SECTION A

GENERAL REQUIREMENTS ELECTRICAL

INDEX

SECTION	DESCRIPTION	
A	TECHNICAL SPECIFICATONS – ELETRICAL SYSTEM	
	GENERAL	
	1	SUMMARY
	2	INSTRUCTION TO CONTRACTOR
	3	SCOPE OF PLUMBING SYSTEM CONTRACTOR
	4	SUBMISSIONS
	5	MAINTENANCE
	6	QUALITY ASSURANCE
	7	DELIVERY, STORAGE & HANDLING
	8	COORDINATION
	9	INSPECTION, TESTING AND COMMISSIONING.
	10	REFERENCE

1 SUMMARY

A. Project is a Hi-end mixed used project coming up at Mumbai. The site is spread over an area of
   1. Location : Mumbai
   2. Elevation above Sea Level : Less than 60 meters
   3. Maximum DBT with corresponding WBT : 35.3 ºC/22.8 ºC
   4. Minimum DBT with corresponding WBT : 16.5 ºC/13.9 ºC
   5. Design temperature for electrical equipment/devices : 40 ºC
   6. Relative Humidity: Monsoon- 90% , December to January-63 to 71%
   7. Air quality: Atmosphere generally hot, humid, dusty, polluted conducive to dust and fungus growth.
   8. Earthquake Factor : Zone III as per IS:1893
   9. AC Voltage : Voltage variations ± 10%, Frequency variation ± 3%

   The Intended Usage of the space is as residential complex.

B. Electrical Supply
   1. Three phase electric supply will be 415 V, 50 Hz, 4 wires.
   2. Single phase electric supply will be 230 V, 50 Hz, 3 wires.
   3. TN-S type of earthing is to be provided throughout.

C. The entire works which is part of this contract shall be completed in all respects and handed over in line with the employers programme.

D. The Electrical System must comply with the standard acceptable authority requirements, State PWD, NEC2011, IEC References, BIS References, CPWD Norms, NFPA References, NBC2005, IPC, Local Municipal Authorities, MOEF guidelines and subject to approval by the Employers Representatives.

E. The entire work shall be carried out in a manner consistent with good engineering practice. The Contractor shall take into account all site conditions including space allocation for Electrical System while designing the system and selecting the equipment.

F. The Contractor shall be responsible for engaging a qualified, competent and experienced Electrical System staff to perform the system design verification, preparation and submission of system proposal, obtaining approvals from relevant authorities and site supervision for installation, testing and commissioning.

G. The Contractor shall perform the system design verification based on the criteria / data and technical requirements specified in this section / drawings and the local Authorities regulations / requirements.

H. The Contractor shall provide systems which comprises products of manufacturers who have designed, developed and used these products successfully for a period of at least five years.

I. The Contractor shall submit catalogue information, design calculations and samples complete with full technical data and shop drawings for the entire system, test certificates, etc. and any other information required by the Employer's Representative for acceptance prior to commencement of installation.

J. The Contractor shall submit analytical test reports for the Electrical Systems wherever applicable after the commissioning or after the system is put into operation or as required by the Employer's Representative. The result should comply with local authority requirements

2 INSTRUCTION TO CONTRACTOR

A. The Bidder / Tenderer shall furnish all the information called for in the all the sections of this contract, failing which the bid will be treated as incomplete and the Employer's Representative reserves the right to reject the bid. The Contractor is advised to fill information strictly in the format enclosed.

B. The Bidder / Tenderer shall carefully study all sections and drawings enclosed (if any) with specification and indicate deviations in the relevant Sections of the Specification. If no deviations are stated it will be assumed that the offer conforms in all respects to the specification and the Employer's Representative reserves the right to evaluate the Bid as such without further reference to the Contractor.

C. The Bidder / Tenderer is also advised to have discussion with Employer's Representative before preparing the Bid and bring out clearly in the Bid any discrepancies found in the tender package or any items which in his opinion have not been included in the tender package but is required for the completion of the project. Bidders/Tenderer are instructed through this documents to include all such items separately in the BOQ. If such items are not highlighted in Pre Bid techno/commercial meetings and thereafter in the BOQ then all such works are deemed included in the scope of the vendor.

D. The Bidder / Tenderer must obtain for himself on his own responsibility and at his own expense all the information's which may be necessary for the purpose of making a tender and for entering it into a contract and must examine the drawings, inspect the site of the work and acquaint himself with all local conditions means of access to the work, nature of the work and all matters appertaining thereto.

E. Time allowed for carrying out the work as mentioned in the Memorandum shall be strictly observed by the Contractor and it shall be reckoned from the day written order to commence the work is issued. The work shall proceed with all due diligence, if the contractor fails to complete the work within the specified period he shall be liable to pay a penalty as defined in the General Conditions of Contract. The Contractor shall before commencing work prepare a detailed work programme which shall be approved by the Employer's Representative.

F. Each Bidder shall submit in his bid a list of large works of a like nature he has executed giving details as to their magnitude and cost, the proportion of work done by the Bidder in it and the time within which the works were completed, the Bidder shall also submit along with his bid a list of long lead items & his procurement strategy.

G. The successful Bidder is bound to carry out any item of work necessary for the completion of the job even though such items are not included in the quantities and rates. Schedule of instructions in respect of such additional items and their quantities will be issued in writing by the Consultants with the prior consent in writing to the Employer's Representative.

3 SCOPE OF ELECTRICAL SYSTEM CONTRACTOR

A. Technical specifications, bill of quantities, Tender drawings and all the other sections enclosed here in cover the design verification as required, preparation of shop drawing and required calculations, selection, manufacture, handling at site, supply, installation, testing, commissioning and handing over of completely operational HT/LT Electrical System for Lodha, Mumbai.

B. Works to be carried out under this Contract includes BOQ verification as per drawings & highlighting any discrepancy before submission of tender, the preparation of shop drawing, selection, manufacture, supply, installation, testing and commissioning of the Electrical System and associated installation to comply with the requirements from any authorities having jurisdiction over the said system and installation and the requirements on performance, materials and equipment as stipulated in the Technical Specifications.

C. Contractor's equipment layout must comply with the space allocated for the same and as allocated in the Tender drawings. The Contractor's proposals shall work under the space/area limitations shown on the drawings for compliance. Contractor shall also note the limitation of equipment access as shown on the drawings and shall ensure that all equipment can be safely transferred to the planned space. The Contractor shall include in his scope if necessary the work for dismantling and reassembly / assembly of the equipment to accommodate any access restriction.

D. All Electrical infrastructure past the utility revenue meters shall be provided for under this contract (Refer Schematic for clarity of scope, however coordination and assistance shall be part of scope of work of Electrical contractor)

1. Supply, Installation, testing and commissioning of HT cables upto Transformer including termination under this contract (Refer scope statement/work order/ Schematic for more clarity of battery limit of internal / external relevant works)
2. SITC of HT Switch Gears (Refer scope statement/work order/ Schematic for more clarity of battery limit of internal / external relevant works)
3. SITC of Battery & Battery charging system(Refer scope statement/work order/ Schematic for more clarity of battery limit of internal / external relevant works)
4. SITC of Transformers(Refer scope statement/work order/ Schematic for more clarity of battery limit of internal / external relevant works)

5. SITC of DG Set
6. SIT of Acoustic Enclosing System
7. Supply, installation, testing and commissioning of local check meters within the installation to monitor various parameters under both mains and generator usage,
8. All cable containment (conduits, tray, basket, ladder etc) installed under these works shall be deemed to be provided for under the Electrical Contract,
9. Supply, installation, termination and testing of a complete Lighting control system (Client will free issue all luminaries to the Contractor, the Contractor is responsible for the safe keeping, installation, termination and testing of the luminaries themselves).
10. Supply, installation, termination and testing of a complete Emergency Lighting system,
11. Supply, installation termination and testing of a complete Lightning Protection system incorporating the building reinforced concrete as natural down conductors,
12. Supply, installation termination and testing of a complete Earthing system terminating in earth electrodes located around the building perimeter. Due to anticipated high soil resistivity on site additional soil treatment to lower soil resistivity will be provided under this contract.
13. Supply, Install, testing & commissioning of IT & data system cabling work inside the apartment unit, Television cabling work inside the apartment unit.

E. Clearing away rubbish. Tools, Tackles, Scaffolding including the provision, maintenance and removal of any special scaffolding as required.Unloading, distribution and placing in position all plant, machinery, etc.

F. Coordination of the other services/trades entering in your work front.

G. Cutting chases for sleeves, containment and the like in walls, floors, partitions etc (except on structural members) and the like and subsequent making good. Cutting or forming holes for pipes, ducts and the like through walls, floors, partitions, roofs and the like (except Structural members), subsequent making good and providing sleeves and/or sub-frames as required.

H. Pinning ends of supports for containment, equipment, appliances, fittings and the like to wall, floors, partitions, soffits etc and making good. Leaving mortises, sinking and the like for holding down bolts, brackets, supports and the like and grouting in. Filling around, boring holes through and making good of finishing up to pipes, supports, brackets and the like.

I. Application of Paint on exposed containment, fittings, equipment and the similar items with Rust proof paint.

J. Co-ordination and connection of the lighting protection systems air termination network to the buildings concrete embedded down conductor network to the earth termination network.

K. All equipotential / supplementary bonding of buildings exposed metalwork to earthing system will be in the scope of the contractor.

L. The contractor must bear in mind that all the work shall be carried out strictly in accordance with the approved specifications and approved working drawings as instructed by the Employer's Representative and also in compliance with the local public authorities and to the requirements of any acts, rules and regulations. No deviation on any account will be permitted.

M. Providing all necessary documentations/calculations, etc as required to furnish submission for the local authority approval for all the Electrical Scope of Works defined under the particular contracts. All works associated to provide assistance to Lodha shall be deemed included in the scope of Electrical Contractors.

N. Electrical works from and including control panel, inside the Electrical system plant room.

O. It is the intent to specify completely herein all details of design and construction of system/ plant/ equipment to be supplied / erected. However the system/ plant/ equipment supplied shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous operation in a manner acceptable to the employers Representative who will interpret the meaning of drawings and specifications and shall have the power to reject any work or material which in his judgement are not in full accordance therewith.

P. The entire works which is part of this contract shall be completed in all respects and handed over in line with the employers programme.

Q. The scope of works listed below shall not be considered as comprehensive description of the Contract, but only as an indication of the extent of works.

R. Provision of Design Verification, detailed calculations (viz., voltage drop calculations, selection of APFC, DG sizing, Cable Sizing, Short Circuit Current calculation, etc.,), selection of equipments, preparation of overall co-ordinated drawings of all trades, working drawings, builders' work drawings, supply, installation, testing, commissioning and handing over for the complete Electrical System to the client's/project requirement as stipulated in this specification and local government authority shall be in the contractor's scope.

S. After hours testing of plant shall be provided as required under given conditions.

T. Testing and commissioning of installation under normal operational conditions shall be conducted. The tests should be Factory Acceptance Test(as required), Functional Test, Routine Test, Installation tests, Integrated System testing but should not be limited to above and should include tests as required for special equipments. All tests should be non destructive type tests. Contractors are instructed to list down any/all deviations with regard to testing and commissioning requirements listed/required in tender documents or as required for system functioning.

U. For HVAC, Fire Protection and Plumbing systems the electrical works demarcation shall be as described on the Contract drawings.

V. Priming and finishing coats painting as per the standards and listed else where in the tender/contract documents. All galvanised surfaces which are cut at site should be cleaned and reapplied with cold zinc paint viz galvaroid,etc

W. As-built drawings and operation / maintenance manual as detailed elsewhere in the specification shall be provided.

X. Where containment/electrical services passes through the fire rated partitions/walls, the space around /within the containment shall be fire sealed. Seal the gaps between containment sleeves and containment / conduit, etc. if any.

Y. Warranty and maintenance service for the period as specified in GCC, SCC from the date of handover of the works shall be included in the offer.

Z. Fire stopping shall be provide; wherever the services are crossing he floor slab, shafts, fire rated walls.

AA. OTHER ASSOCIATED WORKS

1. ASSOCIATED CIVIL WORK

a) Following civil works associated with Electrical installation are excluded from the scope of this contract except for all minor civil work like wall chasing by wall chaser, making holes etc. for installation of conduits/cables and making good.

b) Floor/ wall cut-outs inside Electrical / Panel room or wherever required.

c) Fire doors of minimum 2 hours fire rated as per local codes for Electrical/HT- LT panel rooms.

d) Electrical supply to work front during construction.

e) False ceiling work as shown on the Employer's Representative drawings.

f) Foundation for Transformers & DG sets

2. HVAC SYSTEM

1. For Ventilation, power cable along with earthing up to PLC/MCC panels shall be in the scope of Electrical contractor. Supply, Installation, testing and commissioning along with termination of MCC/PLC panel and further power cabling and earthing from panel up to equipment by HVAC contractor.

3. PLUMBING & DRAINAGE SYSTEM

1. Terminating power and earthing up to MCC panel for Pumps shall be in the scope of Electrical contractor. Supply of MCC, further power cabling and earthing from MCC panel up to equipment by Plumbing Contractor.

4. FIRE FIGHTING SYSTEM

1. Termination of power and earthing at the incoming MCCB of fire fighting MCC panel in the scope of Electrical contractor. Supply of fire MCC panel and further cabling and earthing from panel up to pump by Fire Fighting system Contractor.

5. ELEVATOR SYSTEM

1. Supply of TPN isolator panel including cabling and earthing near elevator machine in the scope of Electrical contractor. Further power cabling and earthing from isolator to the Lift machine, Car Light, Car fan, Lift shaft light and power by Elevator Contractor. Containment for lift intercom from lift shaft to the central IBMS room/designated location by Electrical contractor, all cabling/system device by Lift contractor.

6. FACADE CLEANING

1. Cabling, earthing up to Facade cleaning panel by Electrical Contractor. Further distribution by respective Contractor.

7. ELV SYSTEM

1. Supply of sockets and termination of UPS power/ earthing connection by Electrical Contractor.
2. All conduiting/cable trays/containment and earthing by Electrical contractor. Inside flat all cable containment and Cat 5e/RG6/RG11/Telephone cabling to the designated points as shown on drawings.

8. SECURITY & IBS SYSTEMS

1. Supply of sockets and termination of UPS power/ earthing connection plus associated provision of conduits and containment by the Electrical Contractor.

9. FIRE ALARM / VOICE ALARM

1. Provision of emergency power outlets, conduits and containment, equipotential earthing for installation of the FA/VA system and any tie-ins to the building earthing system by Electrical Contractor.

10. FIBRE TO THE HOME (FTTH)

1. Provision of power outlets, earthing, conduits and containment to support the FTTH system only by Electrical Contractor.

11. BUILDING MAINTENANCE UNIT (BMU)

1. Provision of sub-main cabling, earthing and containment to support the BMU by the Contractor plus cross bonding the BMU rails with the buildings lightning protection system.

4 SUMBISSIONS

A. TENDER STAGE

1. All tenderer shall furnish stamped and signed copy of tender documents. In cases wherein bidder/tenderer wishes to optimize cost on paper works it is earnestly required that contractor should submit letter stating the tender compliance and deviations as listed below on company letter head with duly signed by authorised person.
2. Deviations from this specification are only acceptable where the Contractor has listed in his quotation the requirements he cannot or does not wish to comply with proper engineering

justification and alternative system/proposal and the Employers Representative's have accepted, in writing, the deviations before the order is placed. If the Contractor is also to offer alternatives resulting in technical or price advantages he should submit a supplement to the main tender with detailed engineering justification and calculations together with detailed BOQ for review and approval. In cases wherein BOQ is not availed or items are not listed in detailed by bidder it is deemed included in the scope of works on contract award for SITC of the system without any cost variation at a later date to the contract and same shall remain rejected.

3. In the absence of a list of deviations, it will be assumed by the Employers Representative's that the Contractor complies with this specification and design intent with strict compliance to the listed codes. In cases wherein contractor proposes system with upgraded codes it is responsibility of the contractor to included the same as a proposal in the tender submission.
4. The Contractor shall furnish all the information called for in the relevant sections attached with the tender, failing which the bid will be treated as incomplete and the Employer's Representative reserves the right to reject the bid. The Contractor is advised to fill information strictly in the format enclosed.
5. Preliminary design drawings including system schematic and layout plans showing the arrangement of the Electrical System to demonstrate adequacy of the allocated plant space and all being accommodated within the given architectural and structural constraints.
6. Preliminary design calculations if required/in case of any deviations for engineering justifications and approval.
7. Proposed equipment schedule showing capacities and rating required with the corresponding selection of manufacturer, model, types, etc. Relevant technical catalogues shall also be submitted with relevant sections clearly highlighted. In all cases compliance certificates to be provided.
8. Previous local job reference for major plant and equipment for the last 5 years
9. Contractor shall confirm in writing that the design on which this tender is prepared has been verified by them Contractor shall confirm that the design is verified by them and is good enough to maintain the specified design condition as per specifications and drawings.
10. Contractor shall also confirm that in their opinion the design is economical and safe and they have nothing to suggest either by way of effecting further economy or providing additional safety or better performance
11. Tenderer shall confirm that the space provided for various equipment in the tender drawings is adequate to install and maintain all the equipments.
12. If the spaces provided in the tender drawings are inadequate to install the Tenderer's equipment, it shall be clearly indicated in the tender itself.

B. AFTER AWARD OF CONTRACT

Within 7 days of acceptance or as specified in GCC/SCC of the tender the contractor shall submit for approval:

1. Construction schedule with WBS based on the Lodha baseline project schedule
2. Shop Drawing Submittal schedule.
3. Material Submittal Schedule.
4. Procurement Schedule.
5. Method statement submittal schedule.
6. Inspection Test Plan Schedule.
7. Logistic plan.
8. Schedule of manufacturers for all major equipment, devices & installation, etc or as required by Employers Representative's
9. Resource allocation schedule,

10. Project Staff Organisation Chart (Engineering, Quality and Execution) together with CV.
11. Contractor's Representatives
    1. The Contractor shall employ qualified representatives on full time basis (and shall be available at site) whose name shall have previously been communicated in writing to the Employer's Representative and approved by them to supervise the execution. Any written order or instruction given to the representative shall be deemed to have been given to the Contractor.
    2. The Employer's Representative shall be at liberty to object to any particular representative or any persons employed by the Contractor on the work and the Contractor shall remove the person objected to, on receipt from the Employers Representative's, in writing, a request requiring him to do so. The Contractor shall provide in his place another competent representative acceptable to the Employer's Representative.

C. CONTRACT STAGE:

These submissions shall among other things include the following major items:-

1. Shall make all the necessary submission at such appropriate times to suit the works programme of the Project.
2. Provide builders work documentation (schedules and drawings) as per schedule listed in construction programme of works. This may require detailed site survey work – before installation, - to ascertain the exact conditions on site, any claims arising from this exercise not being undertaken will not be entertained by the Employers Representative's.
3. Submit the documentation to, and obtain approval from, the Employers Representative's before any structural work requiring holes or other modification is executed.
4. Where appropriate, mark on site the actual locations of the following:
    1. Holes through walls, partitions, floors, etc.,
    2. Chases in walls, floors, etc.
    3. Pockets cast in concrete.
    4. Inserts and any built in sleeves or similar items
5. Holes may not be cut in steelwork, reinforced or precast concrete without written permission from the Employers Representative's.
6. Builder work drawings with detailed setting-out and dimensions showing requirements for all water tanks, pits, plinth, support, structural and non structural openings etc. These shall be submitted within 15 days after award of the Contract. (Or As Mentioned in GCC& SCC)
7. System shop drawings with representation of approved material submittal.
8. Co-ordinated services drawings
9. Detailed system schematic diagram.
10. Detailed layout plans for the Electrical Systems.
11. Installation details
12. Wiring diagram including power installation for motor control centre, control schematic, etc.
13. Equipment and material submittals and schedule.
14. Detailed design calculations.
15. Necessary drawings and documents for submission to the local authorities for approval.
16. Establish a method of installation with the Employers Representative's to ensure the works proceed without hindrance and produce method statements as requested.
17. Shipping of equipments shall suit to the site conditions. Contractor shall include all such requirements in the scope of works of self. As per site condition equipments equipment can

be shipped in single unit/knocked down stage where contractor to adhere with the warranty clause of the contract and same shall be availed in writing during submission.

18. Provide special project warranty, signed by vendors/suppliers, agreeing to replace, repair, or restore defective materials and workmanship of work for a period as per warranty time clause stated under contract GCC/SCC after successful commissioning. Warranty to be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.
19. Defective Equipment: Is defined to include, but not by way of limitation, operation or control system failures, performances below specified ratings, excessive wear, unusual deterioration or aging of materials or finishes, unsafe conditions, the need for excessive maintenance, abnormal noise or vibration, and similar unusual, unexpected, and unsatisfactory conditions.
20. Provide coincidental product warranties where available for major components and Submit with maintenance manuals.
21. As-fitted drawings and O&M Manuals.

D. DRAWINGS AND LITERATURE

1. List of Equipment/ Materials:
2. The Following submittals shall be included with the tenders. Failure to provide the required information may cause rejection of the tender. Detailed equipment list, identifying types, models, and all materials & equipment proposed. This submittal shall include manufacturer's data sheets showing the types and models of all equipment and materials. The submittals shall be in the format given in relevant sections of tender documents.
3. When a data sheet shows more than one make, the proposed make shall be clearly indicated by arrows or other suitable means.
4. The data shall be submitted in a ring binder, indexed by product.
5. The data shall not include superfluous cut sheets (i.e. unedited manufacturer's catalogues are not acceptable).
6. Origin of material / components to be included.
7. Shop Drawings / Technical Data:
    1. After the award of work, the Contractor shall submit shop drawings including Builders Work Drawings and technical data for approval. Shop drawings and technical submittals shall include sufficient data to indicate complete compliance with Specification, Contract Documents and System Requirements. Submissions shall be in the form of drawings, brochures, catalogues and/or narrative descriptions with certified standards.
    2. Tender Drawings have been prepared by the Architects/Consultants/Employer's Representative showing the equipment and Electrical system layouts and the space allocated for Plant/ Equipment.
    3. The tender drawings represent the design intent and a feasible scheme / layout that may be re-arranged in the space allocated during the shop drawing preparation subjected to prior approval by the Architects / Consultants / Employer's Representative before the actual shop drawing and execution.
    4. Within 15 days of the award of Contract (Or As Mentioned in GCC/SCC) the Contractor shall submit for approval, Technical submittals for equipment/ System/ Plant including detailed selection chart, performance curves and calculation marking the selection of all equipment, general layout, Equipment submittals, assembly drawings and such additional assembly and sub-assembly detailed drawings as are necessary to demonstrate fully that all parts of the apparatus to be furnished conform to the specifications.
    5. Four sets of all catalogues (at least one set original) for all equipment, accessories and materials shall be submitted to the Employer's Representative for approval.
    6. Within 10 days of the award of contract(Or as mentioned in GCC/SCC), the Contractor shall furnish Eight (8) prints and soft copy of the equipment layouts, containment layouts, riser layouts, SLDs and assembly and erection drawings etc for approval. If modifications

are proposed by the Employers Representative's, three (3) further prints of the modified drawings shall be submitted. Modifications shall be only made in the drawing after it has been approved by the Employers Representative's with their prior consent. All drawings necessary for assembly, erection, maintenance, repair and operation of the system /equipment/ materials shall be furnished. Scale for the shop drawings shall be minimum 1:100 for the plans and 1:50 for sections. All plans should be provided with adequate sections at critical locations.

7. After the award of work, all changes in architectural, structural, interior design, facilities planning or any decision of Employer's Representative causes redesign of the system, the contractor shall carry out the same in shop drawings / calculations and get approval from the Employer's Representative. The Employer's Representative will advise / guide the Contractor to carry out such changes but will not provide any drawing further to the tender drawings, issued with these documents.
8. Approval by the Employer's Representative of the Technical Submittals and drawings shall not relieve the contractor of any part of his obligation to meet all the requirements of the Contract or of the correctness of his drawings. The Contractor shall be responsible for and pay for all alterations of the works due to discrepancies or omissions in the drawings or other particulars supplied by him, whether such drawings have been approved by the Employers Representative's/ or not.

8. Contractor shall furnish and install in or near all the machine rooms the following:
   1. A neatly typed/ stencilled set of operating and maintenance instructions for the relevant equipment.
   2. Neatly drawn and well presented schematic diagrams for all the systems viz. LV SLD, wiring diagrams, DB schedules etc. All the drawings shall be glazed and securely framed at convenient locations within the machine room.
   3. Samples of materials/fabrications shall be submitted for approval to the Employer's Representative as required or called for by the Employer's Representative before installation.
9. As-Built Drawings:
   1. A separate set of approved shop drawings corrected to indicate the as-built conditions shall be kept at the site. These drawings shall be maintained in a current condition at all times and shall be made available for review upon request. All variations from the approved shop drawings, for whatever reason, including those occasioned by modifications, change orders, optional materials and/or required coordination between other Contractors shall be indicated in sufficient detail to accurately reflect the as-built conditions.
   2. Upon completion of the work, before final payment, one complete Mylar set and two additional blue-line sets of as-built drawings shall be submitted for approval, which shall include plans, sections, specific details, schematic diagrams, riser diagrams, control diagrams and any other drawing as directed by the Employers Representative's.
   3. Contractor shall submit as-built drawings on CD-ROM in addition to the above. All drawings shall be made on the latest version of authentic Auto CAD.
10. Quality Control Submittals:
    1. Proof of compliance to applicable codes and standards.
    2. Final commissioning and testing reports.
11. Operation and Maintenance (O & M) Manuals :
    1. Submit two (2) draft copies of O & M manuals for review. After review by Employer's Representative, the Contractor shall incorporate review comments and submit Six (6) final copies together with soft copies of all the contents of O&M manuals in CD- 6copies.
    2. During guarantee period, the Contractor shall update the manuals with modifications made to system, providing replacement pages or supplements in quantity stated above.
    3. O & M manuals shall be assembled into multi-volume sets as necessary and required by the Employers Representative's.

4. Each volume shall be protected with a heavy duty vinyl plastic binder. Volumes shall have plastic printed dividers between major sections and shall have oversized binders to accommodate up to 20 mm thick set of additional information.
5. Each binder shall be silk screened with project name and volume title on front cover and binder.
6. First page of each manual shall be identified with project name, manual title, Employer's Representative name address and service phone number and person who prepared the manual.
7. Operating and maintenance Manual shall serve as training and reference manual for all aspects of day-to-day operation of the system, such as:
   a. Technical descriptions of each system.
   b. Step by step direction.
   c. Provision of alarms and their sequences.
   d. Do's and Don'ts in operation.
   e. Fault location and remedy chart.
   f. Operation Instructions (full operating information to be attached).
   g. Recommended maintenance schedule.
   h. Parts List.
   i. Schedule of spares.
   j. 24/7 Emergency Contact Numbers and Names against each system.
   k. Full Warranty Information
   l. Modification Instructions
   m. Disposal Instructions.
   n. Not included above however required to complete the installation as per the Tender Documents.

E. TESTING & COMMISSIONING STAGE:

1. All equipment and the whole system shall be tested as required by the various sections of the specifications and test data as required shall be furnished.
2. Routine tests for the various items of equipment shall be performed at the Contractor's works and relevant test certificates to be furnished. If required by the Employer's Representative, the Contractor shall permit the Employer's Representative to be present during any of the tests. After notification of the Employer's Representative that installation has been virtually completed, the Contractor shall conduct under the direction and in the presence of the Employers Representative's, such tests and inspection as have been specified or as the Employer's Representative shall consider necessary to determine whether or not the full intent of the Requirements of the drawings and specifications have been fulfilled. In case the work does not meet the full intent of the specifications and further tests considered necessary, the Contractor shall conduct such tests and bear the expenses thereof.
3. The Contractor shall operate, test and adjust all lighting, switchgear, RCDs, power systems and other electrical equipment provided in connection with this installation and shall make all necessary adjustments and corrections to establish the specified system / equipment capacity at given designed condition.
4. All cabling shall be tested and visually checked to ensure outer sheeting is not damaged, that the cabling is properly supported and not under stress.
5. All equipment and systems shall be tested after installation and test readings submitted as specified.
6. Any/all equipments, devices, material, systems and installation not complying to the testing requirements should be replaced by contractors at their own cost.
7. Detailed commissioning report to be prepared and furnished by Contractor to the Employer's Representative for approval during handing over.

NOTE: No drawings / submittals will be accepted for examination by the Employer's Representative unless entirely complete, first checked and approved by the Contractor.

F. REJECTION OF DEFECTIVE EQUIPMENT

A. If the completed system installation or any portion thereof, before it is taken over or during the guarantee and defects liability period, is found to be defective or fails to fulfil the intent of these specifications, the Contractor shall on receipt of notice from the Employer's Representative forthwith dismantle and replace the defective equipment/ material/ system installations.

B. Should he fail to do so within 15 days (or as noted in the GCC or SCC) of notification by the Employers Representative's, the Employer's Representative may reject and replace at the risk and expense of the Contractor, the whole or any portion of the equipment/ material/ system installations found defective or that fails to fulfil the requirements of the Contract.

C. The Employer's Representative shall have the right to operate all equipment or systems whether or not such equipment or system have been accepted as complete and satisfactory. Repairs and alterations shall be made at such times and as directed by the Employers Representative's.

G. SAFETY CODE

A. There shall be maintained in a readily accessible place first-aid appliances including adequate supply of sterilized dressing and cotton wool.

B. The injured person shall be taken to a public hospital without loss of time.

C. Suitable and strong scaffolds should be provided for workmen for all works that cannot be done safely from the ground.

D. No portable single ladder shall be over 8 metres in length. The width between the side rails shall not be less than 30 cm (clear) and the distance between the two adjacent rungs shall not be more than 30 cm. When a ladder is used an extra mazdoor (labour) shall be engaged for holding the ladder.

E. Every opening in a floor of a building or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be one metre.

F. No floor, roof or other part of the structure shall be as over-loaded with debris or materials as to render it unsafe.

G. Protective gear such as safety helmets, boots, belts, etc. shall be provided by the Contractor at his own cost to all his manpower at site. The Contractor shall impose such requirements on all Sub-Contractors also. It shall be the responsibility of the Contractor to ensure that such protective gear is worn at all times by all personnel working at site. The Employers Representative shall have the right to stop any person not wearing such protective gear from working on the site.

H. Those engaged in welding works shall be provided with welder's protective eye-shields and gloves. Fire extinguishers must be provided during welding at all times. The Contractor shall employ a welding permit system and shall co-ordinate their works with all relevant parties.

I. The Contractor shall employ a power on permit system along with a lock and tag system. All areas / systems being made live shall be done only after notification of all relevant parties and operatives and after the earthing system has been properly implemented.

J. No paint containing lead or lead products shall be used except in the form of paste or readymade paint.

K. Suitable facemasks should be supplied for use by the workers when the paint is applied in the form of spray or surface having lead paint dry rubbed and scrapped.

L. Overalls shall be supplied by the Contractor to the painters and adequate facilities shall be provided to enable the working painters to wash during the cessation of work.

M. In case the Contractor fails to make arrangements and provide necessary facilities as aforesaid, the Employer's Representative shall be entitled to do so and recover the costs thereof from the Contractor. The decision of the Employer's Representative in this regard shall be final and binding on the Contractor.

N. Use of hoisting machines and tackle including their attachments, anchorage and supports shall be in perfect condition.

O. The ropes used in hoisting or lowering material or as a means of suspension shall be durable and in perfect condition.

P. All electrical connections for construction activity shall be taken through proper receptacles only. No loose wire connections shall be allowed.

H. CONTRACTOR AGREEMENT –

A. The Contractor shall be responsible to read and agree the scope of work as detailed in SOW, GCC & SCC documents.

I. CEA (MEASURES RELATING TO SAFETY AND ELECTRIC SUPPLY) REGULATIONS, 2010

A. Pursuant to CEA (Measures relating to Safety and Electric Supply) Regulations, 2010 the contractor shall appoint a designed electrical safety officer who shall be responsible for observance of the safety provisions laid out under this act and for ensuring inspection and testing of their works.

B. Safety signage in accordance with Section 18 “Danger Notices “of the CEA shall be provided by the Contractor.

C. All Electrical works undertaken under this contract shall be via an Electrical Contractor licensed by the state government. Staff shall hold certificates of competency recognised by the State Government.

D. The Contractor shall provide two distinct and separate earth connections for all their equipment back to its respective switchboard.

E. Interlocking of suppliers shall comply with Section 45 of the CEA.

F. The Contractor shall ensure such testing is carried out and records maintained – in line with CEA Section 46 – to satisfy the Utility and Chief Electrical Inspectors requirements.

J. GENERAL REQUIREMENTS

A. Ensure all equipment and systems are to provide electromagnetic compatibility within the systems and with any other systems installed in the same location.

B. The Contractor shall install systems strictly in line with manufacturers recommendations and shall ensure all works are in line with recommended EMC mitigation measures in IEC 61000-5 (Installation and mitigation guidelines).

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

D. Harmonic data to be provided by the Contractor for each piece of harmonic generating equipment. This data will list:

- Equipment Name
- Manufacturers reference
- Contract document reference
- Power Factor of complete unit
- Input current
- Power Requirements
- Balanced load (Y/N)
- Details of inverter (if applicable)
- Harmonic data listing **ALL** harmonic current and % harmonic distortion from the fundamental to the 50^{th} harmonic.

Note: if equipment if designed to operate at part load the power factor, input current, power requirements and harmonic data must be provided for both fully rated and partial load. The Contractor shall be obliged – under this contract to provide completed data sheets for each harmonic generating item of plant in line with the data sheet below:

: Harmonic Prediction Data Sheet

Project Alpha

Revision 00

Table A: Harmonic Prediction

Supplier	
Type Reference	
Rating [kVA]	
Rated Current [A]	
Load Power [kW]	
Rectifier Type	
Power Factor	
Balanced Load (Yes / No)	

Table B: Network Data

Primary Voltage [V]	
Secondary Voltage [V]	
Transformer Rating	
Transformer Impedance (assumed)	
Network [MVA] (assumed)	

Table C: Site Specific Data

Buro Happold Equipment Reference Name	

Table D: Equipment Harmonic Prediction

Harmonics Order	Harmonic Frequency (Hz)	In Current [A] Column A	In/I1 (%) Column B
Fund.	50		
2	100		
3	150		
5	250		
7	350		
9	450		
11	550		
13	650		
15	750		
17	850		
19	950		
21	1050		
23	1150		
25	1250		
27	1350		
29	1450		
31	1550		
33	1650		
35	1750		
37	1850		
39	1950		
41	2050		
43	2150		
45	2250		
47	2350		
49	2450		
50	2500		

Notes:

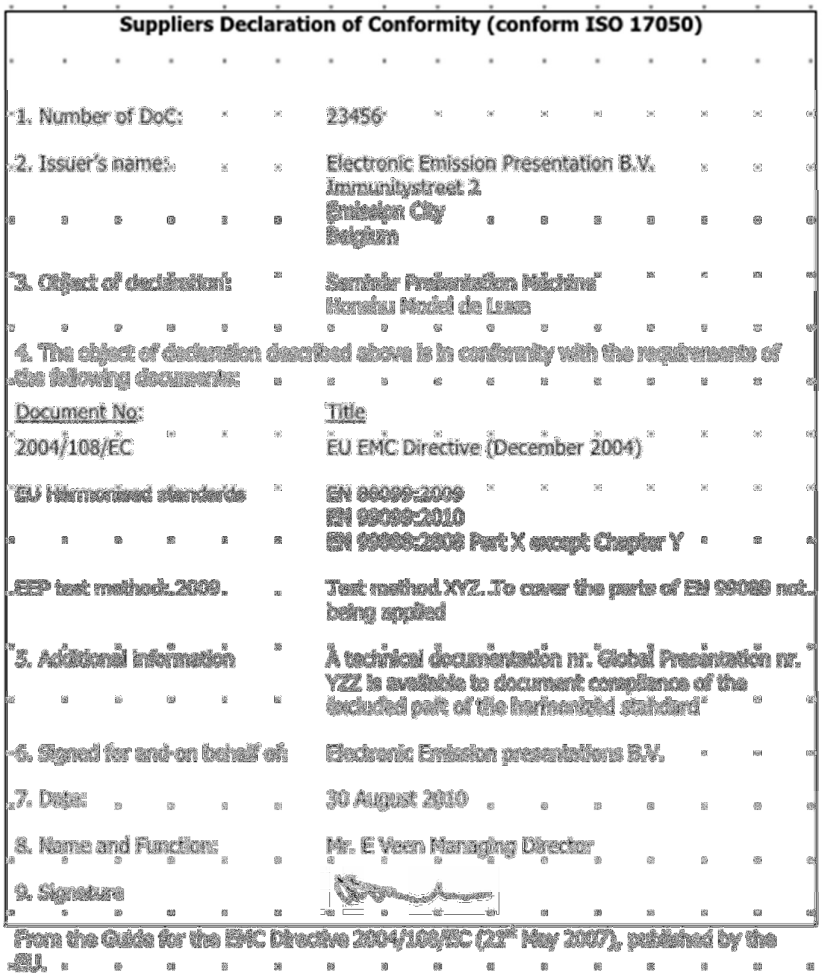
1) The responsibility of the equipment supplier is to identify the harmonic currents generated by the equipment under defined conditions. This form is to be completed for **EACH** harmonic generating piece of equipment.
2) Tables A, C and D are to be filled out in their entirety by the Specialist Trade Contractor (STC).
3) For Table C The contractor shall reference the Buro Happold equipment reference name.
4) For Table D Columns A and B are to be completed by the Specialist Trade Contractor. In completing Column B the current at the fundamental frequency is deemed to be I1. At each harmonic the current (In) shall be divided by (I1) to determine the harmonic distortion at that frequency.

E. The electrical contractor shall supply, install, terminate, test and commission all sub-main cables to the switchgear and to field devices requiring power. The respective HVAC, plumbing, Fire Protection or BMS services contractor shall provide termination devices for the sub-mains cabling and final power wiring within their equipment for direct termination of cabling.

F. Work shall be carried out in accordance with this specification and shall comply with the latest relevant Indian Standards, National Building Code 2005 and the National Electrical Code 2011.

G. All switchboards and plumbing equipment shall be Central Power Research Institute (CPRI) / Electrical Research And Development Association (ERDA) approved and shall be suitable for operation on three phase / single phase 415/230 volts (±6%), 50Hz cycles power supply system. Type Testing certification shall be provided against item of equipment.

H. The Contractor shall be obliged to provide Declarations of Conformity certificates (DoCs) for all items of equipment supplied. These DoCs shall state the directive and standards the equipment is compliant with. The Contractor shall be responsible for collating the equipment list and compiling DoCs against each item of equipment for their package. All such documentation shall be kept in the projects safety file for handover to the Client.



Suppliers Declaration of Conformity (conform ISO 17050)

1. Number of DoC:	23456
2. Issuer's name:	Electronic Emission Presentation B.V. Immunitystreet 2 Emissieln City Belgium
3. Object of declaration:	Semidar Presentation Machine Homebu Model de Luxe
4. The object of declaration described above is in conformity with the requirements of the following documents:	
Document No:	Title
2004/108/EC	EU EMC Directive (December 2004)
EU Harmonised standards	EN 99099:2009 EN 99099:2010 EN 99099:2008 Part X except Chapter Y
EEP test method 2009.	Test method XYZ. To cover the parts of EN 99099 not being applied
5. Additional information	A technical documentation nr. Global Presentation nr. YZZ is available to document compliance of the declared part of the harmonised standard
6. Signed for and on behalf of:	Electronic Emission presentations B.V.
7. Date:	30 August 2010
8. Name and Function:	Mr. E Veen Managing Director
9. Signature	

From the Guide for the EMC Directive 2004/108/EC (2nd May 2007), published by the EU.

I. The EMC zoning – based on the likely electromagnetic phenomena, which will be encountered by the electronic and electrical equipment installed and located within the building – shall be classed as:

Light industrial / commercial / residential

The prescribed limits set down in the generic standards below will be used as a reference for zoning this development.

The Contractor shall be obliged to ensure the EMC characteristics for each item of equipment proposed for this project does not offend the buildings EMC Zoning noted below:

Description of Environment	**Relevant Standards**	**Applicable Areas**
Light industrial / commercial / residential	IEC 61000-6-1 IEC 61000-6-4 Equivalent Product Codes	All areas
Notes: This table highlights the minimum test standards required to ensure the procured equipment will meet minimum requirements for the local EMC environment. 2) The Contractor shall be responsible for ensuring their equipment suppliers documentation demonstrates compliance with EMC emissions / immunity based on relevant standards above.		

5 MAINTENANCE

A. General

Provide the following free maintenance for the time period as per the GCC & SCC after handing over the Plumbing System to the Client (i.e. during warranty period)

1. Examinations: Bi-Weekly, including adjustments, cleaning and lubrication of equipment.
2. Replacement: Replace components when required, using parts produced by original manufacturer.
3. Spare Parts: Provide necessary spare parts; maintain locally an inventory of all wearing parts of the system.
4. Call Backs: Provide 24-hour emergency call back service at no expense to the Client.
5. Records: Maintain complete maintenance records including check charts, lubrication logs and activity logs; provide check charts and activity logs.

B. Extended Service Contract

At time of Bid, submit cost for full maintenance contract i.e. after the expiry of warrantee and free maintenance period as specified in GCC & SCC.

6. Contract Term: Upon expiration of new installation, free maintenance, provide full maintenance service for five (5) years, including spare parts.

Service: Provide examinations, logs, replacements and spare parts as specified for maintenance, including monitoring of power consumption on daily /weekly basis, periodic servicing of the electrical equipments etc.

6 QUALITY ASSURANCE

A. **Scope**

The following quality assurance, inspection, testing and commissioning procedures shall be required to be carried out upon award of work.

i. Provide quality assurance program (QAP), works quality assurance program (WQAP), field quality assurance program (FQAP) and quality plan.
ii. Tests at manufacturer's works.
iii. Perform site tests and commissioning.

B. **Submittals**

i. After award of work following information shall be submitted.
   a. Quality Assurance Program (QAP)
   b. Works Quality Assurance programme (WQAP)
   c. Field Quality Assurance Programme (FQAP)

ii. For inspection and testing, submit inspection and testing procedures, programme, record sheets applicable at each hold point.
iii. After completion of testing, submit test records, packaging, transportation and storage instructions and methods.
iv. For site installation and commissioning, submit installation methods or procedures, notification and procedures for pre commission and commissioning.
v. After commissioning, submit site test records, as-built drawings, manufacturer's operation maintenance manuals and list of recommended spares and tools.

C. **Quality Assurance Concept And Control**

i. Minimum requirements for establishing and implementing a quality assurance programme shall be applied to all aspects of the work necessary for carrying out the contract. Quality assurance shall extend to material parts, components, systems and services as a means of obtaining and sustaining the reliability of critical items, operating performance, maintenance and safety.
ii. Acceptance of the Contractor's quality assurance programme does not relieve the Contractor's obligation to comply with the requirement of the contract document. If the programme is found to be ineffective, then the Owner's site representative reserves the right to request for necessary revisions of the programme.
iii. The Contractor is required to produce readily identifiable documentary evidence covering the extent and details of both his own and his sub contractor's quality assurances system as follows :
    a. Quality Assurance Program (QAP)
    b. Works Quality Assurance programme (WQAP)
    c. Field Quality Assurance Programme (FQAP)
    d. Quality Plan.
iv. These documents shall be prepared separately and submitted to the Owner's site representative at the time of starting the work.
v. Quality Plan and Manual shall be prepared by the Contractor for all items and services to be supplied, after the contract has been placed, but before commencement of fabrication, and shall be subject to evaluation and acceptance by the Owner's site representative before start of work.

D. Quality Assurance Manual (QAM)

i. The QAM shall be a general comprehensive document outlining the Contractor's basic organization, policies and procedures. The information to be given in the QAM shall include but not limited to :
    a. Quality Policy.
    b. Quality Assurance Programme
    c. Organization Structure showing inter relationships.
    d. Functional responsibilities and levels of authority.
    e. Lines of communication.
    f. Customer relations.
    g. Laboratory Facilities.

E. Works Quality Assurance Programme (WQAP)

i. The WQAP shall identify the Contractor's Quality Assurance Programme at works applicable throughout all phases of Contract performance, including design, procurement, manufacture, inspection and testing. It shall identify each of the programme elements to be designed, developed, executed and maintained by the Contractor for the purpose of ensuring that all supplies and services comply with this specifications.
ii. The information to be given under this programme shall include but not limited to :
Organization and Responsibility.
    a. Contract Review.
    b. Design and Document Control.
    c. Procurement Control.
iii. Production Control.
    a. Control on Sub-contractors.
    b. In-process Quality Control and Traceability.
    c. Inspection and Testing.
    d. Control of Non-conformances.
    e. Corrective Action.
    f. Control of Inspection, Measuring and Test Equipment.

g. Handling, Storage, Packaging and Delivery.
h. Records.
i. Quality Audits.
j. After - Sales Servicing.

F. Field Quality Assurance Programme (FQAP)

i. This programme shall identify the Contractor's Quality Assurance Programme at site applicable throughout site construction, erection and commissioning. It is the underlying philosophy that the quality built into the product at works shall be maintained throughout the construction and commissioning stages.

II. While, in principle, the FQAP shall include the items discussed in WQAP, it shall, however, be approached differently to take into account site conditions.

III. The FQAP shall include, but not limited to the following information :

a. Organization and responsibility.
b. Control of Drawings and Documentation.
c. Product Checklist.
d. Control and Traceability of Purchased materials and services.
e. Receipt Inspection of materials at site.
f. Material Storage Control.
g. Inspection and Examination Procedures.
h. Control of Painting and Insulation Works.
i. Pre-commissioning.
j. Commissioning.
k. Control of Non-conformances.
l. Corrective Action.
m. Control of Inspection, Measuring and Test Equipment.
n. Records.
o. Complétion Documents.
p. List of recommended spares and tools.
q. Personal Training.
r. Servicing during Defects Liability Period.

G. **Quality Plan**

I. The contractor shall be required to prepare manufacturing and construction/erection quality plans for all equipment items and services. The quality plan shall also define the involvement of Owner's site representative in the inspection and test programme.

II. The Quality Plan shall incorporate as appropriate :

a) Charts indicating flow of materials, parts and components through manufacturing quality control inspection and test to delivery and erection.
b) The charts shall indicate the location of hold points for quality control, inspection and test beyond which manufacture shall not continue until the action required by the hold point is met, and the documentation required is generated.
c) The control documents associated with each hold point, i.e. drawings, material, specification, Works Process Schedule (WPS), Process Quality Records (PQR), quality control methods and procedures and acceptance standards.

H. **Site Quality Control Section**

I. The Contractor's Quality Control (Q.C.) section shall be headed by an experienced Quality Control Engineer. He shall be assisted by other supervisors. The section shall be an independent one, reporting to the contractor's Site Manager only on administrative matters, but otherwise under full control by the Contractor's Corporate Quality System Management.

II. The Contractor's Q.C. Section shall liaise closely with the Owner's site representative in charge of Quality Assurance/Quality Control, and to whom it shall give fullest cooperation. It is the underlying principle of this contract document that while the Contractor's Q.C. Engineer implements the Contractor's Quality Programme, the adequacy and effectiveness of that implementation shall be audited by the Owner's site representative whose recommendations on improving or maintaining quality shall be acted upon promptly by the Contractor's Q.C. Section.

I. **Regulatory Requirements**: Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.

J. Comply with the "Approval Guide," published by IS

K. **Workmanship**

The workmanship shall be best of its kind and shall conform to the specifications, as below or Indian Standard Specifications in every respect or latest trade practices and shall be subject to approval of the Employer's Representative. All materials and/or Workmanship which in the opinion of the Employer's Site Representative is defective or unsuitable shall be removed immediately from the site and shall be substituted with proper materials and/or workmanship forthwith.

L. **Materials**

- Electrical Components, Devices, and Accessories: Listed and labeled as defined in IS 732 1989 (reaffirmed 2005) by a qualified testing agency, and marked for intended location and application.
- Comply with the "Approval Guide," published by IS

All materials shall be best of their kind and shall meet minimum requirement of applicable latest Indian Standards. All materials shall be of approved quality as per samples and origins approved by the Employer's Representative.
As and when required by the Employer's Representative, the contractor shall arrange to test the materials and/or portions of works at his own cost to prove their soundness and efficiency. If after tests any materials, work or portions or work are found defective or unsound by the Employer's Representative the contractor shall remove the defective material from the site, pull down and re-execute the works at his own cost to the satisfaction of the Employer's Site Representative. To prove that the materials used are as specified the contractor shall furnish the Employer's Representative with original vouchers on demand.

7 DELIVERY, STORAGE & HANDLING

A. Preparation for Transport: Prepare equipment, according to the following:
   1. Ensure that all material to be transported to be protected against rust and corrosion.
   2. Protect the material against damage.
   3. Set material in best position for handling. Set material closed to prevent rattling.

B. During Storage: Use precautions for material, according to the following:
   1. Do not remove end protectors / wrappings etc. unless necessary for inspection; then reinstall for storage.
   2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle materials if size requires handling by crane or lift. Do not use hand wheels or stems as lifting or rigging points for handing the heavy materials.

D. Deliver conduits with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent conduits-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored conduits from moisture and dirt. Elevate above grade.

F. Protect equipment from moisture and dirt.

G. Store plastic conduiting protected from direct sunlight. Provide supports to prevent sagging and bending.

8 COORDINATION

A. The Electrical contractor shall be solely responsible for overall coordination with all the trades and shall have sole responsibility for the preparation of fully detailed coordinated services drawings for all the trades. Work shall be carried out in conformity with the specifications and accompanying drawings after approval by the Employer's Representative. The Contractor shall also co-operate with the Employers Representative's other Contractors, to compare and coordinate drawings, and time schedules and so arrange his work that there will be no interferences. The Contractor shall forward to the Employers Representative copies of all correspondence and drawings (prior to the

execution) so exchange. Failure to check plans and conditions will render the Contractor responsible for bearing the cost of any subsequent change found necessary.

B. The contractor shall be required to do part / complete installation work in phases so as to take maximum advantage of the work front as and when it becomes available.

9 INSPECTION, TESTING AND COMMISSIONING.

A. **Inspection And Testing :-**

I. All equipment and components supplied may be subjected to inspection and tests by the Consultant/ Owner's site representative during manufacture, erection/installation and after completion. The inspection and tests shall include but not be limited by the requirements of this contract document. Prior to inspection and testing, the equipment shall undergo pre-service cleaning and protection.

II. Tenderers shall state and guarantee the technical particulars listed in the Schedule of Technical Data. These guarantees and particulars shall be binding and shall not be varied without the written permission of the Owner's site representative.

III. No tolerances shall be allowed other than the tolerances specified or permitted in the relevant approved Standards, unless otherwise stated.

IV. If the guaranteed performance of any item of equipment is not met and / or if any item fails to comply with the specification requirement in any respect whatsoever at any stage of manufacture, test or erection, the Owner's site representative may reject the item, or defective component thereof, whichever he considers necessary; and after adjustment or modification as directed by the Owner's site representative, the contractor shall submit the item for further inspection and /or test.

V. The approval of the Owner's site representative of inspection and/or test results shall not prejudice the right of the Owner's site representative to reject an item of equipment if it does not comply with the contract document when erected, does not or prove completely satisfactory in service.

VI. The Contractor shall be responsible for the timely transmission of the relevant and appropriate sections of the contract document to manufacturers and sub-contractors for the proper execution of all tests at their works as per contract specifications.

B. **Tests At Manufacturer's Works**

I. All tests to be performed during manufacture, fabrication and inspection shall be agreed with the Consultant/ Owner's site representative prior to commencement of the work. The Contractor shall prepare the details of the schedule and submit these to the Consultant/ Owner's site representative for approval. It must be ensured that adequate relevant information on the design code/standard employed, the manufacture /fabrication/assembly procedure and the attendant quality control steps proposed are made available to the Consultant/Owner's site representative who will mark in the appropriate spaces his intention to attend or waive the invited tests, or inspections.

II. A minimum of twenty-one days' notice of the readiness of equipment for test or inspection shall be provided to the Owner's site representative by the Contractor (whether the tests be held at the Contractor's of Sub-contractor's works). The subject items should remain available for Owner's site representative inspection and test up to a minimum 10 days beyond the agreed date of witnessing the test. Every facility in respect of access, drawings, instruments and manpower shall be provided by the Contractor and sub-contractor to enable the Owner's site representative to carry out the necessary inspection and testing of the Equipment.

III. No equipment shall be packed, prepared for shipment, or dismantled for the purpose of packing for shipment, unless it has been satisfactorily inspected, all tests called for have been successfully carried out in the presence of the Owner's site representative or approved for shipment, or alternatively inspection has been waived.

IV. Functional electrical, mechanical and hydraulic tests shall be carried out on completed assemblies in the works. The extent of these tests and method of recording the results shall be submitted to, and agreed by, the Owner's site representative in sufficient time to enable the tests to be satisfactorily witnesses, or if necessary for any changes required to the proposed programme of tests to be agreed.

V. The Consultant/Owner's site representative reserves the right to visit the Manufacturer's works at any reasonable time during fabrication of equipment and to familiarize himself with the progress made and the quantity of the work to date.

VI. Within 30 days of completion of any tests, triplicate sets of all principal test records, test certificates and correction and performance curves shall be supplied to the Owner's site representative.

VII. These test records, certificates and performance curves shall be supplied for all tests, whether or not they have been witnessed by the Owner's site representative or not. The information given on such test certificates and curves shall be sufficient to identify the material or equipment to which the certificate refers and should also bear the Contract reference title.

VIII. When all equipment has been tested, the test certificates from all works and site tests shall be compiled by the Contractor into volumes and bound in an approved from complete with index and four copies of each volume shall be supplied to Consultant/ Owner's site representative.

IX. Stage wise inspection of equipment in factory in waived.

C. **Performance Tests At Manufacturer's Woks**

i. All equipment may be subjected to routine performance tests at the Manufacturer's Works in accordance with the relevant IEC, BS EN, ANSI, ASME, ASTM, BIS standard including operating tests of complete assemblies to ensure correct operation of apparatus and components.

ii. Transformer, cables, DG set and other rotating equipment shall be given full load tests, and run to 10% over speed for 5 minutes to check performance.

iii. The Contractor shall submit single line diagrams including the layout of the Equipment together with the location of test instrumentation and the principal dimensions of the layout. All calculations to derive performance data shall be made strictly in accordance with format given in the approved standards. Any alterations or deviations from the approved standard test layout or formulae shall be subjected to the prior approval of the Owner's Site Representative.

iv. The performance test shall be conducted as per technical specification & site requirement. Any proposal for the omission of this test shall be to the approval of the Consultant/ Owner's site representative.

v. On completion of the tests the Contractor shall submit a report showing the test results obtained together with the curves corrected to the site operating conditions.

10 REFERENCES

A. Tender specifications, drawings, schedules, general and special conditions of the Contract apply to this Section.

Code Number	**Description**
	Unless specifically mentioned otherwise, all the applicable Codes and Standards published by the Bureau of Indian Standards and their subsequent revision/ BS Standards shall govern the design, workmanship, quality and properties of materials and method of testing.
NBC 2005	National Building Code of India 2005
NEC 2011	National Electrical Code 2011
NLC 2010	National Lighting Code 2010
Codes for Earthing / Lightning Protections :	
IS: 3043	Earthing Code of Practice
IS: 2309	Lightning Protection System – Latest Edition
IEC 61024-1-2	Lightning Protection System – Latest Edition
BS EN 62305 (1 to 4)	Lightning Protection System – Latest Edition
EN 50164	Accessories for Lightning Protection Systems
Codes for L.V. Switch-gears :	
IS 5082	Material for data for aluminium bus bars
IS 13703	Low voltage fuses.
IS 13947	Specification for Low Voltage Switchgear and Control gear Part 5
(Part 5/Sec 1) :1993	Control Circuit devices and switching elements Section 1 Electromechanical control circuit devices (First Revision)
IS 60898	Electrical accessories - Circuit-breakers for over current protection

	for household and similar installations
IS 2705	Current transformers.
IS 3156	Voltage transformers.
IS 4146	Application Guide for Voltage Transformers
IS 1248	Electrical indicating instruments.
IS 722	Integrating meters.
IS 3231	Electrical relays for power system protection.
IS 6875	Control switches and push buttons.
IS 11353	Guide for uniform system of marking and identification of conductors and apparatus terminals.
IS 5578	Guide for marking of insulated conductors.
IS 3618	Phosphate treatment of Iron and steel for protection against corrosion.
IS 6005	Code of practice of phosphating of Iron and steel.
IS 5	Colours for ready mixed paints and enamels.
IS 2147	Degree of protection provided by enclosures for switchgear and Control.
IS 8624, Part 3	Distribution Boards
IEC 61008	Residual Current Device (RCD)/RCBO.
IEC 60898-I	MCB's
IEC 60255	Electrical relays.
IEC 60974 / IS1822	Motor Protection Circuit Breaker
IEC 60269	Low-voltage fuses.
IEC 60417 DB	Graphical symbols for use on equipment.
IEC 60439/ IS-8623	Low voltage switchgear and control gear assemblies.
IS-8828	Circuit breakers for household applications – MCB
IS-3854	Switches for domestic and similar purpose
IS-4615	Switch socket outlets (non-interlocking type)
IS 732	Code of Practice for Electrical Wiring Installations.
IEC 60445	Basic and safety principles for man-machine interface marking and identification. Identification of equipment terminals and of termination's of certain designated conductors. Including general rules for an alphanumeric system.
IEC 60529	Degrees of protection provided by enclosures. (IP Code)
IEC 60715	Dimensions of low voltage switchgear and control gear. Standardized mounting on rails for mechanical support of electrical devices in switchgear and control gear installations.
IEC 60947	Low Voltage switchgear and control gear
IEC 62271	High Voltage Switchgear and Control gear
IEC TR 61641	Enclosed LV Switchgear and Control gear assemblies – guide for testing under conditions of arcing due to internal fault.
IEEE 386	Separable Insulated Connector Systems for Power Distribution Systems Above 600 V
IEEE 48	IEEE Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV
IEEE 404	Standard for Extruded and Laminated Dielectric Shielded Cable Joints
IEEE C62.41.2	
UL 1284 & UL 1449	Electrical Components, devices & accessories
BS-7671 17th Edition Wiring Regulation	
IEC 60439	Low voltage switchgear and control gear assemblies.
IEC 62052	Class 0.5, 1 and 2 alternating current watt-hour meters.
IEC 60529	Degrees of protection provided by enclosures. (IP
IEC 60947	Low Voltage switchgear and control gear
IEC 60269	Low-voltage fuses.
UL 1008	Standard for Transfer Switch Equipment (ATS)
OISD-RP-149	Design Aspects for Safety in Electrical System.

IEC 62052	Class 0.5, 1 and 2 alternating current watt-hour meters.
IEC 60044	Instrument transformers.
IEC 60051	Direct acting indicating analogue electrical measuring instruments and their accessories.
IEC 60074	Coding principles for indicator lights and push buttons.
IEC 60258	Direct acting recording electrical measuring instruments and their accessories.
IEC 61643-1	Surge Protective Devices connected to low voltage power distribution systems

Code for Cable Trays :

IS-1079 IS- 2629 IS-2633	Cable Tray
IS-1079 IS- 2629 IS-2633	Cable Ladder

Code for Trunkings

IS 14927, IEC 1084.	Cable Trunking

Code for Conduits & Accessories

IS:9537 (Part-II)/ CEE 24 & IEC 60695-2-1:1991	Steel Conduit and Fitting Accessories PVC Conduit and Fitting Accessories

Codes for Cables

IS 11353	Guide for uniform system of marking and identification of conductors and apparatus terminals.
BS 6387	Specifications for performance requirements for cables required to maintain circuit integrity under fire conditions
IS-7098(part2)	Cross-linked Polyethylene (XLPE) insulated PVC sheathed cables For working voltages from 4.4 KV up to and including 44 KV
IS-1554	Specification for PVC insulated (heavy duty) electric cables
IS 8130	Conductors for insulated electric cables and flexible cords
IS 3975	Mild steel wires, formed wires and tapes for armouring of cables
IS 10418	Drums for electric cables
IS 10810	Method of test for cables
IS 694	PVC insulated cables for working voltages upto and including 1100V.
IS-7098-1	Cross-linked Polyethylene (XLPE) insulated PVC sheathed cables.
BS 7846	Electric cables - thermosetting insulated armoured, fire-resistant cables of rated voltage 600/1000V, having low emission of smoke and corrosive gases when affected by fire – specification.
IEC 60502-1	Power cables with extruded insulation and their accessories for rated voltages from 1 Kv (Um = 1,2 Kv) up to 40 Kv (Um = 46 Kv)
BS-8519-2010	Selection and installation of fire-resistant power and control cable systems for life safety and fire-fighting applications – Code of practice

BS 8434-2	Methods of test for assessment of the fire integrity of electric cables. Test for unprotected small cables for use in emergency circuits - BS EN 50200 with a 940℃ flame and with water spray (+A2:2009)
BS 8491:2008	Method for assessment of fire integrity of large diameter power cables for use as components for smoke and heat control systems and certain other active fire safety systems

Code for Identification for Electrical System

IS 732 / IS 12307 / IS 12349 / NBC

IS 5578	Guide for marking of insulated conductors.
IEC 60068-2-52	Environmental testing - Part 2: Tests - Test Kb: Salt mist, cyclic (sodium, chloride solution)
IEC 61851-1	Electric vehicle conductive charging system - Part 1: General requirements
IEC 61851-21	Electric vehicle conductive charging system - Part 21: Electric vehicle requirements for conductive connection to an a.c./d.c. supply
IEC 61851-22	Electric vehicle conductive charging system - Part 22: AC electric vehicle charging station
IEC 62196-1	Plugs, socket-outlets, vehicle couplers and vehicle inlets - Conductive charging of electric vehicles - Part 1: Charging of electric vehicles up to 250 A a.c. and 400 A d.c.
IEC 62196-2	Part 2: Dimensional compatibility and interchangeability requirements for a.c. pin and contact-tube accessories
ISO/IEC 14443	Identification cards - Contactless integrated circuit cards - Proximity cards specifications (Parts 1-4)
ISO/IEC 15693	Identification cards — Contactless integrated circuit(s) cards — Vicinity cards (Parts 1-4)

Code for Switch Sockets

IS 3854/ IS 1293

Code for Automatic transfer switch

IEC 947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Automatic Transfer Switching Equipment

Codes for Bus ducts

IEC 61439-1	General rules
IEC 61439-2	Power switchgear and control gear ASSEMBLIES (Replacing IEC 60449-1)
IEC 61439-4	Distribution boards (to supersede IEC 60449-4)
IEC 61439-4	Assemblies for construction sites (to supersede IEC 60449-4)
IEC 61439-5	Assemblies for power distribution (to supersede IEC 60449-5)
IEC 61439-6	Busbar trunking systems (to supersede IEC 60449-2)

- Unless specifically mentioned otherwise, all the applicable Codes and Standards published by the Bureau of Indian Standards and their subsequent revision/ BS Standards shall govern the design, workmanship, quality and properties of materials and method of testing.
- CFO NOC

END OF SECTION-A