CHENNAI METRO RAIL LIMITED

CHENNAI METRO RAIL PROJECT PHASE 1 EXTENSION

BIDDING FOR
CMRL-PS&OHE-04-2018

DESIGN, MANUFACTURE, VERIFICATION, DELIVERY, INSTALLATION, TESTING, COMMISSIONING AND TECHNICAL / MAINTENANCE SUPPORT INCLUDING TRAINING OF PERSONNEL FOR A COMPLETE, INTEGRATED POWER SUPPLY SYSTEM AND OVERHEAD EQUIPMENT FOR CMRL PHASE 1 EXTENSION BETWEEN WASHERMANPET TO WIMCO NAGAR INCLUDING DEPOT AT WIMCO NAGAR.

Addendum - I

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Chennai Metro Rail Limited
Chennai Metro rail Admin Building
Poonamallee High Road
India

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CMRL-PS&OHE-04-2018 Prebid meeting clarification

Held on 22.03.2018 & 09.04.2018

S no	page no 1/ clause/ volume	Query	Proposed Reply
1	General	Whether it is responsibility of the contractor's representative for obtaining statutory Clearance from other department.	Refer PC 9.7
2	SCADA	Whether the SCADA system shall be a completely new setup that interfaces with the existing SCADA system of Phase 1 or its development/alteration to existing SCADA in CMRL	Field equipment shall be in contractor scope, while the servers of existing SCADA shall be used with required alteration in SCADA software Any additional software license requirement shall be met by contractor
3	Section-VI Employer's Requirement 6.16.1.22 Section Earth detector	*A System shall be implemented to detect the status of OHE (floating or earthed) and feedback shall be given to SCADA which shall prevent accidental energisation of section during maintenance* We request to provide any vendor details or to provide scheme	CMRL has already designed a prototype. Contractor can take a look or is free to develop his own philosophy. The approximate cost of product is Rs.10,000/-
4	Section-VI Employer's Requirement 6.5.8-25kv GIS	*Within the various GIS cubicles, the following typical compartments shall be Categorically identified as* *a. Encapsulated bus bars (three phase for 33kV and single phase for 25kV) in separate SF6 insulated compartment* We request you to open the requirement in for Gas insulated Bus bar/Solid touch proof insulated bus bar outside SF6.As solid insulated bus bar is the state of art technology with same reliability, Type Tested, Safe and User Friendly Design of GIS.	Accepted
5	Section-III Evaluation and Qualification Criteria EQC-13-2.5 Clause 2.5, S.No-3 for 33kV GIS	*Type tested* *Shall have supplied 100 bays in last 5 years* *Shall have service capability in Chennai with a lead time of 24 Hrs* In case of a new product is offered which does not meet the criteria of supply of 100 bays in last 5 years, same shall be offered with additional warranty of 2 years over and above the contractual warranty. Request you to accept the above modification	Accepted subjected to additional warranty of 3 years and Complete type test. All specifications shall be matched.
6	Section-VI	*The Overhead Equipment for Depot shall be of Rigid overhead contact system*	Yes, drop arms in covered area of Depot and Portal boom for Depot entry is in contractor scope.

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	Employer's Requirement 3.4.4-depot OHE page no 329	We request to provide scope clarity on for supporting structure inside depot to fix drop arm for ROCS in depot	
7	Section-VI Employer's Requirement 3.4.4.e page no 329	*OHE dropdown supports for tunnel section* We request CMRL to provide clarity on dropdown supports	Supports in tunnel section, depot and station area shall be in contractor scope
8	Section-VI Employer's Requirement 3.4.4.j page no 329	*Adequate measures to be taken to minimize EMI/EMC impacts on the BSNL cables etc to along the cmrl route alignment* . We request CMRL to clarify what type of measures to be taken? & to provide the utility details along alignment not known. Any additional interface with BSNL?	Interfacing with BSNL and other utilities shall be CMRL's responsibility.
9	3.5.3- page n 330	Will details of station load will be shared by CMRL in tendering stage or needs to be interfaced.	Contractor shall get data by interfacing with interface contractor.
10	Section-VI Employer's Requirement 6.3.3.2 Pg.no 359 & 6.16.1.14 Pg.No.379	Two clauses are contradicted to each other for supply of Infeed Isolator. We request CMRL to clarify what type (motorize or manual) to be provided.	Infeed at switching station (from GIS) shall have manual isolator with feedback as given in clause 6.3.3.2. Clause 6.16.1.14 is revised as "*25 kV manual isolator on main line shall be provided at the feeding post of OHE from GIS…..")..* Depot infeed isolator shall be of motorised type.
11	Section-VI Employer's Requirement 6.6.2.2, Pg.no 362	1. *WPC protection* *2. Current based Circuit breaker failure (50BF)* *3. Panto-Flashover relay* We request CMRL to clarify what is meant by Current based CB failure?	Breaker failure protection shall function based on the feedback taken from Current Transformer used for protection and not by status of Circuit breaker.
12	Section-VI Employer's Requirement 6.9.4-page no 370	*Transformers shall be of Dry type cast resin with enclosure having provision of top cable entry for HV & cable/bus duct entry for LV (tentative) . Cable entry shall be clarified with interface contractor.* We request CMRL to confirm the LV entry side and type	LV side cable/bus duct entry also shall be of top entry. Provisions may be made in enclosure accordingly.
13	Section-VI Employer's	*As a part of scope Viaduct contractor shall provide bolts for mast erection in precast deck as shown in the drawing in Employer drawings. Contractor shall prepare pegging plan to utilize these bolts*	OHE bolt cannot be provided at 2m on either end of the deck.

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	Requirement6. 15.3, pg no. 374	*to maximum extent.* ***If contractor design does not suit to bolts locations given by viaduct contractor, contractor shall fix bolts on the deck duly considering the load calculations*** We request CMRL to confirm the strength of segment if additional bolts to be done. And also request to clarify the criteria / restrictions if any.	
14	Part-I, Bidding Procedures Section-I, Instruction to Bidders	Pricing break up We request CMRL to clarify the mismatch in % apportioned between Para 1.3 in pg. no. 61 & table in pg. no. 65	1.3.5 is corrected as "*The sum of the amounts apportioned to System Acceptance Testing and Integrated Testing and Commissioning and Operational Acceptance, as contained in Cost Center is be between 2.5% to 5% of the contract value".* 1.3.6 is corrected as *"The sum of amount apportionate for Detailed design is 5% of the bid price total."* 1.3.8 is corrected as *"The sum of the amounts apportioned for Supply, installed and testing and commissioning is 75% of the total contract price Including the System Acceptance Testing and Integrated Testing and Commissioning and Operational Acceptance (B11)."* *Point no 2 in notes of appendix A is corrected as* "2) The sum of the amounts apportioned to Schedule B (B2-B11)–Phase 1 Extension shall be 75% of the Bid Price Total and schedule B1 to 5%." *Point no 3 in notes of appendix A is corrected as* "3) The sum of the amounts apportioned to System Acceptance Testing and Integrated Testing and Commissioning and Operational Acceptance shall be 2.5% to 5% of the Contract value." (same is corrected in tabular column) Refer revised pride in attachment 8 of addendum 1.
15	Section-VII Employer's Requirement PC 14, Pg no.823	*Statutory Variation* We request CMRL to include Statutory variation regarding taxes and duties.	Change in Taxes and Duties during execution of project shall be compensated for both positive and negative change. i.e Tax slab shall be revised (increased/decreased) based on variation on tax regulation. No increase in tax will be compensated for periods of delay for which the contractor is responsible. Refer revised price bid in attachment 8 of addendum 1.
16	Section-VI Employer's Requirement Appendix-A, pg no. 712	*SCHEDULE OF ACCESS DATES* We request CMRL to explain what is 'D' and request to provide clarity on start and end dates	D' refers to Effective date. For definition of Effective date refer GC clause 1 & Article 3 of contract agreement.
17	Section-VI	We request CMRL to provide more clarity on equipment type and	Revised spare list is enclosed in attachment 1 of addendum 1

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	Employer's Requirement 9.2.4, pg no. 407	numbers rather providing % and generic name of equipment.	
18	Section-VI Employer's Requirement 3.1.5 page no 327	*Tools* We request CMRL to provide list of tools to be supplied	Tools shall be limited to those required for regular maintenance and breakdown attendance. A short descriptive list is enclosed in attachment 2 of addendum 1
19	Section-VI Employer's Requirement 8.3.3 page no 405	*Training* We request CMRL to recheck the trainer man month which is too high and also request to provide detail break-up.	Revised requirement is enclosed in attachment 3 of addendum 1
20	Section-VII Employer's Requirement	*Employer's Representative* We request CMRL to provide details of Employer's Representative and request to clarify Who will act as Employer's Representative?	CMRL representative shall act as Employer representative
21	Section-VI Employer's Requirement page no 636 Drw no CMRL-PS&OHE04-BID-PS-180001	*49T* We request CMRL to clarify whether 49T - TRANSFORMER THERMAL PROTECTION is a separate protection required or same as that of WTI protection provided.	Straight Through Joint interconnecting between Phase 1 & Phase 1 ext 33kV networks shall be located within 100m either side to the platform of Washermanpet station. Transformer Thermal protection 49T shall be inbuilt protection implemented with Transformer.
22	page no 65 appendix A	*Range for apportionment %* We request CMRL to make range for apportionment for contractor for all cost centers except Mobilization apportioned %.	refer price schedule document in Section IV

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23	Section - VII Particular Conditions PC 36.1 pg no 830	*Change in Laws and Regulations* We request CMRL to consider Change in Law & regulation during the course of contract We note that the revised provision for change in taxes does not take into account any change in the rate of indirect taxes. Considering the frequent changes in tax rates under the new GST regime, this would expose bidders to a significant taxation risk. Higher provision for such risks would ultimately lead to higher prices. We would therefore request that the following wording be included: "If any rates of tax are increased or decreased, a new tax is introduced, an existing tax is abolished, or any change in the interpretation or application of any Tax occurs in the course of the performance of the Contract, which was or will be assessed on the Contractor, Subcontractors or their employees in connection with the performance of this Contract, an equitable adjustment of the Contract Price shall be made to fully take into account such change by addition to the Contract Price or deduction therefrom as the case may be."	PC 36.1 refers to the change in law and regulation. For clarity with respect to taxes and duties refer item no 15 of this addendum in connection to PC14.
24	Section IV, Bidding Forms Clause 1.1.2, pg no.60	*15% of each bill shall be hold on account of Taxes and Duties and same shall be reimbursed separately by CMRL on actual production of documentary evidence of the payment of same including tax invoice* CMRL is requested to delete this clause as GST being proposed to consider extra at actual	Accepted, Terms shall be corrected as " GST of current bill shall be paid based on the GST invoice submission subjected to submission of previous GST paid proof along wit auditor certificate" Refer attachment 8 of addendum 1.
25	pg no 10 4.1 a	In case of consortium Alstom assumes that payment shall be made separately. Is consortium is allowed or only JV allowed.	Yes separate payment shall be made to consortium. consortium is accepted,
26	Section - VII Particular Conditions	*Custom Duty* Whether Project Import benefit is available for the extension is not clear from tender conditions. Confirm concessional custom duty is applicable. Will employer give certificate for the same.	Yes concessional Custom Duty is applicable for this project
27	pg no 858 & 99	project time line: should the bidder submit its own time line for the contract or Employer will give a brief timeline.	Based on key dates and access dates issued in appendix E, Contractor shall submit the detailed schedule indicating all key activities including design submission, procurement, mobilisation of tools and plants etc

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28	page no 714	which is date is to be taken as effective date whether it is LOA or NTP.	D' refers to Effective date. For definition of Effective date refer GC clause 1 & Article 3 of contract agreement.
29	page 60 price schedule1.1.2	Whether BOCW (1%) is applicable for this tender. If so should it be applied for the entire project or only the execution part.	BOCW cess shall be applicable on full value of work.
30		Bidder understanding is this contract is treated as works contract and applicable GST will be 12% please confirm.	Yes Contract shall be treated as works contract with GST of 12%
31	pg no 62 price schedule.	Provisional sum shall be over and above the bidders price quoted. i.e the bidder shall not quote for the cost center D and that shall be 5% of bidders lump sum price. Consideration of the cost center D for financial evaluation shall be as per ITB 38.2 (a) Is this value 5% of Bidders lump sum or fixed as shown instable above the clause. Also clarify whether provisional sum is considered 100% or 50% only ie only for employer.	Provisional sum is fixed and not 5% of bidders lump sum. incase of utilising provisional sum for DRB, provisional sum shall only makeup for Employer share and not the contractor share on DRB expense. Contractor has to bear the 50% expenditure incurred on DRB.
32	pg no 415, 425	Drawings are not legible kindly provide a good quality copy.	legible soft copies are included in attachment 4 addendum 1.
33	pg no 364	Exact rating of compensation equipment (in KVA or KVAr) shall be provided. Limits for pF correction to provided.	The rating of Compensation equipment shall be designed based on the reactive power requirement of the 33kV cable network with additional capacity of 30% in each equipments. With the provided capacity it shall be possible to maintain power factor between 0.9 lead and 0.9 lag at 33kV level
34	pg no 364	Kindly confirm whether the ventilation for reactive power compensation is part of bidder or not.	Ventilation for power room is in E&M/VAC scope and hence proper interface shall be done to meet the required parameters. If equipment supplied requires Air-conditioning, it shall be supplied by PS&OHE04 contractor by using precision cooling method. (ie air-conditioning the only the panel and not the entire room)
35	General	Source of power supply and traction network may be clarified	Refer Drw no CMRL-PS&OHE04-BID-PS-180001 & CMRL-PS&OHE04-BID-OHE-180001 page no 636 & 638
36	SCADA	Clarify whether the interconnection of RTU with Telecom server is in the bidder scope.	refer drawing in page no 719. Backbone port shall be provided in power room. Connection of RTU to backbone shall be done by PS&OHE04 contractor. Location of Backbone port in the Power room shall be coordinated with the telecom contractor.
37	Section-VI Employer's Requirement pg 3.2.1 b, pg no. 327	*Dedicated cable feed from washermanpet Switching station to Wimco Nagar switching station to feed depot when main line is under power block.* Whether separate cable to be laid for Depot infeed from Washermanpet Switching station. CMRL may please clarify.	yes, separate cable feed shall run along the corridor from Washermanpet SSP to Wimco nagar SSP cum Depot feeder switching station. Refer drawing no CMRL-PS&OHE04-BID-PS-180002 page no 637
38	Section-VI Employer's	*Interface Specification.*	Shall be issue in addendum 2

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	Requirement pg no 331 3.7.3	CMRL may please add the detail interface specification	
39	Section-VI Employer's Requirement Appendix -E pg no 714	*Correlation of AD & KD.* CMRL may please provide the AD & KD correlation. Is there any possibility to split KD accordingly to civil works in future?	Updated sheet for KDs is enclosed in attachment 5 of addendum 1 and the same reveals the relationship between KDs.
40	General	*RDSO approved Source* Is it mandatory to procure materials from only RDSO approved vendors or vendors meeting RDSO specifications can also be considered	Vendor with RDSO approved vendor is desirable.
41	General	*Storage area/Site office* Drawing for Work area (storage/site site office) proposed for use by CMRL-PS&OHE-04-2018 contractor may be ear marked in the tender documents	It is not possible to Allocated work area at this stage and work area shall be handed over to contractor within 60 days from effective date.
42	Section 3-2.4.2 (b) Specific Experience	it is request CMRL to modify this requirement as "2.4.2 (a) Specific Experience : A minimum number of 3 similar (ii) contracts that have been satisfactorily and substantially (iii) completed as a prime contractor (single entity or JV member)(iv) between 1st January 2008 and the Bid submission deadline"	Accepted

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43	Section 3-2.4.2 (b) Specific Experience	Request CMRL to consider experience of last 10 years, uniformly for all the requirements. Further considering the fact that most of the metro corridors around the world uses 750 - 1500 voltage level, we request CMRL to allow credentials of voltage level 750 and above for consideration in this project. Hence the clause shall be modified as follow: “ For the above or other contracts completed and under implementation as prime contractor (single entity or JV member), management contractor or Subcontractor(vi) between 1st January 2008 and the Bid submission deadline, a minimum experience in the following key activities successfully completed 1. ROCS work (750 V and above) of minimum 5 km in last 10 years (January 2008) including design, erection, testing and commissioning 2. FOCS work (750 V and above) of minimum 50km in last 10 years (January 2008), including design, erection, testing and commissioning including at least 1 set of SSP 3. 11kV and above substation and cable ring network with latest 5 substations in last 10 (January 2008) years 4. SCADA for Traction or Power Supply System for Metro Rail System / Suburban / Mainline Railway Project in last 10 (January 2008) years	Last 10 year’s experience as requested is accepted. 1. Accepted 2. Accepted 3. Accepted 4. Accepted. Note: If ROCS requisite experience is not available with the bidder but possess requisite FOCS experience in Indian metro projects, The specific experience will be relaxed on submission of details submission of design, source of material, any work under progress with 25kV ROCS where the design is already approved and CV of designer.
44	Section 3-2.4.2 (b) Specific Experience	Request CMRL to allow bidder to also use their Associate reference for qualification purpose, this clause is in line with other metro tender like pune metro. Reference of associate clause from other metro tenders is as follows: “For this purpose, the experience of Associate / Affiliate firm of the Bidder (or Consortium Member) shall be considered. “Associate” or “Affiliate” means, in relation to Bidder {and/or Consortium Members}, a person who controls, is controlled by, or is under the common control with such Bidder {or Consortium Member} (as used in this definition, the expression “control” means, with respect to a person which is a company or corporation, the ownership, directly or indirectly, of more than 50% (fifty per cent) of the voting shares of such person).”	Not accepted.
45	Appendix 1 Terms and Procedures of Payment 6. Payment	We understand that each partner of JV would receive payments separately in their respective quoted currency. Kindly confirm.	Accepted. Detailed split up to be provided along with bid.

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46	ITB 24.1	The deadline for Bid submission is: Date: 24.04.2018 Time: up to 14:00 Hrs Last date for seeking clarification: 27.03.2018	Accepted. Refer corrigendum 1
47	page no 3.7.2	Please provide the mentioned document. " The opening of Delhi Metro Railway for „Public Carriage of Passengers rules 2002".	The respective line deleted.
48	4.2 of particular employer requirement page no 335	Refer to mentioned clause, Bidder would like to request to Elaborate the “Operability Requirements and other things mentioned in the clause. As per Bidder experience, Safety Assessment shall be performed to make the system capable of being put into use; which the Customer already asked us to do via :- -. " The opening of Delhi Metro Railway for „Public Carriage of Passengers rules 2002" - Safety Requirement mentioned in 4.3 clause of the same section. - Fulfilling the CMRS requirements time to time. Then please explain what is specific required under “Operability”.	Operability is the ability to keep an equipment, a system in a safe and reliable functioning condition, according to pre-defined operational requirements Operable conditions are to be given by contractor in Design Built project
49	4.3 Safety Requirement Pg.No 335	Refer to the mentioned clause, is for Safety Requirement but asked for RAM Plan. Bidder would like to clarify; will it be - a System Safety Assurance Plan as detailed under Clause 3.7 of Part 2- Section VI/Employers’ Requirements/Section-A/ GS/Sub-section-3/ Management plan submission Pg 153/894? - RAM & Safety Plan combine document. -Or, any other requirement. If it is other than the above two, Please elaborate the Safety requirements and confirm	System requirement is implicit of RAM plan. System safety assurance plan has to be submitted. RAM and safety plan can be combined document.
50	4.4 RAM Requirement Pg.No. 336	As per bidder understanding, to take the accountability of RAM Performance, the Operation Plan and Maintenance Plan shall be supplied by CMRL with its existing approach so that the RAM prediction can be performed. Please confirm. Please define the “Performance Checking Period”? What will	Operation plan and maintenance plan has to be submitted by contractor to maintain the performance. DLP period will be the performance checking period
51	4.7 RAM Requirements Verification Pg.No.337	As per Bidder understanding, the warranty period is similar as DLP period of 24 months. Please confirm our understanding.	Accepted.
52	4.8 Reliability Requirements Pg.No 337	"The Power Supply system shall achieve a MTBMA of no less than 7 days for the RSS." Refer to the mentioned Clause; RSS is not the scope of this tender. Thus this clause is not relevant for this tender. Please clarify.	"The Power Supply system shall achieve a MTBMA of no less than 7 days for the ASS and OHE equipment."

53	*4.9 Availability Requirements Pg.No.338*	*"The availability figures shown in the following schedule shall be met by the Power Supply system and Overhead Equipment for both corridors."* Refer to the Scope of work is for the Phase 1 Extension, there is no Two corridors involved in this scope. Thus please clarify and confirm which two corridors are referring here?	Accepted. "The availability figures shown in the following schedule shall be met by the Power Supply system and Overhead Equipment"
54	*4.9 Availability Requirements Pg.No.338*	*"The MTBF for the following items of plant shall exceed the values listed:"* There no List available for the MTBF values. Please clarified and provide (if any)..	List has to be provided by Contractor.
55	*4.9 Availability Requirements Pg.No.338*	*"In all availability calculations the following access times shall be assumed: (Point 3)* *• The availability of the Power Supply system and Overhead Equipment shall be demonstrated by the Contractor in accordance with the processes defined in the Specification"* Refer to the mentioned clause and its point 3, Bidder would like to request to mention the CLAUSE No. in Specification where the Availability demonstration process in defined?	If the process in defined in the specification it has to be demonstrated.
56	4.10 Perturbation Analysis Pg.No.338	Refer to the GS/Sub-section-3/ Management plan submission/ 3.6 / 3.6.2 is asking for FMECA. Both the studies are same and containing the same requirements as asked in clause 4.10. So, please clarify what will be the deliverable?	If FMECA asked in 3.6/3.6.2 includes Perturbation analysis, then Deliverable can be one
57	4.11 Maintainability Requirement Pg.No.338	*"System and Equipment design: Point (c)* ***First Sentence:** The Contractor shall specify, for each Line Replaceable Unit (LRU), the mean time needed to recover to a normal operation configuration.* ***Second Sentence:** 90% of these recovery times shall be lower than the estimated value "* Refer to the tender document; these are two sentences in the mentioned clause. **First sentence** is talking about MTTR (mean time to recover) for LRU's. Please confirm the Bidder understanding. **Second Sentence** is talking about the 90% of these MTTR shall be lower than the estimated value. Please confirm the Bidder understanding about the sentence. As well as please clarify how and who will provide the ESTIMATED VALUE?	Yes, It refers to MTTR. Estimated value shall be given by contractor

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58	4.11 Maintainability Requirement Pg.No.339	System and Equipment design: Point (g) *"The Contractor shall design the System in order to allow most of the maintenance workload to take place during Business Hours."* Refer to the Scope of CMRL-PS&OHE-04-2018 tender, there will be a need of Power blocks always for the maintenance of the Power supply and OHE equipment; thus this clause is not applicable. Please confirm.	Accepted. Point G removed
59	4.12 Mean Time to Restore Pg.No.339	"Point (c): The following MTTR shall be achieved: i. 15 minutes for ASS equipment; " As per our experience Power Supply Equipment in ASS, the MTTR target of 15 minute is quite stringent. Request you to please modify the clause as: “240 minutes for ASS equipment”, which is a bare minimum requirement for ASS Transformer, Switch gear etc.	Redundancy is built-in in the system. Hence the MTTR is practical
60	4.12 Mean Time to Restore Pg.No.339	"Point (c): The following MTTR shall be achieved: ii. 15 minutes for Low Voltage equipment; " As per our experience Power Supply, Low Voltage Equipment, the MTTR target of 15 minute is quite stringent. Request you to please modify the clause as: “180 minutes for Low Voltage equipment”, which is a bare minimum requirement for Low voltage equipment.	Redundancy is built-in in the system. Hence the MTTR is practical
61	4.12 Mean Time to Restore Pg.No.339	*"Point (c): The following MTTR shall be achieved: iv. 15 minutes for equipment located in equipment rooms or control rooms or on the platform."* As per our experience for Power Supply Equipment in equipment room or control room or on the platform, the MTTR target of 15 minute is quite stringent. Request you to please modify the clause as: “180 minutes for equipment located in control rooms”	Redundancy is built-in in the system. Hence the MTTR is practical
62	4.12 Mean Time to Restore Pg.No.339	"Point (c): The following MTTR shall be achieved: iii. 30 minutes for RSS equipment; and"This requirement is not available as RSS is not the part of this tender.	Accepted and deleted
63	4.14 General Maintainability Requirement Pg.No.340	"Point (a) - The Contractor shall define in the maintainability prediction studies, the unavailability and maintainability times of each failure of the transportation system. The Contractor shall perform all tests that the Employer shall require before and after the revenue	Prediction studies has to be submitted by Contractor, and the test to be perform thereof shall be specified in it.

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		service, in order to control the times defined by the Contractor. If the times measured during the tests are higher than the times defined by the Contractor, the Contractor shall update the RAM studies." Referring to mentioned clause, tender document doesn't talk about the specific test about the maintainability. Please elaborate the required TEST before and after the revenue service to be performed.	
64	4.15 Service Capability Pg.No 340	*"The Power Supply system shall provide hot swappable modules from which commutation shall not affect the normal and emergency operation of the system"* Please clarify, which part of Power supply system shall complied with the mentioned requirement of the Clause 4.15?	Accepted and removed.
65		Appendix-18 : SHE document As mentioned Appendix-18, SHE manual has not been provided, Please provide the same.	Enclosed in attachment 7-addendum 1
66	EQC-13-2.5 Pg.No.51	*"In the case of a Bidder who offers to supply and install major items of supply under the Contract that the Bidder did not manufacture or otherwise produce, the Bidder shall provide the manufacturer's authorization, using Form MAN provided in Section IV,"* Being Extension project and contractor are responsible for complete Design and build; manufacturer's authorization Form MAN requirement shall be removed.	Not accepted. It is required for all major items like Switchgear, Transformer Cables, Section insulators, regulating devices, Insulators, RTU, etc.,
67	Appendix A & 65 of 894	As General Administrative activity and Preliminary design activities are different, we request you to split the Range for apportionment between General administrative cost & Preliminary design as 2.5% & 2.5% respectively.	Accepted. General administrative cost & Preliminary design shall be 2.5% & 2.5% respectively.
68	Employer requirement Page 295 of 894	Appendix 16 as per mentioned in point (5) is missing in the contract.	Enclosed in attachment 6-addendum 1
69	Employer requirement 7.2.5	Volume 1 Appendix 16 as per mentioned in point (c) is missing in the contract which indicates Earthing and Bonding Policy.	
70	Section VI Employer Requirement Section A 1.12.7	It is request you to modify the existing clause for the following reasons: 1. The Standard IEC 61000-4-2 is for Electrostatic discharge immunity of equipment. For electromagnetic fields, Fast transient interference, high energy transients we need to refer to other standards. EN	Accepted.

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		50121-5 provides the immunity for all the given types which are Railway EMC standard for fixed power supply installations and apparatus. So the IEC 61000-4-2 should be replaced by EN 50121-5 2. The clause states to immunize Electronic equipment initially, but in later part it is mentioned Electronic equipment room. Kindly modify equipment room by electronic equipment as the standard provides immunity for equipment.	
71	BF-8Price schedule, BDS Pg.No.60	*The Bidder shall quote his Lump Sum Price inclusive of all taxes, duties, levies, cess, insurance, and other charges leviable and payable to the authorities including GST, Custom duty. The Contractor shall be solely responsible for payment of all custom duties, custom clearances, port handling charges, etc., for all imports. The Contractor shall be solely responsible for all statutory clearances, including customs, taxes, levies, transportation etc. required for successful execution of this Contract.* We request CMRL to exclude GST from lump sum Price. GST shall be charged to each invoice based on rate prevailing at the time of invoicing. As per BDS, taxes GST and Excise duty are reimbursed to contractor which is contradictory to clause no. 1.1.2. Please confirm the price should be inclusive of GST and Excise duty	Bid price shall include the Taxes and duties. Bidder shall provide detailed split-up of the taxes and duties separately as given in appendix A1 of section VI. And the same shall not be considered for bid evaluation. Accordingly relevant pages are changed and enclosed in attachment 8-Addendum 1.
72	BF-11 & Page No. 63	Being Design & Build package and contractor is responsible for performance of complete system including the product supplied; the minimum criteria defined in the clause no. 2.5 shall not be applicable for contractor's own manufactured equipment / items.	Not acceptable. Minimum criteria defined in the clause no. 2.5 shall be adhered.
73	BF-11 & Page No. 63	*"The Bidders should note that for the following Key Staff; QA Manager, Safety Manager and Chief Interface Coordinator not employed and on site within 30 days of date of mobilization in accordance with the contractor's programme there shall be a deduction of 2 lakhs for each month."* As contractor we are responsible for completion of project as per the key dates defined in the tender document, though we will deploy the manpower as early as possible, we request you to delete this Paragraph clause 1.8.	No relaxation is permitted.

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74		Please propose the date of official site visit arranged by CMRL for this extension lines.	Site visit was organised on 09.04.2018
75	ER-6.5.19, pg no. 360	If the 25kV switchgear BIL level is the least in 25kV network appropriate LA shall be provided in switchgear.	LA shall be provided in switchgear to maintain 200kV BIL for entire 25kV network as all other OHE fitting BIL is 250kV (insulator, isolators, cables)
76	Dwg. No. CMRL-PS&OHE04-BID-PS-180001, Pg no.636	We request CMRL to clarify where three position disconnector @ 33kV GIS cable feeder?	Updated drawing is enclosed in attachment 4 of Addendum 1
77	General Query	We understand that, with the lowering of GST rate for works contract from 18% to 12% effective 25-1-18 , the GST law has been amended in a such a way that refund mechanism in Rule 89 specifies 'turnover of inverted rate of supply of goods' and not about services and works contract are treated as services . The difference between input tax and output tax as % of sales is not eligible for refund and will be treated as cost. Kindly confirm.	Confirmed
78	Section II. Bid Data Sheet, BDS-3 ITB 22.2	*"The written confirmation of authorization to sign on behalf of the Bidder shall consist of:* (a) *Board resolution of each member authorizing the respective signatories"* Generally the board resolution is issued only for the Chairman/MD of the company, who can further delegate his powers to other employees within the company for specific tenders. As you would appreciate, it is not practical to have a separate board resolution passed each time a Power of Attorney is required to be issued for a new tender. We would therefor request CMRL to waive off the requirement of board resolution for each authorized signatories. However bidder should provide Board resolution of Chairman/MD of the company."	Accepted. Board resolution of Chairman/MD along with documents enforcing further delegation of powers to concern person shall be acceptable.
79	ITB-4 , Page	*"4.1 A Bidder may be a firm that is a single entity or any combination of such entities in the form of a joint venture (JV) under an existing*	Yes Indian partner can act as lead partner. Separate invoice is acceptable in case of consortium only. (needs to

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	no 10 of 894 4 – Eligible Bidders	*agreement or with the intent to enter into such an agreement supported by a letter of intent. In the case of a JV:* *(a) all members shall be jointly and severally liable for the execution of the Contract in accordance with the Contract terms, and* *(b) the JV shall nominate a Representative who shall have the authority to conduct all business for and on behalf of any and all the members of the JV during the bidding process and, in the event the JV is awarded the Contract, during Contract execution."* We understand that any bidder can submit the tender in consortium, comprising of Indian partner and Foreign partner, keeping Indian partner as lead partner. Kindly confirm Further respective partners can submit invoices separately according to the scope of work determined in consortium agreement and will get paid separately by the client Please confirm .	declare the splitup during bidding process)
80	Section VII-GCC 9.6-Contractors Responsibilities . Page 739 of 894	*"If the Contractor is a joint venture of two or more persons ,all such persons shall be jointly and severally bound to the employer for the fulfilment of the provisions of the contract , and shall designate one of such persons to act as a leader with authority to bind the JV . "* We understand that any bidder can submit the tender in consortium, comprising of Indian partner and Foreign partner, keeping Indian partner as lead partner. Kindly confirm	confirmed
81	Section VII-GCC 14 – Taxes & Duties	*"14.2Notwithstanding GC sub-clause 14.1 , the employer shall bear and promptly pay all customs and import duties for the plant specified in price schedule no 1 "* Please confirm whether this project is eligible for import under 9801 .i,e whether the employer will issue sponsoring letter to contractor to import at lower rate of customs duty	Yes Project is eligible for lower rate of customs Duty and CMRL shall give sponsoring letter
82	Section VII-GCC 31- Transfer of	*"31.1 Ownership of plant to be imported into country where site is located shall be transferred to the employer upon loading on to the mode of transport to be used to convey the plant from the country of*	E-Way bill shall be issued

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	ownership	*origin to that country* *31.3 Ownership of the contractors equipment used by the contractor and its sub-contractors in connection with the contract shall remain with the contractors or its sub-contractors"* Please confirm whether the employer will be the importer As the material upon delivery to site is handed over to contractor for safe custody, for movement of material for erection e-way bill is required. Please confirm employer will issue e-way bill.	
83	Appendix 4 & Page no 858 Time Schedule	*The bidder required to submit a more detailed outlined program, with reference to a brief outline time schedule given in section 4.* 1. Section 4 mentioned in the Appendix 4 is not found in the RFP document 2. The format(month/ week etc) in which schedule need to be submitted during tender stage	1. Corrected as "The Bid Documents contain a brief outline Time Schedule **in form of Access Dates and Key Dates**, and the Bidder shall be required to submit with its bid a more detailed outline program" 2. Monthly format shall be followed
84	Appendix E & Page no 709 Schedule of Key dates & completion dates	Different Key dates & access dates are given with respect to effective date Which date is needed to be considered as effective date- LOA or NTP?	Refer point no 16 of Addendum no 1
85	General	*Taxes* Bidder understanding is this contract will be treated as Works Contract and applicable GST will be 12%. Please confirm whether our understanding is correct	Refer point no 30 of Addendum no 1
86	Section IV, 65 of 894 Appendix A	*Appendix A – Bid Price Total* Bidder understanding they need to provide only filled Appendix A – BID PRICE TOTAL and Schedule C (Spare List) in the Financial package. Rest the entire supporting appendix, cost centres schedule need not to be filled. It is for price bifurcation of payment milestone	Only, Appendix A and Appendix A1 and spare schedule C (for spare list shall be filled by bidder.

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<table>
<tr><td></td><td></td><td>only. Please confirm</td><td></td></tr>
<tr><td>87</td><td>Appendix 2, 850 of 894

Table 3</td><td>Steel – WPI Iron & Steel (RBI)

As per enclosed RBI Bulletin WPI Iron & Steel not available. Requesting CMRL to recommend which indices need to be considered.</td><td>Steel-“WPI Mild Steel -Long Products” shall be used</td></tr>
<tr><td>88</td><td>Appendix 2, 850 of 894

Table 3</td><td>Copper – WPI Other Non-Ferrous Metals (RBI)

As per enclosed RBI Bulletin WPI for Other Non-Ferrous Metals not available. Requesting CMRL to recommend which indices need to be considered</td><td>Copper-“WPI Non-ferrous metals incl. precious metals”

shall be used</td></tr>
<tr><td>89</td><td>Appendix 2, 850 of 894

Table 3</td><td>Aluminium – WPI Non-Ferrous Metals Aluminium (RBI)

As per RBI Bulletin WPI Non-Ferrous Metals Aluminium not available. Requesting CMRL to recommend which indices need to be considered.</td><td>Aluminium-“WPI Non-ferrous metals incl. precious metals”

shall be used</td></tr>
<tr><td>90</td><td>Page 330 of 894

Cl. No. 3.5.4</td><td>Auxiliary Sub Station names and its transformer ratings are provided.

Chainages of KORUKKUPET ASS and SIR THIYAGARAYA COLLEGE ASS are not listed alignment drawings. Please provide.</td><td>Chainage of each station is included in same table
<table>
<tr><th>Sl. No.</th><th colspan="2">Section</th><th colspan="2">Station Chainages (Km)</th></tr>
<tr><th></th><th>From</th><th>To</th><th>From</th><th>To</th></tr>
<tr><td></td><td>WASHERMANPET END</td><td>THEAGARAYA COLLEGE</td><td>111.089</td><td>1051.648</td></tr>
<tr><td>1</td><td>THEAGARAYA COLLEGE</td><td>KORUKKUPET</td><td>1051.648</td><td>2008.941</td></tr>
<tr><td>2</td><td>KORUKKUPET</td><td>TONDIARPET</td><td>2008.941</td><td>3232.008</td></tr>
<tr><td>3</td><td>TONDIARPET</td><td>TOLL GATE</td><td>3232.008</td><td>4286.463</td></tr>
<tr><td>4</td><td>TOLL GATE</td><td>THANGAL</td><td>4286.463</td><td>5195.435</td></tr>
<tr><td>5</td><td>THANGAL</td><td>GOWRI ASHRAM</td><td>5195.435</td><td>6243.291</td></tr>
<tr><td>6</td><td>GOWRI ASHRAM</td><td>THIRUVOTTIYUR</td><td>6243.291</td><td>7606.638</td></tr>
<tr><td>7</td><td>THIRUVOTTIYUR</td><td>WIMCONAGAR</td><td>7606.638</td><td>8464.712</td></tr>
<tr><td>8</td><td>WIMCONAGAR</td><td>WIMCONAGAR END</td><td>8464.712</td><td>9000.000</td></tr>
</table></td></tr>
<tr><td>91</td><td>Page 415, 425 of 894</td><td>General Query

We request employer to provide legible General Power Supply Alignment drawings.</td><td>Clear Drawing can be downloaded at below link

http://cmrlvent.co.in/share/fullsetdrawings.zip</td></tr>
<tr><td>92</td><td>Page 364 of 894

CL. 6.7</td><td>Reactive Power Compensation

We request employer to provide the following details:

1. Exact rating of compensation equipment (either kVA or kVAR)</td><td>1. Minimum of 2X150A Active filter shall be installed
2. 0.9 (lead or lag)
3. THD<8%
4. Upto the capacity of the Filter
5. PCC shall be feeder no B0120211 (ie 33kV feeder at</td></tr>
</table>

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		Specify the limits like how much power factor to be improved. 2. Specify the limits of Harmonic compensation. 3. Specify the limits of load unbalance. 4. Specify the point of common coupling (PCC) at which the limits to be maintained. *5.* Number of PF compensator to be provided	Washermanpet feeding Sir Thiagaraya College) and B010421 (ie 33kV feeder at Chennai Central ASS feeding Tandiarpet ASS) 6. 2 nos in each ASS
93	Page 364 of 894 CL. 6.7	*Reactive Power Compensation* We request employer to provide the distance between MDB and reactive power equipment (where it needs to be installed.)	Both MDB & Reactive power equipment is either located in same room in elevated station and in rooms one above the other in UG stations. Distance between MDB & Reactive power equipment shall approx. between 50-100m
94	Page 364 of 894 CL. 6.7	*Reactive Power Compensation* We presume that Ventilation or Air conditioning requirement (if required) for Reactive Power Compensation equipment is not in the scope of bidder.	For ventilation : refer point no 34 of addendum 1
95	General	*General Query* Station Drawings provided are not legible. Tentative ASS Equipment room layout Plan & Switching Room Layout plan to be provided.	Tentative ASS equipment room layout plan & switching room layout plan is provided, For high resolution copy refer point no 92 of addendum 1
96	Page 637 of 894	*General Query* 1. Two feeders are taken out from Wimco Nagar SSP to depot. Connectivity details of these two feeders at depot to be provided *2.* . Distance between these SSP's to be provided	Refer: Drawing no CMRL-PS&OGHE04-BID-OHE-180002 Two lines take off from mainline to depot. Thwo feeder shall feed these two line separately to ensure that 50% depot can be operation when other feed is under maintenance or failure. Washing line shall be part of depot OHE only and shall not be a part of mainline at any cause. Distance shall be arrived from drawing shared
97	Page 636 of 894	General Query We presume that only one 33kV cable laying in Washermanpet ASS to Thiyagaraya college ASS is in bidder scope. All Other panel equipment's including terminations already exist in Washermanpet ASS please confirm	Yes. Kindly refer drawing no no CMRL-PS&OGHE04-BID-PS-180001
98	Page 659 of 894 Appendix B	Technical Specification We presume that we have to quote as per the ratings mentioned in tender specification for all the equipment's. (Items 1, 2 , 3 & 4	Yes quote shall be as per tender specification only. Any deviation if design build contractor wants to implement, shall add in quantifiable non material non conformities with required variations. The same shall be accepted only if Employer accepts the technical and commercial proposal.

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99	PS&OHE04-2018, Appendix Section VI Employer Requirement, Page 415 – 424 Appendix: A – Bid Drawings	*Appendix: A – Bid Drawings* The drawings are not legible and chainages in some areas are difficult to read. Please provide the legible copies of the drawings.	Refer point no 91 & 92
100	PS&OHE04-2018, Appendix Section VI Employer Requirement, Page 425 – 432 Appendix: A – Bid Drawings	*Underground corridor, General alignment drawings* Alignment drawings for the underground sections are not legible. Chainages and features of track alignment cannot be determined from the drawings. The drawing title and notes are also not legible. Please provide the legible copies of the drawings.	Refer point no 91 & 92
101	PS&OHE04-2018, Appendix Section VI Employer Requirement, Page 459 – 591 Appendix: A – Bid Drawings	*General arrangement drawings for Stations and for Depot* Drawings are not legible. Please provide the legible copies of the drawings	Refer point no 92
102	PS&OHE04-2018, Section VI Employer's Requirements, Subsection 3, Scope of	*Wimco Nagar Depot:* *The Overhead Equipment for Depot shall be of Rigid overhead contact system .It consists of stabling line: 12 nos, Inspection bay line: 3 nos and One Emergency Repair Bay. The Washing plant is available on the Down Ramp. The elevated Depot OHE is*	It is confirmed that the Depot shall be of ROCS type

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	Works, Page no. 329 3.4 Overhead Equipment, 3.4.4 Wimco Nagar Depot	*approximately 8 km.* It is mentioned in the clause that the overhead equipment for the Wimco Nagar Depot will be rigid overhead contact system however in 'Appendix Section VI Employer's Requirements, Page 459 – 591, Appendix: A – Bid Drawings' the general arrangement drawings for the Wimco Nagar Depot show cantilever type structures which indicate that it will be FOCS. Please confirm the arrangement required for the Depot.	
103	PS&OHE04-2018, Section VI Employer's Requirements, Subsection 2, Overview of the project, Page no. 323 2.2.1	**2.2 Over View of the Project:** 2.2.1 CMRL phase 1 extension comprises of 9km which constitutes approximately km of Underground section and km of elevated section with a elevated depot at Wimco Nagar.This 9km stretch is extension of corriodor 1 of Phase 1 project which runs between Chennai Airport to Washermanpet . Key data about the project is as below. • No of UG station: 2 • No of elevated station: 7 • No of depot: 1 (elevated depot t Wimco Nagar • Elevated construction: Double U deck • Underground construction: shield tunnelling method, except station which will be cut and cover method • Traction system : 25kV Flexible Overhead system in elevated section • 25kV Rigid overhead equipment. • Track guage: Standard gauge (1,435 mm) • Rolling stock : 2.9m width 4 Car & 6 car alignment • PSD door: Full height in underground station • No PSD in elevated station • Signalling : Same as Phase 1 Corridor alignment available in employer drawings Bullet point no. 1 and 2 mention that there are 2 underground stations and 7 overground stations, however in the schematic diagram for mainline (PS&OHE04-2018, Appendix Section VI Employer's Requirements, Appendix: A – Bid Drawings, Page no. 636 & 638) it is only shown 8 stations in total, 2 UG and 6 OG. It is understood that 7 over ground station mean 7 ASS	Is corrected as "2 UG station and 6 Elevated station with 1 depot" Each station and depot has 1 ASS. Refer SLD for better clarity (Drw no PS&OHE04-BID-PS-180001
104	PS&OHE04-2018, Section IV Bidding Forms, Page no. 71 Appendix C – Brief Description of	**SCHEDULE A2 and B - STAGE 1** **Preliminary design ,Detailed Design, Supply, Installation, Testing and Commissioning of Power Supply System and Overhead Equipment for Phase 1 Extension are as follows;** • Auxiliary Substations (ASS) • Sectioning Posts and Sub-Sectioning posts including (Civil Works if any) • Overhead Equipment & Accessories • Masts foundations for Overhead equipment • 33 kV Cables • 25 kV Cables • Cables for control/command and emergency trip of 25kV network • SCADA System • DG Sets • All related interfaces DG sets mentioned in the table. It is not clear what the DG sets	It is confirmed that the DG sets are not in scope of the contractor.

	Schedules	mentioned in the table are for. Please elaborate the purpose of this requirement of DG. Rating and the locations of the DG set also to be provided.	
105	clause2.4.3:	*The attainment of the reliability, availability, maintainability and safety requirements of the System will be verified by analysis, simulation, testing and commissioning, and system demonstrations as required in this Specification* Please confirm the type of simulation to be undertaken as the RSS and TSS is not in the scope	RAMS on RSS/TSS is not is scope of contractor.
106	Clause 3.4.4	*The Overhead Equipment for Depot shall be of Rigid overhead contact system .It consists of stabling line: 12 nos, Inspection bay line: 3 nos and One Emergency Repair Bay. The Washing plant is available on the Down Ramp . The elevated Depot OHE is approximately 8 km* Is the depot is to be electrified with Rigid OCS or flexible tramway equipment. please confirm Clause 3.4.4 mentions rigid conductor for underground stations and tunnels. What about 8 km of elevated section? Is it Completer flexible OCS or tramway equipment? If inside the stabling lines rigid overhead contact systems to be installed details of the covered shed or open area shall be furnished along with track centers for support system	1. UG section (Tunnel & Station) is ROCS type 2. Elevated section (station 7 viaduct) is Regulated FOCS type 3. Depot shall be ROCS type
107	Clause 6.15.3	*In elevated section, As a part of scope Viaduct contractor shall provide bolts for mast erection in precast deck as shown in the drawing in Employer drawings. Contractor shall prepare pegging plan to utilize these bolts to maximum extent. If contractor design does not suit to bolts locations given by viaduct contractor, contractor shall fix bolts on the deck duly considering the load calculations* Please confirm the exact locations of bolts provided by viaduct contractor for verification and Engineering.	Refer page no 592 to 596 of 894 for location of U bolt in each deck. Pier/Deck alignment of the corridor is also attached attachment of this addendum (item no 34 on index of attachment 4)
108	Clause 6.16.1.2	*Hot dip galvanized steel structures of overhead equipment support:*	Galvanisation thickness shall be 1000g/sq.mt

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		the contractor shall ensure zinc coatings of various type of mast, tubes and fittings including fabricated mast and SPS as per IS 209, ETI/OHE/13 latest version and shall not be less than 1000 g/m sq Please confirm 1000 g/sqm is minimum for SPS . 1000 g/sqm is not possible for below certain thickness. Can we follow the ranges governed in ETI/OHE/13 for various thickness	
109	Clause 6.16.1.4	*The contractor shall select proper type of portal and head span arrangement which shall be used in main line depending on number of tracks and the clear span of the portal* Please confirm whether head spans can be designed in station areas with multiple track	Only Portal arrangement shall be used.
110	Clause 6.16.1.5	*Contact wire* *The contact wire shall be of 150 sq mm hard drawn copper conductor, as per EN 50149 configuration similar to AC-150. The contact wire shall be of 150 sq mm hard drawn grooved, diameter 14.8 mm. The contact wire should be drawn out of Continuous cast rods of minimum diameter of 23 mm rod with South ware process. Contact wire shall Conform to latest EN 50149, latest RDSO specification ETI/OHE/76 specification* Please confirm whether both EN 50149 and RDSO standard to be followed for contact wire or any one standard will suffice	Contact wire profile shall be as per EN 50149 Specification (latest revision) and specification as per RDSO
111	Clause 6.16.1.9 Dropper wire	*Clause 6.16.1.9 Dropper wire* *Flexible droppers shall be 12 sq mm, made of bronze, consisting of 1 wire of 7 strands each of 0.65 mm diameter and 6 wires of 7 strands each of 0.54 mm diameter, with crimped endings with eye on either end and reinforced automatic clamps (copper alloy made) on messenger wire and contact wire, are and the diameter is 5 mm.* Please confirm whether 12sqmm dropper wire is minimum or fixed size.	12 sq.mm shall be used

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		Can we use 10sqmm dropper wire as per DIN43138	
112	Clause 6.16.2.5	*6.16.2.5* *b) Sections of transportable lengths will be joined together to form lengths up to 250m between overlap joints.* Please confirm the distance between two overlap joints be 500m if design permits	Accepted, distance between two overlap joints upto 500m is acceptable
113	Clause 6.16.2.5	*The length offered shall be supported by the data of various metro systems using similar/same size rigid conductor ROCS and the site condition which shall generally be 10 m* Can the length of the rail be 12m if design permits	Not accepted. Rail length shall be 10m
114	Clause 6.16.2.12	*Maximum ROCS span length permitted shall be 10 m The distance between supports depends on the speed of rolling stock, the inertia of* the *system and the maximum sag allowed.* Please clarify whether the span can be increased to 12m if the pantograph simulation permits as for speed less than 90km 12m spans can be adopted	
115	Clause 6.16.2.13 Drop arm	*Drop Arm and SPS for ROCS steel supporting structure and fittings to be hot dip galvanized as per IS 209 and Indian Railway RDSO specification ETI/OHE/13 latest version. Zinc coating shall not be less than 1000g/m2* Zinc coating of 1000 g/sqm is not feasiblesince they are installed inside the tunnel can it be reduced to 80 to 90 microns	Galvanisation thickness shall be 1000g/sq.mt
116	Page 371 of 894 Cl. No. 6.10	*ACDB/DCDB/ Battery/Battery Charger* We presume the following: 1. We consider Auxiliary load (240V AC & 110V DC) for Washermanpet SSP is already considered in Existing Washermanpet ASS (ACDB/DCDB). Please confirm our understanding. Please specify the scope of power & control cabling of Washermanpet SSP from exsiting Washermanpet ASS.	Yes. Auxiliary load (240V AC & 110V DC) for Washermanpet SSP is already considered. Control cable (both power and data) of Washermanpet SSP is in the scope of the contractor Yes, Auxiliary Supply (240V AC & 110V DC) for Toll Gate SS & Wimconagar SSP needs to be considered in the respective ASS ACDB/DCDB

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		Auxiliary Supply (240V AC & 110V DC) for Toll Gate SS & Wimconagar SSP needs to be considered in the respective ASS ACDB/DCDB i.e. Toll Gate ASS and Wimconagar ASS. Please confirm.	
117	*General*	We consider that ASS & SSP/SS switchgear will be placed in different room of the station. It is requested to provide tentative ASS/SSP/SS room layout or dimensions along with the location in the station layout plan	ASS & SS/SSP shall be in same room
118	Page 371 of 894 CL. No. 6.10	*ACDB/DCDB Cabling* We presume that power & control cabling of Wimconagar SSP/Toll Gate SS from the respective ASS room is under the scope of the bidder. Please confirm	confirmed
119	Section VI, Employer Requirements, GS, Sub-section 3, Page 154 of 894 3.10	*3.10.1 The Contractor shall prepare and submit for Notice of No Objection by the Employer an EMC Management Plan which shall, based upon a top-down approach, define the EMC philosophy, activities, means of control for the design processes and EMC submissions to be supplied to demonstrate compliance with the Particular Specification and this GENERAL SPECIFICATION 3.10.2 The EMC Management Plan shall identify a comprehensive list of specifications, standards, method statements and procedures to be submitted to the Employer for Notice of No Objection . The EMC Management Plan shall also include a programme that shall identify the dates for EMC submissions.* *3.10.3 The EMC Management Plan shall include an initial list of design documentation, test specifications and test reports with a single paragraph description of each document to indicate compliance with the Specification.* *3.10.4 The EMC Management Plan shall include a definition and description of the process and methods used for Verification and Validation that the Works will achieve the required EMC parameters in all respects.* *3.10.5 The Contractor shall co-ordinate the levels of interference emissions and susceptibility of all equipment which are to be designed, manufactured, supplied and installed by the Contractor and*	Confirmed. Contractor shall be the lead person in interface

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		its sub-contractors and suppliers. The Contractor shall designate a person as the main point of contact to deal with EMC matters. Details of the nominated person and any subsequent change of the nominated person shall be subject to Notice of No Objection by the Employer. *3.10.6 The Contractor shall liaise and co-ordinate with all Interface Contractors in the exchange of EMC data and related equipment performance characteristics and advice the Employer when any such information is requested from any Other Contractor. A copy of all EMC related information exchange shall be sent to the Employer for information.* As per our understanding, we need to develop a control plan for Auxiliary supply and OCS. All the equipment which involve the use of electronic equipment need to be complied with relevant EMC standards as per contract. Type test reports of such equipment will be submitted. The EMC at system level will be taken care by other sub-system contractor. Please confirm our understanding.	
120	Section VI, Employer Requirements, PS, Sub-section 3, Page 329 of 894 3.4.4	*The following items of work are within the scope of work of this tender but not limited to:* *a) All survey on site necessary to do in order to design OHE.* *b) The design of the OHE.* *c) Supply and Erection of 25 kV Traction Overhead Equipment for Elevated Lines,Depots and Underground sections d) OHE masts with base plate for viaduct.* *e) OHE dropdown supports for tunnel section.* *f) Portals with drop arms with base plate welded for viaducts.* *g) Drop arms attached to roof trusses in stations and in depot.* *h) Cantilever assemblies with silicon composite insulators for main line and depot.* *i) Overhead equipment conductors like messenger wire, contact wire, jumpers, and* *dropper wires etc.* ***j) Adequate measures to be taken to minimise EMI/EMC impacts on the BSNL cables etc to along the cmrl route alignment*** *k) Rigid overhead conductor system in underground stations and*	Refer point no 8 of addendum 1

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		tunnels. l) Aerial earth wire (AEC) and Buried earth conductor (BEC). m) Integral transverse link (ITL), earth electrodes, earth connectors, earth strips etc. *n) Termination assemblies for conductors with silicon composite insulators.* As per our understanding, the requirement for additional measures to minimize EMI impacts on BSNL cables etc will be provided to us by Signalling contractor after they conduct site test. Please confirm our understanding is correct.	
121	Section VI, Employer Requirements, PS, subsection 6, Page 375 of 894 6.15.16	*The contractor should ensure that hazards due to electricity must be limited to acceptable values by adequate design of installations. Those hazards could arise from:* *a) The overhead contact line to rail voltage,* *b) The operating current and short circuit current,* *c) The electric field,* *d) The Heating effect,* *e) The magnetic field,* *f) Rail to earth potential,* *g) Induced longitudinal voltages,* *h) Capacitive charges etc.* As per our understanding, induced longitudinal voltage on signalling cables and other cables laid along the track will be studied by signalling contractor. Please confirm our understanding.	induced longitudinal voltage on signalling cables and other cables laid along the track will be studied by PS&OHE contractor.
122	Section VI, Employer Requirements, PS, subsection 7, Page 397 of 894 7.2.5	*Earthing:* *a. Each wires will be checked for continuity and electrical isolation for every 1000 m approx. including at integral transverse bond by the contractor.* *b. Clearance between earth wires and out-of-run wires of overhead equipment's and signals shall be checked by the contractor.* *c. Earth resistance shall be measured separately for each pit and inter-connected earth pit at every switching station by the contractor and meet the requirement of the Earthing and bonding policy note (*	Yes,

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		Volume1 Appendix 16). As per our understanding, the location of impedance bonds to be provided by signaling contractor keeping in view of achieving the allowable rail to earth potential.	
123	Sect.VI Page 383 6.16.2.3.1	*The sag should not be more than 8.5 mm under normal condition* For maximum speed below 90 km/h, support span of 12 m is normally used (reducing the number of supports and also joints) and related sag (below 13 mm) provides a satisfactory current collection, Please confirm.	10 meter span shall be adopted
124	Sect.VI Page 384 6.16.2.5 b	*Sections of transportable lengths will be joined together to form length up to 250m between two overlap joints* Section length between two overlap joints shall be calculated according to expected temperature range, but should not be limited to 250 m only in order to reduce the number of overlaps (typical section lengths are in the range of 400-500 m). Please confirm	Refer point no 113 of addendum no 1
125	Sect.VI Page 384 6.16.2.5 e	*The length offered shall be supported by the data of various metro systems using similar/same size rigid conductor ROCS and the site condition which shall generally be 10 m.* For maximum speed below 90 km/h, support span of 12 m is normally used (reducing the number of supports and also joints). Please confirm	10 m span shall be adopted
126	Sect.VI Page 385 6.16.2.12	*Maximum ROCS span length permitted shall be 10 m* For maximum speed below 90 km/h, support span of 12 m is normally used (reducing the number of supports and also joints) Please confirm	
127	Sect.VI Page 385 6.16.2.14	*An earth rod support shall be installed approximately at every 20 metres which is fixes on the aluminium profile by means of a clip flange* Normally three earth rod supports per section are used (one at each end, one in the middle). One earth support every 20 metres is a huge	Shall be provided every 100m

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		quantity, the span should be increased. Please confirm.	
128	Sect.VI Page 386 6.16.2.17	*Anchor suspensions are made of -aluminum alloy* Please clarify which part shall be made of aluminium alloy. Normally heavy duty anchor clamps are made of stainless steel and they are anchored by stainless steel wire. Please confirm	No *Anchor suspensions are made of -aluminium alloy*
129	Sect.VI Page 386 6.16.2.18	*The maximum length of aluminium rail is 10m* For maximum speed below 90 km/h, support span of 12 m is normally used (reducing the number of supports and also joints) and therefore the rail length is also 12 m to keep a constant distance between joints and supports, Please confirm	10 meter span shall be adopted

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Attachment 1 – Spare list

SPARE PARTS LIST			
Sl. No.	**Description**	**Unit**	**Qty.**
	33 kV Equipment		
1	Low Voltage Components (All Control and relay compartment)	Nos.	2% of each item rounded off to upper whole number
	Cable		
1	Length 33kV feeder cable (FLRS & FLRSOH)	Mtr	100 each
2	Length of 25kV Cable (FRLS & FRLSOH)	Mtr	100 each
3	Straight through joint kit For 33kV cable For 25kV cable	quantity	 3 2
	Termination kit 33kV GIS end , 25kV GIS end 25kV OHE end)	quantity	 3 nos 2 nos 2 nos
	SCADA		
1	Protocol Converter	No.	2 each
2	Fibre Optic	km	3
3	PLC	No.	2
4	I/O cards of each type	Nos.	20
5	Power supply unit of each type	Set	5
6	Media converter	Nos	2 nos each
	Protection & Metering		
1	Set of Protection relays consisting of one relay of each type	Set	1
2	Set of Transducers consisting of one transducer of each type	Set	1
3	Set of Metering relays consisting of one relay of each type	Set	1
	Traction Equipment (25 kV)		
1	Manually operated Isolator with operating rod insulator	Nos.	3
2	Motor operated Isolator with operating rod insulator	Nos.	1
3	Manually operated Isolator with earthing heel with operating rod insulator	Nos.	1
8	Lightening arrester	Nos.	4
9	Automatic tensioning device (complete set)	Set	4
	OHE – Insulators		
1	Bracket tube insulator	Nos.	130
2	Stay tube insulator	Nos.	130
3	25 kV post insulator	Set	1
4	9 tonne insulator	Nos.	10
5	Light weight Section insulator assembly for Main Line	Nos.	3
6	Section insulator assembly for Depot Lines	Nos.	2

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OHE – Cantilever Fittings			
1	Complete set of fittings including bracket tube, stay tube, register arm, steady arm, register and suspension fittings, Silicon composite insulators, etc. (for Pull-off type)	Set	65
2	Complete set of fittings including bracket tube, stay tube, register arm, steady arm, registration and suspension fittings, Silicon composite insulators, etc. (for Push-off type)	Set	65
3	Swivelling fastening for bracket tube	Nos.	40
4	Swivelling fastening for top tube	Nos.	40
5	Nuts and bolts etc.		5% of the installed qty of each type
6	Different Clamps used	Nos	5% of the installed qty of each type

(* Tubes shall be supplied, duly cut to sizes according to the requirements, to be advised during the construction stage)

OHE – Poles and Beams			
1	Pole with base plate each type	Nos.	2% each type of the Mast rounded off to upper whole number
2	Portal each type	Nos.	
3	Pole to be used at grade each type	Nos.	
4	Two-track cantilever masts (TTC)	Nos.	
5	BFB drop arm each type	Nos.	
OHE – fittings			
1	Contact wire splice (for 150 sq mm Contact Wire)	Nos.	15
2	Contact wire ending clamp (for 150 sq mm Contact Wire)	Nos.	10
3	Messenger wire ending clamp	Nos.	15
4	Messenger wire splice (crimped)	Nos.	10
5	Strain clamp (bolted) for 93 sq mm ACSR	Nos.	6
6	Splice AEC (crimped), for 93 sq mm ACSR	Nos.	10
7	Crimped ending eye for droppers	Nos.	5% of the installed quantity.
8	Contact wire clamp for steady arm(for 150 sq mm Contact Wire)	Nos.	5% of the installed quantity.
9	Set of half messenger clamps (each set containing 2 halves) for dropper	Set	5% of the installed quantity.
10	Set of half contact wire clamps (each set containing 2 halves) for dropper	Set	5% of the installed quantity.
11	Nuts and bolts etc.	Set	5% of the installed quantity.
1	Contact wire (150 sq mm)	km	3
2	Messenger wire	km	3
3	12 sq mm dropper wire	km	1.5
4	93 sq mm ACSR (AEC)	km	4.5
5	95 sq mm jumper wire	m	5% of the installed qty

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6	Control cables	m	5% of the installed qty of each type
Rigid overhead contact system			
1	Conductor rail	Nos.	25
2	Expansion joint/Overlap	Nos.	10
3	Insulators	Nos.	25
4	Suspension Clamp gliding	Nos.	10
5	Suspension Clamp Fixed		
6	Copper aluminium hanger clamp	Nos.	25
7	Joints(Splice)	Nos.	25
8	Steel supporting structure	Nos.	25
9	Nuts and bolts etc.	Set	5%of the installed qty of each type
10	Jumper wire	m	5% of the installed qty of each type

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Attachment 2- Tools list

TOOLS LIST			
Sl. No.	**Description**	**Unit**	**Qty.**
	Power supply		
1	Basic Substation Tools Multimeter CAT-II Full spanner set Screw driver set Tools related to battery bank Specific tools related to GIS Power supply extension cord 15A, 25m length Cupboard for tools and drawing 2 no of Earth rod suitable for 33kV system 33kV insulation glow Emergency lamps/tourch Tool kit box	Nos.	1 per ASS
2	Gas handling unit		1
3	Air blower		3
4	Arc suits		6
5	Crimping tools For Power cable For Control cable		 1 3
6	Insulation tester 500V-5kV	No.	1
7	Earth tester 3 terminal	No	1
8	Software Relay configuration package RTU configuration package Laptop industrial grade with accessories to interface with Relay/RTU	 Users Users no	 2 2 2
	OHE tools		
1	Spanners of all types	Nos	Each type 2
2	Torque wrench	Nos	2
3	Pipe wrench ½ to 18inch	Nos	2
4	Tirfor of required ratings	Nos	Each 2
5	Pull lift Required ratings	Nos	Each 2
6	Web slings Required ratings	Nos	Each 2
7	D shackle	Nos	10
8	Trackle Rope	Nos	1
9	PP rope 16mm/20mtr	Nos	3
10	Steel pulley Single pulley 2T	Nos	4
11	OHE tool kit	Nos	2
12	Spirit level 300mm	Nos	2
13	33kV Gloves	Nos	3
14	Discharge Rod	Nos	10
15	Binocular 10*50 DPSI	Nos	2
16	Kink Remover	Nos	2

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17	Plumb up	Nos	2
18	Come along clamp catenary	Nos	4
19	Come along contact	Nos	4
20	Hydraulic Battery operated crimping tool	Nos	2
21	Hydraulic manual crimping tool	Nos	2
22	Allen key set	Nos	2
23	Dynamometer	Nos	2
24	Thermal image camera	Nos	1
25	Earth Rod	Nos	50

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Attachment 3 – Training Program

Sl. No	Description	Total Period (Man weeks)	Remarks
1	Design of Rigid Overhead Catenary System	3	During the Design Stage
2	Design of flexible Catenary System	3	During the Design Stage
3	Design of 33kV auxiliary network system including protection	4	During the Design Stage
4	Design of 25 kV traction supply (TSS/FP/SP/SSP) including earthing system	2	
5	Manufacturing facilities, Testing methods and procedures, Working Metro installations. Short Module course on System description, architecture and installation practices of Power supply system	3	
6	Manufacturing facilities, Testing methods and procedures, Working Metro installations. Short Module course on System description, architecture and installation practices of OHE system	3	

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Addendum I
Attachment 4 Drawings

Drawing are available in link shared below

http://cmrlvent.co.in/share/fullsetdrawings.zip

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APPENDIX E

SCHEDULE OF KEY DATES AND COMPLETION DATES

Effective Date : (Tentative)

Key Date Ref.	Description	Key Date
KD1	Commissioning of ASS's at Sir Theagaraya College Metro Station	AD8+ 40
KD2	Commissioning of ASS's at Korukkupet Station	AD8+ 40
KD3	Commissioning of ASS's at Tondiarpet Station	AD5a+ 40
KD4	Commissioning of ASS's at Toll Gate Station	AD5b+ 40
KD5	Commissioning of ASS's at Thangal Station	AD5c+ 40
KD6	Commissioning of ASS's at Gowri Ashram station	AD7a+ 40
KD7	Commissioning of ASS's at Thiruvottiyur metro station	AD7b+ 40
KD8	Commissioning of ASS's at Wimco Nagar station	AD7c+ 40
KD9	Commissioning of ASS's at Wimco Nagar Depot	AD13+ 40
KD10	Commissioning of SSP at Washermanpet station	AD1+ 90
KD11	Commissioning of SS's at Toll gate	AD5b+ 40
KD 12	Commissioning of SSP and depot 25kV feeder at WImco Nagar station	AD7c+ 40
KD13	Commissioning of 25kV cable between Washermanpet SSP to Wimco Nagar SSP	AD10+ 30
KD14	Traction energisation for Underground section (ROCS) from Theagaraya college Station and ramp between Korukupet -Tondiarpet station	AD8+ 60

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KD15	Traction energisation for elevated section (FOCS) from ramp between Korukupet -Tondiarpet station and Toll Gate SS	AD09+ 60
KD16	Traction energisation for elevated section (FOCS) from Toll Gate SS to Wimco Nagar shunting neck.	AD10+ 60
KD17	Traction energisation for elevated depot section (ROCS) at Wimco Nagar.	AD12+ 120
KD18	Testing and Commissioning of SCADA system for Under Ground stations	AD8+ 60
KD19	Testing and Commissioning of SCADA system for Elevated stations Tondiarpet, Toll gate & Thangal	(AD5a, AD5b, AD5c) +60
KD20	Testing and Commissioning of SCADA system for Elevated stations Gowri Ashram, Thiruvotriyur & Wimco nagar	(AD7a, AD7b, AD7c) +60
KD21	Testing and Commissioning of SCADA system for Depot 25kV equipments including Depot ASS	AD12+ 140
KD22	Acceptance of Integrated Testing and Commissioning for Phase 1 Extension Revenue Service	KD 21 + 30
KD23	Issue of Completion Certificate for Phase 1 Extension Revenue Service	KD 22 + 28
KD24	Achieve Operational Acceptance for Phase 1 Extension Revenue Service	KD 23 + 366

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1. INTRODUCTION

1.1 Introduction Scope

1.1.1 The purpose of this Earthing, Bonding, Lightning Protection and Corrosion Protection Policy is to define the requirements for the earthing and bonding of the electrical power supply systems and other parts of the Metro system to ensure, as far as possible:

i. the safety of operating personnel and other persons from electrical shock.

ii. the minimum of electrical interference between the electrical power supply and other electrical and electronic systems and the protection of electrical equipment.

iii. the minimum of disturbance to existing statutory services and parts of the Metro system due to any electrolytic corrosion effects arising from AC traction currents flowing to and from the general mass of earth.

1.1.2 This document is divided into several sections. Sections 2 and 3 are of a general nature whilst Sections 4 to 7 deal with specific items under system and equipment-specific general headings and Section 8 deals with stray current corrosion control.

1.1.3 It should be noted that no Single section can be taken alone as being complete in itself in covering all aspects of earthing under the general heading of that section. In the implementation of the earthing policy account has to be taken of the interrelationship, interface and integration of all systems comprising the Metro system.

1.1.4 The Contractor shall develop its own designs as required for Earthing, Bonding, Lightning Protection and Stray Current Corrosion Control using this document as a basis for doing so.

1.1.5 The Contractor shall coordinate his designs for earthing, Bonding, Lightning Protection and Stray Current Corrosion Control as required with all Other Contractors.

1.1.6 Reference in other documents to "Grounding" shall be taken to be synonymous with 'Earthing".

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2. CATEGORIES OF EARTHING

2.1 General Requirement

2.1.1 The earthing system provided at any location may be common to two or more categories of earthing, in which case all the earthing points on the individual items of equipment will be bonded together to discharge any earth fault currents: In general, earthing and bonding is required under one or more of the following categories.

2.2 Neutral Earthing

2.2.1 Connection to earth at one or more nominally equipotential points of the current-carrying conductors of each section of the power supply system shall be arranged to ensure that the voltage at any point in the system relative to the general mass of earth will be within defined limits and will provide a low impedance path for earth fault return currents.

2.2.2 For low impedance earth paths to be established the ground conditions must first be measured (earth resistivity Ohms / m) and the system designed according to the results. Allowance shall be made for the fact that conditions may vary throughout the year due to seasonal weather.

2.3 Protective Earthing

2.3.1 Connection to earth at one or more points of the non-current-carrying parts of electrical equipment shall be arranged to ensure that, in the event of a failure of insulation or other inadvertent connection between current and non-current-carrying parts, no dangerous potential difference occurs between the non-current-carrying parts of the equipment and the general mass of earth or adjacent equipment, and to provide a low impedance path for earth fault currents.

2.4 Adjacent Metallic Structures

2.4.1 This relates to connection to earth of metallic structures, which are not part of the electrical equipment but are in close proximity to the electrical system.

2.5 Mitigation of Interference Effects

2.5.1 This relates to the connection to earth of the screening of light current signal and control cables. The connection to earth of the screening conductors of any light current cables will, in general, be confined to one end in order to avoid circulating currents in the screen causing interference on the signal chores.

2.5.2 There may be exceptions to this and EMC considerations will determine the solution to be adopted in individual cases.

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2.6 Treatment of unearthed systems

2.6.1 This relates to unearthed systems where the current carrying conductors are fully insulated from earth at all points. No part of such a system need to be automatically disconnected immediately on the occurrence of a single earth fault in that part. However special care needs to be taken during design and installation when considering this type of earth system.

2.7 Earthing for Lightning Protection

2.7.1 This relates to the protection of buildings and structures from lightning by the provision of lightning arrester and hence connection to the earth electrode system. Account shall be taken of the locality and lightning incidence rate and applied to the protection of the Railway Systems as a whole from "Far" and "Near" strikes, individual structures and personnel protection.

2.8 Traction return current circuit

2.8.1 This relates to the connection to earth of the track rails and the protection cables (Buried Earth Cable, Aerial Earth Conductor, etc...).

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3. GENERAL REQUIREMENTS

3.1 Legislation and Standards

3.1.1 Earthing, bonding, lightning and corrosion protection has to be in accordance with current standards applicable Requirements applicable to the Metro system for the purposes of this Earthing Policy shall be assumed to be no less onerous than the relevant requirements of the following:

a European Standard EN50122-1 - 'Railway Applications Fixed Installations Protective provisions relating to electrical safety and earthing'.

b European Standard EN50122-2 - 'Railway Applications - Protective provisions against the effects of stray currents traction systems

c British Standard 7361, Part 1 - Cathodic Protection - Code of Practice for Land and Marine Applications.

d. International Union of Railways Codes (UIC) 605 'Protection from Corrosion' - Measures to be taken on catenaries to reduce the risk on adjacent piping and cable systems.

e BS 7671 - Requirements for Electrical Installations

f IEC 60364 - Electrical Installations of Buildings

g IEC 61312 - Protection Against Lightning

h IEC 61024-1; Protection of Structures against Lightning, Part 1: General Principles.

i IEC 61024-4; Series protection against lightning electromagnetic impulses for structure with electrical and electronic systems.

j IEC 61000-5 Edition1, Electromagnetic Compatibility (EMC) Part 5

k BS 7430 - Code of Practice for Earthing.

l ANSI/IEEE 80 - Earthing of Substations

m IS—3043--EARTHING

n BS-1013---SUBSTATION EARTHING

o NFPA-- 780-- LIGHTNING PROTECTION

p IEEE- 1100—EARTHING OF ELECTRONIC EQUIPMENT EN- 50122-2 Insulation from Earth

q EARTH RESISTANCE VALUES (ETI/PSI/EARTHING OF RDSO) RDSO’s Code No: ET1/PS I /120 (2/91) Code of practice for earthing of Power Supply Installation for 25kV ac single phase traction system

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r European Standard EN50121-1 -Railway Applications – Electromagnetic compatibility - General'.

s European Standard EN50121-4 - Railway Applications – Electromagnetic compatibility – Emission and immunity of the signalling and telecommunications apparatus'.

t European Standard EN50121-5 - Railway Applications – Electromagnetic compatibility – Emission and immunity of fixed power supply installations and apparatus'.

u RDSO/SPN/144/2004 Safety and reliability requirement of electronic signalling equipment,

v Local Codes. These may however conflict with International Codes/Standards in which case discussion and agreement with the employer representative will be required.

3.2 Treatment of AC Power Supplies

3.2.1 The general policy followed in this document is to provide an earth farm for each of the auxiliary substations and at other locations as required for purposes of earthing AC power supply systems under the category of Clause 2.2 and metallic enclosures and structures under Clauses 2.3 and 2.4.

3.2.2 The earth farms at each substation and other locations shall be multiple-interconnected by provision of bonding connections cable sheaths, cable armouring, to adjacent earth farms to form an incidental earth mat embracing the whole of the Metro system.

3.2.3 The armouring of HV power supply cables will not be connected to the incoming supply to the bulk substation earthing system (this must be agreed with the local authority) or other mitigation measures taken. However, there shall be provision to do so conveniently on a temporary basis whilst work and testing requiring this is carried out.

3.2.4 The alternative solution of segregating the utility supplier and Metro system earth farm and its associated earth system from utility supplier earth farms and earth systems could be difficult to implement and to maintain.

3.2.5 Although segregation will tend to discourage the flow of stray traction currents through the earth systems, this will not necessarily decrease the corrosion of particular electrodes and may well encourage stray currents to pass from buried structure to buried structure, leading to corrosion of the structures.

3.2.6 Two other difficulties could arise with segregation as follows:

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a transferred potentials will appear across insulated joints used to segregate the systems where there are interconnecting cables etc. and between adjacent structures bonded to different earthing systems

b provision of earthing for the screening of telecommunications cables to reduce interference (Clause 2.5 above).

3.2.7 For the reasons described above, the effects of the segregation will need to be monitored closely.

3.3 Treatment of Unearthed Auxiliary Supplies

3.3.1 Certain low voltage auxiliary, signalling, control or indication systems come under the category of Clause 2.6, where the ability to temporarily continue in operation with a single earth fault gives increased security of supply. The signalling or control circuit can be isolated from Earth to avoid maloperation or Nuisance Tripping of the control circuit which will therefore need its own Alarm to draw attention to this fact and hence start the fault rectification process (normally by manual investigation and maintenance operations).

3.3.2 The incoming power supplies to the control system however may have their own Earth Fault detection.

3.4 Lightning Protection

3.4.1 The protection of above ground structures from lightning under the category of Clause 2.7 is included within this policy document..

3.5 Traction return current circuit System

3.5.1 The power supply contractor will have to handle a traction power supply simulation. The traction return current circuit will be designed according to tender requirements, standards and traction simulation results.

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4. OVERALL EARTHING STRATEGY FOR THE CHENNAI METRO RAIL PROJECT

4.1 Earthing, Bonding, Lightning Protection and Corrosion Protection Principles

4.1.1 Taking into account the previous general requirements in section 3:

a A "Structure Earthing" strategy shall be applied throughout theChennai Metro Rail Project to ensure electrical safety and provide the basis of lightning protection;

b All trackwork with workshop buildings shall be bonded to the structure earth of the building.

4.1.2 All buildings *I* structures shall be connected to mass earth via earth farms which form part of the building *I* structure foundations and this earth shall be continuous through all building structures by the appropriate interconnection and bonding of all metalwork.

4.2 Viaducts

4.2.1 Earth farms shall be incorporated into the foundations of every column by the provision of interconnected flat steel bars in the footings *I* piles, pile caps and up through the actual columns. These shall be provided by the relevant civil contractor to a design provided by the power supply contractor.

4.2.2 The reinforcement in the viaduct shall be bonded together throughout the entire length of each span. Where post-tensioned segmental construction is used, all reinforcement in each segment shall be bonded together with welded flat steel bars which shall be brought out to two principal terminals on each side of each segment and every segment in the span shall be electrically connected with a copper bonding cable which shall subsequently be bonded to the earth bars in the supporting columns. The bonding of reinforcement with the civil works shall be provided by the relevant civil contractor to a design provided by the power supply contractor. The interconnection of segments by copper cable and connections to the columns earths shall be provided by the power supply contractor.

4.2.3 Lightning interception facilities shall be provided along the sides of the viaduct which shall be securely bonded to the structure earth of the viaduct. These shall be provided by the civil contractor to a design provided by the power supply contractor.

4.3 Stations

4.3.1 Earth farms shall be incorporated into the foundations of every column by the provision of interconnected flat steel bars in the footings *I* piles, pile caps and up

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through the actual columns. These shall be provided by the relevant civil contractor to a design provided by the power supply contractor.

4.3.2 The reinforcement in the building *I* structure shall be bonded together throughout by the use of welded flat steel bars. The bonding of reinforcement with the civil works shall be provided by the relevant civil contractor to a design provided by the power supply contractor.

4.3.3 The flat steel bars shall be brought out into every auxiliary service substation and every traction power substation to main earth bars located on a wall.

4.3.4 Further flat steel bars shall be brought out to earthing terminals in:

a Every Station Control Room

b Every Ticket Office

c Every plant and equipment room

d Other locations where required as an earthing point for metal work and lightning protection. (It should be noted that general earthing of typical electrical equipment should be through the reticulated earth of the low voltage power supply system or back to the nearest earthing terminal.)

4.3.5 The flat steel bars shall be provided by the civil contractor to a design provided by the power supply contractor.

4.3.6 Any distribution of earthing required beyond the above nominated locations shall be provided by the respective contractor responsible for the provision of the particular equipment.

4.3.7 Lightning interception facilities shall be provided on the roofs of buildings *I* structures which shall be securely bonded to the structure earth of the building *I* structure. These shall be provided by the civil contractor to a design provided by the power supply contractor.

4.4 Main Line and Depot External Track work

4.4.1 In order to ensure electrical safety and prevent the potential of the running rails rising to excessive potentials above the structure earth, proper earthing shall be used at appropriate locations to clamp the running rails to the structure earth. These shall be provided by the power supply contractor at an appropriate number of locations to control the rail potential to safe levels. As a minimum, one shall be provided at each station and in each depot external area

4.4.2 The Main Line track work and the depot external track work shall be electrically isolated from each other by the use of insulation joints boundary

4.5 Depot Workshop Track work

4.5.1 The running rails and traction return system of the Chennai Metro rail Project

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within the depot workshops shall be solidly bonded to the traction return earth.

4.5.2 The traction return rails for the depot workshop and the pit wheel lathe lane are electrically isolated from the main line by means of insulated rail joints.

4.6 Traction return current circuit

4.6.1 The traction return current circuit of the Chennai Metro Rail Project will use the rail and the following return current conductors:

- Buried Earth Cables
- Aerial Earth Cables
- Integral Transverse Bonds.

Cables cross sections will have to conform to EN 50122. Buried Earth cable, Aerial earth cable, Integral Transverse Bond - and Earth pit when available – will be bonded together:

- on earth bar provided at the bottom of OHE mast on viaducts and in Depot
- on earth connecting box in stations and in underground.

4.7 Interfaces

4.7.1 The design of the earthing, bonding, lightning protection and corrosion protection of the chennai Metro Rail Project shall be undertaken by the power supply contractor.

4.7.2 During the development of its design, the power supply contractor shall coordinate the earthing requirements of all Other Contractors.

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5. EARTHING OF POWER SUPPLY SYSTEMS

5.1 Supplies

5.1.1 The electrical power supply systems comprise 110/ 33 kV, 110/25 kV and 415 V, 3 phase, *3/4* wire ac supplies, 240 V and 110 V, 1 phase, 2 wire ac supplies, at 50 Hz and 110 V dc equipment control supplies.

5.2 Earth Electrodes and Earth Systems

5.2.1 Earth Systems for Bulk In-feed Substations

5.2.1.1 Each bulk In-feed substation will be provided with earthing farms for both utility supplier and Metro system.

5.2.1.2 Connections to the earth farms will be through two 'Principal Connections' links by means of stranded insulated copper cables with a cross- section area calculated for the worst case conditions of earth current through marshalling earth bars in the area of the farms

5.2.2 Earth Systems for Substations

5.2.2.1 Each services Substation will be provided with an earth farm, of resistance less than 1 ohm, and connected to the substation earthing system through two 'Principal Connection' links by means of stranded insulated copper cables with a cross-section area calculated for the worst case conditions of earth current.

5.2.2.2 The substation earthing system is to be compliant with IEC 60364 and IEC 61312 or BS 1013

5.2.3 Earthing for Distribution Systems

5.2.3.1 Supplies at 415/240 V, or 110 V are made available for Depot and station equipment, and, where applicable, trackside equipment. These supplies are derived from the Secondary winding of the power source (Transformer/Generator etc) 415 V star-connected 3-phase supplies, the star point of which is to be bonded to the auxiliary Substation earthing system.

5.2.3.2 Continuity of this earth connection to the point of supply shall be provided by the cable sheath / armouring and/or additional bonding cables.

5.2.3.3 All locations receiving such supplies, which are remote from the earth system of any traction or distribution substation, are to be earthed by one of the following methods:.

a by low impedance connection to the trunk earth system such that the minimum earth fault current is adequate to operate the over current protection in accordance with IEC 60364;

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b where the requirement in (a) cannot be met, approved earth leakage protection is to be provided;

c by connection of the earth terminal to the earth electrodes at any adjacent location via cable sheaths and armouring and/or additional bonding cables such that the earthing impedance meets the requirement in (a) above;

d by connection of the earth terminal via sheaths and armouring of the supply cables or other bonding conductor to the earth system of the auxiliary substation, such that the earth fault loop is entirely metallic and of sufficiently low impedance to meet the requirement of (a) above.

5.2.3.4 The earthing of all distribution and sub-distribution systems is to be in accordance with IEC 60364.

5.3 System Earthing

5.3.1 General

5.3.1.1 This section describes the connection to earth of the neutral or negative, nominally equi-potential points of the current carrying conductors in each section of the power supply system.

5.3.2 110 kV Supplies

5.3.2.1 The method of earthing of 110kV, 3 phase supplies from utility supplier must be coordinated with utility supplier.

5.3.3 415V Supplies

5.3.3.1 The star point of the 415V secondary winding of the auxiliary transformer will be connected to the earth bar of the 415V switchboard.

5.3.3.2 The earth bar will be connected to the neutral bar via a neutral link in the switchboard

5.3.3.3 The neutral bar of the transformer is to be solidly earthed, via a bolted link to the earth system.

5.3.4 240V Supplies

5.3.4.1 The 240 volt supplies are taken from one phase and the neutral of the above 415V supplies. The neutral shall be earthed in accordance with Clause 4.3.5.

5.3.5 110V AC Supplies

5.3.5.1 The 110V supplies are obtained from *240/110V* transformers. Each 110V winding of these transformers is to be fitted with a centre tap which is to be solidly earthed.

5.3.5.2 Approved earth fault detection equipment is to be provided.

5.3.6 110V DC Supplies

5.3.6.1 Both poles of the 110V battery supplies used in traction and distribution substations

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and elsewhere in connection with the power supply system are to be insulated from earth.

5.3.6.2 Approved positive pole and negative pole earth fault detection equipment is to be provided.

5.4 Equipment Earthing (non-track side)

5.4.1 This section refers to the treatment of metal enclosures or supporting metalwork for the equipment associated with the power supply systems covered in Section 4.3 above, with the exception of the trackside equipment which is covered in Section 5.5 below.

5.4.2 Earthing and bonding of electrical equipment is required to reduce the effects of interference, and to ensure the personal safety of the public, operational and maintenance staff by limiting the step and touch voltages to within acceptable limits. Where there is a conflict between these requirements, personal safety is always to take precedence.

5.4.3 33 kV Cables / 25 kV cables

5.4.3.1 The earthing of screens and armouring of all 33 kV and 25 kV cables is to be earthed at both ends. Exception may be made at the extreme ends of the system to avoid any circulating currents detected in service.

5.4.3.2 Means are to be provided for disconnecting the screen ends, individually, from earth for testing purposes.

5.4.4 Other Power Supply Cables

5.4.4.1 This section covers the cables for the distribution of 415/240Vac supplies and 110Vdc Supplies

5.4.4.2 The armouring of multicore cables (e.g. 3 phase or twin and earth etc.) is to be earthed at both ends via an earth terminal provided with the gland, or via the metalwork of the cable box and structure to the earth bar or terminal of the equipment at which the cable is terminated.

5.4.4.3 Exceptions will be where the equipment at each end does not share the same earth system as, for example, the dc switchgear for which the enclosures are insulated from the substation earth and connected to it via a leakage current measuring shunt. In this case the armouring will be earthed only at the distribution board end.

5.4.4.4 Single core cables are to be earthed in a similar manner but at one end only and must avoid circulating eddy currents where the metallic cable sheath is connected to a metallic cabinet.

5.4.5 110 kV/ 33 kV and 25 kV Switchgear

5.4.5.1 All ac switchgear will be earthed directly to the substation earthing system.

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5.4.6 415V, 240v and 110 V Switchgear

5.4.6.1 All metallic components of the cubicles are to be bonded to an earth bar or terminal which is to be connected to the substation earth system.

5.4.7 Battery Equipment

5.4.7.1 All metallic components of metal stands and cubicles for batteries, battery chargers and DC distribution switchboards are to be bonded to an earth bar or terminal which is to be connected to the earth system.

5.4.8 Transformer

5.4.8.1 All electrically separate parts of each transformer core are to be bonded together and the core as a whole is to be insulated from the enclosure/tank. An accessible removable link is to be provided between the core and the enclosure/tank for earthing the core for core testing.

5.4.8.2 All metallic components of control compartments are to be bonded to an earth terminal or bar, which is to be connected to the enclosure. The enclosure is to be connected to the substation earth system with a suitable fault rated earth connection.

5.4.9 415/110VTransformers

5.4.9.1 Each transformer is to be provided with a screen between the primary and secondary windings so that in the event of a fault the primary winding or its connections cannot be connected to the secondary winding or its connections

5.4.9.2 The centre point of the secondary 110 V winding is to be connected to the substation earth system.

5.4.9.3 This screen, the core and framework of each transformer is to be connected to the earth bar or terminal of the enclosure in which the transformer is located.

5.4.9.4 The earth bar or terminal of the enclosure is to be connected to the substation earth system.

5.4.10 Marshalling Panels

5.4.10.1 All metallic components of each cubicle are to be bonded to an earth terminal or bar, which is to be connected to the earth system.

5.4.11 Instruments, Relays, Control Switches and other Electrical Components

5.4.11.1 All metallic cases and/or frames of instruments, relays, control switches and other electrical components mounted on control panels or in cubicles are to be connected to the earth bar or terminals of the cubicle in which the component is mounted.

5.4.12 Ancillary Equipment

5.4.12.1 Cubicles, cabinets, racks and panels are to be provided with a copper earth bar having a suitable cross-sectional area for the possible fault current, placed at a

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convenient position within the equipment. All metal parts, other than those forming part of an electrical circuit, are to be earthed by connection to the earth bar.

5.4.12.2 When apparatus or instruments are accommodated on panel cubicle doors or swinging frames, flexible cable or braid is to be used for earthing these items; the door hinges are not acceptable as means of earthing this part of the equipment.

5.4.12.3 Except where otherwise approved, a stud type terminal of diameter not less than 12 mm, or a tapped boss of equivalent size, is to be provided on the outside of each cubicle or structure for the purpose of making the connection to earth. This terminal is to be connected to the substation earthing system.

5.5 Track and Trackside Equipment

5.5.1 Traction Return Running Rails (Main Lines)

5.5.1.1 The track rails, where used for traction return purposes in main line and Depot areas, have to be regularly bonded to the Buried Earth Cable. Maximum distance between two bondings should not exceed 500 m. In Track circuited areas, the bonding will be through appropriate track circuit device.

5.5.1.2 As the Metro system uses the train wheels and track rails for the traction current return circuit, the rails electrical continuity has to be ensured. Whenever the rails continuity is not ensured – mechanical joints for signalling purpose, expansion joints for track purpose only – the rails continuity shall be recreated using continuity bonds.

5.5.1.3 Concerning the expansion joints for track purpose only, the continuity will be ensured by 2* 70 mm^2 (minimum cross section) cables bolted on the rails. The drilling and the preparation of rail bonds shall be done in factory.

5.5.1.4 Concerning the mechanical joints for signalling purpose, the continuity will be ensured by impedance bond.

5.5.1.5 As the Metro system uses the train wheels and track rails for the traction current return circuit, the track rails will have volt drop along them as a result of the flow of traction current. The rails are imperfectly insulated from earth or the structures on which they are fixed and therefore a circuit parallel to the rails can occur by means of which current driven by the volt drop flows out of and back into the rails. The current, which flows out of the rails and returns at some other point, is referred to as stray current.

5.5.1.6 The most serious effect of the stray current is electrolytic corrosion at the point where current flows out of a metal surface into concrete or soil. An equivalent of an Electrolytic circuit is formed the same as a battery cell is set up at the interface, the potential of which varies with the ground, structure and rail materials present.

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For corrosion to take place the interface potential must exceed the potential of the cell.

5.5.1. 7 The rails shall be properly bonded to Buried Earth Cables so that Buried Earth Cable nominally constitutes the return path and limits the stray currents.

5.5.1.8 Track rails, Buried Earth Cables, Aerial Earth cables, Earth pits will be connected together via Integral Transverse Bonds provided:

- with a maximum 500 meter spacing
- at mechanical joints.

Spacing will be determined in contractor EMI study.

5.5.2 Clearance To Earthed Equipment or Structures

5.5.2.1 Any exposed, non live, conductive part (metallic structure or other equipment), which is closer than 2.0 m from vehicle static envelope shall be earthed to the Buried Earth Cable. If already part of an earthing system, the conductive part should be connected to the buried earth cable via voltage limiting device.

5.5.2.2 Screen doors on station platforms, where installed, will be bonded to the track by duplicate insulated cables and insulated from the general body of earth. Metal enclosed electrical equipment within 2.5 metres of the screens will not be earthed but the enclosed live equipment 'double insulated' from the enclosure.

5.5.2.3 The station platform surface in the vicinity of the screen doors, where installed, will be of insulating material.

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6. EARTHING OF COMMUNICATION AND CONTROL SYSTEMS

6.1 General

6.1.1 There are several separate sub-systems which collectively form the control and communications system. Equipment, enclosures and mountings associated with these sub-systems are distributed throughout the Metro system at trackside, stations and depot locations.

6.1.2 The equipment, enclosures and mountings associated with the control and communications system are not anticipated to be located within 2m of any part of the Metro system that is intentionally connected to the traction return system. Earthing of the control and communications system will thus be by conventional methods to the protected earth of the distribution switch board.

6.1.3 Should it become necessary, during construction, to locate any item of equipment associated with the control and communication system within 2m of a part of the Metro system that is connected to the traction return system then additional protective measures will need to be adopted. In such instances the provisions of clause 7.1, to limit the touch potential between the two earth systems, will apply, and the equipment enclosure will be earthed to the Buried Earth Cable through voltage limiting devices.

6.1.4 Two separate clean earths of value not exceeding 0.5 Ohms required at each station for signalling and telecommunication (including AFC), to be terminated in signal, telecom and AFC equipment rooms as well as in telecom closets rooms at all stations, depot and OCC.

6.2 Trackside Equipment

6.2.1 Trackside equipment is considered to comprise all equipment, enclosures and mountings located at stations, substations and adjacent to the track but, remote from stations and substations.

6.2.2 Integral Transverse Bonds and insulated joints

6.2.2.1 The integral transverse bonds have to be connected at a maximum spacing of 500 m. These integral transverse bonds will also serve the need of equipotential link.

6.2.2.2 Insulated joints are mandatory on track at traction substations

6.2.3 Station Locations

6.2.3.1 At each station a UPS and UPS distribution switchboard will be provided by a designated contractor.

6.2.3.2 Each item of control and communications equipment that is connected to a 240V

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single phase supply derived from this source is to have its earth terminal directly connected to the main protected earth terminal at the distribution board by an appropriate protective conductor.

6.2.3.3 All metalwork (including enclosures, mountings, racks, trays etc.), associated with an item of control and communications equipment that is not intended to carry current is to be bonded to the earth terminal within the equipment enclosure and extended to distribution board by an appropriate conductor.

6.2.3.4 Alternatively, if the design of the equipment requires, a direct earth cable, to the station earth farm principal earth connection, may be provided.

6.2.4 Trackside Locations

6.2.4.1 Control and communication equipment at trackside locations, e.g. points machines, are to derive their power supply from the UPS of the nearest station or the depot as appropriate.

6.2.4.2 Each item of control and communications equipment that is connected to a 240V single phase supply derived from this source or otherwise is to have its earth terminal directly connected to the main system earth cable running between the earth systems of successive auxiliary substations. In these cases the earth core of the supply cable will be left open at the end remote from the supply to avoid excessive currents during fault conditions.

6.2.4.3 All metal work (including enclosures, mountings, etc.), associated with an item of control and communications equipment that is not intended to carry current e.g. signal lamp enclosures, is to be bonded to the main system earth cable running between the earth systems of successive auxiliary substations.

6.2.4.4 The touch potential of the trunk earthing conductor will be controlled as described in clause 5.5.2 above.

6.2.5 Substation locations

6.2.5.1 Control and communication equipment, housed within or immediately adjacent to Sub-stations, are to derive their power supply by dedicated feed from the UPS of the station or depot as appropriate.

6.2.5.2 Each item of control and communications equipment that is connected to a single phase supply derived from this source is to have its earth terminal directly connected to the protective earth terminal at the distribution board.

6.2.5.3 All metalwork (including enclosures, mountings etc.), associated with an item of control and communications equipment that is not intended to carry current shall be bonded to the equipment earth terminal.

6.2.5.4 The earth terminal of the distribution board will be connected to the distribution switchboard protective earth.

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6.3 Depot Equipment

Depot equipment comprises all control and communications equipment contained within the Depot building and that located in the stabling yard and mounted on the depot buildings.

6.3.1 Signalling and Telecommunications Room

6.3.1.1 Equipment contained within the signalling and communications is to be fed from the UPS distribution board, installed complete with protective devices and earth terminal.

6.3.1.2 Power distribution to the various items of ancillary equipment and cubicles shall be by means of several ring main circuits. Each circuit contains a dedicated protective conductor (separate conductor or cable armouring) connected to the protected earth terminal at the distribution Switchboard.

6.3.1.3 All items of control and communication equipment are to have a direct connection between the equipment earth terminal and the circuit protective conductor.

6.3.2 Operations Control Centre

6.3.2.1 Equipment contained within the Control centre is to be fed from the UPS distribution board, installed complete with protective devices including surge suppressor and earth terminal.

6.3.2.2 Power distribution to the various items of ancillary equipment and desks shall be by means of several ring main or radial circuits. Each circuit contains a dedicated protective conductor (separate conductor or cable armouring) connected to the protected earth terminal at the distribution switchboard.

6.3.2.3 All items of control and communication equipment are to have a direct connection between the equipment earth terminal and the circuit protective conductor.

6.3.3 Other Depot Locations.

6.3.3.1 Control and communication equipment, located externally or on depot buildings, is to derive its power from the control centre UPS.

6.3.3.2 Internal earthing of the equipment will be to a dedicated earth terminal connected to the enclosure.

6.3.3.3 Where the equipment is outside the 3.0m limit to the vehicle static envelope an earthing circuit for the metallic enclosure will be provided back to the protected earth of the distribution switchboard. Where the equipment is within the 2.0 m limit the enclosure will be earthed to the depot system earth. The touch potential of this earth system will be controlled by strategically situated voltage limiting devices as described in 5.5.2 above.

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7. EARTHING OF OTHER METALLIC STRUCTURES

7.1 General

7.1.1 Other metallic structures comprise those structures which do not form part of the Power Supply or Communication and Control Systems covered in Section 4 and 5 above. They include the reinforcing in concrete construction, pipes for other services and fixtures and fittings in buildings and stations and depot.

7.1.2 Lightning protection of structures and buildings is also included in this Section.

7.1.3 The ac systems are generally arranged to operate with their neutrals earthed, and with associated metallic enclosures also connected to earth, by conventional methods.

7.1.4 The Buried Earth Cable shall be regularly earthed and connected to earth pits.

7.1.5 Earth pits shall be provided at each stations and their spacing should not exceed 300 m on viaducts and in depot. Earth pits earthing value shall not exceed 1 Ohm.

7.1.6 Earth pit shall be provided with disconnecting bars so that their earthing value can easily be checked.

7.1.7 Any exposed metallic structure, concerned by 7.1.1, which is closer than 10 m from the Over Head Line shall be earthed to the Buried Earth Cable as per clause 5.5.2.1.

7.1.8 The self-restoring properties of high voltage limiting devices avoid a permanent leakage path for limited faults whereas a latched contactor needs to be manually reset or a device needs to be physically replaced.

7.2 Over ground Structures

7.2.1 The frames of all buildings and other structural steelwork are to be bonded to the local earth system unless all parts of the frame or structure are completely encased in concrete, masonry or other non-metallic cladding.

7.2.2 Where a local earth system is not provided under the provisions of Clauses 4.2.1 such a system is to be provided for the purposes of this Clause in those locations where accidental contact with the traction system is possible. Such an earth system is to have an overall resistance not exceeding 10 ohms between any point of the earthed frame or structure and the general body of the earth. In addition a self-restoring spark gap device is to be connected between each separate structure and the traction return system

7.2.3 In the case of the building structure of the Depot workshop, where the traction return system is deliberately earthed, the structure E&M service and traction earthing systems are all to be interconnected.

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7.2.4 In general the reinforcing bars in concrete structures or foundations are not to be earthed in those cases where the reinforcing bars are completely encased in concrete. This applies to substation foundation slabs.

7.2.5 Where external connections are made to the reinforcing, for the purpose of providing studs for securing metallic structures or components which are earthed, insulating sleeves and washers are to be fitted to the studs if there is a possibility of traction return currents passing into the reinforcing via the studs.

7.3 Reinforced Concrete Track slab

7.3.1 If the reinforcement of the concrete slab below the rail is discontinuous, then no specific provision for leakage current collection is required.

7.3.2 If the steel reinforcement of the concrete slab below the rail is continuous, then at every 150 meters, provision of bonding of steel reinforcement shall be provided out of the concrete in the track to allow future connection to buried cable if necessary.

7.4 Services To Metro system premises.

7.4.1 Metallic service (I.e. water, gas, waste water etc) pipes entering the Metro system premises, both over and underground, are to be provided with an insulated insert at the point of entry, and the pipework within the Metro system premises is to be bonded to the local earth system.

7.4.2 Where both plastic and metal pipes are used, all lengths of exposed metal pipes, or those connected to taps or apparatus, are to be bonded to the local earth system. A separate bond is not required for the pipe if it is electrically continuous with earthed apparatus.

7.5 Small Metallic Components

7.5.1 Small metallic and isolated structural parts which are effectively segregated from any electrical apparatus or cables etc. or earthed metallic enclosures and structures do not require to be bonded to the local earth system.

7.5.2 For the purposes of this Clause the metal angle supports for trench covers and similar metalwork in electrical traction and distribution substations are not effectively segregated and are to be bonded to the substation earth system.

7.6 Depot Fencing

7.6.1 Metallic fencing associated with the Metro system within 2.0 metres of the track or any part of any structure or other equipment which is connected to it, is to be earthed to the depot slab structural earth system.

7.6.2 The depot Substations will also derive their earthing from the depot slab structural earth system

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7.6.3 Metallic fencing associated with the Metro system within 10.0 metres of the overhead contact line, is to be earthed to the Buried Earth Cable.

7.6.4 Each separate section of fencing is to be separately earthed in the appropriate manner as above.

7.6.5 All gate posts are to be bonded to each other across the gate opening by an underground conductor, and the gates themselves bonded across the hinges.

7.7 Lightning Protection

7.7.1 The need for lightning protection for individual mass transit system buildings is to be assessed in accordance with IEC 61024-1 or the local building code. Where lightning protection is found to be necessary, it shall be provided in accordance with this Standard.

7.7.2 All building structures will be of steel or steel reinforced concrete with every pillar of the structures bonded into the structure earth of the depot

7.7.3 Metal roofing will be multiple bonded into the metal of the building structure. Lightning conductors will be provided to bridge any non-metallic roofing and conduct into the steel structure in the most efficient manner.

7.7.4 Cables with metal sheaths and other metallic services entering the building are to be bonded to the structure at the point of entry and to any electrodes provided for lightning protection, if not already adequately bonded via the local earth system.

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8. CORROSION CONTROL

8.1 The measures to be used to reduce corrosion and other interference effects are:

i to ensure that the along-track resistance is as low as practicable.

ii to ensure that the track-to-buried earth resistance is as low as possible,

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Attachment 7- SHE Document

STATEMENT OF INTENT

Chennai Metro Rail Limited firmly believes in a "development which meets the needs of the present without compromising the ability of future generations to meet their own needs". This commitment towards sustainable development is manifested clearly in our corporate culture, even as we continue to build a world-class metro.

CMRL intends to incorporate ISO 14001 standards in its construction. This commitment entails aggressive employment of methods and strategies during construction that maximize energy efficiency, use cleaner technologies, reuse and or recycle materials and similar other efforts that help to prevent and reduce environmental degradation.

It is the intent of CMRL to demonstrate continual improvement in its environmental management system during the execution of the project.

This manual represents the minimum standards that Chennai Metro Rail Limited will accept on matters of Environment. It lays down the guidance for environmental protection measures to be adopted as part of mitigation strategy for overcoming adverse environmental impacts during construction. It suggests environmentally friendly construction practices that the Contractors are encouraged to adopt in order to contain various types of pollutants that may be generated due to construction activities.

Chennai Metro Rail Limited actively supports the efforts and initiatives that are instigated by the Contractors and sub-contractors in their efforts for achieving good standards of Environment on the project. The Corporation will use its best endeavours to ensure that all of the Contractors employed on the Project achieve these Standards.

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CHENNAI METRO RAIL PROJECT

Environmental Policy

We at Chennai Metro Rail Project accord high priority to the protection of environment while building a world class Metro system for the city of Chennai.

In this endeavour, we are committed to:

- Adopt environment friendly construction methods and practices so as to cause minimum inconvenience to public and protect ecological degradation.
- Create assets that are aesthetically appealing, optimise the use of energy and causing minimum impact on the environment.
- Conserve and enhance green cover through transplantation of trees and compensatory afforestation
- Make all efforts to create environmental awareness among our employees, Contractors and Metro users.
- Strive for continual improvement in our environment policies, processes and procedures
- Comply with applicable local and National environmental legislations.

The above Environmental Policy is communicated to all employees for adherence and to be made available to interested persons/parties.

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1. Introduction

Significant success has been made in India in developing and enforcing environmental regulations in many areas. However, there still remain a number of areas that have not yet seen the promulgation of environmental standards and regulations. Many of these areas have a high potential for adverse environmental impact if allowed to go unregulated. As the CMRL undertakes to build this Metro system it shall institute and enforce adequate environmental standards to provide for the protection of the people and the environment.

In response, the Contractor shall comply with all applicable Indian laws and regulations to mitigate the adverse environmental impacts from the construction activities. Based on the Employer's Environmental Impact Assessment (EIA) report (Ref. Annexure 1) the Contractor shall conduct an analysis of the environmental Impacts, and implement suitable measures to mitigate the adverse impacts so as to comply with all the environmental standards & regulations. All appropriate categories/areas, such as air quality, noise, water quality, etc. are to be considered in the environmental analysis. The Contractor will have to undertake Environmental Monitoring and Audit during construction to measure the environmental impacts. Should the impact measurements exceed the respective limits set forth in EIA Report, the Contractor shall be required to review and implement effective measures so as to ensure that the impact of the construction works will not exceed the respective limits set forth in the EIA report.

The Contractor shall be responsible for the total compliance of the Environmental Protection safeguards as elaborated in this Environmental Management Arrangements.

1.1 The 'Environmental Management Arrangements' (EMA) document forms an essential part of the overall environmental protection system employed by CMRL for the construction of the Chennai Metro Rail project.

1.2 The EMA has been prepared to facilitate construction progress while ensuring fulfilment of environmental commitments. It provides systematic procedures for monitoring and minimizing environmental impacts that may arise from the construction activities.

1.3 The EMA will apply to all construction works of the Chennai Metro Rail Project carried out by the Contractors and Sub-contractors.

1.4 The primary reason for adopting the EMA approach is to make the Contractor aware of his environmental responsibilities and to ensure his commitment to achieving the specified standards.

1.5 The CMRL EMA is meant to be a living document that will be updated as design and construction progresses and when further environmental issues are identified.

1.6 Periodic reviews of the plan and procedures will be performed to ensure continual improvement of the Plan's adequacy and it will be expanded and updated during the project duration.

1.7 Because the work potentially involves design-build contracts, this EMA is intended to be flexible and tailored to match highly variable construction activities and locations throughout the project.

1.8 The EMA is set out as follows:

- Section 2 highlights the purpose and scope

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- Section 3 outlines the objective, which will form a basis for Environmental Management System
- Section 4 lists the definitions and abbreviation of terms used
- Section 5 sets out the responsibilities for application of the procedures
- Section 6 provides guidance to the Contractor for preparation of his contract specific Site Environmental Plan
- Section 7 commits the Contractor's Method Statement to incorporate environmental issues during execution of works
- Section 8 focuses on the Environmental Performance Review of Contractor's activities through Environmental Audits
- Section 9 details measures to contain Air, Water, and Noise Pollution and management of waste through Environmental Friendly Construction Practices
- Section 10 specifies good Housekeeping measures
- Section 11 presents Landscape and Aesthetics
- Section 12 suggests measures to conserve energy through effective Energy Management
- Section 13 deals with Traffic Management
- Section 14 focuses on requirements that the Contractor shall have to meet in case Archaeological and Historic Resources are encountered
- Section 15 on Environmental Monitoring - lists the relevant monitoring equipment, compliance criteria and monitoring programme to be undertaken by the Contractor during construction
- Section 16 details requirements for impact monitoring for air quality including Air Monitoring and Control Plan
- Section 17 details requirements for impact monitoring for noise including Noise Monitoring and Control Plan
- Section 18 describes the Environmental Site Inspection process to be implemented by the Contractor
- Section 19 details the Environmental Audits, which the Employer's Representative may undertake as part of environmental performance review
- Section 20 details the Reporting requirements as related to submission of Contractor's Monthly Environmental Management Report under this EMA
- Section 21 sets out the Complaint response process and finally,
- Section 22 mentions the requirements of Completion of the EMA programme

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2. Purpose & Scope

2.1 The purpose of this Environmental Management Arrangements is to make the Contractors aware of the environmental concerns of CMRL, and to establish guidelines for the application of environmental controls during the construction of the project.

2.2 The Environmental Management Arrangements is intended to translate into practice, three important principles of CMRL's mandate, which the construction activities should not:

- Cause inconvenience or endanger public
- Create a permanent visual eyesore
- Result in unmitigated ecological or environmental degradation

2.3 The EMA is intended to guide and assist the Contractors in exploring all reasonable and feasible means for reducing construction related environmental impacts as they prepare and produce contract-specific Aspect / Impact Assessments and Site Environmental Plans.

2.4 The EMA stipulates environmental controls that in lieu of alternative controls specified by the Contractor must be applied.

2.5 Environmental controls adopted by the individual contractors as an alternative to the measures identified herein must be as protective of the environment.

2.6 The scope of the EMA is to establish procedures to:

- Supervise Contractor's compliance with defined environmental control criteria by carrying out reviews of monitored impact data
- Oversee the procedure for identification of mitigation measures, their design and implementation
- Carry out environmental monitoring emissions during construction through an impact monitoring programme
- Undertake additional ad hoc monitoring if required, to address specific instances

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3. Objective

3.1 The various components included in the EMA along with the Employer's requirements on Environment will form the basis of an Environmental Management System to be implemented by CMRL, which will enable it to manage the environmental challenges and resolve environmental issues posed during construction of Chennai Metro Rail project.

3.2 The main objectives are to:

- Provide database from which environmental impacts of the project can be determined.
- Provide timely indication if any environmental control measure fails to achieve desired results.
- Monitor effectiveness of environmental mitigation measures
- Initiate remedial action if unacceptable impacts arise.
- Determine contractor's compliance with statutory and legal requirements.

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4. Definitions & Abbreviations

4.1 **Air Monitoring and Control Plan** is abbreviated as AMCP.

4.2 **Auditor:** Person with the competence to conduct an audit.

4.3 **A – Weighted** Noise levels in Decibels (referenced to 20 micro-Pascal) as measured with A - weighting network of standard sound level meter, abbreviated dB(A).

4.4 **Central Pollution Control Board**, New Delhi is abbreviated as CPCB.

4.5 **Continual improvement:** Recurring process or enhancing the environmental management system in order to achieve improvements in overall environmental performance consistent with the organization's environmental policy.

4.6 **Corrective action:** Action to eliminate the cause of a detected nonconformity.

4.7 **Decibel** is measure on a logarithmic scale of the magnitude of a particular quantity (such as sound pressure, sound power) with respect to a standardized reference quantity.

4.8 **Document:** Information and its supporting medium.

4.9 **Energy Equivalent Level (L_{eq})** is the level of a steady noise which has the same energy as the fluctuating noise level integrated over the period of measurement. L_{max} is the maximum Noise Level during the period of measurement. L_{10} and L_{90} are the are the percentile exceeding levels of sound which are exceeded 10% and 90% of the time of measurement.

4.10 **Environmental Pollutant** means any solid, liquid or gaseous substance present in such concentration as may be or tend to be injurious to environment.

4.11 **Environmental Pollution** means the presence in the environment of any environmental pollutant.

4.12 **Environment:** Surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation.

4.13 **Environmental Aspect**: Element of an organization's activities or products or services that can interact with the environment.

4.14 **Environmental Impact**: Any change to the environment whether adverse or beneficial, wholly or partially resulting from an organization's environmental aspects.

4.15 **Environmental Management Manual** is abbreviated as EMM.

4.16 **Environmental Management System**: Part of an organization's management system used to develop and implement its environmental policy and manage its environmental aspects.

4.17 **Environmental Objective**: Overall environmental goal, consistent with the environmental policy that an organization sets itself to achieve.

4.18 **Environmental Performance**: Measurable results of an organization's management of its environment aspects.

4.19 **Environmental Policy**: Overall intentions and direction of an organization related to its environmental performance as formally expressed by top management, under signature.

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4.20 **Environmental Target**: Detailed performance requirement applicable to the organization or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.

4.21 **Interested Party**: Person or group concerned with or affected by the environmental performance of an organization.

4.22 **Internal audit:** Systematic, independent and documented process for obtaining audit evaluating it objectively to determine the extent to which the environmental management system audit criteria set by the organization are fulfilled.

4.23 **Ministry of Environment and Forest**, Government of India is abbreviated as MoEF.

4.24 **Monitoring** is the use of direct or indirect reading field instrumentation to provide information regarding the levels of pollutants released during construction.

4.25 **Noise** is any unwanted sound disturbance of the environment around the area of construction operations.

4.26 **Noise Monitoring and Control Plan** is abbreviated as NMCP.

4.27 **Nonconformity**: Non-fulfilment of a requirement.

4.28 **Nuisance** is annoyance, which results from any construction activity that affects the material comfort and quality of life of the inhabitants of the area surrounding the construction site.

4.29 **Organization**: Company, corporation, firm, enterprise, authority or institution, or part or combination thereof, whether incorporated or not, public or private, that has its own functions and administration. It also includes the Contractor executing the CMRL contract of Chennai Metro.

4.30 **Preventive Action**: Action to eliminate the cause of a potential nonconformity.

4.31 **Prevention of pollution**: Use processes, practices, techniques, materials, products, services or energy to avoid, reduce or control the creation, emission or discharge of any type of pollutant or waste, in order to reduce adverse environmental impacts.

4.32 **Procedure**: Specified way to carry out an activity or a process.

4.33 **Record**: Document stating results achieved or providing evidence of activities performed.

4.34 **Respirable Particulate Matter** is abbreviated as RPM and is particulate matter with size less than 10 µm and is measured in µg/m^3(microgram per cubic meter)

4.35 **Suspended Particulate Matter** is abbreviated as SPM and measured in µg/m^3(microgram per cubic meter)

4.36 **Site Environmental Plan**: A document prepared by the Contractor that contains detailed procedures on implementing the Employer's Representative requirements on Environment.

4.37 **Usage factor**: Expressed as the percent of time that the equipment is operated at full power while on site.

4.38 **Waste** is unwanted surplus substance arising from the application of all construction operations and any substance or articles, which is required to be disposed.

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5. Responsibilities

5.1 The Contractor shall set up an environmental team to execute the environmental requirements.

5.2 The duties of the Contractor's Environmental Team will include (but not limited to):

- To monitor the various environmental parameters as required by the EMA
- To inspect, investigate and audit the work methodology with respect to environmental mitigation and control
- To anticipate environmental issues before they arise and plan for their mitigation
- To prepare audit reports, weekly/monthly reports on site environmental conditions for submission to the Employer's Representative.

5.3 Reporting to the Employer's Representative, the Contractor shall

- Work within the scope of contract and other tender condition.
- Operate and strictly adhere to the requirements of his contract specific-SEP
- Undertake any corrective actions as instructed by his Environmental Manager

5.4 To lead his Environmental team, the Contractor shall deploy an Environment Manager who shall be responsible for environmental control, pollution monitoring, and record keeping and be available to the Employer's Representative for resolution of environmental issues.

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6. Site Environmental Plan

6.1 To effectively implement monitoring, mitigation and remedial requirements, an appropriate contractual and supervisory framework needs to be established.

6.2 The basis of framework within which implementation will be managed is through the preparation of contract-specific Site Environmental Plan by the Contractor. The Employer's Representative will audit this contract-specific plan and advise the necessary remedial actions required through contractual means.

6.3 The Site Environmental Plan shall provide details of the means by which the Contractor (and all subcontractors working for the Contractor) will implement the recommended mitigation measures and achieve the environmental performance standards defined both in Indian environmental legislation and in the Employer's Representative's requirements.

6.4 Based on Site Environmental Plan outline given in this document, as Appendix – I, Contractor shall prepare a Site Environmental Plan for submission as part of the tender process.

6.5 The outline Environmental Plan shall demonstrate the determination and commitment of Contractor's organisation towards environment and indicate how the environmental performance requirements laid out in the Employer's Representative's requirements will be met and, where appropriate exceeded.

6.6 Within 28 days of the date of Notice to commence, the Contractor shall submit a draft contract – specific Site Environmental Plan for notice of no objection of the Employer's Representative and a final version prior to the commencement of the works.

6.7 The contract-specific Site Environmental Plan will contain description of all procedures developed to control environmental pollution. Elements of the plan must address the management of pollution, the monitoring programme, and the reporting requirements.

6.8 The Site Specific Environmental Plan shall contain an Aspect Impact register together with outline proposals/procedure for mitigating negative impacts.

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7. Contractor's Method Statement

7.1 It shall be the practice for the Contractor to prepare method Statement in advancement of actual works, for the notice of no objection of the Employer's Representative.

7.2 The Contractor's Environmental Manager will be one of the signatories to the Method Statement, after assessing and verifying the environmental impact of the prepared construction activity and ensuring that effective control measures will be in place, timely.

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8. Environmental Performance Reviews

8.1 Environmental Performance Reviews, will be carried out regularly (on quarterly basis) by the Employer's Representative to assess the effectiveness of the Site Environmental Plan, and that the required mitigation measures are routinely implemented and environmental standards are maintained.

8.2 The preliminary objective of the audit programme will be to assess the effectiveness of management systems established by the Contractor to implement the environmental mitigation measures.

8.3 The reviews by Employers Representative shall focus on the effectiveness of the implemented measures to achieve the purpose not simply the fact that a measure has been implemented.

8.4 In such reviews, demonstrable evidence on the part of the environmental requirements will be sought.

8.5 The Contractor shall carry out daily, environment inspection of his works and submit a weekly report as per format for reporting is suggested as Appendix – II.

8.6 The Contractor shall ensure that his weekly/monthly environmental reports and mandating audits are linked to respective previous submission. The Employers Representative will ensure that this procedure is followed by the institution of a monitoring and reporting system that provides information about the environmental performance of the construction Contractor throughout the duration of the contract.

8.7 The Employer's Representative will monitor Contractor's performance of tasks specified, and will inspect necessary records, reports and procedures as defined in this manual.

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9. Environmentally Friendly Construction Practices

9.1 Containment of Air Pollution

9.1.1 During Transport of Material

(a) The Contractor shall take precautions to minimise visible particulate matter from being deposited upon public roadways as a direct result of his operations. Precautions include removal of particulate matter from equipment before movement to paved streets or prompt removal of material from paved streets onto which such material has been dropped.

(b) All construction equipment should be washed clean of visible dirt/mud before exiting the construction sites. Any deposition of material on public streets by construction equipment should be removed by manual sweeping, or by deploying electro – mechanical devices.

(c) The Contractor shall provide a wash pit or a wheel washing and/or vehicle cleaning facility at the exits from work sites such as construction depots and batching plants. At such facility, high-pressure water jets will be directed at the wheels of vehicles to remove all spoil and dirt. Water shall be pumped through an electrically operated pump set, to hydrants attached with rubber hoses, by activation of push button located at the hydrant, allowing for up to 10 minutes of wash time.

(d) Wheel washing facilities will be provided with efficient drainage, incorporating silt traps to prevent any excessive build up of water. These facilities could include water re-circulation apparatus to minimise water consumption. At the wheel wash facility, water, dirt, gravel etc. shall be drained into precast trench drains with removable grated cover. This dirty water shall flow, through a piping, into solids separator and from there to oil separator before final discharge.

(e) Where wheel-washing facility is not possible, the Contractor shall ensure manual cleaning of wheels by wire brushes or similar suitable means.

(f) The Contractor shall ensure that vehicles with an open load carrying area used for moving potentially dust-producing materials shall have properly fitting side and tailboards. Materials having the potential to create dust shall not be loaded to a level higher than the side and tail boards, and shall be carried in vehicles fitted with covers.

9.1.2 At Dumping Sites

(a) The Contractor shall place excavated materials in the dumping/disposal areas designated in the drawings.

(b) The Contractor shall place material in a manner that will minimise dust production. Material shall be stabilised each day by watering or other accepted dust suppression techniques.

(c) The heights from which materials are dropped shall be the minimum practical height to limit fugitive dust generation.

(d) The Contractor shall stockpile material in the designated and approved locations with suitable slopes. Access to the site shall be regulated for entry of men, material and machine.

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(e) During dry weather, dust control methods such as water sprinkling must be used daily especially on windy, dry days to prevent any dust from blowing and causing nuisance. During rains, the stockpile may be covered with tarpaulin or similar material to prevent run off.

(f) The Contractor shall provide water sprinkling at any time that it is required for dust control use.

(g) Sufficient equipment, water, and personnel shall be available on dumping sites at all time to minimise dust formation and movements to prevent nuisance.

(h) Dust control activities shall continue even during work stoppages.

9.1.3 At Construction Site

(a) At each construction site, the Contractor shall provide storage facilities for dust generating materials and shall be closed containers/bins or wind protected shelters or mat covering or walled or any combination of the above to the satisfaction of the Employer's Representative. The Contractor shall spray water at construction sites as required to suppress dust, during handling of excavation soil or debris or during demolition.

(b) Stockpiles of sand and aggregate greater than $20m^3$ for use in concrete manufacture shall be enclosed on three sides, with walls extending above the stockpile and two (2) metres beyond the front of the stockpile.

(c) Effective water sprays shall be used during the delivery and handling of all raw sand and aggregate and other similar materials, when dust is likely to be created and to dampen all stored materials during dry and windy weather.

(d) Areas within the Site such as construction depots and batching plants, where there is a regular movement of vehicles shall have an approved hard surface that is kept clear of loose surface material.

(e) Unless the Employer's Representative has given notice otherwise, the Contractor shall restrict all motorised vehicles on the Site to a maximum speed of 15 kilometres per hour and confine haulage and delivery vehicles to the designated roadways inside the site.

(f) At the Batching plant the following additional conditions shall be complied with:

- The Contractor shall undertake at all times the prevention of dust nuisance as a result of his activities.
- The Contractor shall frequently clean and water the concrete batching plant and crushing plant sites and ancillary areas to minimise any dust emission.

(g) The Contractor shall erect hoardings as specified in Employer's Representative requirements – construction, securely around all construction work sites during the main construction activity, to contain dust within the site area and also to reduce air turbulence caused by passing traffic. The hoarding shall be safely secured to the ground to prevent from toppling with minimum gap between the base of hoarding and ground surface.

9.1.4 During Drilling and Blasting

(a) Water spray should be used to control dust during breaking of rock/concrete.

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(b) During blasting operations, appropriate precautions should be taken to minimise dust such as the use of blast nets, canvas covers and watering.

(c) Wire mesh made of heavy-duty tyres or sand bags should be used over blast area on each shot to prevent flying rock and reduce dust.

(d) Blasting technique should be consistent not only with nature and quantity of rock to be blasted but also the location of blasting.

(e) The Contractor shall give due preference to explosives with better environmental characteristics.

(f) Vibration shall be monitored during blasting and values shall not exceed as those given in this Environmental Management Manual

9.2 Containment of Water Pollution

(a) The Contractor shall comply with the Indian Government legislation and other State regulations in existence in Chennai insofar as they relate to water pollution control and monitoring.

(b) The Contractor shall provide adequate precautions to ensure that no spoil or debris of any kind is pushed, washed, fallen or deposited on land adjacent to the site perimeter.

(c) In the event of any spoil or debris from construction works being deposited on adjacent land or any silt washed down to any area, then all such spoil, debris or material and silt shall be immediately removed and the affected land and areas restored to their natural state by the Contractor to the satisfaction of the Employer's Representative.

(d) At construction depots and batching plants temporary drainage works should be maintained, removed and reinstated as necessary and all other necessary precautions should be taken for avoidance of damage by flooding and silt.

(e) Sedimentation tanks or other acceptable measures, of sufficient capacity to trap silt-laden water before discharge into the outlet drain should be provided. The system should be flexible and be able to handle multiple inputs from a variety of sources.

(f) Temporary open storage of excavated materials meant for backfilling on site, should be covered with tarpaulin or similar fabric during rainy season or at any time of the year when rainstorms are likely. Washout of construction or excavated materials should be diverted to drainage system through appropriate sediment traps.

(g) Bentonite slurries or other grouts used in diaphragm wall construction piling and other concrete works should be collected in a separate slurry collection system. If reuse is not practicable then it should be disposed off at nearest landfill site after obtaining permission from the agency owning the landfill and under the conditions imposed by the agency concerned. .

(h) Due to lowering of potable water supplies in Chennai and subsequent contamination of ground water, the Contractor is not allowed to discharge water from the site without the notice of no objection of the Employer's Representative. The Contractor must comply with the requirements of the Central Ground Water Board for discharge of water arising from dewatering. Any water obtained from dewatering systems installed in the works must be either re-used for construction purposes and this water may subsequently be

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discharged to the drainage system or, if not re-used, recharged to the ground water at suitable aquifer levels. The Contractor must submit his proposals for notice of no objection of Employer's Representative, on his proposed locations of dewatering of excavation and collection of water for either construction re-use or recharge directly to aquifers. The Contractor's recharge proposals must be sufficient for recharging of the quantity of water remaining after deduction of water re-used for construction. The Contractor will not be permitted to directly discharge, to the drainage system, unused ground water obtaining from the excavation without obtaining notice of no objection from the Agency controlling the system.

(i) The Contractor shall prevent soil particles and debris from entering the wells or water discharge points by use of filters and sedimentation basins as required.

(j) The Contractor shall provide treatment facilities as necessary to prevent the discharge of contaminated ground water.

(k) The Contractor shall at all times ensure that all existing stream courses and drains within, and adjacent to the site are kept safe and free from any debris and any excavated materials arising from the Works.

(l) The Contractor shall discharge wastewater arising from site offices, canteens or toilet facilities constructed by him into sewers after obtaining prior notice of no objection of agency controlling the system. A wastewater drainage system shall be provided by the Contractor to drain wastewater into the sewerage system.

(m) Oil separator/interceptors shall be provided at Batching Plant and construction depot location for vehicle maintenance to prevent the release of oils and grease into the drainage system. These shall be cleaned on a regular basis.

(n) A Spill Prevention and Control Procedure shall be prepared to identify project components such as storage areas, storage tanks that could allow discharge of oil grease or hazardous materials to the drainage system or ultimately in any water body during spillage. The volume of spill should be calculated as well as storage volume to contain spill within the materials storage containment areas. The procedure shall include measures to contain and mitigate transportation of oil, grease or hazardous materials to the drainage system or any water body.

(o) The Contractor shall ensure that earth, bentonite, chemicals and concrete agitator washings etc. are not deposited/drained in the watercourses but are suitably treated and effluents and residue disposed off in a manner approved by local Regulatory Authorities.

(p) Perimeter channels/drains should be constructed in advance of site formation works and earthworks. Silt removal facilities, channels and manholes should be maintained and the deposited silt and grit should be removed regularly, to ensure that these facilities are functioning properly at all times.

(q) Construction works should be programmed to minimize soil excavation works in rainy season. If excavation in soil could not be avoided in these months or at any time of year when rains are likely, for the purpose of preventing soil erosion, temporarily exposed slope surfaces should be covered e.g. by tarpaulin, and temporary access roads should be protected by crushed stone or gravel, as excavation proceeds. Arrangement should always

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be in place to ensure that adequate surface protection measures can be safely carried out well before the arrival of rains.

(r) Measures should be taken to minimize the ingress of rainwater into trenches. If excavation of trenches in wet seasons is necessary, they should be dug and backfilled in short sections. Rainwater pumped out from trenches or foundation excavation should be discharged into storm drains via silt removal facilities.

(s) Open stockpiles of construction materials (e.g. aggregates, sand and fill material) on sites should be covered with tarpaulin or similar fabric during rainstorms. Measures should be taken to prevent the washing away of construction materials, soil, silt or debris into any drainage system.

(t) Manholes (including newly constructed ones) should always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris from getting into the drainage system, and to prevent storm run-off from getting into sewers. Discharge of surface run-off into sewers must always be prevented in order not to unduly overload the sewerage system.

(u) Groundwater pumped out of wells, etc. for the lowering of ground water level in basement of foundation shall be discharged into storm water drains after the removal of silt in silt removal facilities.

(v) Wastewater from Concrete Batching & Precast Concrete Casting and that generated from the washing down of mixer trucks and drum mixers and similar equipment should wherever practicable be recycled. The discharge of wastewater should be kept to a minimum.

(w) The section of construction road between the wheel washing bay and the public road should be paved to reduce vehicle tracking of soil and to prevent site run-off from entering public road drains.

(x) Surface run-off should be segregated from the concrete batching plant and casting yard area as much as possible and diverted to the storm water drainage system. Surface run-off contaminated by materials in a concrete batching plant or casting yard must be treated to, within the discharge norms before disposal into storm water drains.

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9.3 Containment of Noise

(a) Construction of facilities and structures would require the use of equipment, which may generate high noise levels and adversely affect noise sensitive receivers.

(b) In assessing the impact of construction noise and hence its containment, the nature and level of activities that generate noise, the pathway through which noise travels, the sensitivity of the receptor, and the period of exposure should be considered.

(c) Environmental noise is measured in decibels (dB). To better approximate the range of sensitivity of the human ear to sounds of different frequencies, the A-weighted decibel scale (dBA) was devised. As the human ear is less sensitive to low frequency sounds, the A-scale de-emphasizes these frequencies by incorporating frequency weighting of the sound signal. When the A-scale is used, the decibel levels are represented by dBA.

(d) On this scale, the range of human hearing extends from about 3 dBA to about 140 dBA. A 10-dBA increase is judged by most people as a doubling of the sound level.

(e) To the extent required to meet the noise limits the Contractor shall use reasonable efforts to include noise reduction measures listed below to minimize construction noise emission levels. Noise reduction measures – include, but not limited to the following:

(i) Minimize the use of impact devices, such as jackhammers, and pavement breakers. Where possible, use concrete crushers or pavement saws for tasks such as concrete deck removal and retaining wall demolition.

(ii) Equip noise producing equipment such as jackhammers and pavement breakers with acoustically attenuating shields or shrouds recommended by the manufacturers thereof, to meet relevant noise limitations.

(iii) Pneumatic impact tools and equipment used at the construction site shall have intake and exhaust mufflers recommended by the manufacturers thereof, to meet relevant noise limitations.

(iv) Provide mufflers or shield panelling for other equipment, including internal combustion engines, recommended by manufacturers thereof.

(v) Employ prefabricated structures instead of assembling on-site.

(vi) Use construction equipment manufactured or modified to dampen noise and vibration emissions, such as:

- Use electric instead of diesel-powered equipment.
- Use hydraulic tools instead of pneumatic impact tools.

(f) Maximize physical separation, as far as practicable, between noise generators and noise receptors. Separation includes following measures:

- Provide enclosures for stationary items of equipment and barriers around particularly noisy areas on site.
- Locating stationary equipment in such a way, so as to minimize noise and vibration impact on community.

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(g) To the extent feasible, configure the construction site in a manner that keeps noisier equipment and activities as far as possible away from noise sensitive locations and nearby buildings. Plant and equipment known to emit noise strongly in one direction should where possible, be oriented in a direction away from noise sensitive receptor and reduce the number of plant and equipment operating in critical areas close to noise sensitive receptors.

(h) Scheduling truck loading, unloading, and hauling operations in such a way so as to minimize noise impact near noise sensitive locations and surrounding communities.

(i) Minimize noise intrusive impacts during most noise sensitive hours by adopting the following.

- Plan noisier operations during times of highest ambient noise levels.
- Keep noise levels relatively uniform; avoid excessive and impulse noises.

(j) Equipment and plant are not to be kept idling when not in use.

(k) Use only well maintained plant/equipment at site, which should be serviced regularly.

(l) Maintain equipment such that parts of vehicles and loads are secure against vibrations and rattling.

(m) Grading of surfaced irregularities on construction sites to prevent the generation of impact noise and ground vibrations by passing vehicles.

(n) Schedule work to avoid simultaneous activities that generate high noise levels.

(o) The construction of temporary noise barriers.

(p) If back-up alarms are used on construction equipment, their noise emission level near noise sensitive receptors such as residences, schools, hospitals and similar areas where calmness is essential, should be regulated, especially at night time.

(q) Select truck routes for muck disposal so that noise from heavy-duty trucks will have minimal impact on sensitive areas (e.g., residential) and submit to the Employer's Representative for notice of no objection:

- Conduct truck loading, unloading and hauling operations in a manner such that noise and vibration are kept to a minimum.
- Route construction equipment and vehicles carrying soil, concrete or other materials over streets and routes that will cause least disturbance to residents in vicinity of work.
- Avoid operating truck on streets that pass by schools during school hours.

(r) The maximum permissible sound pressure level for new generator sets (up to 1000 KVA) run on diesel, shall be 75 dB(A) at one metre from the enclosure surface.

(s) For existing diesel generator sets, the noise from the DG set shall be controlled by providing an acoustic enclosure or acoustic treatment of the room for DG sets. Such acoustic enclosures/acoustically treated rooms, shall be so designed for minimum 25 dB(A) insertion loss or for meeting the ambient noise standards, whichever is on higher side.

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9.4 Containment of Waste

(a) Careful design, planning and good site management can minimise waste of materials such as concrete, mortars and cement grouts. The Contractor shall ensure regular maintenance and cleaning of the waste storage areas.

(b) Construction activities are expected to generate a variety of waste such as:

(i) General refuse
(ii) Construction Waste including waste from excavated material
(iii) Chemical waste and
(iv) Hazardous waste

(c) Handling and disposal of such waste may cause environmental degradation and nuisance. To prevent it, such waste has to be handled and disposed properly. As such, transportation and disposal of all waste shall be strictly managed**.**

i. General Refuse

1. Each worksite would generate general refuse including paper and food waste. There is likely to be a concentration of such waste at batching plants on major worksite. The storage of general refuse has the potential to give rise to negative environmental impacts.
2. Handling and disposal of general refuse should cope with the peak construction workforce during the construction period. The refuse should be stored and transported in accordance with good practice and disposed at licensed landfills
3. General refuse should be stored in enclosed bins or units and has to be separated from construction and chemical wastes. An authorised waste collector should be employed by the Contractor to remove general refuse from the site, on a daily basis to minimise odour, pest and litter impacts.

ii. Construction Waste

1. Construction Waste would mainly arise from the project construction activities and from the demolition of existing structures where necessitated. It includes unwanted materials generated during construction, rejected structures and materials, materials that have been over-ordered and materials, which have been used and discarded such as:
   - Material and equipment wrapping packaging material
   - Unusable/surplus concrete/grouting mixes
   - Damaged/contaminated/surplus construction materials; and
   - Wood from formwork and false work.
2. Also, demolition of buildings and houses to accommodate station buildings and construction depots will generate concrete rubble, plastics, metal, glass, asphalt from surfaces, wood and refuse.
3. Waste from excavation would comprise soil, rubble, sand, rock, brick etc.
4. It is estimated that construction activities used generate 2.5million m3 of soil, majority of which will be used for filling purpose.

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iii. Chemical Waste

1. Chemical waste is likely to be generated by construction and maintenance activities. For those processes, which generate chemical waste, it may be possible to find alternatives, which generate reduced quantities or even no chemical waste, or less dangerous types of chemical waste.
2. The contractor should explore the possibilities given in (i) above and produce evidence of acceptable disposal methods (e.g., waste transfer) to the Employer's Representative.
3. Containers used for the storage of chemical waste should:
   - Be suitable for the substances they are holding, resistant to corrosion, maintained in good condition, and securely closed.
   - Be of adequate capacity and
   - Display a label in English and local language as to the contents, quantity and safe method of disposal in accordance with instructions contained in MSDS.
4. The storage area for chemical waste should:
   - Be clearly labelled and used solely for the storage of chemical waste;
   - Be enclosed on at least three sides;
   - Have an impermeable floor and bunding, of capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in that area, whichever is higher
   - Have adequate ventilation;
   - Be covered to prevent rainfall entering and
   - Be arranged so that incompatible materials are adequately separated.
5. Disposal of chemical waste should be through a licensed waste collector, duly authorized by MoEF or State Pollution Control Board as the case may be. License of the waste collector shall be shown to the Employer's Representative on demand.
6. The Contractor should maintain an inventory of chemicals, solvents and adhesives. He should minimise disposal of excess material, reuse when applicable and dispose of chemical waste properly. He should prepare a plan that identifies proper ventilation, protected clothing and personal protective equipment.
7. The Contractor should have a point of contact, who will maintain the above information and also conducts periodic inspections.

iv. Hazardous Waste

1. Classification of waste as Hazardous shall be in accordance with Hazards Waste (Management & Handing) Rules 1989, and 2003 or its latest amendment.
2. The Contractor shall identify all the hazardous waste generated as a result of his activities. If such waste is generated then the Contractor shall apply to State Pollution Control Board for 'authorisation' according to Form 1 of the Hazardous Waste (Management & Handling) Rules and dispose the same only to currently authorised recyclers(a list of which can be obtained from State Pollution Control Board) under intimation to the Employer's Representative.

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3. The Rules given in (i) above shall govern the Classification, Handling, Storage and disposal of such Hazardous Waste.

4. Hazardous waste would mainly arise from the maintenance of equipment. These may include, but not be limited to, the following:

   - Used engine oils, hydraulic fluids and waste fuel;
   - Spent mineral oils/cleaning fluids from mechanical machinery;
   - Scrap batteries or spent acid/alkali; and
   - Spent solvents/solutions, some of which may be derived, from equipment cleaning activities.

5. For disposal of waste requiring special attention and hazardous waste the contractor shall enter into agreement with authorised agencies dealing with the same.

6. The hazardous waste shall be stored on an impermeable surface with containment bunding to retain leaks, spills and ruptures.

7. Waste oil and chemical containers shall be delivered to the Contractor's Storage yard. The Contractor is responsible for the correct storage and handling of waste oil/waste chemical containers for such a time until they are transported to the chosen disposal area or waste oil containers.

8. All waste collection containers shall be of appropriate size with a closed lid. Each container will be clearly labelled both with a colour code system and labelled in local language and English. Original labels of empty containers should be completely covered and the contents of the type of waste stored in the used containers clearly indicated.

9.5 Storage and Segregation of Waste

(i) Disposal and collection points should be established around all construction work sites. The waste containers should be of at least 50L/100L

(ii) Burning of refuse at construction sites is not permitted.

(iii) The contractor shall enter into a contract with a licensed organisation to collect waste from Construction depots, Labour Colony etc. and dispose it at their landfill as per existing norms.

(iv) The Contractor is responsible for the separation of construction and demolition material into re-usable and non-reusable materials, and transfer of these materials to low lying areas or landfills, depending on the type of material and the percentage of inert material.

(v) Segregation of Waste should be done on site. All construction waste including debris should be sorted on site into inert and non-inert components as given in Table - I. Different areas of the worksites should be designated for such segregation and storage wherever site conditions permit.

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Table –1

Storage of Waste

Waste Container	Colour Code	Sign
Landfill / Biodegradable	Green	Waste
Recyclable	Blue	Paper & Plastic
Burning / Combustible	Red	Burning
Scrap Metal	Brown	Metal

(vi) On-site measures promoting proper segregation and disposal of construction waste should be implemented e.g. provide separate containers for inert (rubber, sand, stone etc.) and non-inert (wood, organics etc.) wastes. The inert waste should be used on site before disposed of at filling area and the non-inert waste should be sorted for re-use or recycling before being transported to landfills.

(vii) Non-inert materials such as wood, glass and plastic are acceptable for disposal to a landfill as a last resort if these can no longer be reused or recycled.

(viii) Inert materials such as excavated materials comprising soil, rubble, sand, rock, brick and concrete should be separated and broken down to size suitable for subsequent filling in low lying areas, if it is determined that such material can no longer be reused at the site itself.

9.6 Reuse and Recycle

(i) If some good quality reusable topsoil is expected from site clearance works it shall be locally stockpiled and used later in final landscaping works, thus saving on costs for such works and transportation and environmental impacts of disposal.

(ii) The design of framework should maximise use of wooden panels so that high reuse levels can be achieved. Alternatives such as steel framework should be considered to increase the potential for reuse.

(iii) The Contractor should recycle as much of the construction waste as possible on-site.

(iv) Excavated materials are usually inert such as soil and rock, and can normally be reused on site or in public filling areas. The excavated material may have to be temporarily stockpiled on-site for subsequent re-use.

(v) Steel and other metals should be recovered from the construction waste and recycled as far as practical. If possible, scrap steel mills can use steel bars.

9.7 Transportation of Waste

(i) The transportation of construction spoil shall be allowed only to officially designated dumpsites after obtaining necessary permission from appropriate authority.

(ii) A procedure to facilitate tracking of loads should be developed to prevent illegal disposal of waste. This procedure should include, inter alia, the name of driver,

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vehicle registration number, type and quantity of waste, place and time of origin, place of disposal and route of haulage.

(iii) In orders to avoid dust or odour impacts, vehicles leaving a site carrying excavate should have their load covered. Vehicles should be routed as far as possible to avoid sensitive receivers in the area.

(iv) Contractors who produce significant quantities of scrap are obliged to enter into agreement with authorised dealers of scrap for its disposal. Copies of such agreements shall be shown to the Employer's Representative on request.

9.8 Training

(i) The Contractor's Environmental Department is responsible for training of workers and personnel involved in generation of waste.

(ii) The Contractor shall provide training for workers about the concepts of site cleanliness and appropriate waste management procedure, including waste separation, reduction, reuse and recycling. Failure to do so would result in poorly separated waste, resulting in difficulties in treating the waste correctly and/or a bad market for reuse /recycling.

(iii) The awareness will be created through briefings and toolbox talks. The personnel/workers should be trained in waste classification and separation. The training should include:

- Organic waste
- Combustible waste
- Hazardous waste
- Minimisation of waste

(iv) Separation awareness training shall be given to employees responsible for the separation of the waste and information regarding waste separation shall be posted at appropriate locations around the site.

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10. Housekeeping

10.1 The Contractor shall constitute a special group of housekeeping personnel in charge of each work section. Senior engineer of each section shall be responsible for housekeeping at their respective sites.

10.2 Each section of work site shall maintain the site reasonably clean, keep free from obstruction and properly store any construction equipment, tools, and materials. Any wreckage, rubbish shall be temporarily stored in wreckage and rubbish bins. These wreckage and rubbish bins shall be cleaned at frequent intervals. Special housekeeping group will ensure daily cleaning work at the site and its surrounding areas.

10.3 General Housekeeping shall be carried out and ensured at all times at work sites, Labour Camps, Stores and Offices.

10.4 Full height fence, barriers etc. will be installed at the site in order to preserve the surrounding area from excavated soil, rubbish etc which may cause inconvenience to public.

10.5 The Contractor will ensure that all sub-contractors maintain the site reasonably clean through the sub-contract's provision related to housekeeping.

10.6 The Contractor's designated department through daily pre-work meeting (tool box talk), safety meeting etc. will impart the necessary introduction and education to labour on housekeeping. Other staff such as supervisors and engineers working at the site will also be educated on the necessity of good housekeeping.

10.7 Every individual would be responsible for housekeeping in his area i.e.

- At Work Site: All workers should clean their work place after completion of their job. Supervisor should ensure good housekeeping of their respective work area through their workers. Section Managers shall ensure housekeeping in their area through their supervisors. Contractor's designate department will monitor this activity through section manager as well as site supervisor.
- At Labour Camp: All workers should be responsible to maintain good housekeeping and hygienic condition in their respective rooms/dormitories. The Contractor should ensure the availability of dustbins at required place and regular cleaning of rooms, kitchens, toilet blocks and dustbins. Safe disposal of all waste materials should also be ensured. Arrangement for regular fumigation should be made by the contractor.
- At Store: Proper access and stacking shall be ensured at the Stores. A list will display daily stock of materials. All work material should be stored in clearly marked containers or at designated storage area.
- At Office: Everyone is responsible to maintain housekeeping of their work station. Disposal of waste materials (i.e. stationary, cigarette butts, tea bags etc.) must be in dustbin only.

10.8 Avoidance of Nuisance

(a) The Contractor shall take all precautions to avoid any nuisance arising from his operations. This shall be accomplished, wherever possible by suppression of nuisance at source rather than abatement of the nuisance once generated.

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(b) Following site clearing and before construction, the Contractor shall remove all trash, debris and other weeds.

(c) The Contractor shall ensure that the work place is free of trash, garbage, debris and weeds.

(d) The Contractor shall provide at site, metal or heavy-duty plastic 'Refuse Containers' with tight fitting lids for disposal of all garbage or trash associated with food.

(e) To keep the area free of litter and garbage, specific locations shall be designated for consuming food and snacks to prevent random disposal of waste. All waste shall be deposited in the refuse containers. Suitable all weather signage shall be prominently displayed for compliance of these requirements.

(f) The refuse containers shall be kept upright with their lids shut. These containers shall be emptied at least once daily by the Contractor to maintain site sanitation. There shall be different containers for bio-degradable/recyclable and hazardous (flammable) wastes.

(g) All plants/equipment/machinery shall be well maintained by regular servicing and kept free from oil/grease dripping. Drip pans of suitable size shall be used to collect oil leakages and spills. The area shall be cleaned after completion of maintenance/repair and generated waste disposed off in approved manner.

(h) The contractor shall make available Material Supply Data Sheet (MSDS) for material/chemicals/substances used, for which these are available to the Employer's Representative when requested.

(i) Such material/chemicals/substances used shall be treated, handled, stored, transported and disposed off, by the contractor, in a manner specified in the MSDS.

10.9 Prevention of Mosquito Breeding

(a) Measures shall be taken to prevent mosquito breeding at site. The measures to be taken shall include, but not limited to, the following:

(i) Construction run of shall not be allowed to stagnate at work sites specially at construction depots and batching plant locations, by executing and efficient drainage system and/ or levelling off low lying areas;

(ii) Empty cans, oil drums, packing and other receptacles which may retain water shall be deposited at a central collection point and shall be removed from the Site regularly;

(iii) Still waters shall be treated at least once every week with oil in order to prevent mosquito breeding;

(iv) Contractor's Equipment and other items on the Site, which may retain water, shall be stored, covered or treated in such a manner that water could not be retained.

Posters in both local language and English which draw attention to the dangers of permitting mosquito breeding shall be displayed prominently on the site.

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11. Landscape and Aesthetics

11.1 The Contractor should be able to demonstrate evidence that the landscape and aesthetics quality during construction have been considered and appropriate actions have seen taken to mitigate negative impacts due to construction.

11.2 The construction of metro system will have negative but temporary impacts on the landscape and aesthetics due to loss of amenities and trees. Large-scale construction activity will impact negatively on roadside areas and residential communities immediately adjacent to the construction sites.

11.3 However, transplanting, replanting of trees and additional landscape treatment are likely to result in long-term beneficial impacts. Some such species are given in Table –2 for guidance.

Table – 2

Recommended species for Plantation and Landscaping

Sl. No.	Botanical Name	Common Name
A	**TREES**	
1.	Bambosa goldiana	Golden Bamboo
2.	Bauhinia blackiana	Kachnar
3.	Cassia renigera	Pink Cassia
4.	Ficus regionald (Topiart)	RegionalD
5.	Ficus retusa	Retusa
B	**PALMS**	
1.	Areca leutescens	Areca Palm
2.	Cycus Revoluta	Cycus
3.	Oreodoxa Regia	Royal Palm/Bottle Palm
4.	Phoenix palm	Date Palm
5.	Rhapihis palm	Rhaphis Palm
C	**GROUND COVER**	
1.	Asparagu sprengeril	Asparagus
2.	Chlorophytum comosum	Chlorophythum
3.	Duranta goldeana	Golden Duranta
4.	Iresin herbestii	Lal Sag
5.	Lantana alba	White Lanta

11.4 Light used for construction lighting can illuminate adjacent areas in undesired ways. Such lighting and glare shall be prevented from striking adjacent areas, where feasible, through directional shielding.

11.5 The other measures include but not limited to:

(a) Erection of decorative screen hoarding prominently displaying the logo of Chennai Metro Rail Limited.

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(b) Minimising height of temporary buildings.

(c) Careful positioning of construction equipment.

(d) Eliminating the possibility of stockpiles of material from being visible to public.

(e) Strategically placing hi visibility site markings at construction sites indicating facilities, offices and stores.

(f) Adequate and properly managed parking of vehicles at construction depots and batching plants.

11.6 Consent for height of stacks of Diesel Engines with rating more than 800 KV shall be obtained by the Contractor from statutory Government agency. Where the calculated height of stack is obtrusive and does not blend with the neighbourhood, the contractor will provide either alternative source of power or provide a solution that is acceptable to the Employer's Representative. This may include but not limited to providing appropriate cladding for the stack.

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12. Energy Management

12.1 By using energy efficiently, the same services can be delivered with less energy, which helps protect the environment by preventing pollution.

12.2 The Contractor should optimize the use of tools and plants and equipment to perform tasks with correct power. Optimizing cable sizes and joints can control voltage drops.

12.3 The Contractor should use energy efficient pumps (at least 80% efficiency) and motors (95% efficiency or more). The efficiency should be measured during installation and also periodically.

12.4 The Contractor should use Diesel Generating sets that have specific fuel consumption of at least 3.5 units per litre of diesel. The Contractor should rigorously follow the maintenance regime of his DG sets.

12.5 The Contractor should maximize the use of energy efficient luminaries such as CFLs and T5 florescent tubes, metal halide lamps and similar and ensure optimum illumination levels to save energy. The Contractor shall make provision of Earth Leakage Circuit Breakers (ELCBS) to prevent loss of excessive earth currents which are unsafe.

12.6 The Contractor should plan in advance and select locations to receive and store material such that these are at the least distance from place of use. Such an approach will result in less energy being consumed since optimum energy will be expended for transport of material.

12.7 The Contractor should plan works in a manner as to avoid reworking especially during meeting the interface requirements of systems contractor.

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13. Traffic Management

13.1 Traffic Management for the project includes public roadways and sidewalks and the maintenance of access to residence, business and public services throughout the construction area. Traffic delays and reduction in roadways capacity are anticipated during aspects of the construction of the metro rail.

13.2 Even though vehicular, pedestrian and surface transit traffic will be impacted at a few locations, the contractor should minimize such impacts through the development of Traffic Management Plans, which will be submitted in advance to the Employer's Representative for his notice of no objection. These plans will provide specific guidance on traffic management for various portions of construction zones and staging.

13.3 The types of mitigation measures to be implemented by the Contractors will be on a site-specific basis and will include

- Signage and barriers for protecting and guiding pedestrians
- Detour signs placed at strategic locations
- Relocation of bus stops at construction sites
- Provision of sidewalks of least 2m where feasible
- Physical separation between construction zone and sidewalks of concrete barriers or wood fencing or mesh fencing

13.4 Wherever heavy equipment like cranes or dozers have to be moved on public roads and the normal moving dimensions are infringed, these shall be moved under advice to traffic police, and with adequate precautions and at low speed.

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14. Archaeological and Historic Resources

14.1 During the construction period, archaeological or historic resources may potentially be affected by direct or indirect construction activity. If any such structures are likely to be affected, special measures will be initiated with the notice of no objection of the Employer's Representative.

14.2 Prior to the initiation of construction Employer's Representative intends to review a resource protection plan for historic structures where it appears that they may be affected by the project. This plan will be developed by the Contractor in consultation with The Archaeological Survey of India (ASI).

14.3 The plan will identify the sensitive resources as well as specify the construction monitoring requirements. These requirements may include ground vibration monitoring and recording any components inadvertently subjected to impact.

14.4 If the project is likely to affect a previously unidentified historic property, work in that area shall cease until actions that will take into account the effect of the undertaking on the property can be implemented. .The Contractor shall consult the Employer's Representative before proceeding further in such an event.

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15. Environmental Monitoring - General

15.1 The Contractor's Environmental Team shall carry out the monitoring of environmental impacts during construction. Representative sensitive receivers in the vicinity of the works shall be monitored for noise, water and air quality impacts.

15.2 For carrying out impact monitoring for noise and air, equipment shall be provided, operated and maintained by the Contractor. The equipment shall be kept in a good state of repair in accordance with the manufacturer's recommendations and maintained in proper working order with sufficient spare equipment available in the event of breakdown to maintain the planned monitoring programme.

15.3 The calibration of monitoring instruments and their respective calibrators shall be carried out in accordance with the manufacturer's requirement to ensure they perform to the same level of accuracy as stated in the manufacturer's specifications.

15.4 Suspended Particulate Matter (SPM) levels shall be measured by following the standard high volume sampling method as set out in High Volume Method for Suspended Particulate, BIS: 5182-1981. Respirable Particulate Matter (RPM) shall be measured in accordance with BIS 5182 Part 4.

15.5 24-hour average SPM concentration shall be measured by drawing air through a High Volume Sampler (HVS) fitted with pre-weighted Glass Fibre filter paper at an average flow rate not less than $1.1m^3$ per minute. Similarly for RPM, Respirable dust sampler, fitted with pre-weighted Glass Fiber and an average flow rate of not less than $1.1m^3$/minute shall be used. The duration of monitoring of RPM shall be 24 hrs.

15.6 The minimum requirements to the specifications of sound level meter are given in IS: 9779-1981.

15.7 The Contractor's monitoring programme is summarised in Table –3.

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Table –3

Summary of Contractor's Environmental Monitoring Programme (Tentative)

Parameter	Noise	Air	
Sampling	Day Time (6 AM – 10PM) L_{max}, L_{eq}, L_{10}, L_{90} Night Time (10PM – 6AM) L_{max}, L_{eq}, L_{10}, L_{90}	SPM 24 hour	RPM 24 hour
Frequency at each location	Once a week (when noise-generating activities are underway.	Two 24 hours samples every week.	Two 24 hours sample every week
Locations and number	To be determined, by the Contractor and approved by the Employer's Representative based on noise sensitive receptors, but at least at all metro station sites, Batching Plant and sensitive sites such as school, hospital archaeological sites etc.	To be determined by the Contractor and approved by the 'Employer's Representative, based on air sensitive receptors, but at least all metro station sites, Batching Plant and sensitive location like school hospital archaeological site etc. are to be monitored	To be determined by the Contractor and approved by the Employer's Representative, based on air sensitive receptors, but at least all metro station sites, Batching Plant and sensitive location like school hospital archaeological site etc. are to be monitored
Duration of Monitoring by Contractor	During Civil Construction	During Civil Construction	

The above indicated Contractor's Environmental Monitoring Programme is mandatory and any additional monitoring, with respect to additional environmental attributes (like surface water & ground water, soil etc.), additional locations, frequency, parameters etc., as directed by the Employer's representative, will have to be undertaken by the Contractor.

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16. Air Monitoring

16.1 Construction activities that will generate dust impacts include excavation, material handling and stockpiling, vehicular movement, and wind erosion of unpaved work areas.

16.2 The impact of fugitive dust on ambient air pollution depends on the quantity generated, as well as the drift potential of the dust particles injected into the atmosphere. Large dust particles will settle out near the source and smaller particles are likely to undergo dispersal over greater distance from the sources and impeded setting. SPM and RPM levels will be monitored to evaluate the dust impact during the construction phase of the Project.

16.3 The Air Quality Monitoring and Control Plan (AMCP) in contract-specific Site Environmental Plan prepared by the Contractor shall establish procedures to monitor impact air quality and measures to control air pollution including dust suppression due to construction activities at work sites. This plan shall contain description of activities that will cause degradation in air quality, environmental procedures to manage pollutants, monitoring programme record keeping and reporting.

16.4 The Employer's Representative shall monitor Contractor's performance of tasks specified and will inspect necessary records, reports and procedures related to the control of air quality given in AMCP.

16.5 Information gathered during the AMCP will be catalogued and maintained by the Contractor and shall be available for review by the Employer's Representative.

16.6 The exact location of the air monitoring stations located near air sensitive receptors adjoining the construction sites, such as residences, schools, and hospitals and placement of monitoring equipment shall be agreed with the Employer's Representative prior to commencement of air monitoring programme.

16.7 Impact monitoring during the course of the Works shall be carried out at the monitoring stations for two days (continuous twenty-four hours) every fifteen days and where there is a perceived air quality problem.

16.8 The Contractor should construct suitable fence, lockable gate, 220V AC power point and suitable access at each air monitoring station. Monitoring stations should be free from local obstructions or sheltering.

16.9 Should impact monitoring record dust levels which are:

- Indicative of a deteriorating situation such that closer monitoring is reasonably indicated, or
- When in the opinion of the Employer's Representative additional measurements are required in view of deteriorating air quality;

Then, the Employer's Representative may require the Contractor to increase the frequency of impact monitoring at any one or more of the monitoring stations until the results indicate an improving and acceptable level of air quality.

16.10 The Contractor shall keep records of air quality monitoring (including location, date, time). The Contractor shall submit a copy of monitoring results to the Employer's Representative. The results should represent a statistical evaluation of data by calculating maximum, minimum, mean, for valuation of trends, and comparison with emission standards.

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16.11 The National Ambient Air Quality Standards given in Air (Prevention and Control of Pollution) Act, 1981 may be referred by the Contractor for Limit Levels of SPM and RPM in ambient air which may be followed in estimating the pollution level caused by Contractor's activities.

16.12 Where the Employer's Representative determines that the recorded SPM level is significantly greater than the Limit levels, the Employer's Representative may direct the Contractor to take effective remedial measures including, but not limited to, reviewing dust sources and modifying working procedures.

16.13 Where the recorded baseline levels exceed the ambient air quality standards, then at such locations the limit level is the recorded base line. Contractor shall take all effective remedial measures to contain the levels to their baseline value as a result of his activities.

16.14 The Contractor should inform Employer's Representative of all steps taken to investigate cause of non-conformance and immediate action taken to avoid further occurrences through written reports and proposals for action.

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17. Noise Monitoring

17.1 The activities which are expected to cause noise during the construction include noise from construction equipment, construction activities such as portal construction, earthwork excavation, concreting, removal of spoil, movement of construction vehicles and delivery vehicles travelling to and from the construction and disposal sites etc.

17.2 The level of impact of these noise sources depends upon the noise characteristics of the equipment and activities involved the construction schedule, and the distance from noise sensitive receptors.

17.3 The Noise Monitoring and Control Plan (NMCP) in contract specific site Environmental Management Plan prepared by the Contractor shall establish procedures to monitor construction noise and determine when to apply measures to control noise pollution due to construction activities at works site.

17.4 The NMCP will provide site description, define acceptable noise monitoring equipment, provide monitoring locations and operating procedures for noise equipment and indicate reports and record keeping on noise monitoring data.

17.5 The NMCP will provide guidance for construction activity. It shall also address noise performance criteria used in the selection of construction equipment. In defining the requirements of the NMCP, available measures for noise control, such as, the use of equipment with special exhaust silencers or enclosures, and the construction of temporary enclosures or noise barriers around specific construction site activity areas shall be considered.

17.6 The NMCP will be reviewed on a regular basis and updated as necessary to assure current construction activities are addressed.

17.7 The Employer's Representative shall monitor Contractor's performance of tasks specified, and will inspect necessary records, report and procedures related to the control of noise.

17.8 Noise monitoring shall be carried out at noise sensitive receptor locations within 200 feet of the construction site once each week and after a change in construction activity. Construction noise measurements shall coincide with daytime and night-time periods of maximum noise generating construction activities.

17.9 The appropriate parameter for measuring construction noise impacts shall be the equivalent A-weighted sound pressure level (Leq) measured in decibels (dB). The two statistical sound levels L_{10} and L_{90}; the level exceeded for 10 and 90 percent of the time respectively, shall also be recorded during monitoring. The L90 may be considered as the ambient level into which the L_{10} as average peak level intrudes. The L_{max}, L_{eq}, L_{10} and L_{90} values will be reported in the noise measurement form along with allowable noise limit. The duration of monitoring shall be on hourly basis for 24hours.

17.10 In no case shall the Contractor expose the public to construction noise levels exceeding 90dBA(slow) or to impulsive noise levels with a peak sound pressure level exceeding 140dB as measured on an impulse sound level meter.

17.11 Limit for construction noise is based on the existing ambient noise levels in areas adjoining the construction sites. If the measured noise levels exceed the noise limits, the noise levels shall be reduced by appropriate abatement measures.

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17.12 The noise levels emanating from any source during construction, shall not exceed 10 dB(A) or more above existing ambient pre-construction noise levels when measured at a point outside the premises of the location of source. The same may be varied from time to time by and at the sole discretion of the Employer's Representative.

17.13 The construction activities shall be limited to levels measured at a distance of 200 feet from the construction limits or at the nearest affected building, whichever is closer, as given in **Table - 4**.

Table- 4

Allowable construction noise

LAND USE	**MAXIMUM NOISE LEVELS – L_{max} dB (A)**	
Residential	Day Time 75	Night Time 65
Commercial	At all Times 85	
Industrial	90	

17.14 The ground borne noise levels within building structures due to tunnel boring machine and any other underground and tunnelling construction activities shall not cause interior noise levels to exceed the levels given below as measured in the inside of the affected noise sensitive structure:

Residential: L_{max} 55 dB(A)

Commercial: L_{max} 60 dB(A)

17.15 At the surface of the construction site during night time hours, the Contractor shall use only equipment that operating under full load meets the noise limits specified in **Table-5**, if a sensitive receptor would be affected.

Table - 5

Noise emission limits for construction equipment measured at 50 feet from construction equipment*

Equipment Category	**L_{max} Level dB(A)**
Backhoe	80
Bar Bender	75
Chain Saw	81
Compactor	80
Compressor	80
Concrete Mixer	85
Concrete Pump	82
Crane	85

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Equipment Category	L_{max} Level dB(A)
Dozer	85
Front End Loader	80
Generator	82
Gradall	85
Grader	85
Paver	85
Pneumatic Tools	85
Scraper	85
Tractor	84

17.16 The adjustments for close in equipment noise measurement shall be made in accordance with **Table - 6**.

Table – 6

Adjustments for close in equipment noise measurements (Measurement Values to be subtracted from Measured Sound)

Distance (Feet)	Level to Estimate Sound Level at 50 Feet dB(A)
19-21	8
22-23	7
24-26	6
27-29	5
30-33	4
34-37	3
38-42	2
43-47	1
48-50	0

17.17 Should the impact monitoring record noise levels which are:

- indicative of a deteriorating situation such that closer monitoring is reasonably indicated, or
- when in the opinion of the Employer's Representative additional measurements are required in view of deteriorating noise environment,

then, the Employer's Representative may require the Contractor to increase the frequency of impact monitoring at any one or more of the monitoring stations until the results indicate an improving and acceptable level of noise.

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17.18 The Contractor shall inform the Employer's Representative of all steps taken to investigate cause of non-conformance and immediate action taken to avoid further occurrences through written reports and proposals for action.

17.19 The Contractor shall submit a copy of monitoring results. The results should represent a statistical evaluation of data for evaluation of trends and comparison with noise emission standards.

17.20 Where the Employer's Representative determines that the recorded Noise level is significantly greater than the acceptable levels, the Employer's Representative may direct the Contractor to take effective remedial measures including, but not limited to, reviewing noise sources and modifying working procedures.

17.21 Protection against the effects of occupational noise exposure should be provided when the sound levels exceed those shown in Table No. 7 below when measured on the A-scale of a standard sound level meter at slow response.

17.22 When employees are subjected to sound levels exceeding those listed in the Table No. 7 feasible administrative or engineering controls should be utilized.

17.23 If such controls fail to reduce sound levels within the levels of the table, personal protective equipment shall be provide and used to reduce sound levels within the levels of the table.

Table – 7

Permissible Noise Exposures

Duration per day, Hours	Sound level (slow Response)
8	90
6	92
4	95
3	97
2	100
1 ½	102
1	105
½	110
¼ or less	115

17.24 When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. Exposure to different levels for various periods of time shall be computed according to the formula as given below.

F_e = $(T_1/L_1) + (T_2/T_2) + \ldots + (T_n/L_n)$ where,

F_e= the equivalent nose exposure factor.

T= the period of noise exposure at any essentially constant level.

L = the duration of the permissible noise exposure at the constant level (from Table)

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If the value of f exceeds unity (1) the exposure exceeds permissible levels.

17.25 A sample computation showing an application of the above formula is as follows. An employee is exposed at these levels of these periods:

11 dB(A) 1/4 hour.

100 dB(A) 1/2 hour.

90 dB(A) 1/2 hours.

Then,

Fe = (1/41/2) + (1/2/2) +(1 1/2/8)

Fe = 0.500 +0.25 +0.188

Fe = 0.938

Since the value of Fe does not exceed unity, the exposure is within permissible limits.

17.26 The vibration level limits at work sites adjacent to the alignment shall conform to permit values of peak particle velocity as give in Table No. 8.

Table 8

Permitted Values of PPV

Sl. No.	Condition of Structure	Max. PPV in mm/sec
1.	Most structures in “good condition”	25
2.	Most structures in “fair condition”	12
3.	Most structures in “poor condition”	5
4.	Water supply structures	5
5.	Heritage structures/bridge structures	5

17.27 When Diesel Generator (DG) Sets are used for operation of equipment and machinery, then Ministry of Environment and Forest notification dated 17th May 2002, issued under Environment Protection Act (Protection) Rules, 1986, on noise limits shall apply.

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18. Environmental Site Inspection

18.1 Site inspection shall be undertaken by the Contractor's staff to inspect the construction activities in order to ensure that appropriate environmental protection and pollution control measures are properly followed and implemented. The frequency of site inspection shall be at least once a week.

18.2 The Contractor shall prepare an 'Environmental Inspection and Action Reporting System', submit to the Employer's Representative for notice of no objection and make amendments as suggested. It shall contain a contract specific comprehensive Environmental Inspection checklist as requirement of Site Environmental Plan.

18.3 The area of inspection shall not be limited to environmental compliance within the site but areas outside the site which are likely to be affected, directly or indirectly by activities at site.

18.4 Results of inspection shall be discussed with Employer's Representative and his recommendations on better environmental protection shall be notified to the Contractor for taking immediate action and rapid resolution of identified non-compliance.

18.5 If significant environmental problems are identified or if there is an environmental complaint or as a part of investigation work, then the Employer's Representative shall also carry out Ad hoc site inspection which shall be attended by Contractor's Representative.

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19. Environmental Audits

19.1 As indicated earlier in this EMA, the Employer's Representative may undertake regular audits at quarterly intervals, of the Contractor's onsite practices and procedures as a means of assessing the ongoing performance of the Contractor.

19.2 A checklist of environmental requirements will be prepared and amended as necessary, throughout the construction phase to focus on areas of frequent non-compliance and to reflect the potential impacts associated with specific activities within the construction programme

19.3 The criteria against which the review will be undertaken will be derived from (but not be limited to):

(a) The approaches, procedures and commitments given by the Contractor in the 'Site Environmental Plan'

(b) The clauses contained within the Employer's Representative's Requirement on Environment.

(c) The allocation of responsibility for fulfilling environmental requirements and the effective lines of communication with regard to environmental issues;

(d) Compliance with procedures established to enable and effective response to environmental incident or non-compliance;

(e) The extent and accuracy of record-keeping related to environmental performance indicators;

(f) The effectiveness of ensuring high levels of awareness with regard to environmental requirements; and

(g) The effectiveness of environmental management activities, including the speed and effectiveness of responses to complaints.

19.4 The likely protocol will include (but not limited), the auditing of the following activities**:**

- The allocation of responsibility for fulfilling environmental requirements and effectiveness of lines of communication.
- Compliance with procedures established to enable effective response to environmental issues.
- The extent and accuracy of record keeping related to environment.
- The effectiveness of staff training ensuring high levels of awareness with regard to environmental requirements.
- The speed and effectiveness of responses to complaints.

19.5 The criteria against which the audits will be undertaken shall be derived from the clauses within the Employer's Representatives Requirements contract-specific Site Environmental Plan and previous site inspection results.

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20. Reporting System

20.1 Reporting under the Environmental Management System will contain results of monitoring and inspection programmes.

20.2 In Site Environmental Plan, the Contractor shall prepare and submit monthly Environmental Management Reports in accordance with Employer's Representatives Requirements.

20.3 The monthly report shall include (but not limited to) the following:

- Executive Summary
- Brief mention of construction activities
- Monitoring results under AMCP, and NMCP
- Interpretation of monitoring results, significance and influencing factors
- Graphical representation of monitored results over past four reporting periods.
- Details on Fly ash consumption as given in Appendix-III.
- Raw material consumption details such as electricity, diesel, water
- Generation of scrap during the month and sold to authorised recyclers
- Generation of other type of waste and sold to respected authorised buyers.
- Measures to control spills
- Action taken on recommendation under site inspection programme or specific directions.
- Summary of complaints, results of investigations and follow-up action
- Future key issues.

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21. Complaint Response Process

21.1 Enquiries, complaints and requests for information can be expected from a wide range of individuals and organisations both private and government. The majority of complaints is likely to be received by CMRL, although the site offices are also likely to be contacted.

21.2 The objective of complaint process is to ensure that public and agency complaints are addressed and resolved consistently and expeditiously.

21.3 The Contractor's Site Manager will be notified immediately on receipt of complaint that may relate to environmental impacts. The Site Manager will immediately inform the Employer's Representative.

21.4 Field investigation should determine whether the complaint has merit, and if so action should be taken to address the impact.

21.5 The outcome of the investigation and the action taken shall be documented on a complaint Performa prepared by the Contractor and submitted for notice by the Employer's Representative in advance of the works.

21.6 Where possible, a formal response to each complaint received shall be prepared by the Contractor within seven days in order to notify the concerned person(s) that action has been taken.

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22. Completion of the EMA Programme

22.1 The construction of Chennai Metro will be undertaken as a series of individual construction contracts with necessarily different construction programme and completion dates.

22.2 The Employer's Representative shall maintain an overview of the 'impact causing potential' of each site, monitoring parameter or contract with a view to maintaining the most cost effective use of the environmental resources dedicated to the Project.

22.3 For release of final bill the contractor shall ensure

(i) Closure of all non-conformance reports

(ii) Submittal of all environment related documents and records pertaining to monitoring and trend analysis on key parameters such as but not limited to consumption/efficient use of resources such as energy, water, material such as cement, fly ash, iron and steel, recycle/reuse of waste etc that shall demonstrate continual improvement in the implementation of Environmental Management System

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1.1. Appendix –I SITE ENVIRONMENTAL PLAN OUTLINE

Sl. NO.	SITE ENVIRONMENTAL PLAN OUTLINE
1	**GENERAL**
(i)	The Environmental Policy of the Contractor is clearly defined in the Site Environmental Plan, which, inter-alia, commits the Contractor to follow national and state environmental legislation and regulations.
(ii)	The Contractor is committed to CMRL's Environmental Management System and shall provide desired manpower and financial resources for its success
(iii)	The person responsible for day-to-day environmental matters is identified and vested with authority to execute the Site Environmental Plan.
(iv)	Procedure is available for Contractor's system of enforcing good environmental practices of its Sub-contractor.
(v)	The Site Environmental Plan contains procedures for screening material used in the contract, for their environmental friendliness.
2	**ENVIRONMENTALLY FRIENDLY CONSTRUCTION PRACTICES**
(i)	The Site Environmental Plan must contain specific procedures for achieving environmental performance requirements as given in the Employer's Representative requirements on Environment and CMRL Environmental Management Manual.
(ii)	Procedures for carrying out Aspect/Impact analysis of contractor's proposed works and their affect on environment.
(iii)	Procedures for setting up Objectives and Targets commensurate with Employer's Representative requirements on Environment and CMRL Environmental Management Manual and how these shall be met.
(iv)	Procedures for formulating Environmental Management Plans and Operational Control Procedures to meet contractual requirements.
(v)	Procedures for offering environmental training and methods for promoting environmental awareness amongst his employees.
(vi)	The SEP must contain details on Air Monitoring and Control Plan which details Mitigation measures / Corrective Action / Preventive Action and Monitoring Schedule.
(vii)	The SEP must contain details on Noise Monitoring and Control Plan which details Mitigation measures / Corrective Action / Preventive Action and Monitoring Schedule.
(viii)	The SEP must contain procedures on prevention and control of water pollution from sanitary surface runoff and process wastewater.
(ix)	The SEP must contain details on procedures for Storage, handling and disposal of waste including, municipal, construction, chemical and hazardous wastes.
(x)	The SEP must contain procedures for reuse/recycle of waste, selling to authorised recyclers and records thereof.

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Sl. NO.	SITE ENVIRONMENTAL PLAN OUTLINE
(xi)	The SEP must contain procedures for preservation of landscape disturbed due to construction, housekeeping and traffic management as required under the contract.
(xii)	The SEP must contain procedures for dealing with unforeseen environmental situations under Environmental Emergency.
3	**MONITORING, AUDITS AND RECORDS**
(i)	The Contractor keeps records of monitoring and the SEP contains provision for reporting results of environmental monitoring in a manner as specified in the contract.
(ii)	The Contractor carries out weekly inspection under the 'Environmental Inspection and Action Reporting System' through Environmental Inspection checklist and submits to the Employer's Representative.
(iii)	The SEP contains procedures for mandatory audits by the contractor as given in the contract.
(iv)	The SEP contains provisions for submitting monthly Environmental Quality Management reports.
(v)	The SEP contains procedures for recording environmental complaints and response process.

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1.2. Appendix – II Weekly Environmental Inspection Checklist

SUMMARY SHEET

1. Major issues of non-conformity in the past week are:

	Issue	Reason
(i)	Air (Specify)	
(ii)	Water (Specify)	
(iii)	Noise (Specify)	
(iv)	Waste (Specify)	
(v)	Storage (Specify)	
(vi)	Housekeeping (Specify)	
(vii)	Roads (Specify)	

2. Over the last week have been able to implement environmental management requirements as per contract

Yes ☐ No ☐ if not yes reasons are

(i)

(ii)

(iii)

3. Following issues have not been resolved for more than past two weeks

(i)

(ii)

(iii)

4. Support/Clarification from Employer's Representative required in the following:

(i)

(ii)

(iii)

5. Complaints received in the past week.

	From	Action Taken	Reasons for Delay
(i)			
(ii)	Public		

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(iii) Client

(iv) Statutory Agency

Auditor: Project Manager

Contract Number: Contractor:

Environmental Manager	**Project Director**	**Document No.:**

Weekly Environmental Inspection

Report No.:	**Inspection Date:**	**Inspected by :**
Inspection Area:		
Participants:		

SL. NO.	**ITEM**	**OBSERVATION**	**REMARKS**	ACTION	
				By Date	By whom
1.0	**AIR POLLUTION**				
1.1	**Dust** (approach roads, adjacent roads, working area, cement handling etc.)	□ Site Satisfactory □ Site Dusty □ Sprinkling carried out as required □ Excavate removal within 2 days			

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SL. NO.	ITEM	OBSERVATION	REMARKS	ACTION	
				By Date	By whom
1.2	**Generators**	□ Satisfactory □ Maintenance regime followed □ Black smoke □ Leaking oil □ Drip Pans not available			
1.3	**Vehicles**	□ Satisfactory □ PUC certificate available □ Black smoke □ Wheel Washed /Cleaned □ Leaking oil □ Side of vehicle clear of mud □ Material transported in closed manner			
1.4	**Air Monitoring**	□ Carried out as per contract □ Results reported as per contract □ Remedial measures in place where required			
2.0	**WATER POLLUTION**				
2.1	**Site Drains**	□ Drainage system functional □ No Contamination □ Not blocked by debris/ garbage □ No indications of Oil spilled in drains □ Storage of chemical waste not nearby			
2.1	**Site Drains**	□ storage of refuse/ excavate muck not near the drains			
2.2	**Adjacent Drains**	□ Not damaged □ No signs of pouring bentonite □ No signs of pouring Chemicals □ Signs of discharging Silt/ debris			

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SL. NO.	ITEM	OBSERVATION	REMARKS	ACTION	
				By Date	By whom
2.3	**Separator Tanks**	□Tank not full of silt □ Tank regularly emptied			
3.0	**NOISE POLLUTION**				
3.1	**Noise control measures**	□ All powered mechanical equipments are sound reduced □ Acoustic / enclosures constructed in areas of excessive noise □ Equipment located and directed away from noise receptors			
3.2	**Generators provided with acoustic enclosures**	□ Effective □ Not effective □ Not provide			
3.3	**Noise Monitoring**	□ Carried out as per contract □ Not exceeded baseline values □ Remedial measures in place □ Results evaluated statistically for inclusion in Monthly report			
4.0	**WASTE MANAGEMENT**				
4.1	**Waste Identified**	□ Chemical Flammable Corrosive Construction related/ oil/ Filters/ Batteries □ Hazardous □ Other (Specify)			

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SL. NO.	ITEM	OBSERVATION	REMARKS	ACTION	
				By Date	By whom
4.2	**Storage Containers & Bins**	□ Adequate number and properly place □ Proper quality □ Emptied regularly □ Labelling proper □ No spillage on container surface noticed			
4.2	**Storage Containers & Bins**	□ Pollutants (e.g. waste chemical), not dumped in bins □ Recyclable (e.g. metal) not dumped in garbage bins			
4.3	**Oil Waste**	□ Drip pans available □ No oil stains on ground □ Spill absorption material available □ Waste oil poured in to designated waste drums □ Used oil filters not dumped in garbage bins			
4.4	**Excavate/Muck**	□ Storage satisfactory/ properly secured □ Dumping in authorized areas □ No interference with nearby drainage			
5.0	**STORAGE**				

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SL. NO.	ITEM	OBSERVATION	REMARKS	ACTION	
				By Date	By whom
5.1	**Diesel Storage**	□ Extensive diesel spillage on ground not visible □ Drip pans used when pumping diesel □ Pipes / connectors/ pumps not leaking □ Not located close to storm water drains □ transfer arrangement satisfactory			
6.	**AESTHETICS & CLEANLINESS**				
6.1	**Housekeeping & Hygiene**	□ Designated storage area for materials □ Scraps/brickbats/rubbish scattered at site □ Proper space for handling waste □ Area Clean and dry □ Stagnant water treated weekly □ Proper stacking of drums □ Barricades are clean, in line, firmly secured and proper earthling □ Water not allowed to accumulate in work area for any reason			
7.0	**ROADS**				
7.1	Access Roads	□ Satisfactory Maintenance □ In urgent need of Maintenance			
7.2	Public Roads used by Contractor	□ Satisfactory maintenance □ Repair not carried out			

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WEEKLY ENVIRONMENTAL AUDIT		
AUDIT No. : WEEK ENDING : **PROGRESS IN THE LAST WEEK:** **PLANNING /GOALS FOR THE NEXT WEEK:**		
Environmental Manager	**Project Director**	**Document No.:**

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1.3. APPENDIX - III - DETAILS ON FLY ASH

The Employer's Representative shall give his consent to the civil Contractor for using Fly Ash in concrete or brick works. The Contractor shall record all relevant details on the consumption of Fly Ash from the data of initial consumption to date of final use.

The details on Fly Ash consumption shall be reported on a monthly basis in the Contractor's monthly Environmental Management Report required to be submitted to the Employer's Representative.

The details on Fly Ash shall be reported in groups and sub groups as noted below: -

F1 Data required from the Concrete Production Contractor

F1.1 Concrete Production

- Daily records of concrete production
- Mix Design

F1.2 Material consumption from Daily production Records:

- Cement delivery records
- Fly ash delivery records

F1.3 Transportation Cement

- Load capacity of cement delivery vehicles (tons)
- Distance of batching plants to cement plant (km)
- Fuel consumption of delivery vehicles (km/l)

F1.4 Transportation (Fly Ash)

- Load capacity of fly ash delivery vehicles (tons)
- Distance of batching plants to fly ash source (km)
- Fuel consumption of delivery vehicles (km/l)

F2 Data required from Cement Manufacturer (to be obtained by the contractor and submitted to the Employer's Representative, on a monthly basis)

F2.1 Process Emission from daily production records

- Quantity of calcareous raw material (limestone etc.) consumed
- % of CaO in raw material
- % of MgO in raw material
- % of CaO in clinker
- % of MgO in clinker

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- Quantity of clinker produced

F2.2 Kiln fuel emissions from Monthly Consumption Records

- Quantity of each type of fuel used in the kiln
- CO_2 Emission factor (tons CO_2/MJ) and specific heat for each fuel type (MJ/Kg)

  or % carbon and density (if liquid) for each fuel type

F2.3 Non- Kiln Fuel emission from Monthly consumption records

- Quantity and specific uses for each type of non-kiln fuel used
- CO_2 emissions factor (tons CO_2/MJ) and specific heat for each fuel (MJ/kg)

  or % carbon and density (if liquid) for each fuel type

F2.4 Emission from Electricity consumption in clinker production from Monthly electricity consumption records

- Electricity consumption of equipment related to cement production (kWh)
- Grid electricity supplier
- Quantity of electricity drawn from grid
- Quantity of electricity self generated
- Fuel consumption of generating plant
- Waste heat capture from kiln

F2.5 Additives from daily production records

- Quantities of all additives blended with clinker at cement plant

F2.6 Cement Delivery

Monthly records of cement delivery to batching plants

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1. Scope

1.1 The Employer's Requirements OHS&E Volume 1 details the requirements of the Employer for Safety, Health and Environmental control measures associated with the Contractor and any other agency, to be practiced on all Chennai Metro Rail Limited (CMRL) construction sites or associated premises.

1.2 Application of this document

1.2.1 The Employer's Requirements, OHS&E Volume 1 applies to all aspects of the Contractor's scope of work, including that conducted by their appointed sub-Contractor's and other agencies on their behalf. There shall be no activity associated with the Chennai Metro Rail project, which is exempted from the purview of this document. The Employer's Requirements OHS&E Volume 1 is supplemented with a further 3 OHS&E Volumes for ease of reference. Their individual scope and applicability is as follows;

1.2.2 OHS&E Volume 1 is the controlling document for all Contracts and is fixed throughout the term of the project. Compliance with OHS&E Volume 1 is mandatory.

1.2.3 OHS&E Volume 2 provides Safety & Health guidance that the Contractor may choose to use unless stated as mandatory within Volume 1. The contents of OHS&E Volume 2 remains subject to revision by the Employer's Representative in the event of new Legislation or changing circumstances. The information contained within Volume 2 shall be used by the Employer's Representative in assessing the sufficiency and suitability of the Contractor's management systems and performance.

1.2.4 OHS&E Volume 3 provides Environmental guidance and procedural requirements for the project. Volume 3 remains subject to periodic revision and updating.

1.2.5 OHS&E Volume 4 is specifically for projects involving tunnelling and its use is mandatory. Volume 4 remains subject to revision and updating during the project period in light of legislative or methodology changes.

1.3 Purpose of this document

The purpose of this document, the Employer's Requirements, OHS&E Volume 1 is to provide Contractors and other interested parties with the mandatory requirements relating to Health, Safety and the Environment practices and performance expectations on the Chennai Metro Rail Project.

This document:

a) Describes the OHS&E interfaces between the Employer, Employer's Representative and the Contractor;

b) Details the processes by which the Contractor shall manage OHS&E issues while carrying out the works under the contract and;

c) Describes by reference, the practices, procedures and requirements pertaining to the Chennai Metro Rail Project.

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1.4 Chennai Metro Rail OHS&E Objectives

Chennai Metro Rail Limited has identified five principle objectives for attainment during the project. These long term objectives shall be supported with quarterly, short and medium term objectives to enable structured advancement in overall performance. Our Short and medium term objectives also aims to facilitate effective monitoring and measurement to identify where a directional change may be necessary. Our Long term objectives are:

1. To eliminate or minimize the unwanted effects of hazards and risks to personnel, members of the public and other stakeholders who may be exposed to the undertakings associated with the construction of the Chennai Metro Rail project
2. Establish an effective and robust OHS&E management system that will enable Contractors to achieve international recognition and registration to the BS EN 18001:2007 Series.
3. Actively contribute to Contractors development through support, encouragement, determination in control and transfer of knowledge and skills in order to make the move from traditional compliance driven management through to risk managed processes.
4. To simplify the risk concept, to ensure a sensible approach to risk management and simplify hazard awareness training through adoption of the ALARP (As low as reasonably practicable) principles.
5. To practice 'Best Practice' within the construction industry - Establishing a work environment that conforms to international health & safety standards and make recommendation to improve effectiveness of regulations both nationally and locally.

2. Reference publications

BS EN ISO 9000:2005, Quality management systems — Fundamentals and vocabulary

BS EN ISO 9001:2008, Quality management systems — Requirements

BSENISO 14001:2004, Environmental management systems — Requirements with guidance

BS EN ISO 19011:2002, Guidelines for quality and/or environmental management systems auditing

BS OHSAS 18001:2007, Occupational health and safety management systems Requirements

BS OHSAS 18002, Occupational health and safety management systems – Guidelines for the implementation of BS OHSAS 18001

PAS 99, Specification of common management system requirements as a framework for integration

International Labour Organization:2001, Guidelines on occupational health and safety management systems — ILO-OSH 2001

Health & Safety Guidance (HSG) Health and Safety Executive publications United Kingdom

3. Terms and definitions

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3.1 **Acceptable risk.** Risk that has been reduced to a level that can be tolerated by the organization having regard to its legal obligations and its own OHS&E policy

3.2 Accident. Incident giving rise to injury, ill health or fatality

3.3 ALARP (As low as reasonably practicable) principles.

3.4 Audit. Systematic, independent and documented process for obtaining "audit evidence" and evaluating it objectively to determine the extent to which "audit criteria" are fulfilled

3.5 BOCWA. Building and Other Construction Workers (Regular Employment and Conditions of Service) Act, 1996

3.6 BOCWR. Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Central Rules, 1998

3.7 Chief Safety Manager. An officer nominated by CMRL who is the overall responsible for monitoring all OHS&E functions prescribed in this document.

3.8 CMRL. Chennai Metro Rail Limited

3.9 Competent person. Person with the appropriate combination of skill, knowledge, qualifications and experience

3.10 Continual improvement. Recurring process of enhancing the OHS&E management system in order to achieve improvements in overall OHS&E performance consistent with the organization's OHS&E policy

3.11 Corrective action. Action to eliminate the cause of a detected nonconformity or other undesirable situation

3.12 Design Risk Assessments. Used to record the actions of designers when reducing risks in construction and for future repairs and maintenance issues.

3.13 Employer. Chennai Metro Rail Limited (CMRL).

3.14 Hazard. Source, situation, or act with a potential for harm in terms of human injury or ill health, or a combination of these

3.15 Hazard identification. Process of recognizing that a hazard exists and defining its characteristics

3.16 Health surveillance. Monitoring health of employees to detect signs or symptoms of work-related ill health so that steps can be taken to eliminate, or reduce the probability of, further harm

3.17 Ill health. Identifiable, adverse physical or mental condition arising from and/or made worse by a work activity and/or work-related situation

3.18 Incident. Work-related event(s) in which an injury or ill health (regardless of severity) or fatality occurred, or could have occurred. An accident is an incident which has given rise to injury, ill health or fatality. An incident where no injury, ill health, or fatality occurs may also be referred to as a "near-miss", or "dangerous occurrence".

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3.19 Interested party. Person or group, inside or outside the workplace, concerned with or affected by the OHS&EOHS&E performance of an organization

3.20 Nonconformity. Non-fulfilment of a requirement; A nonconformity can be any deviation from: relevant work standards, practices, procedures, legal requirements, etc. or OHS&E management system requirements. A nonconformity can be any deviation from: — relevant work standards, practices, procedures, legal requirements, etc. — OHS&E management system criteria.

3.21 OHS&E management system. Part of an organization's management system used to develop and implement its OHS&E policy and manage its OHS&E risks. A management system is a set of interrelated elements used to establish policy and objectives and to achieve those objectives. A management system includes organizational structure, planning activities (including for example, risk assessment and the setting of objectives), responsibilities, practices, procedures, processes and resources.

3.22 OHS&E objective. OHS&E goal, in terms of OHS&E performance that an organization sets itself to achieve.

3.23 OHS&E performance. Measurable results of an organization's management of its OHS&E risks

3.24 OHS&E policy. Overall intentions and direction of an organization related to its OHS&E performance as formally expressed by top management

3.25 Preventive action. Action to eliminate the cause of a potential nonconformity (3.19) or other undesirable potential situation

3.26 Procedure. Specified way to carry out an activity or a process

3.27 Record. Document stating results achieved or providing evidence of activities performed

3.28 Risk. Combination of the likelihood of an occurrence of a hazardous event or exposure(s) and the severity of injury or ill health that can be caused by the event or exposure(s)

3.29 Risk assessment. Process of evaluating the risk(s) arising from a hazard(s), taking into account the adequacy of any existing controls, and deciding whether or not the risk(s) is acceptable

3.30 Risk control. Selection and application of suitable measures to reduce risk

3.31 Shall. Indicates a mandatory requirement within this document

3.32 Stakeholders. Those with a vested interest in an organization's achievements that includes, but is not limited to, internal and "outsourced" employees, customers, suppliers, partners, employees, distributors, investors, insurers, shareholders, owners, government and regulators.

3.33 Status review. Formal evaluation of the OHS&E management system

3.34 Top management. Person or group of people who direct and control an organization at the highest level

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3.35 Worker representative. Representative of employee occupational health and safety

4. SHE management system requirements

4.1 General requirement

4.1.1 The Contractor shall define and document the scope of its Occupational Safety Health and Environmental (OHS&E) management system to meet legal requirements and the requirements of Chennai Metro Rail Limited as stated within this document.

4.1.2 The Contractor's OHS&E management system shall determine how the organisation shall document, implement, maintain and continually improve upon performance in accordance with the requirements of the International OHSAS Standard to which the Employer is committed.

4.2 CMRL OHS&E Policy Statement of Intent

Chennai Metro Rail Limited consider that health, safety and environmental is of equal importance in comparison to any other aspect of business management and as such is committed to promoting high standards of safety, health, environment and welfare on all of their sites and premises. To achieve this Chennai Metro Rail shall:

- Constantly work towards improving the safety culture at all levels.
- Ensure compliance with all relevant legal duties in respect of health and safety at work legislation.
- Provide adequate resources for planning and controlling working conditions and safe systems of work.
- Work with our Contractors and suppliers to improve their safety performance, by measuring and monitoring their performance.

Responsibilities and performance requirements for Safety, Health and the Environment are available on the Chennai Metro Rail Limited website. In summary: -

- All Contractors, employees, sub-Contractors, consultants, suppliers and visitors have aduty to play an active role in achieving our objectives through compliance with their legal obligations and this Safety Policy.

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- Participation and consultation are vital aspects of this Policy and to the achievement of our objectives. Contractors and Staff are encouraged and expected to:
- Discuss safety, health and welfare matters with their managers, and company Safety, Health & Environmental Representatives who will offer or obtain further expert advice, where necessary.
- Co-operate at all times; contribute good ideas and improvements; report defects and short falls.

The correction of any breach of statutory provision or Chennai Metro Rail Limited requirements on health and safety shall take priority. Should appropriate action not be taken to meet the required standards, this will be taken seriously and may lead to disciplinary action being taken.

This Policy Statement shall be displayed prominently on all Chennai Metro Rail Limited sites and offices and will be kept under review to ensure its relevance.

4.3 Planning

4.3.1 Hazard identification, risk assessment and determining controls

4.3.1.1 The Contractor shall submit a procedure detailing the process in place for the identification of Hazards and Risks and the determination of control measures including the relevant standards as per clause 4.4.4.1.2. The Procedure shall incorporate the Employer's Requirements within this and other applicable OHS&E Volumes.

4.3.1.2 Management of Change

4.3.1.2.1 All temporary and permanent changes to organisational, personnel, systems, procedures, equipment, products, materials or substances shall be evaluated by the Contractor and managed to ensure that health, safety and environmental risks arising from these changes remain at an acceptable level. Changes made by the Contractor are subject to submittal and notice of no objection by the Employer's Representative prior to adopting change.

4.3.1.3 Risk Register & Hazard Log

4.3.1.3.1 The Contractor's Construction Health and safety Plan shall contain a detailed 'Risk Register' and 'Hazard Log' specific to the project. The register and log shall be assessed against the CMRL OHS&E requirements Volume 2.

4.3.1.3.2 The Hazard Log shall identify future method statement, risk assessment and operational procedures pertaining to specific equipment and operations in relation risk and local environmental constraints. Construction phase OHS&E Plans shall not be accepted without a fully completed Hazard Log and Risk Register.

4.3.1.4 Method Statements

4.3.1.4.1 Method statements are to be submitted to the Employer's Representative a minimum of 28 days prior to task commencement to ensure sufficient time is available for review and notice of no objection.

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4.3.1.4.2 Method statements shall contain the information requirements as prescript within the CMRL OHS&E Volume 2.

4.3.1.4.3 Method statements shall incorporate the control measures within the process methodology as identified within the risk assessment.

4.3.1.4.4 A copy of the relevant method statement for the activity being undertaken shall be available on site for reference by all site management and supervisors.

4.3.1.5 Risk Assessment production & submittal

4.3.1.5.1 Risk assessments shall contain as a minimum, the information as specified within the CMRL OHS&E Volume 2. The Contractor may choose to use their own format however the risk tolerances, probability and consequences must be included.

4.3.1.5.2 Risk assessments shall be produced and submitted to the Employer a minimum of 28 days prior to task commencement for notice of no objection. Risk assessments may be submitted independently or as part of a Method Statement.

4.3.1.5.3 Generic risk assessments other than routine activities of low risk shall not be accepted by the Employer.

4.3.1.5.4 Risk assessments shall be regularly reviewed to ensure they remain suitable and sufficient. Risk assessment reviews shall be undertaken where an incident has occurred and when a change in location may introduce additional risks from construction activities.

4.3.1.5.5 Substances hazardous to health shall be subject to assessment by the Contractor. Where Hazardous substances are identified for use within a process the assessment and determining controls shall be included within the relative method statement.

4.3.1.6 Design Risk Assessment

4.3.1.6.1 Design Risk Assessments shall be submitted to the Employer's Representative for granting of no objection. Design risk assessments shall accompany all drawing submittals for operations involving;

- Temporary works,
- Formwork & false-work
- Heavy lifting equipment.

4.3.1.6.2 Drawings shall not be accepted by the Employers Representative without an accompanying design risk assessment.

4.3.2 Legal and other requirements

4.3.2.1 Contractor shall comply with all legal obligations and the requirements of Chennai Metro Rail Limited as contained herein.

4.3.2.2 Indian statutory requirements

The Contractor shall abide by all national, state and local bye-laws. It is the duty of the Contractor to ensure that all sub-Contractors appointed also comply with their legal obligations as listed below but

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not limited to:

i. Indian Electricity Act 2003 and Rules 1956

ii. National Building Code, 2005

iii. Factories Act, 1948,

iv. Motor Vehicles Act as amended in 1994, The Central Motor Vehicles Rules, 1989.

v. Indian Road Congress Code IRC: SP: 55-2001 'Guidelines on Safety In Road Construction Zones.

vi. The Petroleum Act, 1934 and Rules 1976

vii. Gas Cylinder Rules, 2003

viii. Indian Explosives Act. 1884, along with the Explosives substance Act 1908 and the explosives Rules 1983

ix. The (Indian) Boilers Act, 1923

x. The Public Liability Insurance Act 1991 and Rules 1991

xi. Minimum Wages Act, 1948 and Rules 1950

xii. Contract Labour Act, 1970 and Rules 1971

xiii. Child Labour (Prohibitions & Regulations) Act, 1986 and Rules 1950

xiv. Environment Protection Act, 1986 and Rules 1986

xv. Air (Prevention and control of Pollution) Act, 1981

xvi. Water (Prevention and Control of Pollution) Act, 1974

xvii. The Noise Pollution (Regulation & Control) Rules, 2000

xviii. Notification on Control of Noise from Diesel Generator (DG) sets, 2002

xix. Recycled Plastic Usage Rules, 1998

xx. Notification, Central Ground Water Board, Act January 1997

xxi. Manufacture, Storage & Import of Hazardous Chemicals Rules, 1989

xxii. The Hazardous Waste (Management & Handling) Rules, 1989

xxiii. Hazardous Waste Management Rules 1989 (as amended in 1999)

xxiv. Batteries (Management and Handling) Rules

xxv. Fly ash utilization notification, Sept 1999 as amended in August 2003

xxvi. Workman Compensation Act, 1923 along with allied Rules

4.3.2.3 International Standards, Guidelines & ISO Certifications

4.3.2.3.1 If the requirements stated in this document are in conflict or inconsistent with the requirements of applicable laws or the Employer's Requirements for the CMR project, the more stringent requirements shall apply.

4.3.2.3.2 The works shall be undertaken in accordance with the applicable international guidelines, standards and specifications on OHS&E and every Contractor shall actively pursue the achievement of:

- BS EN OHSAS 18001:2007 - OHS Management Systems

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- ISO 14001-2004: Environmental Management Systems

4.3.2.3.3 The process of international certification to BS EN 18001:2007 and ISO 14001-2004 standard shall commence immediately after the award of Contract through appointment of ISO accrediting body for obtaining the certification. Should this not be undertaken by the Contractor within 3 months of the Contract award, the Employer's Representative shall appoint at the Contractor's cost.

4.3.2.3.4 Should the Contractor already posses such certification, the scope of the CMR project must be included on the Contractor's certification within 1 year of Contract commencement and proof of such attainment demonstrated to Chennai Metro Rail Limited.

4.3.3 Objectives and programme(s)

4.3.3.1 The Contractor shall maintain procedures to establish detailed OHS&E objectives and performance criteria. Such objectives and performance criteria shall be developed to incorporate the Chennai Metro Rail policy and strategic OHS&E objectives. The Contractor's objectives shall be quantified, wherever practicable, and identified with defined timescales. The Contractor is required to submit for notice of no objection their procedure and objectives as per clause 4.4.4.1 of this control document.

4.4 Implementation and operation

4.4.1 Resources, roles, responsibility, accountability and authority

4.4.1.1 The Contractor shall detail within the Construction Health, Safety and Environmental Plan the planned roles and resources allocated for the CMR project. In addition to the staffing arrangements the Contractor shall prescribe the responsibilities specific to role, accountability and the authority under which they operate.

4.4.1.2 Safety, health & environmental resources shall be provided by the Contractor as per the Contract value in table 1.

Table 1 Mandatory Contractor OHS&E management resource requirement

<table>
<tr><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
<tr><td>Contract Value in (Cr.)</td><td>Chief OH S&E Manager</td><td>Senior OHS&E Manager</td><td>Junior OHS&E Manager</td><td>Safety Steward</td><td>Senior Electrical Engineer</td><td>Junior Electrical Engineer</td></tr>
<tr><td>Up to 2</td><td>-</td><td>-</td><td>1</td><td rowspan="5">Refer to note 1</td><td>-</td><td>1</td></tr>
<tr><td>Up to 10</td><td>-</td><td>1</td><td rowspan="4">Refer to note 1</td><td>1</td><td rowspan="4">Refer to note 2</td></tr>
<tr><td>Up to 25</td><td>1</td><td rowspan="3">Refer to note 1O note 1</td><td>1</td></tr>
<tr><td>Up to 100</td><td>1</td><td>1</td></tr>
<tr><td>Up to 250</td><td>1</td><td>1</td></tr>
</table>

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4.4.1.3 Responsibility

4.4.1.4 The General Manager of the Contractor is responsible and accountable for compliance with the conditions and clauses within this document.

4.4.1.5 The General Manager is responsible to ensure that the necessary resources are allocated and made available to meet the requirements as laid out within this document and other referenced materials to include Legal Requirements (4.3.2).

4.4.1.6 For all works carried out by the Contractor and appointed sub-Contractor's, the responsibility for ensuring OHS&E resources remains with the main Contractor. Activities undertaken by the

	7	8	9	10	11
Contract Value in (Cr.)	Occupational Health officer with Necessary Nursing Assistants (Refer Note 3)	Environmental Manager	Senior OHS&E Traffic Engineer Refer to Note 4	Housekeeping & barricade maintenance	Labour Welfare Officer
Up to 2	-	-	-	Refer to Note 5	-
Up to 10	1 (PT)	1	1		1
Up to 25	1(PT)	1	1		1
Up to 100	1(PT)	1	1		1
Up to 250	2(FT)	1	1		1 with support staff
250 or More	2(FT)	1 with support staff	1		1 with support staff
Note 1	Qualified and trained OHS&E Professionals as per Table 2 with required support staff to be deployed at each worksite at each shift. Qualifications of appointed OHS&E personnel shall be in accordance with section 4.4.2 Competence, Awareness and Training, within this document.				
Note 2	Qualified and trained Electrical Engineers / supervisors to be deployed at each worksite for each shift.				
Note 3	(PT) means Part-Time and (FT) means Full-time.				
Note 4	Senior OHS&E (Traffic) Engineer Post and Barricade Manager posts are applicable to contracts where the work has to be executed either below or over the public right-of-way such as Viaduct, Station Contracts.				
Note 5	One Housekeeping Manager / Barricade Manager supported by required supervisors and workmen necessary to maintain a clean and tidy site or yard.				

Contractor's Sub-Contractors shall be monitored by the Contractor at all times to ensure compliance with agreed safe systems of working.

4.4.1.7 All Contractor's OHS&E personnel shall report to the Chief OHS&E Manager who shall report directly to the General Manager or Corporate Safety Director of the Contractor's organisation. This shall be reflected in the Contractor's organisation charts within the OHS&E plan and Quality Management Plan.

4.4.1.8 The Employer shall monitor adherence to the provisions of Table 1. Where deviation is evident this shall be recorded as a non-conformance.

4.4.1.9 The Contractor shall provide all OHS&E personnel with such facilities, equipment and information that are necessary to enable them to dispatch their duties effectively.

4.4.1.10 The Contractor's Safety Managers, Safety Advisors and Officers are responsible for ensuring that

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reports on the performance of the OHS&E management system are presented to top management for review and used as a basis for improvement of the OHS&E management system.

4.4.1.11 The Contractor's Safety Managers, Safety Advisors and Officers are responsible for independently monitoring the operations of the Contractor, where deficiencies are identified they are responsible to report their findings immediately to the Site Engineer in charge who then must take action as directed.

4.4.1.12 Accountability

4.4.1.13 In cases where the Contractor fails to provide the minimum required manpower as illustrated in Table 1, or fails to fill vacancies created within 30 days, the same may be provided by the Employer's Representative at the Contractor's cost. Any administrative expenses involved in providing the same for example, vacancy advertisements or recruitment consultant charges, shall also be at the cost of Contractor.

4.4.1.14 No OHS&E personnel shall be permitted to do any work which is unconnected to, inconsistent with or detrimental to the performance of the OHS&E duties.

4.4.1.15 Supervisors must ensure that the employees under their direct supervision are working incompliance with the approved safe systems of working.

4.4.1.16 Authority

4.4.1.17 The Contractor's Safety Managers, Safety Advisors and Officers authority shall be stated within the Construction Health and Safety Plan and the authority level must be communicated to all Contractor's Staff including sub-Contractors.

4.4.1.18 The Contractor's Safety Managers, Safety Advisors and Officers shall have the authority as assigned by the General Manager to suspend works where deviation from an approved method of working occurs that presents a risk of injury, equipment or property damage.

4.4.1.19 The Employer's Representative shall have the right to stop the work at his/her sole discretion, if in his opinion the work is being carried out in such a way that a risk of injury, property and or equipment damage may exist. The Contractor shall not proceed with the work until remedial works have been complied with under the direction and satisfaction of the Employer. Should the Contractor continue to work without implementing the Employer's Representatives instruction, clause 4.4.2.2 shall be applied to the individual responsible for the decision to proceed.

4.4.1.20 The Contractor shall not be entitled to any damages or compensation for stoppage of work, due to safety reasons. The period of such stoppages of work shall not be taken as an extension of time for completion of the facilities and will not be the ground for waiver of levy of liquidated damages.

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4.4.2 Competence, training and awareness

4.4.2.1 The Contractor shall ensure that the recruitment, selection and placement processes shall be in place to ensure that personnel are qualified, competent, and physically fit for assigned tasks. The Contractor shall produce a procedure that shall be made available to the Employer's Representative for notice of no objection as per Clause 4.4.4.1.2 of this document. The procedure shall define the processes in place to ensure competence.

4.4.2.2 The Contractor's attention is drawn to Part I General Conditions Clause 6.9 (d), whereby any person employed thereon, who in the opinion of the Employer's Representative, misconducts himself or is incompetent or negligent or fails to conform with any particular provisions with regard to safety, health or environment which is set out in the Contractor's OHS&E Plan or a requirement of the Contract, or persists in any conduct which is prejudicial to safety or health, shall be removed from site immediately, and such persons shall not be employed again upon the Works. The decision of the Employer's Representative in this regard shall be final.

4.4.2.3 Notice of No Objection from the Employer's Representative

4.4.2.3.1 The name, educational qualifications and work experience for all persons intended for a Contractor's OHS&E role shall be submitted to the Employer's Representative for notice prior to employment. Only upon notice of no objection by the Employer's Representative shall OHS&E personnel be authorised to work on a CMRL site.

4.4.2.3.2 The Contractor shall appoint the required OHS&E personnel in accordance with the qualifications and experience as listed in Table 2.

Table 2 OHS&E Personnel Qualifications & Experience

Item	Designation	Qualification	Experience (Years)
1	Chief OHS&E Manager	The Chief OHS&E Manager shall be qualified in any of the following degrees/diplomas: Post Graduate Diploma in Industrial Safety & Environmental Management (PGDISEM) M.E. in Industrial Safety from NIT, B.E. in Fire and Safety Engg. B.E. with advanced Safety Management Diploma B.E / B.Arch., with one year Full Time advanced Safety diploma B.E/B.Tech full time Degree / Diploma in Safety. International qualifications, CSP (Certified Safety Professional), NEBOSH, MIOSH, MSISO etc	15

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2	Senior OHS&E Manager	As stated in Sl. No:1 and in addition the following categories: i) B.Sc.(Physics/Chemistry/Maths) with one year Full Time advanced Safety diploma ii) B.Sc. / Diploma in Engg. with advanced safety Management Diploma iii) B.Sc. (Physics/Chemistry/Maths) with One year Full Time diploma in Safety Engineering iv) Any Graduate or diploma holder with 7 years of work experience in a OHS&E department upon approval of Employer's Representative.	2 years for category (i) (ii) and (iii)
3	Junior OHS&E Manager	i) Degree in Science / Diploma in Engineering with Govt. recognized safety diplomas ii)Any Graduate or diploma holder with 5 years of work experience in a OHS&E department with prior approval of Employer's Representative? on a case to case basis	i) 2 Years
4	Safety Steward	Any basic qualification with any OHS&E related certificate courses.	2 Years
5	Senior Electrical Manager	Degree in Electrical Engineering + Govt. Recognized Electrical Licence holder	2 Years
6	Electrical Manager	Diploma in Electrical Engineering + Govt. Recognized Electrical Licence holder	1 Year
7	Occupational Health Officer	MBBS with Govt. recognized degree/diploma in Industrial/ occupational health	1 Year
8	Environmental Manager	Govt. recognized PG Degree / PG Diploma / Degree in Environmental Engineering / Science	2 Years
9	Senior Traffic Engineer	Govt. recognized PG Degree / Degree / Diploma in Traffic/Transportation Engineering or Planning	1 Year
10	Housekeeping & Barrier Manager	Any Diploma in Engineering	1 Year

4.4.2.3.3 Where a potential candidate has previously worked in a Metro Rail construction environment and does not possess the qualifications and or the necessary experience as listed in Table 2 for the particular role, the Employer's Representative may upon a successful interview of

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the candidate grant a waiver subject to successful completion of a probation period of 3 months.

4.4.2.3.4 In order to effectively interact on labour welfare matters with the Employer's Representative? and the statutory authorities enforcing the labour welfare legislations every Contractor shall employ a full time Labour Welfare Officer duly qualified and experienced as per clause

4.4.2.3.5 OHS&E Induction Training

4.4.2.3.6 The Contractor shall ensure that all personnel working at the site receive an induction OHS&E training explaining the nature of the work, reporting & communication routes the hazards that may be encountered during the site work and the particular hazards attached to their own function within the operation. The training shall cover as a minimum the contents as directed within OHS&E Volume 2.

4.4.2.3.7 Records of all inductions shall be maintained by the Contractor and be made available for inspection by the Employer upon request.

4.4.2.3.8 The Contractor shall provide their workforce and management staff with an OHS&E induction Handbook containing the information as per the induction training.

4.4.2.3.9 A condensed induction shall be given by the Contractor to all visitors. The induction briefing shall include the risk and hazards associated with the particular site and the operations being conducted.

4.4.2.3.10 All personnel shall be issued a temporary ID upon the completion of the Contractor's' induction. The temporary ID shall be signed by the Human Resource Manager or appointed representative and limited to a 2 week validity period at which time the temporary ID shall be replaced with a permanent ID including photograph.

4.4.2.3.11 Individuals found on site by the Employer's Representative without-dated temporary ID cards shall be removed from site

4.4.2.4 OHS&E Training

4.4.2.4.1 The Contractor shall assess the training requirements for all the employees, plan and initiate a training program to fulfil the training needs assessment. The assessment of training needs shall incorporate all levels of staff including Sub-Contractor's against an individual's role, responsibility, ability, language skill and risk.

4.4.2.4.2 The Contractor shall produce a 'Training Implementation Plan' to incorporate the findings of the needs assessment.

4.4.2.4.3 The training needs assessment together with Implementation Plan shall be submitted to the Employer's Representative for notice of no objection within 4 weeks of commencement. The Employer's Representative shall evaluate the assessment and plan against the base line training matrix contained within OHS&E Volume 2.

4.4.2.4.4 Records of all training conducted shall be maintained and made available for inspection by the Employer's Representative upon request.

4.4.2.4.5 Should the Contractor fail to provide the training identified within the Contractor's assessment, implementation plan and the Employer's Representative's Training matrix within the agreed timescales, this shall be reflected in the potential scores awarded within the monthly audit report.

4.4.2.4.6 Specific training with regard to the provisions of the Construction Safety Plan, and associated operational and system procedures shall be conducted by the Contractor for all persons with

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supervision responsibilities. Records of training including duration shall be maintained.

4.4.3 Communication, participation and consultation

4.4.3.1 Communication

4.4.3.1.1 The Contractor shall produce a 'High Quality' quarterly newsletter on a rotational basis with other Contractors. Rotation shall be announced within the Employer's Representative's OHS&E Committee meetings.

4.4.3.1.2 All Contractors including the Employer's Representative shall provide input into the rotational Contractor for the newsletter content such as details of accidents, incidents and near misses together with any lessons learned; specific safety initiatives; internal competitions and workforce awards etc.

4.4.3.1.3 The Employer's Representative shall be issued the draft newsletter for review prior to the Contractor's publishing.

4.4.3.1.4 The OHS&E Newsletters shall publicise all Contractors OHS&E performances over the previous 3 months in relation to OHS&E Audits and shall form the basis for the Employer's Representative's Awards programme. Results of audits shall be provided by the Employer's Representative for inclusion.

4.4.3.1.5 The quarterly newsletters shall be issued to all interested parties and be promulgated at site level. Where language barriers exists the contents of the newsletters shall be communicated by the Workforce Representative to ensure understanding.

4.4.3.1.6 At site level the Contractor shall erect pertinent awareness signage and posters. Posters shall be changed on a monthly basis to maintain impact.

4.4.3.1.7 Poster campaigns shall be discussed and agreed at the Employer's Representative's Committee Meeting to maintain a consistent improvement programme across all CMRL Sites.

4.4.3.1.8 Informational posters, banners etc shall be provided both in Tamil and English.

4.4.3.1.9 Toolbox talks or team briefings shall be carried out daily by the Contractor and correspond to the works activities being undertaken or to communicate a specific awareness initiative. Toolbox talks shall not replace professional training.

4.4.3.1.10 Records of all toolbox talks undertaken together with the date, topic, participant's names and signatures shall be maintained and made available for inspection by the Employer's Representative.

4.4.3.1.11 Method statement and risk assessment briefings shall be carried out prior to the commencement of a new task and or when a change to the method of working arises. Records of all such briefings shall be maintained by the Contractor.

4.4.3.1.12 Visitor information signage shall be posted at site entrances detailing where to report and contact information. Note: visitors shall be accompanied at all times by site security where office locations require walking through operational areas.

4.4.3.1.13 Public Liaison

4.4.3.1.14 Public informational signage and Contractor contact information shall be posted externally to the site.

4.4.3.1.15 The Contractor shall appoint an individual as a Public liaison Officer to communicate directly with members of the public regarding forthcoming operations, what to expect, noise expectancy, duration of operations etc.

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4.4.3.2 Participation and consultation

4.4.3.2.1. The Contractor shall establish a Safety Committee within 4 weeks of commencement that shall be chaired by the Contractor's Project Director.

4.4.3.2.2 The Contractor shall notify the Employer's Representative of the establishment of the Committee together with the committee members' names and designation. The Contractor's Chief Safety Manager, Senior Safety Manager, Plant & procurement Manager and Human Resources Manager shall form the minimum committee members. Site based personal shall be represented within the Committee by the attendance of Site Manager(s) and the Workforce OHS&E Representative.

4.4.3.2.3 The Employer's Representative shall be invited to attend the Contractor's Safety Committee meetings.

4.4.3.2.4 The Contractor's OHS&E Committee shall meet on a monthly basis throughout the duration of the Contract.

4.4.3.2.5 The Committee shall review the previous month's performance, to include, inspections and audits undertaken, accidents and incidents and any concerns or complaints that have been raised. Short term objectives and targets for improvement shall be set for completion by the next scheduled Committee meeting.

4.4.3.2.6 The Safety committee shall undertake a formal site inspection to be scheduled on a 2 monthly basis. The inspection shall review progress regarding the achievement of short term targets. The Committee shall produce a report stating progress made together with any corrective actions required and issue to the Employer's Representative within 7 days following the Inspection.

4.4.3.2.7 Minutes of the Committee meeting shall be issued within 2 days and promulgated to all members including the Employer's Representative. The minutes of meeting shall also be posted on all sites within the workforce area. The minutes intended for site communication shall be in both Tamil and English.

4.4.3.3 Employer's Representative OHS&E Committee

4.4.3.3.1 A Safety Health and Environmental Committee shall be established by the Employer's Representative and shall sit every 3 months throughout the project period. All Contractors shall be required to attend the quarterly meetings who shall be represented by their General Manager and Chief Safety Manager.

4.4.3.3.2 The Committee shall review previous performances project wide and set short and medium term objectives and targets for achievement within the next reporting period.

4.4.3.3.3 The Employer's Representative reserves the right to call an Emergency Meeting of the Committee members in the event of a serious incident that requires immediate change to the operational methods of working.

4.4.3.3.4 Minutes of the Employer's Representatives OHS&E Committee shall be promulgated to all Contractor's within 3 days.

4.4.3.4 Workforce Representation

4.4.3.4.1 All workers shall have access to a Workforce OHS&E Representative who is responsible to communicate directly with the labour force with regard to safety and health. The representative's name and contact number shall be posted on all sites externally to the site office.

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4.4.3.4.2 The Workforce OHS&E Representative shall be made a member of the OHS&E Committee and attend all meetings.

4.4.3.4.3 The OHS&E Representative shall meet the labour force on a monthly basis to discuss health, welfare, safety initiatives and or concerns the workforce may have. Minutes are to be produced by the Representative and issued formally within 2 days after the meeting date to the Contractor's Project Manager, General Manager and Employer's Representative

4.4.3.4.4 A lockable site suggestion box to which only the workforce OHS&E Representative shall have access shall be installed on all sites and within any labour accommodation camps. The suggestion box shall be located independent from any offices, in a public area and protected from bad weather. The OHS&E Representative shall inform the workforce that the purpose of the suggestion box is to provide a means of participation, communicating ideas and initiatives and also for raising concerns without fear of reprisal.

4.4.3.4.5 The contents of all suggestion boxes shall be collected and collated on a weekly basis. Where concerns or complaints regarding the standards of health, safety or welfare have been reported these shall be immediately reported to the Chief OHS&E Manager and Project Manager who shall investigate the concern(s). Records of such investigations and resultant outcomes shall be maintained.

4.4.3.4.6 Ideas, suggestions and concerns raised by the workforce during the OHS&E representative's on site monthly meetings shall form an agenda item within the Contractor's OHS&E Committee meeting.

4.4.3.4.7 Where an idea or specific suggestion is subsequently adopted for use by the Contractor's OHS&E Committee, the individual shall receive an OHS&E award as determined by the Contractor.

4.4.3.4.7 Where Employee awards are issued this shall be notified to the Employer's Representative to ensure inclusion within the Quarterly Newsletter.

4.4.3.5 Contractor Awards

The Employer shall recognize the effort, participation and commitment demonstrated by the Contractor by nominating awards. The award type shall be at the discretion of the Employer.

4.4.4 Documentation

4.4.4.1 Management System procedures

4.4.4.1.1 The Contractor is required to submit for notice of no objection, the organisation's top tier Management System Procedures as listed in Table 3 that shall be adopted for use on the CMR project.

4.4.4.1.2 System procedures shall be submitted to the Employer's Representative within 4 weeks of commencement.

4.4.4.1.3 Construction works shall not commence until such time as a notice of no objection has been received; applicable to all management system procedures as listed in Table 3. Should the Contractor commence operations on site without notice, the Employer's Representative shall award a 'Zero' audit score for every month of non-compliance with this clause.

4.4.4.1.4 The Employer's Representative shall evaluate the suitability of the Contractor's system procedures against the BS EN 18001:2007 and ISO 14001:2004 standards.

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4.4.4.1.5 The submitted procedures shall be individually identified with a unique reference and detail in sequence the scope, purpose, referenced material and procedure processes.

4.4.4.1.6 Where such procedures as listed in Table 3 exist within other areas of the Contractor's organisational management systems such as quality management, these shall not be subject to replication if the procedure makes specific reference to Health, Safety and Environmental control.

4.4.4.1.7 Compliance standards against the Contractor's management system procedures shall be subject to audit by the Employer's Representative.

Table 3 OHS&E Management System Procedures

Hazard identification, risk assessment and determining controls	Communication, participation & consultation	Environmental Impact Aspect Assessment	Objectives and programme(s)
Training, awareness and competence	Implementation and operation	Accident & Incident Investigation	Legal requirements
Documentation	Monitoring & Measurement	Emergency Preparedness	Change control
Procurement	Record keeping	Audit	Management review

4.4.5 Control of documents

4.4.5.1 All plans, procedures and method statements shall be controlled and subject to review and formal approval by the Contractor's Project Director prior to issue to the Employer's Representative.

4.4.5.2 All documents subject to review by the Employer's Representative shall be signed by the Contractor's Project Director and issued formally.

4.4.5.3 Documents shall be issued as per the Employer's Representative's requirements regarding Quality Management.

4.4.5.4 OHS&E Documents shall be issued, maintained, traceable and available for retrieval pursuant to the Contractor's ISO accredited Quality Management System.

4.4.6 Operational control

4.4.6.1 Operational control shall be maintained through the implementation of the provisions stated within the Contractor's site specific Construction Health Safety and Environmental Plans, the contents of which are outlined in Safety, Health and Environmental Volumes 2 and 3 and Tunnelling Volume 4 to which the Contractor shall comply.

4.4.6.2 Construction Phase Health & Safety Plan

4.4.6.2.1 The Contractor shall produce a Contract specific Construction Health & Safety Plan (CHSP) and submit to the Employer's Representative within 28 days of commencement.

4.4.6.2.2 The Construction Health and Safety Plan shall contain the informational requirements as per the

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CHSP contents as prescript within the CMRL OHS&E Volume 2, Safety Plan contents.

4.4.6.2.3 The CHSP shall be assessed by the Employer's Representative against the provisions as stated within OHS&E Volume 2. Where deficiencies exist to an extent where an objection is raised, construction activities shall be suspended until such time as the deficiencies are subject to corrective action, re-submittal and notice of no objection by the Employer.

4.4.6.2.4 Delays incurred as a result of the Contractor failing to achieve a 'No objection' statusfrom failing to submit within the specified timescale or non compliance with OHS&E Volume 2 shall be entirely at the Contractor's risk and cost.

4.4.6.2.5 The Contractor shall undertake a monthly review of the CHSP. The review shall be recorded and the Employer's Representative notified of any updates.

4.4.6.3 Construction Phase Site Environmental Plan

4.4.6.3.1 The Contractor shall produce a Contract specific Site Environmental Plan (SEP) and submit to the Employer's Representative within 28 days of commencement.

4.4.6.3.2 The Site Environmental Plan (SEP) shall contain the informational requirements as per the contents as prescript within the CMRL Environmental Management Arrangements Volume 3, Environmental Plan contents.

4.4.6.3.3 The SEP shall be assessed by the Employer's Representative against the provisions as stated within the Environmental Management Arrangements Volume 3. Where deficiencies exist to an extent where an objection is raised, construction activities shall be suspended until such time as the deficiencies are subject to corrective action, re-submittal and notice of no objection by the Employer's Representative.

4.4.6.3.4 Delays incurred as a result of the Contractor failing to achieve a 'No objection' status from failing to submit within the specified timescale or non compliance with Environmental Management Arrangements Volume 3 shall be entirely at the Contractor's risk and cost.

4.4.6.3.5 The Contractor shall undertake a monthly review of the SEP. The review shall be recorded and the Employer's Representative notified of any updates.

4.4.6.4 Operational procedures

4.4.6.4.1 The Contractor shall identify within the Hazard Log and Risk Register the operational control procedures that shall be applicable for the CMR project under their individual scope of works.

4.4.6.4.2 Operational procedures shall be submitted for review to the Employer's Representative for notice of no objection together with the Construction Site Safety Plan within 4 weeks of commencement.

4.4.6.4.3 The operational procedures shall be evaluated by the Employer's Representative against the requirements stated within OHS&E Volume 2, international safety standards such as the International Labour Organisation, European Norms and British Standards where an equivalent Indian Standard does not exist.

4.4.6.4.4 Construction works shall not commence until such time as a notice of no objection has been received; applicable to all operational procedures as identified within Table 4 and the Contractor's

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Hazard Log & Risk Register. Should the Contractor commence operations on site without notice, the Employer's Representative shall award a 'Zero' audit score for every month of non-compliance with this clause.

4.4.6.4.5 The submitted procedures shall be individually identified with a unique reference and detail in sequence the scope, purpose, referenced material and procedure processes.

4.4.6.4.6 In the event that the Contractor is unable to comply with the 28 day timeframe for submittal of the minimum operational procedures as detailed within Table 4, the Contractor shall assign an individual identification reference for the outstanding procedure within the Construction Health, Safety & Environmental Plan together with the statement 'Under process'. The 'Under Process' procedure shall be required to be submitted for notice of no objection a minimum of 28 days prior to commencement of any activity that involves the application of the procedure.

Table 4 Operational Procedures

Lifting Operations & Lifting Equipment	Plant & Equipment	Occupational Health provisions	Emergency Medical Facilities & First Aid
Personal Protective Equipment	Permit to Work Systems	Site Electricity & Distribution	Welding & Cutting operations
Incident Investigation	Traffic Management	Working at Height	Hazardous Substances
Site Security	Fire Safety	Manual Handling	Site Set-up
Abrasive Wheels	Public Interface	Noise and Vibration	Welfare Arrangements

4.4.6.4.8 The Contractor shall adopt the following colour code scheme across all CMRL Sites to ensure efficient recognition of relevant personnel.

Safety Helmet Colour with Logo	Designation
White	CMRL Staff and Employer's Representative
Violet	Contractor's Engineers & Supervisors
Blue	Sub-Contractor's Engineers & Supervisors
Red	All Electricians
Green	Safety personnel
Orange	Security Guards & Traffic Marshals
Yellow	General Workforce
White (With VISITOR Sticker)	Visitors

4.4.7 Emergency preparedness and response

4.4.7.1 Emergency Response Plan

4.4.7.1.1 The Contractor shall prepare a project specific Emergency Plan and submit to the Employer's

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Representative for notice of no objection. The Emergency Plan shall be submitted within 4 weeks of contract Commencement.

4.4.7.1.2 The plan must identify the potential for emergencies and the provisions for responding to such emergencies, particular to their environment and location. The Emergency planning arrangements shall be assessed as per the provisions in OHS&E Volume 2 for suitability.

4.4.7.1.3 The Contractor shall ensure that all persons including sub-Contractors on site are aware of the emergency procedure to follow in the event of an emergency. Awareness training shall commence at induction and thereafter through refresher training such as toolbox talks and monthly emergency drills. Records of refresher training and emergency drills shall be maintained.

4.4.7.1.4 Site signage shall be erected and detail the emergency process to follow and include emergency telephone numbers, fire, ambulance, police, nearest hospital etc.

4.4.7.1.5 Arrangements shall be made by the Contractor for casualty evacuation and emergency medical treatment. The Contractor shall enter into an agreement with a hospital to provide ambulance services. Alternatively the Contractor shall provide a fully equipped ambulance on-site that shall be manned by a paramedic. This provision shall be subject to the Employer's Representatives audit.

4.5 Checking

4.5.1 Performance measurement and monitoring

4.5.1.1 The Contractor shall submit a Monthly OHS&E Progress Report no later than 7th of each month to the Employer's Representative. The Report shall contain the minimum information specified within OHS&E Volume 2. The report shall contain text, tables and colour photographs.

4.5.1.2 Site Inspection

4.5.1.3 Independent of the plant and equipment inspection, testing and maintenance regimes that shall be stated within the Contractor's Plant and Equipment Procedures, the Contractor shall carry out site monitoring exercises on a daily and weekly basis.

4.5.1.4 The Contractor shall ensure that all monitoring equipment is calibrated as per the manufactures requirements. The Employer's Representative shall be provided with test certificates for such equipment

4.5.1.5 Site Engineers shall be required to participate in daily internal OHS&E inspections to facilitate prompt communication and rectification of minor deviations. Records of such inspections and rectification needs shall be maintained at site level and made available for review by the Employer's Representative other interested parties.

4.5.1.6 Formal site inspection reports shall be produced on a weekly basis by the Contractor's OHS&E personnel for each site and submitted to the Project Director and copied to the Contractor's General Manager.

4.5.1.7 The Contractor may choose inspection format of his/her choice, however format shall contain the minimum information as provided within OHS&E Volume 2 regarding weekly inspection form.

4.5.1.8 The Contractor's OHS&E Personnel shall be accompanied during a formal site inspection by the Site Manager responsible for the particular site. The resulting inspection report shall be signed by both the Site Manager and the OHS&E officer.

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4.5.1.9 The Employer's Representative shall formally inspect and report the Contractor's site conditions against the compliance criteria set within the Contractor's operational procedures and the Employer's Representative's requirements on a weekly basis. These inspections shall include batching plant and associated yards.

4.5.1.10 The Contractor shall undertake specific inspections at the Employer's Representative's request where concerns have been raised regarding the suitability of control measures and or plant or equipment condition. Such inspections shall be carried out with immediate effect.

4.5.2 Evaluation of compliance

4.5.2.1 The information submitted by the Contractor within the OHS&E Monthly Progress Report together with the Employer's Representatives Reports shall be evaluated against the Employer's compliance requirements and OHS&E objectives.

4.5.2.2 Inspection reports shall be evaluated against the Legal Requirements (4.3.2) to which the Contractor is bound to comply.

4.5.2.3 The Contractor's OHS&E Committee shall formally evaluate reports and results of accidents and or injury on a monthly basis. The results of this evaluation such as identified changes to safe systems of working' shall be included with the Committee minutes

4.5.2.4 The Employer's Representative shall evaluate 'Accident Injury Rates' and 'Frequency Rates' per individual Contractor and as a project to determine performance against the international rates. The international rates used to benchmark performance shall be promulgated to all Contractor's and other interested parties.

4.5.2.5 A Project Monthly Progress Report shall be produced by the Employer's Representative. Evaluation results shall be included within the relevant sections for Health Safety & the Environment.

4.5.2.6 The Contractor's External OHS&E Audits (4.5.5) shall be evaluated by the Employer's Representative against the internal Standards BS EN 18001:2007 AND ISO 14001:2004.

4.5.3 Incident investigation, nonconformity, corrective action and preventive action

4.5.3.1 Incident investigation

4.5.3.1.1 The Contractor shall undertake accident investigation for all fatal accidents, major injuries and dangerous occurrences as defined within the Employer's Project OHS&E VOL 2.

4.5.3.1.2 In the event of a fatality, major injury or dangerous occurrence, the Contractor shall not disturb the accident scene or remove equipment beyond that required to make the area safe and/or for the treatment and/or removal of casualty(s) to hospital.

4.5.3.1.3 Should the Employer's Representative find an accident scene disturbed beyond that reasonably expected with making an area safe, this shall be subject to thorough investigation by the Employer's Representative.

4.5.3.1.4 The Employer's Representative shall be informed immediately of all fatalities, major injuries or dangerous occurrences. Any delay in reporting to the Employer's Representative may be subject to disciplinary action.

4.5.3.1.5 The Contractor is responsible to report accidents, incidents and dangerous occurrences to the relevant governing bodies as per their statutory obligations. The Contractor shall maintain

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responsibility for ensuring sub-Contractor's under their direct control also comply with this requirement.

4.5.3.1.6 A preliminary accident notification report shall be issued to the Employer's Representative for all fatal and major injuries and or dangerous occurrences within 12 hours as per OHS&E Volume 2. This shall be followed by the detailed accident report as per OHS&E Volume 2 within 48 hours of the investigation completion.

4.5.3.1.7 Near misses and minor accidents should also be investigated by the Contractor as soon as possible as they are signals that there are inadequacies in the safety management system.

4.5.3.1.8 In case of fatal accidents, major injuries or dangerous occurrences the Employer's Representative shall conduct an independent investigation. The Contractor and his staff shall extend the necessary co-operation.

4.5.3.2 Nonconformity, corrective action and preventive action

4.5.3.2.1 The Contractor shall conform to their internal procedures regarding nonconformity, corrective action and preventive action. The Contractor shall be audited by the Employer's Representative for compliance with internal procedures.

4.5.3.2.2 Major and Minor non-conformances shall be raised by the Employer's Representative as per the Employer's Quality Management requirements and the OHS&E Audit criteria as defined within OHS&E Volume 2.

4.5.3.2.3 Open non-conformances shall be reflected in the Contractor's Monthly Audit Report and are subject to verification by the Employer's Representative as detailed in OHS&E Volume 2. Failure to successfully take corrective action and close out non-conformances will impact negatively on the Contractor's total quarterly audit score 4.5.5.

4.5.3.2.4 Where non-conformances have been raised by an External Auditor against the BS EN 18001:2007 or ISO 14001 Standard, the Contractor shall produce and submit for review within 2 weeks, an action plan of how and within what timescale shall the non-conformance(s) be closed-out.

4.5.3.2.5 Where the corrective action and preventive action identifies new or changed hazards or the need for new or changed controls, the proposed actions shall be taken through the risk assessment process. The associated method statement and risk assessment shall be amended and re-submitted to the Employer's Representative for notice of no objection.

4.5.3.2.5 A change in work methodology shall be communicated to the workforce. Evidence of such communications shall be made available for inspection by the Employer's Representative. The Employer's Representative shall also make random enquiries at site level to establish workforce awareness.

4.5.4 Control of records

4.5.4.1 The Contractor shall maintain all OHS&E records in accordance with the Contactors ISO 9001 Quality Management System.

4.5.4.2 Records shall be made available to the Employer's Representative upon request for the purpose of incident investigation and management review.

4.5.5 Audit

4.5.5.1 Monthly Audit Report (MAR)

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4.5.5.1.1 The Contractor shall undertake an internal monthly audit using the process and audit report form (MAR) as prescribed within OHS&E Volume 2.

4.5.5.1.2 The Contractor shall submit the completed audit report no later than the 7th of each month within the Contractor's monthly OHS&E Report. Failure to submit the monthly audit report within the stipulated timescale shall result in the Employer's Representative awarding a 'Zero' score for the month.

4.5.5.1.3 The audit scores awarded internally by the Contractor shall be subject to review and verification by the Employer's Representative. The Employer's Representative shall substantiate the awarded scores through making comparison with the results of a physical site inspection against the model audit scores criteria as provided within OHS&E Volume 2.

4.5.5.1.4 The Employer's Representative shall formally verify that the Contractor's self awarded scores comply with the audit scoring system and scoring criteria as defined within OHS&E Volume 2. Where discrepancy exists the Employer's Representative shall provide supporting evidence (Photographic) and instruct the Contractor to amend the initial awarded score. Following adjustment, the monthly audit report shall be re-submitted to the Employer's Representative within 3 days.

4.5.5.1.5 The Contractor shall be required to achieve a minimum 65% overall audit score on a monthly basis.

4.5.5.1.6 Monthly audit scores shall be totalled over a 3 month (3 audit results) period. Where the average score for three (3) months of audits is below 65%, then the OHS&E lump sum item in the preliminaries section of Volume 7 pricing shall be withheld.

4.5.5.1.7 If non-payment of the lump sum item in preliminaries occurs as a result of failing to achieve the required 65% over a single quarterly reporting period, the Employer's Representative may reinstate the lump sum item at his discretion should the Contractor achieve above 65% for the following six (6) consecutive monthly OHS&E audits equating to two (2) quarterly reporting periods. This repayment of the lump sum item shall not occur if the quarterly aggregate is less than 50%.

4.5.5.1.8 In the event the Contractor fails to achieve a minimum of 65% on a monthly audit, an action plan shall be submitted together with the audit results detailing the actions that shall be taken within timescales.

4.5.5.1.9 Monthly audits shall be conducted prior to the sitting of the Contractor's Safety Committee and shall form part of the agenda.

4.5.5.2 External OHS&E Audit

4.5.5.2.1 The Contractor is required to conduct external audits as per the BS EN 18001:2007 & ISO 14001:2004 international standards on a quarterly basis throughout the Contract period or until the Contractor achieves accreditation to the standard whereby monitoring timescales shall be instructed by the ISO accrediting body.

4.5.5.2.2 External audit and follow up audit reports shall be submitted to the Employer's Representative for review within 7 days of audit completion.

4.5.5.2.3 Should the Contractor fail to undertake external audits within the 3 month period the Employer's Representative shall appoint an ISO accredited 3rd party agency to conduct the audit at the Contractor's cost.

4.5.5.2.4 Where 'Major' non-conformances with international standards are identified, a follow-up external

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audit shall be carried out within 28 days for closing out of the non-conformance(s). Follow-up audits shall continue on a 28 day rotation until such time as Major non-conformances are closed to the satisfaction of the 3rd Party ISO accredited auditor.

4.6 Management review

4.6.1 Management Reviews shall be undertaken annually by the Employer's Representative in compliance with ISO 9001:2008.

4.6.2 The Management Review Report shall make recommendations for improvement.

4.6.3 The Contractor shall carry out a formal Management Review on an annual basis as a minimum. The Management Review may form part of the review under the organisations Quality Management System.

4.6.4 The Contractor shall submit Management Review Report to the Employer's Representative within 7 days after meeting completion together with the organisations new objectives.

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1.1. General

1.1.1. This is a Lump Sum Price Contract for the Design, Manufacture, Supply, Installation, Testing and Commissioning (including Integrated Testing and Commissioning and Operational Acceptance) for the Traction / Substations (Power Supply System and Overhead Equipment), along with training of personnel and supply of spares.

1.1.2. The Bidder shall quote his Lump Sum Price inclusive of all taxes, duties, levies, cess, insurance, and other charges leviable and payable to the authorities including GST, Custom duty. The Contractor shall be solely responsible for payment of all custom duties, custom clearances, port handling charges, etc., for all imports. The Contractor shall be solely responsible for all statutory clearances, including customs, taxes, levies, transportation etc. required for successful execution of this Contract. The tax breakup submitted in appendix A1 and provisional sum shall be excluded for bid evaluation.

1.1.3. The Bidder shall also give a breakdown of his Lump Sum Price clearly showing the Customs Duty/GST, Cess, etc., along with the applicable rate in the Form attached as Appendix A1.

1.1.4. The successful Bidder shall maintain complete records of duties, taxes, and levies etc payable to various authorities in respect of completely assembled / manufactured plants / equipment and works and submit the receipts / records as and when demanded in writing by the Employer for verification.

1.2. Apportionment of Lump Sum Price to Bid Price Total Summary and to Schedules

1.2.1. The whole of Works including design, are detailed in the Bid Price Total Summary in Appendix A and the Schedule Summaries in Appendix B. Each Schedule is further divided into the various Cost Centers in Appendix D named according to their general scope of work.

1.2.2. The Lump Sum Price for whole of the Works shall be apportioned by the Bidder amongst the Bid Price Total Summary in Appendix A. The apportioned amount amounts are to be priced separately for the Indian Rupee portion and the Foreign Currency portions. The allowable currencies for the prices are as per BDS 19.1

1.3. Pricing

1.3.1 The scope and extent of the Works are to be ascertained by reference to the Contract Documents as a whole and shall not be limited in any manner whatsoever by the descriptions of the Bid Price Total Summary, the Schedule Summaries or the Cost Centers, as given in Appendix D to the Price schedule .

1.3.2 The Bidder is not to enter any sums or amounts in the Appendix D Cost Centers A1.1 to D11.3, which includes predetermined percentages for sub-items which have been inserted by the Employer and which will form the basis of payments. The Bidder is however to utilize Appendix D Cost CentersC1 to C6 – Miscellaneous for the purpose of pricing the relevant Items and is to carry forward the Totals of these Cost Centers to the Bid Price Total Summary.

1.3.3 Cost Center "M" on the Bid Price Total Summary is predetermined to be the Non-recoverable Advance payment amount for Mobilization at 10 % of the Bid Price Total. No interest will be

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charged on the amount of the Advance Payment. The sum total of Cost Centers A1 to C6 will therefore not equate to more than 90% of the Bid Price Total.

1.3.4 The sum of the amounts apportioned to Schedule A1 - General Administrative Cost shall equal 5% of the Bid Price Total.

1.3.5 The sum of the amounts apportioned to System Acceptance Testing and Integrated Testing and Commissioning and Operational Acceptance, as contained in Cost Center is be between 2.5% to 5% of the contract value.

1.3.6 The sum of the amount apportioned for Detailed Design is 5% of the Bid Price Total.

1.3.7 The sum of the amounts apportioned to Schedule C – Miscellaneous, which includes Training, Spares, Maintenance Tools, Operation & Maintenance Manuals, and Comprehensive Maintenance, shall not be less than 5 % of the Bid Price Total.

1.3.8 The sum of the amounts apportioned for Supply, installed and testing and commissioning is 70% of the total contract price excluding cost center B1.

1.4. Bid Price

1.4.1. The Bid Price submitted by the Bidder shall be in the format shown in Appendix A to C of the Price schedule

1.4.2. The Price schedule contains the Bid Price Total, Bid Price Total Summary, Schedule Summaries and Cost Centers.

1.4.3. The Price schedule completed and submitted by the Bidder, as part of his Bid, should use an indexing and page numbering system such that its extent and completeness is clearly evident.

1.5. Currencies

1.5.1. The Bid Price Total, Bid Price Total Summary and Cost Center C shall be indicated in Indian Rupees and the allowable Foreign Currencies. The allowable currencies for the prices are Indian Rupees, Japanese Yen and two other specified Foreign Currencies from an OECD Country.

1.6. Systems Bid Price

1.6.1 The Bid Price shall be for all systems, sub-systems, etc. which fully comply with the Employer's Requirements in Section VI for the Design and Build of (Power Supply System and Overhead Equipment) for the Chennai Metro Rail Project Phase 1 Extension. The Bidder shall quote a Lump Sum Price for the whole of works as mentioned above.

1.7. Description of Schedules

1.8. Cost Centers A1 are dedicated to General Admistrative cost, the following as per the requirements and other details given in the Employer's Requirements, Drawings and Specifications;

a) Initial works programme,
b) Three month rolling programme,

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c) Detailed works programme,
d) Monthly progress report,
e) Software support plan,
f) Back-up copies of the software submission,
g) Interface management plan,
h) Interface matrix and specific contract interface sheets,
i) Project management information system,
j) Contractor's staff organization plan,
k) Project signboard submission,
l) Occupational Safety, Health & Environmental Plan,
m) OHS&E Manual requirements submission,
n) Environmental management plan,
o) Temporary traffic and control plan,
p) Provision, construction, maintenance and removal of the site office(s) for Employer's staff,
q) Procurement Plan,
r) Contractor's manufacturing management plan,
s) Comprehensive testing programme,
t) Installation plan and programme,
u) Method statements,
v) Comprehensive testing and commissioning programme,
w) Test procedures,
x) Inspection and Test Plans,
y) Factory test plans,
z) Partial acceptance test plans,
aa) System acceptance test plans,
bb) Maintenance support plans,
cc) Schedule of spare parts,
dd) All interfacing works within the Project and other interfacing Contractors,
ee) Traction Power simulation study,
ff) AC load flow study,
gg) Preliminary design of the power supply & distribution system,
hh) Preliminary design of ASS equipment layout,
ii) Preliminary design of Overhead Equipments,
jj) Preliminary design of SCADA system in, ASS, OCC
kk) Preliminary design of Emergency Trip System (ETS) for mainline and depot,
ll) Preliminary design of earthing and bonding system
mm) Management and Project team Cost
nn) Project site team cost
oo) Project office Running Cost
pp) Site running Cost

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The Bidders should note that for the following Key Staff; QA Manager, Safety Manager and Chief Interface Coordinator, not employed and on site within 30 days of date of mobilization in accordance with the Contractor's Programme, there shall be a deduction of 2 lakhs for each month, or part thereof, as determined by the Employer, whose decision shall be final and binding.

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APPENDIX TO
PRICE SCHEDULE

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APPENDIX A – BID PRICE TOTAL

The Lump Sum Price of this Bid is:

In Rupees ..... (in figures)……...…..
…….....(in words)
plus …….. (figures) in Japanese Yen …….....…….……
…….....……...(in words)
plus……..figures)in Foreign Currency 1
……....……....……..... ....(in words)
plus …… (figures) in Foreign Currency 2……
…….....……...(in words)

BID TOTAL PRICE SUMAMRY

S no	Description	Indian Rupee (A)	Japanese Yen	Foreign Currency 1 (enter currency)	Foreign Currency 2 (enter currency)	Equvivalent Indian Rupee (As per conversion rate defined)
		(A)	(B)	(C)	(D)	(E)
1	Base Price					
2	Basic Customs Duty		NA	NA	NA	
3	IGST		NA	NA	NA	
4	GST		NA	NA	NA	
Total						
Provisional Sum		4,65,00,000/-.	NA	NA	NA	

Note:Cell 1E of above table only shall be considered for bid evaluation.

BASE PRICE TOTAL SUMMARY : Apportionment of Lump Sum Price among Cost Centres

Cost Center	COST CENTRE DESCRIPTION	Total Apportioned Amounts of Cost Centre Items	Apportionment	Range for apportion

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		Indian Rupees A	**Japanese Yen B**	**Foreign Currency 1 C**	**Foreign Currency 2 D**		
M	Mobilization (Non-recoverable)					**10.0**	**10%**
A1	General Administrative Cost						**2.5%**
A2	Preliminary Design						**2.5%**
B1	Detailed Design						**5%**
B2	Supply, erection, Testing and commissioning of Auxiliary Substations (UG-ASS)						**75%**
B3	Supply, erection, Testing and commissioning of Auxiliary Substations (Elevated ASS)						
B4	Supply, erection, Testing and commissioning of Overhead Equipment and Accessories for Under ground section.						
B5	Supply, erection, Testing and commissioning of Overhead Equipment and Accessories in elevated section						
B6	Supply, erection, Testing and commissioning of Overhead Equipment and Accessories in elevated depot						
B7	Supply, erection, Testing and commissioning of sectioning Post, Sub sectioning post.						
B8	Supply, erection, Testing and commissioning of 33kV cables						
B9	Supply, Factory Testing and Installation Testing of emergency trip ,Control cables for 25kV equipment						

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	and earthing and bonding system						
B10	Supply, erection, Testing and commissioning of SCADA system						
B11	System Acceptance Testing and Integrated Testing and Commissioning and Operational Acceptance					**>2.5% & <5%**	
C1	Operation& Maintenance Manuals					**0.5%**	**5%**
C2	Training of Operation & Maintenance Personnel					**2%**	
C3	Spare					**1.5%**	
C4	Tool					**0.5%**	
C5	Comprehensive Maintenance					**0.5%**	
	Total					**100%**	
D	Provisional Sum	4,65,00,000					

Bidders to show Cost Centres for columns A, B, C and D where appropriate. (Total number of currencies not to exceed four including local currency).

Notes :

1) The sum of the amounts apportioned to Schedule A - General Admistrative & Preliminary cost shall equal 5% of the Bid Price Total.
2) The sum of the amounts apportioned to Schedule B (B2-B11)–Phase 1 Extension shall be 75% of the Bid Price Total and schedule B1 to 5%.
3) The sum of the amounts apportioned to System Acceptance Testing and Integrated Testing and Commissioning and Operational Acceptance shall be 2.5% to 5% of the Contract value.
4) The sum of the amounts apportioned to Schedule C – Miscellaneous, which includes Training, Spares, Maintenance Tools, Operation & Maintenance Manuals and Comprehensive Maintenance, shall not be less than 5% of the Bid Price Total.
5) The Bid Price total amount at the beginning of this Appendix shall be equalt to sum of each cost center filled in column below it including taxes & duties entersed in Appendix A1 but excluding provisional sum. If there are discrepancies between the Bid Price Total amount filled up at the beginning of this Appendix and the column total and taxes & duties for the respective currencies in the Bid Price Total Summary, the column totals will be taken as the

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Bid Price Total amount, for all purposes.

6) If the Column total contains an arithmetic error, it will be corrected by taking the individual figures as correct, for all purposes.
7) For the purpose of Bid Evaluation, the amounts mentioned above, other than Indian Rupees, will be converted to Indian Rupees by using the Bill Selling rates of exchange for those currencies at the close of business of the Reserve Bank of India on the last working day 28 days before the date for submission of bids.
8) The Apportioned amounts for the Cost Centers in the Bid Price Total Summary to be filled in by the Bidders are for the purposes of evaluation only. The actual payments for the delivery of the Facilities and other items of work/ services will be made as per the details Terms and Procedures of Payment.
9) Cost Center "M" is predetermined to be the Non-recoverable Advance payment amount for Mobilization at 10% of the Bid Price Total. The sum total of Cost Centers A1 to C 5 will therefore not equate to more than 90% of the Bid Price Total.
10) GSt of current bill shall be paid based on the GST invoice submission subjected to submission of previous GST paid proof along wit auditor certificate.
11) Provisional sum shall be over and above the bidders price quoted. i.e the bidder shall not quote for the cost center D. Consideration of the cost center D for financial evaluation shall be as per ITB 38.2 (a). Provisonal sum shall be operated for additional works subjected to employer's approval.

AUTHORISED SIGNATURE OF BIDDER WITH COMPANY SEAL

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Appendix A1- Details of Taxes and Duties included in Bid Total price

Schedule	Taxes. Duties & other levy								Total Amount 5=sum 1 to 4
	Basic Custom Duty (*)		IGST(**)		GST		BOCW		
	1		2		3		4		
	%	Amount	%	Amount	%	Amount	%	Amount	
A									
B									
C									
Total									

*** Custom Duty for fully imported items as sold to CMRL. CMRL import/export code of CMRL to avail concessional Custom Duty**

**** IGST for fully imported items as sold to CMRL. This shall include Custom Duty (BCD + IGS INCLUDING social welfare surcharge & GST cess.**

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Notes:

- **The bidder to give in his offer breakdown of his lump sum price clearly giving the following:**
  (a) Customs Duty in India on off-shore manufactured planyt and equipment. If any, along with rate of Custom Duty after considering the concessional rate of basic Customs Duty available under Project Import Scheme. Customs Duty on imported components are parts which go into manufacturing of Plant & Equipment in India will **NOT** be menitoned in this table. These rates will be subject to the concessional Duty benefit, as mentioned as per existing laws.
  (b) Custom Duty on imported spare, fixtures, special tools and diognastic equipments and etc along with the rate of custom Duty.
  (c) GST on the completely assembled/manufactured plant and equipment.
  (d) GST for indiginious finished spare/fixutes, special tools and testing & diagnostic equipments along with rate.
  (e) BOCW along with applicable rate

- **For evaluation of the bid, the componen of all the above taxes & duty would not be considered**
- **The bidders shall note that the Customs Duty, GST, levies etc indicated in the above table are considered to be inclided in the lumpsum bid price total and will be reimbursed by the employer, by the method indicated on point no 10 of attachement A of Bid Price total subject to the celling of the amounts indicated in this table. All taxes mentioned here shall be in Indian Rupees only.**

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