/Legrand/Schneider
Telephone, Network, Access control/ CCTV systems		
1	PIJF underground telephone cable	Polycab/Delton/Finolex/KEC/Paramount
2	Optical Fiber Cable	Finolex / KEC/ Paramount / Birla Ericsson / Aksh Optifibre
3	Telephone cable	Finolex/Havells/Polycab/RR cable/Molex
4	Telephone Crone Connector	D-link /systemax/digilinc/molex/Krone or equivalent.
5	Telephone/Cat6 IO/ LIU/CAT 6 Jack Panel	Molex/ Systimax/Tyco/Panduit
6	CAT-6 LAN Cable	Molex/ Systimax/Tyco/Panduit
7	Network Rack	Net Rack/ Wall Rack/Panduit/Rittal

8	LAN / Data/ Voice Networking components	D-Link/Digilink/Molex/Panduit/Systimax/ Tyco
9	Network switches-L3 Managed switches	CISCO/Juniper/Fortinet/ HP/
10	CCTV/ Video surveillance all types of cameras	Axis/CP Plus/Sony/Honeywell/Pelco
11	Access control system	Bosch/Matrix/ Axis/Honeywell
12	Electromagnetic locks	Dorma/Godrej/Algatec/Assa-Abloy/BEL
13	NAS Storage system for CCTV	Seagate/ WD/ Honeywell/ HP/ EMC2/ Axis/ Pelco
14	Video surveillance hard disc	Seagate-Sky Hawk/WD-Purple
15	Outdoor pole mounted enclosure and wall mounted enclosures for faulty housing	Hensel/Hoffman/Panduit
16	IP66 rated external splicing kit for outdoor fibre optics cable	3M/Raychem/Tyco
17	IP EPABX System	Unify/ Alcatel/ Nortel/
Road Works		
1	Wet Mix Macadam (WMM)	Local Supply (as per MORTH grade)
2	Granular Sub base (GSB)	Local Supply (as per MORTH grade)
3	Aggregates (40mm, 20mm, 10mm)	Local Supply (as per MORTH grade)
4	Concrete Kerb Stones / Edging Blocks	KK Manhole / Local precast vendor
5	Paver Blocks (M40 or M50 Grade)	KK / UltraTech / Local ISI vendors
6	Road Marking Paint	Asian Paints / Berger / Shalimar/ Dulux/ Nerolac
7	Sign Boards & Delineators	3M/ Avery Dennison / Local IS codes
Firefighting		
1	M.S Pipe	TATA /Jindal / Suryaprakash / Asian
2	M.S Fittings	R-brand / Koel /Swastik
3	Hydrant Valve (ISI Mark)	Fire squad/ WINCO/ / Newage / Priyanka/ Minimax

4	CI Butterfly valves	Leader /Audco /zoloto/ Kirloskar
5	Fire hose (ISI Marks)	Fire squad/ WINCO/ / Newage / Priyanka/ Minimax
6	Hose Cabinet	Newage/ Firesheild/ Guard Fire/ Minimax / Priyanka
7	Fire bridge inlet	Fire squad/ WINCO/ / Newage / Priyanka/ Minimax
8	Branch Pipe & Nozzle	Fire squad/ WINCO/ / Newage / Priyanka/ Minimax
9	Hose Reel Drum	Fire squad/ WINCO/ / Newage / Priyanka/ Minimax
10	Ball Valve	Leader /Audco / zoloto/ Kirloskar
11	Portable Fire extinguishers	Fire squad/ WINCO/ / Newage / Priyanka/ Minimax
12	Paint (Enamel)	Asian / Nerolac / Burger/Dulex
13	Passive Fire protection	3M / Promort /Metacaulk (UL Listed)
14	Wrapping & Coating	IWL / Pypokote
15	Sluice valve / Non return valve	Kirloskar of Class PN 1.6 /Equivalent in Audco/Leader/ Advance
16	Gun Metal Valve (ISI marked)	Kirloskar / Sant/Leader
17	Pressure Switch	Danfoss / Honeywell / Indfos / Fiebig / HGuru
18	First aid hose reel drum	Dunlop / Newage/ Minimax / Ceasefire / Mitras /Safeguard
19	Cushy foot / Anti vibration pads	Dunlop / Resistoflex / GERB
20	Firefighting pumps	Kirloskar/ MATHER & PLATT/ Crompton
21	Motor starter	L&T/ Siemens/Crompton/ Schneider
Fire Detection and Alarm System		
1	Analog Addressable fire alarm system (Fire control Panel / Sounder / Manual Call box & accessories)	Notifier (Honeywell)/Cerberus (SIEMENS)/ SIMPLEX/ Edwards/ COOPER

2	UL approved Fire alarm detector (smoke / heat / optical / multi-function etc.)	System Sensor/ Apollo/ Edwards/ Notifier (Honeywell)/Simplex/ cooper
3	Industrial siren	ASES/AGNI/ISI make
4	Fire alarm cables	Polycab/ Havells / Finolex/ RR KABEL
5	PA Speaker & Console	Bosch/ Philips/ Siemens/ Bose
Plumbing Drainage & STP Works		
1	Sanitary Fittings (EWC/IWC/Washbasin/Urinals)	Hindware/ Parryware/ Jaquar/ Cera
2	CP sanitary pipe fittings	Hindware/ Parryware/ Jaquar/ Cera
3	UPVC, PVC pipes with fittings	Supreme/ Finolex/ Astral/Aashirvad
4	All types of Valves	Zoloto/Apollo/Leader/Audco /Kirloskar
5	Solenoid valves	Dwyer/Taylor/Audco
6	Cast iron pipes and fittings	NECO/ RIF/ BIC/ KAPILANSH,
7	Injection Grouting	Fosroc/ Sika/ MYK/Pidilite.
8	Grab bars for Disabled	Dorma/ D-line/ Cera/ Jaquar/ Hindware
9	Water dispenser	Crossfields/Aqua clan/ Conway/ Voltas/Thermax/
10	Water storage tank	Sintex/Aquatech/Vectus/Plasto/Supreme
11	Hydro-pneumatic pump	Grundfos/ Kirloskar/ KSB/ Mather Platt
12	Sewage pump and other pumps	Grundfos/ Kirloskar/ KSB/ Lubi
13	Galvanised Iron pipes	Jindal/ Techno flex
14	Wall Mixer, Kitchen sink,	Hindware/ Parryware/ Jaquar/Cera
15	Electromagnetic flow meter	Reputed make with NABL calibration
16	RCC Hume Pipes (NP2/NP3 Class)	Spun Pipe/KK/ISI-approved vendor
17	Precast RCC Drain Covers	KK / Local Precast ISI vendor
18	Stoneware Pipes (if used in gravity drains)	Supreme / Prince / Local ISI
19	Sump / Catchpit Precast Chambers	KK Manhole / Local Precast

20	Drainage Inspection Chamber Covers	Neco/ Skf/Rif/Rpmf/ Bic/ Kapilansh/ Nfl
21	Manhole Steps (FRP coated or MS)	Neco/ Skf/Rif/Rpmf/ Bic/ Kapilansh/ Nfl
22	Drainage Waterproofing Compound	Fosroc / Cico/ Dr. Fixit/ Sika
Interiors		
1	False Ceiling/ Panels of all types	Gyproc/ India Gypsum/ Usg Knauf/ Armstrong
2	Workstations And Senior Executives Room Tables	Featherlite/ Godrej Interio/ Haworth/ Wipro/ Durian/Damro
3	Loose Furnitures - Like Chairs, Sofa, CRCA storage cabinets	Featherlite/ Godrej Interio/ Haworth/ Wipro/ Durian/Damro
4	Plywoods	Greenply/ Kitply/ Sharonply/ Centuryply
5	Fluted Panels	Rang/ Gloirio (Emporio)/ Mag Veneer
6	Laminates	New Mika/ Greenlam/ Merino/ Dorby Mica/ Formica
7	Window Blinds	Mac/ Trac/ Vista Levelor
8	Texture Painting	Asian Paints (Royale)/ Berger (Silk Glamour)/ Nerolac (Impressions HD) / Dulux(velvet touch)
9	Decorative LED Light Fittings	Havells/ Bajaj/ Phillips/White Teak Company (Asian Paints)/Hybec
10	Locks And Hinges for Cabinets And Cupboards	Godrej/ Ebco/ Hettich
11	Cabinet Handles, Tower bolts, Door Closers	Godrej/ Ebco/ Hettich
12	Melamine Polish	Asian Paints/Berger/ICI

Note: Contractor shall obtain prior approval of BEML before procurement of the Materials from the manufacturers listed above for the work. If any of the above Brands of Materials are not available, Engineer-in-charge shall allow use of other brand material duly approved by OIC/EIC provided they confirm to the requirement of IS as per Technical Specification/Quality Plan.

For category of materials not mentioned above approved list, contractor shall use reputed and BIS certified brands. Before using prior approval for the brands for such materials shall be obtained from OIC/EIC, BEML

BEML reserves the right to reject or accept any of the make given above without assigning any reasons and contractor is bound to supply other brands in the list.

COLOUR CODES

Particulars	Colour Code	Grade
Main Floor (Base)	Slate Grey	RAL 7012
	Signal Yellow for Border	RAL1003
	Sky Blue in Aisle Way	RAL 5015
Jigs & Fixtures	Light Blue	RAL 5012
Overhead Crane & Structure Railing, Stair Case	Traffic Yellow	RAL 1023
Crane Hook	Signal Red	RAL 3001
Machine Body (Fixed part)	Sky Blue	RAL 5015
Rotating & Moving Parts, Machine Movable Part	Pure Orange	RAL 2004
Interior Wall	White Bush (Asian Paints)	L 126
Interior Beam	Grey Day N (Asian Paint)	K 103
Exterior Wall	White Bush and Grey Day N border	L 126 K 103

Note : LED Display on top of the entrance gate of Workshop

BILL OF QUANTITIES					
BEML LIMITED, BHOPAL					
Tender No. 6300040354		Period of Contract		18 Months from DOC	
		EMD		Rs. 131404465.00	
Sub: Engineering, Procurement & Construction pertaining to establishment of Rail coach factory including Civil Construction of manufacturing blocks, testing bay, other utility buildings (Non factory buildings), Railway Track sidings, water supply and distribution System, Roads, Drainage and sewerage systems, General Electric works including regular and emergency power supply and distribution system, related installations & services (Fire, Gas, Compressed air, IT, BMS, etc.), MFA (Miscellaneous fixed assets) and other Land & Site development works including grading, levelling works in connection with setting up of a Rail Coach Factory hereinafter referred as BEML RAIL HUB FOR ADVANCE MANUFACTURING (BRAHMA)near Umaria village, Obaidullaganj, District- Raissen, Madhya Pradesh (India) PIN code 464993 on EPC Mode					
Sl. No.	Name of the component	Unit	Qty	Rate/Unit in Fig. & in words Rs.	Amount (Rs.)
1	Execution of the work pertaining to establishment of Rail coach manufacturing facility mode on EPC Mode as per scope detailed. Earthwork in formation (Cutting & Filling)- RCC Road- Storm water drainage system- Sewerage system excluding (STP) RCC service trench Greenbelt Development Other External Development works Gate Complex for Truck entry & exit Gate Complex for railway siding Material Gate Laying of Stabling and dispatch Railway Track (4 km)	Job	1.00		
	1. Car Body manufacturing cum storage Block – 01 No. Manufacturing line will have dimension of 400m X 72 m. A road of 10 m has been proposed in between the Production line for the logistic support and for meeting the Fire safety norms. 2. Car body inspection and testing line facility - 01 No. Inspection & Testing line will have dimension of 852m X 24 m. A road of 10 m has been proposed in between the Production line for the logistic support and to meeting the Fire safety norms. 3. Raw material storage yard Hard Stand of 50mx40m 4. Water supply & Fire water pump house including sump - single-storey industrial form with adequate internal clear heights for pump installation, maintenance, and overhead piping size - 30x 28 Mtr (Inclusive of Sump area) 5. Main Receiving Sub Station – MRSS- 01 RCC/partially steel structure, 40 m X12.5 m				
	6. Emergency Power Supply System - EPSS Hard stand- 01 RCC Structure of Size- 30x30 M 7. Centralised compressed air station 01 No. RCC Structure of Size- 12M x 20 M 8. Centralised Gas bank Shed – 01 OPEN/ RCC of size 40 M x 16 M 09. Safety Office- 01 Single floor RCC building of size 14.4m x 25.2 m 10.RO Plant (Hard Stand)- 01 RCC structure of size - 15mx10m				
	11. Chiller Plant Building – 01 RCC Structure with 46.6mx16m 12. Fire station 01 RCC structure with 32.4mx10.8m 13. Sewage Treatment Plant (STP) – 01 RCC structure with 15mx13.5m 14. Traverser Foundation – 02 Nos (Hard stand – 240m x 32m- 01 No. Hard stand 160m X 32M -01 No.) 15. Office complex This facility shall be RCC Framed structure with Ground + 5 Floor configuration. The ground floor size of building shall be 75.6m x 18.9 m 16. Canteen Building – The size of the building shall be 64.8m x 56.4 m. 17. Medical Centre- 01 shall be RCC Framed single storeyed structure. The infill material used shall be brick wall or cement concrete blocks. The Overall size of the building shall be 28.8 m x 10.8m approximately.				
	18. Multi-level parking (G+2). Size is as mentioned- 61.6m x 64.4m 19. Toilet Block- The size of the building shall 7.6m x 13.6 m. 20. Storage Yard				
	21. Required Furniture for the plant 22. Air conditioner for the annexe-building 23. Main Plant & Equipment Interplant Traverser (75 t) - 02 Nos Interlay Track Shifter (50 t)-01 No 24. Miscellaneous fixed Assets (MFA) A. Material Handling – Crane •DG EOT Crane- Ground floor- 25 T- 04 Nos First floor - 10 T -) - 04 Nos •□ 2T SG Under slung crane- Water pump house •□ Goliath Crane □01 24. HVAC System for Canteen, admin building, safety office, Medical Centre 25. Fire Fighting systems				

Sl. No.	Name of the component	Unit	Qty	Rate/Unit in Fig. & in words Rs.	Amount (Rs.)
	26. WATER SUPPLY FACILITIES 27. Compressed air facilities 28. STP (MBR technology) 29. DG Set 750 KVA 02 Nos 30. Industrial Gases 31. Weigh Bridge (100 Ft, 70 T) – 01 No. 32. Fire Detection and Alarm System- 01 No. 33. Test Track with covered accommodation 34. Electrical Works 35. Instrumentation & Process Control				
	All connected inside & out side electrical works, mechanical works, fire and safety works, plumbing, retaining walls, storm water waters, Rain water harvesting, cable trenches, laying of tracks both standard gauge and board gauge, hard standing, cement concrete connectivity roads , perimeter roads, site formation, filling of land, demolishing of any existing old building/ structures both RCC/steel etc. complete project. liasoning work etc in EPC mode (design and build basis) As per the scope of work mentioned in Technical Bid.				
	Total Rs inclusive of all Taxes and Duties:				

Total Amount in words. Rs.

Soil report Due to its size, uploaded in SRM portal Tender documents only in the name of "Soil Report".

Tender no. 6300040354