ANNEXURE E :

MEP SPECIFICATIONS

ANNEXURE C: MEP SPECIFICATIONS

PART 1 : ELECTRICAL

PROPOSED CONSTRUCTION OF THE NEW CHANCERY AND OFFICIAL RESIDENCE

IN NEW DELHI INDIA

TENDER DOCUMENTS

ELECTRICAL & LV SYSTEM

(Special Conditions &Technical Specification)

Date: - 02/05/2025

ARCHITECT

SPACE ARCHITECTURE STUDIO
V-12/23, DLF- PHASE-III
Gurgaon, Haryana - 122002.
Off Ph: +91-124-4734320
contact@studiosas.in

SERVICES CONSULTANT

MULTIPLE SERVICES CONSULTANTS
253/B, Rajpur Khurd Extension,
Chhatarpur, New Delhi-110068,
Ph. no. -8920225677/8920228058
msc@msc-mep.com

SPECIALCONDITIONS

1. GENERAL

These special conditions are intended to amplify the General Conditions of Contract, and shall be read in conjunction with the same. For any discrepancies between the General Conditions and these Special Conditions, the more stringent shall apply.

2. SCOPE OF WORK

The general character and the scope of work to be carried out under this contract is illustrated in Drawings, Specifications and Schedule of Quantities. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Owner's site representative. The contractor shall furnish all labour, materials and equipment (except those to be supplied by the owner) as listed under Schedule of Quantities and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete electrical system as described in the Specifications and as shown on the drawings. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract. The electrical system shall comprise ofthe following:

a. All conduit work including junction boxes, outlet boxes and wiring for lighting and power circuit.

b. Switches, plug sockets, cover plates and other wiring accessories.

c. LT Cables, Mains and Sub-Mains.

d. GI raceways and junction boxes.

e. Distribution panels &Final Distribution panels.

f. Cables on cable trays and / or within suspended ceiling spaces including installation, cable trays, hangers, supports, cable terminations and all fixing accessories.

g. Earthing (Grounding) System.

h. Supply and installation of Lighting Fixtures

i. Supply and installation of conducting& cabling for Voice & Data Network.

j. Supply and installation of conducting& cabling for MATV / PA System

k. Supply and installation of Metering cubical & Transformer.

l. Installation of Landscape lighting, supply and installation of cabling, feeder pillars, earthing.

m. Testing and commissioning.

3. ASSOCIATED CIVIL WORKS

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. These shall be executed by other agencies in accordance with approved shop drawings of, and under direct supervision of the electrical contractor.

a. PCC foundation blocks with angle iron frame work edging for all power control centres and motor control centres.

b. Repair of all disturbed surfaces/openings made by Electrical Contractor.

4. PROJECT EXECUTION AND MANAGEMENT

The Contractor shall ensure that senior planning and erection personnel from his organization are assigned exclusively for this project. The Contractor shall appoint one Project Engineer holding senior management position in the organization. He shall be assisted on full time basis by a minimum of two senior supervisors. The entire staff shall be posted at site on full time basis. Separate ID card to be given by the Contractor to each worker working on site.

The project management shall be through modern technique. The Contractor's office at site shall be fully equipped with fax, computers & plotter and shall prepare proper bar chart and completion schedules to be submitted & ensure timely completion. Erection engineer and supervisors shall be provided with mobile communication system so that they can always be reached.

For quality control & monitoring of workmanship, contractor shall assign at least one full-time engineer who would be exclusively responsible for ensuring strict quality control, adherence to specifications and ensuring top class workmanship for the electrical installation. Contractor shall furnish details of licenses of supervisors/workmen to be employed at site.

5. PERFORMANCE GUARANTEE

The contractor shall carry out the work in accordance with the Drawings, Specifications, Schedule of Quantities and other documents forming part of the Contract.

The contractor shall be fully responsible for the performance of the selected equipment (installed by him) at the specified parameters and for the efficiency of the installation to deliver the required end result.

The contractor shall guarantee that the Electrical system as installed shall perform to complete satisfaction of the owner. The guarantee shall be submitted in the proforma given in Appendix - II.

Complete set of architectural drawings is available in the Architect/Consultant's office and reference may be made to same for any details or information. The contractor shall also guarantee that the performance of various equipment individually, shall not be less than the quoted capacity; also actual power consumption shall not exceed the quoted rating, during testing and commissioning, handing over and guarantee period.

At the close of the work and before issue of final certificate of virtual complete on, the contractor shall furnish written performance guarantee against defective materials and workman-ship for a period of one years from date of testing, commissioning and handing over. The guarantee shall be submitted in preforma given in Appendix-II. The Contractor shall hold himself fully responsible for reinstallation or replacement, free of cost to Owner the following:

a. Any defective work or material supplied by the Contractor.

b. Any material or equipment damaged or destroyed as a result of defective workmanship by the Contractor.

6. BYE-LAWS AND REGULATIONS

The work shall be carried out to the satisfaction of the Owner's site representative and in accordance with the Specifications, Regulations of the Electric Supply Authority, Indian Electricity Rules and Regulations, latest Indian Standards and as per the requirements of the Chief Fire Officer.

7. FEES AND PERMITS

The Contractor shall pay any and all fees and obtain permits apply & get load sanction as required for the installation of this work. On completion of the work, the contractor shall obtain and deliver to the Owner, certificate of final inspection and approval by the local electricity authority (CFO/ Municipal, State/Central govt. whichever is applicable)

8. DRAWINGS

The Electrical Drawings, which may be issued with tenders, are diagrammatic only and indicate arrangement of various systems and the extent of work covered in the contract. These Drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. Under no circumstances shall dimensions be scaled from these Drawings. The architectural/interiors drawings and details shall be examined for exact location of equipment, electrical points & fixtures.

The contractor shall follow the tender drawings in preparation of his shop drawings, and for subsequent installation work. He shall check the drawings of other trades to verify spaces in which his work will be installed.

Maximum headroom and space conditions shall be maintained at all points. Where headroom appears inadequate, the contractor shall notify the Architect/Consultant/Owner's site representative before proceeding with the installation. In case installation is carried out without notifying, the work shall be rejected and contractor shall rectify the same at his own cost.

The contractor shall examine all architectural, structural, plumbing, HVAC and other services drawings and check the as-built works before starting the work and report to the Owner's site representative any discrepancies and obtain clarification. Any changes found essential to coordinate installation of his work with other services and trades, shall be made with prior approval of the Architect/Consultant/Owner's site representative without additional cost to the Owner.

9. SPECIFICATIONS

The Specifications shall be considered as part of this contract. The Drawings indicate the extent and general arrangement of power distribution, location of lighting fixtures, controlling switches, wiring system, cabling and earthing. These drawings are essentially diagrammatic. The Drawings indicate the point of termination of conduit runs and broadly suggest the routes to be followed. The work shall be installed as indicated on the Drawings. However, any change found essential to coordinate the installation of this work with other trades shall be made without any additional cost to the Owner. The data given here in and on the Drawings is as exact as could be secured, but ts complete accuracy is not guaranteed. The drawings are for the guidance of the contractor, exact locations, distances and levels shall be governed by the site conditions and the Architectural & Interior layouts.

10. SHOP DRAWINGS

10.1 All the shop drawings shall be prepared on computer through AutoCAD System based on Architectural Drawings, site measurements and Interior Designer's Drawings. Within four weeks of the award of the contract, contractor shall furnish, for the approval of the Architect/Consultant, two Set of detailed shop drawings of all equipment and materials including layouts for all conduit layouts, distribution panels, switch boards, cabinets, special pull boxes, cable trays and any other requirement to be fabricated or purchased by the contractor.

10.2 These shop drawings shall contain all information required to complete the Project as per specifications and as required by the Architect/Consultant/Owner's site representative. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings.

Each item of equipment/material proposed shall be a standard catalogue product of an established manufacturer strictly from the manufacturers listed in Appendix-III.

When the Architect/Consultant makes any amendments in the above drawings, the contractor shall supply two fresh Set of drawings with the amendments duly incorporated along with check print, for approval. The contractor shall submit further six Set of shop drawings to the Owner's site representative for the exclusive use by the Owner's site representative and all other agencies. No material or equipment may be delivered or installed at the job site until the contractor has in his possession, the approved shop drawing for the particular material/equipment/installation.

10.3 Shop drawings shall be submitted for approval sufficiently in advance of planned delivery and installation of any material to allow Architect/Consultant ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved programme.

10.4 Manufacturers drawings, catalogues, pamphlets and other documents submitted for approval shall be in four Set. Each item in each set shall be properly labeled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.

10.5 Samples of all materials like conduits, accessories, switches, wires, control cables etc shall be submitted to the Owner's site representative prior to procurement. These shall be submitted in two Set for approval and retention by Owner's site representative and shall be kept in their site office for reference and verification till the completion of the Project.

10.6 Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supersede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract.

10.7 Where the contractor proposes to use an item of equipment, other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundation, wiring or any other part of the mechanical, electrical or architectural layouts; all such re-design, and all new drawings and detailing required therefore, shall be prepared by the contractor at his own expense and gotten approved by the Architect//Consultant/ Owner's site representative.

10.8 The contractor shall extend full cooperation to HVAC contractor in preparation of his coordinated services drawings. He shall issue floppies and hard prints of his shop drawings to HVAC contractor well in advance to complete the coordinated services drawings in accordance with schedule prepared by the Owner site representatives. Where the work of the contractor has to be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the Owner's site representative, the contractor shall prepare composite working drawings and sections at a suitable scale, not less than 1:50, clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordinating with other trades, or so as to cause any interference with work of other trades, he shall make all the necessary changes without extra cost to the Owner.

10.9 Within two weeks of approval of all the relevant shop drawings, the contractor shall submit four copies of a comprehensive variation in quantity statement, and itemized price list of recommended (by manufacturers) imported and local spare parts and tools, covering all equipment and materials in this contract. The Project Manager shall make recommendation to Owner for acceptance of anticipated variation in contract amounts and also advise Owner to initiate action for procurement of spare parts and tools at the completion of project.

11. ACCESSIBILITY

The Contractor shall verify the sufficiency of the size of the shaft openings, clearances in wall cavities and suspended ceilings for proper installation of his conduits cables, cable trays, panels etc.. His failure to communicate insufficiency of any of the above, shall constitute his acceptance of sufficiency of the same**.** The Contractor shall locate all equipment which must be serviced, operated or maintained in fully accessible positions. The exact location and size of all access panels, required for each concealed control damper, valve or other devices requiring attendance, shall be finalized and communicated in sufficient time, to be provided in the normal course of work. Failing this, the Contractor shall make all the necessary repairs and changes at his own expense. Access panel shall be standardized for each piece of equipment / device / accessory and shall be clearly nomenclature / marked.

12. MATERIALS AND EQUIPMENT

All materials and equipment shall conform to the relevant Indian Standards and shall be of the approved make and design. Makes shall be strictly in conformity with list of approved manufacturers as per Appendix - I.

The Contractor shall be responsible for the safe custody of all materials and shall insure them against theft or damage in handling or storage etc. A list of items of materials and equipment, together with a sample of each shall be submitted to the Owner's site representative within 15 days of the awardofthe contract. Any item which is proposed as a substitute, the contractor shall state the credit, if any, due to the Owner in the event the substitution is approved. All changes and substitutions shall be requested in writing and approvals obtained in writing from the Owner's site representative.

13. MANUFACTURERS INSTRUCTIONS

Where manufacturer has furnished specific instructions, relating to the material and equipment used in this project, covering points not specifically mentioned in these documents, manufacturer's instructions shall be followed in that case.

14. COMPLETION CERTIFICATE

On completion of the electrical installation a certificate shall be furnished by the Contractor countersigned by the licensed supervisor, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local, state/central govt./ municipal / fire authorities concerned.

15. INSPECTION AND TESTING

The Owner may carry out inspection and testing at manufacturer's works for this contract. No equipment shall be delivered without prior written confirmation from the Owner's site Engineer. In case factory inspection is carried out then all travelling and lodging expenses for two persons one from owner and one from consultants shall be borne by the Contractor, also all expenses related to testing shall be to Contractor account. Tests on site of completed works shall demonstrate the following:

That the equipment installed complies with specification in all respect and is of the correct rating for the duty and site conditions.

That all items operate efficiently and quietly to meet the specified requirements.

That all circuits are fully protected and that protective devices are properly co-ordinated.

That all non-current carrying metal parts are properly and safely grounded in accordance with the specification and appropriate Codes of Practice.

The contractor shall provide all necessary instruments and labour for testing, shall make adequate records of test procedures and readings, shall repeat any tests requested by the Owner and shall provide test certificate signed by authorized person. Such test shall be conducted on all materials and equipment and tests on completed work as called for by the Owner at contractor's expenses unless otherwise called for.

If it is proved that the installation or part thereof is not satisfactorily carried out then the contractor shall be liable for the rectification of the same. Owner Site Engineer's decision as to what constitutes a satisfactory installation shall be final.

All tests shall be carried out by a test house approved by the Owner / Consultants.

16. COMPLETION DRAWINGS

Upon completion of the work and before issuance of certificate of virtual completion the contractor shall submit to the Owner's site representative four Set of layout drawings in progressive manner for individual systems drawn at approved scale indicating the complete wiring system as installed. Drawings shall be prepared on AUTO-CAD (latest version). Along with the hard copies, the contractor shall submit copies of all drawings on CD and one set of all drawings on RTF shall also be submitted. These drawings must provide:

a. Single line power distribution diagram including control wiring.

b. Cable Trays with number and size of cables installed.

c. Run and size of conduits, inspection, junction and pull boxes.

d. Raceways and Junction Boxes.

e. Number and size of conductors in each conduit with phase identification.

f. Location and rating of sockets and switches controlling the lighting and power outlets.

g. Location and details of distribution boards/panels, mains, switches along with phase balancing details.

h. A complete wiring diagram as installed and single line diagrams showing all connections in the complete electrical system.

i. Location of all earthing stations, route and size of all earthing conductors manhole.

j. Layout and particulars of all LT cables.

k. Instruction, maintenance and operation manuals including maintenance schedule for all equipment. Testing & commissioning reports of all electrical equipment.

17. OPERATING INSTRUCTION & MAINTENANCE MANUAL

Upon completion and commissioning of part Electrical system **t**he contractor shall submit a draft copy of comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the contractor shall submit four (4) complete bound Set of typewritten operating instructions and maintenance manuals; one each for retention by Consultant and Owner's site representative and two for Owners Operating Personnel. These manuals shall also include basis of design, detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for 4 year period of maintenance of each equipment.

18. ON SITE TRAINING

Upon completion of all work and all tests, the Contractor shall furnish necessary operators, labour and helpers for operating the entire installation for a period of thirty (30) working days of ten (10) hours each, to enable the Owner's staff to get acquainted with the operation of the system. During this period, the contractor shall train the Owner's personnel in the operation, adjustment and maintenance of all equipment installed**.**

19. MAINTENANCE DURING DEFECTS LIABILITY PERIOD

19.1 Complaints

The Contractor shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 10 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

19.2 Repairs

All equipment that requires repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free-of-charge to the Owner.

20. UPTIME GUARANTEE

The contractor shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall get extended by a month for every month having shortfall. In case of shortfall beyond the defects liability period, the contract for Operation and Maintenance shall get extended by a month for every month having the shortfall and no reimbursement shall be made for the extended period.

The Contractor shall provide log in the form of diskettes and bound printed comprehensive log book containing tables for daily record of all temperatures, pressures, humidity, power consumption. starting and stopping times for various equipment, daily services rendered for the system alarms, maintenance and record of unusual observations etc. Contractor shall also submit preventive maintenance schedule.

Each tenderer shall submit along with the tender, a detailed operation assistance proposal for the Owner's site representatives/Consultant's review. This shall include the type of service planned to be offered during Defects Liability Period and beyond. The operation assistance proposal shall give the details of the proposed monthly reports to the Management.

The tenderer shall include a list of other projects where such an Operation Assistance has been provided.

21. OPERATION AND MAINTENANCE

Contractor may be required to carry out the operation of the Electrical installation for the defects liability period. Further, he may also be required to carry out operation and all inclusive maintenance of the entire system for a period of three years beyond the defects liability period**.**

21.1 Operation contract (Electrical System)

a. 10 hours a day, year round during working office hours for full load

b. 14 hours a day, year round during non-work hours for part load.

c. All stand-by equipment to be operated as per mutually agreed programme.

d. Proper entry and upkeep of relevant log books.

e. Maintain complaints register. Submit weekly report.

f. Proper housekeeping of all areas under the contract.

g. Prepare daily consumption report and summary of operation.

21.2 Terms of payment

i. Monthly at the end of each month on pro-rata basis.

21.3 All Inclusive Maintenance Contract

a. Scope

The AMC shall cover all the items installed by the contractor including replacement of all switches, fittings etc. consumable like bulbs, tubes, oil etc. shall be excluded.

b. Routine Preventive Maintenance Schedule to be submitted

i. Schedule to cover manufacturer's recommendation and/or common engineering practice (for all plant and machinery under contract).

ii. Plant and machinery history card giving full details of equipment and frequency of checks and overhaul.

iii. Monthly status report.

iv. Entire Electrical installation to be repainted in fourth year (from commissioning) before the expiry of operation and maintenance contract.

c. Uptime during maintenance contract

i. 98% uptime of all systems under contract.

ii. Up time shall be assessed every month and in case of shortfall during any month the contract shall be extended by a month.

iii. There shall be no reimbursement for the extended period.

iv. Break-downs shall be attended to within ten hours of reporting.

d. Manpower

i. Adequate number of persons to the satisfaction of the Owner's site representative shall be provided including relievers.

ii. Statutory requirements of EPF, ESIC and other applicable labour legislations to be complied with; and monthly certification to that effect to be submitted.

iii. Duty allocation and Roaster control shall be contractor's responsibility.

iv. No overtime shall be payable by Owner for any reason whatsoever.

e. Shut Downs

i. Routine shut downs shall be permitted only as allowed by the Chief Engineer.

ii. Contractor shall be at liberty to carry out routine maintenance as and when required but with prior permission of the Owner.

f. Payment Terms

i. Quarterly payment at the beginning of each quarter on pro-rata basis**.**

22. METHOD OF MEASUREMENT

The works shall be measured in accordance with relevant IS codes. Notwithstanding any general or local custom, except where otherwise specifically described or prescribed in the contract.

23. DEMONSTRATION TO OWNER

At completion, devices subject to manual operation shall be operated atleast five times in presence of Owner's site representative to demonstrate satisfactory operation.

24. TOOLS AND TACKLES

The Contractor shall provide and install all necessary hoists, ladders, scaffolding, tools, tackles, all transport for labour and materials and plant necessary for the proper execution and completion of the work to the satisfaction of the Owner's site representative.

25. PARTIAL ORDERING

Owner through the Architect/Consultant/ Owner's site representative reserves the right to order equipment and material from any and all alternates, and /or to order high side and /or low side equipment and materials or parts thereof from one or more tenderers**.**

26. RATING

Rating of all equipment shall be appropriate for the conditions on the location where the equipment will be installed and operate. All the equipment shall be suitable for continuous operation under the most severe conditions of site and shall be rated for the following ambient condition.

Location	:	DELHI
Altitude	:	216 meters above sea level (approx.)
Ambient Temperature		
Maximum	:	47 deg. C
Minimum	:	4 deg.

***Note**: All equipment shall give required output under the above conditions.*

A P P E N D I X – I

LIST OF APPROVED MAKES FOR EQUIPMENT & MATERIALS

S. No.	Details of Materials / Equipment	Manufacturer's Name
A.	**HIGH VOLTAGE EQUIPMENT**	
1.	Transformer:	Sudhir Engg. Unimag PVJ
2.	Compact Sub Station	Sudhir Engg. Unimag PVJ Zeniya Electech Pvt. Ltd.
3.	11 KV VCB	Schneider Electric ABB L&T Siemens
4.	Microprocessor based Protection Relay	
	Numeric Type	ABB L & T Schneider Electric Siemens
5.	Potential Transformer	Kappa AE Pragati
6.	Current Transformer (Cast Resin Epoxy Coated)	Kappa AE Pragati
7.	Static Power Meter & Logger (Trivector Meters)	Enersole Conzerv (Schneider) Trinity
8.	Electronic Digital Meter (A/V/PF/HZ/KWH) With LED Display.	Conzerv (Schneider) Larsen & Toubro Schneider Electric

A P P E N D I X – III

LIST OF APPROVED MAKES FOR EQUIPMENT & MATERIALS

S. No.	Details of Materials / Equipment		Manufacturer's Name
B.	**MEDIUM VOLTAGE EQUIPMENT**		
1.	Power Distribution Panel and Motor Control Centre		Advance Panels & Switchgears Pvt. Ltd, Haridwar Ambit Switchgear India Pvt. Ltd, Noida SPC Elecrotech Pvt. Ltd, Noida RST Electricals Pvt Ltd Gem Tech Power Control Pvt Ltd Application Control Pvt Ltd. Zeniya Electech Pvt. Ltd.
2.	Final Distribution Board		Schneider Electric Lauritz Knudsen ABB Legrand C&S
3.	Air Circuit Breakers (ACB)		Schneider Electric Lauritz Knudsen ABB Legrand C&S
4.	Molded Case Circuit Breaker (MCCB)		Schneider Electric Lauritz Knudsen ABB Legrand C&S
5.	Miniature Circuit Breakers (MCB)		Schneider Electric Lauritz Knudsen ABB Legrand C&S
6.	Residual Current Circuit Breaker (RCCB)		Schneider Electric Lauritz Knudsen ABB Legrand C&S
7.	Control Transformer/CT/Potential Transformers		Automatic Electric Gilbert & Maxwell Pragati
8.	Indicating Lamps LED type and Push Button		Larsen & Toubro (ESBEE) Schneider Electric Siemens Vaishno Electricals
9.	Overload relays with built-in Single-Phase preventer		ABB Larsen & Toubro Schneider Electric Siemens
10.	Electronic Digital Meters (A/V/PF/Hz/KW/KWH) with LED Display		Enersole Trinity

S. No.	Details of Materials / Equipment	Manufacturer's Name
11.	PVC insulated XLPE aluminium/copper conductor armoured MV Cables upto 1100V grade	Rallison RR Keble KEI DIACAB Paramount
12.	Cable Glands Single/Double Compression with earthing links	Baliga Lighting Comet Cosmos
13.	LT Jointing Kit / Termination	Birla-3M Raychem REPL Safe Kit
14.	PVC Glands	Control Well Lapp
15.	Bimetallic/AL Cable Lug	Comet Dowell's (Biller India) Hax Brass (Copper Alloy India)
16.	PVC insulated copper conductor stranded flexible wires(FRLS) -	Rallison RR Keble KEI Batra Henley Paramount Agilon
17.	PVC Conduit & Accessories (ISI approved)	AKG BEC Relision
18.	Switch & Socket	Legrand (Mylinc) Lauritz Knudsen C&S MK
19.	Terminal Blocks	Connect Well Elmex Wago
20.	Industrial Socket	
	a. Splash Proof	Legrand Schneider Electric
	b. Metal Clad	BCH MDS
21.	Ceiling Fan	Crompton Greaves Havells Orient Usha

S. No.	Details of Materials / Equipment	Manufacturer's Name
22.	LED Lighting Fixture	Jaquar Wipro Panasonic Eveready
23.	Occupancy sensors	L&T MK (Honeywell) Wipro
24.	Selector Switch, Toggle switch	Kaycee Salzer (Larsen & Toubro)
25.	Fire Sealant & Fire-Retardant Paint	3 M India Ltd. Hilti Promat
26.	HDPE underground cable duct	Ashlock Indelec Forend
27.	Cable Trays	MEM SPC Profab

S. No.	Details of Materials / Equipment	Manufacturer's Name
C.	**UPS SYSTEM**	
1.	UPS	Numeric Socomec Delta Consul Neowatt UPS Power
2.	Sealed Maintenance Free Lead Acid Batteries(VRLA)	Shinkobe Exide Global Amar Raja U-PLUS
3.	Isolation Transformer Dry Type	Recon AE Abhishek Electricals
4.	Cables	Universal Skytone Nicco Batra Henlay
D.	**STRUCTURED CABLING SYSTEM (VOICE / DATA)**	
1.	Cat-6 Cable	Penduit Schneider Beldon Legrand
2.	Patch Cords, patch panels, cross connect outlet	Amp Schneider Systimax Beldon
3.	Main Distribution Frame	Krone
4.	Metallic Conduit (ISI approved)	AKG BEC
5.	Telephone Armoured Cables	Finolex Skytone
6.	Data Rack	Legrand Retail Scheinder
7.	Data Switch	CISCO
8.	EPBAX	Alktel Siemens

S. No.	Details of Materials / Equipment	Manufacturer's Name
E.	**PA**	
1.	Bullet Amplifiers	Catvision Dx Portopia Pacific Vision Hire
2.	LNB	Eurostar Gardiner
3.	Speaker	Ateis Bose Bosch Philips
4.	R.F. amplifiers (Head end Amplifiers & Line Amplifiers)	Catvision Gain star Scientific Atlanta Triscope Vision Hire
F.	**FIRE DETECTION & ALARM SYSTEM**	
1.	Fire Alarm System with components / Accessories (i.e. FACP, Notification Appliances, Interfacing devices & Initiating devices) as per as per technical specifications.	Notifier Edwards (GST) Honeywell (Morley) Schrack
2.	FRLS / Fire Survival cable / other cables	KEI Skytone Havells Fusion
3.	PVC FRLS Conduit Accessories	AKG BEC Relision
4.	Cable Tray	AKG MEM SPC

S. No.	Details of Materials / Equipment	Manufacturer's Name
G.	**CCTV SYSTEM**	
1.	Indoor/Outdoor IP Cameras	Honeywell Pelco Bosch Hakvision (USA)
2.	Joystick with Keyboard	Honeywell Pelco Bosch Hakvision (USA)
3.	Network video management and recording software	Milestone Genetec Nice
4.	Recording/Management Server	IBM Dell HP
5.	Fiber based SAN Storage with RAID	IBM DELL HP EMC
6.	LED Screen	Samsung Panasonic LG
7.	Rack	AP APW President Valrack

A P P E N D I X – III

LIST OF INDIAN STANDARDS (IS)

IS-325 Three phase induction motors

IS-398 (part-1) Aluminium stranded conductors

IS-694 PVC insulated cables for working voltage up to 1100V

IS-732 Code of practice for electrical wiring installation

IS-900 Code of practice for installation and maintenance of induction motors

IS-1248 Electrical measuring meters : Part 1,2,3,4,5,6,7,8,9

IS-1255 Code of practice for installation and maintenance of power cables including andup to 33 kV rating

IS-1293 Three pin plugs and socket outlets

IS-1554 (Part-1) Specification for PVC insulated (heavy duty) electric cables for working voltage up to andincluding 1100V

IS-1554 (Part-2) Specification for PVC insulated (heavy duty) electric cables for working voltage from 3.3 to 11 KV

IS-1646 Electrical installation fire safety of buildings (general) Code of practice

IS-1777 Industrial luminaire with metal reflectors

IS-1885 Glossary of items for electrical cables and conductors

IS -1913 General and safety requirements for fluorescent lamps luminaries Tubular.

IS-1944 Part 1 &2 – Code of practice for lighting of public through fares

IS-2026(Part 1 to 4) Specification for power transformers

IS-2071(Part1 to 3) Method of high voltage testing

IS-2147 Degree of protection provided by enclosures for low voltage switchgears and control gears.

IS-2148 Specification for double compression cable glands

IS-2309 Protection of building and allied structure against lightning.

IS-2418 Tubular fluorescent lamps for general lighting service

IS-2440 Guide for day lighting of building

IS-2551 Danger notice board

IS-2667 Fittings rigid steel conduits for electrical wiring

IS-2705(Parts 1 to 4) Specification for Current transformer

IS-3043 Code of practice for earthing

IS-3070 Lightning arrester for alternating current system

IS-3419 Fittings for rigid non-metallic conduits

IS-3427 Metal enclosed switchgear and control gear for voltages above 1000V but not exceeding 11000V

IS-3480 Flexible steel conduits for electrical wiring

IS-3639 Fittings and accessories for power transformers

IS-3636(Part 1 & 2) Code of practice for interior illumination

IS-3837 Accessories for rigid steel conduits for electrical wiring

IS-3854 Switches for domestic and similar purpose

IS-3961(Parts 2,3 & 5) Current ratings for cables

IS-4004 Application guide for surge arrestors for AC system

IS-4012 Specification for dust proof electric light fittings

IS-4013 Specification for dust tight electric light fittings

IS-4146 Application guide for voltage transformers

IS-4160 Interlocking switch socket outlets

IS-4615 Switch socket outlets (non-interlocking type)

IS-5039 Specification for distribution pillars upto 1100V AC

IS-5133(part 1) Boxes for enclosure of electrical accessories Part-1 : Steel & cast iron boxes

IS – 5077 Decorative lighting outfits

IS-5216(Part 1&2) Recommendation on safety procedures and practices in electrical works

IS : 5578 & Marking and arrangement of bus bars – 11353

IS-5819 Recommended short circuit rating of high voltage PVC cables

IS-5987 Code of practice for selection of switches

IS-6600 Guide for loading oil immersed transformers

IS - 6616 Ballast for HP MV lamps

IS-7098(part2) Cross-linked Polyethylene (XLPE) insulated PVC sheathed cables For working voltages from 3.3 KV up to and including 33 KV

IS-7987 Guide for selection of HT AC circuit breakers

IS-8623(Part1,2&3) Specification for Low voltage switchgear and control gear assemblies

IS-8828 Circuit breakers for household applications – MCB

IS-9537(Part 1 &2) Rigid steel conduits

IS-9537(Part 3) PVC rigid conduits

IS-10028(Part 1,2&3) Code of practice for selection, installation and maintenance of transformer

IS-10118(Part 1,2,3&4) Code of practice for selection, installation and maintenance of switchgear and control gear

IS – 10322 (Part-1) Luminaries – General requirement

IS – 10322 (Part-2) Luminaries – Constructional requirement

IS – 10322 (Part-3)

IS- 10810 Methods of test for cables

IS-11171 Specification for dry type transformer

IS-12360 Voltage bands for electrical installation including preferred voltages and frequency

IS-12640 Specification for RCCB

IS-12729 Switchgear and control gear for voltage exceeding 1000V

IS-12943 Specification single compression cable gland

IS – 13021 (Part-1) Electronic Ballasts for fluorescent lamps – General & Safety requirement

IS – 13021 (Part-2) Electronic Ballasts for fluorescent lamps – Performance requirement

IS – 13021 (Part-3) Luminaries – Screw and Screwless termination

IS – 10322 (Part-4) Luminaries – Methods of Tests

IS- 10322 (Part-5/Sec-1) Particular requirement – General purpose Luminaries

IS-10322 (Part-5/Sec-2) Particular requirement – Recessed Luminaries

IS -10322 (Part-5/Sec-3) Particular requirement - Luminaries for Road and Street lighting

IS -10322 (Part-5/Sec-4) Particular requirement – Portable General purpose Luminaries

IS -10322 (Part-5/Sec-5) Particular requirement – Flood Lighting

IS-13118 Specification for high voltage AC circuit breakers

IS-13703 Specification for low voltage fuses upto 1000V

IS-13947(Part 1,23) Specification for low voltage switchgear and control gear

IS-15652-2006 Specification for rubber mats for electrical purposes

IS : 1651 & 1652Stationary cells and batteries lead acid type.

IEEE 32 : Standard requirements, terminologies , test procedures for Neutral Grounding Resistors

IEEE 446 : Recommended practices for Emergency & standby power systems

IEEE 519-1992:IEEE recommended practices & Requirements for harmonic control in Electrical Power Systems

IEEE 1100 :IEEE Recommended Practice for Powering and Grounding Electronic Equipment

IEEE 241Recommended Practice for Electric Power Systems in Commercial Buildings

A P P E N D I X – IV

ABBREVIATIONS

The following abbreviations have been used in the accompanying Specifications, drawings and Schedule of Quantities.

CU	stands for copper.
GI	stands for Galvanised Iron (Mild Steel)
V	stands for Volts
KV	stands for Kilo Volts
HV	stands for High Voltage (3.3 KV and above)
MV	stands for Medium Voltage (110 V ,230 V ,415 V, 600 V, 110 V)
LV	stands for Low Voltage (32 V & Below)
HT	stands for High Tension
LT	stands for Low Tension
VCB	stands for Vacuum Circuit Breaker
PVC	stands for Polyvinyl Chloride
AMP	stands for Amperes
KWH	stands for Kilowatt Hours
KW	stands for Kilo Watts
BIS	stands for Bureau of Indian Standards
IS	Stands for Indian Standards
IEC	stands for International Electrotechnical Commision
IEE	stands for Institution of Electrical Engineers - London
IEEE	stands for Institution of Electrical & Electronics Engineers
NEC	stands for National Electrical Code
ACB	stands for Air Circuit Breaker
RCCB	stands for Residual Current Circuit Breaker
MCB	stands for Miniature Circuit Breaker
MCCB	stands for Moulded Case Circuit Breaker
SP	stands for Single Pole
DP	stands for Double Pole
TP	stands for Triple Pole
TPN	stands for Triple Pole and Neutral

4 Pole	stands for 3 phase and neutral of same capacity (size)
MDB	stands for Main Distribution Board
SDB	stands for Sub Distribution Board
FDB	stands for Final Distribution Board
MCC	stands for Motor Control Centre

TECHNICAL SPECIFICATIONS

1. INTERNAL WIRING

1.1 SYSTEM OF WIRING

The system of wiring shall consist of PVC insulated copper stranded conductor flexible FRLS wires in metallic / nonmetallic (Rigid heavy Duty ISI -marked fire retarded PVC Conduits of minimum 2mm Wall thickness and Sizes starting from 20 mm diameter) conduits and shall be concealed or surface mounted above false ceiling as called for.

1.2 GENERAL

Prior to laying and fixing of conduits, the contractor shall mark the conduit route, carefully examine the working drawings prepared by him and approved by the Consultant indicating the layout, satisfy himself about the non-interference in the route, sufficiency of number and sizes of conduits, location of junction boxes, sizes and location of switchboxes and other relevant details. Any discrepancy found shall be brought to the notice of the Owner's site representative. Any modifications suggested by the contractor should get written approval before the actual laying of conduits is commenced.

In laying of conduits it is important that not more than two right angle bends are provided for each circuit without a pull box. No junction box shall be provided in the entire length of conduit run for drawing of wires. Only switch outlets, lighting fixture outlets, equipment power outlets and socket outlets shall be considered for drawing of wires.

1.3 METAL CONDUITS & ACCESSORIES

1.3.1 Conduits

Conduits and Accessories shall conform to latest edition of Indian Standards IS-9537 part 1 & 2.16/14 (16 gauge upto 32mm diameter& 14 gauge above 32 mm diameter) gauge screwed GI or MS conduits as specified on schedule of quantities shall be used. Joints between conduits and accessories shall be securely made by standard accessories, as per IS-2667, IS-3837 and IS-5133 to ensure earth continuity. All conduit accessories shall be threaded type only. Threaded metal shall be painted with bitmastic paint.

Only approved make of conduits and accessories shall be used. Conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of the manufacturer.

Note: *Whatever materials required to be billed by the Contractor should come on site with proper Challan Numbers and quantity mentioned in each such Challan.*

1.3.2 Joints

All jointing shall be subject to the approval of the Owner's site representative. The threads and sockets shall be free from grease and oil. End termination of conduit on GI boxes shall bemeans of hexagon check nuts & spring washer on both sides of the conduit. The joints in conduits shall befree of burrs to avoid damage to insulation of conductors while pulling them through the conduits. Rubberised bushes shall be used in the conduit entry and exit from DBs, switch boxes etc, so that wires are protected from damage to insulation of the incoming and outgoing wires

1.3.3 Recessed Or Exposed Conduits

All conduits shall be as per Schedule of Quantities.

1.3.4 Flexible Conduits

Flexible conduits shall be made of heavy gauge MS strip galvanized after making the spiral. Both edges of the strip to have interlocking to avoid opening up.

Flexible conduit shall be heat resistant, lead coated steel, water leak, fire and rust proof. The flexible conduit shall be heat resistant on continuous temperature upto 150 deg. C and intermittent temperature upto 200 deg. C. The flexible conduit shall be corrosion resistant as per IS-3480 & BS-731.

1.4 PVC CONDUIT AND ACCESSORIES

PVC Conduit

Conduits and accessories shall conform to latest edition of IS-9537 part 3 and shall be heavy duty with minimum wall thickness of 2.0 mm rigid tubes which are unscrewed without coupling and with plain ends. All conduits used shall be ISI-marked and shall not be less than 20 mm diameter.

Heavy duty Low smoke FR PVC conduit shall be used when specified.

The layout of conduit should be such that any condensation or sweating inside the conduit is drained out. Suitable precaution should also be taken to prevent entry of insects inside the conduit.

PVC Conduit Accessories

Accessories used for conduit shall be of an approved brand and type complying to relevant IS code.

All accessories used shall be of standard white or black colour, identical to conduit used.

Plain conduits shall be joined by slip type of couplers with manufacturer's standard sealing cement.

All conduit entries to outlet boxes, trunking and switchgear are to be made with adaptors female thread and screwed male bushes.

PVC-switch and socket boxes with round knockouts are to be used. The colours of these boxes and the conduits shall be the same.

Standard PVC circular junction boxes are to be used with conduits for intersection, Tee-junction, angle-junction and terminal. For the drawing-in of cables, standard circular through boxes shall be used.

Samples of accessories shall be submitted for approval prior to installation.

All jointing of PVC conduits shall be by means of adhesive jointing. Adequate expansion joints shall be allowed to take up the expansion of PVC conduits.

Conduit shall have the solvent cement capabilities for permanent joint and all conduit joints shall be made by using the solvent cements.

1.5 BENDS IN CONDUIT

Where necessary, bends or diversions may be achieved by means of bends and / or circular cast iron boxes with inspection cover and with adequate and suitable inlet and outlet screwed joints. In case of recessed system each junction box shall be provided with a cover properly secured and flush with the finished wall surface. No bends shall have radius less than 7.5 cms or three times the outside diameter of the conduits. For metallic conduits, bends of defined radius shall be made by compactly filling fine sand inside the conduit length, to avoid non-uniform shape, once the bend is done. Proper jigs shall be used to ensure that the Enamelling /Galvanising of the Conduit is not damaged.

1.6 FIXING OF CONDUITS

All conduits shall be installed so as to avoid direct exposure to steam, hot water or any other process pipes. After the conduits, junction boxes, outlet boxes and switch boxes are installed in position, their outlets shall be properly plugged or covered so that water, mortar, rodents and insects , insects or any other foreign matter does not enter into the conduit system.

Surface conduits shall be fixed by means of heavy gauge GI saddles secured at intervals not more than 1000 mm, and on either side of couplers or bends or similar fitting saddles shall be fixed at a distance of 300 mm from centre of each fitting. For conduit fixing suitable PVC/Nylon fasteners shall be used.

The saddles should not be less than 24 gauge for conduits upto 25mm dia and not less than 20 gauge for larger diameter conduits. The corresponding widths shall be 19mm & 25mm. Where conduit pipes are to be laid along the trusses, steel joint etc. the same shall be secured by means of special clamps made of MS. Whereas it is not possible to drill holes in the trusses members suitable clamps with bolts and nuts shall be used (as per instruction of Engineer in charge).

For 25mm diameter conduit width of clip shall be 19mm and of 20SWG. For conduit of 32 mm and above, width of clip shall be 25mm and of 18SWG.Where conduit pipes are to be laid above false ceiling, either conduit pipes shall be clamp to false ceiling frame work or suspended with suitable supports from the soffit of slab. For conduit pipe run along with wall, the conduit pipe shall be clamped to wall above false ceiling in uniform pattern with special clamps if required to be approved by the Engineer at site

Recessed conduiting shall be done by making chase in the masonry by chase cutter; the conduit shall be fixed in the chase by means of GI hooks not more than 600 mm apart. After fixing of conduit the chase shall be filled with cement mortar after fixing of chicken mesh and brought to the original finish level of the surface to the entire satisfaction of Owner.

The chase in the wall shall be neatly made and of ample dimensions to permit the conduit to be fixed in the manner desired. In the case of building under construction, conduit shall be buried in the wall before plastering and shall be finished neatly after erection of conduit. In case of exposed brick/rubble masonry work, special care shall be taken to fix the conduit and accessories in the position along with the building work. Entire work of chasing the wall, fixing the conduit in chases, and burying the conduit in mortar before plastering shall form part of point wiring work. The conduit pipe shall be fixed by means of staples or by means of saddles not more than 60cm apart or by any other approved means of fixing. Fixing of standard bends and elbows shall be avoided as far as practicable and all curves maintained by bending the conduit pipe itself with treated with some approved preservative compound to secure protection against rust. Suitable inspection boxes to the barest minimum requirements shall be provided to permit periodical inspection and to facilitate replacement of wires, if necessary. These shall be mounted flush with the wall. Suitable ventilating holes shall be provided in the inspection box covers. Wherever the length of conduit run is more than 10 meters, then circular junction box shall be provided. Each pipe should be connecting through junction box.

1.7 SWITCH OUTLETS AND JUNCTION BOXES

All outlet boxes for switches, sockets and other receptacles shall be rust proof and shall be of 1.6 mm thick mild steel sheets with HOT dipped galvanizing (or as specified in SOQ), having smooth external and internal surfaces to true finish. All outlet boxes for receiving plug sockets and switches shall be fabricated to approved sizes. All boxes shall have adequate number of knock out holes of required diameter and earthing terminal screws. Outlet boxes shall generally be of 50mm depth subject to maximum depth of 65 mm.

1.8 INSPECTION BOXES

50 mm dia inspection boxes and pull boxes shall have smooth external and internal finish to facilitate removal and replacement of wires, where required.

The conduit of each circuit or section shall be completed before conductors are drawn in. The entire system of conduit after erection shall be tested for mechanical and electrical continuity throughout and permanently connected to earth conforming to the requirement by means of special approved type of earthing clamp effectively fastened to conduit pipe in a workmen like manner for a perfect continuity between the earth and conduit. Gas, Water pipe shall not be used as earth medium.

1.9 FISH WIRE

To facilitate subsequent drawing of wires in the conduit, GI fish wires of 2.0 mm (14 SWG) shall be provided along with the laying of recessed conduit.

1.10 CONDUCTORS

All PVC insulated copper conductor flexible FRLS or ZHFR, as specified in BOQ, wires shall conform in all respects to Standards as listed under sub-head Indian Standards and shall be IS approved and ISI marked.

1.11 BUNCHING OF WIRES

Wires carrying current shall be so bunched that the outgoing and return wires are drawn into the same conduit. Wires originating from two different phases shall not run in the same conduit. All wires shall have ferrules for identification. Lighting and power circuits shall be separate. Each Power/ Light Circuit's Neutral shall be individual per Circuit and shall not be looped from any other Circuit.

1.12 DRAWING CONDUCTORS

The drawing and jointing of PVC insulated copper conductor wires shall be executed with due regard to the following precautions. While drawing wires through conduits, care shall be taken to avoid scratches and kinks which may cause breakage of conductors. There shall be no sharp bends. Wire reel stands to be used for pulling of wires to avoid kinks. Care shall be exercised while drawing the wires from reels, by taking appropriate measures to ensure that wires are not spread on ground, causing dust and dirt accumulation on the new wires.

Maximum permissible number of 1100 volt grade PVC insulated wires that may be drawn into metallic Conduits are given below:

Size of wires Nominal Cross Section Area (Sq. mm.)	**Maximum number of wires within conduit size(mm)**				
	20	**25**	**32**	**40**	**50**
1.5	5	10	14	--	--
2.5	5	8	12	--	--
4	3	7	10	--	--
6	2	5	8	--	--
10	--	3	5	6	--
16	--	2	3	6	6
25	--	--	2	4	6
35	--	--	--	3	5

Maximum permissible number of 1100 volt grade PVC insulated wires that may be drawn into rigid non metallic or PVC Conduits are given below:

Size of wires Nominal Cross Section Area (Sq. mm.)	**Maximum number of wires within conduit size(mm)**				
	20	**25**	**32**	**40**	**50**
1.5	7	12	16	--	--
2.5	5	10	14	--	--
4	4	8	12	--	--
6	3	6	8	--	--
10	--	4	5	6	--
16	--	3	3	6	6
25	--	--	2	4	6
35	--	--	--	3	5

Insulation shall be removed by insulation stripper only. Few Strands of wires shall not be cut/reduced for convenience in connecting into terminals. The terminals shall have sufficient cross sectional area to take all strands and it's connecting brass screws shall have flats ends. All looped joints shall be connected through terminal block/connectors. The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less. All light points shall be terminated through a connector.

Conductors having nominal cross sectional areas exceeding 10 sq.mm shall always be provided with cable sockets. At all bolted terminals brass flat washer of large area and approved steel spring washer shall be used. Brass nuts and bolts with brass washers shall be used for all connections.

Only licensed wiremen (Before doing the work or before appointing him on site contractor has to submit his wiring license to Owner) and cable jointers shall be employed to do jointing work. Before entrusting cable jointing work to any technician, or before appointing Cable Jointers or Wiremen on Site, Contractor has to submit such Technicians' / Wireman's / Cable Jointer's license to Owner.

All wires and cables shall be embossed with the manufacturer's label with ISI mark and shall be brought to site in original packing. For all internal wiring. PVC insulated wires of 1100 volts grade (FRLS) shall be used.

The sub-circuit wiring for point shall be carried out in loop system and no joints shall be allowed in the length of the conductors. No wire shall be drawn into any conduit until all defective work of conduit installation of any nature that may cause injury to wire is completed. Care shall be taken while pulling out the wires so that no damage occurs to conduits/wire itself, the conduits shall be thoroughly cleaned of moisture, dust , dirt or any other obstruction. The minimum size of PVC insulated copper conductor wires for all sub-circuit wiring for light points shall be minimum 2.5 sq.mm copper. Separate neutral to be pulled for each circuit.

1.13 JOINTS

All joints shall be made at main switches, distribution boards. socket outlets, lighting outlets and switches boxes only. No joints shall be made in conduits and in junction boxes. Conductors shall be continuous from outlet to inlet.

1.14 MAINS AND SUB-MAINS

Mains and sub-mains cable or wires where called for shall be of the rated capacity and approved make. Every main and sub main wires shall be drawn into an independent adequate size of conduit. Earthing shall be in conformity with relevant IS codes and calculations shall be submitted for verification. An independent earth wire of the proper rating shall be provided for every single phase sub-main. For every 3 - phase sub-main, 2 No. earth wires of proper rating shall be provided along with the sub-main.

The earth wires shall be drawn along with circuit wires through conduit. Where mains and sub-mains cables are connected to switchgear, sufficient extra lengths of cable shall be provided to facilitate easy connections and maintenance. Where ever necessary, powder-coated 1.6 mm thick sheet steel covering (also called trunking) shall be provided to cover the group of conduits and cables entering and exiting the Wall mounted/Floor mounted Sub-DBs, DBs, and FDBs, so that the Installation looks neat .The colour of such sheet steel covering (trunking) shall be matching with the colour of the SDBs, DBs and FDBs

1.15 LOAD BALANCING

Balancing of circuits in three phase installation shall be as planned by the Consultants in the tender drawings and shall be checked by the contractor before the commencement of wiring and shall be strictly adhered to.

1.16 COLOUR CODE OF CONDUCTORS

Colour code shall be maintained as indicated by the Consultant for the entire wiring installations. Red, yellow, blue shall be for three phases, black for neutral and green with yellow band shall be for earthing.

1.17 FLOOR RACEWAY

Floor raceway shall be of 2mm thick heavy duly hot dipped galvanised and the dimensions for the same shall be as per the BOQ. The raceways shall be as per the make specified in the tender. The raceways shall be free of any sort of welding edges or other sharp edges to protect cutting of wires during pulling. The raceways shall be laid with use of junction boxes fabricated from 2mm thick hot dip GI.

Junction Boxes: Junction boxes made of sheet metal having a corrosion resistant finish. Provide access opening with heavy gauge inner plate and capable of minimum leveling adjustment of 3/8 inch after base has been fastened in floor slab. Provide junction box with 4 screws for adjusting height and leveling complete box. Provide the following additional features junction box raceway openings to match raceway system.

Contractor to provide hold-down strap for securing raceway in the floor

1.18 INSTALLATION

INSPECTION: Examine areas and conditions under which under floor raceways are to be installed, and substrate which will support raceways.

GENERAL: Install under floor raceways as indicated, in accordance with manufacturer's written instructions, applicable requirements of NFPA 70, and National Electrical Contractors Association (NECA) "Standard of Installation" and complying with recognized industry practices.

COORDINATION: Coordinate with other work including metal and concrete deck work, as necessary to interface installation of electrical raceways and components of other work. Plan and route under floor raceway systems to prevent interference with other work without increasing thickness of floor construction.

2. SWITCHES, RECEPTACLES (MODULAR), LIGHTING FIXTURES

All switches shall be enclosed type flush mounted suitable for 240 volts AC. All switches shall be fixed inside the switch boxes on adjustable flat M S strips/plates with tapped holes and brass machine screws, leaving ample space at the back and sides for accommodating wires. Switch controlling the light point shall be connected to the phase wire of the circuit and load shall be restricted to maximum **800 watts per switch & maximum 1500 watts per circuit**. All wiring accessories shall be BIS approved. Perfect alignment shall be maintained while fixing of the back boxes.

All switches and sockets are modular type which shall be made of fire retardant; self-extinguish polycarbonate plastic, able to withstand the glow wire test ai 960 deg. C.

The switches shall confirm IS 3854 :1997, The internal design of terminals and contact shall make the switch capable of high overload conditions, The switch shall be of flush type with silver inlay contact on pure copper

All switches, sockets, telephone outlets, TV controlling the lights or fans shall be connected to the phase wire of the circuit. Switches shall be located at 1200mm above finished floor level unless otherwise indicated on drawings.

Switches shall be suitable for indoor or outdoor service according to location housed in standardized purpose manufactured galvanized steel boxes completed with conduit knockouts made up into single or multi-gang units employing a grid switch system of fully interchangeable components at standardized fixing centers of matching switches of different types and ratings but of identical dimensions, push buttons, neon indicator lamps, blanking units, grids, steel boxes and plates all capable of integration into standard composite assemblies in any combination as required.

Grids shall be adjustable for variation in depth of plaster and for squaring errors and of the same type for surface or flush mounting.

Switches located on brick or concrete walls shall be mounted in horizontal arrangement in plaster depth steel boxes or in galvanized steel boxes using box suspension straps and cover plates. Countersunk screws shall be provided for fixing to the conduit boxes.
Switches for external use shall be of weatherproof construction with IP65 rating unless otherwise specified. Samples of all switches, conduit boxes and plaster depth boxes shall be submitted to the Engineer for approval prior to installation.

Switches shall be rated for 6 Amps (minimum light switch rating 6A), 16 Amps or 20 Amps (as determined by circuit load). Inductive lighting circuit shall be assessed at twice the steady state connected load current.

2.1 SOCKET OUTLET

Socket outlets shall be of the three pin. All socket shall fully comply with IS 1293: 2005 specifications.

The switch controlling the socket outlet shall be on the phase wire of the circuit and not more than two socket outlets of 16 amps shall be connected on one circuit. An earth wire shall be provided along with the circuit wires and shall be connected to earthing screw inside the box. All sockets shall be shuttered type.

a. Every socket outlet shall be controlled by an individual switch unless mentioned otherwise.

b. The switch controlling the socket outlet shall be on the `Live' side of the line.

c. 6 amps and 16 amps socket outlet shall normally be fixed at any convenient height above the floor level as desired by the Architect. The switch for 6 and 16 amps, socket outlet shall be kept along with the socket outlet. However, in special case, if desired by the Architect the 6 amp. socket outlet can be placed at the normal switch level.

   16 amps socket outlet in the kitchen of the residential or commercial buildings shall be fixed at any convenient height above working platform or as specified in drawings / schedule of equipments.

   In a room containing a fixed bath or shower, there shall be no socket outlet and there shall be no provision for connecting a portable appliance. Any stationary appliance connected permanently in the bath room shall be controlled by an isolator switch or circuit breaker having outlets at such location where water / moisture does not effect. Generally, switches and outlets shall be planned at a minimum distance of 1.5 Metre away from any water supply outlet, so that splashed water may not affect the live installation.

d. Where socket outlets are placed at lower level, they shall be enclosed in a suitable metallic box with the system of wiring adopted or shutter type sockets shall be provided as specified.

e. In an earthed system of supply, a socket outlet and plug shall be of three pin type, the third terminal shall be connected to earth.

f. Conductors connecting electrical appliance with socket outlet shall be flexible twin cord with an earthing cord which shall be secured by connecting between the earth terminal of plug and the metallic body of the electrical appliance.

g. Where use of shutter type of interlocking type of socket is required for any special installation, the items should be separately and specifically listed in the Schedule of Quantities of that particular work.

h. All switches, sockets, telephone and TV outlets etc. shall be fixed on 3mm thick phenolic laminated sheet cover unless otherwise called for in drawing or BOQ. Flush cover plate shall be secured to the box with counter sunk brass screws & cup washers.

i. All 5 and 15Amp socket outlet shall be modular type 5/6 pin respectively. Each outlet shall have a switch located beside the socket preferable on the same flush cover plate.

j. The earth terminal of the socket shall be connected to the earth wire.

Generally switch socket outlets shall be positioned 300 mm above floor level except in plant rooms, kitchen, etc. where they shall be positioned 1400 mm above floor level or 150 mm above counters or benches as per requirement unless otherwise specified.

2.2 LIGHTING FIXTURES & ACCESSORIES

The light fixtures and fittings shall be LED type assembled and installed in position complete and ready for service, in accordance with details, drawings, manufacturer's instructions and to the satisfaction of the Project Manager.

2.2.1 Scope:

Scope of work under this section shall include inspection at suppliers/manufacturer's premises at site, receiving at site, safe storage, transportation from point of storage to point of erection, erection and commissioning of light fittings, fixtures and accessories including all necessary supports, brackets, down rods and painting etc. as required.

2.2.2 Standards:

The lighting and their associated accessories such as lamps, reflectors, housings, ballasts etc., shall comply with the latest applicable standards, more specifically the following:

Industrial lighting fittings with metal reflectors	-	IS - 1777
Decorative lighting outfits	-	IS - 5077
Bayonet lamp holders	-	IS - 1258
Bi-pin lamp holders for tubular fluorescent lamps	-	IS - 3323
Luminaries – General requirement	-	IS – 10322 (Part-1)
Luminaries – Constructional requirement	-	IS – 10322 (Part-2)
Luminaries – Screw and Screwless termination	-	IS – 10322 (Part-3)
Luminaries – Methods of Tests	-	IS – 10322 (Part-4)
Particular requirement – General purpose Luminaries	-	IS – 10322 (Part-5/Sec-1)
Particular requirement – Recessed Luminaries	-	IS – 10322 (Part-5/Sec-2)
Particular requirement – Luminaries for Road and Street lighting	-	IS – 10322 (Part-5/Sec-3)
Particular requirement – Portable General purpose Luminaries	-	IS – 10322 (Part-5/Sec-4)

2.2.3 Light Fittings-General Requirements **:**

a. Fittings shall be designed for continuous trouble free operation under atmospheric conditions without reduction in lamp life or without deterioration of materials and internal wiring. Degree of protection of enclosure shall be IP-65 for outdoor fittings except bulkhead fitting. Bulkhead fitting shall be provided with IP-54 protection.

b. Fittings shall be so designed as to facilitate easy maintenance including cleaning, replacement of lamps/ ballasts.

d. Each fitting shall have a terminal block suitable for loop-out connection by 1100 V PVC insulated copper conductor wires upto 4 sq.mm. the internal wiring should be completed by the manufacturer by means of standard copper wire and terminated on the terminal block.

e. All hardware used in the fitting shall be suitably plated or anodized and passivated.

f. Earthing: Each lighting fitting shall be provided with an earthing terminal. All metal or metal enclosed parts of the housing shall be bonded and connected to the earthing terminal so as to ensure satisfactory earthing continuity throughout the fixture.

g. Painting/Finish: All surfaces of the fittings shall be thoroughly cleaned and degreased and the fittings shall be free from scale, rust, sharp-edges, and burns.

h. The housing shall be powder coated/stove-enameled or anodised as required. The surface shall be scratch resistant and shall show no sign of cracking or flaking when bent through 90 deg. over 12 mm dia mandrel.

2.2.4 Light Fittings – Special Requirements

All lighting fixture shall be LED type with minimum 80% efficacy. The Down light shall be with 90 lumen/watt, 2'x2, and TL fitting shall be with 120lumen/watt with 50000 Buring hours and less than 3% THD and power factor shall be minimum 0.8.

Box Channel Type Industrial Fittings

Box type slim line channel must be in screwless construction manufactured from M.S. CRCA sheet steel powder coated with MS CRCA cover, powder coated white. Light reflection surface in Box/Channel type fittings shall be in a Polyester pre-coated steel having a reflection factor of not less than 80%. Screw less design & construction Light fixtures shall be preferred due to their ease of maintenance, especially for box/channel for box/channel type fixtures.

Moisture Proof Industrial Fittings

Surface mounted totally enclosed moisture proof fixtures must be in polycarbonate body and diffuser with transparent prismatic interior and smooth exterior and frosted end. Fixture must be completely sealed with polyurethane double gasket to achieve IP 65 protection. Fixture is complete with CRCA steel white powder coated / enameled finish reflector.

2.2.5 Accessories for Light Fittings - Reflectors

The reflectors shall be made of CRCA sheet steel/aluminium /Silvered glass/Chromium plated sheet copper as specified. The thickness of reflectors shall be as per relevant standards. Reflectors made of steel shall have stove enameled/ vitreous enameled/epoxy coating finish. Aluminium used for reflectors shall be anodized/epoxy stove enameled /mirror polished. The finish for the reflector shall be as specified. The reflectors shall be free from scratches / blisters and shall have a smooth and glossy surface having optimum light reflecting coefficient. Reflectors shall be readily removable from the housing for cleaning and maintenance without use of tools.

2.2.6 Installation

Fixtures shall be installed at mounting heights as detailed on the Drawings or as instructed on site by the Engineer.

All light fittings shall be supported with appropriate fixing accessories such as clips, supporting brackets, suspension sets, nuts, washers, screws etc. for their proper installation on different types of ceiling panels. Suspension sets shall be of adjustable type suitable to carry the weight of the lighting fittings unless otherwise stated or indicated on drawings. The suspension sets shall be generally of 900 mm length. Exact lengths required shall be provided to suit the site requirement.

2.2.7 The Testing

After all lighting fixtures are installed and are connected their respective switches, test all fixtures to ensure operation on their correct switch in the presence of the Engineer. All un-operating fixtures or ones connected to the wrong or inconveniently located switch shall be correctly connected as directed by the Engineer.

3. MEDIUM VOLTAGE 1.1 KV GRADE XLPE / PVC CABLES

3.1 GENERAL

The MV cables shall be supplied, inspected, laid, tested and commissioned in accordance with drawings, Specifications, relevant Standard Specifications and cable manufacturer's instruction.

The cables and cables jointing & terminating accessories shall comply with the requirements of latest revision of the following codes/standards, unless otherwise specified:

IS: 1554 -Specification for PVC Insulated (Heavy Duty) Electric Cables

IS: 3961 -Recommended current ratings for cables

IS: 3975 -Mild steel wires, formed wires and tapes for armouring of cables

IS: 5831 -PVC insulation and sheath of electric cables

IS: 6474 -Polyethylene insulation and sheath of electric cables

IS: 7098 –Cross-linked polyethylene insulated PVC sheathed cables

IS: 8130 -Conductors for insulated electric cables and flexible cords

IS: 10810 -Methods of Test for Cables

IEC: 60028 -International Standard of Resistance for Copper

IEC: 60502 -Power cables with extruded insulation & their accessories for rated voltage from 1kV upto 30kV.

IEC 60228 - Conductors of insulated cables. Guide to the dimensional limits of circular conductors.

IEC 60331 Parts11 & 21 -Fire resisting characteristics of electric cables

IEC 60332 Part 3-10 - Tests on electric cables under fire conditions. Part 3: Tests on bunched wires or cables.

IEC 60754 Part 1 - Test on gases evolved during combustion of materials from cables. Part 1: Determination of the amount of halogen acid gas evolved during combustion of polymeric material taken from cables.

IEC 60811 Parts 1 & 2 - Common test methods for insulating and sheathing materials of electric cables.

IEC 60885 Parts 1, 2 & 3 - Electric test methods for electric cables.

IEC 61034 Parts 1 & 2 -Measurement of smoke density of electric cables burning under defined conditions

In case of imported item, the standards of the country of origin shall be applicable if these standards are equivalent or more stringent than the applicable Indian standards.

The cables shall also conform to the provisions of Indian Electricity Rules and other statutory regulations currently in force in the country. In case Indian standards are not available for any item, standards issued by IEC/IEEE or equivalent agency shall be applicable.

3.2 MATERIAL

The MV cables shall be cross linked polyethylene (XLPE) insulated PVC inner sheathed and HR PVC / FRLS PVC outer sheath of 1100 volts grade as asked for in the schedule of quantities. Cables up to 16 sq.mm shall be with copper conductor and 25 sq.mm and above shall be with aluminium conductor.

The MV cables 25 sq. mm & above shall be cross linked polyethylene (XLPE) insulated PVC inner sheathed and FRLS PVC outer sheath of 1100 volts grade. Cables below 25 sq.mm shall be with copper conductor , with HR PVC core insulation and sheathing..

3.2.1 Specifications of PVC insulated copper cable shall be as follows:

a. Conductor

The conductors shall be solid for conductor of nominal area of up to 10 mm2 for Aluminium, and the conductor shall be solid or stranded for nominal area of 1.5 mm2 to 6 mm2 for Copper. The conductor from 10 mm2 and above for Copper and from 16 mm2 and above for Aluminium shall be stranded as per IS 8130. Cables with reduced neutral conductor shall have sizes as per Table 1 of IS 1554.

b. Insulation

The core insulation shall be with PVC compound applied over the conductor by extrusion and shall conform to the requirements of type 'A' compound as per IS: 5831. The thickness of insulation and the tolerance on thickness of insulation shall be as per Table 2 of IS: 1554. Control cables having 6 cores and above shall be identified with prominent and indelible Arabic numerals on the outer surface of the insulation. Colour of the numbers shall contrast with the colour of insulation with a spacing of maximum 50 mm between two consecutive numbers. Colour coding for cables up to 5 cores shall be as per Indian standard.

c. Laying-up

Insulated conductors of multi core cables shall be with thermoplastic fillers in the interstices. The phase identification of cores shall be by coloured strips.

d. Inner Sheath

Cores shall be surrounded either by a wrapped or an extruded PVC sheath.

The inner sheath shall be applied over the laid-up cores by extrusion and shall be of PVC conforming to the requirements of Type ST-1 PVC compound as per IS: 5831. The minimum thickness of inner sheath shall be as per IS: 1554. Single core cables shall have no inner sheath.

e. Armouring

The armouring shall be provided over the inner sheath.

Single core cable shall have dia -magnetic armouring. If armouring is specified for multi core cables in the data sheet, the same shall be by single round galvanized steel wires where the calculated diameter below armouring does not exceed 13 mm and by galvanized steel strips where this dimension is greater than 13 mm. Requirement and methods of tests for armour material and uniformity of galvanization shall be as per IS: 3975 and IS: 10810. The dimensions of Armour shall be as per method (b) of IS: 1554. If armouring is specified for single core cables in the data sheet, the same shall be with H4 grade hard drawn aluminium round wire of 2.5 mm diameter

f. Outer Sheath

Single and multi-core cables are provided with an extruded FRLS grade PVC outer-sheath. The thickness of the sheath shall be as per IS:1554-1988. The PVC compound for the outer-sheath shall confirm to Type ST1 of IS 5831. The colour of the outer sheath shall be black with marking at every meter.

Suitable additives be added to prevent attack by rodents and termites. All serving must be given anti-termite treatment.

3.2.2 Specifications for XLPE aluminum / copper cable shall be as follows:

a. Conductor

Stranded compacted circular conductor shall be of electrical grade high conductivity aluminum per IS 8130/84

b. Insulation

The insulation shall be of natural unfilled chemically cross linked polyethylene conforming to IS 7098. The thickness of insulation shall be as per the relevant codes.

It shall be free from voids and shall withstand all mechanical and thermal stresses under steady state and transient operating conditions.

The insulation screen shall consist of non-metallic extruded semi-conducting compound in combination with a non-magnetic metallic copper/Aluminium screen. Unless specified otherwise, the copper/Aluminum screen for all the three cores together shall be capable of carrying the single line to ground fault current value and the duration specified in the data sheet.

The conductor screen, XLPE insulation and insulation screen shall all be extruded in one operation by Triple Extrusion' process to ensure perfect bonding between the layers. The core identification shall be by coloured strips or by printed numerals

c. Laying-up

Insulated conductors of multi core cables shall be with plastic fibre in the interstices.The phase identification of cores shall be by coloured strips.

d. Inner Sheath

The cores shall be surrounded by either a wrapped or by an extruded PVC sheath.

The thickness of the inner sheath shall be as indicated in the relevant codes.

The inner sheath shall be applied over the laid up cores by extrusion and shall conform to the requirements of type ST 2 compound of IS: 5831. The extruded inner sheath shall be of uniform thickness. In case of single core cables, there shall be extruded inner sheath between insulation metallic screen and armouring.

e. Armouring

The armouring shall be provided over the inner sheath.

Single core cable shall have non-magnetic armouring. Multi core cables shall have either galvanized round steel wires or flat steel strip. Steel wires and strips for armouring confirm to IS:3975. The direction of lay of armouring shall be opposite to that of cores.

f. Outer Sheath

Single and multi-core cables are provided with an extruded FRLS grade PVC outer-sheath. The thickness of the sheath shall be as per IS:1554-1988. The PVC compound for the outer-sheath shall confirm to Type ST2 of IS 5831. The colour of the outer sheath shall be black with marking at every meter.

3.2.3 Current ratings of the cables shall be as per IS : 3961. The Conductor shall be stranded Aluminum/Copper circular/ sector shaped and compacted. In multi core cables the core shall be identified by red, yellow, blue and black coloring of insulation. Repaired cables shall not be used.

3.2.4 The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installation with uncontrolled back fill and chances of flooding by water.

3.2.5 Progressive automatic in line sequential marking of the length of cables in meters at every one meter shall be provided on the outer sheath of all cables.

3.2.6 Cables shall be supplied in non-returnable wooden drums as per IS : 10418.

Both ends of the cables shall be properly sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation, storage and erection.

3.2.7 The product should be coded as per IS :- 7098 Part-I as follows :-

Aluminium Conductor	A
XLPE Insulation	2X
Steel round wire armour	W
Steel strip armour	F
Steel Double round wire armour	WW
Steel Double strip armour	FF
Non-magnetic (Al.) round wire armour	Wa
Non-magnetic (Al.) strip armour	Fa
PVC outer sheath	Y

Control cables and indicating panel cables shall be multi core PVC insulated copper conductor and armoured cables.

3.3 INSPECTION

All cables shall be inspected by the contractor upon receipt at site and checked for any damage during transit.

3.4 JOINTS IN CABLES

The Contractor shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoid cable jointing. This apportion-ing shall be got approved by the Owner's site representative before the cables are cut to lengths. Where joints are unavoidable heat shrinkable type joints shall be made. The location of such joints shall be got approved from the Owner's site representative and shall be identified through a marker.

3.5 JOINTING BOXES FOR CABLES

Cable joint boxes shall be installed with heat shrinkable sleeve and of appropriate size, suitable for XLPE armoured cables of particular voltage rating.

3.6 JOINTING OF CABLES

All cable joints shall be made in suitable, approved cable joint boxes and the filling in of compound shall be done in accordance with manufactures' instructions and in an approved manner. All straight through joints shall be done in epoxy mould boxes with epoxy resin.
All cables shall be joined colour to colour and tested for continuity and insulation resistance before jointing commence. The seals of cables must not be removed until preparations for jointing are completed. Joints shall be finished on the same day as commenced and sufficient protection from the weather shall be arranged. The conductors shall be efficiently insulated with high voltage insulating tape and by using of spreaders of approved size and pattern. The joints shall be completely topped up with epoxy compound so as to ensure that the box is properly filled.

3.7 CABLE END TERMINATIONS

Cable end termination shall be done in cable terminal box using crimping sockets and proper size of glands of double compression type

3.8 BONDING OF CABLES

Where a cable enters any piece of apparatus, it shall be connected to the casing by means of an approved type of armour clamp and gland. The clamps must grip the armouring firmly to the gland or casing, so that no undue stress is passed on to the cable conductors.

3.9 CABLE ACCESSORIES

The termination and straight through jointing kits for use on the systems shall be suitable for the type of cables offered as per this specification.

The accessories shall be supplied in kit form. Each component of the kit shall carry the manufacturer's mark of origin.

The kit shall include all stress grading, insulating and sealing materials apart from conductor fittings and consumable items. An installation instruction sheet shall also be included in each kit.

The contents of the accessories kit including all consumable shall be suitable for storage without deterioration at a temperature of 45° C, with shelf life extending to more than 5 years.

3.9.1 Terminating kits

The terminating kits shall be suitable for termination of the cables to indoor switchgear or to a weatherproof cable box of an outdoor mounted equipment e.g. transformer / motor. For outdoor terminations, weather shields / sealing ends and any other accessories required shall also form part of the kit. The terminating kits shall be from one of the makes / types mentioned in the data sheet.

3.9.2 Jointing kits

The straight through jointing kits shall be suitable for installation on overhead trays, concrete lined trenches, and ducts and for underground burial with uncontrolled backfill and possibility of flooding by water and chemicals. These shall have protection against any mechanical damage and suitably designed to be protected against rodent and termite attack. The inner sheath similar to that provided for cables shall be provided as part of straight through joint. The jointing kits shall be from one of the makes / types mentioned in the data sheet.

3.10 PACKING & DESPATCH

Cables shall be drummed in maximum continuous lengths:

a) Returnable steel drums for all H.V. cables and L.V. cables of large cross sectional areas or long drum lengths.

b) Non-returnable wooden drums where the manufacturer can guarantee that such drums are of sufficient strength to protect cable during shipping, handling and outdoor storage for three year period.

Cable ends shall be sealed and fixed to the drum so that both ends are accessible. To protect the cable during shipment, battens shall be fitted around the entire periphery of the drum. Drums shall be suitable for long term outdoor storage at site.

All cable drums shall have the Purchase Order Number, Purchase Order Item Number, Drum Number and Stock Code Number clearly stenciled on the outside of both flanges.

Drum identification labels shall be of non-corrosive, non-hygroscopic material and attached to the outside and inside of the drum flanges. Labels shall be protected by transparent plastic envelopes and give the following information:

a) Drum identification number and its direction of rotation for cable removal.

b) Cable voltage grade

c) Cable construction (e.g. PVC SWA PVC or AYFY)

d) Number of cores and cross sectional area

e) Cable quantity (Metres)

f) Purchase order number and item number

g) Total weight of cable and drum (kg)

h) Manufacturer's name

i) Year of manufacture

j) Stock code number

The following minimum information shall be furnished.

a) Standard and maximum drum lengths for all the types of cable offered and the proposed drum lengths for all items.

b) Inspection test plan.

c) Cable dimensions (together with tolerances) :
   i. Diameter of (individual in case of multi stranded) conductor wire
   ii. Percentage of compaction as per data sheet.
   iii. Diameter under conductor screen (where applicable)
   iv. Diameter over conductor screen (where applicable)
   v. Diameter over individual core insulators
   vi. Lay of cable in case of multi-core cable
   vii. Diameter over inner sheath (mm)
   viii. Diameter over centre sheath (mm)
   ix. Diameter over lead sheath (mm) (where applicable)
   x. Diameter under armour (mm)
   xi. Diameter over armour (mm)
   xii. Diameter of armour wires (mm)
   xiii. Overall diameter (mm)

d) Cable Physical Properties:
   i. The filler materials to be used.
   ii. Cable weight in kg/km
   iii. Minimum bending radius (x OD)
   iv. Maximum conductor continuous operating temperature (°C)
   v. Suitability of outer sheath to resist attack from chemicals.

e) Cable electrical data :
   i. Conductor dc resistance per km at 20°C
   ii. Conductor ac resistance per km at operating temperature and system frequency
   iii. Conductor inductive reactance per km at system frequency
   iv. Conductor impedance per km at operating temperature and system frequency
   v. Conductor capacitance per km
   vi. Cable armour resistance per km

f) The current carrying capacity of single and multi-core cables when installed in defined conditions in air, in ducts and direct buried in the soil, together with rating factors for varying ambient temperatures, grouping and installation conditions and methods.

g) Cable short circuits withstand capacity presented in graphical form or by formulae.

h) Descriptive literature (catalogues etc.).

i) Cross sectional view of the physical make up of each cable.

j) Recommended temperatures below which installation of cable should not be carried out.

k) Minimum ambient temperature at which cables can be used.

l) Maximum pulling force for each cable and any special pulling instructions.

m) Maximum unsupported run of cable both horizontally and vertically.

3.11 TEST / INSPECTION

After completion of manufacture of cables and prior to dispatch, the cables shall be subjected to type, routine, acceptance and special tests as detailed below. Consultant's / Owner reserve the right to witness all tests with sufficient advance notice from seller. The test reports for all cables shall be approved from the Engineer before dispatch of the cables.

All routine tests, acceptance tests, type tests and additional type tests for improved fire performance shall be carried out as listed in IS: 1554 and IS: 7098 on PVC and XLPE insulated cables respectively.The test requirements for PVC insulation and sheath of cables, shall be as per latest revision of IS: 5831.

Test for Resistance to Ultra Violet Radiation: This test shall be carried out as per ASTMG-53 on outer sheath. Test certificates with respect to this test (not older than one year) from recognised testing laboratory to be furnished for review by Consultant's before dispatch clearance of cables. In case test certificates are not available, test is to be conducted by seller at his own cost in any recognised test laboratory or in house testing laboratory, before dispatch clearance of cables. Sampling for this test is to be done randomly once for each order, provided outer sheath remains same.

Acceptance tests as per IS-1554, IS-7098 and the following special tests to be performed on the cables as per sampling plan.

a) Accelerated water absorption test for insulation as per IS 10810. Test certificates with respect to the test (not older than one year) from recognised testing laboratory to be furnished for review by Consultant's before dispatch clearance of cables. In case test certificates are not available, test is to be conducted by seller at his own cost in any recognized test laboratory or in house testing laboratory, before dispatch clearance of cables. Sampling for this test is to be done randomly once for each order, provided type of insulation remains same.

b) Dielectric Retention Test: The dielectric strength of the cable insulation tested in accordance with NEMA WC - 5 at 75 ± 1° C shall not be less than 50 % of the original dielectric strength. (For PVC insulated cables). Test certificates with respect to this test (not older than one year) from recognized testing laboratory to be furnished for review by Consultant's before dispatch clearance of cables.

   In case test certificates are not available, test is to be conducted by seller at his own cost in any recognized test laboratory or in house testing laboratory, before dispatch clearance of cables. .Sampling for this test is to be done randomly and once for each order.

c) Oxygen Index Test: The test shall be carried out as per IS 10810 or applicable Indian Standard specifications. Sampling to be done for every offered lot/size as per sampling plan.

d) Flammability Test: The test shall be carried out on finished cable as per IS - 10810. Sampling for these tests is to be done randomly once for each order, provided outer sheath remains same. The acceptance criteria for tests conducted shall be as under:

e) The cable meets the requirement if there is no visible damage on the test specimen within 300 mm from its upper end.

f) The maximum extent of the charred portion measured on the test sample should not have reached a height exceeding 2.5m above the bottom edge of the burner at the front of the ladder.

g) Test for rodent and termite repulsion property: The sellers shall furnish the test details to analyse the property by chemical method. Sampling to be done for every offered lot / size as per sampling plan.

3.12 CABLE INSTALLATION

Cables shall be laid by skilled and experienced workmen using adequate rollers to minimize stretching of the cable. The cable drums shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming kinks.

Laying of Cables on Cable Trays

The relative position of the cables, laid on the cable tray shall be preserved and the cables shall not cross each other. At all changes in direction in horizontal and vertical planes, the cable shall be bent smooth with

a radius as recommended by the manufacturers. All cables shall be laid with minimum one diameter gap and shall be clamped at every meter to the cable tray. Cables shall be tagged for identification with aluminum tag and clamped properly at every 20M. Tags shall be provided at both ends and all changes in directions both sides of wall and floor crossings. All cable shall be identified by embossing on the tag the size of the cable, place of origin and termination.

All cables passing through holes in floor or walls shall be sealed with fire retardant Sealant and shall be painted with fire retardant paint up to one meter on all joints, terminations and both sides of the wall crossings

3.13 CABLES INSIDE BUILDING

Cables inside buildings shall be laid on the cable trays. All cables passing through walls shall run through GI Pipes sleeves of adequate diameter 50 mm apart maintaining the relative position over the entire length.

3.14 CABLE TRAYS

Cable Tray and Cable Ladder systems are intended for the support and accommodation of cables and possibly other Electrical equipment in Electrical/Instrumentation/Communication systems.

Design and Fabrication of Cable Trays / Ladders:

The cable trays / ladders shall be fabricated according to the design specified by IEC 61537 and should be tested for Safe Working Load (SWL). The relevant details of SWL and the load chart with respect to SWL, supporting distance and the deflection should be according to the following chart.

Safe Working Load (SWL) with a span length up to 3 meters						
Description	Side Height (in mm)	Width (in mm)	Span length (in meters)			
			1.5m	2m	2.5m	3m
			Permitted Load (in kg/meter)			
Perforated Cable Tray	35	50 - 300	125	90	50	-
	60	50 - 600	150	100	50	-
	85	100 - 600	175	110	50	-
	110	100 - 550	185	130	75	60

Safe Working Load (SWL) with a span length up to 10 meters									
Description	Side Height (in mm)	Width (in mm)	Span length (in meters)						
			4m	5m	6m	7m	8m	9m	10m
			Permitted Load (in kg/meter)						
Perforated Cable Tray for long span distance	110	200 - 300	160	110	75	-	20	-	-
		400 - 600	200	150	100	-	40	-	-
	160	200 - 300	230	180	140	100	70	-	-
		400 - 600	250	200	160	130	100	-	-

Fabrication of Tray and accessories at site and welding is not permitted. In unavoidable circumstances, If any cut or holes are made in the trays/Ladder/ accessories, zinc spray need to be applied over the surface. The metal edge has to be protected by edge protection sleeves to avoid cable damage. Edge of the supports has to be protected with plastic END caps. Screwed connections and internal fixing Devices should not create any damage to the cable when correctly fixed. Sudden or jerky motions shall not be used to tighten reusable screw connections.

Cables shall run in cable tray/ladder mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures using mounting accessories.

The cable tray and all accessories shall be fabricated from sheet steel and has to be hot dip galvanized against corrosion confirming to ISO 1461-1999 for installations in both indoor and outdoor applications &

should have a Base Perforation Class B according to IEC 61537. The cable trays shall be supplied in standard lengths of 3000mm and the width of the tray shall be as follows.

Width: 50, 100, 150, 200, 300, 400, 500, 600 & 750 mm.

All the cable tray accessories like Bend's, TEES's, Cross over's etc should be designed in accordance with IEC 61537 and shall be factory fabricated. The accessories shall be from the same material as of the tray and modular type, it should be connected with the trays by using fasteners. Typical details of trays, fittings and accessories etc. are shown in the enclosed drawings.

For Cable trays designed, tested and confirming to IEC 61537, thickness of cable tray should be according to the manufacturer's catalogue. For locally fabricated and non-tested tray, thickness should be 2 mm up to span length of 1.5 meter, 2.5 mm for span length between 2 to 3 meter and 3 to 4 mm for span length between 4 and 10 meter

3.15 SPECIFICATION FOR HOT DIP GALVANIZING PROCESS

(for Mild Steel Used For Earthing, Cable Trays Or Junction Boxes For Electrical Installation.)

General Requirements

a. Quality of Zinc

Zinc to be used shall conform to minimum Zn 98 grade as per requirement of IS:209-1992.

b. Coating Requirement

Minimum weight of zinc coating for mild steel flats with thickness upto 6 mm in accordance with IS:6745-1972 shall be 400 g/sqm.

The weight of coating expressed in grams per square metre shall be calculated by dividing the total weight of Zinc by total area (both sides) of the coated surface.

The Zinc coating shall be uniform, smooth and free from imperfections as flux, ash and dross inclusions, bare patches black spots, pimples, lumpiness, runs, rust stains bulky white deposits, blisters.
Mild steel flats / wires shall undergo a process of degreasing pickling in acid, cold rinsing and then galvanizing.

3.16 MOUNTING ACCESSORIES (SUPPORTS AND BRACKETS):

The mounting accessories shall be fabricated from steel and has to be hot dip galvanized against corrosion confirming to ISO 1461-1999 for installations in both indoor and outdoor applications and should be of completely modular type.

All supports and Brackets should be factory made, hot dip galvanized after completing welding, cutting, drilling, other machining operations and tested according to IEC 61537 according to the arrangements in the enclosed drawing. The system shall be designed such that it allows easy assembly at site by using Bolts and Nuts. The main support and brackets shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hard ware etc to form various arrangements required to support the cable trays. Welding of the components at the site shall not be allowed.

JOINTS

Joints shall be smooth and without projections or rough edges that may damage the cables.

The Contractor will be required to cover joints with rubber cement or other non-hardeningrubberised or plastic compounds if in the opinion of the Department joints may damage cables.

Joints shall as far as possible be arranged to fall on supports. The two cable tray ends shall butt tightly at the centre of the splice and the splice shall be bolted to each cable tray be means of at least 8 round head bolts, nuts and washers. Splices shall have the same finish as the rest of the tray.

3.17 FIXING TO SUPPORTS

Trays shall be bolted to supports by at least two round head bolts per support. Bolts shall be securely tightened against the tray surface to avoid projections which might damage cables during installation.

3.18 FIXING TO THE STRUCTURE

Where installed on concrete or brick, the supports for cable trays and ladders shall be securely fixed by means of at least 2 heavy duty, expansion type anchor bolts. Cantilevered trays shall be supported by a minimum of two expansion bolts per support.

It is the responsibility of the Contractor to ensure that adequate fixing is provided since cable trays and ladders that work loose shall be rectified at his expense. The fixing shall take in to account site conditions that prevail during installation.

Horizontal trays and ladders shall in general be installed below slabs, ceilings, etc. tofacilitate access during installation of cables.

Multiple runs shall be spaced at least 300 mm apart unless a different spacing is specified.

Corrosion Protection:

The cable tray / ladder/accessories shall be of HOT DIP Galvanized (ISO 1461-1999) for installations in corrosive atmospheres both indoor and outdoor application. Sample tray / ladder / accessories / mounting accessories and supports should be salt spray tested according to ISO 9227 for > 500 hours. (*550 hours according to class 6 for Hot dip Galvanized surface as per ISO)

3.19 TESTING AND CERTIFICATION IF INSTALLATION:

Cable tray / Ladder, bend, T Bend, cross, and all supports are to be tested for Safe Working Load (SWL), deflections, Impact resistance, Salt Spray & Electrical continuity test according to IEC 61537. The cable tray/ladder should not deflect more than 1/100th of the span length at SWL in Mid span and the transverse deflection of all mounting accessories at SWL shall not exceed 1/20th of the length.
The cable tray / cable ladder should be tested up to 1.7 times SWL at minimum and maximum room temperature. The temperature classification of cable tray system should be - 5 to + 150°C.

3.20 MARKING, DOCUMENTATION, COMPLIANCE AND INSPECTION:

Each system component shall be durably and legibly marked with:

-the manufacturer’s or responsible vendor’s name or trade mark or identification mark;

-a product identification mark which may be, for example, a catalogue number, a symbol, or the like.

When system components other than cable tray lengths and cable ladder lengths are supplied in a package, the product identification mark may be, as an alternative, marked on the smallest package unit.

Marking shall be applied, by moulding, pressing, engraving, printing, adhesive labels, or water slide transfers. Compliance is checked by inspection and, for marking on the product, by rubbing by hand for 15 s with a piece of cotton cloth soaked with water and again for 15 s with a piece of cotton cloth soaked with petroleum spirit. Marking made by moulding pressing, or engraving is not subjected to the rubbing test. After the test, the marking shall be legible.

If a system component is stored and transported at a temperature outside the declared minimum and maximum temperatures, the manufacturer or responsible vendor shall declare the precautions and the alternative temperature limits. Compliance is checked by inspection.

The manufacturer or responsible vendor shall provide in his literature all information necessary for the proper and safe installation and use of the cable tray system and cable ladder system. The SWL and impact resistance is valid for the whole temperature classification declared.

3.21 FIRE RETARDANT CABLE PAINT & FIRE BARRIER

The fire retardant paint / barrier shall be listed by independent test agencies such as UL, FM or OPL and be tested to, and pass the criteria of ASTM E 814 (UL1479) standard test method for fire test through-penetration fire stops and ASTM E 1996 (UL 2079) standard test method for fire resistive joint system/

3.21.1 Fire retardant cable Paint

The Fire resistant cable coating / painting shall be intumescent / ablative, water based compound, The coating shall expand up to 10 times, supplied in a manufacturer seal container indicating manufacturing and expiry dates. The coating material shall be non-toxic, asbestos free, & halogen free and shall have good mechanical strength. The colour of paint shall be white and density of coating shall be 1.3kg/ltr, coating shall have a snap time of 30 minutes, the expansion shall begin at 230 deg.C and it shall have a oxygen index of 41%.

Coating shall be applied by ordinary paint brush after cleaning the cables of dust and oil deposition. A minimum textured finish of 3 mm wet film thickness shall be achieved by applying the material in 2-3 layers leaving intervals of 2 to 8 hours depending upon the moisture and thickness, moisture and temperature hours between each coat.

3.22 TESTING OF CABLES

Cables shall be tested at works for all routine tests as per IS including the following tests before being dispatched to site by the project team.

a) Insulation Resistance Test.
b) Continuity test.
c) Sheathing continuity test
d) Earth test.(in armoured cables)
e) Hi Pot Test.

Test shall also be conducted at site for insulation between phases and between phase and earth for each length of cable, before and after jointing. On completion of cable laying work, the following tests shall be conducted in the presence of the Owner's site representative.

a) Insulation Resistance Test(Sectional and overall)
b) Continuity test.
c) Sheathing continuity test
d) Earth test.

All tests shall be carried out in accordance with relevant Standard Code of Practice and Electricity Rules. The Contractor shall provide necessary instruments, equipment and labour for conducting the above tests and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the Owner's site representative, results will be noted and signed by all present and record be maintained.

4(A) DISTRIBUTION PANELS/BOARDS

Main Distribution Panels, Sub-Distribution Panels and Final Distribution shall be covered under this section. Panels/Boardsshallbesuitableforoperationon3 Phase/single phase, 415/240 volts, 50 cycles, 4 wire system with neutral grounded at transformer. All Distribution panels shall be CPRI tested design and manufactured by a approved manufacturer. CPRI certificate shall be made available.

Distribution panels shall comply with the latest Relevant Indian Standards and Electricity Rules and Regulations and shall be as per IS-13947-1993.

4.1 Construction Features

Distribution panels shallbe2 mm thick sheet steel cabinet for indoor installation, dead front, floor mounting/wall mounting type and shall be form 3b construction. The Distribution panels shall be totallyen closed, completely dust and vermin proof and shall be with hinged doors and folded covers, Neoprene gasket, padlocking arrangement and bolted back. All removable/ hinged doors and covers shall be grounded by flexible standard connectors. Distribution panel shall be suitable for the climatic conditions as specified in Special Conditions. Steel sheets used in the construction of Distribution panels shall be 2 mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded, all welding, slag shall be rounded off and welding pits wiped smooth with plumber metal. The general construction shall confirm to IS-8623-1977 (Part-1) for factory built assembled switchgear & control gear for voltage upto and including 1100 V AC.

All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with wing nuts. Self-threading screws shall not be used in the construction of Distribution panels. A base channel of 75 mm x 40 mm x 5 mm thick shall be provided at the bottom for floor mounted panels. Minimum operating clearance of275mm shall be provided between the floor of Distribution panels and the lowest operating height.

Distribution panels shall be of adequate size with a provision of spare switchgear as indicated on the Single Line Diagram. Feeders shall be arranged in multi-tier. Knockout holes of appropriate size and number shall be provided in the Distribution panels in conformity with the location of cable/conduit connections. Removable sheet steel plates shall be provided at the top to make holes for additional cable entry at site if required.

Every cabinet shall be provided with Trifoliate or engraved metal nameplates. All panels shall be provided with circuit diagram engraved on PVC sheet. All live accessible connections shall be shrouded and shall be finger touch proof and minimum clearance between phase and earth shall be 20 mm and phase to phase shall be 25 mm.

4.2 Bus Bar Connections

Bus bar and interconnections shall be of high conductivity electrolytic grade aluminium /copper as indicated in the bill of quantities complying with requirement of IS : 5082 – 1981 and of rectangular cross section suitable for carrying the rated full load current and short circuit current and shall be extendable on either side. Bus bars and interconnections shall be insulated with heat shrinkable sleeve of 1.1 kV grade and shall be colour coded. Busbars shall be supported on glass fiber reinforced thermo setting plastic insulated supports at regular intervals to withstand the force arising from in case of short circuit in the system. All busbars shall be provided in a separate chamber and all connections shall be done by bolting. Additional cross sectional area to be added to the bus bar to compensate for the holes. All connections between bus bars and breakers shall be through solid copper / aluminium strips of proper size to carry full rated current and insulated with insulating sleeves. Maximum current density for the busbars shall be 0.8 A/sq.mm for aluminium and 1.4 A/sq.mm for copper busbars.

Maximum allowable temperature for the Bus bar to be restricted to 85 deg C.

4.2.1 Temperature - Rise Limit

Unless otherwise specified, in the case of external surface of enclosures of bus bar compartment which shall be accessible but do not need to be touched during normal operation, an increase in the temperature rise limits of 25° C above ambient temperature shall be permissible for metal surface and of 15° C above ambient temperature for insulating surfaces as per IS 8623(Part-2) 1993.

All main distribution panels and sub distribution panels shall be provided with MCCB of appropriate capacity as per Single Line Diagram. All final Distribution boards shall be provided with Miniature Circuit Breakers. Final Single Phase Distribution boards shall be connected to the incoming supply through double pole MCB units & earth leakage circuit breakers. All wiring for final distribution boards shall be concealed behind 5 mm thick bakelite sheet or M S sheet cover. All Distribution boards shall be completely factory wired, ready for connection. All the terminals shall be of proper current rating and sized to suit individual feeder requirements. Each circuit shall be clearly numbered from left to right to correspond with wiring diagram. All the switches and circuits shall be distinctly marked with a small description the service installed.

Continuous earth bus sized for prospective fault current shall be provided with arrangement for connecting to station earth at two points. Hinged doors/ frames shall be connected to earth through adequately sized flexible braids.

4.3 Cable Compartments

Cable compartment of adequate size shall be provided in the Distribution panels for easy clamping of all incoming and outgoing cables entering from the top/bottom. Adequate supports shall be provided in cable compartment to support cables.

4.4 Air Circuit Breakers (ACB)

4.4.1 The ACB shall conform to the requirements of IEC 60947-2 / IS 13947-2 and shall be type tested & certified for compliance to standards from–CPRI, ERDA/ any accredited international lab. The circuit breaker shall be suitable for 415 V $\pm$ 10%, 50 Hz supply system. Air Circuit Breakers shall be with moulded housing flush front, draw out type and shall be provided with a trip free manual operating mechanism or as indicated in drawings and bill of quantities with mechanical "ON" "OFF""TRIP" indications.

The ACB shall be 3/ 4 pole with modular construction, draw out, manually or electrically operated version as specified. The circuit breakers shall be for continuous rating and service short Circuit Breaking capacity (Ics) shall be as specified on the single line diagram and should be equal to the Ultimate breaking capacity(Icu) and short circuit withstand values(Icw) for 1 sec.

Circuit breakers shall be designed to 'close' and `trip' without opening the circuit breaker compartment door. The operating handle and the mechanical trip push button shall be at the front of the breakers panel. Inspection of main contacts should be possible without using any tools. The ACB shall be provided with a door interlock. i.e. door should not be open when circuit breaker is closed and breaker should not be closed when door is open.

All current carrying parts shall be silver plated and suitable arcing contacts with proper arc chutes shall be provided to protect the main contacts. The ACB shall have double insulation (Class-II) with moving and fixed contacts totally enclosed for enhanced safety and in accessibility to live parts. All electrical closing breaker shall be with electrical motor wound stored energy spring closing mechanism with mechanical indicator to provide ON/OFF status of the ACB.

The auxiliary contacts blocks shall be so located as to be accessible from the front. The auxiliary contacts in the trip circuits shall close before the main contacts have closed. All other contacts shall close simultaneously with the main contacts. The auxiliary contacts in the trip circuits shall open after the main contacts open. Minimum 4 NO and 4 NC auxiliary contacts shall be provided on each breaker.

Rated insulation voltage shall be 1000 volts AC.

4.4.2 Cradle

The cradle shall be so designed and constructed as to permit smooth withdrawal and insertion of the breaker into it. The movements shall be free from jerks, easy to operate and shall be on steel balls/rollers and not on flat surfaces.

There shall be 4 distinct and separate position of the circuit breaker on the cradle.
Racking Interlock in Connected/Test/Disconnected Position.

Service Position: Main Isolating contacts and control contacts of the breaker are engaged.

Test Position: Main Isolating contacts are isolated but control contacts are still engaged.

Isolated Position: Both main isolating and control contacts are isolated.

There shall be provision for locking the breaker in any or all of the first three positions.

The following safety features shall be incorporated :

a. Withdrawal or engagement of Circuit breaker shall not be possible unless it is in open condition.

b. Operation of Circuit breaker shall not be possible unless it is fully in service, test or drawn out position.

c. All modules shall be provided with safety shutters operated automatically by movement of the carriage to cover exposed live parts when the module is withdrawn.

d. All Switchgear module front covers shall have provision for locking.

e. Switchgear operating handles shall be provided with arrangement for locking in 'OFF' position.

4.4.3 Protections

The breaker should be equipped with micro-controller based, communicable type release with RS 485 port for communication to offer accurate and versatile protection with complete flexibility and shall offer complete over current protection to the electrical system in the following four zones :

- Long time protection.
- Short time protection with intentional delay.
- Instantaneous protection.
- Ground fault protection.

The protection release shall generally have following features and settings however for exact requirement of protection releases, reference shall be made to SOQ:

a. True RMS Sensing

The release shall sample the current at the rate of 16 times per cycle to monitor the actual load current waveform flowing in the system and shall monitor the true RMS value of the load current. It shall take into account the effect of harmonics also.

b. Thermal Memory

When the breaker shall reclose after tripping on overload, then the thermal stresses caused by the overload if not dissipated completely, shall get stored in the memory of the release and this thermal memory shall ensure reduced tripping time in case of subsequent overloads. Realistic Hot/Cold curves shall take into account the integrated heating effects to offer closer protection to the system.

c. Defined time-current characteristics :

A variety of pick-up and time delay settings shall be available to define the current thresholds and the delays to be set independently for different protection zones thereby achieving a close-to-ideal protection curve.

d. Trip Indication

Individual fault indication for each type of fault should be provided by LEDs for faster fault diagnosis.

e. Self-powered

The release shall draw its power from the main breaker CTs and shall require no external power supply for its operation.

f. Zone Selective Interlocking

The release shall be suitable for communication between breakers to enable zone selective interlocking. This feature shall be provided for both short circuit and ground fault protection zones to offer intelligent discrimination between breakers. This feature enables faster clearance of fault conditions, thereby reducing the thermal and dynamic stresses produced during fault conditions and thus minimises the damage to the system. To implement ZSI manufacturer should supply all related equipment like power supply, wiring etc.

On-Line change of settings should be possible. It should be possible to carry out testing of release without tripping the breaker.

g. The release shall meet the EMI / EMC requirements.

h. The setting range of release shall be generally as follows :

TYPE OF PROTECTION	SETTING RANGE OF RELEASE	
	PICK-UP CURRENT	TIME DELAY
Long Time	0.4 to 1.0 times I_n (I_r) Steps : 0.4, 0.5, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90, 0.95, 1.00. Operating Limit : 1.05 to 1.2 times I_r	0.5 to 30 sec at 6 I_r Steps 0.5,1, 2,4, 6, 8,12,18,24 and 30 secs Tolerance : Corresponding to ±10% of current.
Short Time	2 to 10 times I_r Steps : 2,3,4,5,6,7,8,9 & 10 Tolerance : ±10%	20 ms to 600 ms Steps 20,60,100,160,200,260,300 400,500 and 600 ms Tolerance : ±10% or 20ms whichever is higher
Instantaneous	2 to 12 times I_n Steps : 2,3,4,6,8,10,12 Tolerance : ±10%	
Ground Fault	0.2 to 0.6 time I_n Steps : 0.2,0.3,0.4,0.5,0.6 Tolerance : ±10%	100 ms to 400 ms Steps : 100,200,300,400ms Tolerance: +10% or 20 ms whichever is higher.

All **incomer** ACBs shall have following additional protections other than mentioned above.

- Under and over voltage
- Under and over frequency
- Restricted Earth Fault protection
- Trip Circuit supervision with PS class CT's.
- Undercurrent, (for DG set only)
- Reverse power (for DG set only)
- Phase sequence reversal
- Load shedding and reconnection thru programmable contacts.
- Release should display the Contact wear indication.

The release should provide local indication of actual %age loading at any instant. The release should be able to communicate on MODBUS RTU protocol using inbuilt RS485 port and shall be integral part of supply with trip unit. Parameters of the Protection Release should be changeable from Release as well as thru communication network. Release should have graphical LCD for display of power parameters. The release of incoming breakers should provide comprehensive metering with the following parameters

- Phase currents (running, avg & max) – All parameters in single window.
- Release should be able to capture short circuit current on which ACB has tripped. The last ten trips and alarms shall be stored in memory with the date & time stamping along with type of fault and alarm. The sensing CT Should be Rogowsky type with measurement precision of 1%.
- Release should be self-powered.
- Release should have facility to select different type of IDMTL protection(DT,SIT,VIT,EIT,HVF) for better co-ordination with HT Breaker/Fuse.
- Phase voltages (running, avg& max)
- Energy & power parameters (active, reactive and apparent)
- PF
- Frequency
- Maximum Demand (KVA & KW)
- Total Harmonics distortion

All **O/G** ACBs shall have following functions.

Protection

- The ACB control unit shall offer the following protection functions as standard:
- Long-time (LT) protection with an adjustable current setting and time delay;
- Short-time (ST) protection with an adjustable pick-up and time delay;

- Instantaneous (INST) protection with an adjustable pick-up and an OFF Position.
- Current and time delay setting shall be indicated in amperes and seconds respectively On a digital display.
- Earth-fault protection with an adjustable pick-up and time delay shall be provided if indicated on the appended single-line diagram.

Measurements

- An ammeter with a digital display shall indicate the true rms values of the currents for each phase. Release shall acknowledge the current & time delay settings done by user on the LCD display.
- A LED bargraph shall simultaneously display the load level on the three phases.
- A maximeter shall store in memory and display the maximum current value observed since the last reset. The data shall continue to be stored and displayed even after opening of the circuit breaker.

4.4.4 Safety Features

i. The safety shutter shall prevent inadvertent contact with isolating contacts when breaker is withdrawn from the Cradle.

ii. It shall not be possible to interchange two circuit breakers of two different thermal ratings. For Draw-out breakers, an arrangement shall be provided to prevent rating mismatch between breaker and cradle.

iii. There shall be provision of positive earth connection between fixed and moving portion of the ACB either thru connector plug or sliding solid earth mechanism. Earthing bolts shall be provided on the cradle or body of fixed ACB.

iv. The incoming panel accommodating ACB shall be provided with indicating lamps for ON-OFF positions, digital voltmeter and ammeter of size not less than 96 mm x 96 mm, selector switches, MCB for protection circuit and measuring instrument circuits.

v. It shall be possible to bolt the draw out frame not only in connected position but also in TEST and DISCONNECTED position to prevent dislocation due to vibration and shocks.

vi. Draw out breakers should not close unless in distinct Service/Test/Isolated positions.

vii. The insulation material used shall conform to Glow wire test as per IEC60695.

viii. The ACB shall provide in built electrical and mechanical anti-pumping.

ix. All EDO ACB`s Shall have Ready to Close Contact to ensure that the ACB gets a command only when it is ready to close for applications of Remote Control, AMF, Synchronization and Auto Source Change Over Systems.

4.5 Moulded Case Circuit Breaker (MCCB)

The MCCB should be current limiting type with trip time of less than 10 msec under short circuit conditions. The MCCB should be either 3 or 4 poles as specified in BOQ. MCCB shall comply with the requirements of the relevant standards IS13947 – Part 2/IEC 60947-2 and should have test certificates for Breaking capacities from independent test authorities CPRI / ERDA or any accredited international lab.

MCCB shall comprise of Quick Make -break switching mechanism, arc extinguishing device and the tripping unit shall be contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses

The breaking capacity of MCCB shall be as specified in the schedule of quantities. The rated service breaking capacity (Ics) should be equal to rated ultimate breaking capacities (Icu).MCCBs for motor

application should be selected in line with Type-2 Co-ordination as per IEC-60947-2, 1989/IS 13947-2. The breaker as supplied with ROM should meet IP54 degree of protection.

4.5.1 Current Limiting & Coordination

- The MCCB shall employ maintenance free minimum let-through energies and capable of achieving discrimination up to the full short circuit capacity of the downstream MCCB. The manufacturer shall provide both the discrimination tables and let-through energy curves for all.

  Protection Functions

  - MCCBs with ratings up to 200 A shall be equipped with Thermal-magnetic (adjustable thermal for overload and fixed magnetic for short-circuit protection) trip units
  - Microprocessor MCCBs with ratings 250A and above shall be equipped with microprocessor based trip units.
  - Microprocessor and thermal-magnetic trip units shall be adjustable and it shall be possible to fit lead seals to prevent unauthorised access to the settings
  - Microprocessor trip units shall comply with appendix F of IEC 60947-2 standard (measurement of rms current values, electromagnetic compatibility, etc.)
  - Protection settings shall apply to all poles of circuit breaker.
  - All Microprocessor components shall withstand temperatures up to 125 °C

4.5.2 Testing

a. Original test certificate of the MCCB as per IEC 60947-1 &2 or IS13947 shall be furnished.

b. Pre-commissioning tests on the switch board panel incorporating the MCCB shall be done as per standard specifications.

4.5.3 Interlocking

Moulded, case circuit breakers shall be provided with the following interlocking devices for interlocking the door of a switch board.

a. Handle interlock to prevent unnecessary manipulations of the breaker.

b. Door interlock to prevent the door being opened when the breaker is in ON position.

c. Defeat-interlocking device to open the door even if the breaker is in ON position.

- The MCCB shall be current limiting type and comprise of quick make – Break switching mechanism. MCCBs shall be capable of defined variable overload adjustment. All MCCBs rated 200 Amps and above shall have adjustable over load &short circuit pick-up both in Thermal magnetic and Microprocessor Trip Units.
- All MCCB with microprocessor based release unit, the protection shall be adjustable Overload, Short circuit and earth fault protection with time delay.
- The trip command shall override all other commands.

4.6 Motor Protection Circuit Breaker (MPCB)

Motor circuit breakers shall conform to the general recommendations of standard IEC 947 -1,2 and 4 (VDE 660, 0113 NF EN 60 947-1-2-4, BS 4752) and to standards UL 508 and CSA C22-2 N°14.

The devices shall be in utilization category A, conforming to IEC 947-2 and AC3 conforming to IEC 947-4.MPCB shall have a rated operational and insulation voltage of 690V AC (50 Hz) and MPCB shall be suitable for isolation conforming to standard IEC 60947-2 and shall have a rated impulse withstand voltage (Uimp) of 6 kV. The motor circuit breakers shall be designed to be mounted vertically or horizontally without derating. Power supply shall be from the top or from the bottom. In order to ensure maximum safety, the contacts shall be isolated from other functions such as the operating mechanism, casing, releases, auxiliaries, etc, by high performance thermoplastic chambers. The operating mechanism of the

motor circuit breakers must have snap action opening and closing with free tripping of the control devices. All the poles shall close, open, and trip simultaneously. The motor circuit breakers shall accept a padlocking device in the "isolated" position.

The motor circuit breakers shall be equipped with a "PUSH TO TRIP" device on the front enabling the correct operation of the mechanism and poles opening to be checked. The auxiliary contacts shall be front or side mounting, and both arrangements shall be possible. The front-mounting attachments shall not change the breaker surface area. Depending on its mounting direction the single pole contact block could be NO or NC. All the electrical auxiliaries and accessories shall be equipped with terminal blocks and shall be plug-in type. The motor circuit breakers shall have a combination with the downstream contactor enabling the provision of a perfectly coordinated motor-starter. This combination shall enable type 1 or type 2 co-ordination of the protective devices conforming to IEC 60947-4-1.Type 2 co-ordination shall be guaranteed by tables tested and certified by an official laboratory: LOVAG (or other official laboratory).The motor circuit breakers, depending on the type, could be equipped with a door-mounted operator which shall allow the device setting. The motor circuit breakers shall be equipped with releases comprising a thermal element assuring overload protection and a magnetic element for short-circuit protection. In order to ensure safety and avoid unwanted tripping, the magnetic trip threshold (fixed) shall be factory set to an average value of 12 Ir.

All the elements of the motor circuit breakers shall be designated to enable operation at an ambient temperature of 60°C without derating. The thermal trips shall be adjustable on the front by a rotary selector. The adjustment of the protection shall be simultaneous for all poles. Phase unbalance and phase loss detection shall be available. Temperature compensation (-20°C to +60°C)

4.7 Miniature Circuit Breaker (MCB)

Miniature Circuit Breaker shall comply with IS-8828-1996/IEC898-1995. Miniature circuit breakers shall be quick make and break type for 240/415 VAC 50 Hz application with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be less than 10 KA at 415 VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting type (Class-3). MCBs shall be classified (B,C,D ref IS standard) as per their Tripping Characteristic curves defined by the manufacturer. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values. MCB shall ensure complete electrical isolation & downstream circuit or equipment when the MCB is switched OFF.

The housing shall be heat resistant and having high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection. All DP, TP, TPN and 4 Pole miniature circuit breakers shall have a common trip bar independent to the
external operating handle.

4.8 Residual Current Circuit Breaker Current Operated Type (RCCB)

i. System of Operation

Residual Current Circuit Breaker shall confirm to IEC 61008.RCCB shall work on the principle of core balance transformer. The incoming shall pass through the torroidal core transformer. AS long as the currents in the phase and neutral shall be the same, no electromotive force shall be generated in the secondary winding of the transformer. In the event of a leakage to earth, an unbalance shall be created which shall cause a current to be generated in the secondary winding, this current shall be fed to a highly sensitive miniature relay, which shall trip the circuit if the earth leakage current exceeds predetermined critical value. RCCB shall be current operated independent of the line voltage, current sensitivity shall be of 30 mA at 240/415 volts AC and shall have a minimum of 20,000 electrical operations.

ii. Mechanical Operation

The moving contacts of the phases shall be mounted on a common bridge, actuated by a rugged toggle mechanism. Hence, the closing/opening of all the three phases shall occur simultaneously. This also shall ensure simultaneous opening of all the contacts under tripping conditions.

iii. Neutral Advance Feature

The neutral moving contact shall be so mounted on the common bridge that, at the time of closing, the neutral shall make contact First before the phases; and at the time of opening, the neutral shall

breaks last after allowing the phases to open first. This is an important safety feature which is also required by regulations.

iv. Testing Provision

A test device shall be incorporated to check the integrity of the earth leakage detection system and the tripping mechanism. When the unit is connected to service, pressing the test knob shall trip the ELCB/ RCCB and the operating handle shall move to the "OFF" position.

4.9 Earthing

Earthing shall be provided as per IS:3043-1987.

4.10 Painting

All sheet steelwork shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphating, passivaiting(seven tank processing) and then painted with electrostatic paint (Powder coating). The shade of colour of panel inside/outside shall be as per BOQ confirming to IS Code No.5.

4.11 Labels

Engraved PVC labels shall be provided on all incoming and outgoing feeder. Circuit diagram showing the arrangements of the circuit inside the distribution panels shall be pasted on inside of the panel door and covered with transparent plastic sheet.

4.12 Meters

i. All voltmeters and indicating lamps shall be through MCB's.

ii. Meters and indicating instruments shall be flush type.

iii. All CT's connection for meters shall be through Test Terminal Block (TTB).

iv. CT ratio and burdens shall be as specified on the Single line diagram.

4.13 Current Transformers

Current transformers shall be provided for Distribution panels carrying current in excess of 60 amps. All phase shall be provided with current transformers of suitable VA burden with 5 amps secondaries for operation of associated metering.

The CTs shall confirm to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitable to a terminal block which shall be easily accessible for testing and terminal connections. The protection CTs shall be of accuracy class 5P10 and measurement CTs shall be of accuracy class I.

4.14 Potential Free Contacts

Potential free contacts shall be provided for connection to Building Automation System in panels indicated in Schedule of Quantities.

4.15 Indicating Panel

All meters and indicating instruments shall be in accordance with relevant Indian Standards. Meters shall be flush mounted type. Indicating lamps shall be of low burden, and shall be backed up with 2 amps MCB/MPCB as per relevant fault level and toggle switch.

4.16 Testing

Testing of panels shall be as per following codes:

i. IS: 8623 (Part -I) 1977 for factory built assemblies of switchgear forvoltages upto and including 1000 VAC.
ii. IS: 13947 : 1993 Degree of protection

iii. IS: 5578 &11353:1985 Arrangement of bus bars.

4.17 Wiring

In wiring a distribution panel it shall be insured that total load of various distribution panel and/or consuming devices is divided evenly between the phases and number of ways as per Consultants drawing. Only FRLS wires shall be used.

4.18 Anti-Condensation Space Heaters

1 No. 100 W, 240 volts, single phase, 50 Hz AC Anti Condensation space heaters controlled by thermostat and protected by6 amps MCB's or MPCB's as per fault level at the panel shall be provided in each vertical section of main LT panel and 1 No. 60 watt Anti Condensation space heater with thermostat shall be provided in each cable alley of main distribution boards and sub distribution boards.

4.19 Installation

Installation of all LT panels shall include but not limited to the following to complete the installation, testing and commissioning:

a. Transporting materials from stores to exact location of installation.

b. Supply and installation of required base frame made of MS angle or channel sections and duly painted with black paint.

c. Positioning, aligning, fixing, assembling, and installation of LT panel issued free of cost by Client after carrying out proper cleaning and inspection.
d. Site supervision, testing for proper functioning / operation, and pre-commissioning tests.

4.20 Commissioning and onsite Testing

a. All switchboards shall be tested for dielectric test with 1000V megger.

b. All earth connections shall be checked for continuity.

c. All busbar connections shall be checked and tightened properly.

d. All cable terminations and terminal shrouding shall be checked if they are properly done.

e. The operation of protective devices shall be tested by secondary injection test.
f. The operation of circuit breaker shall be tested for all interlocks.

g. Functional test shall be done for all ACBs, MCCBs and other components.

h. Indicating lamps and meters shall be checked for proper working.

4(B) FINAL DISTRIBUTION BOARDS (FDB's)

Final Distribution Boards (FDBs) shall be suitable for operation on3 Phase/single phase, 415/240 volts, 50 cycles, neutral grounded at transformer. The DB shall be minimum di-electric strength of 2.5 KV / Sec. All Distribution Boards shall manufactured by a manufacturer listed in Appendix-I.

FDB's shall comply with the latest Relevant Indian Standards and Electricity Rules and Regulations and shall be as per IS-13947-1993.

4.1 Construction Features

FDB's shall be made out of 1.6 mm thick high quality CRCA sheet steel and shall be pre-treated and powder coated sheet steel used in the construction of FDB shall be folded and braced as necessary to provide a rigid support for all component. FDB shall be suitable for indoor / outdoor installation, wall mounting free standing type, in double door construction. The Final Distribution Boards shall be totally enclosed, completely dust and vermin proof and shall be with hinged doors, Neoprene gasket, padlocking arrangement. All removable/ hinged doors and covers shall be grounded by 4.0 sqm tinned stranded copper connectors. Final Distribution Boards shall be suitable for the climatic conditions. Joints of any kind in sheet metal shall be seam welded, all welding, slag shall be rounded off and welding pits wiped smooth with plumber metal. The general construction shall confirm to IS-8623-1977 (Part-1) for factory built assembled switchgear & control gear for voltage upto and including 1100 V AC.

All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with wing nuts. Self-threading screws shall not be used in the construction of FDBs.

Knockout holes of appropriate size and number shall be provided in the FDB's in conformity with the location of cable/conduit connections. Detachable sheet steel gland plates shall be provided at the top / bottom to make holes for additional cable entry at site if required.

Final Distribution Boards shall comprises of the following:

4.1.1 A panel for mounting where appropriate incoming supply circuit breaker & other auxiliaries for Control & distribution as required.

4.1.2 Installation accessories shall be part of the DB for fixing conductor and rails for mounting MCB's and RCCB's etc.. neutral bus bars & earthing bus bars required in the circuit. All bus bars in the FDB shall be insulated type.

4.1.3 Service cable /enter connection shall be part of the Distribution Boards.

4.1.4 The board shall be installed at a height such that the operating is within reach of the normal human height i.e. 1.2 to 1.8 meters from finish floor level.

4.1.5 Degree of protection shall be IP-52 for indoor application, IP-54 for kitchen & laundry and IP-55 for outdoor application.

4.1.6 All three phase distribution boards shall have 4 rows and single phase distribution boards shall have single rows for housing of MCB's and RCCB's unless noted otherwise.

4.1.7 Phase segregation to be maintained in all three phase distribution boards as per 7 segment configuration & as per Chennai regulations.

4.1.8 Earthing shall be provided in each FDB's.

4.2 Miniature Circuit Breaker (MCB)

For specifications refer Section 4A, clause 4.7

4.3 Residual Current Circuit Breaker Current Operated Type (RCCB)

For specifications refer Section 4A, clause 4.8

4.4 Earthing

Earthing shall be provided as per IS:3043-1987.

4.5 Painting

All sheet steelwork shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphating, passivaiting(seven tank processing) and then painted with electrostatic paint (Powder coating). The shade of colour of panel inside/outside shall be of Siemens gray paint shade no. RAL-7032 of IS Code No.5.

4.6 Labels

Engraved PVC labels shall be provided on all incoming and outgoing feeder. Circuit diagram showing the arrangements of the circuit inside the distribution panels shall be pasted on inside of the panel door and covered with transparent plastic sheet.

4.7 Testing

Testing of panels shall be as per following codes:

i. IS: 8623 (Part -I) 1977 for factory built assemblies of switch gear for voltages upto and including 1000 VAC.

ii. IS: 13947 : 1993 Degree of protection

4.8 Wiring

In wiring a distribution panel it shall be insured that total load of various distribution panel and/or consuming devices is divided evenly between the phases and number of ways as per Consultants drawing.

5. POWER FACTOR CORRECTION SYSTEM (WITH DETUNED FILTER)

5.1 Scope

Design, manufacture, supply, erection, testing and commissioning of Indoor type power correction capacitor banks for power factor improvement as per specification given below:

5.2 Standard

Unless otherwise stated below, the capacitor shall comply with the following standards (and their latest amendments) : IS 13340-1993, IS 13341-1992, IEC 60831-1+2

5.3 Rating

50 KVAR(or less) capacitor units as specified in the BOQ shall be used to form bank of capacitors of desired capacity.

5.4 Enclosure

The panel shall be indoor type, free standing, and floor mounting with IP42 degree of protection. It shall be completely made of CRCA sheet steel. The enclosure shall have sturdy support structure with angle supports as necessary and shall be finished with powder coating in the approved colour shade/s to match the colour of the other panels. The thickness of powder coating should be minimum 60-80 microns.

Suitable provisions shall be made in the panel for proper heat dissipation. Air aspiration louvers for heat dissipation shall be provided as a necessary.

The front portion shall house the switchgear and the rear portion shall house capacitors and series reactors. The enclosure is to be suitably sized to accommodate all the components, providing necessary air clearance between live and non-live parts, providing necessary working clearance.

5.5 APFC Relay / Controller

Microprocessor based APFC relay (Intelligent VAr controller) shall have dual sensing so that on generator supply it can suitably switch to desired power factor and automatically switch ON / OFF the capacitor unit or stage to achieve the preset target PF. The controller shall have the following features :

- Controller shall provide thyristorized output of 8/16 stage.
- Digital settings of parameters like PF, Switching time delay, Step limit etc.
- LCD Display displaying PF/V/I/KVA/KW/KVAR temp./Harmonics (THD and Individual for Voltage and Current)
- Indication of PF, preset parameters, Contactors switching operation and capacitors operating life.
- Minimum threshold setting of 1% of CT current.
- No-volt release.
- Protective shut down in case of harmonic overload.
- Shall have data logging for all Electrical parameter for 2 months.
- Shall have RS 232 interface.
- Output command shall have maximum 16 outputs.
- Indication for Failure to achieve the target PF, Harmonic overloading, Step failure etc.

5.6 Construction

Each basic unit of)/ MPP Gas Filled, filled with inert gas capacitor shall be built with a number of elements. These elements shall be combination of capacitor tissue paper and biaxially oriented polypropylene film impregnated with non PCB bio-degradable impregnant or Film Foil capacitor manufactured using Poly propylene film placed between 2 layers of metal foil and winding or shall have wave cut MPP design. The elements shall be connected to the external bus bars through these leads in a series parallel connection to form a three phase unit.

The capacitor units shall be floor mounting type using minimum floor space. The container of capacitors shall be made out of 2 mm thick M S sheet steel of polyster paint coated finish/ cylindrical Aluminium can. Each standard unit shall be provided with internal fuses (operation co-ordinated with case-rupture characteristics to avoid rusting).

Total Harmonic Distortion (THD) of upto 5% on voltage and current waveforms shall not affect the life of capacitors. 440±10% variation in line voltage shall not affect the life of the capacitors.

5.7 Capacitors

- Capacitor shall be 525 V and output shall be increased considering reactor suitability.
- General specifications : 3 phase, delta connected, 50 Hz.
- Capacitor shall be ISI marked.
- Voltage : Shall be designed for minimum 520V and shall with stand system over voltage, increased voltage due to series reactor and harmonics.
- Capacitor type : Super heavy duty with double side metallised capacitor tissue paper. Oil impregnated and self-healing type with bi-axially oriented polypropylene film shall be fitted with pressure sensitive disconnect or in each individual capacitor cell.
  Or Gas filled type, MPP design, with wave cut technology with PSD for individual cell.
- Overvoltage +10% (12h / 24h), + 15% (30m / 24h), + 20% (5m), +30% (1m) as per Clause 5.1 of IS 13340-1993.
- Overcurrent : 2.5 x In
- Peak Inrush current withstand : 350 x In
- Total watt-losses excluding discharge resistors :$\leq$0.45 W / k V Ar.
- Temperature category : -25 deg.C to 70 deg.C or at D Class.
- Capacitor shall be self-heating type and oil impregnated for longer life. The impregnant shall be non-PCB, biodegradable type, must be properly treated and de-gasified, so as not to have any degeneration properties and shall be non-oxidizing / inert gas.
- The design shall be modular for simple mechanical assembly, no extra accessories / metal parts to be required. Unit must be free standing with an IP 41 protection level.

5.8 Switching Module

contactor switching module shall be capable of voltage peak withstand capacity of upto 2400 Vpk.

5.9 Terminals

Each capacitor bank shall be provided with a terminal chamber and cable glands suitable for PVC insulated aluminum conductor armoured cables as specified. Or Sigut terminal shall be preferable.

5.10 Earthing

Two separate earthing terminals shall be provided for earth connection of each bank.

5.11 Low Voltage Filter Reactor

Filter reactor shall be series type having a three phase, iron core construction suitable for indoor use. The reactor shall be air cooled and the layout shall be in accordance with IEC 75. The complete unit shall be impregnated under vacuum and over-pressure in impregnation resin and shall be suitable for temperature class H operation. The reactor coils shall be wound with high grade aluminum / copper and termination shall be provided with suitably designed copper bars.

5.12 Testing

The reactor shall be tested `using a separate source voltage test of 3 KV (coil to core) for one minute as per IEC 76/3.The reactor shall be fitted with a temperature sensitive micro-switch in the centre coil (normally open) for connection to trip circuit in case of high operating temperature.

5.13 Series Reactor

Application

LV Harmonic Filters shall be used with harmonic filter duty power capacitors to mitigate harmonics, improve power factor and avoid electrical reasonance in LV electrical networks.

Construction, Testing & Protection

The low voltage filter reactor shall be series type having a three phase, iron core construction suitable for indoor use (IP 00).The reactor shall be air cooled and the layout shall be in accordance with IEC 60289/ IS-5553.

The complete unit shall be impregnated under vacuum and over-pressure in impregnation resin and shall be suitable for temperature Class H (T60/H) operation.

The reactor shall be tested using a separate source voltage test of 3.0kV (coil to core) for 1 minute as per IEC / IS standards.

The permitted tolerance of inductance shall be ±5% of rated inductance value.

Reactor tuning factor shall be 5.67% and the current rating of the reactor shall include the effects of harmonics and other possible over-currents.

The limit of linearity of inductance of the filter reactor shall be as follows $2.08 \bullet \sum I\eta$ with $L = 0.95\ L_N$

The reactor shall be fitted with a temperature sensitive micro-switch in the centre coil (normally open) for connection to trip circuits in case of high operating temperatures.

5.14 Switchgear & Protection

Incomer switchgear shall be TP&N breaker appropriate rating (**minimum 1.8 times** the normal current to take care of inrush switching current).Suitable contactor for each step shall be used and must be capable of capacitor switching duty at each step for short circuit protection.

Busbars shall be suitably colour coded and must be mounted on appropriate insulator supports.

Power cables used shall have superior mechanical, electrical and thermal properties, and shall have the capability to continuously operate at very high temperatures upto125 deg.C.

Internal wiring between main bus-bars, breaker, contactor and capacitors shall be made with 1100 V grade, PVC insulated, copper conductor cable of appropriate size, by using suitable copper crimping terminal ends etc. Suitable bus links for input supply cable termination shall be provided.

5.15 Control Circuit & General Protection

The control circuit shall be duly protected by using suitable rating MCB.

An emergency stop push button shall be provided to trip the entire system (22.5 mm dia, mushroom type, press to stop and turn to reset).

Wiring of the control circuit shall be done by using 1.5 sq.mm, 1100 V grade, PVC insulated, multi-stranded copper control wire.

Inspection terminal strip, number ferruling, labeling etc. shall be provided.

440 V caution board on the panel shall be provided.

5.16 Testing

The capacitor bank shall be subject to tests as specified in relevant Indian Standards at the factory and the test certificates shall be furnished in quadruplicate.

5.17 Installation

a. Capacitors banks shall be installed as per installation manual of supplier and shall conform to relevant Indian Standards.

b. All interconnections in the control panel shall be checked before commissioning.

c. Cable end boxes shall be sealed after cable connections to prevent absorption of moisture.

d. Insulation matting as per IS-15652 of an approved make platform shall be provided in front of the full length of the capacitor bank and control panel.

5.18 Testing & Commissioning

a. Insulation resistance shall be testedwitha1000volts meagger between phases and phase to earth.

b. Residual voltage shall be measured after switching of the capacitors and the same shall not be more than 50 volts after one minute.

c. Each discharge resistor shall be tested for its working.

6. EARTHING

6.1 Earthing

The system shall be TNS with four wire supply system (R,Y,B,N and 2 No. E) brought from the main L T Panel. All the non-current carrying metal parts of electrical installation and all metal conduits trunking, cables heaths, switchgear, distribution panels, light fittings and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. All metal work such as pipe lines, ducts, cable trays, stair case railing etc, shall be bonded to earth.

All earthing shall be in conformity with IS:3043 1987, and the basic system of earthing shall be TNS.

6.2 Earthing Conductors

Earthing conductors shall be of copper / GI as mentioned in schedule of quantities and shall be protected against mechanical injury and corrosion.

6.3 Sizing of Earthing Conductors

The cross sectional area of earthing conductor shall not be smaller than half of the largest current carrying conductor subject to an upper limit of 80Sq.mm. If the area of the largest current carrying conductor or bus bar exceeds160 sq.mm then two or more earthing conductors shall be used in parallel, to provide at least half the cross sectional area of the current carrying conductor or bus bars. All fixtures, outlet boxes, junction boxes and power circuits up to 15 amps shall be earthed with PVC insulated copper wire.

6.4 Connection of Earthing Conductors

Main earthing conductors shall be taken from the earth connections at the main LT panel to an earth electrode with which the connection is to be made. All joints in tapes shall be with four rivets and shall be brazed in case of copper and by welding bolting in case of GI, wires shall be connected with crimping lugs, all bolts shall have spring washers. Sub- mains earthing conductors shall run from the main distribution panel to the sub distribution panel. Final distribution panel earthing conductors shall run from sub-distribution panel.

Circuit earthing conductor shall run from the exposed metal of equipment and shall be connected to any point on the main earthing conductor, orits distribution panel. Metal conduits, cable sheathing and armouring shall be earthed at the ends adjacent to distribution panel at which they originate, or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing. Where equipment is connected by flexible cord, all exposed metal parts of the equipment shall be earthed by means of an earthing conductor enclosed with the current carrying conductors within the flexible cord. Switches, accessories, lighting fitting etc. which are rigidly secured ineffective electrical contact with a run of metallic conduit shall not be considered as apart of the earthing conductor for earthing purposes, even though the run of metallic conduit is earthed. The installation shall be complete in all respects for efficient and trouble free service. All work shall be carried out in a first class quality and neat workmanship. Grounding conductors shall be handled carefully to avoid kinking and cutting of the conductors during their installation. All exposed ground conductors run shall be taken in a neat manner horizontal, vertical and parallel to the building walls or columns and shall not be laid haphazardly. All connections to the grounding grid shall be made with **earthing** strip welded to grid and bolted at equipment ends.

6.5 Prohibited Connections

Neutral conductor, sprinkler pipes, or pipes conveying gas, water or in flammable liquid, structural steelwork, metallic enclosures, metallic conduits and lightning protection system conductors shall not be used as a means of earthing an installation or even as a link in an earthing system.

The electrical resistance measured between earth connection at the main LT panel and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate or circuit breakers, and shall not exceed1ohm.All switches carrying medium voltage shall be connected with earth by two separate and distinct connections.
The earthing conductors inside the building wherever exposed shall be properly protected from mechanical injury by running the same in G I pipe of adequate size. The overlapping in strips at joints where required

shall be minimum 75 mm. The joints shall be riveted and brazed in case of copper and by welding / bolting in case of GI in an approved manner. Sweated lugs of adequate capacity and size shall be used for termination of all conductor wires above 6 sq.mm size. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substances and properly tinned. Equipotential bonding of all metallic structures shall be done.

6.6 Earthing

The following must always be ensured in earthing system.

- All earths must be interconnected at the earth pits. This includes generator neutrals, transformer neutrals, transformer body, lightning protection system earths, UPS earths etc.

- Extraneous conductive parts such as gas pipes, other service pipes and ducting risers and pipes of fire protection equipment and exposed metalic parts of the building structure.

6.7 The Contractor shall get the soil resistivity test done at his own cost of the area where earthing pits are to be located before starting the installation.

6.8 Resistance to Earth

The resistance of earthing system shall not exceed 1 ohm.

6.9 Specification for Hot Dip Galvanizing Process

General Requirements

i. Quality of Zinc
Zinc to be used shall conform to minimum Zn 98 grade as per requirement of IS:209-1992.

ii. Coating Requirement
Minimum weight of zinc coating for mild steel flats with thickness upto 6 mm in accordance with IS:6745-1972 shall be 400 g/sqm.

The weight of coating expressed in grams per square metre shall be calculated by dividing the total weight of Zinc by total area (both sides) of the coated surface.

The Zinc coating shall be uniform, smooth and free from imperfections as flux, ash and dross inclusions, bare patches black spots, pimples, lumpiness, runs, rust stains bulky white deposits, blisters.

Mild steel flats / wires shall undergo a process of degreasing pickling in acid, cold rinsing and then galvanizing. Jointing of earthing tape shall be by welding. All joints and cut ends shall be properly painted with aluminium paint.

6.10 Earthing Electrode

6.10.1 Copper Earth Electrode

Earthing electrode shall be600 x 600 x 3.15 mm thick tined copper plate electrode, with 2 No 50 x6mm copper strips from earth plate electrode to inspection chamber, 50mmdia medium class GI pipe, CI funnel with 20 gauge GI wire mesh, masonry chamber 1000 x 500 mm with concrete base CI heavy duty / chequered plate manhole cover with frame painted with bit mastic paint and packing with mixture of charcoal and common salt around plate electrode including digging of pit up to permanent moisture level and as per soil condition but not less than 3 meters and back filling as required.

6.10.2 GI Earth Electrode

Earthing electrode shall be600 x 600 x 6.3 mm thick GI plate electrode, with 2 No. 50 X 6 mm GI strips from earth plate electrode to inspection chamber, 50 mm dia medium class GI pipe, CI funnel with 20

gauge GI wire mesh, masonry chamber 1000 X 500 mm with concrete base CI manhole cover with frame painted with bitumastic paint and packing with mixture of charcoal and common salt around plate electrode including digging of pit up to permanent moisture level but not less than 3 meters and back filling as required.

6.11 Earth for UPS / Low volt / Servers

Clean earth shall be used for earthing UPS / Low volt / Server systems and shall be separate from safety earthing. Separate earthing electrode shall be provided in the ground and from this electrode, single core copper cable of required size shall be taken as earth conductor to be laid in the vertical shaft. This cable shall be terminated on each floor in a earth terminal box located in the shaft. The earth terminal box shall have 50x6mm copper bus bar mounted on insulators. The bus bar shall have facility to terminate the incoming earth cable as well as required number of outgoing earth conductors.

7. LIGHTNING PROTECTION SYSTEM

7.1 SCOPE OF WORK

The work to be done under this section comprises the supply & installation necessary for the complete installation of the lightning protection system. The design of the components shall be traceable to field research, laboratory testing, fundamental analysis, and statistical levels of the lightning event.

The design of the components shall be traceable to long term practical field studies laboratory testing, fundamental scientific principles and statistical levels of the lightning event as documented in international standard.

The lightning protection system should complies in accordance with IS/IEC 62305-3:2010 standard and shall be installed strictly to the manufacturer's instructions. The lightning protection system shall include components as follows:

Air terminal
Mechanical supports
Strip on roof and periphery
Down-conductors
Underground periphery
A low impedance Grounding system.

7.2 STANDARDS

Complete installation shall be engineering and constructed in accordance with the latest revision of the following:

- IS/IEC 62305-3:2010 : Protection against lighting-part-3: physical damage to structure and life Hazard.
- IEC 60364-5-54: Low Voltage Installation part 5-54: Selection and erection of electrical system earthing arrangement, protective bonding conductor.
- IEC 62561,Part 1-7 Lighting protection system component. Requirement and Testing methods.
- IS 3043:1987: Code of practice for earthing.
- NEC SP30:2011: National electric code.
- Ul467 Grounding and Bonding equipment.

The details of the lightning protection system shall also confirm to the requirements of all relevant local codes, as applicable, together with the additional requirements referred to in this specification and drawings, whichever is more stringent and acceptable to the engineer.

7.3 AIR TERMINAL

Air termination intended to intercept lightning flesh consisting of metal rod, metal mesh conductor.

Air termination system components installed on a structure shall be located at corner, exposed points and edges in accordance with angle/rolling/mesh methods as per given table.

Protection Class	Rolling sphere method	Mesh Method	Protection Angle Method	
	radius of rolling spare R(m)	Mesh spacing W/m	Air terminal Height	Protection Angle
I	20	5X5	20	70
II	30	10X10	30	74
III	45	15X15	45	78
IV	60	20X20	60	80

7.4 HORIZENTAL AND DOWN CONDUCTOR

The horizontal and down conductor should be used 25 x 3 mm GI strip. The conductor shall be arranged in such a way that the length shall be minimum. Increasing of no of conductors can reduce dangerous electromagnetic effect of lighting current. a equal spacing of the down conductor is preferred around the perimeter of the building. Maximum distance between two down conductors in different lighting protection level shall be as below-

Class of LPS	Typical Distance (M)
I	10
II	10
III	15
IV.	20

The down conductor must be kept in constant physical contact with the structure via conductive mounting clamps.

7.5 LIGHTNING FLASH COUNTER

Each protection system shall be supplied with Lightning strike counter. The counter shall have a register that activates one count for every discharge where the peak current exceeds 400A at the 8/20us standard.

The lightning flash counter shall be robust and easy to install. The counter shall operate from the energy of the lightning discharge and should not work on external or battery power to operate.

The lightning flash counter shall be installed to the manufacturer's instructions in a readily accessible manner (always 2mts above the Ground) so that reading can be taken at regular intervals. It shall be positioned such that its operating temperature is within the range -20℃ to + 60℃.

7.6 GROUNDING SYSTEM

The Lightning arrestor grounding system reading shall not exceed 10 ohms static impedance except with prior approval by the specifying engineer or manufacturer of the lightning protection system.

Grounding will be done by copper bonded steel core ground rods especially designed for electrical grounding.

Bonding of the grounding system to metallic parts of the building, the structural reinforcing steel of the building to arriving services is recommended.

Electrically conductive, non-soluble TEREC Powder should be used to achieve low ground resistance. Provided the materials are mixed and installed strictly in accordance with the manufacturer's instructions.

8. AUXILIARY EQUIPMENT FOR SUB-STATION

8.1 Battery Charger Unit

i General

The battery charger shall be Float cum Boost type Thyrist or controlled. The charger shall have selector switch for Auto Float – Boost / Manual Float / Manual Boost Mode of operation. During Auto Float – Boost Mode, Automatic Changeover shall take place from Float Mode to Boost mode and Vice-Versa. This means that when the Batteries are fully charged the charging shall automatically change from Boost charge to trickle charge.

ii. Construction Feature

Float cum Boost charger and DC Distribution Board shall be housed in sheet steel cubicle with panels of 1.6 mm thickness, louvers for ventilation glands plate will be provided for cable entry from bottom. The cubicle shall be painted in Siemens grey shade RAL-7032.The battery charger is divided into two compartments. The upper compartment houses the battery charger with all the necessary controls. The lower compartment is suitable for housing the batteries.

iii. Performance

The D.C output voltage of Float / Boost charger shall be stabilized within $\pm$ 2% for AC input variation of 230 V $\pm$ 10%, frequency variation of 50 Hz $\pm$ 5% and DC load variation of 0-100%.The voltage regulation shall be achieved by a constant voltage regulator having fast response SCR control. The ripple content will be within 3% of DC output nominal voltage.

There shall be provision to select Auto Float / Manual Float / Manual Boost modes.During Auto Float Mode the battery charging shall automatically changeover from Boost Mode to Float Mode and Vice Versa. During Manual Float / Boost modes it shall be possible to set the output volts by separate potentiometers.

The battery charger shall have automatic output current limiting feature.

iv. Components

The battery charger shall essentially comprise of the following

1 No. double pole ON/OFF MCB at AC input.

1 No. pilot lamp to indicate charger ON.

1 No. Main Transformer :Double wound, naturally air cooled, having copper winding.

1 set single phase full wave bridge rectifier consisting of 2 No. diodes and 2 No. SCRs, liberally rated, mounted on heat sinks and complete with resistor /condensor network for surge suppression.

1 No. rotary switch to select auto float / manual float / manual boost. During auto float mode automatic changeover shall take place from float mode to boost mode and vice versa.

1 set solid state constant potential controller to stabilize the DC output voltage of the float cum boost charger at $\pm$ 2% of time set value for AC input voltage variation of 230 V $\pm$ 10%, frequency variation of $\pm$ 5% from 50 Hz and simultaneous load variation of 0-100% and also complete with Current Limiting Circuit to drop the Float Charger output voltage upon overloads to enable the battery to take over.

1 No. electronic controller to automatically changeover battery charging from boost to float and vice versa..

1 No. DC ammeter and toggle switch to read charger output current and battery charge / discharge current.
1 No. moving coil DC voltmeter to read the DC output voltage.

2 set potentiometer to adjust the output voltage during manual /auto float and boost modes.

1 No. double pole ON/OFF MCB for Charger Output (24 V DC Rating).

2 set DC output terminals.1 set for the load and the other set for the battery.

Alarm Annunciation :Visual and audible alarm with manual accept reset facility shall be provided for the following :

a. AC mains fail

b. Charger Fail

c. Load / Output overvolt.

Rating

AC Input	:	230 V ± 10% AC 50 Hz single phase.
DC Output	:	To float / boost charge 24 V / 200 AH batteries and also supply a continuous load.
Current Rating	:	30.0 Amps
Float Mode	:	28.0 V nominal (Adjustable) between24-28.0 V.
Boost Mode	:	28.2 V nominal (Adjustable) between24-29.0 V.
Voltage Regulation	:	± 2% for AC input variation of 230 V ± 10%.Frequency Variation of50 Hz ± 5% and DC load variation 0-100%
Ripple	:	Less than 5%

v. DC Distribution Board

It shall be provided in the charging cubicle, it will comprises of the following:

Incoming :1 No. 63 A DP MCB

Outgoing :10No. 16 A DP MCB

8.2 Safety Equipment

Danger Plate

Danger plate shall be provided on HV and MV equipment. MV danger notice plate shall be200 mm x 150 mm made of mild steel at least 2 mm thick with vitreous enamelled white on both side and with inscription in red colour on front side.

Fire Extinguishers

Portable CO_2 conforming to IS:2878-1976, and dry chemical conforming to IS:2171-1967 shall be provided in the Sub-station.

Insulating Mats for Electrical Purpose

Materials :

Insulating Mats shall be in compliance with IS-15652-2006 /IEC 61111-2002-08.

The insulating mats shall be made of Elastomer (a generic term that includes rubber, latex and elastomer compounds that may be natural or synthetic or a mixture of both) for use as floor covering for the protection of workers on AC and DC installation with the system voltage upto 66 KV AC and 240 volts DC.

Classes and max.use voltages of insulation mats shall be as follows:

S. No.	Class	AC (rms)	DC (volts)
i.	A	3.3	240
ii.	B	11	-
iii.	C	33	-
iv.	D	66	-

Mats shall be resistant to acid and oil and low temperatures and shall be identified by therespective class symbol.

Thickness of mats for different classes, physical properties, dielectric properties and all other specification shall be as per IS:15652-2008.be free from blisters, pin holes, cracks, embeded foreign matters and other defects.

9. HT CABLE : 11 KV GRADE XLPE

9.1 General

Cables shall be aluminium conductor, cross linked polyurethene construction and shall be supplied, inspected, laid, tested and commissioned in accordance with drawings, specifications, relevant Standard Specifications and cable manufacturers instructions.

9.2 Material

a. Conductor

The Conductor shall be made from electrical purity aluminum stranded wires compacted together.

b. Insulation

High quality TROPOTHEN - X (XLPE) unfilled insulating compound of natural colour shall be used for insulation. Insulation shall be applied by extrusion process and shall be chemically cross linked in continuos vulcanization process.

c. Shielding

Cables shall be provided with conductor shielding as well as insulation shielding and shall consist of extruded semi-conducting compound, additionally insulation shield shall be provided with semi-conducting and metallic tape shield over the extruded insulation shield.XLPE insulation and outer core shielding shall be extruded in one operation.

d. Armouring

Armouring shall be applied over the inner sheath and shall comprise of flat steel wires (strips).

e. Outer Sheath

Tough outer sheath of heat resisting PVC compound shall be extruded over the armouring in case of armoured cables or over extruded over the armouring in case of armoured cables or over inner sheath in the case of unarmoured cables.

9.3 Tests

Cables shall be type tested and routine tested in accordance with IS:7098 (Part II).

a. Conductor resistance test.

b. Partial discharge test.

c. High Voltage test.

The following tests shall be carried out at site for insulation between phases and between phase and earth before and after cable laying.

a. Insulation Resistance Test.

b. Continuity resistance test.

c. Sheathing continuity test.

d. Earth test.

e. High Voltage test.

Cables shall be laid with a clearance of at least 75 mm between two cables.

9.4 End Termination of HT Cable

Pre-moulded cable terminations for XLPE cable shall be used as per manufacturer's instructions. The steel cone of M-seal Push-On shall consist of highly track resistant insulating section vulcanised to a semi-conducting section. The pad material shall have cold-flow properties and shall be flame retardant.

Each end terminal shall undergo Hi Pot Test.

9.5 Laying of HT Cables

Direct in Ground

The work shall involve excavation of trench and laying of cable(s) as indicated in drawing and Schedule of Quantities.

The depth of the excavation shall not be less than 900 mm for 11 KV from the upper surface of ground. Where more than one multicore cable is laid in the same trench, a horizontal inter spacing of250 mm shall be left in order to reduce mutual heating and also to ensure that fault occuring on one cable will not damage the adjacent cable.

Cable shall be laid in cement pipes encased in concrete or hume pipes at all road crossing. Cables shall be laid in trenches over rollers placed inside the trenches. After the cable has been properly laid and straightened, it shall be covered with 80 mm thick layer of sand. Cable shall then be lifted and placed over this sand cushion. Again, the cable shall be covered with a 80 mm layer of sand. Over the sand a layer of cable protection tiles shall be placed by overlapping 50 mm on either side. Trenches shall then be back-filled with earth and shall be consolidated. Suitable cable markers made of cast iron with aluminium paint indicating the voltage grade and direction of run of the cables shall be installed at regular intervals.

9.6 RCC/Masonry Trench

For layingof HT cable in RCC/Masonry trench refer detail on sub-station layout drawing and IS-1255-1983.

10. COMPACT SUBSTATION

10.1 CODE & STANDARDS

All equipment and material shall be designed manufactured and tested in accordance with the latest applicable Indian Standard / IEC standard shall be type tested and shall have necessary statutory approval **from local authority.**

Equipment and material conforming to any other standard which ensures equal or better quality may be accepted. In such case copies of English version of the standard adopted shall be submitted.

The electrical installation shall meet the requirement of Indian Electricity Rules as amended upto date relevant IS code of practice and Indian electricity act.

The Compact Secondary Sub-station offered shall in general comply with the latest issues including amendments of the following standards but not restricted to it.

Title	**Indian Standards**
High Voltage Low Voltage Pre-Fabricated Substation	IEC:1330
11 kV Switchgear cubicles	IS:13118, IS:3427, IEC:694. IEC:298
Ring main unit 11 kV grade	IS:9920, IEC:265
Code of practice for selection, installation and maintenance of Switchgear	IS:10118
Distribution Transformer	IS: 2026
Dry Type Power Transformer	IS:11171
Colour for ready mix paints	IS:5
Enamel synthetic, exterior a) Undercoating b) finishing	IS:2932
Indian Electricity Rules	1956
Indian Electricity Act	1910

10.2 DESIGN CRITERIA

Compact Secondary Sub-station consisting of **11kV HT VCB Panel + Transformer + L.T. Switchgear** with all connection accessories, fitting & auxiliary equipment in an Enclosure to supply Low-voltage energy from high-voltage system as detailed in this specification. The complete unit shall be installed on a substation plinth (base) as **Outdoor substation** located at very congested places. The HT Circuit Breaker shall be used to control and isolate the 11kV / 433V Distribution transformer. The transformer L.T. side shall be connected to L.T. switchgear. The connection cables to Feeder Pillars shall be taken out from the L.T. switchgear.

The prefabricated-Compact Secondary substation shall be designed for a) Compactness, b) fast installation, c) maintenance free operation, d) safety for worker/operator & public.

The Switchgear and component thereof shall be capable of withstanding the mechanical and thermal stresses of short circuit listed in ratings and requirements clause without any damage or deterioration of the materials.

For continues operation at specified ratings temperature rise of the various switchgear components shall be limited to permissible values stipulated in the relevant standard and / or this specification.

Service Conditions: The equipment offered shall be suitable for continuous satisfactory operation in tropical area of Installation.

Enclosure: The Enclosure, High Voltage switchgear-control gear, Low Voltage switchgear-control gear & Transformer of the Compact Secondary substation shall be designed to be used under **normal outdoor service condition (IP-55)** as mentioned. The enclosure should take minimum space for the installation including the space required for approaching various doors & equipment inside. The enclosure construction shall be such that it fully protects ingress of rain water &rusting .For this purpose, construction without welded joint is preferred.

10.3 SPECIFIC REQUIREMENT

The main components of a prefabricated-Compact Secondary substation are Transformer, High-voltage switchgear-control gear, Low-voltage switchgear-control gear, corresponding interconnections (cable, flexible, bus bars) & auxiliary equipment. The components shall be enclosed, by either common enclosure or by an assembly of enclosure. All the components shall comply with their relevant IS/IEC standards.

10.3.1 Ratings

Description	**Value**
Rated Voltage/ Operating Voltage	11 kV rms
Rated frequency & Number of phases	50Hz & 3nos.
Rated maximum power of sub-station	As given in B.O.Q.
Rated Ingress protection class of Enclosure	IP-23D for substation enclosure and IP:54 for LT Switchgear & HT Switchgear enclosure

10.3.2 HV Insulation Level

Rated withstand voltage at power frequency of 50 Hz	28 kV rms
Rated Impulse withstand Voltage	75 kV peak

10.3. 3 HV Network & Bus bar

Rated current	630 Amp
Bus Bar current density (Cu)	1 Amps/sq.mm
Rated short time withstand current	21 kA rms/1sec
Making capacity for switch-disconnector & earthing switches	52.5 kA peak
Breaking capacity of Isolators (rated full load)	630 A
Tap off Breaker	630 A

10.3.4 LT Network — As per BOQ

10.4 OUTDOOR ENCLOSURE

The enclosure shall be made of Galvanized Iron tropicalized to Indian whether conditions.

The metal base shall ensure rigidity for easy transport & installation.

The structure of the substation shall be capable of supporting the gross weight of all the equipment & the roof of the substation compartment shall be designed to support adequate loads.

The protection degree of the Enclosure shall be **IP55 for LT & HT switchgear compartment & IP23D for Transformer compartment.** Proper / adequate ventilation aperture shall be provided with Louvers for natural ventilation etc. and thermal class K10 with interlock arrangement, approved shade of paint and arcing withstand test of 18.4 kA for 1 sec.

The doors shall be provided with proper interlocking arrangement for safety of operator.

The H.V. & L.V. outgoing of the transformer are to be connected to HT Breaker & incomer of the L.V.

Internal Fault: Failure within the Compact Secondary substation due to either a defect, an exceptional service condition or mal-operation may initiate an internal arc. Such an event may lead to the risk of injury, if persons are present. It is desirable that the highest practicable degree of protection to persons shall be provided.

Covers & Doors: Covers & doors shall be part of the enclosure. When they are closed, they shall provide the degree of protection specified for the enclosure. Ventilation openings shall be so arranged or shielded that same degree of protection as specified for enclosure is obtained. Additional wire mesh may be used with proper Danger board for safety of the operator. All covers, doors or roof shall be provided with locking facility or it shall not be possible to open or remove them before doors used for normal operation have been opened. The doors shall open outward at an angle of at least 90° & be equipped with a device able to maintain them in an open position.

Earthing: All metallic components shall be earthed to a common earthing point. It shall be terminated by an adequate terminal intended for connection to the earth system of the installation, by way of flexible jumpers/strips & Lug arrangement. The continuity of the earth system shall be ensured taking into account the thermal & mechanical stresses caused by the current it may have to carry. The components to be connected to the earth system shall include:

a. The enclosure of Compact Secondary / prefabricated substation,

b. The enclosure of High voltage switchgear & control gear from the terminal provided for the purpose,

c. The metal screen & the high voltage cable earth conductor,

d. The transformer tank or metal frame of transformer,

e. The frame &/or enclosure of low voltage switchgear,

Their shall be arrangement for internal lighting activated by associated switch for HV, Transformer & LT compartments separately.

Labels: Labels for warning, manufacturer's operating instructions etc. & those according to local standards & regulations shall be durable & clearly legible.

Cleaning & Painting:

a. The paints shall be carefully selected to withstand tropical heat rain. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.

b. Special care shall be taken by the manufacturer to ensure against rusting of nuts, bolts and fittings during operation. All bushings and current carrying parts shall be cleaned properly after final painting.

10.5 11KV VCB Panel

10.5.1 SCOPE

Manufacturing and supplying of integrated cubicle type, floor mounted, free standing extensible, sheet steel enclosed, front operated outdoor type 11 KV Switch Board as per specifications given below:

System

The switchgear shall be suitable for the following system:

a.	Rated Current	-	630 Amps
b.	Rated Voltage	-	11 KV, 3 Phase earthed system.
c.	Rated Frequency	-	50 Hz
d.	Rated short circuit breaker current	-	18.4 KA
e.	Rated short circuit making current	-	50 KA
f.	Insulation level	-	75 KV

Unless otherwise stated HT Switchgear shall conform to IS:2516-1985 other relevant Indian Standards and Indian Electricity Rules and Regulations.

Construction Features

The enclosure shall be fabricated from MS Sheet steel 2 mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded, all welding slag rounded off and welding pits wiped smooth with plumber metal, all panels and covers shall be properly fitted and square with the frames, and holes in the panel correctly positioned. Fixing screw shall enter into holes tapped into an adequate thickness of metal or provided with hank nuts. Self-threading screws shall not be used in the construction of switch boards. The boards shall be totally enclosed design, completely dust tight and vermin proof, Gaskets between all adjacent units and beneath all cover shall be used to render the joints effectively dust tight.

The switch board shall be extensible at site on either side. Neoprene gasket shall be used between all metal joints, doors and covers to prevent ingress of dust.

10.5.2 INSTRUMENT ACCOMMODATIONS

Separate and adequate compartments shall be provided for accommodating instruments, indicating lamps and control contactors etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, bus bars and connections.

10.5.3 GENERAL ARRANGEMENT

The HT switch board shall comprise of one panel consisting of 630 amps incoming and 630 amps outgoing VCB Breaker. Provision shall be made for extension of switch board in future.

10.5.4 CIRCUIT ARRANGEMENT

The panel shall be provided with TP 11 KV VCB Circuit Breakers as specified in the schedule of quantities with symmetrical breaking capacity of 18.4 KA at 11 KV.

The breaker shall be flush front, metal clad, draw out type and shall be provided with trip free, electrical/ manual closing mechanism with mechanical ON/OFF indication. The operating handle and the mechanical trip push button shall be at the front of the breaker and integral with the breaker.

10.5.5 CIRCUIT

Each circuit breaker shall housed in a separate compartment and shall be enclosed on all sides. The following safety interlocks shall be provided.

i. The breaker shall be provided with a complete system of interlock. The draw out mechanism cannot be operated unless the breaker is open ensuring that the breaker position can be changed only when the breaker is open.

ii. The breaker cannot be closed at any points between the fully connected positions. In addition, the breakers of the same rated continuous current can be interchangeable to each other's switchgear panel, but the breakers shall be prevented from joining with panels of a different rating.

10.5.6 CRADLE

The Cradle shall be so designed and constructed as to permit smooth withdrawl and insertion of the breaker. The movement shall be free of jerks, easy to operate and shall preferably be on steel balls/rollers and not on flat surfaces.

10.5.7 BARRIER

Sheet steel barriers shall be provided between:

i. Instrument panel and potential transformer.
ii. Bus Bar Chamber and Circuit Breaker compartment.

10.5.8 BUS BAR SECTION

i. General Requirements

The switch board shall be single bus bar pattern with air insulated encapsulated bus bars housed in a separate compartment, segregated from other compartments. Inspection covers shall be provided to facilitate inspection of bus bar assembly and for cleaning. In case of access to the bus bars by removing the inspection cover, no dismantling of units, wiring etc. shall be necessary. Each unit chamber shall be separated from adjacent unit by insulating barriers.

ii. Material

The bus bar shall be of high conductivity electrolytic copper as specified with minimum of 630 amps. The bus bars shall be sized for carrying the rated and short circuit current without over-heating. Maximum bus bar temperature shall not exceed 60°C under normal operating conditions.

10.5.9 CURRENT TRANSFORMER

i. General Requirements

Accommodation shall be provided in the circuit breaker panel, to mount one set of duel ratio CT. Access to the CTS for cleaning, testing or changing shall be from the front, back or top of the panel.

ii. Rating

Duel ratio CTS of suitable burden (but each not less than 15 VA) shall be preferred with 5 amps secondaries.

The CTS shall conform to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTS shall be brought out suitable to a terminal block which will be easily accessible for testing and terminal connections. The protection CTS shall be of accuracy class 5 P 10 of IS 2705-Part III - 1992.

10.5.10 POTENTIALTRANSFORMER

General Requirements

A potential transformer of burden not less the 100 VA and of proper ratio as specified, shall be provided at the incoming panel. The accuracy class for PT shall be class I as per IS 3156.

10.5.11 PROTECTION AND TRIPPING ARRANGEMENT

The protection and tripping arrangement of circuit breaker shall be:

i. Instantaneous short circuit protection Device No.50 Range 500 – 2000% shall be provided on all phases.

ii. Back up over current protection for Phase faults Device No.51 Range 50 – 200% shall be provided on all phases.

iii. Ground fault protection Device No.50G with stabilising resistor.CT's. Range 20 – 80% shall be provided.

iv. Lockout and trip supervisory relays etc shall be provided with manual reset facility.

v. Auxiliary relay for transformer fault – Trip & Alarm (FIVE no of fault to be consider on each transformer).

vi. 10 window Annunciator

vii. Incomer board: 2O/C & 1 E/F (51, 51N)

viii. Outgoing of each panel board: 2O/c & 1 E/F (50, 50N)

ix. Antipumping& Gas pressor

10.5.12 CONTROL WIRING

The control wiring shall be carried out with minimum 2.5 sq. mm. PVC insulated copper conductor cables. The wiring shall be securely fixed and neatly arranged to enable easy tracing of wires. Identification PVC ferrules shall be fitted to all wire terminals to render easy identification and facilitate checking in accordance with IS 5578 and 11353.

10.5.13 Earthing Switch

Cable earthing switch shall be provided in the cable chamber and shall be operated from the front of the panel. The ON/OFF position of switch shall be indicated by mechanical indicator. The earthing switch shall be suitably interlocked with the breaker, so that it can be operated only when the breaker is in OFF position.

Earthing switch shall also be provided on bus bar side. The ON/OFF Switch shall be indicated by mechanical indicator. The earthing switch shall be suitably interlocked with the breaker, so that it can be operated only when the breaker is in OFF position.

10.5.14 METERING INSTRUMENT PANEL ACCESSORIES

i. Metering

Incomer panel board:	Digital type Trivector meter. Digital type combine VAF meter
Output panel:	Digital ameter

ii. Instrument Panels

The instrument panel shall be part of the housing. Relays, meters and instruments shall be mounted as per general arrangement drawings to be submitted by the vendors. They shall be of flush mounting type.

iii. Instrumentations

a. Digital type VAF of class 1.0 accuracy and 96 x 96 mm square in size as per IS-1248 shall be provided at each incomer panel, with selector switch. The instrument shall be calibrated for the ranges specified.

b. Digital type Power factor meter of class 1.0 accuracy conforming to IS: 1284-1948 shall be provided.

c. Digital type Ammeter of specified range to class 1.0 accuracy and 96 x 96 sq mm in size as per IS - 1248 shall be provided at both incomer and outgoing panels alongwith necessary selector switches.

d. The board assembly have the following requirements:

- Lamp indication shall be provided to indicate ON/OFF (By red/green respectively) of switch gear.
- Trip Circuit Healthy supply shall be indicated by clear lamp.
- Separate MCB's shall be provided for lamps, heaters and voltmeters, other instrumentation etc. on each panel.
- Anti-condensation space heaters suitable for operation on 240 V single phase, 50 Hz A.C. for each panel. Supply & control equipment for the above shall be provided by the vendors.
- Where there is more than one incomer and bus sections, these shall be mechanical and electrical interlocked as per interlocking where specified.

10.5.15 CABLE BOXES

Cable boxes shall be suited in a compartment at the rear side of the housing or as specified. Cable boxes shall be complete with brass glands suitable for XLPE cable to be terminated with heat shrinkable cable terminations.

10.6. OIL FILLED TRANSFORMERS WITH OFF LOAD TAP CHANGING AND RTCC PANEL ON HV SIDE

10.6.1 **SCOPE**

Design, manufacture, testing, supplying and commissioning of 11000 / 433 volts step down, core type, transformer as per specification.

10.6.2 **STANDARD**

Transformer shall Conform to Indian Standard IS: 2026-Part I to Part IV and IS 1180 part 1 : 2014 Energy efficiency level 2 and ECBC 2017(ECBC + Building).

10.6.3 **RATING**

Selected Transformer shall be of specified rating suitable for continuous operation.

10.6.4 **CONNECTIONS AND VECTOR GROUP**

Delta on High Voltage side and star on low voltage side with neutral terminal brought out for solid earthing corresponding to the Vector Symbol Dyn - 16.

10.6.5 **SYSTEM OF SUPPLY**

3 phase, 50 Hz, 11 KV earthed system.

10.6.6 **TAPPINGS**

'ON' load tap changing on HV side. The trappings to be provided for variation on HV side from (+) 5% to (-) 15% in steps of 1.25% each.

10.6.7 **TEMPERATURE RISE**

Continuously rated for full load, temperature rise not exceeding 35° C by thermometer in oil or 40 Deg C by resistance.

10.6.8 **TYPE**

Outdoor type sealed transformer.

10.6.9 **TERMINALS**

The cable box with glands on H T side shall be suitable for 3 core XLPE cable of specified capacity. Flanges with bus duct on LT side shall be suitable for cables of size mentioned in BOQ. All cable glands shall be earthed.

10.6.10 **COOLING**

Natural cooling by means of pressed /round tubes around transformer tank.

10.6.11 **INSULATION**

The transformer shall be oil insulated type.

10.6.12 **EARTHING**

Two separate earthing terminals to be provided at the bottom on both sides.

10.6.13 **FITTINGS AND ACCESSORIES**

A. The following accessories and fittings shall be provided for Transformer:

- Lifting Lugs:

  The arrangement for lifting the active part out of the transformer tank along with the cover by means of lifting lugs without disturbing the connections.

- Swivel Type Rollers:

  The transformer to be provided with 4 Nos Bi-Directional rollers fitted on cross channels to facilitate the movement of the transformer in both directions.

- Oil Conservator:

  The transformer to be provided with an oil conservator with welded end plates. It is to be bolted to the cover and can be dismounted for purpose of transport. It has to be provided with magnetic oil level gauge and an oil filling hole 1 1/4" BSF size with a cap, which can be used for filtering oil. For draining purpose a plug shall provide. A connection pipe between the conservator and the main tank is to be provided which projects inside the conservator and the main tank is to be provided which projects inside the conservator.

- Air release Valve

An air release valve is to be provided on the top of the tank cover facilitate the release of the entrapped air and filling of oil.

- Breather:

  The transformer to be provided with an indicating dehydrating silicagel breather of sufficient capacity.

- Drain-cum-oil Filter Valves :

  The transformer to be provided with a drain-cum-oil filter valve of 1 1/4" BSF size at the bottom of the tank.

- Diagram and rating plate :

  Diagram and rating plate shall be provided indicating the details of transformer, connection diagram, vector group, tap changing diagram etc.

- Dial type thermometer (150 mm dia) with maximum set pointer at 75 deg.C C and electrical contacts for electrical alarm at high temperature.

- Winding temperature indication and electrical contacts for trip / alrm.

- Buchholz relay of double float type with electrical contacts for low oil level alarm and high gas pressure trip suitable for 24 volts DC supply.

- Filter valve of 1 1/4" BSF at top.

- Explosion vent.

- Disconnecting chamber shall be provided for cable termination.

10.6.14 **WINDING**

The transformer shall be copper wound.

10.6.15 **CORE**

The magnetic core shall be made up of cold rolled grain oriented low loss steel stampings.

10.6.16 **DRAWINGS AND LEAFLETS**

Three copies of operation and maintenance manual with complete instructions for the installation, operations, maintenance and repairs, circuit diagram, foundation and trenching details shall be provided with the transformer.

10.6.17 **TESTING**

The transformer shall be subject to the following tests at the factory before despatching the same and test certificates shall be furnished.

a. Measurement of winding resistance.
b. Ratio polarity and phase relationship.
c. Impedance voltage.
d. Load losses.
e. No-load losses and no-load current.
f. Insulation resistance.
g. Induced over voltage withstand.
h. Separate - source voltage withstand.
i. Temperature rise.
j. Di-electric strength of oil.

10.7. LT PANEL

As appendix -4 per LT Panel specification.

10.8. TYPE / ROUTINE TEST ON COMPACT SECONDARY SUBSTATION:

Type Tests:

The offered Compact Secondary substation should be fully type tested as per the IEC-1330

Routine Tests:

The routine tests shall be made on each complete prefabricated substation.

a) Voltage tests on auxiliary circuit.
b) Functional test.
c) Verification of complete wiring.

Test Witness: Routine test shall be performed in presence of Owner's representative if so desired by the Owner. The Client/supplier shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.

Test Certificates:

Test report for the test mentioned under Type tests clause shall be submitted along with offer.

Certified reports of all the tests carried out at the works shall be furnished in three (3) copies for approval of the Owner.

11. EXTERNAL / STREET LIGHTING POLES

11.1 M.S. Tubular Poles

11.1.1 7 Meter High Pole with Ladder Bars

7 meter high (8.75 meters above and 1.25 meters below ground shall be M.S.step tubular pole in 3 steps (bottom part shall be 4 meters high, 114.3 mm outer dia and 3.65 mm walll thickness, middle part shall be 1.5 meter high, 88.9 mm outer dia and 3.25 mm wall thickness, top part shall be 1.5 meters high, 78.1 mm outer dia and 3.25 mm wall thickness) with 300 mm x 300 mm x 6 mm thick base plate. Foundation for the pole shall be of cement concrete in 1:2:4 ratio.(1 part cement, 2 parts, coarse sand and 4 parts stone aggregate) IP-55 weather proof junction box shall also be provided to accommodate 1 No. 3 phase and neutral terminal block and 1 No. 6 amps SP MCB including 2.5 sq.mm PVC insulated copper conductor wire from the terminals block to the fixture and 2 No. 32 mm dia GI sleeves of suitable length shall be provided to the junction box.

11.1.2 4.5 Meter High Pole

4.5 meter high (3.6 meter above and 0.9 meter below ground) shall be 75 mm dia, 3.25 mm wall thickness MS tubular straight pole with a cast aluminium adaptor for post top mounting. Pole shall be provided with 300 mm x 300 mm x 6 mm thick MS base plate. Foundation for the pole shall be of cement concrete in 1:2:4 rates (1 part cement, 2 parts coarse sand and 4 parts stone aggregate) IP-55 weather proof junction box shall also be provided to accommodate 1 No. 3 phase and neutral terminal block and 1 No. 6 amps SP MCB including 2.5 sq.mm PVC insulated copper conductor wires from the terminal block to the fixture and 2 No. 32 mm dia GI sleeves of suitable length shall be provided to the junction box.

11.2 Cast Aluminium Poles

Design & Construction

Ornamental cast aluminum pole shall be made out of cast aluminum as per requirements of IS:202 (1993).Casting of all pole Sections shall be accurately done from permanent moulds and cores of the design submitted to Achieve uniformity in all design aspects in internal and external shape of the unit. All sections shall be free from defects like blow holes, porosity, hard spots, cracks, Hot tears, cold shuts, distortion, sand and slag inclusion and other harmful defects. All the casted sections used in the pole shall be free from welding of any kind used to repair it.The casted sections shall be machined from all the locations used to insert the pieces into one another using either threading or socket method. Accuracy of all machined parts shall be maintained throughout a lot for random replacements of sections if and when required. All the threaded joints shall be mechanically tightened and sealed using industrial tools to make the entire unit vandal resistant.

Aesthetic appearance

All the grooves and carvings of the pole unit shall be free from any kind of distortion for a pleasing aesthetic appearance.

Material

Cast aluminum material used for casting pole unit shall be Grade FG-220 type, as described in IS:202 and shall have minimum tensile strength of the order of 200 N/mmsq.

Pre-treatment

Each and every casted piece shall be subject to Sand blasting at a pressure of 10-15 kgf to remove all its external dirt and sand remains etc..

Painting and Finishing

Entire unit shall be given an extensive three stage treatment with PU based two packZn-Ph primer and paint prescribed for CI surfaces to make it absolutely rust and corrosion proof, as well as giving it a pleasing appearance. PU based paint shall be MRF make or equivalent.

Thickness of the coating

A minimum of 80 microns of coating thickness shall be achieved on the final piece.

Mounting arrangement

Pole unit shall be grouted using 4 No. anchor bolts of size M-16x450 mm confirming to 8.8 Gr.as per IS 2062.Pole unit shall be grouted on a foundation made out of 1:3:6 concrete cement after excavating the earth with proper cable sleeves etc.. laid in the foundation itself.

Dimensions of the unit

Total height = 3000 mm
Dia of base plate = 380 mm
Pitch Circle Dia = 335 mm

Description of top bracket / arms

Single double decorative arm shall be provided on the pole (as asked for in B.O.Q.), secured with the help of two No. bolts outreach not less than 400 mm.

Service window

A service window of the size 150 mm x 100 mm shall be provided in the base of the pole to allow access to electrical connections and terminations. It shall be covered with MS plate and proper rubber gaskets shall be provided to prevent any ingress of water etc..

Electrical connections

Four way connectors shall be provided along with Slide lock and 1 no. 6 amps Sp MCB including 2.5 sqmm PVC insulated copper conducter wires from the terminal block to the fixture and 2 No. 32 mm dia GI sleeves of suitable length shall be provided up to the service window. An earth boss is provided on the control plate along with connectors and interrupters.

11.3 Galvanized Octagonal Poles

Design

The Octagonal poles shall be designed to withstand the maximum wind speed of 169 KM / Hr. as per IS 878. The top loading i.e. area and the weight of fixtures are to be considered to calculate maximum deflection of the pole and the same shall meet the requirement of BS : 5649 Part VI 1982.

Pole Shaft

The pole shaft shall have octagonal cross section and shall be continuously tapered with single longitudinal welding. There shall not be any circumferential welding. The welding of pole shaft shall be done by submerged Arc Welding (SAW) process.

All octagonal pole shafts shall be provided with the rigid flange plate of suitable thickness with provision for fixing 4 foundation bolts. This base plate shall be fillet welded to the pole shaft at two locations i.e. from inside and outside. The welding shall be done as per qualified MMAW process approved by Third Party Inspection agency.

Door opening

The octagonal poles shall have door of approximate 500 mm length at the elevation of 500 mm from the Base plate. The door shall be vandal resistance and shall be weather proof to ensure safety of inside connections. The door shall be flush with the exterior surface and shall have suitable locking arrangement. There shall also be suitable arrangement for the purpose of earthing.

The pole shall be adequately strengthened at the location of the door to compensate for the loss in section.

Material

Octagonal Poles	:	HT Steel Conforming to grade S355JO
Base Plate	:	Fe 410 conforming to IS 226 / IS 2062
Foundation Bolts	:	EN.8 grade

Welding

The welding shall be carried out confirming to approved procedures duly qualified by third party inspection agency. The welders shall also be qualified for welding the octagonal shafts.

Pole sections

The Octagonal Poles shall be in single section (up to11mtr).There shall not be any circumferential weld joint.

Galvanization

The poles shall be hot dip galvanized as per IS 2629 / IS 2633 / IS 4759 standards with average coating thickness of 70 micron. The galvanizing shall be done in single dipping.

Xing type

The Octagonal Poles shall be bolted on a pre-cast foundation with a set of four foundation bolts for greater rigidity.

Top Mountings

The galvanized mounting bracket shall be supplied along with the Octagonal Poles for Installation of the luminaries.

Manufacturing

The pole manufacturing & galvanizing unit shall be ISO 9001 : 2000 & ISO 14001 certified to ensure consistent quality & environmental protection.

Service window

A service window of the size 150 mm x 100 mm shall be provided in the base of the pole to allow access to electrical connections and terminations. It shall be covered with MS plate and proper rubber gaskets shall be provided to prevent any ingress of water etc..

Electrical connections

Four way connectors shall be provided along with Slide lock and 1 no. 6 amps Sp MCB including 2.5 sqmm PVC insulated copper conductor wires from the terminal block to the fixture and 2 No. 32 mm dia GI sleeves of suitable length shall be provided upto the service window. An earth boss is provided on the control plate along with connectors and interrupters.

Galvanized Octagonal Poles Dimensions

Height	Top Dia (A/F)	Bottom Dia (A/F)	Sheet Thick Ness	Base Plate Dimensions (LxBxT)	Foundation Bolt			
					Bolt Size (No. x Dia)	Pitch Circle Dia (PCD)	Bolt Length (MM)	Projected Bolt Length
(mtr)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
3	70	130	3	200 x 200 x 12	4 x 16 Dia	200	450	80
4	70	130	3	200 x 200 x 12	4 x 16 Dia	200	450	80
5	70	130	3	200 x 200 x 12	4 x 16 Dia	200	600	80
6	70	130	3	220 x 220 x 12	4 x 20 Dia	205	600	100
7	70	130	3	220 x 220 x 12	4 x 20 Dia	205	700	100
8	70	135	3	225 x 225 x 16	4 x 20 Dia	210	750	100
9	70	155	3	260 x 260 x 16	4 x 24 Dia	250	750	125
10	70	175	3	275 x 275 x 16	4 x 24 Dia	270	750	125
11	90	210	3	300 x 300 x 20	4 x 24 Dia	300	750	125
12	90	240	3	320 x 320 x 20	4 x 24 Dia	325	850	125

12. TESTING

12.1 GENERAL

At the completion of the work, the entire installation shall be subject to the following tests in the presence of the Engineer-in-charge.

Insulation resistance test.
Earth continuity test.
Earth resistivity test.
Test as per Appendix `E' of IS: 732 -1989

Besides the above, any other test specified by the local authority shall also be carried out. All tested and calibrated instruments for testing, labour, materials and incidentals necessary to conduct the above tests shall be provided by the Contractor at his own cost.

12.2 INSULATION RESISTANCE TEST

The insulation resistance shall be measured between earth and the whole system of conductors, or any section thereof, with all switches closed and except in concentric wiring all lamps in position of both poles of the installation otherwise electrically connected together, a direct current pressure of not less than twice the working pressure provided that it does not exceed 660 volts for medium voltage circuits. Where the supply is derived from AC three phase system, the neutral pole of which is connected to earth, either direct or through added resistance, pressure shall be deemed to be that which is maintained between the phase conductor and the neutral. The insulation resistance measured as above shall not be less than 50 divided by the number of points provided on the circuit, the whole installation shall have an insulation resistance greater than one mega ohms. The insulation resistance between the frame work of housing of power appliances and all live parts of each appliance shall not be less than that specified in the relevant standard specification or where there is no such specification, shall not be less than one a mega ohms. All equipment's, cables shall be inspected at works by the Architect as per relevant IS and testing commissioning of installation as per Appendix `E' of IS: 732-1989 shall be done and all record to be maintained.

12.3 TESTING OF EARTH CONTINUITY PATH

The earth continuity conductor metallic envelopes of cables shall be tested for electric continuity and the electrical resistance of the same, along with the earthing lead but excluding any added resistance or earth leakage circuit breaker, measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation, shall not exceed one ohm.

12.4 TESTING OF POLARITY OF NON-LINKED SINGLE POLE SWITCH

In a two wire installation a test shall be made to verify that all non-lined single pole switches have been connected to the same conductor throughout, and such conductor shall be labeled or marked for connection to an outer or phase conductor or to the non-earthed conductor of the supply. In the three or four wire installation, a test shall be made to verify that every non-linked single pole switch is fitted to one of the outer or phase conductor of the supply. The entire electrical installation shall be subject to the final acceptance of the Engineer-in-charge as well as the local authorities.

B. FIRE DETECTION & ALARM SYSTEM WITH VOICE EVACUATION SYSTEM AND PUBLIC ANNOUNCEMENT

1. GENERAL DESCRIPTION

- The Fire Alarm System supplier shall furnish and install a fully integrated Fire Detection cum Voice Evacuation system.
- It is proposed to have a single, unified and integrated Fire Alarm cum Voice Evacuation system to meet the Life Safety Standards defined in NFPA standards and NBC standards.
- The Fire Alarm System shall consist of Smoke detectors, Heat Detectors, and combination detectors selected as per specific requirements of the area to be installed in, as well as various input / output modules.
- It is proposed to have Fire Detection Panels distributed at various floors, in the LV shafts.
- Distributed on the floors are also the Voice and Fire Fighter's Telephone Command Centers, in direct peer-to-peer network with the Fire Alarm Panels.
- Every Staircase shall be provided with a Fire Fighter's telephone station comprising of a Firefighters telephone and jack, and a cabinet to house the same securely.
- Voice evacuation speakers to meet the sound pressure levels as decreed by NFPA 72, NFPA 101 shall be deployed in the entire complex. Exit sounders, which shall emit a distinct temporal sound signature to help occupant evacuate the floor shall be deployed at the Fire Exit Staircases.
- Digital Voice amplifiers shall be deployed on floor levels as per the attached schematics.
- Touch Screen Panels, which shall enable the Fire Fighters to have immediate first-hand information of any fire scenario, along with the facility to display auxiliary information which shall be programmed to facilitate firefighting, shall be deployed at the entrances to the individual sections of the building, as depicted in the Schematic.
- In Conclusion, a Truly Peer to Peer network of intelligent nodes shall be deployed to ensure life safety of the occupant of the building, and shall be programmed to ensure the fastest detection and safe evacuation of the occupants.
- The fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.
- The system shall be an active/interrogative type system where each addressable device is repetitively scanned, causing a signal to be transmitted to the main fire alarm control panel (FACP) indicating that the device and its associated circuit wiring is functional. Loss of this signal at the main FACP shall result in a trouble indication as specified hereinafter for the particular input.
- The facility shall have an emergency voice alarm communication system. Digitally stored message sequences shall notify the building occupants that a fire or life safety condition has been reported. Message generator(s) shall be capable of automatically distributing up to eight (8) simultaneous, unique messages to appropriate audio zones within the facility based on the type and location of the initiating event. The Fire Command Center (FCC) shall also support Emergency manual voice announcement capability for both system wide or selected audio zones, and shall include provisions for the system operator to override automatic messages system wide or in selected zones.
- The system shall be support additional, alternate Fire Command Centers, which shall be capable of simultaneous monitoring of all system events. Alternate Fire Command Centers shall also support an approved method of transferring the control functions to an alternate Fire Command Center when necessary. All Fire Command Centers shall be individually capable of assuming Audio Command functions such as Emergency Paging, audio zone control functions, and Firefighter's Telephone communication functions.
- Each designated zone shall transmit separate and different alarm, supervisory and trouble signals to

the Fire Command Center (FCC) and designated personnel in other buildings at the site via a multiplex communication network.

- The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.

2.0 SCOPE OF WORK

2.1 Intelligent reporting, microprocessor controlled fire detection cum Voice Evacuation system shall be installed in accordance with the specifications and drawings.

The basic system comprises of Main Addressable Intelligent fire alarm panels, Voice and Fire Fighters Telephone Command Systems, Network Repeaters, Touch Screen Displays, networked on a peer to peer network as the head end of the System.

The Low side of the System shall comprise of the initiating devices such as the smoke / Heat / Combination Sensors, Manual Pull Stations etc.

Notification Appliances shall include Hooter cum Strobes, Speakers and Speakercum Strobes, Flashers, Alarm Bells etc.

All the above components shall be connected by interconnecting flexible copper cables, FRLS, PVC grade, laid in GI conduits, or Armoured Cable for physical protection.

The scope shall include laying of the cables described above, citing of the various components to the direction of the architects and consultants, networking and programming to achieve the desired functionality.

2.2 The system shall be designed such that each signaling line circuit (SLC) is limited to only 80% of its total capacity at initial installation.

a. Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D) as part of an addressable device connected by the SLC Circuit.

b. On Style 6 or 7 (Class A) configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.

c. Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.

d. Speaker circuits may be controlled by NAC outputs built into the amplifiers, which shall function as addressable points on the Digital Audio Loop.

e. Notification Appliance Circuits (NAC) speaker circuits shall be arranged such that there is a minimum of one speaker circuit per floor of the building or smoke zone whichever is greater.

f. Audio amplifiers and tone generating equipment shall be electrically supervised for normal and abnormal conditions.

g. Notification Appliance Circuits (NAC) speaker circuits and control equipment shall be arranged such that loss of any one (1) speaker circuit will not cause the loss of any other speaker circuit in the system.

h. Two-way emergency telephone communication circuits shall be supervised for open and short circuit conditions.

i. Speaker circuits shall be arranged such that there is a minimum of one speaker circuit per smoke zone.

j. Speaker circuits shall be electrically supervised for open and short circuit conditions. If a short

circuit exists on a speaker circuit, it shall not be possible to activate that circuit.

k. Audio amplifiers and tone generating equipment shall be electrically supervised for abnormal conditions. Digital amplifiers shall provide built-in speaker circuits, field configurable as four Class B (Style Y), or two Class A (Style Z) circuits.

l. Digital amplifiers shall be capable of storing up to two minutes of digitally recorded audio messages and tones. The digital amplifiers shall also be capable of supervising the connection to the associated digital message generator, and upon loss of that connection shall be capable of one of the following system responses:

i. The digital amplifier shall automatically broadcast the stored audio message.

ii. The digital amplifier shall switch to a mode where a local bus input on the digital amplifier will accept an input to initiate a broadcast of the stored message. This bus input shall be connected to a NAC on a local FACP for the purpose of providing an alternate means of initiating an emergency message during a communication fault condition.

iii. Speaker circuits shall be either 25 VRMS or 70VRMS. Speaker circuits shall have 20% space capacity for future expansion or increased power output requirements.

iv. Two-way emergency telephone (Fire Fighter Telephone) communication shall be supported between the Audio Command Center and up to seven (7) remote Fire Fighter's Telephone locations simultaneously on a telephone riser.

v. Means shall be provided to connect FFT voice communications to the speaker circuits in order to allow voice paging over the speaker circuit from a telephone handset.

vi. The digital audio message generator shall be of reliable, non-moving parts, and support the digital storage of at least 16 or 32 minutes of tones and emergency messages, shall support programming options to string audio segments together to create up to 1000 messages, or to loop messages and parts of messages to repeat for pre-determined cycles or indefinitely.

2.3 Basic System Functional Operation

When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:

a. The System Alarm LED shall flash.

b. A local piezo electric signal in the control panel shall sound.

c. The 640-character LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.

d. Printing and history storage equipment shall log the information associated each new fire alarm control panel condition, along with time and date of occurrence.

e. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.

f. The audio portion of the system shall sound the proper audio signal (consisting of tone, voice, or tone and voice) to the appropriate zones.

3.0 CODES AND STANDARDS

The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only.

A. Underwriters Laboratories Inc. (UL) - USA:

No. 50	Cabinets and Boxes
No. 268	Smoke Detectors for Fire Protective Signaling Systems
No. 864	Control Units for Fire Protective Signaling Systems
No. 268A	Smoke Detectors for Duct Applications.
No. 521	Heat Detectors for Fire Protective
No. 228	Door Closers-Holders for Fire Protective Signaling Systems.
No. 464	Audible Signaling Appliances.
No. 38	Manually Actuated Signaling Boxes.
No. 346	Water flow Indicators for Fire Protective Signaling Systems.
No. 1481	Power supplies for Fire Protective Signaling Systems.
No. 1076	Control Units for Burglar Alarm Proprietary Protective Signaling Systems.
No. 1971	Visual Notification Appliances.

NFPA CODE 70 (NEC)

NFPA 72 Fire Alarm Code

NFPA 101 Life Safety Code

B. National Building Code of India, 2005.

C. All requirements of the Authority Having Jurisdiction (AHJ).

3.1 APPROVALS

3.1.1 The system shall have proper listing and/or approval from the following nationally recognized agencies:

UL Underwriters Laboratories Inc. / FM Factory Mutual

3.1.2 The Fire Alarm Control Panel and all transponders shall meet the modular listing requirements of Underwriters Laboratories, Inc.

3.1.3 Each sub-assembly, including all printed circuits, shall include the appropriate UL modular label.

3.1.4 This includes all printed circuit board assemblies, power supplies, and enclosure parts. Systems that do not include modular labels may require return to the factory for system upgrades, and are not acceptable.

4.0 PRODUCT / MATERIAL SPECIFICATIONS

4.1 General

This section of the specification includes the furnishing, installation, and connection of a microprocessor controlled, analog addressable, intelligent fire alarm equipment required to form a complete coordinated system ready for operation.

It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control panels, auxiliary control devices, annunciators, power supplies, and wiring as shown on the drawings and specified herein.

The panel shall further extend fire and fault outputs, and on line data of status of all components, to the BMS for critical alarm monitoring, and it shall be possible to connect a interface card for open Protocol based (Commonly Bacnet Over IP, Modbus or eqv.) output to enable a software level integration with the BMS System.

The Panel shall be with integral voice evacuation cum Fire Fighters telephone system to relay evacuation messages in case of a fire emergency.

Each designated zone shall transmit separate and different alarm, supervisory and trouble signals to the Central Monitoring Stations (Fire Command Center Room) and designated personnel, and if required, in other buildings at the site via a multiplex communication network.

The system shall also support independent gas release circuits for activation of various Fire Suppression systems, as required.

The system shall include hardware, modules to facilitate cross zoning of specific sensors, abort release functions, time delay and inputs for pressure switch and 24V output for Output operations.

The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.

The main panel is to be located in the BMS Room on the Lower Basement Floor. All the other panels shall be distributed throughout the building complex, and shall be of multiple loops to accommodate all the sensors and devices with the spare loop capacity of 20% on every loop.

All the sensors and devices are connected to floor panels and all output circuits are activated from the same.

The Hooters cum Strobes / Speaker Strobes (Refer layout plans) are located at strategic locations to ensure audible alarm and voice messages reach every corner of the floor.

The panel shall be capable to zone all the sensors and devices and shall be able to activate outputs against activation of zone.

Wherever Applicable, The sensors located in Server Room shall be programmed in 2 separate zones per room to facilitate cross zoning, time delay and output to Gas Release system Panel in these rooms.

The panels shall be supplied with UPS power 230V AC and shall have its in-built battery backup and battery charger for 24 hours of standby operation, and the system shall be able to function for 30 minutes in full Alarm Condition, even during a Power Failure.

4.2 Basic Performance:

- Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Style 6 (Class A) Signaling Line Circuits (SLC).

- Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D) as part of an addressable device connected by the SLC Circuit.

- Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z) as part of an addressable device connected by the SLC Circuit.

- On Style 6 or 7 (Class A) configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.

- Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.

When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:

The System Alarm LED shall flash.

A local piezo electric signal in the control panel shall sound.

The LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.

All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.

The audio portion of the system shall sound the proper signal (tone or voice) to the appropriate zones.

The fire alarm system shall detect all changes in status of monitored points and shall initiate appropriate acts to alert/evacuate occupants, provide event annunciation and activate auxiliary controls as specified herein.

The system shall accept process and evaluate the following types of input signals:

- Automatic Fire Detectors

- Manual Alarms

- Supervisory (Tamper) Condition

- Trouble

The system shall store a record of alarm, supervisory and trouble events in non-volatile history file. This file shall contain the most recent 1000 events, with time and date of each event. It shall be possible to select the number of events to be viewed in the history file by date, so the entire file does not have to be downloaded. The history file shall remain intact in the event of a loss of AC and battery power.

The system shall be capable of being expanded and field reprogrammed at any time up to the predetermined maximum capacity of the system, without the requirement to return the operating system to the factory for program changes. All field programming shall be done by an authorized manufacturer's representative.

Intelligent, Analog and Addressable input devices shall receive power and communication protocol signals over a single pair of wires per channel (SLC) from the control unit.

Each channel (SLC) shall support Minimum of 159 analog and/or addressable devices.

Channels shall be field programmable for NFPA 72(1993) Style 4 and 6 operations, with capability for Style 7 when used with approved loop isolation units.

Photoelectric, Laser, Multi criteria, Beam detectors and Thermal detectors shall be of the Intelligent, analog addressable type, and shall provide dual level alarm and pre-alarm reporting. Pre-alarm shall serve as early warning of an impending alarm condition, and shall generate a trouble condition in the panel.

Each detector head shall incorporate a microprocessor which provides for distributed system intelligence. The micro shall provide full monitoring and control of the device with memory for storage of pre-set sensitivity levels and other detection device parameters. For security purposes and system integrity no mechanical addressing switches shall be allowed for field devices. All setting of device parameter shall be done electronically.

System Power shall be adequate to accommodate all connected addressable and analog input devices in alarm simultaneously and shall be capable of operating all connected addressable output relays while all addressable inputs are in alarm. Prior to owner / contractor acceptance of installed system, manufacturer or his representative shall demonstrate 100% system alarm status with no loss of performance.

Activation of any manual alarm station or any other approved alarm initiating device (excluding Automatic Fire Detectors which will be described later) shall immediately result in the following:

Display the alarm condition on the LCD Displays of all the Peer-to-Peer networked Panels, Network Repeaters and Slave Repeaters, Touch Screen Displays.

Visual alarm signals shall be provided as indicated on the plans.

System shall shutdown/redirect all HVAC system fans, dampers, etc.; close fire doors, recall elevators, etc., in accordance with the schedule provided and with appropriate local/national code.

Operation of the system alarm silence switch shall silence all alarm audible connected to the system, with the exception of circuits programmed for the non-silence water flow feature. When properly configured, a silence command shall not extinguish visual alarm appliances. Circuits containing alarm visual circuits shall not be silenceble except upon system reset.

The system alarm LED and all other associated alarm displays shall remain illuminated until the alarm condition has been corrected and the panel has been reset.

A connected system printer (if supplied) shall record all the status changes that take place within the fire protection system, including alarm / trouble restoration. All status changes shall be logged.

The activation of an Automatic Fire Detector shall provide for all operations.

Alarm Verification per device in accordance with NFPA 72 - 1993 and UL 864.

Positive Alarm Sequence in accordance with NFPA 72 -1993 and UL 864.

Analog-Addressable smoke detectors shall be equipped with a Day/Night Sensitivity Mode which may be selected by either manual or automatic input.

Because certain smoke detector environments change from day (occupied) tonight (unoccupied), a more sensitive or Night setting may be desirable. Adjustable sensitivity smoke detector values shall be distinctly identified in the system memory and by display.

Supervisory conditions shall cause a distinct annunciation at the panel. The system printer shall record supervisory events in a manner consistent for all status changes.

The fire alarm panel shall fully supervise its operation. The physical opening or cutting of the wiring to any initiation, alarm indicating, signaling line, or associated supervisory monitoring circuit shall cause distinct annunciation via the LCD display.

Analogue signals from detectors shall be processed in such a way as to discriminate, as far as possible, between sources of fire and false alarms, and shall identify detectors that are becoming dirty. As a minimum, multi-state indications, i.e. normal, fire, fault and pre-alarm warning, shall be provided for each detector.

It shall be possible to interrogate detectors to determine their analogue values and display these on the alphanumeric display of each control panel. There shall be the facility to display an individual detector's value separately as well as values of all detectors together. It shall also be possible to set a value and display the addresses of all those detectors with values above that value.

The controlling software of the system shall be configured to group detectors and manual call points into zones.

Output signals, for example, to sounder circuits and interfaces, corresponding to individual device inputs and/or their related zones, shall be configurable in the controlling software of the system. They shall be freely assignable; i.e. each input shall be capable of being programmed to operate any, some, or all outputs.

It shall be possible to modify the configuration of zones and reconfigure the relationship between inputs and outputs. This shall be site programmable.

The system shall be immune to EMC-related interference. In particular, the Contractor shall take into account the use of VHF/UHF radio communication systems, mobile telephones, pagers and computers, and other electrical equipment used in the building.

The system shall be installed in accordance with the manufacturer's instructions. In particular, the Contractor shall take due note of, and shall comply with, the manufacturer's instructions on circuit design, minimum signal strengths, loadings and end-of-line terminations, where appropriate.

4.3 Wiring Arrangements

It shall be the responsibility of the Contractor to determine the number of loops and other circuits required for the system.
Where the system is distributed, the network linking the control panels shall be capable of being extended in the future to link to further compatible control panels. The capacity of the network shall be expandable by 25%

4.4 Circuit Design

Each detection loop shall originate and terminate at the control and indicating equipment.

The number of loops required for the system shall be determined on the basis of device capacity, total loop length and the area of coverage of each loop. The maximum area coverage per loop shall not exceed 10,000m².

Each loop shall incorporate a minimum of 25% spare device capacity for possible future use. The spare capacity shall relate to manual call points, detectors, sounder and beacons (where relevant) and loop interfaces in any combination.

All wiring shall be monitored for faults.

Loop wiring shall tolerate a single open-circuit fault without affecting any device on the same loop. Loop wiring shall also tolerate multiple open-circuits or short-circuit faults in one area, without affecting the devices in any other area or on any other loop or circuit.

Removal of a device from a loop shall not cause any remaining devices in the system to become inoperative.

It shall be possible to disable detectors on the system. The controlling software shall permit individual detector disablement and detector group disablement. As a minimum, a group shall correspond with the detectors in a particular zone. Group detector disablement shall not render manual call points in the same area inoperative.

Short-circuit isolators shall be provided at the beginning and end of each loop. Also, a single short circuit or open-circuit fault on an automatic fire detector circuit shall neither disable protection within an area of more than 2,000m², nor on more than one floor of the building plus a maximum of five devices (automatic detection, manual call points, sounders or a combination of these) on the floor immediately above and five devices on the floor immediately below that floor.

Where the system is distributed, the network between control panels shall be configured as a loop and shall be capable of tolerating a single open- or short-circuit without loss of communication between panels. It shall be a 'peer to peer' network that is not wholly dependent on a single, centralized processor or panel. In the event of failure of the network, each control panel on the network shall be capable of operating in a 'stand-alone' mode and thus generating fire alarm warnings in response to activation of a device connected to it.

4.5 False Alarms

Great care shall be taken, at the design stage, to minimize the likelihood of false alarms occurring in the new or modified system.

Devices shall be of types appropriate to the local environment. For example, optical smoke detectors shall not be installed in areas where there is likely to be steam or dust present. Also, manual call points shall be fitted with transparent hinged covers where there is the possibility of accidental operation, e.g. in kitchens or service areas.

4.6 SYSTEM COMPONENTS

4.6.1 System Architecture

The system shall have a centralized structure. The locations of control and indicating equipment shall be as shown on the Contract Drawings.

A centralized system has one set of control and indicating equipment in a single location in the building. (The control panel may also be connected to repeater or mimic panel(s) elsewhere in the building.) This means that all detection loop wiring, and separate sounders wiring (if appropriate) will emanate from the centrally located control and indicating equipment. Centralized systems are suitable where the lengths of loop and sounder cables do not become excessive because of the size of the building.

4.6.2 Main Components

All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.

All equipment and components shall be installed in strict compliance with each manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc. before beginning system installation. Refer to the riser/connection diagram for all specific system installation/termination/wiring data.

All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

4.6.3 CABLING

All fire alarm system wiring must be as specified here in.

Wiring shall be in accordance with local, state and national codes (NBC of India, IS 2189, NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 1.5 Sq. mm for initiating device circuits and signaling line circuits, for notification appliance circuits.

The Cables used shall be annealed tinned copper conductor XLPE / Elastomeric Insulted insulated

FRLS armoured cable with Copper conductor having cross-linkable halogen free Ethylene Propylene Rubber (EPR) insulation and LSZH inner & outer sheath. Basic design as per BS 7846, IEC-502, IEC-61034.Fire performance tests as per BS 8491:2008 Cat.3 (120 mins) for above 20 mm overall dia& for below 20 mm overall dia as per BS 6387 C.W.Z. & BS EN 50200 PH-120 + Annex-E. BRE GLOBAL / LPCB certified.

4.6.4 FIRE ALARM CONTROL PANEL OR NETWORK NODE

The main FACP Central Console shall be a suitable to accommodate required number of devices having 1 Loop as spare for detectors & devices as well. It shall contain a microprocessor based Central Processing Unit (CPU).

The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, panel modules including initiating circuits, control circuits, and notification appliance circuits, local and remote operator terminals, printers, annunciators, and other system controlled devices.

In conjunction with intelligent Loop Control Modules and Loop Expander Modules, the main FACP shall perform the following functions:

- Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.

- Supervise all initiating signaling and notification circuits throughout the facility by way of connection to addressable monitor and control modules.

- Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed. In the event of CPU failure, all SLC loop modules shall fallback to degrade mode. Such degrade mode shall treat the corresponding SLC loop control modules and associated detection devices as conventional two-wire operation. Any activation of a detector in this mode shall automatically activate associated Notification Appliance Circuits.

- Visually and audibly annunciate any trouble, supervisory, security or alarm condition on operator's terminals, panel display, and annunciators.

When a fire alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

- The system alarm LED shall flash.

- A local piezo-electric audible device in the control panel shall sound a distinctive signal.

- The backlit LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.

- Printing and history storage equipment shall log and print the event information along with a time and date stamp.

- All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

When a trouble condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

The system trouble LED shall flash.

- A local piezo-electric audible device in the control panel shall sound a distinctive signal.
- The LCD display shall indicate all information associated with the trouble condition, including the type of trouble point and its location within the protected premises.
- Printing and history storage equipment shall log and print the event information along with a time and date stamp.
- All system outputs assigned via preprogrammed equations for a particular point in trouble shall be executed, and the associated system outputs (trouble notification appliances and/or relays) shall be activated.

When a supervisory condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

- The system trouble LED shall flash.
- A local piezo-electric audible device in the control panel shall sound a distinctive signal.
- The LCD display shall indicate all information associated with the supervisory condition, including the type of trouble point and its location within the protected premises.
- Printing and history storage equipment shall log and print the event information along with a time and date stamp.
- All system outputs assigned via preprogrammed equations for a particular point in trouble shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.

When a security alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

- The system security LED shall flash.
- A local piezo-electric audible device in the control panel shall sound a distinctive signal.
- The backlit LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
- Printing and history storage equipment shall log and print the event information along with a time and date stamp.

- All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

  When a pre-alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

- The system pre-alarm LED shall flash.

- A local piezo-electric audible device in the control panel shall sound a distinctive signal.

- The backlit LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.

- Printing and history storage equipment shall log and print the event information along with a time and date stamp.

- All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

4.6.5 Operator Control

4.6.5.1 Acknowledge Switch:

a) Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the LCD display to the next alarm or trouble condition. In addition, the FACP shall support Block Acknowledge to allow multiple trouble conditions to be acknowledged with a single depression of this switch.

b) Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.

c) Signal Silence Switch: Depression of the Signal Silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition. The selection of notification circuits and relays that are silence able by this switch shall be fully fielded programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.

4.6.5.2 Drill Switch

Depression of the Drill switch shall activate all programmed notification appliance circuits. The drill function shall latch until the panel is silenced or reset.

4.6.5.3 System Reset Switch

Depression of the System Reset switch shall cause all electronically latched initiating devices to return to their normal condition. Initiating devices shall re-report if active. Active notification appliance circuits shall not silence upon Reset. Systems that de-activate and subsequently re-activate notification appliance circuits shall not be considered equal. All programmed Control-By-Event equations shall be re-evaluated

after the reset sequence is complete if the initiating condition has cleared. Non-latching trouble conditions shall not clear and re-report upon reset.

4.6.5.4 Lamp Test

The Lamp Test switch shall activate all local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personal.

4.6.5.5 Scroll Display Keys

There shall be Scroll Display keys for FIRE ALARM, SECURITY, SUPERVISORY, TROUBLE, and OTHER EVENTS. Depression of the Scroll Display key shall display the next event in the selected queue allowing the operator to view events by type.

4.5.5.6 Print Screen

Depression of the PRINT SCREEN switch shall send the information currently displayed on the display to the printer.

4.6 System Capacity and General Operation

4.6.1 The control panel shall be capable of expansion via up to 10 SLC modules. Each module shall support a maximum of 318 analog/addressable devices for a maximum system capacity of 3180 points. The system shall be capable of 3072 annunciation points per system regardless of the number of addressable devices and shall support up to 96 panel circuits which may consist of either inputs or outputs.

4.6.2 The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit liquid crystal display, individual, color coded system status LEDs, and a QWERTY style alphanumeric keypad for the field programming and control of the fire alarm system. Said LCD shall also support graphic bit maps capable of displaying the company name and logo of either the owner or installing company.

4.6.3 All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel.

4.6.4 The FACP shall be able to provide the following software and hardware features:

a) Pre-signal and Positive Alarm Sequence: The system shall provide means to cause alarm signals to only sound in specific areas with a delay of the alarm from 60 to up to 180 seconds after start of alarm processing. In addition, a Positive Alarm Sequence selection shall be available that allows a 15-second time period for acknowledging an alarm signal from a fire detection/initiating device. If the alarm is not acknowledged within 15 seconds, all local and remote outputs shall automatically activate immediately.

b) Smoke Detector Pre-alarm Indication at Control Panel: To obtain early warning of incipient or potential fire conditions, the system shall support a programmable option to determine system response to real-time detector sensing values above the programmed setting. Two levels of Pre-alarm indication shall be available at the control panel: alert and action.

c) Alert: It shall be possible to set individual smoke detectors for pre-programmed pre-alarm thresholds. If the individual threshold is reached, the pre-alarm condition shall be activated.

d) Action: If programmed for action, and the detector reaches a level exceeding the pre-programmed level, the control panel shall indicate an action condition. Sounder bases installed with either heat or

smoke detectors shall automatically activate on action Pre-Alarm level, with general evacuation on alarm level.

e) The system shall support a detector response time to meet world annunciation requirements of less than 3 seconds.

f) Device Blink Control: Means shall be provided to turn off detector/module LED strobes for special areas.

g) NFPA 72 Smoke Detector Sensitivity Test: The system shall provide an automatic smoke detector test function that meets the requirements of NFPA 72.

h) Programmable Trouble Reminder: The system shall provide means to automatically initiate a reminder that troubles exist in the system. The reminder will appear on the system display and (if enabled) will sound a piezo alarm.

i) On-line or Off-line programming: The system shall provide means to allow panel programming either through an off-line software utility program away from the panel or while connected and on-line. The system shall also support upload and download of programmed database and panel executive system program to a Personal Computer/laptop.

j) History Events: The panel shall maintain a history file of the last 4000 events, each with a time and date stamp. History events shall include all alarms, troubles, operator actions, and programming entries. The control panels shall also maintain a 1000 event Alarm History buffer, which consists of the 1000 most recent alarm events from the 4000 event history file.

k) Smoke Control Modes: The system shall provide means to perform FSCS mode Smoke Control to meet NFPA-92A and 90B and HVAC mode to meet NFPA 90A.

l) The system shall provide means for all SLC devices on any SLC loop to be auto programmed into the system by specific address. The system shall recognize specific device type ID's and associate that ID with the corresponding address of the device.

m) Drill: The system shall support means to activate all silenceable fire output circuits in the event of a practice evacuation or "drill". If enabled for local control, the front panel switch shall be held for a minimum of 2 seconds prior to activating the drill function

n) Passwords and Users: The system shall support two password levels, master and user. Up to 9 user passwords shall be available, each of which may be assigned access to the programming change menus, the alter status menus, or both. Only the master password shall allow access to password change screens.

o) Block Acknowledge: The system shall support a block Acknowledge for Trouble Conditions

p) Sensitivity Adjust: The system shall provide Automatic Detector Sensitivity Adjust based on Occupancy schedules including a Holiday list of up to 15 days.

q) Environmental Drift Control: The system shall provide means for setting Environmental Drift Compensation by device. When a detector accumulates dust in the chamber and reaches an unacceptable level but yet still below the allowed limit, the control panel shall indicate a maintenance alert warning. When the detector accumulates dust in the chamber above the allowed limit, the control panel shall indicate a maintenance urgent warning.

r) Custom Action Messages: The system shall provide means to enter up to 100 custom action messages of up to 160 characters each. It shall be possible to assign any of the 100 messages to any point.

s) Print Functions: The system shall provide means to obtain a variety of reports listing all event, alarm, trouble, supervisory, or security history. Additional reports shall be available for point activation for the last Walk Test performed, detector maintenance report containing the detector maintenance status of each installed addressable detector, all network parameters, all panel settings including broad cast time, event ordering, and block acknowledge, panel timer values for Auto Silence, Silence Inhibit, AC Fail Delay time and if enabled, Proprietary Reminder, and Remote Reminder timers, supervision settings for power supply and printers, all programmed logic equations, all custom action messages, all non-fire and output activations (if pre-programmed for logging) all active points filtered by alarms only, troubles only, supervisory alarms, pre alarms, disabled points and activated points, all installed points filtered by SLC points, panel circuits, logic zones, annunciators, releasing zones, spal zones, and trouble zones.

t) Local Mode: If communication is lost to the central processor the system shall provide added survivability through the intelligent loop control modules. Inputs from devices connected to the SLC and loop control modules shall activate outputs on the same loop when the inputs and outputs have been set with point programming to participate in local mode or when the type codes are of the same type: that is, an input with a fir alarm type code shall activate an output with a fire alarm type code.

u) Resound based on type for security or supervisory: The system shall indicate a Security alarm when a monitor module point programmed with a security Type Code activates. If silenced alarms exist, a Security alarm will resound the panel sounder. The system shall indicate a Supervisory alarm when a monitor module point programmed with a supervisory Type Code activates. If there are silenced alarms, a Supervisory alarm will resound the panel sounder.

v) Read status preview - enabled and disabled points: Prior to re-enabling points, the system shall inform the user that a disabled device is in the alarm state. This shall provide notice that the device must be reset before the device is enabled thereby avoiding activation of the notification circuits.

w) Custom Graphics: When fitted with an LCD display, the panel shall permit uploading of a custom bit-mapped graphic to the display screen.

x) Multi-Detector and Cooperating Detectors: The system shall provide means to link one detector to up to two detectors at other addresses on the same loop in cooperative multi-detector sensing. There shall be no requirement for sequential addresses on the detectors and the alarm event shall be a result or product of all cooperating detectors chamber readings.

y) Tracking/Latching Duct (ion and photo): The system shall support both tracking and latching duct detectors either ion or photo types.

z) ACTIVE EVENT: The system shall provide a Type ID called FIRE CONTROL for purposes of air-handling shutdown, which shall be intended to override normal operating automatic functions. Activation of a FIRE CONTROL point shall cause the control panel to (1) initiate the monitor module Control-by-Event, (2) send a message to the panel display, history buffer, installed printer and annunciators, (3) shall not light an indicator at the control panel, (4) Shall display ACTIVE on the LCD as well a display a FIRE CONTROL Type Code and other information specific to the device.

aa) NON-FIRE Alarm Module Reporting: A point with a type ID of NON-FIRE shall be available for use for energy management or other non-fire situations. NON-FIRE point operation shall not affect control panel operation nor shall it display a message at the panel LDC. Activation of a NON-FIRE point shall activate control by event logic but shall not cause any indication on the control panel.

bb) Security Monitor Points: The system shall provide means to monitor any point as a type security.

cc) One-Man Walk Test: The system shall provide both a basic and advanced walk test for testing the entire fire alarm system. The basic walk test shall allow a single operator to run audible tests on the panel. All logic equation automation shall be suspended during the test and while annunciators can be enabled for the test, all shall default to the disabled state. During an advanced walk test, field-supplied output point programming will react to input stimuli such as CBE and logic equations. When points are activated in advanced test mode, each initiating event shall latch the input. The advanced test shall be audible and shall be used for pull station verification, magnet activated tests on input devices, input and output device and wiring operation/verification.

dd) Control by Event Functions: CBE software functions shall provide means to program a variety of output responses based on various initiating events. The control panel shall operate CBE through lists of zones. A zone shall become listed when it is added to a point's zone map through point programming. Each input point such as detector, monitor module or panel circuit module shall support listing of up to 10 zones into its programmed zone map.

ee) Permitted zone types shall be general zone, releasing zone and special zone. Each output point (control module, panel circuit module) can support a list of up to 10 zones including general zone, logic zone, releasing zone and trouble zone. It shall be possible for output points to be assigned to list general alarm. Non-Alarm or Supervisory points shall not activate the general alarm zone.

ff) 1000 General Zones: The system shall support up to 1000 general purpose software zones for linking inputs to outputs. When an input device activates, any general zone programmed into that device's zone map will be active and any output device that has an active general zone in its map will be active. It shall also be possible to use general zone as arguments in logic equations.

gg) 1000 Logic Equations: The system shall support up to 1000 logic equations for AND, OR, NOT, ONLY1, ANYX, XZONE or RANGE operators that allow conditional I/O linking. When any logic equation becomes true, all output points mapped to the logic zone shall activate.

hh) 10 trouble equations per device: The system shall provide support for up to 10 trouble equations for each device, which shall permit programming parameters to be altered, based on specific fault conditions. If the trouble equation becomes true, all output points mapped to the trouble zone shall activate.

ii) Control-By-Time: A time based logic function shall be available to delay an action for a specific period of time based upon a logic input with tracking feature. A latched version shall also be available. Another version of this shall permit activation on specific days of the week or year with ability to set and restore based on a 24 hour time schedule on any day of the week or year.

jj) Multiple agent releasing zones: The system shall support up to 10 releasing zones to protect against 10 independent hazards. Releasing zones shall provide up to three cross-zones with four abort options to satisfy any local jurisdiction requirements.

kk) Alarm Verification, by device, with timer and tally: The system shall provide a user-defined global software timer function that can be set for a specific detector or indicating panel module input. The timer function shall delay an alarm signal for a user-specified time period and the control panel shall ignore the alarm verification timer if another alarm is detected during the verification period. It shall also be possible to set a maximum verification count between 0 and 20 with the "0" setting producing no alarm verification. When the counter exceeds the threshold value entered, a trouble shall be generated to the panel.

4.6.5 Central Processing Unit

a. The Central Processing Unit shall communicate with, monitor, and control all other modules within the control panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the system display by the Central Processing Unit.

b. The Central Processing Unit shall contain and execute all control-by-event (including Boolean functions including but not limited to AND, OR, NOT, ANYx, and CROSSZONE) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure.

c. The Central Processing Unit shall also provide a real-time clock for time annotation, to the second, of all system events. The time-of-day and date shall not be lost if system primary and secondary power supplies fail.

d. The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.

e. Consistent with UL864 standards, the CPU and associated equipment are to be protected so that voltage surges or line transients will not affect them.

f. Each peripheral device connected to the CPU shall be continuously scanned for proper operation. Data transmissions between the CPU and peripheral devices shall be reliable and error free. The transmission scheme used shall employ dual transmission or other equivalent error checking techniques.

g. The CPU shall provide an EIA-232 interface between the fire alarm control panel and the UL Listed Electronic Data Processing (EDP) peripherals.

h. The CPU shall provide two EIA-485 ports for the serial connection to annunciation and control subsystem components.

i. The EIA-232 serial output circuit shall be optically isolated to assure protection from earth ground.

j. The CPU shall provide one high-speed serial connection for support of network communication modules.

k. The CPU shall provide double pole relays for FIRE ALARM, SYSTEM TROUBLE, SUPERVISORY, and SECURITY. The SUPERVISORY and SECURITY relays shall provide selection for additional FIRE ALARM contacts.

4.6.6 Display

a. The system display shall provide all the controls and indicators used by the system operator and may also be used to program all system operational parameters.

b. The display assembly shall contain, and display as required, custom alphanumeric labels for all intelligent detectors, addressable modules, and software zones.

c. The system display shall provide a backlit alphanumeric Liquid Crystal Display (LCD). It shall also provide ten Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM, SECURITY, SUPERVISORY, SYSTEM TROUBLE, OTHER EVENT, SIGNALS SILENCED, POINT DISABLED, and CPU FAILURE.

d. The system display shall provide a QWERTY style keypad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels with up to ten (one Master and nine User) passwords shall be accessible through the display interface assembly to prevent unauthorized system control or programming.

e. The system display shall include the following operator control switches: ACKNOWLEDGE, SIGNAL SILENCE, RESET, DRILL, and LAMP TEST. Additionally, the display interface shall allow scrolling of events by event type including, FIRE ALARM, SECURITY, SUPERVISORY, TROUBLE, and OTHER EVENTS. A PRINT SCREEN button shall be provided for printing the event currently displayed on the 2 X 40-character LCD.

4.6.7 Loop (Signaling Line Circuit) Control Module

a. The Loop Control Module shall monitor and control a minimum of 318 intelligent addressable devices. This includes 159 intelligent detectors (Ionization, Photoelectric, or Thermal) and 159 monitor or control modules.

b. The Loop Control Module shall contain its own microprocessor and shall be capable of operating in a local/degrade mode (any addressable device input shall be capable of activating any or all addressable device outputs) in the unlikely event of a failure in the main CPU.

c. The Loop Control Module shall provide power and communicate with all intelligent addressable detectors and modules on a single pair of wires. This SLC Loop shall be capable of operating as a NFPA Style 6 (Class B) circuit.

d. The SLC interface board shall be able to drive an NFPA Style 6 twisted shielded circuit up to 12,500 feet in length. The SLC Interface shall also be capable of driving an NFPA Style 6, no twist, no shield circuit up to 3,000 feet in length. In addition, SLC wiring shall meet the listing requirements for it to exit the building or structure. "T"-tapping shall be allowed in either case.

e. The SLC interface board shall receive analog or digital information from all intelligent detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that particular device. Each SLC Loop shall be isolated and equipped to annunciate an Earth Fault condition. The SLC interface board software shall include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic detector testing and the automatic determination of detector maintenance requirements.

4.6.8 Enclosures

a. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.

b. The back box and door shall be constructed of 0.060 steel with provisions for electrical cables connections into the sides and top.

c. The door shall provide a key lock and include a transparent opening for viewing all indicators. For convenience, the door shall have the ability to be hinged on either the right or left-hand side.

d. The control unit shall be modular in structure for ease of installation, maintenance, and future expansion.

4.6.9 Digital Voice Command Center

4.6.9.1 The Digital Voice Command Center located with the FACP, shall contain all equipment required for all audio control, emergency telephone system control, signaling and supervisory functions. This shall include speaker zone indication and control, telephone circuit indication and control, digital voice units, microphone and main telephone handset.

4.6.9.2 Function: The Voice Command Center equipment shall perform the following functions:

a. Operate as a supervised multi-channel emergency voice communication system.

b. Operate as a two-way emergency telephone system control center.

c. Audibly and visually annunciate the active or trouble condition of every speaker circuit and emergency telephone circuit.

d. Audibly and visually annunciate any trouble condition for digital tone and voice units required for normal operation of the system.

e. Provide all-call Emergency Paging activities through activation of a single control switch.

f. As required, provide vectored paging control to specific audio zones via dedicated control switches.

g. Provide a factory recorded "library" of voice messages and tones in standard WAV. File format, which may be edited and saved on a PC running a current Windows® operating system.

h. Provide a software utility capable of off-line programming for the VCC operation and the audio message files. This utility shall support the creation of new programs as well as editing and saving existing program files. Uploading or downloading the VCC shall not inhibit the emergency operation of other nodes on the fire alarm network.

i. Support an optional mode of operation with four analog audio outputs capable of being used with UL 864 fire-listed analog audio amplifiers and SCL controlled switching.

j. The Digital Voice Command shall be modular in construction, and shall be capable of being field programmable without requiring the return of any components to the manufacturer and without requiring use of any external computers or other programming equipment.

k. The Digital Voice Command and associated equipment shall be protected against unusually high voltage surges or line transients.

4.6.10 Power Supply:

a. The Addressable Main Power Supply shall operate on 120/240 VAC, 50/60 Hz, and shall provide all necessary power for the FACP.

b. The Addressable Main Power Supply shall provide the required power to the CPU using a switching 24 VDC regulator and shall incorporate a battery charger for 24 hours of standby power using dual-rate charging techniques for fast battery recharge.

c. The Addressable Main Power Supply shall provide a battery charger for 24 hours of standby using dual-rate charging techniques for fast battery recharge. The supply shall be capable of charging batteries ranging in capacity from 25-200 amp-hours within a 48-hour period.

d. The Addressable Main Power Supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.

e. The Addressable Main Power Supply shall be power-limited per UL864 requirements.

4.6.11 Auxiliary Field Power Supply - Addressable

a. The auxiliary addressable power supply is a remote 24 VDC power supply used to power

Notification Devices and field devices that require regulated 24VDC power. The power supply shall also include and charge backup batteries.

b. The addressable power supply for the fire alarm system shall provide up a minimum of 6.0 amps of 24 volt DC regulated power for Notification Appliance Circuit (NAC) power or 5 amps of 24 volt DC general power. The power supply shall have an additional .5 amp of 24 VDC auxiliary powers for use within the same cabinet as the power supply. It shall include an integral charger designed to charge 7.0 - 25.0 amp hour batteries.

c. The addressable power supply shall provide four individually addressable Notification Appliance Circuits that may be configured as two Classes "A" and two Class "B" or four Class "B" only circuits. All circuits shall be power-limited per UL 864 requirements.

d. The addressable power supply shall provide built-in synchronization for certain Notification Appliances on each circuit without the need for additional synchronization modules. The power supply's output circuits shall be individually selected for synchronization. A single addressable power supply shall be capable of supporting both synchronized and non-synchronized Notification Devices at the same time.

e. The addressable power supply shall operate on 120 or 240 VAC, 50/60 Hz.

f. The interface to the power supply from the Fire Alarm Control Panel (FACP) shall be via the Signaling Line Circuit (SLC) or other multiplexed means Power supplies that do not use an intelligent interface are not suitable substitutes. The required wiring from the FACP to the addressable power supply shall be a single unshielded twisted pair wire. Data on the SLC shall be transmitted between 24 VDC, 5 VDC and 0 VDC at approximately 3.33k baud.

g. The addressable power supply shall supervise for battery charging failure, AC power loss, power brownout, battery failure, NAC loss, and optional ground fault detection. In the event of a trouble condition, the addressable power supply shall report the incident and the applicable address to the FACP via the SLC.

h. The addressable power supply shall have an AC Power Loss Delay option. If this option is utilized and the addressable power supply experiences an AC power loss, reporting of the incident to the FACP will be delayed. A delay time of eight or sixteen hours shall be Dip-switch selected.

i. The addressable power supply shall have an option for Canadian Trouble Reporting and this option shall be Dip-switch selectable.

j. The addressable power supply mounts in either the FACP back box or its own dedicated surface mounted back box with cover.

k. Each of the power supply's four output circuits shall be DIP-switch selected for Notification Appliance Circuit or General Purpose 24 VDC power. Any output circuit shall be able to provide up to 2.5 amps of 24 VDC power.

l. The addressable power supply's output circuits shall be individually supervised when they are selected to be either a Notification Appliance Circuit when wired Class "A" or by the use of and end-of-line resistor. When the power supply's output circuit is selected as General 24VDC power, the circuit shall be individually supervised when an end-of-line relay is used.

m. When selected for Notification Appliance Circuits, the output circuits shall be individually DIP-switch selectable for Steady, March Time, Dual Stage or Temporal.

n. When selected as a Notification Appliance Circuit, the output circuits of the addressable power supply shall have the option to be coded by the use of a universal zone coder.

o. The addressable power supply shall interface and synchronize with other power supplies of the same type. The required wiring to interface multiple addressable power supplies shall be a single unshielded, twisted pair wire.

p. An individual or multiple interfaced addressable power supplies shall have the option to use an external charger for battery charging. Interfaced power supplies shall have the option to share backup battery power.

4.6.12 Field Charging Power Supply (FCPS)

The FCPS is a device designed for use as either a remote 24 volt power supply or used to power Notification Appliances.

a. The FCPS shall offer up to 6.0 amps (4.0 amps continuous) of regulated 24 volt power. It shall include an integral charger designed to charge 7.0 amp hour batteries and to support 60 hour standby.

b. The Field Charging Power Supply shall have two input triggers. The input trigger shall be a Notification Appliance Circuit (from the fire alarm control panel) or a relay. Four outputs (two Style Y or Z and two style Y) shall be available for connection to the Notification devices.

c. The FCPS shall include an attractive surface mountbackbox.

d. The Field Charging Power Supply shall include the ability to delay the AC fail delay per NFPA requirements.

e. The FCPS include power limited circuitry, per 1995 UL standards.

4.6.13 System Circuit Supervision

a. The FACP shall supervise all circuits to intelligent devices, transponders, annunciators and peripheral equipment and annunciate loss of communication with these devices. The CPU shall continuously scan above devices for proper system operation and upon loss of response from a device shall sound an audible trouble, indicate which device or devices are not responding and print the information in the history buffer and on the printer.

b. Transponders that lose communication with the CPU shall sound an audible trouble and light an LED indicating loss of communications.

c. Sprinkler system valves, standpipe control valves, PIV, and main gate valves shall be supervised for off-normal position.

d. All speaker and emergency phone circuits shall be supervised for opens and shorts. Each transponder speaker and emergency phone circuit shall have an individual ON/OFF indication (green LED).

4.6.14 Field Wiring Terminal Blocks

All wiring terminal blocks shall be the plug-in/removable type and shall be capable of terminating up to 12 AWG wire. Terminal blocks that are permanently fixed to the PC board are not acceptable

4.6.15 Audio Amplifiers

1. The Audio Amplifiers will provide Audio Power (@25 Volts RMS) for distribution to speaker circuits.

2. Multiple audio amplifiers may be mounted in a single enclosure, either to supply incremental audio power, or to function as an automatically switched backup amplifier(s).

3. The audio amplifier shall include an integral power supply, and shall provide built-in LED indicators for the following conditions:

   - Earth Fault on DAP A (Digital Audio Port A)
   - Earth Fault on DAP B (Digital Audio Port B)
   - Audio Amplifier Failure Detected Trouble
   - Active Alarm Bus input
   - Audio Detected on Aux Input A
   - Audio Detected on Aux Input B
   - Audio Detected on Firefighter's Telephone Riser
   - Receiving Audio from digital audio riser
   - Short circuit on speaker circuit 1
   - Short circuit on speaker circuit 2
   - Short circuit on speaker circuit 3
   - Short circuit on speaker circuit 4
   - Data Transmitted on DAP A
   - Data Received on DAP A
   - Data Transmitted on DAP B
   - Data Received on DAP B
   - Board failure
   - Active fiber optic media connection on port A (fiber optic media applications)
   - Active fiber optic media connection on port B (fiber optic media applications)
   - Power supply Earth Fault

- Power supply 5V present

- Power supply conditions - Brownout, High Battery, Low Battery, Charger Trouble

The audio amplifier shall provide the following built-in controls:

- Amplifier Address Selection Switches

- Signal Silence of communication loss annunciation Reset

- Level adjustment for background music

- Enable/Disable for Earth Fault detection on DAP A

- Enable/Disable for Earth Fault detection on DAP A

- Switch for 2-wire/4-wire FFT riser

5. Adjustment of the correct audio level for the amplifier shall not require any special tools or test equipment.

6. Includes audio input and amplified output supervision, back up input, and automatic switch over function, (if primary amplifier should fail).

7. System shall be capable of backing up digital amplifiers.

4.6.16 <u>240W/250W Analogue Amplifier</u>

- Related output power – 240W/250W

- Main Power supply Voltage - – AC 220V -15% ~ +10% 50~60Hz

- Backup Power Supply Voltage – AC 220V -15% ~ +10% 50~60Hz

- Main Power supply fuse T10AL 250V

- Loudspeaker Output – 100V/70V

- Frequency Response – 70 ~ 15 KHz (+1dB~ -3dB)

- SNR 90Db

4.6.17 <u>6W Ceiling/Wall Mounted Speaker</u>

- 6W ceiling speaker with Max SPL1M/1W 96dB. Frequency response of 80Hz-20KHz with dispersion angle of 160deg. The speaker should have tappings at 6W/3W/1.5W

- Max Power 9W

- Rated Power 6 W
- Power taps @ 100V – 6W/3W/1.5W
- Sound pressure level at 6W/1W (4KHz, 1m) – 96dB /88dB
- Frequency Range -80Hz -20 KHz 10dB
- Dispersion angle (1KHz /-6dB) - 160°
- Related Input Voltage – 100 V /70V
- Rated impedance Connection 1.7KΩ / 3.3 kΩ
- Dimensions (Φ x H) - Φ180 mm x 55 mm
- Hole cut-out size 150mm
- Size of speaker – 5”
- Colour – White (RAL 9010)
- Weight of Magnet – 117g

4.6.18 Armoured 2 Core Cable

- Continuous length of 2 Core ,
- 1.5 sq. mm dia strip
- Armoured, PVC insulated ,
- PVC Sheathed Cable

4.6.19 Laying of 2 Core Armoured Cable

- Itisproposedtolaythe2coreArmouredcableinordertocommissionthePublic Address System.
- The approximate length of the2 Core Armoured cable which is supplied by the contractor to be laid in metres as per BOQ.

4.6.20 Audio Message Generator (Prerecorded Voice)/Speaker Control:

a. Each initiating zone or intelligent device shall interface with an emergency voice communication system capable of transmitting a prerecorded voice message to all speakers in the building.

b. Actuation of any alarm initiating device shall cause a prerecorded message to sound over the speakers. The message shall be repeated four (4) times. Pre- and post-message tones shall be supported.

c. A built-in microphone shall be provided to allow paging through speaker circuits.

d. System paging from emergency telephone circuits shall be supported.

e. The audio message generator shall have the following indicators and controls to allow for proper operator understanding and control:

LED Indicators:

- Lamp Test
- Trouble
- Off-Line Trouble
- Microphone Trouble
- Phone Trouble
- Busy/Wait
- Page Inhibited
- Pre/Post Announcement Tone

4.6.21 Controls with associated LED Indicators:

a. Speaker Switches/Indicators

i. The speaker circuit control switches/indicators shall include visual indication of active and trouble status for each speaker circuit in the system.

ii. The speaker circuit control panel shall include switches to manually activate or deactivate each speaker circuit in the system.

b. Emergency Two-Way Telephone Control Switches/Indicators

i. The emergency telephone circuit control panel shall include visual indication of active and trouble status for each telephone circuit in the system.

ii. The telephone circuit control panel shall include switches to manually activate or deactivate each telephone circuit in the system.

4.6.22 Remote Transmissions:

s. Provide local energy or polarity reversal or trip circuits as required.

b. The system shall be capable of operating a polarity reversal or local energy or fire alarm transmitter for automatically transmitting fire information to the fire department.

c. Provide capability and equipment for transmission of zone alarm and trouble signals to remote operator's terminals, system printers and annunciators.

d. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

4.6.23 System Expansion

Design the main FACP and transponders so that the system can be expanded in the future (to include the addition of twenty percent more circuits or zones) without disruption or replacement of the existing control panel. This shall include hardware capacity, software capacity and cabinet space.

4.6.24 Field Programming

a. The system shall be programmable, configurable and expandable in the field without the need for special tools, laptop computers, or other electronic interface equipment. There shall be no firmware changes required to field modify the system time, point information, equations, or annunciator programming/information.

b. It shall be possible to program through the standard FACP keyboard all system functions.

c. All field defined programs shall be stored in non-volatile memory.

d. Two levels of password protection shall be provided in addition to a key-lock cabinet. One level shall be used for status level changes such as point/zone disable or manual on/off commands (Building Manager). A second (higher-level) shall be used for actual change of the life safety program (installer). These passwords shall be five (5) digits at a minimum. Upon entry of an invalid password for the third time within a one minute time period an encrypted number shall be displayed. This number can be used as a reference for determining a forgotten password.

e. The system programming shall be "backed" up on a 3.5" floppy diskette utilizing an upload/download program. This system back-up disk shall be completed and given in duplicate to the building owner and/or operator upon completion of the final inspection. The program that performs this function shall be "non-proprietary", in that, it shall be possible to forward it to the building owner/operator upon his or her request.

The installer's field programming and hardware shall be functionally tested on a computer against known parameters/norms which are established by the FACP manufacturer. A software program shall test Input-to-Output correlations, device Type ID associations, point associations, time equations, etc. This test shall be performed on an IBM-compatible PC with a verification software package. A report shall be generated of the test results and two copies turned in to the engineer(s) on record.

4.6.25 Specific System Operations

1) Smoke Detector Sensitivity Adjust: Means shall be provided for adjusting the sensitivity of any or all analog intelligent smoke detectors in the system from the system keypad or from the keyboard of the video terminal. Sensitivity range shall be within the allowed UL window.

2) Alarm Verification: Each of the Intelligent Addressable Smoke Detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification function shall be programmable from 5 to 50 seconds and each detector shall be able to be selected for verification during the field programming of the system or any time after system turn-on. Alarm verification shall not require any additional hardware to be added to the control panel. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.
3) System Point Operations –

Any addressable device in the system shall have the capability to be enabled or disabled through the system keypad or video terminal.

4) System output points shall be capable of being turned on or off from the system keypad or the video terminal.

5) Point Read: The system shall be able to display the following point status diagnostic functions without the need for peripheral equipment. Each point shall be annunciated for the parameters listed:

DeviceStatus.
Device Type.
Custom Device Label.
Software Zone Label.
Device Zone Assignments.
Analog Detector Sensitivity.
All Program Parameters.

System Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system statuses:

System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 4000 system events. Each of these events will be stored, with time and date stamp, until an operator requests that the contents be either displayed or printed. The contents of the history buffer may be manually reviewed; one event at a time, and the actual number of activations may also be displayed and or printed. History events shall include all alarms, troubles, operator actions, and programming entries.

The history buffer shall use non-volatile memory. Systems which use volatile memory for history storage are not acceptable.

Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent system detector and shall analyze the detector responses over a period of time.

If any intelligent detector in the system responds with a reading that is below or above normal limits, then the system will enter the trouble mode, and the particular Intelligent Detector will be annunciated on the system display, and printed on the optional system printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.

The system shall include the ability (programmable) to indicate a "pre-alarm" condition. This will be used to alert maintenance personal when a detector is at 80% of its alarm threshold in a 60 second period.

Addressable Devices

1) Addressable devices shall provide an address-setting means using rotary decimal switches / Soft Programming.

2) Addressable devices shall use simple to install and maintain decade (numbered 0 to 9) type address switches.

3) Detectors shall be analog and Addressable, and shall connect to the fire alarm control panel's Signaling Line Circuits.

4) Addressable smoke and thermal detectors shall provide dual (2)status LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. If required, the flashing mode operation of the detector LEDs can be programmed off via the fire control panel program.

5) The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. Sensitivity can be automatically adjusted by the panel on a time-of-day basis.

6) Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.

7) The detectors shall be ceiling-mount and shall include a separate twist-lock base which includes a tamper proof feature.

The following bases and auxiliary functions shall be available:

Sounder base rated at 85 DBA minimum.

FORM-C Relay base rated 30VDC, 2.0A

Isolator base

The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.

Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).

Manual Call Points

• The Manual call points(MCP) used in the building shall confine to the relevant standard shaving the following features

• Manual call points shall be of Double action - break glass type with Push Button.

• The mounted arrangement shall be such that it can be either surface mounted or flush mounted

• Each addressable MCP will comprise of an electronic circuit built in to it to provide addressing capability.

• The MCPs shall be provided with inbuilt fault isolator. (The bidder shall consider anexternal isolator if not inbuilt)

• The MCP shall have a LED to indicate Alarms

• The MCP shall be UL&FM approved list

Intelligent Photoelectric Smoke Detector

The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

The detector **SHALL NOT** respond to refrigerant gas.

Intelligent Self Acclimatising Multi Sensor Detector

The intelligent multi sensor detector shall be an addressable device that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine it's environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.

The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).

The intelligent multi criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation.

It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.

The detector **SHALL NOT** respond to refrigerant gas.

Intelligent Thermal Detectors

Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.

Intelligent Duct Smoke Detector

1. The smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.

2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.

Addressable Dry Contact Monitor Module

1) Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs.

2) The monitor module shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box.

3) The IDC zone shall be suitable for Style D or Style B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

4) For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include Style D or an LED.

Addressable Control Module

1) Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered polarized audio/visual notification appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contract relay.

2) The control module shall mount in a standard 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box, or to a surface mounted back box.

3) The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation, or as a dry contact (Form-C) relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

4) Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised, UL listed remote power supply.

5) The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.

Isolator Module

Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building.

If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.

The isolator module shall not require any address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.

The isolator module shall mount in a standard 4-inch (101.6 mm) deep electrical box or in a surface mounted back box. It shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

LCD Alphanumeric Display Annunciator:

The alphanumeric display annunciator shall be a supervised, back-lit LCD display containing a minimum of 160 characters for alarm annunciation in clear English text.

The LCD annunciator shall display all alarm and trouble conditions in the system.

Up to 32 LCD annunciators may be connected to an EIA 485 interface. LCD annunciators shall not reduce the annunciation or point capacity of the system. Each LCD shall include vital system wide functions such as, System Acknowledge, Silence and Reset.

LCD display annunciators shall mimic the main control panel displays and shall not require special programming.

The LCD annunciator shall have switches which may be programmed for System control such as, Global Acknowledge, Global Signal Silence and Global System Reset. These switch inputs shall be capable of being disabled permanently or by a key lockout function on the front plate.

Beam Detector

The System Sensor beam detectors are four wires conventional reflected beam smoke detectors. It shall be used with UL Listed compatible fire alarm control panels only. Installation of the single-ended reflective design is much quicker than a dual ended projected beam detector. Alignment is easily accomplished with an optical sight and a two-digit signal strength meter incorporated into the beam detector. Listed for operation from –22°F to 131°F. The beam detectors are a transmitter/receiver unit and a reflector. When smoke enters the area between the unit and the reflector, it causes a reduction in the signal strength. When the smoke level (signal strength)reaches the predetermined threshold, an alarm is activated. The detectors have four standard sensitivity selections as well as two Acclimate® settings. When either Acclimate® setting is selected, the detector will automatically adjust its sensitivity using advanced software algorithms to select the optimum sensitivity for the specific environment. The beam detector has an integral sensitivity test feature of a filter attached to a servomotor inside the detector optics.

Features

- Transmitter/receiver built into same unit.
- Six user-selectable sensitivity levels.
- 16' to 328’ protection range.
- Removable plug-in terminal blocks.
- Digital display for easy alignment.
- Built-in automatic gain control compensates for signal deterioration from dust buildup.

- Paintable cover.
- Optional remote test station.
- Optional long-range kit for applications in excess of 230' (70 m).
- Optional multi-mount kit providing ceiling or wall mounts capability with increased angular adjustment.
- Optional heater kits for prevention of condensation Optional heavy-duty mounting bracket

Serially Connected Annunciator Requirements

1. The annunciator shall communicate to the fire alarm control panel via an EIA 485 (multi-drop) two-wire communications loop. The system shall support two 6,000 ft. EIA-485 wire runs. Up to 32 annunciators, each configured up to 96 points, may be connected to the connection, for a system capacity of 3,072 points of annunciation.

2. An EIA-485 repeater shall be available to extend the EIA-485 wire distance in 3,000 ft. increments. An optional version shall allow the EIA-485 circuit to be transmitted over Fiber optics. The repeater shall be UL864 approved.

3. Each annunciator shall provide up to 96 alarm and 97 trouble indications using a long-life programmable color LED's. Up to 96 control switches shall also be available for the control of Fire Alarm Control Panel functions. The annunciator will also have an "ON-LINE" LED, local piezo sounder, local acknowledge and lamp test switch, and custom zone/function identification labels.

4. The annunciator may be field configured to operate as a "Fan Control Annunciator". When configured as "Fan Control," the annunciator may be used to manually control fan or damper operation and can be set to override automatic commands to all fans/dampers programmed to the annunciator.

5. Annunciator switches may be programmed for System control such as, Global Acknowledge, Global Signal Silence, Global System Reset, and on/off control of any control point in the system.

6. An optional module shall be available to utilize annunciator points to drive EIA-485 driven relays. This shall extend the system point capacity by 3,072 remote contacts.

7. The LED annunciator shall offer an interface to a graphic style annunciator and provide each of the features listed above

Battery

1) Shall be 12 volt, Lead Acid Maintenance free type.

2) Battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 30 minutes of alarm upon a normal AC power failure.

3) The batteries are to be completely maintenance free. No liquids are required. Fluid level checks refilling, spills and leakage shall not be required.

Battery Charger

1) Shall be completely automatic, with constant potential charger maintaining the battery fully charged under all service conditions. Charger shall operate from a 240-volt 50/60 hertz source.

2) Shall be rated for fully charging a completely discharged battery within 48 hours while simultaneously supplying any loads connected to the battery.

3) Shall have protection to prevent discharge through the charger.

4) Shall have protection for overloads and short circuits on both AC and DC sides.

Speakers:

1. All speakers shall operate on 25 VRMS or with field selectable output taps from 0.5 to 2.0 Watts.

2. Speakers in corridors and public spaces shall produce a nominal sound output of 84 dBA at 10 feet (3m).

3. Frequency response shall be a minimum of 400 HZ to 4000 HZ.

4. The back of each speaker shall be sealed to protect the speaker cone from damage and dust.

Audible/Visual Combination Devices:

1. Shall meet the applicable requirements of Section A listed above for audibility.

2. Shall meet the requirements of Section B listed above for visibility.

Addressable Relay Module:

Addressable Relay Modules shall be available for HVAC control and other building functions. The relay shall be form C and rated for a minimum of 2.0 Amps resistive or 1.0Amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

Sounder (Hooter) Cum Strobe:

- The Sounder used in this Building shall confine to the relevant standards having the following features
- The Sounder shall be a Addressable sounder.(Bidder shall consider external power supply, cable, conduits, modules required for activating externally powered sounder sand include the costing as part of the item –Sounders)
- The Sounder shall have inbuilt fault isolator module.(bidder shall consider external isolators if not inbuilt)
- The Sounder shall either be addressed by Dip switch or by the Panel.
- The Sounder shall be placed in the detection loop only and a separate loop or cables or sounders shall not be used
- The sounder shall have a sound pressure level of 90dB and the volume shall be adjusted from the Fire Alarm Panel
- The sounder shall be tested and maintained with ease from the FACP
- The Volume levels for Testing and Drill shall be programmed as per site conditions.
- The Sounder shall be capable of either accommodating a Flasher or a Detector and shall work as Sounder cum strobe or Sounder cum detector base.
- The Sounder shall have a feature of synchronizing with other sounder sin the loop.
- The Strobe used in this Building shall confine to the relevant standards having the following features
- The Strobe shall have are d flash light and shall flash at minimum of 1Hz
- The Strobe shall also be part of Testing and Drill and shall be programmed as per site conditions.

- The Strobe shall consume a minimal current of10mA and thus allowing connecting at least 10 strobes in the same loop.

- The Strobe shall be capable of either fixing it in a Sounder and shall work as Sounder cum strobe as per site conditions.

- The Sounder cum strobe shall be UL&FM approved list

Strobe lights:-

Shall meet the requirements of the ADA, UL Standard 1971, be fully synchronized, and shall meet the following criteria:

1. The maximum pulse duration shall be 2/10 of one second

2. Strobe intensity shall meet the requirements of UL 1971.

3. The flash rate shall meet the requirements of UL 1971.

Alphanumeric LCD Type Annunciator:

1. The alphanumeric display annunciator shall be a supervised, remotely located back-lit LCD display containing a minimum of eighty (80) characters for alarm annunciation in clear English text.

2. The LCD annunciator shall display all alarm and trouble conditions in the system.

3. An audible indication of alarm shall be integral to the alphanumeric display.

4. The display shall be UL listed for fire alarm application.

5. It shall be possible to connect up to 32 LCD displays and be capable of wiring distances up to 6,000 feet from the control panel.

6. The annunciator shall connect to a separate, dedicated "terminal mode" EIA-485 interface. This is a two-wire loop connection and shall be capable of distances to 6,000 feet. Each terminal mode LCD display shall mimic the main control panel.

7. The system shall allow a minimum of 32 terminal mode LCD annunciators. Up to 10 LCD annunciators shall be capable of the following system functions: Acknowledge, Signal Silence and Reset, which shall be protected from unauthorized use by a key switch or password.

8. The LED annunciator shall offer an interface to a graphic style annunciator and provide each of the features listed above.

Fixed Emergency Telephone Handset

1. The telephone cabinet shall be painted red and clearly labeled as "Emergency Telephone." The cabinets shall be located where shown on drawings.

2. The handset cradle shall have a switch connection so that lifting the handset off of the cradle shall send a signal to the fire command center, which shall audibly and visually indicate its on-line (off-hook) condition.

3. On activating the remote phone, the phone earpiece shall sound a telephone ring signal until the master handset is lifted.

4. The two-way emergency telephone system shall support a minimum of seven (7) handsets on line without degradation of the signal.

Interactive Touch Screen Display:

This specification includes the furnishing, installation, connection, and testing of an interactive firefighters'

display; including Underwriters Laboratories (UL) listed application software and hardware complete and ready for operation. The basic system shall be Underwriters Laboratories (UL) listed for :No. 864 Control Units or Fire Protective Signaling Systems (Ancillary listing)

An interactive firefighters' display shall be installed in accordance to the project specifications and drawings. The interactive firefighters' display system shall include, but not be limited to, a touch screen interface, network communications media, power supplies, and wire / fiber optic media as shown on the drawings and specified herein.

The interactive firefighters' display shall support fire alarm, supervisory, and security events from the fire alarm control panel(s). The interface shall display building floor plans with respective active fire alarm devices, water supplies, evacuation routes, access routes, gas, power and HVAC shutoffs, chemical hazards, and structural hazards in the building.

The system shall include an easy one-touch method of viewing building, emergency contacts, the facility site plan, and active event information. A supervised interface to fire alarm control panels and network shall be made available. The system shall be electrically supervised and monitor the integrity of all conductors.

Fire Fighter's Display: Performance requirements

A. The network will interface and report the individually monitored system's alarm status via a user-friendly Graphical User Interface (GUI) based software.

B. The software shall operate under Microsoft® Windows® XP Embedded platform as manufactured by Microsoft Corporation.

C. The GUI based software must be capable of graphically representing the facility being monitored with floor plans and icons depicting the actual locations of the fire alarm device locations.

D. The software shall use a 1280 pixel x 1024 pixel GUI display capable of showing a large primary floor plan display, a site plan representative of an aerial view of the facility, the first active fire alarm on the system.

E. The software shall permit automatic navigation to the screen containing an icon that represents the first fire alarm device in alarm in the event of an off-normal condition.

F. The fire alarm device icon shall be visible only when it is in an alarm (or active) condition.

G. The software shall display the activated smoke detectors in a time sequence to track smoke progression.

H. The software shall allow the importation of externally developed floor plans in Windows Metafile (WMF), JPEG (JPG), Graphics Interchange Format (GIF) and Bitmap (BMP) format.

I. The software shall provide a intuitive and easy way to navigate to different screens representing floors and areas within a facility.

J. The system shall provide for continuous monitoring of all fire alarm conditions regardless of the current activity displayed on the screen.

K. The software shall display "YOU ARE HERE" along with icons representing standard building objects (stairs, elevators, etc.) to be shown on the floor plan.

L. The software shall allow icons that represent hazardous materials stored in a facility.

M. The software shall provide a screen that displays preprogrammed building contact information.

N. The software shall provide a screen the displays building occupancy and other general building information.

O. The software shall allow a site plan to be imported that shows an aerial view of the facility.

P. The software shall display all active fire, supervisory, and security events within an event list.

Q. The system shall operate on an UL listed Embedded platform operating at no less than 700 MHz on the Microsoft® Windows® XP Embedded platform.

R. The Embedded platform shall have: no less than 256 megabytes of RAM, a flash drive with no less than 1 Gigabytes of storage space, 100 Base-T Ethernet NIC card, and USB ports.

S. The Embedded platform shall have a minimum 19" touchscreen display.

T. The Embedded platform shall come equipped with all necessary gateway modules to allow connection to the network it monitors as standard equipment.

U. A UL listed Ethernet Hub shall be provided for connection of multiple interactive displays and/or gateways.

MONITORING NETWORK

A. The monitoring network shall consist of a network based on proven ARCNET® technology.

B. The network shall have the ability to use fiber optic cable (single-mode and multi-mode), wire (twisted pair copper media in a style 4 or style 7 configuration), or combination wire/fiber communications with support of up to 103 nodes.

1. Wire networks shall support 12 AWG, 1 Pair Shielded to 24 AWG, 4 Pair Unshielded following the manufacturer's guidelines.

2. Fiber optic networks shall support 62.5/125µm cable 8dB limit (50/125µm cable 4.2dB limit)

3. Wire to fiber conversions using repeaters

C. High-speed data communications (312,500 BPS).

D. True peer-to-peer communications between fire alarm control panels.

MONITORING NETWORK

A. The monitoring network shall consist of a network based on proven ARCNET® technology.

B. The network shall have the ability to use fiber optic cable (single-mode and multi-mode), wire (twisted pair copper media in a style 4 or style 7 configuration), or combination wire/fiber communications with support of up to 103 nodes.

1. Wire networks shall support 12 AWG, 1 Pair Shielded to 24 AWG, 4 Pair Unshielded following the manufacturer's guidelines.

2. Fiber optic networks shall support 62.5/125µm cable 8dB limit (50/125µm cable 4.2dB limit).

3. Wire to fiber conversions using repeaters.

C. High-speed data communications (312,500 BPS)

D. True peer-to-peer communications.

INTEGRATION NETWORK

A. The integration network shall be capable of monitoring a minimum of 100 nodes (Network Input/output Nodes and routers) on an integration gateway consisting of, but not limited to:

1. Intelligent or conventional fire alarm control panels.

2. Competitor's intelligent or conventional fire alarm control panels.

B. Up to 99 gateways shall be connected via Ethernet for a total local area combination of up to 12672 (99x128) nodes.

C. Local area networks shall consist of a free topology network using twisted pair copper media in a bus, star, T-tap, or ring style 7 configurations at 78 Kilo baud.

Transmit/receive twin fiber (multi-mode 62.5/125 µm) strand FT-10 point-to-point topology and bi-directional FO-10 networks shall also be available. Wide area networks shall be supported by the use of network expansion routers.

1. Free topology (FT-10 style) wire network run allows multiple T-taps within a 1,500-foot (457.2 m) radius; 8,000 foot (2438.4 m) point-to-point using twisted pair; or 6,000-foot (1828.8 m) bus topology.

2. Free topology (FT-10 style) fiber network can also use fiber-optic cabling. Operates at 78.5 Kbaud.

3. Fiber optic (FO-10 style) network allows bus or ring topology using only fiber-optic cabling; node-to-node distance of over 10,000 feet (3048 m) with message regeneration. FO-10 style operates at 1250 K baud and utilizes multi-mode bi-directional fiber media (single fiber strand) in a bus or loop configuration.

D. Provide routers, repeaters or bridges where required to increase distance, alter network configuration or change media or to extend to remote facilities over alternate communications media including UL listed dial-up PSTN telephone, leased line, multimode fiber or Ethernet connectivity.

1. Dial-up units shall dial a local number and stay connected. Upon loss of carrier, a supervisory alarm shall be indicated at the workstation and the units shall automatically redial to connect.

2. Network expansion routers shall support public switched telephone circuits, two-wire or four-wire leased lines, and CAT5 Ethernet networks.

E. Network interface software shall be by the same manufacturer as the hardware portion of this specification.

F. The integration network shall utilize Network Input / Output Nodes to interface between the individual buildings' systems to be monitored by the integration network. The Network Input/output Nodes shall act as a translator from the building system's specific panel communications protocol to the integration network protocol as well as serve as a transceiver from the building system panel to the integration network.

1. Network Input/Output Nodes shall be available in configurations that will allow transparent communications via RS 232 serial data ports with intelligent fire alarm control panels, security systems, and CCTV systems.

2. Network Input/OutputNodes shall be available in configurations that will allow monitoring of dry contacts, switched voltages, conventional security devices, access control panels and conventional fire alarm control panels using scheduled, automated and manual control.

3. Network Input/OutputNodes shall be UL listed to Standard 864 and 1076 and be provided with their own enclosure or be available in chassis mount configurations.

4. Network Input/OutputNodes shall operate at 24 VDC and obtain their power from the monitored control panel or a UL listed battery backed auxiliary power supply. All terminals shall be transient protected to 2400V and LEDs shall be provided for status, service and diagnostics.

G. Digital Alarm Communicator Receiver Network

1. The system shall provide a digital alarm communicator receiver (DACR) gateway with a RS 232 interface to the following digital alarm communicator receivers for wide area event

reporting: Ademco 685, Silent Knight 9500 and 9800, Radionics 6600.

2. Each gateway shall support up to 10 digital alarm communicator receivers for alarm and trouble information from reporting devices.

H. Workstation Network:

1. Computers shall be networked using Ethernet supporting the use of TCP/IP protocol for local area systems.

2. The network shall be capable of supporting multiple clients (e.g., workstations, configuration applications, automated response applications) and up to ninety-nine (99) gateways.

3. A UL listed Ethernet Hub shall be provided for connection of multiple workstations, gateways, clients, and/or network printers.

4. System shall be UL listed to communicate between clients and gateways over a business computer network (shared IP).

PC Graphical Station: System Setup &Configuration :

A. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes.

B. The factory trained technician shall install initial data and artwork at each workstation including:

C. Distribution of monitoring, control and security profiles as requested by owner.

D. Area diagrams, floor plans, key maps and screen titles.

E. Auto-navigation criteria.

F. Guidance text as provided by owner.

SUBMITTALS AND DOCUMENTATION

Pre Commissioning

Prior to handover, the Contractor shall furnish with 'as fitted' drawings / wiring diagrams.

As fitted' drawings shall indicate the layout of all equipment, layout of aspirating smoke detector pipework, cable routes and cable sizes/types used. Wiring schematics, including cable termination details, shall also be provided by the Contractor.

'As fitted' CAD drawings shall be prepared using a software package capable of providing dwg format and two electronic copies shall be made available in that format. Also, four sets of A0 prints shall be provided to the Engineer.

Prior to handover, the Contractor shall also furnish GSI with O&M manuals. In addition to the manufacturer's technical data sheets on all components of the system and standard operating and maintenance instructions, the O&M manuals shall include specially written sections covering the specific operation of the system and any special maintenance requirements.

Three printed copies of the O&M manuals shall be supplied along with a copy in electronic form in a format that is computer readable, e.g. the Microsoft Office™ range of software i.e. Word™, Excel™, etc.

The following documentation shall also be provided at handover:

- The site-specific software as loaded into each control panel, to be supplied in both electronic format and printed listing for secure storage on site by GSI.

- Alarm audibility and/or intelligibility information. (This can be recorded on the 'as fitted' drawings.)
- Test results for all system wiring.
- Commissioning testing results/listings.
- Standby battery calculations.

Contract Documentation

The Fire Alarm contractor shall provide a complete set of documents describing the system and its design concepts, installation, final testing, commissioning, and required operating and maintenance procedures.

As a minimum, the following documentation shall be provided for the system:

1. System description.
2. Checklist of equipment and components.
3. Installation instructions.
4. Equipment connection diagrams showing wiring detail of Addressable Device positions with addresses.
5. Standby battery calculations showing system power requirements and formulas used to calculate specified power.

6 Final testing instructions.

7. Commissioning instructions.
8. Certification documents.
9. Log book.
10. System operating instructions.
11. Routine maintenance instructions and schedules.
12. Remote monitoring link description and operating instructions (if this option is being provided).

As a minimum, the following drawings shall be provided for the system:

1. System schematic diagram.
2. Cabling and wiring diagram.
3. Detailed equipment connection diagrams.
4. Building plan showing zoning and location of fire controller, detectors, call points, sounders and ancillary devices.

The Fire Alarm contractor shall provide a complete set of system operating and service manuals for the following:

1. Fire controller
2. Detectors
3. Call points
4. Sounders
5. Ancillary devices

6. Remote monitoring link (if this option is being provided).

The date for submission of all documentation shall be in accordance with the schedule provided by the Fire Alarm contractor and as agreed with the customer.

5.0 AS-BUILT DRAWINGS & OPERATING MANUALS

5.1 The Contractor shall submit As-Built drawings that have been reviewed and deemed satisfactory by the Engineer. Final submission shall include four (4) sets of A1 size, one set of A3 size and two sets of electronic copy (AutoCAD files) on CD-ROM disc.

5.2 The Contractor shall submit three (3) copies of an operating manual that have been reviewed and deemed satisfactory by the Engineer

The manual should include:

- General description of equipment and system.
- Operating instruction for all equipment and system.
- Schedule of equipment clearly stating the type, make, model, serial number, quantity, capacity, location and date of installation.
- Manufacturer's literature including catalogues, wiring diagrams, technical description, etc.
- Recommended frequency and detailed task list for routine maintenance for each system and equipment
- Final factory and site testing results for each equipment and each system with signatures of witnesses.
- Emergency contact lists for 24-hour, 365-days including duty and backup personnel.

5.3 Closes-Out Documents

a. Submit final copies of the shop drawings outlined as above. These final submittals shall reflect all field modifications and change orders required to complete the installation. Submit the following quantities of record submittal drawings immediately following receipt of notification of substantial completion. Auto CAD drawing or VISIO files of all shop drawings on or CD ROM disks.

b. Three complete sets of documents located in a Spiral Bound notebook and organized by subject with divider tabs.

6.0 CLOSEOUT MINIMUM REQUIREMENTS

The Life Safety Contractor shall ensure the following are completed at hand-over:

a Any snagging to be documented and agreed date determined for clearance.

b. All passwords/PIN numbers, levels and operators recorded.

c. Disk copies of all system and data files supplied.

d. Proprietary software manuals & disks.

e. Consumables, printer ribbons, printer paper at agreed levels.

f. All equipment access keys handed over.

g. Complete sets of O&M manuals left with system, any agreed amendments/additions required to be documented and a target date for completion agreed.

h. Training of engineers and operators to be checked complete or program for completion agreed.

7.0 FINAL INSPECTION:

At the final inspection a factory trained representative of the manufacturer of the major equipment shall demonstrate that the systems function properly in every respect.

8.0 INSTRUCTION:

Provide instruction as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

9.0 QUALITY ASSURANCE

General

a. The Life Safety System shall be furnished, engineered, and installed by Trained Engineers of the Contractor.

b. The contractor shall have extensive knowledge in the System Network Integration or shall be a factory trained and certified Integrator.

c. The contractor shall employ technicians who have completed the factory authorized training. The contractor shall employ technicians to provide instruction, routine maintenance, and emergency service within 24 hours upon receipt of request.

10.0 GENERAL INSTALLATION PROCEDURES AND REQUIREMENTS.

Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

All cables, junction boxes, cables supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

Manual Pull Stations shall be suitable for surface mounting or semi flush mounting as shown on the plans, and shall be installed not less than 42 inches, nor more than 48 inches above the finished floor.

Typical Operational Requirement:

Actuation of any manual station, smoke detector heat detector or water flow switch shall cause the following operations to occur unless otherwise specified:

Activate all programmed speaker circuits.

Actuate all strobe units until the panel is reset.

Light the associated indicators corresponding to active speaker circuits.

Release all magnetic door holders to doors to adjacent zones on the floor from that the alarm was initiated.

Return all elevators to the primary or alternate floor of egress.

A smoke detector in any elevator lobby shall, in addition to the above functions, return all elevators to the primary or alternate floor of egress.

Smoke detectors in the elevator machine room or top of hoist way shall return all elevators in to the primary or alternate floor. Smoke detectors or heat detectors installed to shut down elevator power shall do so in accordance with ANSI A17.1 requirements and be coordinated with the electrical contractor.

Correct installation, combined with the use of high quality equipment, components and cabling, ensures that the fire detection and alarm system shall operate as designed and provide many years of trouble-free service.

The Fire Alarm contractor shall install the alarm system in accordance with the documented installation instructions.

The Fire Alarm contractor shall provide all relevant installation documentation required for each component of the system.

Installation of the system shall be in accordance with the recommendations set out in NFPA-72

The Fire Alarm contractor shall be responsible for the correct setting of all equipment and components of the system in accordance with previously agreed plans and drawings.

All cabling and wiring shall be tested before they are connected to the fire controller and its associated devices.

WARNING If the tests are carried out after the cables and wires have been connected to the controller and its devices, components within the controller and the devices will be damaged by high voltages used during testing.

Materials

All cabling and wiring to be used in the system shall be copper Armoured with conductor not less than area 1.5mm² in cross section.

Wiring used for driving devices requiring high currents (e.g. bells, etc.) shall limit the voltage drop to less than 10% of the nominal operating voltage.

Cables used for the transmission of system data and alarm signals shall be in accordance with the types recommended by the manufacturer of the fire alarm system.

The ends of all cables shall be sealed by means of proprietary seals and associated glands. No heat shall be applied to any seal or termination. Cable tails shall be insulated by means of blank PVC sleeving anchored and sealed into the seal.

Where protection of the cable glands is required or terminations are on display, the glands shall be enclosed in red coloured shrouds of the appropriate British Standard colour.

All cables to brick/concrete shall be securely fixed by means of copper saddles sheathed with red PVC. These saddles shall be provided near bends and on straight runs at intervals no greater than recommended in the British Standards or by the manufacturer.

Where multiple cables are to be attached to a wall or soffit, copper saddles shall enclose all cables and shall be secured by means of suitable masonry plugs and two round head plated woodscrews

Where multiple cables are to be attached to the top of horizontal trays they shall be neatly run and securely fixed at suitable intervals. Copper or plastic cable fixings shall be used.

At detector and sounder locations, cables shall be terminated in approved galvanized junction boxes. All other devices forming part of the system shall utilize dedicated /custom back boxes.

Installation of Detectors

All detectors (and bases) shall be installed in accordance with guidelines set out in NFPA -72 and the installation instructions provided by the manufacturer.

All detectors shall be installed in the exact locations specified in the design drawings; thus providing the best possible protection.

The type of detector installed in each particular location shall be the type specified in the design drawings.

All detector bases shall be securely fixed to approved boxes and allow for easy fitting and removal of detectors.

Cable and wire entries to detector bases shall be fitted with grommets to prevent possible damage to the insulation.

Cable and wire strain relief clamps shall be provided at all entries to detector bases.

Cable entries of detector bases used in environments with abnormal atmospheric or operating conditions shall be appropriately sealed to prevent ingress of dust, water, moisture or other such contaminants.

Installation of Control Devices

All control devices (e.g. call points, sounders, interface modules, etc.) shall be installed in accordance with the guidelines set out in NFPA-72 and the installation instructions provided by the manufacturer.

All control devices and associated modules shall be installed in the exact locations specified in the design drawings.

The type of control device installed in each particular location shall be the type specified in the design drawings.

All control devices and associated modules shall be securely fixed, and if required, marked with appropriate notices, warnings, signs as applicable.

Cable and wire entries to all control devices and associated modules shall be fitted with grommets or glands so as to prevent possible damage to the insulation.

Cable and wire strain relief clamps shall be provided at entries to control devices and associated modules as required.

Cable entries of control devices and associated modules used in environments with abnormal atmospheric or operating conditions shall be appropriately sealed to prevent ingress of dust, water, moisture or other such contaminants.

Installation of Fire Controller Equipment

The fire controller equipment shall be installed in accordance with the guidelines set out in NFPA-72 and the installation instructions provided by the manufacturer.

The fire controller and its associated component parts shall be installed in the location specified in the design drawings.

The type of fire controller and its associated component parts installed shall be the type specified in the design drawings.

The fire controller equipment shall be securely fixed, and if required, marked with appropriate notices, warnings, signs as applicable.

Cable and wire entries to the fire controller and associated devices shall be fitted with grommets or glands to prevent possible damage to the insulation.

Cable and wire strain relief clamps shall be provided at entries to fire controller and associated devices as required.

The fire alarm system mains power connections to the fire controller equipment shall be accordance with the guidelines set out in the relevant British Standards and the installation instructions provided by the manufacturer.

The fire alarm system mains power isolating switch shall be coloured red and clearly labeled 'FIRE ALARM: DO NOT SWITCH OFF'.

Each circuit of the system shall be connected to the fire controller via associated fuse or circuit breaker devices located within the fire controller unit.

All cables from the fire controller equipment to the detection and alarm devices shall be clearly labeled as part of the fire detection and alarm system.

11.0 TESTING AND COMMISSIONING, TRAINING

Initial testing can be carried out as per following but not limiting to :-

Sr. No.	Description	Visual	Test Readings	Docume-ntation
1.	All cables are tested for continuty, insulation, resistance etc.			√
2	Carry out visual checks on all panels, cables, interphase modules etc.to ensure they are clean and free from any mechanical damage	√		
3	Check for proper termination & feruling	√		
4	Check input A/C supply voltage		√	
5	Check location/spacing of Detectors as per standards	√		
6	All device are addressed as per drawing		√	
7	Check Distribution of Detector / Loops / Zones as per Drawing.		√	
8	Check all Modules / Detectors, for healthy blinking status.	√		
9	Apply Smoke / Aerosol to random detectors & check output of the same in panel, shall display proper address/Loop/zone. Check for activation of approriate speaker circuits with message.		√	
10	Check distribution of Amplification Zones as per approved shop drawings		√	
11	Check tripping of AHU / Fan / Access doors etc. on activation of detectors.		√	
12	Activation of Hooter circuits as programme ,PA evacuation message/alert message/emergency message		√	
13	All the manual call point are working properly		√	
14	Hooter / Strobe are working as programmed		√	
15	If power fails, whether panel working on battery supply		√	
16	Panel display and all key working properly		√	
17	Check for seamless integration with BMS		√	

tory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system.

2. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

3. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.

4. Verify activation of all flow switches.

5. Open initiating device circuits and verify that the trouble signal actuates.

6. Open signaling line circuits and verify that the trouble signal actuates.

7. Open and short notification appliance circuits and verify that trouble signal actuates.

8. Ground initiating device circuits and verify response of trouble signals.

9. Ground signaling line circuits and verify response of trouble signals.

10. Ground notification appliance circuits and verify response of trouble signals.

11. Check presence and audibility of tone at all alarm notification devices.

12. Check installation, supervision, and operation of all intelligent smoke detectors during a walk test.

13. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

14. When the system is equipped with optional features, the manufacturer's manual should be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

12.0 COMMISSIONING (Pre Commissioning)

At final commissioning of each system, the Contractor shall confirm that:

All detection devices, including point detectors, beam smoke detectors, flame detectors, and aspirating smoke detectors and inputs are tested and operate correctly.

All manual controls, whether manual call points or centrally located controls, operate correctly.

The correct indications are given at the control and indicating equipment, including the repeater panels, mimic panels and graphics PC central control and display terminal.

All outputs operate, in the required manner, including alarm sounders or voice alarm system loudspeakers, visual indicators and connections to ancillary services and other systems. In particular, the Contractor shall check that audibility levels of sounders and/or audibility and intelligibility of voice alarm broadcasts are correct.

The fire detection and fire alarm system complies with the operational sequence detailed in Section 5 of this Specification.

The standby batteries are adequately sized. (Measurements of the quiescent and alarm loads shall be taken and compared to calculated values used at the design stage.) Calculations and measurements shall be submitted to the Engineer.

Commissioning shall be fully documented and the documentation submitted to the Engineer.

The Contractor shall demonstrate each fire detection and fire alarm system to the satisfaction of the Engineer by conducting a series of witnessed acceptance tests as directed by the Engineer. This shall take place after the above final commissioning and following receipt of the commissioning documentation by the Engineer. Acceptance testing shall include the actuation of all devices in the system, simulation of various faults and operation of all manual controls.

Following commissioning, a system soak period of not less than one week shall follow, unless the system incorporates fewer than 50 automatic fire detectors, in which case no soak test is necessary.

Both the installation and the commissioning activities shall be undertaken as a single continuous operation.

Upon completion of the installation activity, the Fire Alarm contractor shall Test, Start-up, Commission and Handover the system to the customer.

The Fire Alarm contractor shall make use of the following documents to record test results and details of commissioning tests:

Cable Test Sheets
Installation Check Report
System Layout Drawing(s)
System Schematic Diagram(s)

The Fire Alarm contractor shall be responsible for inspecting and testing the complete system, including:

1. Detectors
2. Call Points
3. Sounders
4. Ancillary Devices
5. Fire Controller Equipment and Associated Devices
6. Auxiliary Equipment (e.g. Plant Interface Module, etc.)
7. Operating and Control Software.

The fire controller and associated devices and modules shall be tested in accordance with the guidelines set out in NFPA-72 and the testing instructions provider by the manufacturer.

The Fire Alarm contractor shall start up and operate the system for a trial period to ensure that it operates correctly.

The Fire Alarm contractor shall test all functions of the system, including the software, to ensure that it operates in accordance with the requirements of the design specification and relevant standards.

The Fire Alarm contractor shall undertake audibility tests during which the sounders may be operated continuously over a period of two hours. (Should the customer require these tests to be carried out at a separate visit, or out of normal working hours, this can be arranged at additional cost.)

Commissioning of the system shall constitute practical completion

Following the satisfactory completion of installation, testing and start up, the Fire Alarm contractor shall demonstrate to the customer that the system successfully performs all of the functions set out n the design specification.

The Fire Alarm contractor shall provide the customer with an agreed quantity of spare parts testing equipment and consumables which are to be used during routine maintenance and testing of the system.

The Fire Alarm contractor shall provide a customer appointed fire system supervisor with on-site training in the use, operation and maintenance of the system and explain the procedures to be followed in the event of fire and false alarms. The system supervisor shall also be shown how to carry out routine maintenance and testing procedures, and how to keep the Log Book.

The Fire Alarm contractor shall prepare a report detailing all tests performed during installation and commissioning of the system. The report shall include the results of the tests and details of any specific settings or adjustments made. Any outstanding tasks or activities which are to be completed at another time shall also be included in the report.

The Fire Alarm contractor shall present an Acceptance Certificate for signature by the customer.

13. TRAINING OF OPERATING PERSONNEL:

- All training shall be by the Building Controls Contractor and shall utilize specified manuals, as-built documentation, and the on-line help utility.

- Operator training shall include four initial eight-hour sessions.

- The initial operator training program shall be to establish a basic understanding of Windows based software, functions, commands ETC.

- Special Emphasis shall be laid by the Trainer on imparting knowledge to the participants on extracting the maximum mileage out of the Head-end application to achieve energy monitoring and efficiency.

- Participants should be trained in the concept of maximum demand load management and the process logic applied by the IBMS system to achieve the same.

- The training shall encompass as a minimum:

    1. Troubleshooting of input devices, i.e., bad sensors.
    2. Sequence of operation review.
    3. Sign on - sign off.
    4. Selection of all displays and reports.
    5. Use of all dialogue boxes and menus.
    6. System initialization.
    7. GUI Software.
    8. Network Management Software.

14. INTERFACING WITH OTHER SERVICES.

- Interfacing with Third Party Service providers and Equipment Providers is a integral and most important part of the scope of works of the IBMS vendor.

- It shall be the Contractor's responsibility to study and inclulate the Design Logics of various Utilities being provided by third parties

- It is expected and assumed for granted that the Contractor shall study of third party drawings to locate equipment / locate Marshalling boxes to pick up signals relevant to Control and Monitoring of Life Safety

- The Contractor shall also prepare and share data related to software level integrations to the IBMS contractor on .net / xml / or conventional integration on MODBUS / LONWORKS / BACNET over IP Platforms, made availabe either on Serial interface or on a IP Platform.

- The Contractor shall be responsible to ensure that all information relevant to Interfacing with Other Services and Other Systems is collated an put to use to ensure a fully operational Life Safety System as per technical requirements put forth in the Tender, and to the descrition of the Architect / Client / Consultant as Directed from Time to Time.

- During Execution, it shall be Contractor's responsibility to follow Co-ordinated drawings and interface with other Services and contractors for proper laying and installtion of equipment such that there is no fouling of services in any manner.

C. CCTV (IP VIDEO SURVEILLANCE) SYSTEM

1. SCOPE:

The specification of Video Surveillance System covers technical specification and requirement of IP Video Surveillance Systems consisting of Indoor IP dome cameras, Indoor IP PTZ cameras, outdoor IP P/T/Z dome cameras, Video Management Software, Recording servers, switches, colour monitor etc. for surveillance of the facility from a centralized location.

Video Surveillance System shall be an IP enabled system. The recording of the video shall be on an open architecture, non-embedded based recorder server from reputed manufacturers like IBM/HP/Dell. The system shall be able to work on a fibre optic backbone network. The entire system shall be based on nonproprietary open architecture where the Video Management software can work and integrate with any make of standard cameras and encoders, and IT hardware.

2. SYSTEM DESCRIPTION

a. The Video Management Software should be a fully digital IP-based video surveillance system.

b. The VMS should work with the latest compression technologies viz MPEG-4 and H.264 and should be capable to interface with IP cameras streaming both compressions.

c. It should be a fully scalable enterprise-class media management system. This advanced network-based system architecture should enable simultaneous live monitoring from multiple stations and be easily configurable for storage both on and off site. The software should be configured to store and to view images captured by one camera or thousands of cameras and monitor connections across an unlimited number of servers.

d. Video Surveillance System shall consist of outdoor IP PTZ Dome cameras, recording Servers and PC's and associated Ethernet cable, fiber cable, video cable, power cable, twisted pair cable etc. Bidder should consider all necessary network equipment and accessories to provide a LAN / WAN infrastructure dedicated for video surveillance on a fibre optic backbone network which should be not less than 1 Gbps speed.

e. The software should provide a single GUI that monitors, records, and offers analysis functionality to deliver the timely, accurate information required for effectively responding to any challenge.

f. The VMS shall have client station software. The client should offer multi-monitor options, and have drag and drop options and the ability to switch any particular camera onto any monitor through drag operation.

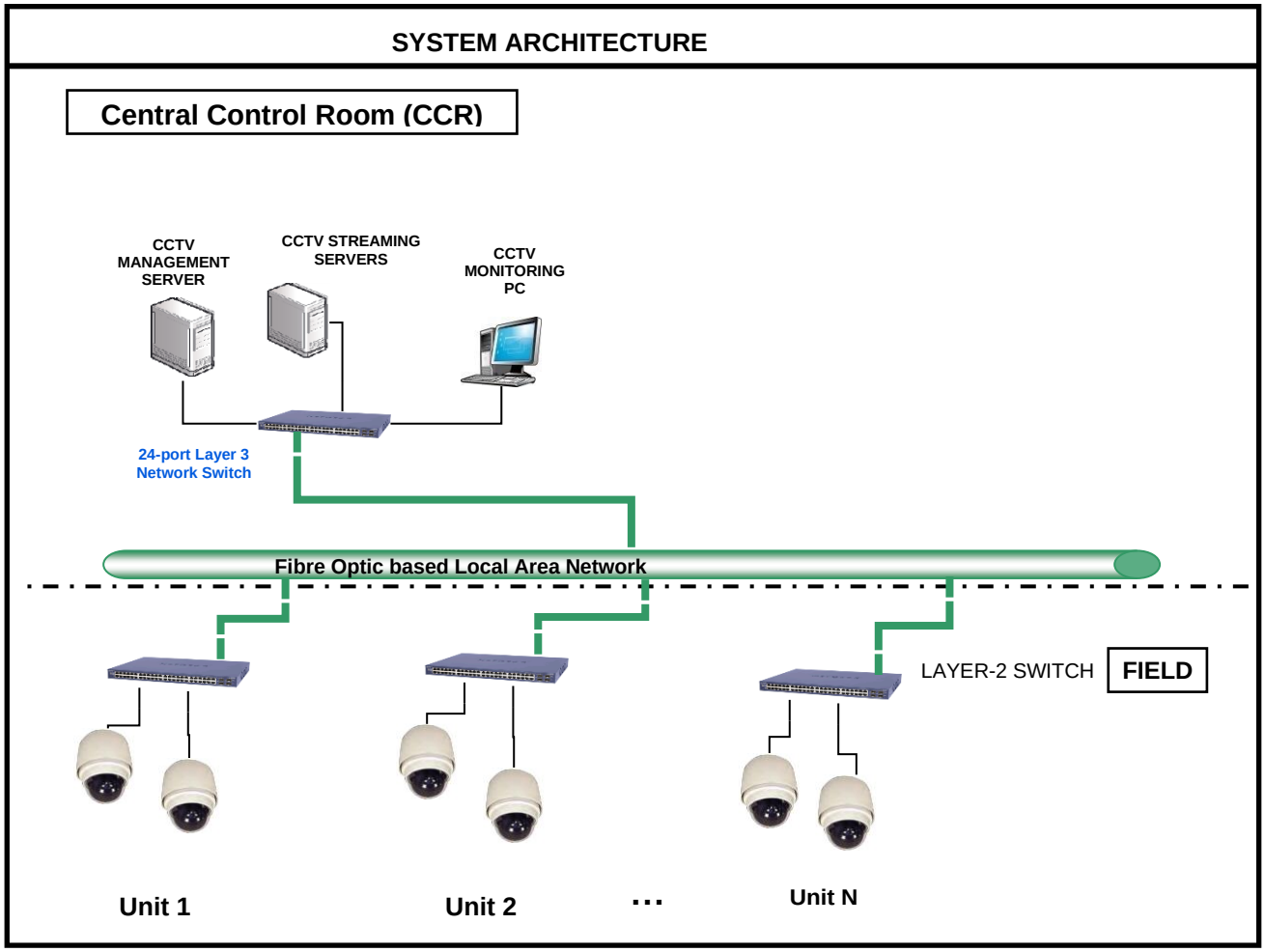
g. It should be possible to set up a video wall from the software.

h. The VMS should have the future capability to integrate video analytics for all the cameras. It should presently support motion detection feature and detect on the basis of size of object and direction of movement etc. and generate various types of alarms.

i. Each camera shall have a video at 4CIF and 25 frames for viewing the videos during live as well as for recording purpose. The storage shall be on a recording server which will be a standard IBM/HP/Dell/ make PC server. The recording shall be stored for at least 30 days at 4CIF and 25 frames per second.

3. SYSTEM ARCHITECTURE

The following diagram explains the relationship of various system and integration components:



4. GENERAL REQUIREMENTS:

i. Manufactured products shall have quality system compliance and shall be either UL or CE (EN) or FCC certified.

ii. The Video Management software and the Cameras should be of the same make.

iii. All software and firmware upgrades shall be free of cost. All the IP cameras shall be freely accessible and programmable from the control room.

iv. Every control room of surveillance system shall be capable of getting connected to the optical or other communication backbone.

v. The power supply available shall be 220 V / 50 Hz AC +/- 10%. All modules of the surveillance system should work using this power supply only with requisite converters, if required.

vi. All the cameras and other modules of Video Surveillance System shall be modular in construction. In case of up gradation of such modules in future, it shall be possible to upgrade them without replacing the entire modules.

5. TECHNICAL REQUIREMENTS:

The Video Surveillance System shall consist of:

5.1 Indoor Fixed IP Dome with Color (Day/ Night) Camera

The following cameras will be provided with Appropriate Lens, housing and support to work indoor in industrial environment. The camera should meet the following minimum requirement.

Image sensor	:	The camera shall use a ¼" Progressive Scan RGB CMOS
Lens	:	Varifocal 2.8 - 10 mm, F1.7, fixed iris
Angle of view, horizontal	:	22° - 80°
Minimum illumination	:	0.9 - 100000 lux, F1.7
Camera angle adjustment	:	Pan 360°, tilt 170°, rotation 340°
Video compression	:	H.264, Motion JPEG
Resolutions	:	160x90 to 1280x800
Frame rate	:	30fps in all resolutions (H.264 & Motion JPEG)
Video Streaming	:	Multiple, individually configurable streams in H.264 and Motion JPEG Controllable frame rate and bandwidth VBR/CBR H.264
Intelligent video	:	Video motion detection, active tampering alarm
Security	:	Password protection, IP address filtering, HTTPS encryption, digest authentication, user access log
Supported protocols:		IPv4/v6, HTTP, HTTPS, QoS Layer 3 DiffServ, FTP, SMTP, Bonjour, UPnP, SNMPv1/v2c/v3(MIB-II), DNS, DynDNS, NTP, RTSP, RTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS

Approvals	:	EN 55022 Class B, EN 61000-3-2, EN 61000-3-3, EN 55024, FCC Part 15 Subpart B Class B, ICES-003 Class B, VCCI Class B, C-tick AS/NZS CISPR 22, EN 60950-1, KCC Class B
Network	:	IPv4/v6, QoS
Power over Ethernet (IEEE 802.3af)	:	Class 2 (max.4.2W)
Serial Connectors	:	RS-45 10BASE-T/100BASE-TX PoE

5.2 Fixed Color (day/ night) Camera with IP 66 Housing

The following cameras will be provided with Appropriate Lens, housing and support to work in industrial environment. Housing will be provided in all the cameras with IP66 rating with heater and blower. The camera should meet the following minimum requirement.

Image sensor	:	The camera shall use a 1/3'' Progressive scan CMOS 2
Lens	:	Camera should support both CS-mount & DC-iris lenses; Varifocal 4-10 and 5-50 mm: F1.8, P-Iris; horizontal: 29° - 61°
Angle of view, horizontal	:	Horizontal: 29° - 61
Minimum illumination	:	Color: 0.6 lux, B/W: 0.08 lux, F1.8
Shutter time	:	1/35500 s to 1/6 s
Video compression	:	H.264, Motion JPEG
Resolutions	:	160 x 90 to 2038 x 1536
Frame rate	:	2 MP 4:3 (1600 x 13200) mode and 1080 (1920 x 1080) mode: 30 fps in all resolution; 3 MP mode: 20 fps in all resolution
Video streaming	:	Multiple, individually configurable stream in H.264 and Motion JPEG. Controlable frame rate and bandwidth VBR/CBR H.264. Up to 8 individually cropped out view areas. When streaming 5 view areas in VGA resolution, the rate is 20 fps per stream in H.264/Motion JPEG (3 MP capture mode)
Image setting	:	Compression, color, brightness, sharpness, contrast, white balance, exposure control, exposure zones, backlight compensation, wide dynamic range, dynamic contrast, fine tuning of behavior at low light
Security	:	Password protection, IP address filtering, HTTPS encryption, IEEE 802.1X network access control, digest authentication, user access log
Supported protocols	:	IPv4/v6, HTTP, HTTPS, QoS Layer 3 DiffServ, FTP, SMTP, Bonjour, UPnP, SNMPv1/v2c/v3(MIB-II), DNS, DynDNS, NTP, RTSP, RTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS
Approvals	:	EN 55022 Class B, EN 61000-3-2, EN 61000-3-3, EN 55024, FCC Part 15 Subpart B Class B, ICES-003 Class B, VCCI Class B, C-tick AS/NZS CISPR 22, EN 60950-1, E: 3.IP66, IK10
Power	:	9.6W PoE Class 3, IEEE 802 ar Power over Ethernet

5.3 FIXED COLOR (Day/ Night) CAMERA WITH IP-66 HOUSINH

The following cameras will be provided with Appropriate Lens, housing and support to work in industrial environment. Housing will be provided in all the cameras with IP66 rating with heater and blower. The camera should meet the following minimum requirement.

Image sensor	:	The camera shall use a 1/3'' Progressive scan CMOS 2 Megapixel
Lens	:	f 5.1 - 51 mm, F1.8 - 2.1, Auto day/night IR filter, autofocus Near focus limit 10mm (wide) or 800mm (tele)
Angle of view, horizontal	:	horizontal: 5.4° - 50°, M37x0.75 mounting thread for optional lens adaptor
Minimum illumination	:	Color: 2 lux at 30IRE, F1.8, B/W: 0.2 lux at 30IRE, F1.8
Zoom	:	10x optical and 12x digital, total 120 xs
Video compression	:	H.264, Motion JPEG
Resolutions	:	HDTV 1080i 1920x1080, HDTV 720p 1280x720
Frame rate	:	30/25 fps in all resolutions (H.264 & Motion JPEG)
Intelligent video	:	Video motion detection, active tampering alarm
Security	:	Password protection, IP address filtering, HTTPS encryption, IEEE 802.1X network access control, digest authentication, user access log
Supported protocols	:	IPv4/v6, HTTP, HTTPS, QoS Layer 3 DiffServ, FTP, SMTP, Bonjour, UPnP, SNMPv1/v2c/v3(MIB-II), DNS, DynDNS, NTP, RTSP, RTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS
Approvals	:	EN 55022 Class B, EN 61000-3-2, EN 61000-3-3, EN 55024, EN 61000-6- 1, EN 61000-6-2, EN 60950-1, FCC Part 15, Subpart B, Class B, VCCI, Class B ITE, C-tick AS/NZS CISPR 22, ICES-003, Class B
Network	:	IPv4/v6, QoS
Power	:	8 – 20 VDC max 11,2 W, 20 - 24 V AC max 17,4 VA, Power over Ethernet IEEE 802.3af Class 3
Serial Connectors	:	RS-45 10BASE-T/100BASE-TX PoE

5.4 PTZ Network Camera (day and night) with Housing

It shall be for indoor or outdoor purpose type with minimum of following details to work properly in industrial and hilly environment. Housing will be provided in all the cameras with IP66 rating with heater and blower. The camera should meet the following minimum requirement.

Image Sensor	:	The camera shall use a 1/4" interlaced CCD
Day night	:	Autofocus
Lens	:	3.8 – 46 mm, F1.6 – F2.7, automatic,
Minimum illumination/ Light Sensitivity (LUX)	:	Color: 1 lux at 30 IRE, F1.6; B/W: 0.3 lux at 30 IRE, F1.6
Shutter time	:	NTSC: 1/50000 s to 4/3 s; PAL: 1/50000 s to 8/5 s

PAN/Tilt/Zoom:		20 preset positions; Auto-flip, E-flip; ±170° (360° via Auto-flip) pan; range, 180°/s pan speed; 180° tilt range, 140°/s tilt speed; 12x optical, 4x digital zoom; Control queue, image freeze, sequence modeSupport Windows compatible joysticks
Video compression	:	MPEG-4 Part 2 (ISO/IEC 14496-2); Motion JPEG
Max Video Resolutions	:	NTSC: 704x480 to 176x120; PAL: 704x576 to 176x144
Frame per second		
(NTSC/PAL)	:	Up to 30/25 (NTSC/PAL) in 2CIF/CIF/QCIF; Up to 26/22 (NTSC/PAL) in 4CIF/2CIFExp
Security	:	Password protection, IP address filtering, HTTPS encryption, IEEE 802.1X network access control
Supported protocols	:	IPv4/v6, HTTP, HTTPS, QoS Layer 3 DiffServ, FTP, SMTP, Bonjour, UPnP, SNMPv1/v2c/v3 (MIB-II), DNS, DynDNS, NTP, RTSP, RTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS
Casing	:	IP66-rated, rugged aluminum casing with clear dome bubble
Processor & memory	:	ETRAX FS, ARTPEC-2, 32 MB RAM, 8 MB Flash
Operating condition	:	-20 °C to 40 °C (-4 °F to 104 °F); 2 built-in heaters, 3 built-in fans
Approvals	:	EN 55022 Class B, EN 55024, EN 61000-3-2, EN 61000-3-3, EN 60950-1, FCC Part 15 Subpart B Class B, ICES-003 Class B, C-tick AS/NZS 3548
Power supply	:	UL, CSA, CE

5.5 PTZ Network Camera (day and night) with Housing

It shall be for indoor or outdoor purpose type with minimum of following details to work properly in industrial and hilly environment. Housing will be provided in all the cameras with IP66 rating with heater and blower. The camera should meet the following minimum requirement.

Image Sensor	:	The camera shall use a ¼" ExView HAD Progressive Scan CCD
Day night	:	Autofocus, automatic day/night
Lens	:	3.4 – 119 mm, F1.4 – 4.2, horizontal angle of view: 1.73° - 55.8°
Minimum illumination/ Light Sensitivity (LUX)	:	Color: 0.5 lux at 30 IRE; B/W: 0.008 lux at 30 IRE
Shutter time	:	NTSC:1/30 000 s – 0.5 s; PAL: 1/30 000 s – 1.5 s
PAN/Tilt/Zoom	:	E-flip; 100 preset positions; Pan: 360° endless, 0.05 – 450°/s;
Tilt	:	180°, 0.05 – 450°/s; 35x optical zoom and 12x digital zoom, total 420x zoom; Guard Tour; Control queue
Video compression	:	H.264 (MPEG-4 Part 10/AVC); Motion JPEG
Resolutions	:	NTSC: 704x480 - 176x120; PAL: 704x576 - 176x144
Frame per second (NTSC/PAL)	:	Up to 30/25fps in all resolutions

Security	:	Password protection, IP address filtering, HTTPS encryption, IEEE 802.1X network access control, digest authentication, user access log
Supported protocols	:	IPv4/v6, HTTP, HTTPS, QoS Layer 3 DiffServ,FTP, SMTP,Bonjour, UPnP, SNMPv1/v2c/v3 (MIB-II), DNS, DynDNS, NTP, RTSP, RTP, TCP, UDP, IGMP, RTCP, ICMP, DHCP, ARP, SOCKS
Casing	:	IP66-rated, metal casing (aluminum, acrylic (PMMA) clear dome cover pre-mounted to casing, sunshield (polycarbonate)
Processor & memory	:	ARTPEC-3, 128MB RAM, 128MB Flash
Power	:	Camera: High power over ethernet, max.50W Midspan, High Power over Ethernet Midspan 1-port 100-240V AC, Max.60W
Operating condition	:	-40 - 50 °C (-40 - 122 °F) Arctic Temperature Control enables camera start-up at temperatures as low as -40C; Humidity 20 – 80% RH (non-condensing)
Approvals	:	EN 55022 Class B, EN 55024, EN 61000-3-2, EN 61000-3-3, EN 61000-6- 1, EN 61000-6-2, FCC Part 15 Subpart B Class B, VCCI Class B, C-tick AS/NZS CISPR22, ICES-003 Class B, EN 60950-1; Midspan: EN 60950-1, GS, UL, cUL, CE,

6. DIGITAL KEYBOARD

Professional joystick for accurate control over network of PTZ (pan/tilt/zoom) and dome network cameras. Connects to PC workstation over USB.

7. TECHNICAL SPECIFICATION FOR 24 PORT POE 10/100/1000 MBPS LAYER 3 SWITCH

Sr No	Desired Specification/Qualitative Requirement
1.0	**Core / Distribution Switches (Layer 3)**
1.1	**Architecture**
(a)	Modular switch with 24 Manageable Gigabit Ethernet ports, 4 RJ 45 ports with option of fibre port of Min 1000 mbps & 03 No's of 10Gigabit Slots for uplink to Switch or Servers for Stacking.
(b)	Switch should provide option of Redundant power supply
1.2	**Network Media**
(a)	SFP's 1000BaseSX,1000BaseLX,1000BaseTX,1000Base Lx WDM
1.3	**Performance**
(a)	The Switch shall have Non-blocking wire speed switch fabric
(b)	The Switch shall have Min. 100 Gbps Back plane
(c)	The Switch shall have Min.80 million pps
(d)	The Switch shall support Min. 16K Mac address
(e)	The Switch shall support Min. 3000 VLANs
(f)	The Switch shall support IPv4/IPv6 Routing
(g)	The Switch shall have 40 Gigabit Stacking Backplane

Sr No	Desired Specification/Qualitative Requirement
(h)	The Switch shall be able to do Physical Stack up to 10 units per stack or more
(i)	The Switch shall be able to do IP Stacking up to 30 units per IP
(j)	The Switch Should support Jumbo Frame (up to 9216 Bytes)
1.4	**Layer 3 Features**
(a)	The Switch should have RIPv1(RFC1058)/RIPv2(RFC2453),RIPng,OSPFv2
(b)	The Switch should have Policy Based Routing ,BGP 4 & VRRP
(c)	The Switch should have DVMRP v3, PIM-DM/SM/SDM for IPv4
(d)	The Switch should have IPv6 Tunneling
(e)	The Switch should have Up to 56 IP Interfaces & 10K route entries
(f)	The Switch should have Multi Path Routing support for Equal cost & Weighted Cost
(g)	The Switch should have Per port Limit IP Multicast Address Range for Control Packet
1.5	**Layer 2 Features**
(a)	The Switch should have IGMP Snooping v1,v2,v3 & MLD Snooping
(b)	The Switch should have Spanning tree 802.1d,802.1w,802.1s
(c)	The Switch should have 802.3ad Link Aggregation Up to 30 groups per device
(d)	The Switch should have Port Mirroring One to one/Many to One & RSPAN
(e)	The Switch shall have the intelligence to detect the loop occurring from the unmanaged network segment
(f)	The Switch shall have the capability to build the trunk across stack
(g)	The Switch shall have ITU-T G.8032
(h)	It shall support LLDP and LLDP-MED including client location information. It shall exchange link and device information in multi vendor networks
1.6	**VLAN**
(a)	The LAN switch shall have IEEE 802.1Q VLAN encapsulation. Up to 255 VLANs per switch and up to 4000 VLAN IDs.
(b)	It shall have Automatic Negotiation of Trunking Protocol, to help minimize the configuration & errors.
(c)	It shall have centralized VLAN Management. VLANs created on the Core Switches shall be propagated to all the others switches automatically, thus reducing the overhead of creating/modifying/deleting VLANs in all the switches in turn eliminating the configuration errors & troubleshooting.
(d)	It shall have support for Detection of Unidirectional links and to disable them to avoid problems such as spanning tree loops
(e)	It shall support 802.1v &Q-in-Q Vlan
1.7	**Quality of Service**
(a)	It shall support 802.1p Priority Queues (8 Queues)
(b)	Queue Handling mode: WRR & Strict Mode
(c)	Granular Rate Limiting functions on per port & flow based to guarantee bandwidth in increments shall be as low as 64 Kilobits per Second.
(d)	Class of shall be based on Switch port, DSCP, Vlan ID,TCP/UDP port, Protocol type,802.1p queues, IPv4/v6 address, IPv6 flow label & User defined packet content
(e)	The Switch shall be MEF 9 & 14 Certified to ensure the Service Level Agreements for Voice, video & Data converged applications

Sr No	Desired Specification/Qualitative Requirement
1.8	**Access Control List**
(a)	The Lan Switch shall have the capability to apply access list control based on IPv4/v6 address, Protocol type,IPv6 flow label, Time based ACL, Vlan-ID, MAC-ID, DSCP, IPv6 traffic class, TCP/UDP Port, Switch port & user defined packet content
(b)	The Switch shall support up to 1600 Access Control Entries minimum
1.9	**Network Security**
(a)	The LAN switch shall support IEEE 802.1x to allow dynamic, port-based security, providing user authentication.
(b)	The LAN switch shall support for Admission Control features to improve the network's ability to automatically identify, prevent and respond to security threats and also to enable the switches to collaborate with third-party such as Microsoft for security-policy compliance and enforcement before a host is permitted to access the network
(c)	It shall support for SSHv2, SNMPv3 to provide network security by encrypting administrator traffic during Telnet and SNMP sessions.
(d)	It shall support RADIUS authentication to enable centralized control of the switch and restrict unauthorized users from altering the configuration.
(e)	It shall support DHCP snooping to allow administrators to ensure consistent mapping of IP to MAC addresses. This can be used to prevent attacks that attempt to poison the DHCP binding database, and to rate limit the amount of DHCP traffic that enters a switch port.
(f)	It shall support DHCP Interface Tracker (Option 82) to augment a host IP address request with the switch port ID.
(g)	It shall support that each end node can be isolated from each other and they should be able to connect to shared ports such as Internet and servers
(h)	It shall support port security to secure the access to an access or trunk port based on MAC address. After a specific timeframe, the aging feature should remove the MAC address from the switch to allow another device to connect to the same port.(up to 14 MAC-ID per port)
(i)	It shall have IP-MAC-Port binding up to 475 Entries per device
(j)	It shall have Web & MAC Based Access Control
1.10	**Management**
(a)	The LAN switch shall have CLI support to provide a common user interface and command set with all routers and switches of the same vendor.
(b)	It shall have Remote Monitoring (RMON) software agent to support four RMON groups (history, statistics, alarms and events) for enhanced traffic management, monitoring and analysis.
(c)	It shall support Trivial File Transfer Protocol (TFTP) to reduce the cost of administering software upgrades by downloading from a centralized location.
(d)	It shall support Network Timing Protocol (NTP/SNTP) to provide an accurate and consistent timestamp to all intranet switches.
(e)	It shall support SNMPv1, SNMPv2c, and SNMPv3 and Telnet interface to deliver comprehensive in-band management, and a CLI-based management console to provide detailed out-of-band management
(f)	It shall provide management functions for network segments (access links and individual circuits), monitors individual links.
(g)	It shall have traffic monitoring for all network ports effective at gigabit speed or higher, shall not impact the network performance while providing the real time & historical data of all devices from Layer 2 to Layer 7.

Sr No	Desired Specification/Qualitative Requirement
(h)	It shall support configuration rollback to replace current configuration with any saved configuration file.

8. TECHNICAL SPECIFICATION FOR 24 POE PORT 10/100/1000 MBPS LAYER 2 SWITCH

Sr No	Desired Specification/Qualitative Requirement
1.0	**Edge Switch (Layer 2)**
1.1	**Architecture**
(a)	Modular switch with 20 POE Manageable Gigabit Ethernet ports, 4 RJ 45 ports with option of fibreport of Min 1000 mbps.
(b)	
1.2	**Network Media**
(a)	SFP's 1000BaseSX,1000BaseLX,1000BaseTX
1.3	**Performance**
(a)	The Switch shall have Non-blocking wire speed switch fabric
(b)	The Switch shall have Min. 48 Gbps Back plane or higher
(c)	The Switch shall have Min.35 million pps or higher
(d)	The Switch shall support Min. 8K Mac address
(e)	The Switch shall support Min. 256 VLANs
(f)	The L2 Switch should have MTBF for 173,467 hours.
(g)	The Switch Should support Jumbo Frame (up to 10240 Bytes)
1.4	**Layer 2 Features**
(a)	The Switch should have IGMP Snooping v1,v2
(b)	The Switch should have Spanning tree 802.1d
(c)	The Switch should have 802.3ad Link Aggregation Up to 6 groups per device
(d)	The Switch should have Port Mirroring One to one/Many to One
(e)	The L2 Switch shall have power saving feature which can automatically powers down ports that have no link or link partner.
(f)	The L2 Switch shall not consume more than 250.3 Watts of Power.

1.5	**VLAN**
(a)	The LAN switch shall have IEEE 802.1Q VLAN encapsulation. Up to 255 VLANs per switch.
(b)	It shall have Management Vlan
(c)	It shall have AsymetricVlan
1.6	**Quality of Service**
(a)	It shall support 802.1p Priority Queues (4 Queues)
(b)	Queue Handling mode: WRR & Strict Mode
(c)	Class of service shall be based on DSCP,802.1p queues
1.7	**Network Security**
(a)	The LAN switch shall support IEEE 802.1x to allow dynamic, port-based security, providing user authentication.
(b)	It shall support RADIUS authentication to enable centralized control of the switch and restrict unauthorized users from altering the configuration.
(c)	It shall have built in mechanism to protect the switch against traffic flooding caused by virus attack
1.8	**Management**
(a)	It shall support Firmware upgrade through Web Management or through software must come along with Switch to reduce the cost of administering software upgrades by downloading from a centralized location.
(b)	It shall support Network Timing Protocol (NTP/SNTP) to provide an accurate and consistent timestamp to all intranet switches.
(c)	It shall support SNMPv1 to deliver comprehensive in-band management
(d)	It shall support configuration rollback to replace current configuration with any saved configuration file.

9. SERVER HARDWARE SPECIFICATIONS:

A. Network Digital Video Management Server (NVMS)-Hardware

(i) The NVMS Server shall be of the most recent computer technology and shall cover the NVMS minimum requirements from reputed makes like HP, IBM, Dell

a) As a minimum the NVMS server shall be:

I. Quad Core Xeon 3.2 GHz or better

II. GB of RAM or Better

III. Dual/redundant power supply

IV. Dual/redundant 10/100/1000 network interface card (NIC)

V. To provide an advanced and reliable system the following server must be provided for the recording system

1) Dual mirrored 40G Hard drive for Windows 2003 Server based Operating system and NVMS server software

2) Video storage on Direct Attached Storage (DAS) system which as minimum configured as RAID5

VI. If storage requires external attached RAID system a Fiber Channel Interface Card shall be used to interface the external RAID to the NVMS Server.

VII. To provide an advanced and reliable system the operating system shall be Windows 2000- Server or 2003- Server level (Win 2000 Pro or XP pro will not be considered as approved equal)

10. STORAGE HARDWARE

I. Two redundant, hot-pluggable active/active RAID controller modules with 2 iSCSI host port per controller

II. Redundant, hot-pluggable power supply/fan modules

III. 512 MB of mirrored cache on each RAID controller module

IV. Battery backup in each RAID controller module that protects against cache data loss for up to 72 hours

V. Online firmware updates for the RAID controller modules, NVSRAM, and physical disks

VI. Multi-path failover for redundant configurations, which automatically reroutes I/O activity from a failed, offline, or removed RAID controller module to its alternate RAID controller module (or from a failed iSCSI NIC to its peer)

VII. Support for RAID levels 0, 1, 5, and 10

VIII. Support for 255 virtual disks with a maximum capacity of 2 TB each

IX. Expandability of Minimum 45 drives either SAS or SATA.

11. CABLING SYSTEM AND COMPONENT SPECIFICATIONS

11.1 UTP Cabling System

S. No.	Details	Specification	Compliance	Deviation
1	Type	Unshielded twisted pair cabling system, TIA / EIA 568-B.1 or B.2-1 addendum Category 6 Cabling system	Yes / No	
2	Networks Supported	10 / 100/1000 Ethernet, 155 Mbps ATM, 1000 Mbps IEEE 802.3ab Ethernet, and proposed Cat 6 Gigabit Ethernet	Yes / No	
3	TIA / EIA 568-B.1 or B.2.1	ETL Verified / UL Listed	Yes / No	
4	Warranty	25 year systems warranty; Warranty to cover Bandwidth of the specified and installed cabling system, and the installation costs	Yes / No	
5	Performance characteristics to be provided along with bid	(a) Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR for 4-connector channel	Yes / No	
		(b) Should perform to CAT6 with short channel	Yes / No	
		(c) Should support 6 Connection Channel and exceed CAT6 Specs	Yes / No	
		(d)Should have a PSNEXT margin of 7.5 dB over CAT6	Yes / No	

11.2 UTP Cable

S.No.	Details	Specification	Compliance	Deviation
1	Type	Unshielded Twisted Pair, Category 6, TIA / EIA 568-B.2-1	Yes / No	
2	Conductors	23 AWG solid bare copper	Yes / No	
3	Insulation	Polyethylene	Yes / No	
4	Jacket	Flame Retardant PVC	Yes / No	
	Pair Separator	Cross-member (+) fluted Spline.		
5	Approvals	(a) UL Listed / UL Verified	Yes / No	
		(b) ETL verified to TIA / EIA Cat 6	Yes / No	
6	Operating temperature	-20 Deg. C to +60 Deg. C	Yes / No	
	Storage Temperature	-20 Deg. C to +80 Deg. C		
7	Frequency tested up to	Minimum 600 MHz	Yes / No	
8	Packing	Box of 305 meters	Yes / No	
9	Cable Outer Diameter	.23 inches	Yes / No	
10	Delay Skew	45ns MAX.	Yes / No	
11	Bend Radius	4 * Cable Diameter	Yes / No	
12	Impedance	100 Ohms + / - 15 ohms, 1 to 600 MHz.	Yes / No	
13	UL/NEC Ratings	CMR Rated	Yes / No	
14	Mutual Capacitance	5.6 NF MAX /100 Mtr.	Yes / No	
15	Conductor Resistance	66.58 Ohms Max / KM	Yes / No	
16	Propagation Delay	536 ns/100 Mtrs. MAX @ 250 Mhz	Yes / No	
17	Performance characteristics to be provided along with bid	Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR	Yes / No	
18	ROHS	ROHS/ELV Compliant	Yes / No	

11.3 UTP Jacks

S No.	Details	Specification	Compliance	Deviation
1	Type	PCB based, Unshielded Twisted Pair, Category 6, TIA /EIA 568-B.2-1 and IEC 60603-7-4	Yes / No	
2	Modular Jack	750 mating cycles	Yes / No	
3	Wire terminal	200 termination cycles	Yes / No	
4	Accessories	Integrated bend-limiting strain-relief unit for cable entry		
		Integrated hinged dust cover	Yes / No	
		Support cable pair termination process on the jacks at 90 degree angle.	Yes / No	
		Bidder should have a mechanism to maintain the quality of the termination ir-respective of the skill level of the termination staff.	Yes / No	
5	Housing	Polyphenylene oxide, 94V-0 rated.	Yes / No	
6	110 Blocks	polycarbonate, 94V-0 rated	Yes / No	
7	Jack contacts	Beryllium copper, plated with 1.27 mm [.000050] thick gold in localized area and 3.81 mm [.000150] minimum thick tin-lead in solder area over 1.27 mm [.000050] minimum thick nickel under plate	Yes / No	
8	Wiring blocks	Polycarbonate, 94V-0 rated	Yes / No	
9	Approvals	(a) UL Listed / CSA Approved	Yes / No	
		(b) ETL verified to TIA / EIA Cat 6	Yes / No	
10	Performance Characteristics to be provided with bid	Attenuation, NEXT, PS NEXT, FEXT and Return Loss	Yes / No	
11	ROHS	ROHS/ELV Compliant	Yes / No	

11.4 Patch Cords

S.No.	Details	Specification	Compliance	Deviation
1	Type	Unshielded Twisted Pair, Category 6, TIA / EIA 568-B.2-1	Yes / No	
2	Conductor	24 AWG 7 / 32, stranded copper conductors 100 Ohm	Yes / No	
3	Length	4 feet, 7 feet, 10 feet	Yes / No	
4	Plug Protection	Transparent Slim boot	Yes / No	
5	Warranty	25-year component	Yes / No	
6	Insulation	Flame Retardant Polyethylene	Yes / No	
7	ROHS	ROHS/ELV Compliant	Yes / No	

11.5 UTP Jack Panels

S. No.	Details	Specification	Compliance	Deviation
1	Type	24/48-port, Modular, PCB based, Unshielded Twisted Pair, Category 6, TIA / EIA 568-B.2-1 and IEC 60603-7-4	Yes / No	
2	Ports	24/48	Yes / No	
3	Port arrangement	Configured as 6 Port Module with individually replaceable CAT-6 Jacks		
4	Circuit Identification	Front of each module shall be capable of accepting 9 mm to 12 mm labels	Yes / No	
5	Port Identification	9mm or 12mm Labels on each of 24-ports (to be included in supply	Yes / No	
6	Modular Jack	750 mating cycles		
7	Wire terminal	200 termination cycles	Yes / No	
8	Accessories	Integrated bend-limiting strain-relief unit for cable entry	Yes / No	
9	Materials			
	Housing	Polyphenylene oxide, 94V-0 rated	Yes / No	
	Wiring blocks	Polycarbonate, 94V-0 rated	Yes / No	
	Jack contacts	Beryllium copper, plated with 1.27 mm [.000050] thick gold in localized area and 3.81 mm [.000150] minimum thick tin-lead in solder area over 1.27 mm [.000050] minimum thick nickel under plate	Yes / No	
	Panel	Black, powder coated steel	Yes / No	
10	Approvals	UL listed / ETL Verified	Yes / No	
11	Termination Pattern	TIA / EIA 568 A and B;	Yes / No	
12	ROHS	ROHS/ELV Compliant	Yes / No	

11.6 FACE PLATE

S No.	Details	Specification	Compliance	Deviation
1	Type	Single Gang	Yes / No	
2	Material	ABS / UL 94 V-0	Yes / No	
3	No. of ports	One/Two	Yes / No	
4	ROHS	ROHS/ELV Compliant	Yes / No	

11.7 Core Multi-Mode Outdoor Fiber OM2

S. No.	Specifications	Requirement	Compliance	Deviation
1	Cable Type	6-core MM, OM2, Corrugated Steel Armored, Gelly Filled; Loose tube OFC	Yes / No	
2	Fibre Type	50/125um MM	Yes / No	
3	No. of cores	6	Yes / No	
4	Armour	Corrugated Steel Tape Armour	Yes / No	
5	Attenuation	@ 850nm<=2.9 Typical and <=3.5 Max	Yes / No	
		@1300nm <=0.9 Typical and <=1.0 Max	Yes / No	
6	Bandwidth	@ 850nm >500 MHz-KM	Yes / No	
		@1300nm >500 MHz-KM	Yes / No	
7	Clad Diameter (um)	125 + - 2	Yes / No	
8	Concentricity Error(um)	<=3	Yes / No	
9	NON-Circularity (%)	<=2	Yes / No	
10	Coat Diameter	245 + - 10	Yes / No	
11	Tensile Strength	1500 Newtons	Yes / No	
12	Crush Resistance	440 N/cm	Yes / No	
13	Bend Radius (Installation/Unloaded)	10 D / 20 D	Yes / No	
14	Cable Diameter	8.5 + - 0.5 mm	Yes / No	
15	Lose Tube Diameter	2.8 + - 0.15 mm	Yes / No	
16	Operating Temperature	-30 Degree C to +70 Degree C	Yes / No	

11.8. Core Multi-Mode Outdoor Fiber OM3

S. No.	Specifications	Requirement	Compliance	Deviation
1	Cable Type	6-core, Multimode, 10G Ethernet OM3, Armored, loose-tube, Gel Filled	Yes/No	
2	Fiber type	50 / 125, Laser Grade, primary coated buffers	Yes/No	
3	No. of cores	6	Yes/No	
4	Cable Construction	BELLCORE GR 20 / IEC 794-1	Yes/No	
5	Fiber Attenuation			
	@850nm	<=2.7 dB / KM	Yes/No	
	@1300nm	<=.7 dB / KM	Yes/No	
6	Bandwidth			
	@850nm	>1500 MHz-KM	Yes/No	
	@1300nm	>500 MHz-KM	Yes/No	
7	Network Support			
	10 / 100 Ethernet	2000m	Yes/No	
	155 Mbps ATM	2000m	Yes/No	
	1000 Base SX	900m	Yes/No	
	1000 Base Lx	550m without Mode Conditioning launch patch cord.	Yes/No	
8	Tensile rating	1200 N	Yes/No	
9	Maximum Crush resistance	3000N	Yes/No	
10	Operating Temperature	-40 Degree C to +60 Degree C	Yes/No	
11	Armor	Corrugated Steel tape Armor	Yes/No	
12	ROHS	ROHS/ELV Compliant	Yes / No	

11.9 Multi-Mode 50/125 um Indoor OFC

S. No.	Specifications	Requirement	Compliance	Deviation
1	Fiber type	50 / 125, Laser Grade, primary coated buffers	Yes/No	
2	No. of cores	6	Yes/No	
3	Fiber Attenuation		Yes/No	
	@850nm	<=2.7 dB / KM		
	@1300nm	<=.7 dB / KM	Yes/No	
4	Bandwidth		Yes/No	
	@850nm	>1500 MHz-KM		
	@1300nm	>500 MHz-KM	Yes/No	
5	Tensile rating	1000 N	Yes/No	
6	Maximum Crush resistance	2000 N		
7	Operating Temperature	-40 Degree C to +60 Degree C	Yes/No	
8	Outer Jacket	LSZH	Yes/No	
9	Should comply below mentioned standards			
9.a	Fire Propagation	IEC 332-1 and 332-3	Yes/No	
	Flammability	IEC 1034	Yes/No	
	Smoke Emission	IEC 1034		
	Acid Gas Emission	IEC 754-1	Yes/No	
	Toxicity	NES 713	Yes/No	
	Water Absorption	IEC 811-1-3 (<2mg/cm2 10 days @ 70 Degree C)	Yes/No	
10	ROHS	ROHS/ELV Compliant	Yes / No	

11.10 Fiber Optic LIU with Pigtails, Splice Trays& Splice Protectors (Fully Loaded)

S. No.	Specifications	Requirement	Compliance	Deviation
1	Connector Type	SC-Style, Simplex	Yes / No	
2	Operating temperature	-40 Degree C to +85 Degree C	Yes / No	
3	Durability & color		Yes / No	
4	MM connectors	500 cycles, Beige	Yes / No	
5	SM connectors	220 cycles, Blue	Yes / No	
6	Ferrules	Pre-radiused Ceramic Ferrules	Yes / No	
7	Attenuation	Not more than 0.75 dB per mated pair	Yes / No	
8	Fiber Optic Patch panels			
9	FMS- Front Patching / Splicing Shelf	1U • 19" / ETSI versions available	Yes / No	
		The FMS fiber management shelf series is ideal for high density front patching applications.	Yes / No	
		Its compact design and high density capacity allows it to deliver carrier class fiber management to central offices, POPs, FTTx, mobile systems and LANs.	Yes / No	
		• High Density:	Yes / No	
		1U: 12/24 Fiber terminations	Yes / No	
		• Should be supplied loaded with secondary coated SC pigtails	Yes / No	
		• Mounting brackets can be placed in different positions	Yes / No	
10	• Drawer concept allows for	o Easy access to splicing tray	Yes / No	
		o Easy access to back side of connector	Yes / No	
		• Trays with hinges(book type) which allows facilitates easy fiber management and greater access during installation and rework	Yes / No	
		• Fiber guides, radius controls & secure tie downs provided	Yes / No	
11	Dimensions	Width- 450 mm & Depth - 280 mm , Height – 44 mm	Yes / No	
12	Color	RAL 7035 / Black	Yes / No	

11.11 SC to SC Patch Cord

S. No.	Specifications	Requirement	Compliance	Deviation
1	Make and Type	SC to SC Duplex Fiber Optic Patch Cord 3 Mtr,9/125 Micron	Yes / No	
2	Cable Sheath	LSZH	Yes / No	
3	Cable Diameter	2.5 mm twin zip	Yes / No	
4	Ferrule	Ceramic	Yes / No	
5	Buffer	.9 mm easy strip	Yes / No	
6	Insertion Loss	MAX .3 db Typical .15 db	Yes / No	
7	Return Loss	> 45 db	Yes / No	
8	Temperature Range	-25 Deg. C +70 Deg. C	Yes / No	
9	ROHS	ROHS/ELV Compliant	Yes / No	

11.12 SC to LC Patch Cord

S. No.	Specifications	Requirement	Compliance	Deviation
1	Make and Type–	SC to LC Duplex Fiber Optic Patch Cords 3m 9/ 125 micron	Yes / No	
2	Cable Sheath	LSZH	Yes / No	
3	Cable Diameter	1.8 mm mini twin zip	Yes / No	
4	Ferrule	Ceramic	Yes / No	
5	Buffer	.6 mm	Yes / No	
6	Return Loss	> 45 db	Yes / No	
7	Insertion Loss	.1 db Typical Max .3 db	Yes / No	
8	ROHS	ROHS/ELV Compliant	Yes / No	

11.13 SC to SC Patch Cord MM

S. No.	Specifications	Requirement	Compliance	Deviation
1	Make and Type	SC to SC Duplex Fiber Optic Patch Cord 3 Mtr,50/125 Micron OM2/OM3	Yes / No	
2	Cable Sheath	LSZH	Yes / No	
3	Cable Diameter	2.5 mm twin zip	Yes / No	
4	Ferrule	Ceramic	Yes / No	
5	Buffer	.9 mm easy strip	Yes / No	
6	Insertion Loss	MAX .3 db	Yes / No	
7	Return Loss	> 20 db	Yes / No	
8	Temperature Range	Minus -10 Degree C to +60 Degree C	Yes / No	
9	ROHS	ROHS/ELV Compliant	Yes / No	

11.14 SC to LC Patch Cord MM

S. No.	Specifications	Requirement	Compliance	Deviation
1	Make and Type	SC to LC Duplex Fiber Optic Patch Cord 3 Mtr 50/125 Micron OM2/OM3	Yes / No	
2	Cable Sheath	LSZH	Yes / No	
3	Cable Diameter	1.8 mm twin zip	Yes / No	
4	Ferrule	Ceramic	Yes / No	
5	Buffer	.6 mm easy strip	Yes / No	
6	Insertion Loss	MAX .3 db	Yes / No	
7	Return Loss	> 20 db	Yes / No	
8	Temperature Range	Minus -10 Degree C to +60 Degree C	Yes / No	
9	ROHS	ROHS/ELV Compliant	Yes / No	

12. Cabinets and Racks:

a. 42 U Floor mounted free Standing cabinets:

- 42 U Floor mounted cabinets having dimensions H 2013 x W 800 xD 800 mm with reversible front door made of safety glass of thickness 4 mm supplied with cable manager.
- Removable side panels fitted with key lock and solid rear door fitted with key lock.
- Integrated base with ventilated plate at the front
- Solid cable entry plate at the top & bottom
- IP 20 as per IEC 60529 with solid sealing.
- IK 08 as per NF EN 62262 and IEC 62262
- RAL 9002

b. 36 U free standing floor Mounted cabinets:

- 36 U Floor mounted cabinets H1747mm x W 800 mm x D800 mm with reversible front door made of safety glass of thickness 4 mm supplied with cable manager.
- Removable side panels fitted with key lock and solid rear door fitted with key lock.
- Integrated base with ventilated plate at the front
- Solid cable entry plate at the top & bottom
- IP 20 as per IEC 60529 with solid sealing.
- IK 08 as per NF EN 62262 and IEC 62262
- RAL 9002

D. UPS SYSTEM

1. GENERAL REQUIREMENTS

1.1 The scope of work for supply and installation of UPS system shall include design manufacture, supply, installation, testing and commissioning of all related equipments together with all accessories and auxiliaries as per specifications.

The system shall be fully operational and shall comply to the specified codes and standards.

The contractor shall be responsible for providing all materials, equipments and engineering services specified or which are required to fulfill the intent of ensuring reliability of the total work covered under these specifications within his quoted price.

1.2 Supply and installation of the UPS system covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable Standards.

a.	IEEE Standard 446-1987	:	Emergency and standby power systems.
b.	IEEE Standard 450-1975	:	cable termination on UPS
c.	IEEE Paper 4-177	:	Some discharge characteristics of lead acid batteries.
d.	IEC 60140-3	:	UPS Performance
e.	IEC 60140-2	:	Electro Magnetic Compatibility
f.	IEC 60140-1	:	Safety
g.	ANSI C 37.90a, IEEE Standard 472	:	Surge withstand capability test.
h.	ANSI C 34.2	:	Practices and requirements for semiconductor power rectifiers.
i.	ANSI C 37.90	:	Relays and relay system associated with electrical power apparatus.
j.	NEMA PE-1-1983	:	Uninterrupted Power System Standard
k.	IS 2208 & IS 9224 (Part 1 & 2) (I.E.C. 269)	:	Cartridge fuses for voltages upto and including 650 V
l.	IS 9224 (Part - 4)	:	Fuses for protection of semiconductors.
m.	BS 2709 (I.E.C 119)	:	The Electrical Performance of Semiconductor Rectifiers. (Metal Rectifiers)
n.	BS 4417 (I.E.C 146)	:	Semi-conductor Rectifier Equipments.
o.	IS 13947 : 1993	:	Specification for Low voltage Switchgear & Control gear
p.	IS 3961(Part 2) :1967	:	Recommended current rating for PVC insulated Cables
q.	IS 1652 & IS 1652	:	Lead-acid stationary cells and batteries.
r.	BD 9720	:	Custom-built transformers and inductors of assessed quality.

s.	IP20	:	Degree of protection.
t.	IEC	:	Semi Conductor Convertor Standards.
u.	JEC	:	Standard of the Japanese Electro technical committee
v.	JIS	:	Japanese Industrial Standard.
w.	JEM	:	The standard of the Japan Electrical Manufactures Association.
x.	ISO 9001 approved		

1.3 The contractor shall submit his offer for UPS systems as indicated in the tender document.

1.4 All components of the UPS equipment shall have Surge Withstand Capability (SWC) to meet the requirements of ANSI C62.41-1980. ANSI C 37.90a, IEEE Standard 472-1974.

1.5 All components of UPS system shall withstand short circuit current without any damage.

1.6 Following general requirements shall be met for ensuring proper circuit protection.

a. Fuses shall not be larger than 125% of the transformer primary circuit current where the secondary circuit fuse protection has not been provided.

Where the secondary fuses are sized not larger than 125% of the secondary current of the transformer, fuses shall not be required in the primary circuit, provided the primary feeder fuses are not larger than 250% of the transformer primary current.

b. All the neutral conductors in three phase UPS systems shall be sized equal to at least 150% of the maximum phase current. In addition, all the isolators and circuit breakers used in three phase UPS system shall also rated such that the neutral poles shall take at least 150% of the maximum phase current.

c. All control shall be designed and positioned such that possibilities of inadvertent or accidental operations are eliminated.

d. All UPS system cabinets, frames and power equipment shall be double earthed.

1.7 The UPS design shall ensure that a single component/ device failure shall not result in failure of the entire UPS system. The design of UPS System shall be modular to permit easy maintenance.

1.8 The various overload capacities of inverters, static switch, step down transformer/voltage stabilizer as specified herein are the minimum requirements. However, if the Contractor's offered system has better overload capacities for the above devices, the same shall be highlighted by the Bidder in his bid.

1.9 The UPS system offered by the contractor shall be suitable for operating continuously at the rated capacity indicated in tender with in ambient temperature 0-40°C and relative humidity of 0 to 95%. Also the UPS system shall be suitable for operation as per full rating upto 1000 meters above sea level without derating. The Contractor shall furnish a certificate towards compliance on ambient conditions permissible.

1.10 The UPS system to be supplied by the contractor shall have maximum humming noise level of 69 DB one meter away from the UPS cabinets.

1.11 Suppression of Radio Interference shall be provided to meet statutory requirements.

1.12 Detailed literature should be provided showing Quality Assurance Procedure adhered to.

1.13 The contractor shall submit detailed item by item compliance statement along with the tender.

2. FUNCTIONAL REQUIREMENTS

2.1 Contractor shall furnish On-Line Uninterruptible Power Supply (UPS) system of continuous duty of the ratings mentioned in Bill of Quantities. Each UPS shall give regulated filtered & uninterruptible power supply as described in the specifications.

2.2 Contractor shall note that the KVA ratings of the UPS systems shall be guaranteed at 40°C ambient temperature. In case contractor's standard UPS KVA rating are based at a lower temperature, the contractor must consider a derating factor of at least 1.5% per deg.C for arriving at the specified UPS capacity at 40°C ambient temperature.

2.3 In case the calculated /specified UPS capacity is not the same as one of the standard KVA ratings of the UPS manufacturer, the next higher standard KVA rating shall be selected. UPS of non-standard rating shall not be acceptable.

2.4 UPS system supplied by the contractor shall be the latest state of the art technology system fully digitalized using microprocessor controlled full wave rectification and IGBT inverter.

2.5 Batteries shall be valve regulated lead acid specially ment for UPS application.

2.6 Monitoring and control system shall also be state of the art technology LCD touch panel type providing all relevant data described in this document.

2.7 The monitoring and control system shall be capable of RS485 with MODBUS protocol input software for connecting to customer's computer system for data display and monitoring.

2.8 All necessary components required for protecting UPS equipment and connected inputs and outputs shall be furnished by the Contractor as an integral part of the UPS system.

2.9 The control logic power supply shall have redundant power supply AC input and the system battery as power sources.

2.10 The UPS systems shall include but not be limited to the following equipment :

a. UPS system including 100% capacity float-cum-boost charger with 100% sealed valve regulated lead acid batteries with guaranteed battery life of 5 years.

b. Suitable factory built battery cabinet for housing the batteries, including terminal isolator / breaker and power disconnect device. The enclosure shall conform to IP 20 as minimum.

c. All cables, connectors, accessories like trunking, cable trays, conduits etc. required for connection between battery and the UPS unit.

3. STATIC CONVERTER

3.1 General

The static converter (rectifier) shall be a multi-functional converter providing functions of power conversion, battery charging and shall have the additional functions of input power factor improvement and current harmonics reduction. The converter equipment shall include all necessary control circuitry and device to conform requirements like voltage regulation, current limiting, wave shaping, transient recovery, automatic synchronization etc. as given below.

The converter shall be a solid state static PWM converter utilizing utilize Insulated Gate Bipolar Transistors (IGBT) or Intelligent Power Module (IPM) transistors and shall include intelligent features like the drive circuitry, over current protection, over temperature protection, control power failure protection and short circuit protection.

The IGBT / IPM transistors shall enable high speed switching at 6 KHz thus reducing the heat dissipation in the UPS and thereby providing high efficiency.

The PWM converter shall utilize the above and achieve unity power factor and reduce input current harmonics as given earlier and thus improve the overall power factor of the converter achieving input KVA savings.

During any step inverter load change (0-100%) the converter shall only supply 100% current to the inverter. The battery shall not be cycled at any time during this step load changes.

3.2 Input Current Limit

The converter logic shall provide input current limiting by limiting the DC output current. Two (2) line-side current transformers shall be employed as a means of sensing the current amplitude. The converter logic shall also be capable of providing auxiliary current limited when the logic is signaled to do so via an external dry contact closure (e.g. UPS fed from generator). The converter shall be capable of supplying overload current in excess to the full load rating. It shall also have sufficient capacity to provide power to a fully loaded inverter while simultaneously recharging the system battery to 95% of full capacity within 10 times the discharge time. The DC output current limit values shall be as follows:

- Rectifier output current (maximum) 100%.
- Rectifier output current (aux.) 25% - 100% variable.

  Note : 100% current shall be under the battery recharging mode.

3.3 Battery Charge Current Limited

The converter logic shall provide current limiting function of battery charging to prevent the battery from damage. The following battery current limit and protection shall be provided.

- Battery charge current limit 10% of battery Ah rate.
- Over-current protection at 120% of above item.

3.4 Voltage Regulation

The rectifier / charger output voltage including variation effects of input voltage does not deviate by more than +/- 1% of the nominal output voltage, due to the following conditions:

- Form 0 to 100% loading.
- Rectifier input variations of voltage and frequency within the limitations set in Section 3.10.
- Environmental condition variations within the limitations set in Section 3.10.

3.5 Automatic Input Current Walk-in

The converter logic shall employ circuitry to allow a delayed and timed ramping of input current. Subsequent to energizing the converter input, the ramping of current shall be delayed by a maximum of 3 seconds. Upon starting the walk-in process, the ramping of current is timed to assume the load gradually within 1 through 60 seconds (every 1 second selectable).

3.6 Input Overload Protection

The A/C input fuses shall be provided at the converter input as a means of overload protection.

The AC maximum current shall be controlled by the Converter.

3.7 Equalizing Charge Timer

The UPS logic shall provide an electronic automatic equalize charge timer which shall be selectable 24 hours for Lead Acid type or 8 hour for Alkaline type batteries. The timer circuit, once activated shall provide a high rate equalizing charge voltage to the system battery for the selected time. The circuit shall also be capable of manual activation via the LCD touch panel mounted on the front door. The level of equalizing voltage shall be equal to that stated by the battery manufacturer. Upon completion of the timer count, the converter output voltage shall automatically return to the specified float voltage.

3.8 Step Load Change

During any step inverter load change (0-100%), only the converter shall supply 100% current to the inverter. The batteries SHALL NOT be cycled at any time during these step load changes.

3.9 Input Voltage

The converter shall be fed from the Normal Power Supply source.

3.10 The converter shall meet the following specifications in addition to other requirements stated herein :

Nominal Voltage	:	415V, 3 Phase, 3 Wire
Voltage Range.	:	+ 15% / - 30% AC
Normal Frequency	:	50 Hz $\pm$ 8 %
Frequency Range	:	$\pm$ 8% ($\pm$ 4 Hz)
Input Power Factor	:	0.9 lagging or more at full load (PF improvement)
Input Harmonic Current THD	:	3% typical at 100% load 6% maximum at 50% load
Duty	:	Continuous at 40 deg.C
Cooling	:	Forced cooling using fans with thermal relays using a latched cut out for re-setting as protection for cooling fans. Each individual fan shall have its own thermal relay.
Ambient operating temperature range	:	Operating - 0 to 40 deg.C maximum. Storage & Transport -20°C to 70°C
Operating Relative Humidity	:	0-95% non-condensing.
Operating Altitude	:	Altitude Operating: to 3,000 ft. (1,000 meters) above Mean Sea Level. Derated for higher altitude applications.

		Storage/Transport: to 40,000 ft. (12 200 meters) above Mean Sea Level
Magnetized sub-cycle in rush current	:	Typically 8 times normal full load current
Converter Walk-in time	:	1 through 60 seconds (every 1 second selectable, (0 to 100% rated load)
Input	:	Suitable terminals shall be provided for termination of cables from the AC distribution board.

4. STATIC INVERTER

4.1 General

The static inverter shall be of solid state type using proven Pulse Width Modulation (PWM) technique. The inverter equipment shall include all necessary control circuitry and devices to conform requirements like voltage regulation, current limiting, wave shaping, transient recovery, automatic synchronization etc. as given below.

The inverter shall utilize Insulated Gate Bipolar Transistors (IGBT) or Intelligent Power Module (IPM) Transistors which shall provide intelligent features like the drive circuitry, over-current protection, over temperature protection, control power failure protection and short circuit protection.

The IGBT / IPM transistors shall enable high speed switching of 6 Khz thus reducing the heat dissipation in the UPS and thereby providing high efficiency.

The UPS shall utilize both Voltage and Current feedback control circuits so that the inverter shall act not only as a constant voltage source but also as a load required current source. This shall enable the inverter to quickly adapt to the changing load current value and wave shape.

4.2 Voltage Regulation

The inverter output voltage shall not deviate by more than + 1% RMS due to the following steady state conditions :

Form 0 to 100% loading
Inverter DC input voltage varies from maximum to minimum.
Environmental conditions variations within the limitations set in the section 4.8.

4.3 Frequency Control

The inverter output frequency shall be controlled by an oscillator internal to the UPS module logic. It shall be capable of synchronizing to an external reference (e.g. the bypass source or another UPS module) or operating asynchronously. The oscillator shall maintain synchronization with the external reference within the limitations set hereunder. The inverter shall operate on self run mode without synchronism if the bypass frequency exceeds the set value. The oscillator, while running asynchronously, shall maintain the frequency as 50 Hz $\pm$ 0.01% (or + 0.005 Hz). Automatic adjustment of phase relationship between inverter output and standby bypass source shall be gradual at a controlled slew rate which shall be adjustable at the rate of 0.5, 1.0, 2.0, 3.0 Hz / second. (Default 2.0 Hz / second).

The inverter output frequency shall not vary during steady state or transient operation due to the following conditions:

a. From 0 to 100% loading.

b. Inverter DC input varies from maximum to minimum.

c. Environmental condition variations within the limitations set in section 4.8.

4.4 Output Voltage Harmonic Distortion

The inverter output shall limit the amount of harmonic content to the values stated in section 4.9. The use of excessive or additional filtering shall not be required to limit the harmonic content thus maintaining a high level of efficiency, reliability and original equipment footprint.

4.5 Output Overload Capability

The inverter output shall be capable of providing an overload current while maintaining rated output voltage to the values stated in section 4.8. An LED indicator shall be located on the control panel to identify this condition. If the time limit associated with the overload condition expires or the overload is in excess of the set current amplitude, the load shall be transferred to the bypass source without interruption.

4.6 Inverter Current Limit

The inverter output shall be limited to 150% of rated load current. The two sensing locations shall operate separately and independently thus providing redundancy and, in the event of a failure, preventing unnecessary damage to power transistor components / fuses. Load current above 150% shall cause an immediate transfer of the load to the bypass source for fault clearing.

4.7 Inverter Overload Protection

The AC output from the inverter shall utilize fuses for overload protection. The inverter shall utilize a contactor to isolate the inverter output from the critical bus.

The inverter fuses shall be the fast acting semiconductor type.

The inverter output isolation contactor shall be located in the UPS module and shall be controlled by the internal UPS module system logic.

4.8 The inverter shall meet the following specifications in addition to other requirements stated herein:

Voltage Input	:	Three Phase UPS : Nominal 360 V DC (Range 290 V to 414 V DC to maximum DC bus voltage during charging the batteries).
Nominal Voltage Output	:	415 V $\pm$ 1% AC 3 Phase, 4 Wire
Inverter Capacity	:	
Voltage Regulation	:	
a. For 0 to 100% loading	:	$<\pm$ 1%
b. Inverter DC input voltage vary from maximum to minimum	:	$<\pm$ 1%
c. Environmental conditions given below	:	$<\pm$ 1%
Transient Voltage Regulation	:	
a. AT 100% step load change.	:	$<\pm$ 3%
b. At loss or return of AC input.	:	$<\pm$ 1%
c. At load transfer from bypass to inverter.	:	$<\pm$ 3%
Time to recover from transient to normal voltage.	:	10 milli seconds
Wave form		
a. Normal frequency	:	50 Hz
b. Frequency regulation for all conditions of input supplies, loads and temperature occurring simultaneously or in any combination (automatically controlled).	:	$\pm$ 0.05%

c.	Synchronization limits for synchronism between the inverter and standby AC source.	:	49 Hz to 51 Hz.
d.	Field adjustment range for above	:	50 $\pm$ 0.25 Hz to 50 $\pm$ 1.5 Hz
4.9	**Total voltage harmonic distortion**	:	< 2% THD for 100% linear load < 4% THD for 100% non-linear load
	Duty	:	Continuous
	Cooling	:	Forced cooling using fans.
	Ambient operating temperature range	:	0 to 44^0C maximum continuous.
	Operating relative humidity	:	0-95% non-condensing.
	Operating altitude.	:	Sea level to 1000 meters.
	Output	:	Suitable terminals are provided for termination of cables for connecting inverter output to AC distribution board.

4.10 Built-in Isolation Transformer

This shall provide neutral separation which shall mean that output neutral will be independent of incoming neutral, hence critical load shall be isolated from the problems like incoming neutral open or, short or, variations in neutral to earth voltage due to sudden loading in neighboring installation.

4.11 Reverse Phase Sequence Protection

In the event of Phase sequence reversal at the input, UPS system shall continue to work on the main power supply, or UPS systems shall go into battery mode, and shall not trip the UPS system.

4.12 Over all efficiency (AC to AC)

94% at 100% load
92% at 75% load
87% at 25 % load

5. UPS BATTERY SYSTEM

a. The UPS system shall, as an integral part, provide battery system for backup time as specified in the Schedule (Full Load) standby capacity.

b. The latest state of the art Valve Regulated Sealed Maintenance Free Lead Acid Batteries shall be used with a 20 hours discharge rating.

c. The battery system shall be sized to provide back up time as specified in the schedule of quantity when the UPS is supplying 100% rated load at 0.8 load power factor.

d. An ageing factor of 15% shall be applied to the capacity arrived at, to allow for compensation against capacity loss during float operation.

e. The battery system design shall be provided with necessary devices to prevent deep discharge beyond recommended limits to prevent the batteries discharging beyond end cell voltage specified by the battery maker. The connections from battery to battery shall be by using copper bus bar strips and the entire battery system shall be used in IP20 steel cabinet enclosure and shall be similar to the UPS enclosure.

f. All batteries shall be clearly identified and identification numbers marked on the batteries and a schematic diagram along with the complete calculations, including manufacturers supporting curves, shall be submitted with the tender.

g. The UPS shall have a properly rated and sized circuit breaker to isolate it from the battery.

6. OPERATION

a. Under normal operation, the UPS load will be fed from the Inverter with the bypass switch inhibited. The Converter, apart from providing DC power to the Inverter, also charges the battery under the float charge mode. The battery charge system shall have float charge, equalizing charge and recovery charge modes, to replenish the batteries self-discharging part while the battery is fully charged, equalizing the battery cell voltage to a constant value forcibly, and recharging the battery system to the required values when the batteries have been used, respectively.

b. The Inverter shall constantly monitor the AC source frequency and shall be in synchronisation with the AC input source till the frequency of the AC input source is within synchronising limit and if the frequency of the standby source exceeds the synchronising limit the Inverter will work on its own internal oscillator maintaining an output frequency of 50 Hz +/- 0.01% under all conditions of load. When the Inverter operates on its internal oscillator, it shall continuously monitor the frequency of the input source and when the input source frequency returns to within synchronisation limit, the Inverter shall automatically synchronise itself with the input A/C source frequency and use it as a signal for Inverter output frequency control.

c. Battery Operation:

   i. When the A/C input voltage drops below specified limits or in case of a power failure the Inverter continues to supply AC power of constant voltage and constant frequency utilising the battery system as a power source until the input voltage returns to normal requirement. When the power supply is resumed or the input voltage returns to limits, the Converter shall automatically start and the load fed for normal operation status.

   ii. If the power failure continues beyond battery backup time or the battery voltage drops to the final discharge voltage, the Inverter should automatically stop and at the same time transferring the load to the bypass circuit. On resumption of power supply, the Converter shall automatically re-start the operations and charge the batteries whereas the Inverter should inhibit automatic start and should be started manually.

d. Bypass Operation:

   When power is supplied from the Inverter in synchronization with the bypass, it shall accomplish the following:

   i. When the UPS output current reaches overload status it shall automatically transfer the load to bypass circuit with no interruption and when the overload status is cleared it automatically re-transfers the load to Inverter.

   ii. When the battery final discharge condition is reached, the load shall automatically be transferred to the bypass circuit without interruption.

   iii. In case of failure of the UPS, the load shall be automatically transferred to the bypass circuit with no interruption and when the failure is cleared, re-transfer the load to the Inverter shall be done manually.

   iv. There should be provision made in the system to prevent, when necessary, asynchronous transfer.

   v. When the UPS goes on bypass mode in any of the conditions described above and if at that time there is no bypass power supply available due to power failure, the UPS shall remain in standby mode and as soon as the bypass power supply is available will transfer the load to bypass.

   vi. A maintenance bypass transfer switch shall be provided with lock and key arrangement and should be manually done by authorised personnel only.

7. CONTROL AND MONITORING

a. The UPS shall utilize state of the art full DDC control software driven Control and Monitoring System.

b. It shall be provided with LED displays.

Metering should display the following parameters on the control panel

i. Input AC voltage line-to-line and line-to-neutral for each phase

ii. Input AC current for each phase

iii. Input frequency

iv. Battery voltage

v. Battery charge/discharge current

vi. Output AC voltage line-to-line and line-to-neutral for each phase

vii. Output AC current for each phase

viii. Output frequency

ix. Percent of rated load being supplied by the UPS

x. Battery time left during battery operation.

xi. Bypass power available.

Following alarm messages to be displayed at the control panel:

i. Input power out of tolerance

ii. Input phase rotation incorrect

iii. Incorrect input frequency

iv. Charger in reduced current mode

v. Battery Charger Problem

vi. Battery failed test

vii. Low battery warning (adjustable 1 to 99 minutes)

viii. Low battery shutdown

ix. DC bus overvoltage

x. Bypass frequency out of range

xi. Load transferred to bypass

xii. Excessive retransfers attempted

xiii. Static switch failure

xiv. UPS output not synchronized to input power

xv. Input power single phased

xvi. Input voltage sensor failed

xvii. Inverter leg over current in X-phase

xviii. Output under-voltage

xix. Output over-voltage

xx. Output over-current

xxi. System output overloaded

xxii. Load transferred to bypass due to overload

xxiii. Overload shutdown

xxiv. Control Error

xxv. Critical power supply failure

xxvi. Load transferred due to internal protection

xxvii. External shutdown (remote EPO activated)

xxviii. Fan failure

xxix. Over temperature shutdown impending

xxx. Over temperature shutdown.

xxxi. Lamp test.

c. The UPS logic should provide one set of normally open dry contact / relay output to allow interfacing of UPS operating status to an external system and should be capable of providing, as a minimum, 10 numbers status and, should the UPS manufacturer's standard product does not provide such software, the bidder must add additional equipment and cost for the same.

d. The UPS shall also have an RS485 port with MODBUS interface card if required for interfacing to BAS system or client's centralized computer network.

e. LCD touch panel (Optional)

i. The UPS shall be provided with a operator friendly large scale LCD touch panel.

ii. The LCD touch panel shall also include graphic measurement display, operational procedures of each activity, fault status display and also have capability to record at least 200 faults.

iii. The touch screen panel shall clearly define specified areas for operational function, execution and message display.

iv. It should be possible to operate the entire UPS system and its components and obtain all measurements and data through the touch screen operation. The measurement software should provide capability to measure phase voltage, current in each phase, frequency, power factor, available battery time etc.

v. Under all operating conditions, the system software should have capability for displaying fault alarm automatically. The tenderer should describe in detail the faults that would be displayed under this mode.

8. UPS TESTING

a. The Contractor shall perform the following tests, as a minimum, at site prior to handing over, to confirm the functional and the performance specification of the UPS as specified. All required test

equipment like Digital Oscilloscope, Voltage Regulator and Measurement Meters etc. shall be the responsibility of the Contractor without any additional cost.

b. The Contractor shall demonstrate as a minimum the following features on site by providing all required test equipment, such as power factor improvement, input current THD, output voltage THD, output frequency and all other performance monitoring requirements detailed before as required by the Owner.

SPECIFICATION FOR UPS SYSTEM

RATING OF UPS	:	AS PER BOQ
TYPE	:	ON LINE
INPUT:		
VOLTAGE	:	415V ± 15%
FREQUENCY	:	50Hz ± 10%
OUTPUT:		
VOLTAGE	:	415V ±1% (True sine wave)
OVER LOAD CAPACITY	:	110% for 20 Minutes 125% for 05 Minutes 150% for 01 Minutes
FREQUENCY	:	50Hz ± 0.05
DC CHARACTERSTICS	:	DC ripple with battery connected = ± 1 %
OPERATING TEMPERATURE	:	40 Degree centigrade maximum 95% Humidity
CABLE ENTRY	:	Cable entry provision to be given for bottom entry.
BYPASS	:	Manual bypass to be provided.
PROTECTIONS & INDICATIONS	:	Standard protections and indications to be provided as required. No Filter.
THD DATA OUTPUT	:	Harmonic distortion shall be less than 20% on linear load 5% on non linear loads as per IEC.
CREST FACTOR	:	Crest Factor should be >3:1. UPS should be parallel upto six units without using any separate synchronization panel.
BATTERIES	:	Batteries to be sealed maintenance free complete with all the required mounting accessories.
BACKUP TIME	:	15 Minutes as per BOQ.
COOLING	:	Forced Air.
BATTERY CHARGING CURRENT	:	Vendor to specify.
BATTERY CAPACITY	:	To be indicated, Calculations to be furnished by the tenderer. Specify VAH.
DIMENSIONS OF UPS & BATTERY	:	To be filled by the tenderer
OVERALL SPACE FOR MOUNTING ALONG WITH ROOM SIZE.	:	To be filled by the tenderer.
EARTHING	:	To be filled by the tenderer.

E. AUTOMATION

SCHEDULES OF TECHNICAL PARTICULARS

(To be submitted on the OEM letter head)

SL NO	Minimum Specifications	Compliance (Y/N)
1.0	**Analog (0-10v) Dimmer**	
1.1	Offerd Make & Model	
1.2	The unit should be of 4 channels to dim 0-10v drivers	
1.3	Each Channel should be able to support Maximum , 5 Amps @ 120 to 240 Volts AC, 1050 Watts @ 230 Volts AC; 0.5 HP; 16 Amps Resistive	
1.4	The Module should be able to support Total 20 Amps @ 120 to 240 Volts AC, 50/60 Hz; 4600 Watts @ 230 Volts AC.	
1.5	The module Should have 4x isolated dimming control outputs along with 4x Isolated Class 1 SPST relay switch	
1.6	The module should have Voltage Control Range: 0 to 10 Volts DC; Maximum Sink Current: 60mA per channel; Output Resolution: 1024 levels (10 bit)	
1.7	The Module Should have override input for external contact closure to momentarily override level	
1.8	The Module should have unique ID for each device to be addressable and able to communicate with control system via RJ45/RS-485/similar communication.	
1.9	Should be CE, UL, CEC Title 24 2013 Compliant.	
2.0	Should be from same OEM as Main control system.	
2.0	**8 Channel Relay**	
2.1	Offerd Make & Model	
2.2	The Unit Should support Maximum Per Channel 10A incandescent @ 120 to 240VAC, 5A fluorescent @ 120 to 240VAC, 0.5 HP @ 120 to 240VAC, 5A at 30VDC, 16A Resistive.	
2.3	The Unit Should support Module Total 80A incandescent @ 120 to 240VAC, 40A fluorescent @ 120 to 240VAC.	
2.4	The Unit Should have 8x Isolated Class 1 SPST relay switch circuits with 10A incandescent, 5A fluorescent, 16A resistive, 0.5 HP @ 240VAC (per channel) Rating.	
2.5	The Unit Should have 8x port isolated inputs (Rated 12-24VDC), for momentary pushbuttons, each input will cause the associated relay to toggle on/off.	
2.6	The Module Should have override input for external contact closure to momentarily override level	
2.7	The Unit Should support standard DIN rail for installation and have unique ID for each device to be addressable and able to communicate with control system via RJ45/RS-485/similar communication.	
2.8	The Unit Should be CE, FCC Compliant.	
2.9	The Unit Should be from same OEM as Main control system.	
3.0	**Photosensor**	
3.1	Offerd Make & Model	
3.2	The unit should be for open- and closed-loop applications.	
3.3	The Unit Should be able to measure ambient light level from all light sources.	
3.4	The Unit Should be able to create 60° cone of coverage for open-loop and closed loop applications.	
3.5	The Unit Should support open-loop light sensitivity with three ranges: 3-300 fc, 30-3000 fc, and 60-6000 fc and Closed-loop light sensitivity ranging from 3-300 fc.	

3.6	The Unit Should have 0 to 10VDC analog control output	
3.7	The Unit Should be suitable for indoor, outdoor, and wet locations.	
3.8	The Unit Should be from same OEM as Main control system.	
	The Sensor Should have unique ID for each device to be addressable and able to communicate with control system via RJ45/RS-485/similar communication.	
3.9	The Unit Should be UL Compliant.	
4.0	**Occupancy Sensor**	
4.1	Offerd Make & Model	
4.2	The Sensor Should be able to cover 2000 Square feet and 360-degree coverage pattern.	
4.3	Sensor Technology : Passive infrared and ultrasonic (40 kHz)	
4.4	The Sensor Should be able to provides independent sensitivity adjustment for each sensor type for optimum performance in any space.	
4.5	The Sensor Should be built-in photosensor, to detects the amount of ambient light in the room.	
	The Sensor Should have unique ID for each device to be addressable and able to communicate with control system via RJ45/RS-485/similar communication.	
4.6	The Sensor Should be CE, FCC, UL Compliant.	
4.7	The Sensor Should be from same OEM as Main control system.	
5.0	**Wall Panel**	
5.1	Offerd Make & Model	
5.2	The Device Should be able to configure with 4 buttons to 10 Buttons.	
5.3	The Device Should be able to program for single tap, double-tap, or press-and-hold events	
5.4	The Device Should have provision for custom engraving from the same OEM.	
5.5	Each button should have individual LED indicator to show press/unpressed.	
5.6	The Device Should have 2x inputs for low voltage contact closure devices such as door switches and motion detectors.	
5.7	The Device Should have unique ID for each device to be addressable and able to communicate with control system via RJ45/RS-495/similar communication.	
5.8	The Device Should be CE, FCC, UL Compliant.	
5.9	The Device Should be from same OEM as Main control system.	
6.0	**Power Supply**	
6.1	Offerd Make & Model	
6.2	Line Power/Mains : 200 VA (2 Amps maximum) at 100-277 Volts AC, 50/60 Hz	
6.3	6nos. of 4-pin 3.5 mm detachable terminal blocks, paralleled; with power output ports & data pass-through;	
6.4	FUSE: 1nos. Of DC output fuse, T3.15AH; 5x20 mm, 250 Volts, 3.15 Amps, time-lag, ceramic cartridge	
6.5	Should be CE, FCC, UL Compliant.	
6.6	Light gray polycarbonate housing with polycarbonate label overlay, UL 94 V-0 rated, 35 mm DIN EN 60715 rail mount, DIN 43880 form factor for enclosures with 45 mm front panel cutout	
7.0	**Central processor**	
7.1	Offerd Make & Model	
7.2	Supply, Installation, Testing and commissioning of DIN rail mount AV Control System with control ports.	

7.3	The unit Should have Quad Core processor / multicore CPU / Ultra-Fast processor, for faster processing and advanced automated system requirements.	
7.4	The unit Should be able to control multiple rooms simultaneously, for future proof and backup purpose.	
7.5	The unit Should have network security protocols Active Directory® service authentication, 802.1X network access control, TLS, SSH and HTTPS to ensure IT policies compliance. And need to be configured and shown during installation.	
7.6	The unit Should be JITC/FIPS/NIAP certified.	
7.7	The unit Should have BACnet communication protocol, which allow integration with third-party building management systems (HVAC, security, and other systems) over Ethernet.	
7.8	The unit Should have minimum 1 GB SDRAM and minimum 8 GB flash memory	
7.9	The unit Should have minimum, 4x IR/serial, 2x Bidirectional RS-232, RS-422, 485 port, 8x I/O, 4x low voltage relay.	
7.10	The unit Should be TAA compliant / IC3S (Indian Common Criteria Certification) compliant / Common Criteria	
7.11	The unit Should have ethernet port with TCP/IP, UDP/IP, DHCP, SSL, SFTP (SSH File Transfer Protocol), IPv4, IPv6.	
7.12	Compliance: UL, CE, FCC, RoHS/WEEE. (Additional BIS to be shared if applicable).	
7.13	The unit Control processor must not require any internet connectivity for configuration, programming and running.	
8.0	**Network & Power Distribution Hub**	
8.1	Offerd Make & Model	
8.2	The unit should beof 3-segment configurable power distribution.	
8.3	The unit Should be able to support 75 Watts at each segment.	
8.4	The unit Should support standard DIN rail for installation.	
8.5	The unit Should be CE, FCC Compliant.	
8.6	The unit Should be from same OEM as Main control system.	
9.0	**Input/Output Module**	
9.1	Offerd Make & Model	
9.2	The Unit should be with 8 Vertiports I/O ports.	
9.3	The Unit Should be able to provide interface for 3rd-party sensors, detectors, contact closures, and alarms.	
9.4	The Unit Should support Digital input rated 0-24 Volts DC, input impedance 20k ohms, logic threshold 1.25 Volts DC, and Digital Output: 250 mA sink from maximum 24 Volts DC.	
9.5	The Unit Should support Analog Input rated for 0-10 Volts DC, protected to 24 Volts DC maximum, input impedance 20k ohms.	
9.6	The Unit Should support standard DIN rail for installation and have unique ID for each device to be addressable and able to communicate with control system via RJ45/RS-495/similar communication.	
9.7	The Unit Should be CE, UL, FCC Compliant.	
9.8	The Unit Should be from same OEM as Main control system.	
10.0	**Universal Dimmer**	
10.1	The unit should consist of 4 Channel Universal Dimmer for forward, reverse phase dimming with Auto load detection.	
10.2	The Unit Should support maximum Per Channel 5A @ 120 to 240VAC, 50/60 Hz, 1150 W @ 230VAC.	

10.3	The Unit Should support Module Total 10A @ 120 to 240VAC, 50/60 Hz, 2300 W @ 230VAC.	
10.4	The Unit Should support Forward Phase (leading edge), Reverse Phase (trailing edge) Electronic Low Voltage, Incandescent, Neon/Cold Cathode, Magnetic Low Voltage, Dimmable 2-Wire Fluorescent, and Non-Dim Lighting.	
10.5	The Unit Should have override input for external contact closure to momentarily override level.	
10.6	The Unit Should support standard DIN rail for installation and have unique ID for each device to be addressable and able to communicate with control system via RJ45/RS-485/similar communication.	
10.7	The Unit Should be CE, UL, FCC Compliant.	
10.8	Should be from same OEM as Main control system.	

E. ACESSES CONTROL

1. Description: The biometric reader and door controller ("reader/controller") shall be an IP-enabled device capable of scanning faces, RFID cards, QR, and mobile access cards, managing users, and controlling access.

Description	Required Parameters	Compliance (Yes/No)
Biometric	Face, RFID	
RF Option	125kHz EM & 13.56MHz MIFARE, MIFARE Plus, DESFire, DESFire EV1/EV2/EV3(1), FeliCa	
RF Read Range	EM/HID Prox/MIFARE/DESFire/HID iCLASS: 30 mm, FeliCa: 15 mm	
Mobile	NFC, BLE	
Barcode and QR code	Supported	
CPU	1.5GHz Quad Core	
Memory	32GB Flash + 4GB RAM	
Crypto Chip	Supported	
LCD Type	5.5" IPS color LCD	
LCD Resolution	720 x 1280 pixels	
Sound	16bit	
Operating Temperature	-20°C ~ 50°C (-4°F ~ 122°F)	
Operating Humidity	0%~80%, non-condensing	
Camera	2MP x 2EA (Visual, IR)	
Dimension (W x H x D)	82.5mm x 171mm x 23.4mm	
Ingress Protection (IP)	IP65	
Vandal Proof (IK)	IK06	
Certificates	CE, UKCA, KC, FCC, IC, RCM, BIS, SIG, RoHS, REACH, WEEE, MIC, TELEC	
Recognition Distance	0.6 ~ 1.0 m (23.6"~39")	
Recognition Height	1.4 ~ 1.9 m (55.1"~74.8")	
Matching Speed	Less than 0.3 sec	
Live Face Detection (Anti-Spoofing)	Supported	
Max. User	1,00,000	
Max. Credential (1:N)	Face: 50,000	
Max. Credential (1:1)	Face: 100,000 / Card: 100,000 / PIN: 100,000	
Max. Text Log	50,00,000	
Max. Image Log	50,000	
Ethernet	Supported (10/100/1000 Mbps, automatic MDI/MDI-X)	
RS-485	1ch Host or Slave (Selectable)	
Wiegand	1ch Input and 1ch Output	
TTL Input	3ch Inputs	
Relay	1 Relay	
Intercom	Supported	
USB	USB 2.0 (Host)	
Extended USB	Supported	
Tamper	Supported	
Power	DC 12 V 2.5A, DC 24 V 1.2A	

2. Standard to be followed by the Controller Cum Reader make:

a. IEEE 802.3 Ethernet Standards
b. FCC - Code of Federal Regulations, Part 15, Class A
c. Conformity for Europe (CE)—Equipment Directive (RED) 2014/53/EU
d. UK Conformity Assessed (UKCA)
e. Korea Certification (KC)
f. Industry Canada (IC)
g. Regulatory Compliance Mark (RCM)
h. Bluetooth SIG
i. Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) - (EC No. 1907/2006)
j. The Waste Electrical and Electronic Equipment (WEEE) - Directive 2012/19/EU
k. Ministry of Internal Affairs and Communications (MIC)
l. Telecom Engineering Centre (TELEC)
m. ANSI / IEC60529 – Degrees of Protection Provided by Enclosures
    i. International Electrotechnical Commission (IEC) – Ingress Protection Rating IP65
n. IEC 62262 - Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts IK06

3. Features

a. Anti-Spoofing technology.
b. Photo enrollment support:
    a. Upload a photo or drag & drop.
    b. Enrollment through an email link.
    c. Bulk enrollment through CSV import.
    d. Integration with DB/ERP/HEMS for photo importing.
c. Authentication with masked face.

Boom Barrier

Sr. No.	Tender Requirement	Product Specification	Compliance (Yes/No)
1	Type of barrier	Electromechanical automatic barrier	
2	Lane width support	2 to 6 meters	
3	Opening time	2.2 to 4 seconds	
4	Motor type	24V	
5	Switching power supply	No	
6	Type of use	Intensive/very intensive	
7	Movement control	Encoder	
8	Barrier configuration	2 separate springs	
9	Barrier body style	New design	
10	Top cover	Removable	
11	Control board position	Under the cap	
12	Manual unlock	Special key	
13	Operating temperature range	-20°C to +55°C	
14	Protection rating	IP54	
15	Boom type	ES + PS compatible	
16	Modular joint for boom	No	
17	Rubber + lights on boom	Yes, up to full boom length	
18	Boom lights	LED RG	
19	Integrated barrier lights	Ring light (optional)	

20	Articulated bar support	Yes	
21	Swing-off mechanism	No	

The product should adhere to the following standards & directives to ensure conformity:

a. EN60335-1:2012+A11:2014
b. EN60335-2-103:2015
c. EN62233:2008
d. EN61000-6-3:2007+A1:2007
e. EN61000-6-2:2005
f. EN300 220-2:2018
g. 2014/53/EU
h. 2011/65/EU
i. 2015/863/EU
j. 2017/2102/EU
k. 2006/42/CE

BOLLARDS

Sr. No.	Tender Requirement	Product Specification	Compliance (Yes/No)
1	Type	Automatic high-security hydraulic bollard	
2	Certification	PAS68:2010 7500/50/N2, ASTM2656 M30 (DoS/DoD K4)	
3	Tube dimensions	Ø273 mm x H800 mm ±3 mm, thickness 10 mm (Fe 360 / S235 JR)	
4	Buried structure	Ø354 mm x H1060 mm (excludes pump)	
5	Foundation	Concrete	
6	Excavation pit	1200 x 1200 x 1400 mm	
7	Break-in resistance	667,000 J (*)	
8	Impact resistance	40,000 J	
9	Coating & Finish	Cataphoresis + RAL7031 (other colours optional)	
10	Visibility enhancement	Reflective film H=100 mm	
11	Flange material	Cast iron, cataphoresis treated, black	
12	Top cover material	Aluminium, cataphoresis black	
13	Actuation	Hydraulic with biodegradable oil	
14	Operating temperature	-40°C to +60°C	
15	Operating humidity	Up to 100%	
16	IP rating	IP67	
17	Manual override	STD: bollard drops on power loss; SCT: stays up with mechanical key release	

18	Weight	Net: 189 kg, Gross: 197 kg	
19	Rise/Lowering time	Rise: ~6.8 s, Lower: ~4.1 s	
20	Power supply	1-phase 230 Vac ±10%, 50–60 Hz (115V optional)	
21	Max power consumption	0.50 kW per bollard	
22	Idle power consumption	28 W	
23	Control unit	Supported	
24	Control unit IP rating	IP54	
25	Control unit temperature range	-40°C to +60°C	
26	Control unit humidity tolerance	Up to 95%, non-condensing	
27	Communication & control interfaces	Digital input, Radio (receiver incl.), RS485/TCP-IP (optional)	
28	Signaling	High-intensity LEDs + buzzer (optional)	
29	Sensors	Position sensors, Obstacle, Overpressure, Anti-tamper (optional)	
30	Multiple bollard operation	Up to 4 per control unit, parallel wiring possible	

The product should adhere to the following standards & directives to ensure conformity:

a. 2004/108/CEE

b. 93/68/CEE

c. 2006/95/CEE

d. 93/68/CEE

e. EN55014-1, EN55014-2
f. N60335-1 (2002)

Advanced Intelligent 4-Door Controller for Versatile Multi-Functional Use

1. **DESCRIPTION:** The intelligent door controller which provides the advantage of a biometric-enabled security over a centralized access control system. This controller provides centralized biometric template management and versatile interfaces with the completed set of reader technologies including RS-485(OSDP) and Wigand.

Description	Required Parameters	Compliance (Yes/No)
Max. User	10	
Max. Credential (1:N)	1,00,000	
Max. Credential (1:1)	5,00,000	
Max. Text Log	5000000	
Max. Image Log	Not supported	
Users (1:1) * Based on one face enrollment per user	30,000	
Users (1:N) * Based on one face enrollment per user	4,000	
CPU	1.4 GHz Octa Core	
Memory	8GB Flash + 1GB RAM	
LCD Type	Not supported	

LED	Multi-color	
Sound	Not supported	
Operating Temperature	0°C ~ 50°C (32°F ~ 122°F)	
Storage Temperature	-40°C ~ 70°C (-40°F ~ 158°F)	
Operating Humidity	0% ~ 80%, non-condensing	
Storage Humidity	0% ~ 95%, non-condensing	
Weight	415 g	
Dimension (WxHxD, mm)	150 x 214 x 21	
Certificates	CE, KC, RoHS, REACH, WEEE, UL 294 Compliant	
Wi-Fi	Not supported	
Ethernet	10/100 Mbps, auto MDI/MDI-X	
RS-485	5 ch	
Wiegand	4 ch	
Relay	4 relays	
USB	Not supported	
SD Card	Not supported	
PoE	Not supported	
Intercom	Not supported	
RS-485 Communication Protocol	OSDP V2 Compliant	
Supervised Input	8 ch(TTL input selectable)	
TTL Output	8 ch	
AUX Input	2 ch(AC POWER FAIL, TAMPER)	
Power	DC 12 V	
Max. Slave Devices (RS-485)	Max. 64 devices (Max. 31 devices per port)	
Max. Wiegand Devices	Max. 132 devices (with Additional Slave Device Only)	

2. <u>Standard to be followed by the controller make:</u>

1. IEEE 802.3 Ethernet Standards
2. FCC - Code of Federal Regulations, Part 15, Class A
3. Conformity for Europe (CE)
4. ETL Listed to UL 294
5. Korea Certification (KC)
6. Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) - (EC No. 1907/2006)
7. The Waste Electrical and Electronic Equipment (WEEE) - Directive 2012/19/EU
8. UK Conformity Assessed (UKCA)
9. Regulatory Compliance Mark (RCM)

3. <u>Features:</u>

1. Full-featured intelligent door controller with fingerprint matching
2. High performance matching - Max. 400,000 match/sec
3. Store up to 500,000 users, 500,000 RFID cards, and 5,000,000 event logs
4. Controls up to 132 access points with door module of same make.
5. Elevator control with output module of same make.
6. OSDP V2 compliant
7. Built-in RS-485 terminations
8. Multi-port interfaces for fingerprint/RFID readers, sensors, locks, alarm devices - TCP/IP, RS-485(OSDP), Wiegand, Relay, Supervised Input, TTL, Aux
9. Easy Installation and Management with same make setup Manager

Access Control Software Technical Specifications:

1. **General Overview:** The Access Control Management Software is a comprehensive security and access control platform that offers flexible and scalable solutions for managing biometric devices, access points, and personnel data. The software should support both web-based and server-based configurations, allowing for easy integration and remote management of access control systems.

    1. **Summary**: Section includes a web-based security platform requirement.

    2. **Product**: A web-based security platform, capable of managing access control system, managing time attendance system, recording image log with Ethernet network connectivity, and integrated visitor system.

    3. **QUALIFICATIONS:** All installation, configuration, and setup of the platform shall provide by qualified technicians. Installers shall be trained by the Manufacturer to install, configure and commission the access control and time attendance system.

2. PRODUCTS:

1. PERFORMANCE CRITERIA

1. System Architecture

A web-based security platform, capable of managing access control system, managing time attendance system, recording image log with Ethernet network connectivity, and integrated visitor system.

a. **Access Control**

1. User management
2. Device management
3. Door management
4. Elevator management
5. Zone management (Anti-passback, Fire Alarm, Schedule Lock, Schedule Unlock, Intrusion Alarm, Interlock, Muster, Occupancy Limit)
6. Access group management
7. Monitoring (Event log, Real-time log, Device status, Door status, Floor status, Zone status, Image log, Alert history and Graphic Map)
8. Alarm management
9. RFID card management
10. Audit trail
11. Report

b. **Time Attendance**

1. Time code management
2. Shift management
3. Schedule template management
4. Overtime rule management
5. Schedule management
6. Leave management
7. Monitoring (Leave and Exception)
8. TA report generation
9. Standard Transmission Control Protocol (TCP/IP) networking communication protocol between servers, clients, and devices.
10. Support Dynamic Host Configuration Protocol (DHCP) or Static IP address.
11. Support network configuration.
12. Support Network Time Protocol (NTP).
13. Support HTTPS communication protected by Secure Socket Layer (SSL) between the client (Web browser) and platform.
14. Support AES-256 for User Name, Fingerprint Template, and Face Template.

15. Support AES-256 for Fingerprint Template and Face Template (Optional).
16. Support SHA-256 for PIN and Password.
17. Support export to CSV or PDF for list items.

C. **Installation Wizard**

1. Separate standalone installation package.
2. Shall support English Language.
3. Shall allow a user to perform the initial configuration.
4. Shall set the password for the admin account.
5. Shall select the database installation (MariaDB 10.1.10 or Custom).
6. Shall set the root password for MariaDB.
7. Shall set the custom database information including Server IP, Server Port, AC DB name, AC DB login information, TA DB login information, TA DB name, VE DB login information, and VE DB name.
8. Shall check the database connection.
9. Shall generate the database tables.
10. Shall change the port number for server.

D. **Interface**

1. Use a Web-based client user interface for configuration, administration, management, and monitoring.
2. Support for multi-lingual UI
3. English and Korean available.
4. Other languages available via language pack from website.
5. German (Deutsch)
6. Latin Spanish
7. Spain Spanish
8. French
9. Italian
10. Japanese
11. Dutch (Nederlands)
12. Portuguese
13. Chinese
14. Russian
15. Arabic
16. Romanian

E. **User**

1. User ID
1. Support numeric user ID.
2. Support alphanumeric user ID (Optional).
2. Supports expiration dates (Period) for the user.
3. Supports card printing for user.
4. Operator levels
1. Provide for a maximum of 6 pre-defined levels.
2. Provide for an unlimited number of custom operator levels.
3. Each level shall have a set of permissions and shall be able to be configured for different operator levels.
5. Custom Field
1. Provide 3 types of custom user fields.
2. Support the Text Input Box, Number Input Box, and Combo Box
3. Provide for a maximum of 20 custom fields.

6. Fingerprint
1. Support up to 10 fingers (20 templates) per user.
2. Support 3 types of fingerprint template format (ISO 19794-2 / ANSI 378).
7. Face
a. Support up to 5 faces (150 templates) per user.
8. Visual Face
a. Support up to 2 faces per user and 20 templates (40 templates) per face.
b. Support Visual Face Mobile Enrollment.

9. Wiegand Card

a. Provide for a maximum of 15 customized formats including 5 pre-defined formats.
b. Support card formats with total bits, facility code, customizable ID fields, and parity bits.
c. Provide for a maximum of 5 pre-defined formats.
1) 26 bit SIA Standard-H10301
2) HID 37 bit-H10302
3) HID 37 bit-H10304
4) HID Corporate 1000
5) HID Corporate 1000 48bit

10. Smart Card

a. Support 3 types of smart card layout and mobile card.
1) MIFARE, iCLASS, DESFire, iCLASS Seos and Mobile
b. Store the fingerprint templates on the smart card up to 4. (Access-on Card)

11. Mobile Access

a. Support the connection with the Access Software Mobile Portal.
b. Issue and revoke mobile access cards remotely.

12. QR/Barcode

1. Support 2 types of QR/Barcode.
2. Directly issue a QR code that contains an encrypted PIN and card ID on Access Software.
3. QR/Barcode: Register users with QR/Barcodes issued from 3rd-party systems.

13. Import/Export User Information via CSV file

a. Support import and export data in Comma-separated Values (CSV) file format.
b. Support multiple languages.
c. Allow the user to import/export the user information and card information in CSV file.
d. Support the auto/manual mapping of CSV fields to the database fields.

14. Support long-term idle user management.

F. Device

1. Support auto search and manual search for a device.
2. Allow the user to change the device settings and perform the action that includes:

a. Firmware upgrade
b. Factory reset
c. Lock/Unlock
d. Time zone
e. Time synchronization
f. Network configuration
g. Serial (RS-485) configuration
h. Authentication settings
i. Card format settings
j. Trigger & action
k. Time attendance settings
l. Administrator level
m. Display and sound settings
n. Wiegand settings
o. Auto synchronization with server
p. Thermal camera and mask settings

G. Door

1. Supported door configuration includes:

a. Two devices (entry device and exit device) for one door
b. Entry device for one door with exit button
c. Entry device for one door without exit button

2. Support two types of relay setting for the exit button and door sensor.

a. Normally open and normally closed

3. Allow the user to configure the door settings that include:

a. Entry device selection
b. Relay selection for a door lock
c. TTL input port for an exit button
d. TTL input port for a door sensor

e. Relay release time for door lock
f. Dual authentication settings
g. Held open time and alarm
h. Forced open alarm
i. Anti-passback alarm

H. Elevator

a. Support the floor button control.
b. Support auto/manual mapping of floor names to the relay numbers.
c. Allow the user to configure the floor control that includes:
d. Controller selection
e. Reader selection
f. Module selection
g. Total number of floors
h. Relay release time for the floor button
i. Dual authentication settings
j. Tamper port setup
k. Alarm configuration
l. Trigger & Action

I. Zone

1.Anti-passback

a. User shall be able to define the areas and assign the entry devices and exit devices to configure an anti-pass back zone.
b. Support the global APB zone which can be set with all devices enrolled in Software.
c. Support the local APB zone which can be set with the entry devices and exit device connected with RS-485.
d. Allow the user to configure an anti-pass-back zone that includes:
1) APB zone mode (Global or Local)
2) Temporary activation or deactivation of the APB zone
3) APB type (Hard APB or Soft APB)
4) Auto reset time
5) Entry device and exit devices selection for the APB zone
6) Network failure action
7) Customizable signal output for alarm
8) Bypass user group configuration

2.Fire Alarm

a. User shall be able to define the areas and assign the doors and/or elevators to configure a fire alarm zone.
b. Support the global fire alarm zone which can be set with all devices enrolled in Software.
c. Support the local fire alarm zone which can be set with the entry devices and exit device connected with RS-485.
d. Allow the user to configure a fire alarm zone that includes:
e. Fire alarm zone mode (Global or Local)
f. Temporary activation or deactivation of the Fire Alarm zone
g. Door and/or elevator selection for the fire alarm zone
h. Customizable signal output for alarm

3.Scheduled Lock

a. User shall be able to define the areas and assign the doors and schedule to configure a scheduled lock zone.
b. Allow the user to configure a scheduled lock zone that includes:
c. Temporary activation or deactivation of the Scheduled Lock zone
d. Door lock method selection
e. Door and schedule selection for the scheduled lock zone
f. Customizable signal output for alarm
g. Bypass user group configuration

4.Scheduled Unlock

a. User shall be able to define the areas and assign the doors and schedule to configure a scheduled unlock zone.

b. Allow the user to configure a scheduled unlock zone that includes:
c. Temporary activation or deactivation of the Scheduled Unlock zone
d. Started by user authentication option
e. Door and schedule selection for the scheduled unlock zone
f. Access group where the user belongs who can start a scheduled unlock

5.Intrusion Alarm

a. User shall be able to define the areas and assign the doors to configure an intrusion alarm zone.
b. Support the global intrusion alarm zone which can be set with all devices enrolled in Software.
c. Support the local intrusion alarm zone which can be set with the entry devices and exit device connected with RS-485.
d. Allow the user to configure an intrusion alarm zone that includes:
e. Intrusion alarm zone mode (Global or Local)
f. Temporary activation or deactivation of the Intrusion Alarm zone
g. Door selection for detecting intrusion
h. Arm and/or disarm settings
i. Customizable signal output for detecting intrusion alarm
j. Customizable signal output when a specified event occurs

6. Interlock

a. User shall be able to define the areas and assign the doors to configure an interlock zone.
b. Support the local interlock zone which can be set with the devices connected to Controller with RS-485.
c. Allow the user to configure an interlock zone that includes:
d. Temporary activation or deactivation of the Interlock zone
e. Door selection for the interlock zone
f. Option to detect the user's stay in the interlock zone
g. Customizable signal output for alarm

7. Muster

a. User shall be able to define the areas and assign the entry & exit devices and the access group to configure a muster zone.
b. Support the global muster zone which can be set with all devices enrolled in Software.
c. Allow the user to configure a muster zone that includes:
d. Temporary activation or deactivation of the Muster zone
e. Door and access group selection for the muster zone
f. Maximum amount of time that user can stay in the muster zone
g. Customizable signal output for alarm

8. Occupancy Limit

a. Users shall be able to define the areas and assign the entry & exit devices and limit the count to configure an occupancy limit zone.
b. Support the global occupancy limit zone, which can be with supported device with software.
c. Allow the user to configure an occupancy limit zone that includes:
d. Temporary activation or deactivation of the occupancy limit zone
e. Entry and exit devices selection for the occupancy limit zone
f. The maximum number of people who can enter the Occupancy limit zone

J. Access Control

a. Provide the access permission status by four pre-defined filters.
b. Door permission by Access Group
c. Elevator permission by Floor Level
d. Access Level
e. Support the user to create an access level which is combined with the doors and schedules.
f. Floor Level
g. Support the user to create a floor level which is combined with the elevators, floor names, and schedules.
h. Access Group
i. Support the user to create an access group for door access permission which is combined with the access levels and user groups/individual users.
j. Support the user to create an access group for floor access permission which is combined with the floor levels and user groups/individual users.

K. Monitoring

1. Provide export the access control event list to the CSV file.
2. Support the filter functionality for sort.
3. Provide all monitoring features of the access control system that includes:

a. Event log
b. Real-time log
c. Device Status
d. Door Status
e. Floor Status
f. Zone Status
g. Alert History
h. Graphic Map View

4. Provide the following operations for the selected door in Door Status.

a. Lock the door manually
b. Unlock the door manually
c. Release the manual lock/unlock
d. Open the door temporarily
e. Clear all door alarm
f. Clear the APB alarm

5. Provide the following operations for the selected floor in Floor Status.

a. Lock the floor manually
b. Unlock the floor manually
c. Release the manual lock/unlock
d. Open the floor temporarily
e. Clear all floor alarm

6. Provide the following operations for the selected zone in Zone Status.

a. Clear the APB alarm
b. Clear all alarm

L. Time Attendance

1. Support the user to configure a time attendance rule and tracking the TA records including:

a. Time code
b. Shift
c. Schedule Template
d. Rule
e. Schedule
f. TA Report

2. TA report shall include 8 pre-defined reports type that can be customized by the user:

a. Daily
b. Daily Summery
c. Individual
d. Individual Summery
e. Leave
f. Exception
g. Edit History
h. Working alarm time

3. Support the filter functionality for customized TA report.
4. Support the user to export the TA reports as CSV or PDF files.
5. Support the user to modify the TA records.

M. System Alert

a. Provide the user to 50 events for system alert include:
b. Device Disconnection Detected
c. Device restarted
d. RS-485 disconnected
e. Tamper on
f. Supervised Input (Short)
g. Supervised Input (Open)
h. AC Power Failure
i. Forced door opened
j. Held door opened

k. Forced door open alarmed
l. Held door open alarmed
m. Enable all floor relays
n. Access denied (Exceeded threshold temp.)
o. Access denied (Temp. not measured correctly)
p. Access denied (Mask not detected)
q. Access granted (Soft temp. violation on check only)
r. Access granted (Soft mask violation on check only)
s. Access granted (Soft temp. and mask violation on check only)
t. Access denied (Exceeded threshold temp. on check only)
u. Access denied (Temp. not measured correctly on check only)
v. Access denied (Mask not detected on check only)
w. Abnormal temp. detected (Exceeded Threshold temp.)
x. Abnormal temp. detected (Temp. not measured correctly)
y. Mask not detected
z. Anti-passback zone alarm detected
i. Fire alarm zone alarm detected
ii. Scheduled lock zone alarm detected
iii. Occupancy Full Detected
iv. Occupancy Availability Recovered
v. Exit Occurred While Occupancy Count Zero
vi. Occupancy Count Alert 1 Detected
vii. Occupancy Count Alert 2 Detected
viii. Intrusion alarm detected
ix. Interlock door open denied alarm
x. Interlock door open denied alarm (Occupied)
xi. Occupancy Limit Violation (Count Full)
xii. Muster zone alarm detected
xiii. 1:1 authentication failed
xiv. 1:1 duress authentication succeeded
xv. 1:N authentication failed
xvi. 1:N duress authentication succeeded
xvii. Access denied (Invalid access group)
xviii. Access denied (Disabled user)
xix. Access denied (Invalid period)
xx. Access denied (Blacklist)
xxi. Access denied (Hard anti-passback)
xxii. Access denied (Forced lock schedule)
xxiii. Access denied (Soft anti-passback)
xxiv. Fake Fingerprint Detected
xxv. Access Denied (Anti-tailgating)

N. Audit Trail

i. Provide the 2 pre-defined filters
1. Last 1 month
2. Last 3 months
3. Support the user to create a filter using each field item that includes:
4. Datetime
5. User
6. Operator Level
7. IP
8. Category
9. Target
10. Action
11. Modification

O. Security

a. Active Directory
1. Support the synchronizing user data stored in Microsoft Windows Active Directory to Access Control.

b. Mobile Access
c. Email Setting
d. Backup & Restore

F. Intrusion Detection System

SCHEDULES OF TECHNICAL PARTICULARS

(To be submitted on the OEM letter head)

SL NO	Minimum Specifications	Compliance (Y/N)
1.0	**Digital Alarm Communicator System (DACS**	
1.01	The DACS shall have the capability to expand up to 599 separately identifiable points, of which 8 are on-board and 472 are off-board wired, addressable or wireless points.	
1.02	The 8 on-board points shall be able to accommodate powered class B functionality using a powered loop interface module.	
1.03	Point Expansion Modules (Wired and Wireless) shall be able to be located remote to the main panel to a maximum distance of 1000 feet.	
1.04	The DACS shall support 32 independent areas. Each of the 32 areas shall have custom text associated with the armed state, disarmed state and point-off-normal state.	
1.05	The DACS shall be capable of assigning 1 to 4 account identifiers to the areas depending on the distribution of areas per account.	
1.06	The DACS shall be capable of assigning 1 to 2 account identifiers to the areas depending on the distribution of areas per account.	
1.07	All of the areas must be capable of Master (All) and/or Perimeter (Part) arming (excluding predefined Interior protection).	
1.08	The DACS shall be capable of logically grouping 1 or more points into an area, or conversely, dividing 2 or more points into two or more areas.	
1.09	The DACS shall be capable of activating 472 additional relay outputs for auxiliary functions based on its classifications (area vs. panel wide). Output Expansion Modules shall be able to be located remote to the main panel to a maximum distance of 1000 feet.	
1.10	The DACS shall be capable of controlling relays and automatically executing system functions based on a time / event scheduling program. The program can be hour, day of week or day of month based.	
1.11	The DACS shall support 5 different types of alarm output selections: Steady, Pulsed, California Standard, Temporal Code 3 and Temporal Code 4.	

1.12	The DACS shall support scheduling capabilities with the following characteristics: 1. Arm / Disarm specific area(s) based on open/close windows. 2. Bypass / Unbypass point(s). 3. Activate / Deactivate relay(s). 4. Send test reports. 5. Up to 4 programmable holiday schedules of 366 days each (includes leap year). Based on the holiday settings, different time windows for open/close and other system functions can be executed. 6. Automatic adjustment of system clock for daylight savings time	
1.13	User Passcodes and Authority: Passcodes shall be programmable with authority levels to allow users to operate any or all areas.	
1.14	The DACS shall be capable of reporting system events and supervisory reports including alarm, trouble, missing modules, restorals, system status, AC failure, battery status to primary and secondary off-site DACR's. The following features shall be supported.	
1.15	The DACS shall be capable of communicating via dial-up analog telephone lines, over a LAN/WAN/Internet using a wired network interface module, or over a cellular network using a CDMA Cellular interface module.	
1.16	The DACS shall be capable of sending text (SMS) messages to compatible devices without requiring that these message are sent to a monitoring center	
1.17	the DACS reports shall be classified, by event, into eleven subcategories or "report groups." Each group represents similar types of events. Individual events within each group shall be selectively enabled or disabled for transmission. The eleven report groups shall be as follows: Fire Reports. Burglar Reports. User Reports. Test Reports. Diagnostic Reports. Relay Reports. Auto Function Reports. RPS Reports. Point Reports. User Change Reports. Access Reports.	
1.18	The DACS shall have the capability to verify the integrity of the remote communications path and switch to alternate paths when a communications failure occurs.	

1.19	The DACS shall be capable of network communications over a LAN, WAN, Intranet, or the Internet. The system shall include supervision of the network communication utilizing configurable periodic heartbeats to the Digital Alarm Communications Receiver (DACR). The DACR shall provide notification of the loss of communications from a networked system after a programmable timeframe since the last communication. The notification options shall be programmable and include local annunciation or indication to automation software.	
1.20	The system shall support a method of authentication between the control panel and the receiver to ensure that the control panel has not been compromised or replaced.	
1.21	The network interface modules shall be capable of supporting encryption using a minimum of 256-bit AES Encryption (Rijndael) certified by NIST (National Institute of Standards and Technology) utilizing the Cipher Block Chaining (CBC) method.	
1.22	The control panel shall be capable of network communication with a programmable poll time to send periodic heartbeats to the receiver, programmable ACK Wait time, and programmable retry time. In the situation where a communication path is unsuccessful, the control panel shall be	
1.23	The control panel shall have the ability to automatically adjust the heartbeat rate of a backup path that is using cellular to the heartbeat rate of the primary path in case of a primary path failure. Upon restoral of the primary path, the heartbeat rate of the backup path shall automatically restore to the original rate.	
1.24	The control panel shall support network diagnostics from a keypad to allow local testing of network connectivity. The diagnostics should include, Ethernet cable connected, gateway configuration ok, DNS lookup operational, and external network connectivity (such as the Internet) operational.	
1.25	The system shall be capable of meeting DCID 6/9 and UL 2050 standards.	
1.26	The DACS shall maintain a log of events indicating time, day, month, year type of event, account number, area number, user ID, point text, user text and primary/secondary event route. The system shall allow the following characteristics:	
1.27	The DACS shall support viewing of logs locally at the ACC and remotely via an upload to a remote central station computer	
1.28	The DACS shall be capable of sending automatic tests daily, weekly or once every 28 days. Automatic test times shall be programmable to provide an offset of up to 24 hours from the current time.	
1.29	DACS shall comply with all ANSI SIA CP-01 2010 requirements for false alarm reduction	

1.30	The DACS shall include a programmable feature that requires 2 separate passcodes to be entered to disarm the system. After 1 passcode is entered, the system will prompt for a second passcode to be entered on the same ACC. Without the second passcode, the system shall not disarm.	
1.31	he DACS shall support Dual Authentication by area. Areas programmed for Dual Authentication require activate of a card and a passcode to allow access to system functions, arm/disarm, or access control doors.	
1.32	The System shall support programmable area re-arm time of 1 minute to 24 hour.	
1.33	Approvals and listings: UL, ULC, FM, ANSI SIA CP-01, CSFM, NYC-CoA, as applicable.	
2.00	**ACOUSTIC GLASS BREAK DETECTORS**	
2.01	The Glass Breakage Detector shall operate on a Multiple Frequency Analysis response to distinct audio frequencies.	
2.02	Each detector shall provide the receiver, signal processing, alarm relay and operating power circuitry in the same enclosure, and shall be ready for wall or ceiling ,surface or flush mounting.	
2.03	Each detector shall be capable of operating from a DC power source rated within the range of 6 volts to 15 volts, and shall draw a nominal 21 milli-amps (mA) across the voltage range.	
2.04	Each detector shall contain a microphone tuned to the audio frequencies of breaking glass. To guard against false alarms, any audio frequencies detected outside of the specifically tuned frequency range shall be ignored by the detector.	
2.05	As a condition of alarm, the sensor must detect two distinct frequencies which possess specified signature and timing relationships.	
2.06	The environmental portion of the test mode shall indicate environmental disturbances near the mounting location. While in test mode, the LED will flash 5 times per second each time a low frequency disturbance is detected. While in test mode, the LED will flash once each time a high frequency disturbance is detected. If a low or high frequency disturbance above the alarm threshold occurs during the test mode, the detector will indicate an alarm by activating its LED and alarm relay.	
2.07	Each detector shall also be capable of alarm memory which shall be reset by power interruption. When memory is activated, an alarm shall be stored in memory, and a stored alarm shall be visually indicated by turning on the red alarm LED indicator continuously.	
2.08	Each detector shall be rated to operate within the Temperature Range of[minus 29° Celsius to plus 49° Celsius (-29°C to + 49°C)	

3.00	**MAGNETIC CONTACT SENSOR**	
3.01	The sensor shall be a reed switch type magnetic contact sensor.	
3.02	The sensing distance shall be between 10mm and 20mm.	
3.03	The output shall be normally closed (NC).	
3.04	Switch Configuration Type: Single pole single throw (SPST) Maximum Contact Resistance: 150 μΩ (micro-ohm) Minimum Breakdown Voltage: 250 VDC Insulation Resistance: 1010 Ω Electrostatic Cap: 0.3 PF Contact Capacity: 10 VAC Maximum Conductive Current: 1.0 A Maximum Voltage: 100 V	
3.05	The sensor shall be suitable for indoor use and shall have a temperature range of -40°C to 60°C.	
3.06	The sensor shall be UL & CE listed.	
4.00	**SHOCK SENSORS**	
4.01	The Sensors should have accelerometer Technology providing a much higher level of accuracy for vibration detection	
4.02	The Sensors should be highly sensitive to sub-surface shock transmissions resulting from attempted forced entry, and completely immune from airborne-based high frequency noise	
4.03	The sensor should detect vibration in 3 dimensions	
4.04	The sensors should have digital signal processing	
4.05	The Sensor should have Digital Signal processing	
4.06	The sensors should have variable sensitivity settings	
4.07	The Sensors should have Built In EoL Resistors	
4.08	The Sensors should have a dual color LED	
4.00	**OUTDOOR DETECTOR**	
4.01	The sensor should have multi beam Passive Infra Red Detection	
4.02	The sensor should have Digital Anti-Masking technology	
4.03	The Coverage area can be varied from 2m-24m	
4.04	The Sensor should have variable sentivity settings	
4.05	The sensors should have Multi-Dimensional Detection, Analysis and Logic functions in-built	
4.06	The sensors should have detectable speeds From minimum 0.3m/s to Max 2.0m/s	
4.07	The sensors should be IP55 rated	
5.00	**PHOTOELECTRIC DETECTOR**	
5.01	The sensors should have a Quad Beam to cut down on false alarms	
5.02	The Sensors Should have a detection range from 60m-200m	

5.03	The sensor should have Double modulated beam - enhances signal discrimination against potential interferences	
5.04	The Sensor should have Auto Beam Power Control Selection	
5.05	The sensros should have LED & Sound assistance for alignment	
5.06	The sensors should have Counter-measures against Reflections & interference	
5.07	The sensors should be IP65 Rated	

ANNEXURE C: MEP SPECIFICATIONS

PART 2 : HVAC

PROPOSED CONSTRUCTION OF THE NEW CHANCERY AND OFFICIAL RESIDENCE

IN NEW DELHI INDIA

TENDER DOCUMENTS

HVAC SYSTEM

(Special Conditions &Technical Specification)

Date: - 02/05/2025

ARCHITECT

SPACE ARCHITECTURE STUDIO

V-12/23, DLF- PHASE-III
Gurgaon, Haryana - 122002.
Off Ph: +91-124-4734320
contact@studiosas.in

SERVICES CONSULTANT

Multiple Service Consultants
235/B, Rajpur Khurd Extension
Chhatarpur, New Delhi-110068
PH : - 8920228058/8920225677
Email:-msc@msc-mep.com

GENERAL SPECIFICATIONS

SPECIAL CONDITIONS

1. GENERAL

These special conditions are intended to amplify the General Conditions of Contract, and shall be read in conjunction with the same. For any discrepancies between the General Conditions and these Special Conditions, the more stringent shall apply.

These General Specifications are to be read in conjunction with other documents issued along with tender. In case of any discrepancy between Design drawings, General conditions,

The contractor shall refer the tender drawings for Preparation of Shop Drawings:

The contractor shall refer the following annexure while bidding and will read them in conjunction with specifications as well as Tender

Annexure - I	:	Codes & Standards / Design Criterion
Annexure -II	:	Technical Specifications
Annexure -III	:	Technical Data Sheets
Annexure -IV	:	Drawing List

2. WORK DESCRIPTION

The work shall be strictly carried out as per the scope listed in this document and in accordance with the specifications. The equipment & material supplied at site will also be selected out of the list of approved makes. Tender provided with the document is for contractor guidance. It is expected that after award of work, contractor shall prepare shop drawings for approval by the Consultant & PMC's representative and also submit Technical documentation duly identifying shortlisted make of material/equipment along .with its data sheets. Actual ordering shall be based on approved shop drawings & documents.

The work at site shall comply with the approved shop drawings and will meet the satisfaction of PMC's representative. The contractor shall be required to demonstrate satisfactory operation of entire system (including client supplied equipment installed by contractor) and furnish the required labor, material & tools to install & commission the system.

The broad scope of work for proposed HVAC system covered under this contract shall include supply, installation, testing & commissioning of the following:

- VRV/VRF System
- Refrigerant piping, fittings etc.
- Air distribution system.
- Ceiling Suspended Unit duct type
- Cassette unit 4 way unit
- Associated electrical works.
- Testing Adjusting & Balancing of the entire HVAC and mechanical ventilation installation.
- Indoor air quality monitoring and proper filtration of PM 1.0 & 2.5 to satisfy health indoor air requirements throughout the year.
- Besides above, contractor shall also be required to undertake following:

- Obtain fire approval from Local Authorities prior & post installation for operation of system.
- All civil works which include making openings in walls & slabs and making good of the same.
- Commissioning of the system including test reports to demonstrate satisfactory working prior to handing over.
- Provide as-built drawings and handing over document comprising of list of recommended spares, catalogues and service schedule for each equipment/material.
- Training of Client's staff.

3. SITE MANAGEMENT

The Contractor shall be required to provide following staffing for the project:

a. Design Engineer who will work with Consultant for getting shop drawings, Technical submittal and variation in quantity statement approved.

b. Procurement team as per tender document.

c. Full time dedicated manager and Engineer (minimum 10 year experience) &supervisor posted at site as per tender document.

The contractor shall submit organization chart and CV prior to starting work at site.

The Contractor shall have required stores, tools & plant, security and facility to transport materials to place of installation for speedy execution of work.

4. REGULATIONS& PERMITS

Prior to starting work at site, the contractor shall obtain required permits/ licenses required for satisfactory execution and operation of the installation.

The executed work shall strictly confirm to applicable laws, regulations and Indian Standards which become applicable. In case the specifications and drawings contained in this document call for higher standard than those required by prevailing regulations, then these specifications & drawings shall become applicable. However, in case of any conflict or violation between the document/drawings and prevailing laws, then the applicable laws & regulations shall be governing & binding.

5. SHOP DRAWINGS

A set of design drawings listed in this document are available at Consultant office and may be issued with the tender document. These design drawings are for reference of the contractor and indicate proposed arrangement and the extent of work covered in the contract. The data given in the drawings and specifications is as exact as could be procured, but its accuracy is not guaranteed. The contractor cannot execute work or scale these drawings for reference.

Following shall be the procedure followed by contractor while preparation of shop drawings:

- The contractor shall refer the design drawings for understanding the scope and proposed routes to be followed during execution.
- Examine all related services drawings but not limited to structural, plumbing, electrical, HVAC, Interior, landscape and others including as-built works before starting the work.Any discrepancy must be report to the PMC's site representative in writing and obtain approval for go-ahead.
- Within one week of award of work, the Contractor shall prepare a list of shop drawing along with submission schedule for approval of PMC's representative/Consultant. The list of drawings must include layouts for Pump room, Typical drawings showing exact location of supports, flanges, bends, tee connections, reducers, detailed Refrigerant piping drawings showing exact location and

type of supports, valves, fittings etc; electrical panels inside/outside views, power and control wiring schematics, cable trays, supports and terminations.

Maximum headroom shall be maintained at all points and in case the same is inadequate, then written approval from Client representative must be obtained prior to execution at site.

These shop drawings shall depict information required to complete the Project as per specifications and as required by the Consultant/PMC's representative. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings.

Where the work under this contract is proposed to be installed in close proximity or is interfering with other trades, then based on client representative/consultant directions, the contractor shall prepare all services coordinated working drawings and sections at a suitable scale (not less than 1:50), clearly showing proposed installed in relation to the work of other trades.

- The contractor shall thereafter furnish Four sets of detailed shop drawings to PMC's representative/Consultant for obtaining comments/approval. The Contractor will make unlimited number of re-submissions of shop drawings unless PMC's representative/Consultant/Architect approval is obtained.

- The Contractor will thereafter submit Four sets of final shop drawings to the PMC's representative for their exclusive use and all other agencies.

- No material or equipment may be delivered or installed at the job site until the contractor has in his possession, the approved shop drawing for the particular material/equipment/installation.

- In case installation is carried out without following above process or obtaining a waiver to follow the procedure from PMC's representative, the work shall be rejected and contractor shall rectify the same at their own cost.

- Shop drawings shall be submitted for approval minimum four weeks in advance of planned delivery and installation of any material to allow PMC's representative/Consultant ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved program.

  Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supersede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract.

6. TECHNICAL DOCUMENTATION

The contractor prior to supplying material at site, will submit the following documentation to Consultant/PMC's representative for approval:

- Manufacturers drawings, catalogues, pamphlets and other documents in triplicate. Each item shall be properly labeled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.

- Samples of all materials shall be submitted to the PMC's site representative prior to procurement. These will be submitted in two sets for approval and retention by PMC's representative and shall be kept in their site office for reference and verification till the completion of the Project. Wherever directed, a mockup or sample installation shall be carried out for approval before proceeding for further installation.

- Where the contractor proposes to use an alternate make or model of equipment other than that specified, all new drawings and detailing required thereafter shall be prepared by the contractor at his own expense including any re-design required for other discipline/trade. Any delay on such account shall also be at the cost of and consequence of the Contractor.

  Contractor to refer list of approved makes & materials for this project:-

6. QUALITY ASSURANCE

The contractor to ensure that all materials and equipment supplied shall be new and of best available quality conforming to the relevant Indian Standard Specifications and to these specifications. Makes shall be strictly in conformity with list of approved make. Client reserve the right to reject any item which in their assessment is second hand

Any deviations from above shall be clearly highlighted prior to supply and shall be brought to the notice of the PMC's representative/Consultant for further instructions in the matter.

Prior to starting execution work at site, the Contractor shall verify the sufficiency of the size of the shaft openings, clearances and ceiling spaces for proper installation. Failure to communicate insufficiency of any of the above, shall constitute Contractor acceptance of the same**.** The Contractor shall locate all equipment in fully accessible locations which can be easily serviced, operated or maintained. The exact location and size of access panels, required for each concealed, valve or other devices requiring attendance shall be finalized and communicated in sufficient time. Failing this, the Contractor shall make all the necessary repairs and changes at own expense. Access panel shall be marked.

7. INTEGRATION WITH BUILDING AUTOMATION SYSTEM

The scope shall include providing following for the interface to Building Automation System.

- Sockets /Nipples including shut-off valve for mounting sensors/transmitters on pipe lines.
- Space in electrical panel for running of LV cables.
- CT of 15 VA burden with potential free taps.
- Auto/manual changeover switch with potential free contact at manual position.
- Installation of motorized control valves with provision of counter flanges
- Installation of current transformer &Transducer along with wiring between Current Transformer & Transducer up to the terminal block
- Provision for mounting BAS sensors.
- 15 Amps. Power supply with MCB in all AHU panels for power supply to DDC Panel.
- Central Control Modules for energy monitoring, temperature control, timer setting, remote settings / diagnostics all complete.

It is to be clearly understood that the final responsibility for the sufficiency, adequacy and conformity to the contract requirements lies solely with the contractor.

8. TESTING, ADJUSTING AND BALANCING

Air and Refrigerant balancing shall be carried out by the contractor through a specialist team (different than erection team) as per Specifications and ASHRAE Guide lines. Performance test shall consist of three days of 10 hour each operation of system for each season. The results for each season shall be submitted to PMC's representative/Consultant. The submittal shall include

operational parameters marked on performance curves for each equipment along with test certificates and safety/control settings.

The installation shall be tested again after removal of defects and shall be commissioned only after approval by the PMC's site representative. All tests shall be carried out in the presence of the representatives of the /Consultant and PMC's site representative. After commissioning, the results shall be submitted for scrutiny in quadruplicate.

All equipment The installation shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the PMC's site representative. In case of rotating machinery sound or vibration noticeable outside the room in which it is installed, or annoyingly noticeable inside its own room, shall be considered objectionable. Such conditions shall be corrected by the Contractor at his own expense. The contractor shall guarantee that the equipment installed shall maintain the specified Noise Control levels.

9. COMPLETION CERTIFICATE

On completion of the installation, a certificate shall be furnished by the contractor, counter signed by the licensed supervisor, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local authority.

The contractor shall be responsible for getting the entire installation duly approved by the local authorities concerned, and shall bear expenses if any, in connection with the same.

10. AS-BUILT DRAWINGS

Contractor shall submit following as-built drawings as and when work is completed:

- Six set of hard copies of all as-built drawings duly corrected and incorporating any modifications during execution.
- Two set of pen drive containing the drawings.

The drawings shall provide plant room layouts, piping layouts, location of all concealed accessories/piping, wiring diagram, control diagram, Single line diagram, control schematic with detailed bill of materials, showing makes, types & description of all components & accessories and sequencing of automatic controls and other services.

11. MAINTENANCE MANUAL

Upon completion and commissioning of works, the contractor shall submit a draft copy of comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the contractor shall submit four (4) complete bound sets of typewritten operating instructions and maintenance manuals; one each for retention by Consultant and PMC's site representative and two for Clients Operating Personnel. These manuals shall also include basis of design, detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for 4 year period of maintenance of each equipment. The manuals shall include:

i. Description of the work carried out / installed.
ii. Operating instructions.
iii. Maintenance instructions including procedures for preventive maintenance.
iv. Manufacturers catalogues.
v. Spare parts list.
vi. Trouble shooting charts.
vii. Drawings
viii. Type and routine test certificates of major items.

Details of all the bought out item should be part of this maintenance manual.

12. ON SITE TRAINING

Upon completion of all work and all tests, the Contractor shall furnish necessary operators, labor and helpers for operating the entire installation for such periods so as to enable the Client's staff to get acquainted with the operation of the system. During this period, the contractor shall train the Client's personnel in the operation, adjustment and maintenance of all equipment installed**.**

13. DEFECTS LIABILITY PERIOD

Complaints

The Contractor shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 10 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

Repairs

All equipment that requires repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs concurrently with the defects liability period, all replacement parts and labor shall be supplied promptly free-of-charge to the Client.

14. UPTIME GUARANTEE

The contractor shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall get extended by a month for every month having shortfall and no reimbursement shall be made for the extended period.

15. OPERATION

Contractor may be required to carry out the operation of the installation during and after the defects liability period.

16. GREEN BUILDING PERFORMANCE GUIDELINES

All system parameters to adhere to IGBC requirements as listed in the Technical Specifications

ANNEXURE–I

CODE & STANDARDS / DESIGN CRITERIA

1.1 REFERENCE STANDARDS:

1.1.1 National Building Code of India (NBC) 2016

1.1.2 Energy Conservation Building Code (ECBC 2017)

1.1.3 ASHRAE Hand Books.

- HVAC Systems and Equipment 2016
- HVAC Applications 2016
- Refrigeration 2014
- Fundamentals 2013

1.1.4 Duct construction standards as per relevant BIS Codes & SMACNA standards

1.1.5 Air filters as per ASHRAE 52.1-1992 and 52.2-2007

1.1.6 Indoor Air Quality as per ASHRAE 62.1-2016

1.1.7 Motors, cabling, wiring and accessories as per BIS Codes

1.1.8 National Fire Codes

1.1.9 National Electric Codes (NEC)

1.1.10 ASHRAE Standard 90.1 2016

1.2 BASIS OF DESIGN:

Site Location	:	NEW DELHI
Geographic location	:	28.47 deg. N; 77.3 deg. E
Altitude	:	236.67 M above mean sea level.

1.2.1 OUTDOOR DESIGN CONDITIONS:

Outdoor Design Conditions for **Gurgaon** are based on Weather data compiled and published by ISHRAE (WEDCO) for Delhi corresponding to 0.4% annual cumulative frequency of occurrence and the outdoor design conditions have been considered as follows:-

Summer

Dry Bulb Temperature	:	113 Deg F	(41.0 Deg. C)
Mean Coincident Wet Bulb Temperature	:	75.Deg. F	(23.4 Deg. C)

Monsoon

Wet Bulb Temperature	:	83 Deg F	(28.3 Deg. C)
Mean Coincident Dry Bulb Temperature	:	95.Deg F	(33.4 Deg. C)

Winter

Dry Bulb Temperature	:	45 Deg F	(8.2 Deg. C) Mean
coincident Wet Bulb Temperature	:	41 Deg F	(7.7 Deg. C)

1.2.2 INDOOR DESIGN CONDITIONS:-

Offices, housing etc.

Dry Bulb Temperature	:	DB : 23 ± 1 Deg. C (73 ± 2 Deg. F)
Relative Humidity	:	Less than 60%

Corridor, Lobby etc.

Dry Bulb Temperature	:	DB : 24 ± 1 Deg C (76 ± 2 Deg F)
Relative Humidity	:	Less than 60%

Note: - outdoor air ventilation rate based on ASHRAE 62.1-2010

1.2.3 MECHANICAL VENTILATION

Pantry/Kitchen	2 ACPH exhaust, with equivalent draw of conditioned air from adjacent areas. Under cut of 25 mm or double louvered door grille shall be provided for the pantry door for achieving the desired result.
ACPH Stores	6
Toilet (Private)	8
Toilet (Public)	Exhaust @ 6-12 ACPH with equivalent amount of conditioned air from adjacent space. Door under cut-out of 40 mm or double louvered air transfer grilles shall be provided in main entrance door to the Toilet for achieving the desired result.
Lift well pressurization	Mechanically pressurized for maintaining 50 Pa differential pressure.
Lift lobby pressurization	Mechanically pressurized for maintaining 25 Pa differential pressure.
Staircase Pressurization	One staircase - Mechanically pressurized for maintaining 25 Pa differential pressure. Second Staircase - Natural ventilated

1.2.4 BUILDING CONSTRUCTION DATA ASSUMED

(Same Required Confirmation from the Client & Architect)

External wall construction:

Wall Assembly	:	0.10 Btu./hr.ft2º F
Roof (with insulation)	:	Assembly U-value = 0.08 Btu./hr.ft2ºF
Floor construction	:	6" thick RCC slab
Fenestration (Double Glass) Assumed	:	U-Value : 0.25 Btu/hr.ft2º F Shading Coefficient (SC) : 0.4
Outdoor Fresh Air Addition Rate:	:	As per ASHRAE Standard-62.1-2010

1.2.5 LIGHT & POWER DENSITY (LPD)

Lighting & Power Load	:	@ 1.0 watts/sqft.
Occupancy	:	@ 100 sqft./person

Note:

1) Thermal insulation shall be carried out by civil contractor for all roofs (above air conditioned area) expose to sun.

2) Wall, roof & glass specifications may be further revised based on recommendation from Client/Architect.

1.2.6. DESIGN PARAMETERS

VRV System		
Performance rating of the VRV Unit shall be based on following design parameters:		
Refrigerant for VRV Units	:	134A/ 410A
Maximum input power for Air Cooled VRV units at full load	:	1.25 IKW/TR
Design parameter for selection of Air Handling Unit and its components shall be :		
Maximum face velocity across pre-filters & MERV 13 filters	:	150 M/Min
Maximum face velocity across cooling / Heating coils	:	150 M/Min
Maximum fan outlet velocity	:	550 M/Min
Maximum fan speed *		
a. Fan above 300 mm dia	:	900 RPM
b. Fans upto and including 300 mm dia	:	1440 RPM
Maximum fan motor speed	:	1450 RPM
Ventilation Fans		
Maximum fan outlet velocity for fans upto 450 mm dia	:	9.14 m/sec (1800 fpm)
Maximum fan outlet velocity for fans above 450 mm dia	:	12 m/sec (2400 fpm)
Maximum fan speed for fans upto 450 mm dia	:	1450 RPM
Maximum fan speed for fans above 450 mm dia	:	1000 RPM
Duct Design		
Maximum flow velocity for ventilation ducts	:	7.5 m / sec – 12.5 m / Sec (1500 – 2500 FPM)
Maximum Friction	:	1cm WG/100 m run or (0.1 inch per 100 Ft)

2.2 Estimate Air Conditioning Load-Residence

S. NO.	CONDITIONED SPACE	ACTUAL AIR CONDITIONED AREA	HEIGHT	INSIDE DESIGN CONDITION		FRESH AIR		OCCUPANCY	LIGHT LOAD	EQPT LOAD	SUMMER LOAD	MONSOON LOAD	WINTER LOAD	SUMMER DEHUMIDIFIED CFM	MONSOON DEHUMIDIFIED CFM	WINTER DEHUMIDIFIED CFM	OUTDOOR AIR REQUIRED	TREATED FRESH AIR	TOTAL TR	INDOOR UNIT	UNIT TR
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)	(O)	(P)	(Q)	(R)	(R)		
		S.FT	FT.	TEMP (˚C)	RH %	75	CFM /S. Ft	NOS.	69.4	W/S.FT	TR	TR		CFM	CFM		CFM	CFM	CFM		
1	**Basement**																				
1.0	Hall	420	11.8	24 ± 1	55	5	0.06	7	1.0	1.0	1.6	1.3	-3.36	701	425	701	60	60	1.8	2.01 TR Ductable Unit	2.01
1.2	Kitchen	85	11.8	24 ± 1	55	5	0.06	1	0.5	1.0	0.4	0.3	-1.01	184	91	184	10	10	0.5	1.0 TR Cassette AC	1
2	**GROUND FLOOR**																				
2.1	Master Bedroom	345	11.8	24 ± 1	55	5	0.06	2	0.5	1.0	1.1	0.8	-2.34	513	301	513	31	31	1.3	2.01 TR Ductable Unit	2.0
2.2	Master Dresser	94	11.8	24 ± 1	55	5	0.06	1	0.5	1.0	0.3	0.2	-0.66	129	73	129	11	11	0.3		
2.3	Dining Area	201	11.8	24 ± 1	55	5	0.06	8	0.5	1.0	1.2	1.1	-1.70	494	338	494	52	52	1.2	1.6 TR Ductable Unit	1.6
2.4	Family Lounge	417	11.8	24 ± 1	55	5	0.06	7	0.5	1.0	1.5	1.3	-2.58	618	401	618	60	60	1.5	2.01 TR Ductable Unit HIGH STAT.	2.0
2.5	Bedroom-1	248	11.8	24 ± 1	55	5	0.06	2	0.5	1.0	0.8	0.6	-1.75	374	215	374	25	25	0.9	1.6 TR Ductable Unit	1.6
2.6	Dresser-1	59	11.8	24 ± 1	55	5	0.06	1	0.5	1.0	0.3	0.2	-0.60	144	62	144	9	9	0.4		
2.7	Bedroom-2	248	11.8	24 ± 1	55	5	0.06	2	0.5	1.0	0.9	0.6	-1.92	402	225	402	25	25	1.0	1.6 TR Ductable Unit	1.6
2.8	Dresser-2	60	11.8	24 ± 1	55	5	0.06	1	0.5	1.0	0.2	0.2	-0.53	104	58	104	9	9	0.3		
2.9	Bedroom-3	272	11.8	24 ± 1	55	5	0.06	2	0.5	1.0	0.9	0.7	-1.76	414	258	414	26	26	1.0	1.6 TR Ductable Unit	1.6
2.10	Dresser-3	55	11.8	24 ± 1	55	5	0.06	1	0.5	1.0	0.3	0.2	-0.45	110	52	110	8	8	0.3		
2.11	Entrance hallway	178	11.8	24 ± 1	55	5	0.06	4	0.5	1.0	0.7	0.6	-1.39	296	178	296	31	31	0.8	1.3 TR Ductable Unit	1.3
2.12	ERV																	286		294 CFM ERV	0.8
3	**FIRST FLOOR**																				
3.1	Formal Lounge	533	14.7	24 ± 1	55	5	0.06	16	0.5	1.0	2.5	2.3	-3.74	990	667	990	112	112	2.5	3.2 TR Ductable Unit HIGH STAT.	3.2

3.2	Dining Area	351	14.7	24 ± 1	55	5	0.06	16	0.5	1.0	2.0	1.9	-2.78	751	509	751	101	101	1.9	2.6 TR Ductable Unit HIGH STAT.	2.6
3.3	Entrance hall	274	14.7	24 ± 1	55	5	0.06	4	0.5	1.0	1.0	0.8	-2.18	457	265	457	36	36	1.1	1.3 TR Ductable Unit	1.3
3.4	Study	280	14.7	24 ± 1	55	5	0.06	2	0.5	1.0	1.1	0.8	-2.58	538	296	538	27	27	1.3	1.6 TR Ductable Unit	1.6
3.5	Guest Suite	289	14.7	24 ± 1	55	5	0.06	2	0.5	1.0	1.4	1.0	-2.83	681	409	681	27	27	1.7	2.01TR Ductable Unit	2.0
3.6	ERV																	326.7		382 CFM ERV	0.95
3.7	Kitchen	301	14.7	24 ± 1	55	5	0.06	1	0.5	1.0	1.0	0.6	-2.71	499	249	499	23	23	1.2	1 Nos. 1.6 TR Cassette Unit AC on stamp alone	1.6

2.3 Estimate Air Conditioning Load- Chancery

1	**BASEMENT**																				
1.1	Control Room	146	9.4	23 ± 1	55	5	0.06	4	1.0	2.0	1.0	0.7	-2.18	507	296	507	29	29	1.3	1 Nos. 1.28 TR Hi wall unit	1.3
1.2	UPS Room	140	9.4	23 ± 1	55	5	0.06	0	1.0	10.0	1.1	0.8	-2.56	636	441	636	8	8	1.6	1 Nos. 2.0 TR Hi wall unit	2.0
1.3	Lift Lobby	167	9.4	23 ± 1	55	5	0.06	1	0.5	1.0	0.7	0.4	-1.81	369	187	369	15	15	0.9	1 Nos. 1.0 TR cassette unit	1.0
2	**GROUND FLOOR**																				
2.1	Conference Room	491	10.6	23 ± 1	55	5	0.06	24	1.0	2.0	3.7	3.7	-4.42	1680	1395	1680	149	149	4.2	1 Nos. 4.5 TR CS Duct Unit	4.5
2.2	Library/Tea Room	272	10.6	23 ± 1	55	5	0.06	6	0.5	1.0	1.3	1.1	-1.98	709	473	709	46	46	1.8	1 Nos. 1.6 TR cassette Unit	1.6
2.3	visa Entrance Foyer	58	10.6	23 ± 1	55	5	0.06	1	0.5	1.0	0.2	0.2	-0.51	115	64	115	8	8	0.3	1 Nos. 4.5 TR CS Duct Unit	4.5
2.4	Consular Waiting & Reception	356	10.6	23 ± 1	55	5	0.06	15	1.0	2.0	1.9	1.9	-2.63	808	605	808	96	96	2.0		
2.5	Interview Room	49	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	0.3	0.3	-0.38	111	93	111	18	18	0.3		
2.6	Interview Room	49	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	0.5	0.5	-0.50	215	180	215	18	18	0.5		
2.7	Sick Bay	91	10.6	23 ± 1	55	5	0.06	4	0.5	1.0	0.5	0.5	-0.87	231	148	231	25	25	0.6		
2.8	Dedicated Holding Space	108	10.6	23 ± 1	55	5	0.06	4	0.5	1.0	0.8	0.6	-1.42	369	220	369	26	26	0.9	1 Nos. 1.0 TR Hi wall unit	1.0
2.9	Sister-4	1050	10.6	23 ± 1	55	5	0.06	15	1.0	2.0	4.9	4.1	-9.03	2537	1758	2537	138	138	6.3	1 Nos. 6.4 TR CS Duct Unit	6.4
2.10	Reception	430	10.6	23 ± 1	55	5	0.06	5	1.0	2.0	3.3	2.7	-3.94	2104	1516	2104	51	51	5.3	1 Nos. 5.4 TR CS Duct Unit	5.4
2.11	Cafeteria	122	10.6	23 ± 1	55	7.5	0.18	4	0.5	1.0	1.1	0.9	-2.11	468	271	468	52	52	1.2	1 Nos. 1.6 TR Hi wall unit	1.6
2.12	Store	166	10.6	24 ± 1	55	5	0.06	0	0.5	1.0	1.3	0.9	-2.84	725	489	725	10	10	1.8	1 Nos. 2.1 TR Cassette Unit	2.1
2.13	Store	377	10.6	24 ± 1	55	5	0.06	0	0.5	1.0	0.9	0.6	-2.24	479	279	479	23	23	1.2	1 Nos. 1.6 TR Cassette Unit	1.6

2.14	ERV Unit																			1 Nos 300 CFM ERV Unit 1 Nos 250 CFM ERV unit 1 Nos 200 CFM ERV unit	1.8
3	**FIRST FLOOR**																				
3.1	MP Hall	728	10.6	23 ± 1	55	5	0.06	60	1.0	2.0	7.3	7.5	-7.38	3105	2489	3105	344	344	7.8	1 Nos. 7.95 TR CS Duct Unit	7.95
3.2	Driver Rest Area	100	10.6	23 ± 1	55	5	0.06	2	0.5	1.0	0.5	0.4	-1.29	278	148	278	16	16	0.7	1 Nos. 5.4 TR CS Duct Unit	5.4
3.3	Registry	113	10.6	23 ± 1	55	5	0.06	3	0.5	10.0	0.7	0.7	-1.07	353	312	353	22	22	0.9		
3.4	Mail Room	142	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	0.7	0.6	-1.02	317	234	317	24	24	0.8		
3.5	Copier Room	108	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	0.5	0.4	-0.85	235	150	235	21	21	0.6		
3.6	Maintenance Officer	323	10.6	23 ± 1	55	5	0.06	6	1.0	2.0	1.5	1.1	-2.73	749	396	749	49	49	1.9		
3.7	DIRCO-3 Part	909	10.6	23 ± 1	55	5	0.06	15	1.0	2.0	4.5	4.0	-7.56	2298	1721	2298	130	130	5.7	1 Nos. 6.4 TR CS Duct Unit	6.4
3.8	Counsellor	272	10.6	23 ± 1	55	5	0.06	6	0.5	1.0	1.1	1.0	-1.82	514	342	514	46	46	1.3	1 Nos. 1.6 TR 2-way Cassette Unit	1.6
3.9	Store	148	10.6	24 ± 1	55	5	0.06	0	0.5	1.0	0.7	0.5	-1.36	368	266	368	9	9	0.9	1 Nos. 1.0 TR Hi wall unit	1.0
3.10	Store	148	10.6	24 ± 1	55	5	0.06	0	0.5	1.0	0.5	0.3	-1.42	285	147	285	9	9	0.7	1 Nos. 1.0 TR Hi wall unit	1.0
3.11	ERV Unit																			2 Nos 350 CFM ERV Unit 1 Nos 300 CFM ERV unit	2.5
4	**SECOND FLOOR**																				
4.1	1/2/3rd Secretary	186	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	0.7	0.6	-1.10	366	250	366	26	26	0.9	1 Nos. 1.0 TR Cassette Unit	1.0
4.2	Registry/Comms Room	154	0.0	23 ± 1	55	5	0.06	3	0.5	1.0	0.7	0.6	-0.96	348	241	348	24	24	0.9	1 Nos. 1.0 TR Cassette Unit	1.0
4.3	1/2/3rd Secretary	194	12.8	23 ± 1	55	5	0.06	3	0.5	1.0	1.2	1.1	-2.04	632	524	632	27	27	1.6	1 Nos. 1.6 TR Cassette Unit	1.6
4.4	Secretary	151	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	0.4	0.5	-0.80	189	171	189	24	24	0.5	1 Nos. 0.8 TR Cassette Unit	0.8
4.5	Registry/Comms Room	155	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	0.7	0.6	-0.95	323	222	323	24	24	0.8	1 Nos. 0.8 TR Cassette Unit	0.8
4.6	Military Attache	181	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	0.8	0.7	-1.39	395	275	395	26	26	1.0	1 Nos. 1.0 TR Cassette Unit	1.0
4.7	Director	233	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	0.9	0.7	-1.94	485	289	485	29	29	1.2	1 Nos. 1.28 TR Cassette Unit	1.28
4.8	Military Attache	184	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	0.8	0.6	-1.57	405	243	405	26	26	1.0	1 Nos. 1.0 TR Cassette Unit	1.0
4.9	Counsellor	239	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	0.9	0.7	-1.90	477	283	477	29	29	1.2	1 Nos. 1.28 TR Cassette Unit	1.28
4.10	Registry	148	10.6	23 ± 1	55	5	0.06	3	0.5	10.0	1.3	1.2	-1.96	695	601	695	24	24	1.7		7.95

4.11	Officer	1025	10.6	23 ± 1	55	5	0.06	15	1.0	2.0	4.7	4.1	-8.36	2416	1754	2416	137	137	6.0	1 Nos. 7.95 TR CS Duct Unit	
4.12	Minister	481	10.6	23 ± 1	55	5	0.06	6	0.5	1.0	1.8	1.6	-4.21	937	672	937	59	59	2.3	1 Nos. 2.5 TR Cassette Unit	2.5
4.13	Store	101	10.6	24 ± 1	55	5	0.06	0	0.5	1.0	0.6	0.5	-1.16	330	243	330	6	6	0.8	1 Nos. 1.0 TR Hi wall unit	1.0
3.11	ERV Unit																			1 Nos 500 CFM ERV Unit 1 Nos 250 CFM ERV unit	1.8
5	**THIRD FLOOR**																				
5.1	1/2/3rd Secretary	197	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	0.7	0.6	-1.19	330	216	330	27	27	0.8	1 Nos. 0.8 TR cassette Unit	0.8
5.2	1/2/3rd Secretary	199	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	0.7	0.6	-1.42	388	244	388	27	27	1.0	1 Nos. 1.0 TR cassette Unit	1.0
5.3	Counsellor	231	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	1.0	0.9	-1.54	502	384	502	29	29	1.3	1 Nos. 1.28 TR cassette Unit	1.28
5.4	Info Asst.	150	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	0.4	0.4	-0.70	188	133	188	24	24	0.5	1 Nos. 0.8 TR cassette Unit	0.8
5.5	Publication Store & Copier Room	135	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	0.8	0.7	-1.19	424	282	424	23	23	1.1	1 Nos. 1.28 TR cassette Unit	1.3
5.6	Registry	113	10.6	23 ± 1	55	5	0.06	3	0.5	10.0	1.1	1.0	-1.58	605	475	605	22	22	1.5	1 Nos. 1.6 TR cassette Unit	1.6
5.7	Secretary	154	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	0.6	0.4	-0.75	334	235	334	24	24	0.8	1 Nos. 0.8 TR cassette Unit	0.8
5.8	Secretary	145	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	0.9	0.8	-1.37	491	388	491	24	24	1.2	1 Nos. 1.28 TR cassette Unit	1.28
5.9	1/2/3rd Secretary	200	10.6	23 ± 1	55	5	0.06	4	0.5	1.0	0.9	0.9	-1.39	468	362	468	32	32	1.2	1 Nos. 1.28 TR cassette Unit	1.28
5.10	Counsellor	228	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	0.9	0.7	-1.86	467	277	467	29	29	1.2	1 Nos. 1.28 TR Cassette Unit	0.8
5.11	Conference	148	10.6	23 ± 1	55	5	0.06	8	1.0	2.0	1.0	1.0	-1.16	404	311	404	49	49	1.0	1 Nos. 1.0 TR Cassette Unit	1.0
5.12	Social Secretary	156	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	0.6	0.5	-0.99	281	187	281	24	24	0.7	1 Nos. 0.8 TR Cassette Unit	0.8
5.13	CFAA	156	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	0.6	0.6	-1.16	296	232	296	24	24	0.7	1 Nos. 0.8 TR cassette Unit	0.5
5.14	Comms Room & Closed Registry	272	10.6	23 ± 1	55	5	0.06	3	0.5	10.0	1.7	1.6	-3.04	959	787	959	31	31	2.4	1 Nos. 2.5 TR cassette Unit	2.5
5.15	Chief Director	380	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	1.7	1.4	-3.09	933	681	933	38	38	2.3	1 Nos. 2.5 TR cassette Unit	2.5
5.16	Minister	256	10.6	23 ± 1	55	5	0.06	3	0.5	1.0	1.4	1.2	-2.51	774	566	774	30	30	1.9	1 Nos. 2.1 TR Cassette Unit	2.1
3.11	ERV Unit																			1 Nos 500 CFM ERV Unit 1 Nos 400 CFM ERV unit	2.2
	TOTAL																		**91.0**		**106.2**

ANNEXURE–II

TECHNICAL SPECIFICATIONS

GREEN BUILDING PERFORMANCE GUIDELINES

Al system parameters shall adhere to IGBC guidelines as mentioned below for our system. These are bare minimum specification requirements. In case of any item specification where the parameters mentioned are lower than the guidelines mentioned for IGBC, the IGBC guidelines shall be followed.

- Air systems shall be balanced in a manner to first minimize throttling losses. Then, for fans with fan system power greater than 0.75 kW, fan speed shall be adjusted to meet design flow conditions.
- COP of VRF system should be 4.2 at AHRI condition.
- Any unitary air conditioning system should have BEE 5 star rating.
- Condensers shall be located such that the heat sink is free of interference from heat discharge by devices located in adjoining spaces, and do not interfere with other such systems installed nearby.
- Indoor units having fan power 0.0003 kW/CFM or less should be selected for all indoor units (VRV Ductable/Cassatte)
- Occupancy controls shall be installed to de-energize or to throttle to minimum the ventilation and/or air conditioning systems when there are no occupants in each conference and meeting rooms.
- The minimum R value of insulation on refrigerant pipe should be minimum 0.4 m2K/W.
- All the insulation (piping and ducting) exposed to weather shall be protected by aluminum sheet metal, painted canvas, or plastic cover. Cellular foam insulation shall be protected as above, or be painted with water retardant paint.

1. VARIABLE REFRIGERANT FLOW SYSTEM

1.1 Scope

The scope of this section comprises the supply, erection, testing and commissioning of Variable Refrigerant Volume System conforming to these specifications and in accordance with the requirements of Drawings and Schedule of quantities.

1.2 Type

Unit shall be air cooled, variable refrigerant volume air conditioner consisting of one outdoor unit and multiple indoor units. Each indoor unit having capability to cool independently for the requirement of the rooms. All indoor units shall be provided with isolation valves so that a particular unit can be isolated and removed for servicing, while system keeps functioning in normal way.

The VRV/VRF System Shall be perform Nonstop Cooling till 52 Deg C & The 100% capacity at high Ambient condition 45Deg C. The VRV Shall all Invertor & with COP above 4.2 & IPLV.

Cooling Capacity 10 Deg C to 52 Deg C
Heating Capacity -10Ceg C to till 24 Deg C.

Condenser Fans shall be provide with DV Motors to regulate air flow Depending on Demand.

All the Outdoor PCB,s Shall Be with Conformal Coting & protects the PCB from the Moisture, Heat, Fungus, Chemicals & Dust.

It shall be possible to connect multiple indoor unit on one refrigerant circuit as shown in the drawings or as indicated in schedule of quantities. The indoor units on any circuit can be of different type and also controlled individually. Following type of indoor units shall be connected to the system :

- Ceiling mounted cassette type.
- Ceiling mounted duct able type.

Compressor installed in outdoor unit shall be equipped with capacity control mechanism and capable of changing the rotating speed / mass flow rate of refrigerant by scroll engaging / dis engaging mechanism to follow variations in cooling. Outdoor unit shall be suitable for mix-match connection of all type of indoor units.

The refrigerant piping between indoor units and outdoor units shall be extended upto 100m with maximum 50 m level difference without any oil traps. Oil recovery system shall be managed without disturbance to normal operation cycle of the system / compressor.

Both indoor unit and outdoor unit shall be factory assembled, tested and filled with first charge of refrigerant before delivery at site.

1.3 Out Door Unit

The outdoor unit shall be factory assembled, weather proof casing constructed from heavy gauge mild steel panels with powder coated finish.

All outdoor units above 5 HP rating shall have minimum two number scroll compressors.

In case of outdoor units with multiple compressors, the operation shall not be disrupted with failure of any compressor.
The noise level shall not be more than 60 dB (A) at normal operation measured horizontally 1m away and 1.5 m above ground level.

The outdoor unit shall be modular in design with possible future expansions.

The unit shall be provided with microprocessor control panel.

1.4 Compressor

The compressor shall be high efficiency scroll type and capable for capacity controlling. It shall change the speed / refrigerant mass flow rate in accordance to the variation in cooling load requirement. Refrigerant mass flow rate can be changed by speed modulation of compressor / mechanical control system. System shall incorporate liquid sub-cooling mechanism with liquid injection at intermediate pressure. The inverter if used shall be IGBT (insulated gate bipolar transistor) type for efficient and quiet operation.

All outdoor units shall have multiple steps of capacity control to meet load fluctuation and indoor unit individual control. All parts of compressor shall be sufficiently lubricated. Forced lubrication may also be employed.

Oil heater shall be provided in the compressor casing.

1.5 Heat Exchanger

The Heat Exchanger shall be constructed with copper tubes mechanically bonded to aluminum fins to form a cross fan coil and larger surface area.

The fins shall have anticorrosion treatment for Heat Exchanger Coil. The treatment shall be suitable for areas of high pollution, moisture and salt laden air.

The casings, fans, motors etc. shall also be with anticorrosion treatment as a standard features.

The unit shall be provided with necessary number of direct driven low noise level propeller type fans arranged for vertical / horizontal discharge. Each fan shall have a safety guard.

1.6 Refrigerant Circuit

The Refrigerant Circuit shall include an liquid receiver /accumulator, liquid & gas shut off valves and a solenoid valve. All necessary safety devices shall be provided to ensure the safety operation of the system.

1.7 Safety Devices

All necessary safety devices shall be provided to ensure safe operation of the system.

Following safety devices shall be part of the outdoor unit : high pressure switch, low pressure switch, fuse, crankcase heater, fusible plug, over current protection for inverter, and short recycling guard timer.

1.8 Piping

All connections of Refrigerant piping shall be in high grade Copper of Refrigeration quality with Eddy Current Testing and material test Certificates.

All connections, tees, reducers etc. shall be standard make fittings.

Insulation of cold lines shall be carried out with Supreme/Armacell insulation sheets and tubes of appropriate thickness so that condensation does not occur.

For individual Piping 50 / 100 mm wide Aluminum Tape shall be used at joints of Piping with Bands for identification.

For outdoor piping, the finish shall be woven GRP Mat finished with colored Epoxy paints to withstand outside ambient conditions and UV Radiation.

1.9 Oil Recovery System

Unit shall be equipped with an oil recovery system to ensure stable operation with long refrigerant piping.

System shall be designed for proper oil return to compressor along with the distribution of oil to individual compressor.

The refrigerant piping shall be extended upped 100 M with 50-M level difference without oil traps.

1.10 Indoor Units

Units shall be factory assembled, wired, piped and tested.

Units shall have DX coils with copper tubes and bonded aluminum fins for highly efficient heat transfer.

Units shall have Centrifugal fans for adequate amount of Air circulation and low Noise.

Units shall have inlet filters, which are easily cleanable and replaceable.

All components of Units are easily accessible for connection, repairs and maintenance.

Units shall have very low noise.

All units with Factory manufactured Units, Grills shall have auto swing feature for proper Air distribution.

All unit shall be controlled by electronic Expansion Valves only.

All units mounted inside the ceiling shall have fans capable of sustaining duct connections, and special filters if necessary.

Visible indoor units shall have wireless remotes. Price of the same shall be included in cost of unit by default.

Concealed indoor units shall have sensor mounted on supply air grilles / diffusers which can be controlled with wireless remotes.

Anticorrosion treatment for avoiding corrosion of coils.

All units shall have adequate insulation or Lining to avoid condensation.

Cooling coil and refrigeration parameters shall be designed in such a way that supply air temperature shall not be less than 14^0C or 1^0C above room dew point temp, whichever is more. Contractor shall guarantee inside conditions with selected supply air temperature.

1.11 Ceiling Mounted Cassette Type Unit (MULTI-FLOW TYPE)

The unit shall be ceiling mounted type. The unit shall include pre-filter, fan section and DX-coil section. The housing of the unit shall be powder coated galvanized steel. The body shall be light in weight and shall be possible to suspend from four corners.

Unit shall have a external attractive panel for supply and return air. Unit shall have four way supply air grilles on sides and return air grille in center.

Each unit shall have high lift drain pump, fresh air intake provision (if specified), low gas level detection system and very low operating sound.

1.12 CEILING MOUNTED DUCTABLE TYPE UNIT

Unit shall be suitable for ceiling mounted type. The unit shall include pre filter, fan section & DX-coil section. The housing of unit shall be light weight powder coated galvanized steel. The unit shall have high static fan for Ductable arrangement.

1.13 High Wall Mounted Units

The units shall be high wall mounted type. The unit shall include pre-filter, fan section & DX-coil section. The housing of unit shall be light weight powder coated galvanized steel.

Unit shall have an attractive external casing for supply and return air.

1.14 ERV Unit (Energy Recovery Ventilation)

The unit shall be suitable Ceiling Suspended. ERV should be equipped with Dual system i.e. direct expansion (DX) coil and advanced Heat Exchanger. ERV should capable for both cooling & heating the outside air. It should have two way with ventilation design with air inlet and outlet on both side of the units.
System should be capable to recovers up to 70 percentage of the energy needed to cool or heat the fresh air.

1.15 Central Remote Controller

A multi-functional microprocessor based centralized controller (central remote controller) shall be supplied as an optional accessory.

The controller shall be able to control upto min. 64 zones of 64 group (each group consisting of max. 16 units) or 128 nos. of indoor units with the following functions.

- Temperature setting for each zone, or group, or indoor unit.
- On/Off as a zone or individual unit.
- Indication of operating condition.
- Select ON of all operation modes for each zone..
- The controller shall have wide screen liquid crystal display and shall be wired by a non-polar 2 wire transmission cable to a distance of 1000m away from the indoor unit.
- The controller shall be integrated to BAS system thru software for monitoring & controlling of all above parameters including start/ stop of each indoor / outdoor unit. All necessary interface cards / units should be supplied as a part of the system to integrate to the BAS Software.

1.16 Unified On/Off Controller

Unified ON / OFF controller shall be supplied as an optional accessory.

The controller shall be able to control minimum 2 groups (each group containing maximum 16 indoor units) or 128 nos. of indoor units with the following functions.

- On / Off as a zone or individual unit.
- Indication of operation condition of each group.
- Select one of 4 operation modes.

The controller shall be wired by a non-polar 2 wire transmission cable to distance of 1 km away from indoor unit.

The controller shall be integrated to BAS system thru software for monitoring & controlling of all above parameters including start/ stop of each indoor / outdoor unit. All necessary interface cards / units should be supplied as a part of the system to integrate to the BAS Software.

1.17 Condensate

25mm dia PVC pipes, 40mm dia PVC headers & fittings shall be used for condensate, from Evaporator Unit to drain point. The joints shall be properly sealed so that there is no water leakage.

U-trap shall be provided at the end. Additional insulation drain tray shall be provided below the Evaporator Unit, if required.

Mounting

All indoor units shall be mounted with Brackets, Hangers etc. with proper size anchor Fasteners.

1.18 Electrical Installation

For Variable Refrigerant flow systems, power will be provided near outdoor unit location. HVAC Contractor to provide suitable distribution panel along with 3-phase power to outdoor units and single phase power to all indoor units fed by these outdoor units. Power / control cabling along with supports shall be included.

1.19 All indoor units shall be equipped with appropriate particle filters up to PM 1.0. In addition to this, the intake air for the ERV shall pass through an Electrostatic Air Filter to cater for the outdoor intake air quality.

2. FANS

The scope of work shall comprise of Supply, installation, testing & commissioning of Fans as per the requirement specified in tender BOQ as well as drawings

2.1 Axial Flow Fan

Fan shall be complete with motor, motor mount, belt driven (or direct driven) and vibration isolation type, suspension arrangement as per approved for construction shop drawings.
.

Casing : shall be constructed of heavy gage sheet steel. Fan casing, motor mount and straightening vane shall be of welded steel construction. Motor mounting plate shall be minimum 15 mm thick and machined to receive motor flange.

An inspection door with handle and neoprene gasket shall be provided. Casing shall have flanged connection on both end for ducted applications. Fan casing are with internal punched inlet and outlet flanges to prevent air leakage, for size upto 1600 mm dia and shall be constructed of rolled steel with a continuous seam welded. Support brackets for ceiling suspension shall be welded to the casing for connection to hanger bolts. Straightening vanes shall be aerodynamically designed for maximum efficiency by converting velocity pressure to static pressure potential and minimizing turbulence. Casing shall be bowdlerized, primed (minimum 2 coats of rust-proof primer) and finish coated with enamel paint or powder coated after phosphating process.

Rotor : hub and blades shall be cast aluminum alloy or cast steel construction. Blades shall be die-formed aero foil shaped for maximum efficiency and shall vary in twist and width from hub to tip to effect equal air distribution along the blade length. Rotor shall be statically and dynamically balanced. Extended grease leads for external lubrication shall be provided. The fan pitch control may be manually readjusted at site upon installation, for obtaining actual air flow values, as specified and quoted. Taper lock bushing shall be used to mount the propeller to the motor shaft. The impeller and fan casing shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.

Motor: shall be energy efficient squirrel-cage, totally-enclosed, fan cooled, standard frame, constant speed, continuous duty, single winding, suitable for 415±10% volts, 50 cycles, 3 phase AC power supply, provided with class `F' insulation. Motor shall be specially designed for quiet operation. The speed of the fans shall not exceed 1000 RPM for fans with impeller diameter above 450 mm, and 1440 RPM for fans with impeller diameter 450 mm and less. For lowest

sound level, fan shall be selected for maximum efficiency or minimum horsepower. Motor conduit box shall be mounted on exterior of fan casing, and lead wires from the motor to the conduit box shall be protected from the air stream by enclosing in a flexible metal conduit.

Drive : Fan shall be provided through direct drive

Vibration Isolation : The assembly of fan and motor shall be suspended from the slab by vibration isolation suspension of heavy duty spring isolators type.

Axial Flow Fan shall be AMCA certified for Air and Sound performance in accordance to AMCA 210 and AMCA 300. Fan shall be suitable for both indoor and outdoor application with all accessories. Base fan performance shall be at standard conditions (density 1.2 Kg/Cu.mt.)

Following table shall be followed while selecting the fan :

S. No	Description	Standard Fan	UL Listed Fan	Fire Rated Fan
1	Casing	It shall be constructed of heavy gauge sheet steel .	It shall be constructed of heavy gauge sheet steel and should come under UL Standards.	It shall be constructed of heavy gauge sheet steel and shall withstand 300 degree C for 2 hours & should be fire rated.
2	Rotor	Hub & Blades shall be cast aluminum alloy or cast steel construction .	Hub & Blades shall be cast aluminum alloy or cast steel construction and should come under UL Standards.	Hub & Blades shall be cast aluminum alloy or cast steel construction and shall withstand 300 degree C for 2 hours & should be fire rated.
3	Motor	Motor shall have class F insulation.	Motor shall pass elevated temperature test and other tests as per UL Standards and shall be UL listed.	Motor for emergency fire, smoke and heat ventilation shall certified according to standard BS EN 12101-3:2002 for 300 degree C for 2 hours & should be fire rated.

3 INLINE & PROPELLER FANS

1. SCOPE

The scope of this section comprises the supply, installation, testing and commissioning of centrifugal and inline fans conforming to these specifications and in accordance with the requirement of drawings and DBR.

2. TYPE

Centrifugal and inline fans shall be of type as indicated in drawings and in DBR.

3a. INLINE FANS

Inline fan shall incorporate SISW direct driven centrifugal fan with TEFC (IP-44) motor. The fan assembly shall be enclosed in a sheet metal housing of 22 gauge GSS and with necessary inspection cover with proper gasket assembly. The fan material shall be galvanized sheet steel. Flanges shall be provided on both sides of inline fan to facilitate easy connection. Flexible anti-vibration joints

shall be provided to arrest vibration being transferred to other equipments connected to inline fan. Motor shall be single phase/three phase as per duty conditions.
All single-phase fans shall be provided with speed regulators while all three phase fans shall be provided with opposed blade dampers in GSS construction at fan outlet for air balancing.

3b CIRCULAR INLINE FAN

In-line centrifugal duct fan shall be single phase, straight through radial fan and shall be compact with high capacity, and easy to install and with acceptable sound levels not exceeding 48dBA.

Casing shall be manufactured from pre-galvanized steel with automatic thermostat contacts to protect windings from over-heating

Circular in-line fans shall be with backward curved impellor directly driven with external rotor, sturdy motor suitable for continuous operation. The impellor shall be engineering plastic/galvanized steel

The fan motor shall be complete with motor protection through built-in thermal contact and TEFC (IP54) enclosure. The motor construction shall be such that it is possible to regulate the speed.

4. PROPELLER FANS

Propeller fans shall be direct driven, three or four blade type mounted on a steel /MS mounting plate with orifice ring.
Mounting plate shall be of steel/MS construction, square with streamlined venturi inlet coated with baked enamel paint. Mounting plate shall be of standard size, constructed of 20 to 22 gauge steel sheet depending upon the fan size. Orifice ring shall be correctly formed by spinning or stamping to provide easy passage of air without turbulence and to direct the air stream.

Fan blades shall be constructed of aluminium or steel. Fan hub shall be of heavy welded steel construction with blades bolted to the hub fan blades and assembly shall be statically and dynamically balanced

Shaft shall be of steel accurately ground and shall not pass through first critical speed through entire range of specified fan speed.

Motor shall be standard permanent split capacitor of shaded pole for small sizes, totally enclosed with pre-lubricated sleeve or ball bearings, designed for a quiet operation with a maximum speed of 1000 RPM for fans 60 cm dia. or larger and 1440 RPM for fans 45 cm dia. and smaller. Motors for larger fans shall be suitable for 415 ± 6% volts. 50 cycle 3-phase power supply and for smaller fans shall be suitable for 220 ± 6% volts, 50 cycles single-phase power supply. Motors shall be suitable for horizontal or vertical service as indicated in drawings and as per requirements.
Propeller fans shall be provided with following accessories: -

a. Wire guard and bird-screen
b. Single-phase preventors for 3 phase fans.
c. Wiring between regulator and fan motor including termination at both ends**.**

6. PERFORMANCE DATA

All fans shall be selected for the lowest operating noise level. Capacity rating, power consumption with operating points clearly indicated shall be submitted and verified at the time of testing and commissioning of installation.

6. TESTING

Capacity of all fans shall be measured by an anemometer. Measured airflow capacities shall conform to the specified capacities and quoted ratings, power consumption shall be computed from measurements of incoming voltage and incoming current.

The Fans shall be preferably AMCA certified. Also, it should be UL & FM/EN approved.

5. REFRIGERANT PIPING

a. All refrigerant pipes and fittings shall be hard drawn copper tubes and wrought copper / brass fittings suitable for connection with silver solder / phos-copper.

b. All joints in copper piping shall be sweat joints using low temperature brazing and / or silver solder. Before joining any copper pipe or fittings, its interiors shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping shall be continuously kept clean of dirt etc. while constructing the joints. Subsequently, it shall be thoroughly blown out using carbon dioxide / nitrogen.

c. Refrigerant lines shall be sized to limit pressure drop between the evaporator and condensing unit to less than 0.2 kg per sq.cm.

d. Sight glass with moisture indicator and removable type combination dryer cum filter with MS housing and brass wire mesh / punched brass sheet shall be installed in liquid line of the refrigeration system incorporating a three valve by pass. After ninety days of operation, liquid line drier cartridges shall be replaced.

e. Heat exchanger shall be MS heavy duty pipe in pipe type and without any joint in the inner pipe.

f. Horizontal suction line shall be pitched towards the compressor and no reducers shall be provided for proper oil return.

g. After the refrigerant piping installation has been completed, the refrigerant piping system shall be pressure tested using Freon mixed with nitrogen / carbon dioxide at a pressure of 20 kg per sq. cm (high side) and 10 kg per sq. cm (low side). Pressure shall be maintained in the system for a minimum of 12 hours. The system shall then be evacuated to a minimum vacuum of 70 cm of mercury and held for 24 hours. Vacuum shall be checked with a vacuum gage.

h. All refrigeration piping shall be installed strictly as per the instructions and recommendations of air conditioning equipment manufacturer.

6. G.I DUCTING (FACTORY/ SITE FABRICATED)

6.1 Scope

The scope of this section comprises supply fabrication, installation and testing of all sheet metal ducts, supply, installation, testing and balancing of all grilles, registers and diffusers. All to be in accordance with these specifications and the general arrangement shown on the Drawings.

6.2 Duct Materials

6.2.1 Raw Materials

Galvanized steel sheets with Class - VIII Galvanizing – light coating of zinc (Zinc coating shall be Lead free), nominal 120gm/sq.m surface area and Lock Forming Quality prime material along with mill test certificates. In addition, if deemed necessary, samples of raw material, selected at random by owner's site representative shall be subject to approval and tested for thickness and zinc coating at contractor's expense.

6.2.2 Factory Fabricated Ducts

All ducts shall be factory fabricated from galvanized steel of the following thickness, as indicated below :For Ducts with External SP upto 250 Pa

Rectangular Ducts G. S.	**External Pressure 250 Pa**		
	Duct Section Length 1.2 m (4 ft)		
Maximum Duct Size	**Gauge**	**Joint Type**	**Bracing Spacing**
1–500 mm	26	C&S Connector	Nil
501 – 750 mm	26	C&S Connector	Nil
751 – 900 mm	26	TDF Flange	Nil
901 – 1200 mm	24	TDF Flange	Nil
1201 – 1500 mm	22	TDF Flange	Nil
1501 – 1800 mm	22	TDF Flange	JTR or ZEE BAR
1801 – 2100 mm	20	TDF Flange	JTR or ZEE BAR
2101 – above	18	TDF Flange	JTR or ZEE BAR

6.2.3 Site Fabricated Ducts

Rectangular Ducts G. S.	**External Pressure 250 Pa**
Maximum Duct Size	**Gauge**
1–75 cm	24
76 – 150 cm	22
151 – 225 cm	20
225 – above	18

FOR ALUMINUM DUCTS MATERIAL SHALL BE ONE COMMERCIAL GAUGE HIGHER WITH 22 G AS MINIMUM

6.2.4 Factory Fabricated Oval/Elliptical Ducts

All ducts shall be factory fabricated by using GI Sheet. The duct shall be factory insulated internally from Antimicrobial Class O insulation. Duct specification for oval duct shall GI Sheet of the following thickness shall be used, as indicated below :

Major axis Duct width	Oval Duct Thickness Gauge(mm)	Duct Fittings Thickness Gauge (mm)
To 600mm	24 (0.63)	20 (1.00)
601mm to 900mm	22 (0.80)	20 (1.00)
901mm to 1200mm	22 (0.80)	18 (1.25)
1201mm to 1500mm	20 (1.00)	18 (1.25)
1501mm to 1800mm	20 (1.00)	16 (1.60)

6.3

Fabrication Standards &Equipment

All duct construction and installation shall be in accordance with SMACNA standards. In addition ducts shall be factory fabricated utilizing the following machines to provide the requisite quality of ducts.

1. Coil (Sheet metal in Roll Form) lines to facilitate location of longitudinal seams at corners/folded edges only, for required duct rigidity and leakage free characteristics. No longitudinal seams permitted along any face side of the duct.

2. All ducts, transformation pieces and fittings to be made on CNC profile cutter for requisite accuracy of dimensions, location and dimensions of notches at the folding lines.

1. All edges to be machine treated using lock formers, flangers and rollers for turning up edges.

2. Kitchen exhaust ducting shall be with 16 G MS welded construction. Suitable access doors shall be provided at every 3m. Provision shall be made for firefighting agency to install duct mounted sprinklers at every 3m. Generally exhaust ducts shall have slope towards kitchen hood. Spot Welded M.S Stuck-up pins shall be provided facilitating insulation of the Duct .

   Laundry and dish washer extract duct shall be air and water tight construction manufactured from Aluminum sheets in accordance to BS 1470

6.4 Duct Construction

6.4.1 All ducts shall be fabricated and installed in workmanlike manner, conforming to relevant SMACNA codes.

a) Ducts so identified on the Drawings shall be acoustically lined and insulated from outside as described in the section “Insulation” and as indicated in schedule of Quantities. Duct dimensions shown on drawings, are overall sheet metal dimensions inclusive of the acoustic lining where required and indicated in Schedule of quantities. The fabricated duct

dimensions should be as per approved drawings and care should be taken to ensure that all connecting sections are dimensionally matched to avoid any gaps.

b) Ducts shall be straight and smooth on the inside with longitudinal seams shall be airtight and at corners only which shall be either Pittsburgh or snap button as per SMACNA practice, to ensure air tightness.

c) All ducts up to 75cms width within conditioned spaces shall have C&S connector. The internal ends of slip joints shall be in the direction of airflow. Care should be taken to ensure that Cleats are mounted on the longer side of the duct and Cleats on the shorter side. Ducts and accessories within ceiling spaces, visible from air-conditioned areas shall be provided with two coats of mat black finish paint.

d) Changes in dimensions and shape of ducts shall be gradual (between 1:4 and 1:7). Air-turns (vanes) shall be installed in all bends and duct collars designed to permit the air to make the turn without appreciable turbulence.

e) Ducts shall be fabricated as per details shown on Drawings. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees, or angles, of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing.

f) All sheet metal connection, partitions and plenums, required to confine the flow of air to and through the filters and fans, shall be constructed of 18 gauge GSS / 16gauge aluminum, thoroughly stiffened with 25mm x 25mm x 3mm galvanized steel angle braces and fitted with all necessary inspection doors as required, to give access to all parts of the apparatus. Access doors shall be not less than 45cm x 45cm in size.

g) Plenums shall be shop/factory fabricated panel type and assembled at site. Fixing of galvanized angle flanges on duct pieces shall be with rivets heads inside i.e. towards GS sheet and riveting shall be done from outside.

h) Self-adhesive Neoprene rubber / UV resistant PVC foam lining 5mm nominal thickness instead of felt, shall be used between duct flanges and between duct supports in all ducting installation.

i) All fire rated duct, smoke exhaust ducts shall be quoted with flame bar BWII or equivalent to achieve the required fire rating also all the related accessories gaskets shall be suitable for the required fire rating.

6.5 Installation Practice

All ducts shall be installed generally as per tender drawings, and in strict accordance with approved shop drawings to be prepared by the Contractor:

a) The Contractor shall provide and neatly erect all sheet metal work as may be required to carry out the intent of these Specifications and Drawings. The work shall meet with the approval of Owner's site representative in all its parts and details

b) All necessary allowances and provisions shall be made by the Contractor for beams, pipes, or other obstructions in the building, whether or not the same are shown on the drawings. Where necessary to avoid beams or other structural work, plumbing or other pipes, and conduits, the ducts shall be transformed, divided or curved to one side (the required area being maintained) all as per the site requirements.

c) If a duct cannot be run as shown on the drawings, the contractor shall install the duct between the required points by any path available in accordance with other services and as per approval of owner's site representative.

d) All ductwork shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with hangers formed of galvanized steel wire ropes and galvanized steel angle/channel or a pair of brackets, connected by galvanized steel wire hangers under ducts, rigid supports may be provided at certain interval if need be. The spacing between supports should be not greater than 2.4 meter. All vertical ductwork shall be supported by structural members on each floor slab. Duct supports may be through galvanized steel insert plates or Toggle end wire fixing left in slab at the time of slab casting.

Galvanized steel cleat with a hole for passing the wire rope hanger shall be welded to the plates. Trapeze hanger formed of galvanized steel wire rope using Grapple shall be hung through these cleats. Wherever use of metal insert plates is not feasible, duct support shall be through dash/anchor fastener driven into the concrete slab by electrically operated gun. Wire rope supports shall hang through the cleats or wire rope threaded studs can be screwed into the anchor fasteners.

e) Alternatively, if mentioned in the SOQ, all ductwork shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with trapeze hangers formed of galvanized steel rods and galvanized steel angle/channel or a pair of brackets, connected by galvanized steel rod under ducts**.** The spacing between supports should be not greater than 2.0 meter.

All vertical ductwork shall be supported by structural members on each floor slab. Duct supports may be through galvanized steel insert plates left in slab at the time of slab casting. Galvanized steel cleat with a hole for passing the hanger rods shall be welded to the plates. Trapeze hanger formed of galvanized steel rods shall be hung through these cleats. Wherever use of metal insert plates is not feasible, duct support shall be through dash/anchor fastener driven into the concrete slab by electrically operated gun. Hanger rods shall then hang through the cleats or fully threaded galvanized rods can be screwed into the anchor fasteners.

f) Ducting over furred ceiling shall be supported from the slab above, or from beams after obtaining approval of Owner's site representative. In no case shall any duct be supported from false ceiling hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other contractor's work in the building.

g) Where ducts pass through brick or masonry openings, it shall be provided with 25mm thick **TF quality expanded polystyrene around the duct and totally covered with fire barrier mortar for complete sealing.**

h) All ducts shall be totally free from vibration under all conditions of operation. Whenever ductwork is connected to fans, air handling units or blower coil units that may cause vibration in the ducts, ducts shall be provided with a flexible connection, located at the unit discharge. Flexible connections shall be constructed of fire retarding flexible heavy canvas sleeve at least 10cm long securely bonded and bolted on both sides. Sleeve shall be made smooth and the connecting ductwork rigidly held by independent supports on both sides of the flexible connection. The flexible connection shall be suitable for pressure at the point of installation.

i) Duct shall not rest on false ceiling and shall be in level from bottom. Taper pieces shall taper from top

6.6 Fire Rated Ductwork

Ducting for kitchen exhaust & fire evacuation, staircase pressurization if not in a separate shaft shall be fire rated as per following specifications.

a. All fire rated ductwork constructed for mechanical or dual ventilation / pressurization/ basement car park/smoke extract systems and shall be fabricated from Lock Forming Quality grade prime galvanized steel sheet, constructed to enhanced SMACNA American / DW144 European standard to either low, medium or high velocity/ pressure.

b. Test requirement of fire rated ductwork should be tested to BS476: Part 24 [1987] and ISO 6944 providing required fire rating for Stability and Integrity.

c. Stability: the ability of a duct, ductwork & the support system to remain intact & fulfill their intended function for a specified period of time, when tested to the requirements of BS476: Part 24 and ISO 6942.

d. Integrity: the ability of a duct or ductwork to remain free of cracks, holes or openings outside the compartment in which the fire is present for a specified period of time, when tested to the requirements of BS476 Part 24 ISO 6942.

e. Insulation: the ability of a duct or ductwork to maintain its separating function without developing temperatures on its external surface outside the compartment in which the fire is present, which exceeds, (i) 140^{O}C as an average value above ambient & or, (ii) 180^{O}C as maximum value above ambient at any point, when tested for a specified period of time to the requirements of BS476: Part 24 ISO 6942.

f. It's important that the fire rated ductwork has a smooth internal surface in order to minimize the pressure loss within the fire rated ductwork system thereby reduce the power requirements.

g. All fire rated ducts for Smoke Extract shall have Stability / Integrity and Insulation for smoke temperatures up to 300^{O}C upto 1.5 hrs, restriction of the duct due to twisting or buckling after the fire test shall not cause 25% or more reduction in cross sectional area proven by certification from an independent test house.

h. Each duct shall have fire rated coating. Fire rated coating compound used for construction of fire rated ductwork shall be protected with minimum 0.7mm to 1mm nominal thickness tested to properties as per the requirements of BS 476: 6 & 7, including non-combustibility Class O and fire propagation - Class 1 surface spread of flame & materials in accordance with Building Regulations.

i. Fire duct to be tested / assessed to BS476: Part 24 for all sizes up to 25 meters x 3 meters cross-sectional area and fully certified to vertical and horizontal plane.

j. Fire rated duct fabricated to Method 3 of BS 5588: Part 9, factory produced. The coating compound shall be applied either offsite or onsite on the ground, dried and cured.

k. Fire duct expansion under fire conditions shall not exceed following:

- at 430^{O}C an expansion of 0.006106mm per mm
- at 600^{O}C an expansion of 0.00852mm per mm
- at 1100^{O}C an expansion of 0.01562mm per mm.

7. AIR DISTRIBUTION

7.1 Dampers

a. Dampers: All duct dampers shall be opposed blade louver dampers of robust 20/22 G GSS construction and tight fitting. The design, method of handling and control shall be suitable for the location and service required.

b. Dampers shall be provided with suitable links levers and quadrants as required for their proper operation. Control or setting device shall be made robust, easily operable and accessible through suitable access door in the duct. Every damper shall have an indicating device clearly showing the damper position at all times.

c. Dampers shall be placed in ducts at every branch supply or return air duct connection, whether or not indicated on the Drawings, for the proper volume control and balancing of the air distribution system.

d. Pressure relief dampers: Pressure relief dampers shall be constructed with 20/22G Aluminum construction with parallel blade construction. Leaf's shall be 100% air tight upon closure. Leaf's shall be loaded with spring pressure of stiffness (k value) corresponding to set point pressure.

e. Non return damper (Back draft damper) : Non return damper shall be constructed out of 20/22G GSS. Blades shall ensure 100% air leak proof performance on closure. Design shall ensure that no rattling noise is produced at design duty.

f. Constant Volume Regulator (For TFA / Exhaust ducts)

Constant volume regulators (KVR) shall be used to obtain constant air volume at a given pressure range.

The constant volume regulators (KVR) shall be of the circular type for high pressures and to be inserted into ductwork and suitable for vertical as well as horizontal mounting and it should be placed at a minimum distance of 3x the duct diameter from air supply grilles and minimum distance of 1x the duct diameter from air exhaust grilles

Constant volume regulator body, valve and piston shall be made out of flame retardant PVC, fire classification M1. They shall contain a self-regulating PVC valve, piston, rubber strip for air tightness inside the duct and stainless steel calibrated spring and shall have preset air volume.

Constant volume regulator shall be made of PVC. The range covers an air flow range from 15 up to 1200 m^3/h within a pressure range from 50 up to 600 Pa.

7.2 Supply & Return Air Registers

Supply & return air registers shall be of either steel or aluminum sections as specified in schedule of quantities. Steel construction registers shall have primer Coat finish whereas extruded aluminum registers shall be either Anodized or Powder Coated as specified in Schedule of Quantities. These registers shall have individually adjustable louvers both horizontal and vertical. Supply air registers shall be provided with key operated opposed blade extruded aluminum volume control damper anodized in matt black shade.

The registers shall be suitable for fixing arrangement having concealed screws as approved by Architect. Linear continuous supply cum return air register shall be extruded aluminum construction with fixed horizontal bars at 15 Deg. inclination & flange on both sides only (none on

top & bottom). The thickness of the fixed bar louvers shall be minimum 5.5 mm in front and 1.8 mm in rear with rounded edges. Flanges on the two sides shall be 20 mm/30 mm wide as approved by Architect.

The grilles shall be suitable for concealed fixing. Volume control dampers of extruded aluminiumanodised in black color shall be provided in supply air duct collars. For fan coil units horizontal fixed bar grilles as described above shall be provided with flanges on four sides, and the core shall be & suitable for clip fixing, permitting its removal without disturbing the flanges.

a. All registers shall be selected in consultation with the Architect. Different spaces shall require horizontal or vertical face bars, and different width of margin frames. These shall be procured only after obtaining written approval from Architect for each type of register.

b. All registers shall have a soft continuous rubber/foam gasket between the periphery of the register and the surface on which it has to be mounted. The effective area of the registers for air flow shall not be less than 66 percent of gross face area.

c. Registers specified with individually adjustable bars shall have adjustable pattern as each grille bar shall be pivotable to provide pattern with 0 to +45 degree horizontal arc and upto 30 degree deflection downwards. Bars shall hold deflection settings under all conditions of velocity and pressure.

d. Bar longer than 45 cm shall be reinforced by set-back vertical members of approved thickness.

e. All volume control dampers shall be anodized aluminum in mat black shade.

7.3 Supply & Return Air Diffusers

Supply and return air diffusers shall be as shown on the Drawings and indicated in Schedule of Quantities. Mild steel diffusers/dampers shall be factory coated with rust-resistant primer. Aluminum diffusers shall be powder coated & made from extruded aluminum section as specified in schedule of quantities.

a. Rectangular Diffusers shall be steel / extruded aluminum construction, square & rectangular diffusers with flush fixed pattern for different spaces as per schedule of quantities These shall be selected in consultation with the Architect. These shall be procured only after obtaining written approval from Architect for each type of diffuser.

b. Supply air diffusers shall be equipped with fixed air distribution grids, removable key-operated volume control dampers, and anti-smudge rings as re-required in specific applications and as per requirements of schedule of quantities. All extruded aluminum diffusers shall be provided with removable central core and concealed key operation for volume control damper.

c. Linear Diffuser shall be extruded aluminum construction with removable core, one or two way blow type. Supply air diffusers shall be provided with volume control/ balancing dampers within the supply air collar. Diffusers for different spaces shall be selected in consultation with the Architect, and provided as per requirements of schedule of quantities. All diffusers shall have volume control dampers of extruded aluminum construction anodized in mat black shade.

d. Slot Diffuser shall be extruded aluminum construction multiplot type with air pattern controller provided in each slot. Supply air diffusers shall be provided with Hit & Miss

volume control dampers in each slot of the supply air diffusers. Diffusers for different spaces shall be selected in consultation with the Architect and provided as per requirement of Schedule of Quantities.

e. Data centers shall be provided with floor grilles. Grilles shall be of nominal size of 600mm x 600mm and shall be fitted in floor tile of false floor. Grille shall be with dampers for flow control. Grill shall be heavy duty 16G Aluminum and shall take care of human traffic load. Damper shall be operable in situ without requirement of removal of grille.

7.4 Grapple

Wire Hangers shall be used to suspend all static HVAC Air Distribution services.

Wire Hangers should consist of a pre-formed wire rope sling with a range of end fixings to fit various substrates and service fixings, these include a ferruled loop, permanently fixed threaded M6 (or M8, M10) stud, permanently fixed nipple end with toggle, at one end or hook or eyelet, cladding hook, barrel, wedge anchor, eyebolt anchor or any other end fixture type or size as per manufacturers recommendation and design. The end fixings and the wire must be of the same manufacturer with several options available. The system should be secured and tensioned with a Hanger self-locking grip (double channel lock) at the other end. Once the grip is locked for safety purpose unlocking should only be done by using a separate setting key and should not be an integral part of the self-locking grip. Only wire and/or supports supplied and/or approved, shall be used with the system.

a. Wire Hangers should have been independently tested by Lloyds Register. APAVE, TUV, UL NEBS, CSA, Chiltern International fire, ADCAS, Intertek, ECA, and SMACNA, approved by ULC and CSA and comply with the requirements of DW/144 and BSRIA – wire Rope Suspension systems. Wire rope should be manufactured to BSEN 12385: 2002

b. The contractor shall select the correct specification of wire hanger to use for supporting each particular service from Table 1 below. Each size is designated with a maximum safe working load limit (which incorporates a 5:1 safety factor).

The correct specification of wire hanger required is determined using the following formula.

Weight per meter of object suspended (kg) X distance between suspension points (m) = weight loading per Hanger suspension point (kg).

Where the installed wire rope is not vertical then the working load limit shall be reduced in accordance with the recommendations give in the manufacturer’s handbook.

The contractor shall select the correct length of wire rope required to support the service. Lengths from 1-10m lengths. Specials can be made, check with manufacturer. No in–line joints should be made in the rope.

The standard range of Hanger Kits should contain galvanized high tensile steel wire rope or stainless steel wire rope as per the application, the minimum specification is as above and should be manufactured to BS 302 (1987), BSEN12385. **Comply with manufacturer's load ratings and recommended installation procedures.**

Table. 1

Wire (Gripple) Hanger Safe Working Loads		
Hanger size	**minimum breaking load of Wire Rope (Kg / lbs)**	**working load limit (kg/lbs)**
No. 1	80kg/176 lbs	0-10 kg / 0-22 lbs
No. 2	260kg/572 lbs	10-45 kg / 23-100 lbs
No. 3	580kg/1276 lbs	45-90 kg / 101-200 lbs
No. 4	1500kg/3300 lbs	90-225 kg / 210-495 lbs
No. 5	2160kg/4752 lbs	225-325 kg / 496-715 lbs
No. 6	2500kg/5500 lbs	325-500 kg / 715-1100 lbs

7.4.1 Ducting Supports:

a. All ductwork shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with hangers formed of galvanized steel wire ropes and galvanized steel angle/channel or a pair of brackets, connected by galvanized steel wire hangers under ducts, rigid supports may be provided at certain interval if need be. The spacing between supports should be not greater than 2.4 meter. All vertical ductwork shall be supported by structural members on each floor slab. Duct supports may be through galvanized steel insert plates or Toggle end wire fixing left in slab at the time of slab casting. Galvanized steel cleat with a hole for passing the wire rope hanger shall be welded to the plates. Trapeze hanger formed of galvanized steel wire rope using Grapple shall be hung through these cleats. Wherever use of metal insert plates is not feasible, duct support shall be through dash/anchor fastener driven into the concrete slab by electrically operated gun. Wire rope supports shall hang through the cleats or wire rope threaded studs can be screwed into the anchor fasteners. In case of PEB structure Loop and Catenary system can be used based on the site conditions as per approved suspension system drawings.

b. All horizontal ducts shall be adequately secured and supported. In an approved manner, with trapeze Hangers formed of galvanized steel wire rope in a cradle support method (refer to typical drawings) under ducts at no greater than 3000mm center, for 3001mm-above appropriate size angle along with neoprene pad in between the duct & MS angle should be used with prior approval. All vertical duct work shall be supported by structural members on each floor slab. Duct support shall be through dash / anchor fastener driven into the concrete slab by electrically
operated gun. Hanger wires shall then hang around the ducting. Rigid supports shall be used in conjunction with wire rope hangers to assist with alignment of services where recommended for by the manufacturer. Rigid support must also be used in conjunction with wire rope hangers with duct work at each change of direction or connection or as per approved drawings. Support ducting in accordance with Schedule I specified below. Any other Gripple solution can be used based on manufacturer's recommendation on site conditions after prior approval. In cases of Spiral ducting the wire can be wrapped directly around the ducting without the need for a spiral ducting clamp for sizes above 1100 a cradle support should be provided, refer to manufacturer's recommendations.

c. Ducting over furred ceiling shall be supported from the slab above or from beams after obtaining approval of Construction manager/consultant. In no case shall any duct be supported from false ceiling Hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other

Contractor's work in the building. All supports of pipe shall be taken from structural slab/wall by means of fastener.
Catenary Supports: Refer to manufacturer's recommendations on Catenary supports with C-clip, special care should be taken with tensioning of the wire and angles at which the installation of services are made**.**

d. Stainless Steel Supports should be provided for food, chemical and High Corrosion areas near coastlines.

For further technical information refer to manufacturers catalogue and installation guide. **Comply with manufacturer's load ratings and recommended installation procedures.**

Schedule I: Duct Hanger Schedule

For ducts with external SP upto 250 Pa			For ducts with external SP upto 500 Pa		
Maximum Duct Size (mm)	**Gauge**	**Gripple Hanger size**	**Maximum Duct Size (mm)**	**Gauge**	**Gripple Hanger size**
1 - 500	26	No. 1 or 2	1–400 mm	26	No. 2
501 - 750	26	No. 1 or 2	401-700 mm	24	No. 2 or 3
751 - 900	26	No. 2	701-900 mm	24	No. 2 or 3
901 - 1200	24	No. 2 or 3	901-1000 mm	22	No. 3 or 4
1201 - 1500	22	No. 3	1001-1200 mm	22	No. 3 or 4
1501 - 1800	22	No. 3 or 4	1201-2100 mm	22	No. 3 or 4
1801-2100	20	No. 3 or 4	2101 - 3000mm	18	No. 4
2101-3000	18	No. 4	3001 - above (Trapeze type support Arrangement)	18	No. 3 or 4
3001 - above (Trapeze type support Arrangement)	18	No. 3 or 4			

Notes: All supports are considered at 2400 mm interval in above table and may vary as per the design but should not be greater than 2400mm.

All units shall be adequately secured and supported in an approved manner using wire hanger suspension Y fit solution as per manufacturers' recommendation with prior approval.
Rigid Supports to be used in conjunction with wire supports:

Rigid supports if required in conjunction with wire hangers shall be of steel, adjustable for height and Zinc chromate primer coated and finish coated black. Where supports and clamps are of dissimilar materials, a gasket shall be provided in between. If the MS angle at the bottom if required as per design should be as per following table:

Longer size of Duct (mm)	**Type of Joints**
Up to 750	25x25x3 mm L angle with M8 nuts & bolts
751-1000	25x25x3 mm L angle with M8 nuts & bolts
1001-1500	40x40x5 mm L angle with M8 nuts & bolts
1501-2250	50x50x5 mm L angle with M10 nuts & bolts
2251 & above	50x50x6 mm L angle with M10 nuts & bolts

All the supporting system should be supplied from the same manufacturer

8. INSULATION

8.1 Scope

The scope of this section comprises the supply and application of insulation conforming to these specifications. The insulation material shall be Closed Cell Elastomeric Nitrile Rubber / Polyethylene Foam

8.2 Material

Thermal insulation material for Duct insulation shall be with factory laminated black fiber glass cloth closed cell Nitrile rubber. Density of the nitrile rubber shall be 40-60 Kg/m^3
or
Al foil faced polyethylene material (XLPE). Density of the polyethylene material shall be 25-30 Kg/m^3

Thermal conductivity as per **BS 874 part 2 – 86 (DIN 52613, 52612) /DIN EN 12667 / EN ISO8497** of the insulation material shall not exceed 0.038 W/m^oK or 0.212 BTU / ($Hr\text{-}ft^2\text{-}^oF$/inch) at an average temperature of 30°C. The product shall have temperature range of –40°C to 105°C. The insulation material shall be fire rated for Class 0 as per BS 476 Part 6 : 1989 for fire propagation test and for Class 1 as per BS 476 Part 7, 1987 for surface spread of flame test. Water vapor permeability shall be not less than 0.024 per inch (2.48×10^{-13} Kg/m.s.Pa i.e. $\mu \geq 7000$: Water vapor diffusion resistance) as per **DIN 53122 part 2, DIN 52615 / EN 12086 & EN13469**.

In addition to above properties the insulation material for ducts shall be anti-microbial. Microbiological growth on insulation surface shall be in accordance with ASTM G-21 and bacterial resistance to ASTM2180/ ISO22196.

The Material shall comply to ISO 5659 / BS 6853 / ABD 0031 for smoke density and toxicity values. The thermal conductivity of insulation material shall not be effected by aging as per **DIN 52616 standard.**

Thickness of the insulation shall be as specified for the individual application. **Each lot of insulation material delivered at site shall be accompanied with manufacturer's test certificate for density and thickness.** Adhesive used for sealing the insulation shall be non-flammable and with low VOC content (maximum 850 gm/l less water) as per IGBC guide lines) strictly as per manufacturer's recommendations. Adhesive shall be externally applied by contractor on site.

Ducting insulation thickness shall be as per table below.

Ducting position	**Thk. for non-coastal places**
SA duct in RA path	13 mm
Ducted return air system	SA duct: 19 mm RA duct: 13 mm
Both SA & RA exposed	Both 25 mm

8.3 Duct Insulation

External thermal insulation shall be provided as follows :

The thickness of insulation material shall be as shown on drawings or identified in the schedule of quantity. Following procedure shall be adhered to:

Duct surfaces shall be cleaned to remove all grease, oil, dirt, etc. prior to carrying out insulation work.

Measurement of surface dimensions shall be taken properly to cut closed cell insulation to size with sufficient allowance in dimension. Cutting of insulation sheets shall be done with adjustable blade to make 90^0 cut in thickness of sheet. Hackshaw or blades are not acceptable tools for cutting the insulation.

Material shall be fitted under compression and no stretching of material shall be permitted. All longitudinal and transverse joints shall be sealed by providing 50 mm wide Fibreglass cloth laminated tape as per manufacturer recommendations. The insulation installers shall be certified by manufacture.

Where ducts/pipes penetrates walls / floor it shall be insulated with intumescent properties insulation material for fire protection. The treatment shall be minimum 500 mm extended on both sides.

8.4 Piping Insulation

8.4.1 Refrigerant pipe insulation

Thermal insulation material for Pipe insulation shall be Elastomeric Nitrile Rubber with factory laminated Non Metallic cladding system made up of double layer laminate of Aluminum, coated with special UV protection and PVC backing. Thermal conductivity as per **DIN EN 12667** of the insulation material shall not exceed 0.038 W/m^{o}K or 0.212 BTU / (Hr-ft^2-^{o}F/inch) at an average temperature of 30^{o}C. Density of the nitrile rubber shall be 40-55 Kg/m^3,. The product shall have temperature range of –40^{o}C to 105^{o}C. The insulation material shall be fire rated for Class 0 as per BS 476 Part 6 : 1989 for fire propagation test and for Class 1 as per BS 476 Part 7, 1987 for surface spread of flame test. Water vapor diffusion resistance of the system i.e. µ value shall be greater than or equal to 60000 as per **EN 12086**

Thickness of the insulation shall be as specified for the individual application. **Each lot of insulation material delivered at site shall be accompanied with manufacturer's test certificate for density and thickness.** Samples of insulation material from each lot delivered at site may be selected by Owner's site representative and gotten tested for thermal conductivity and density at Contractor's cost. Adhesive used for sealing shall be strictly as per manufacturer's recommendations.

The factory lamination on the base material shall be of chemically treated blue colored glass cloth of 7 mil thickness tested for UV resistance as per EN ISO 4892-2 Method-A. Thickness of refrigerant piping insulation shall be 13mm and 19mm unless specified separately.

8.4.2 Drain pipe insulation

Base insulation material for drain pipe shall be same as that of Refrigerant pipe. The factory lamination on the base material shall be of chemically treated blue colored glass cloth of 7 mil thickness tested for UV resistance as per EN ISO 4892-2 Method-A. Thickness of drain piping insulation shall be 13mm unless specified separately

8.5 Duct Acoustic Lining

Open Cell Nitrile Rubber

Duct acoustic lining material shall be Nitrile Rubber open cell foam. Thermal conductivity of the insulation material shall not exceed 0.047 W/m^{o}K at an average temperature of 20^{o}C. Density of the nitrile rubber shall be 140 – 180 Kg/m$^{1.}$ The material should withstand maximum surface temperature of +85^{o}C and minimum surface temperature of -20^{o}C. The material should conform to Class 1 rating for surface spread of Flame in accordance to BS 476 Part 7 & HBF, HF 1 & HF 2 in accordance to UL 94, 1996.

Insulation should have antimicrobial product protection, and should pass Fungi Resistance as per ASTM G 21 and Bacterial Resistance as per ASTM E 2180. The insulation should pass Air Erosion Resistance Test in accordance to ASTM Standard C 1071-05 (section 12.7).

Thickness of the material shall be 15 mm thick specified for the individual application and with noise absorption proprieties as per IS: 8225 / ISO 354 / ASTM423C. The insulation should be installed as per manufacturer's recommendation.

8.6 Kitchen Duct Insulation

All kitchen exhaust ducts connected to kitchen hoods shall be insulated with 50 mm / 75 mm thick 60 kg/m3 density pre-laminated glass wool. PVC strap of 25 mm width shall be fixed at 300 mm interval to secure the insulation in position. Kitchen duct exposed to outside shall be further treated as under:-

a) Wrapping of "scrim glass fabric" and thereafter applying first coat of resin system formulated with activators and inert fillers. This coat is allowed to cure to a non-stick state.
b) Second coat of activated resin with suitable pigment is applied over the first coat and
finished to give a though smooth surface.

Duct Insulation VOC limit shall not exceed to 850 (g/L less water)

8.7 Room Lining

Open Cell Nitrile Rubber

Two walls and ceiling of air conditioning plant room and air handling unit / fan rooms may be provided with acoustic lining.

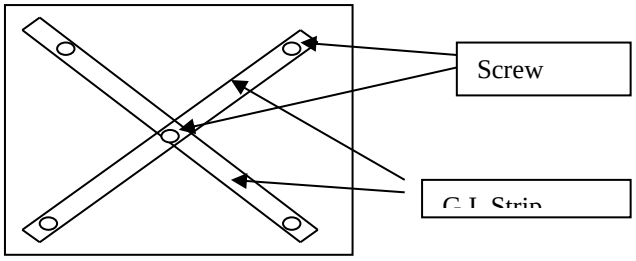
The material shall be Nitrile Rubber open cell foam. Thermal conductivity of the insulation material shall not exceed 0.047 W/m^{o}K at an average temperature of 20^{o}C. Density of the nitrile rubber shall be 140 – 180 Kg/m$^{1.}$ The material should withstand maximum surface temperature of +85^{o}C and minimum surface temperature of -20^{o}C. The material should conform to Class 1 rating for surface spread of Flame in accordance to BS 476 Part 7 & HBF, HF 1 & HF 2 in accordance to UL 94, 1996.

Insulation should have antimicrobial product protection, and should pass Fungi and Bacterial Resistance as per DIN EN ISO 846 Method A and Method C. The insulation should pass Air Erosion Resistance Test in accordance to ASTM Standard C 1071-05 (section 12.7).

Thickness of the material shall be 20mm if not specified separately. Surface shall be cleaned and two coats of adhesive recommended by the manufacturer should be applied on the walls. The foam sheets should be cut to required size and a layer of adhesive should also be applied to it. When it is tack dry it is stuck to the walls / ceiling.

All longitudinal and transfer joint shall be covered with 22 gauge 50 mm wide GI strip with screws as shown below:-

Acoustic lining of walls shall be terminated approximately 15 cm above the finished floor to prevent damage to insulation due to accidental water-logging in plant/AHU / fan rooms.



8.8 Measurement Of Insulation

Unless otherwise specified measurement for duct and pipe insulation for the project shall be on the basis of center line measurements described herewith

a. Pipe Insulation shall be measured in units of length along the center line of the installed pipe, strictly on the same basis as the piping measurements described earlier. The linear measurements shall be taken before the application of the insulation. It may be noted that for piping measurement, all valves, orifice plates and strainers are not separately measurable by their number and size. It is to be clearly understood that for the insulation measurements, all these accessories including cladding, valves, orifice plates and strainers shall be considered strictly by linear measurements along the center line of pipes and no special rate shall be applicable for insulation of any accessories, fixtures or fittings whatsoever.

b. Duct Insulation and Acoustic Lining shall be measured on the basis of surface area along the center line of insulation thickness. Thus the surface area of externally thermally insulated or acoustically lined be based on the perimeter comprising center line (of thickness of insulation) width and depth of the cross section of insulated or lined duct, multiplied by the center-line length including tapered pieces, bends, tees, branches, etc. as measured for bare ducting.

ANNEXURE–III

Technical data Sheets

1.0 VRF UNIT

1.1 General

a. Manufacturer

b. Material and thickness of casing

c. Material and thickness of drain pan.

d. Type of vibration isolator

1.2 Fan Section

a. Manufacturer.

b. Type of fan

c. Type of bearings.

d. Fan RPM

1.3 Motor

a. Manufacturer

b. Type

c. Motor speed (RPM)

d. Motor Efficiency

e. Class of Insulation

2. PIPING

a. Make of pipes / class of pipes

b. Pipe Wall thickness

3. GALVANISED STEEL SHEETS

a. Make

b. Thickness/Gauge

c. Class of Galvanizing

4. GRILLES / DIFFUSERS / DAMPERS

Make, material and gauge of the following :

a. Fire damper, rating, make of damper motor

b. Smoke damper, rating, make of damper motor

c. Grilles/Diffuser

5. INSULATION

a. Manufacturer

b. Duct acoustic lining material & density

c. Duct insulation material & density

d. Pipe insulation material & density

LIST OF APPROVED MAKES FOR EUIPMENT & MATERIALS

S.No.	Martial Description	Approve make
1	Hi-Wall / CASS. UNIT /ERV	All parameters shall satisfy IGBC rating requirements for performance as specified in the document above.
2	Grille/diffuser/insulation	Hira Airmax Airflow Pawan System air Aero foam
3	Nitrile rubber along with adhesive	Nitrile rubber along with adhesive Aeroflex Armacell Eurobatex – Union Foam
4	Pre-Insulated Duct	ALP Nutech Radiant System Air
5	GI Sheet	ESSAR Jindal Lloyd SAIL TATA
6	Factory Made Duct	Alpha duct Ductofab Rolastar Seven star
7	Smoke / Fire Damper	Green heck Mapro Airflow Tristar System air
8	INSULATION: Nitrile rubber along with adhesive	Aeroflex Armacell Eurobatex – Union Foam

ANNEXURE C: MEP SPECIFICATIONS

PART 3 : PLUMBING

PROPOSED CONSTRUCTION OF THE NEW CHANCERY AND OFFICIAL RESIDENCE

IN NEW DELHI INDIA

TENDER DOCUMENTS

PLUMBING SYSTEM

(Special Conditions &Technical Specification)

Date: - 26/02/2025

ARCHITECT

SPACE ARCHITECTURE STUDIO
V-12/23, DLF- PHASE-III
Gurgaon, Haryana - 122002.
Off Ph: +91-124-4734320
contact@studiosas.in

MEP SERVICES CONSULTANTS

235/B, Rajpur Khurd Extention
Chhatarpur,New Delhi-110068
PH : - 8920228058/8920225677
Email:-msc@msc-mep.com

SPECIAL CONDITIONS

1. GENERAL

These special conditions are intended to amplify the General Conditions of Contract and shall be read in conjunction with the same. For any discrepancies between the General Conditions and these Special Conditions, the more stringent shall apply.

2. SCOPE OF WORK

The general character and the scope of work to be carried out under this contract is illustrated in Drawings, Specifications and Schedule of Quantities. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Owner's site representative. The contractor shall furnish all labour, materials and equipment (except those to be supplied by the owner) as listed under Schedule of Quantities and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete Plumbing / Sanitary System as described in the Specifications and as shown on the drawings. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract. The Plumbing / Sanitary System shall comprise of following:

a. Sanitary Fixtures and Fittings.

b. Internal Water Supply.

c. External Water Supply

d. Internal Drainage

e. External Drainage

f. Other Miscellaneous items.

g. Wiring & earthing from MCC panels to various plumbing system, control wiring & interlocking.

h. Cutting holes, chases & like through all types of walls /floors and finishing for all services crossings, including sealing, frame works, fire proofing, providing sleeve, cover plates, making good structure and finishes to an approved standard.

i. Balancing, testing & commissioning of the entire Plumbing System.

j. Test reports, list of recommended spares, as-installed drawings, operation & maintenance manual for the entire Plumbing System.

k. Approval of Chief controller of Explosive Central / Local Pollution Control Board, Electrical inspector etc, if any.

l. Training of Owner's staff.

3. ASSOCIATED CIVIL WORKS

Following civil works associated with Plumbing / Sanitary installation are excluded from the scope of this contract. These shall be executed by other agencies in accordance with approved shop drawings of and under direct supervision of the Plumbing / Sanitary contractor.

a. RCC foundation for machines, pumps & large equipment with angle iron frame work at the edges to protect these from damage.

b. RCC work for water tanks

c. PCC foundation blocks with angle iron frame work edging for all motor control centre.

d. Water proofing of floors.

e. Masonry drain channels and sumps in plant room.

f. Urinal Divisonal Plates

4. ASSOCIATED SERVICES WORKS

a. All associated **ELECTRICAL WORKS** listed below are excluded from the scope of this contract. These shall be installed by other agencies in accordance with approved shop drawings of, and under direct supervision of the Plumbing / Sanitary contractor.

i. Providing power supply with earthing at the incoming of control panel in plant room.

5. BUILDING AUTOMATION SYSTEM

The scope of Plumbing / Sanitary Contractor shall include the following for the interface to Building Automation System and no additional cost shall be paid for providing the interface feasibility.

a. Stop/Manual/ Auto switches along with potential free contacts for monitoring the manual operation status, to be provided for that equipment whose start / stop is controlled by Building Automation System.

b. Potential free 'NO' contacts for monitoring 'Run' status of equipment wherever required.

c. Necessary contactor with potential free contacts and Stop/Manual/ Auto switches to be provided for all 1-phase equipment wherever the starter is not provided, and which requires starting / stopping through Building Automation System.

d. Sockets /Nipples including shut-off valve for mounting sensors/transmitters on pipe.

e. The space provision in allthe equipment panel (MCC) for mounting Current/ Potential transformers & transducers and power supply to the transducer shall be provided by the Plumbing / Sanitary contractor. Separate current transformers shall be provided by Plumbing / Sanitary contractor for monitoring current / KWH (wherever required) through BAS.

f. The installation of current transformer & Transducer along with wiring between Current Transformer & Transducer up to the terminal block shall be provided by the Plumbing / Sanitary contractor. All transducers shall be supplied by BAS contractor.

g. The low voltage BAS Cables shall be brought upto the electric panel by BAS contractor and all terminations into the electrical panels shall be made by Plumbing / Sanitary contractor after satisfying himself of the wiring system. It is to be clearly understood that the final responsibility for the sufficiency, adequacy and conformity to the contract requirements, of the Plumbing / Sanitary System, lies solely with the contractor.

h. All necessary Hardware/ Software shall be made available by the Plumbing / Sanitary Contractor on the Microprocessor based panel for the integration of such panel to Building Automation System for remote monitoring / controlling of marking / equipment thru BAS.

6. PROJECT EXECUTION AND MANAGEMENT

The Contractor shall ensure that senior planning and erection personnel from his organisation are assigned exclusively for this project. They shall have minimum 10 years experience in this type of installation. The Contractor shall appoint one Project Director holding senior management position in the organisation. He shall be assisted on full time basis by a minimum of two erection engineers & three senior supervisors. The entire staff shall be posted at site on full time basis.

The project management shall be through modern technique. The Contractor's office at site shall be fully equipped with fax, modem, computers, plotter and photocopier. Erection engineer and supervisors shall be provided with mobile communication system so that they can always be reached.

For quality control & monitoring of workmanship, contractor shall assign at least one full-time engineer who would be exclusively responsible for ensuring strict quality control, adherence to specifications and ensuring top class workmanship for the installation.

The Contractor shall arrange to have mechanised& modern facilities of transporting material to place of installation for speedy execution of work.

Following manpower deployment shall be provided by the contractor:-

a. One Project Director

b. 1 Senior Engineer (minimum 10 years experience) & 1 Junior Engineer (5 years experience).

c. 2 Senior Supervisors

d. 1 QA/QC Engineer (Part Time)

e. 1 Housekeeping in charge with at any given time minimum 3 years experience.

f. 1 Store Keeper.

7. PERFORMANCE GUARANTEE

The contractor shall carry out the work in accordance with the Drawings, Specifications, Schedule of Quantities and other documents forming part of the Contract.

The contractor shall be fully responsible for the performance of the selected equipment (installed by him) at the specified parameters and for the efficiency of the installation to deliver the required end result.

The contractor shall guarantee that the Plumbing / Sanitary System as installed shall maintain the design conditions as described under "Basis of Design"and relevant clauses in the specifications. The guarantee shall be submitted in the proforma given in Appendix - II.

Complete set of architectural drawings is available in the Architect/Consultant's office and reference may be made to same for any details or information. The contractor shall also guarantee that the performance of various equipments individually, shall not be less than the quoted capacity; also actual power consumption shall not exceed the quoted rating, during testing and commissioning, handing over and guarantee period.

8. INSPECTION AND TESTING

The owner shall carry out inspection and testing at manufacturer's works for items such as water treatment plant, electrical panels & pumps covered under this contract. No equipment shall be delivered without prior written confirmation from Project Manager. In case factory inspection is carried out then all travelling and lodging expenses shall be borne by Client for maximum two persons. All expenses related to testing shall be to Contractor account. Tests on site of completed works shall demonstrate the following, among other things.

That the equipment installed complies with specification in all respects and is of the correct rating for the duty and site conditions.

That all items operate efficiently and quietly to meet the specified requirements

That all electrical circuits are correctly protected and that protective devices are properly coordinated.

The contractor shall provide all necessary instruments and labour for testing, shall make adequate records of test procedures and readings, shall repeat any tests requested by the Project Manager and shall provide test certificate signed by a properly authorized person. Such test shall be conducted on all materials and equipments and tests on completed work as called for by the Project Manager at contractor's expenses unless otherwise called for.

If it is proved that the installation or part thereof is not satisfactorily carried out, then the contractor shall be liable for the rectification and retesting of the same as called for by the Project Manager whose decision as to what constitutes a satisfactory test shall be final.

The above general requirements as to testing shall be read in conjunction with any particular requirements specified elsewhere. All tests shall be carried out by a test house approved by the Project Manager.

9. BYE-LAWS AND REGULATIONS

The installation shall be in conformity with the Bye-laws, Regulations and Standards of the local authorities concerned, in so far as these become applicable to the installation. But if these Specifications and Drawings call for a higher standard of materials and / or workmanship than those required by any of the above regulations and standards, then these Specifications and Drawings shall take precedence over the said regulations and standards. However, if the Drawings and specifications require something which violates the Bye-laws and Regulations, then the Bye-laws and Regulations shall govern the requirement of this installation.

10. FEES AND PERMITS

The Tenderer shall pay any and all fees and obtain permits required for the installation of this work. On completion of the work, the tenderer shall obtain and deliver to the Owner's certificate of final inspection and approval by the local Plumbing authority (CFO/ Municipal, State/Central govt whichever is applicable) at its own cost Owner's not to pay for any clearances. The contractor is liable to take necessary permits and approvals for the entire plumbing System installation works pertaining to HVAC, Electrical other allied engineering services. However, all receipted amount shall be reimbursed on production of proof of payment.

11. DRAWINGS

The Plumbing / Sanitary Drawings listed under Appendix-I, which may be issued with tenders, are diagrammatic only and indicate arrangement of various systems and the extent of work covered in the contract. These Drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. Under no circumstances shall dimensions be scaled from these Drawings. The architectural/interiors drawings and details shall be examined for exact location of equipment and water supply / drainage piping etc.

The contractor shall follow the tender drawings in preparation of his shop drawings, and for subsequent installation work. He shall check the drawings of other trades to verify spaces in which his work will be installed.

Maximum headroom shall be maintained at all points. Where headroom appears inadequate, the contractor shall notify the Architect/Consultant/Owner's site representative before proceeding with the installation. In case installation is carried out without notifying, the work shall be rejected and contractor shall rectify the same at his own cost.

The contractor shall examine all architectural, structural, plumbing, electrical and other services drawings and check the as-built works before starting the work, report to the Owner's site representative any discrepancies and obtain clarification. Any changes found essential to coordinate installation of his work with other services and trades, shall be made with prior approval of the Architect/Consultant/Owner's site representative without additional cost to the Owner. The data given in the Drawings and Specifications is as exact as could be procured, but its accuracy is not guaranteed.

12. TECHNICAL DATA

Each tenderer shall submit along with his tender, the technical data for all items. Failure to furnish complete technical data with tenders may result in summary rejection of the tender.

13. SHOP DRAWINGS

13.1 All the shop drawings shall be prepared on computer through Autocad System based on Architectural Drawings, site measurements and Interior Designer's Drawings. Within four weeks of the award of the contract, contractor shall furnish, for the approval of the Architect/Consultant, two sets of detailed shop drawings of all equipment and materials including layouts for Plant room, Pump room, Typical toilets drawings showing exact location of supports, flanges, bends, tee connections, reducers, detailed piping drawings showing exact location and type of supports, valves, fittings etc; external insulation details for pipe insulation etc; electrical panels inside/outside views, power and control wiring schematics, cable trays, supports and terminations. These shop drawings shall contain all information required to complete the Project as per specifications and as required by the Architect/Consultant/Owner's site representative. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings. Minimum 12 sets of drawings shall be submitted after final approval along with CD.

Each item of equipment/material proposed shall be a standard catalogue product of an established manufacturer strictly from the manufacturers listed in Appendix-III and quoted by the tenderer in technical data part of Appendix - IV.

When the Architect/Consultant makes any amendments in the above drawings, the contractor shall supply two fresh sets of drawings with the amendments duly incorporated along with check prints, for approval. The contractor shall submit further twelve sets of shop drawings to the Owner's site representative for the exclusive use by the Owner's site representative and all other agencies. No material or equipment may be delivered or installed at the job site until the contractor has in his possession, the approved shop drawing for the particular material/equipment/installation.

13.2 Shop drawings shall be submitted for approval four weeks in advance of planned delivery and installation of any material to allow Architect/Consultant ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved programme.

13.3 Manufacturers drawings, catalogues, pamphlets and other documents submitted for approval shall be in four sets. Each item in each set shall be properly labelled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number and clearly

identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.

13.4 Samples of all materials like valves, pipes, insulation, control wires etc shall be submitted to the Owner's site representative prior to procurement. These will be submitted in two sets for approval and retention by Owner's site representative and shall be kept in their site office for reference and verification till the completion of the Project. Wherever directed a mockup or sample installation shall be carried out for approval before proceeding for further installation.

13.5 Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supercede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract.

13.6 Where the contractor proposes to use an item of equipment, other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundation, piping, wiring or any other part of the mechanical, electrical or architectural layouts; all such re-design, and all new drawings and detailing required therefore, shall be prepared by the contractor at his own expense and gotten approved by the Architect/Consultant/ Owner's site representative. Any delay on such account shall be at the cost of and consequence of the Contractor.

13.7 Plumbing / Sanitary Contractor shall prepare coordinated services shop drawings based on the drawings prepared by Electrical, HVAC & Low Voltage Contractors to ensure adequate clearances are available for installation of services for each trade.

Where the work of the contractor has to be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the Owner's site representative, the contractor shall prepare composite working drawings and sections at a suitable scale, not less than 1:50, clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordinating with other trades, or so as to cause any interference with work of other trades, he shall make all the necessary changes without extra cost to the Owner.

13.8 Within two weeks of approval of all the relevant shop drawings, the contractor shall submit four copies of a comprehensive variation in quantity statement, and itemized price list of recommended (by manufacturers) imported and local spare parts and tools, covering all equipment and materials in this contract. The Project Manager shall make recommendation to Owner for acceptance of anticipated variation in contract amounts and also advise Owner to initiate action for procurement of spare parts and tools at the completion of project.

14. QUIET OPERATION AND VIBRATION ISOLATION

All equipment shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Owner's site representative.

In case of rotating machinery sound or vibration noticeable outside the room in which it is installed, or annoyingly noticeable inside its own room, shall be considered objectionable. Such conditions shall be corrected by the Contractor at his own expense. The contractor shall guarantee that the equipment installed shall maintain the desired NC levels.

15. ACCESSIBILITY

The Contractor shall verify the sufficiency of the size of the shaft openings, clearances in cavity walls and suspended ceilings for proper installation of his piping and other ancillaries. His failure to communicate insufficiency of any of the above shall constitute his acceptance of sufficiency of the same**.** The Contractor shall locate all equipment which must be serviced, operated or maintained in fully accessible positions. The exact location and size of all access panels, required for each concealed, valve or other devices requiring attendance, shall be finalized and communicated in sufficient time, to be provided in the normal course of work. Failing this, the Contractor shall make all the necessary repairs and changes at his own expense. Access panel shall be standardised for each piece of equipment / device / accessory and shall be clearly nomenclatured / marked.

16. MATERIALS AND EQUIPMENT

All materials and equipment shall conform to the relevant Indian Standards and shall be of the approved make and design. Makes shall be strictly in conformity with list of approved manufacturers as per Appendix - III.

17. MANUFACTURERS INSTRUCTIONS

Where manufacturer has furnished specific instructions, relating to the material and equipment used in this project, covering points not specifically mentioned in these documents, such instructions shall be followed in all cases.

18. ELECTRICAL INSTALLATION

The electrical work related to Plumbing / Sanitary services, shall be carried out in full knowledge of, and with the complete coordination of the contractor. The electrical installation shall be in total conformity with the control wiring drawings prepared by the contractor and approved by the Architect/Consultant. All equipment shall be connected and tested in the presence of an authorised representative of the contractor.

The Plumbing / Sanitary System shall be commissioned only after the contractor has certified in writing that the electrical installation work for Plumbing / Sanitary services has been thoroughly checked, tested and found to be totally satisfactory and in full conformity with the contract Drawings, Specifications and manufacturers instructions. It is to be clearly understood that the final responsibility for the sufficiency, adequacy and conformity to the contract requirements, of the electrical installation work for Plumbing / Sanitary services, lies solely with the contractor**.**

19. COMPLETION CERTIFICATE

On completion of the Electrical installation for Plumbing / Sanitary services, a certificate shall be furnished by the contractor, counter signed by the licensed supervisor, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local authority.

The contractor shall be responsible for getting the entire electrical installation for Plumbing / Sanitary System duly approved by the local authorities concerned, and shall bear expenses if any, in connection with the same.

20. BALANCING, TESTING AND COMMISSIONING

Balancing of all water systems and all tests as called for the Specifications shall be carried out by the contractor through a specialist group, in accordance with the Specifications and ASPE / ASHRAE Guide lines and Standards. Performance test shall consist of three days of 10 hour each operation of system for each season. Cost of performance witness test of major equipment such as pumps, equipment, panels etc. at factory with two personnel from Owners / Consultant shall be included.

The installation shall be tested again after removal of defects and shall be commissioned only after approval by the Owner's site representative. All tests shall be carried out in the presence of the representatives of the Architect/Consultant and Owner's site representative.

21. COMPLETION DRAWINGS

Contractor shall periodically submit completion drawings as and when work in all respects is completed in a particular area. These drawings shall be submitted in the form of two sets of floppies / CD's and four portfolios (300 x 450 mm) each containing complete set of drawings on approved scale indicating the work as - installed. These drawings shall clearly indicate complete plant room layouts, piping layouts, location of wiringand sequencing ofautomatic controls, location of all concealed piping, valves, controls, wiring and other services. Each portfolio shall also contain consolidated control diagrams and technical literature on all controls. The contractor shall frame under glass, in the plant room, one set of these consolidated control diagrams.

22. OPERATING INSTRUCTION & MAINTENANCE MANUAL

Upon completion and commissioning of part Plumbing / Sanitary System **t**he contractor shall submit a draft copy of comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the contractor shall submit four (4) complete bound sets of typewritten operating instructions and maintenance manuals; one each for retention by Consultant and Owner's site representative and two for Owners Operating Personnel. These manuals shall also include basis of design, detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for 4 year period of maintenance of each equipment.

"***Preventive Maintenance Schedule for each equipment / panel shall be submitted along with Operation and Maintenance Manual".***

23. ON SITE TRAINING

Upon completion of all work and all tests, the Contractor shall furnish necessary operators, labour and helpers for operating the entire installation for a period of fifteen (15) working days of ten (10) hours each, to enable the Owner's staff to get acquainted with the operation of the system. During this period, the contractor shall train the Owner's personnel in the operation, adjustment and maintenance of all equipment installed**.**

24. MAINTENANCE DURING DEFECTS LIABILITY PERIOD

24.1 Complaints

The Contractor shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 10 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

24.2 Repairs

All equipment that require repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free-of-charge to the Owner.

25. UPTIME GUARANTEE

The Contractor shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall get extended by a month for every month having shortfall. In case of shortfall beyond the defects liability period, the contract for Operation and Maintenance shall get extended by a month for every month having the shortfall and no reimbursement shall be made for the extended period.

The Contractor shall provide log in the form of diskettes and bound printed comprehensive log book containing tables for daily record of all pressures, power consumption. starting and stopping times for various equipment, daily services rendered for the system alarms, maintenance and record of unusual observations etc. Contractor shall also submit preventive maintenance schedule.

Each tenderer shall submit along with the tender, a detailed operation assistance proposal for the Owner's site representatives/Consultant's review. This shall include the type of service planned to be offered during Defects Liability Period and beyond. The operation assistance proposal shall give the details of the proposed monthly reports to the Management.

The tenderer shall include a list of other projects where such an Operation Assistance has been provided.

26. All bathroom fittings shall adhere to the following IGBC specifications

Provide water efficient plumbing fixtures as mentioned below: (at 3 bar pressure)

- Water closets: 4/2 Liter per flush (full flush/half flush)
- Urinals: 0.5 Liter per flush
- Faucets/Taps: 1.9 Liter per minute
- Health faucet: 3.8 Liter per minute
- Shower: 4 Liter per minute
- Rain Showere : 12 litres per minute

Provide sub-metering for the following water use applications: (at least 3)

- Municipal water supply
- Treated waste water consumption
- Water consumption for landscape requirements
- Water consumption for flushing

APPENDIX–I

LIST OF APPROVED MAKES FOR EQUIPMENT & MATERIALSPLUMBING SYSTEM

S.No.	Details of Materials / Equipment		Manufacturer's Name
1.	a. Vitreous China Sanitaryware		Spec as per BOQ
	b. WC Connectors		Spec as per BOQ
2.	Stainless Steel Sink		Spec as per BOQ
3.	Auto Urinal Flush System		Spec as per BOQ
4.	Hand Drier		Spec as per BOQ
5.	CP Brass Fittings		Spec as per BOQ
6.	Flow Control Devices		Jaquar Parryware Cera Hindware
7.	Geyser		Spec as per BOQ
8.	Floor Drain Fixture, Rain Water Outlets		ACO GMGR Geberit
9.	Pre fabricated Car parking / Drain channel		ACO Viega
10.	C.P. Grating for Floor Trap		Spec as per BOQ
11.	Drip Seal		ACQUA Bond Vinod Cement Co. Chandigarh Megaseal

S.No.	Details of Materials / Equipment	Manufacturer's Name
12.	Cast Iron Pipes & Fittings Manhole covers & frames	
	a. As per IS:3989 (Pipes & Fittings)	NECO Kapilansh SKF
	b. As per IS:1729 (Manhole covers and frames)	NECO SRIF Raj Iron Foundry Agra
	C. DI Manhole Covers & Frames	Kartar valves & fittings NECO
13.	GI / MS Pipes (IS : 1239 and IS : 3589)	Tata Steel Jindal (Hissar) Jindal (Star)
14.	GI pipes fittings	Jindal (Hissar) Jindal (Star) Tata
15.	GI pipe sealent	Henkel - LOCTITE 55
16.	Pipe clamp & supports	Chilly Euroclamp Kanwal
17.	UPVC Pipe	Akg Astral Finolex
18.	CPVC pipes	Akg Astral Finolex
19.	GM / Forged Brass Ball Valves	AKG SKS Zoloto
20.	Butterfly Valve	AKG SKS Zoloto
21.	Check Valve – WaferType	AKG SKS Zoloto

S.No.	Details of Materials / Equipment		Manufacturer's Name
23.	Check Valve Forged Screwed		AKG SKS Zoloto
24.	Air Release Valve		AKG SKS Zoloto
25.	Ball Float Valve		AKG SKS Zoloto
26.	Y Strainer CI		AKG SKS Zoloto
27.	Storm Water Drainage & Sewage Sump Pumps (Submersible)		Xylem Grunfos Lubi
28.	Transfer Pumps		Xylem Grunfos Lubi
29.	Mechanical Seal		Burgmann Sealol
30.	Couplings		Lovejoy Dunlop
31.	Pressure Gauge		Emerald Fiebig H Guru
32.	Anti Vibration Mounting & Flexible Connections		Dunlop Flexionics Kanwal Industrial Corporation Resistoflex
33.	Water Meter (Mechanical Type)		Adept Kranti Kent
34.	Level Controller & Indicator (Water)		Auto Pump Cirrus Engineering Elegent Controls

35.	Paints	Asian Paints Berger ICI Shalimar Paints

36.	Welding Rods	ADOR Esab Royal Plug
37.	Fastner	Fisher Hilti Wurth
38.	Dosing Pumps	LMI Pulser Feeder Toschon Grundfos
39.	U.V. Sterlizer	ALFA Pentair Eureka Forbes
40.	Pipe Protection Wrapping	IWL - Pypkote Rustech – Coatek
41.	Pipe Protection Wrapping	IWL - Pypkote Rustech – Coatek

A P P E N D I X – I (B)

(As per Approved Electrical make list)

LIST OF APPROVED MAKES FOR EQUIPMENT & MATERIALS ELECTRICAL SYSTEM

S.No.	Details of Materials / Equipment		Manufacturer's Name
1.	Motor Control Centre		Zeniya Electech Pvt. Ltd. Gemtech Power Control Pvt. Ltd. SPC Elecrotech Ltd Advance Panel and switchgear Pvt. Ltd Core metal kraft Ltd.
2.	Moulded Case Circuit Breaker (MCCB)		Schneider Electric (NX) Lauritz Knudsen (D-Sine) Legrand ABB C&S
3.	Motor Protection Circuit Breaker(MPCB)		Schneider Electric (NX) Lauritz Knudsen (D-Sine) Legrand ABB C&S
4.	Miniature Circuit Breakers (MCB)		Schneider Electric (NX) Lauritz Knudsen (D-Sine) Legrand ABB C&S
5.	Residual Current Circuit Breaker (RCCB)		Schneider Electric (NX) Lauritz Knudsen (D-Sine) Legrand ABB C&S
6.	Power/Aux. Contactor / Capacitor Duty Contactor		Schneider Electric (MG) Lauritz Knudsen Legrand ABB
7.	Change Over Switch		HPL – Socomec
8.	Control Transformer/Potential Transformers		Automatic Electric Pragati Precise
9.	Current Transformer (Epoxy Cast Resin)		Automatic Electric Pragati Precise

10.	Protection Relay		ABB Larsen&Toubro Siemens
11.	Indicating Lamps LED type and Push Button		Vaishno Electricals Larsen & Toubro (ESBEE) Schneider Electric Siemens
12.	Overload relays with built in Single Phase preventer		ABB Lauritz Knudsen Schneider Electri Siemens
13.	a. Electronic Digital Meters (A/V/PF/Hz/KW/KWH) with LED Display		Schneider Electric Trinity Enersole
14.	PVC insulated XLPE aluminium/copper conductor armoured MV Cables upto 1100 V grade		RR KABEL Ravin Cable KEI
15.	LT Jointing Kit / Termination		Birla-3M Raychem Safe Kit
16.	Cable Glands Double Compression with earthing links		Baliga Lighting Comet
17.	Bimettalic Cable Lug		Comet Dowell's (Biller India) Hax Brass (Copper Alloy India)
18.	PVC Conduit & Accessories (ISI approved)		AKG BEC
19	PVC insulated copper conductor stranded flexible wires		RR KABLE KEI Batra Henlay APAR
20.	Mettalic / GI Conduit (ISI approved)		AKG BEC
21.	Selector Switch, Toggle switch		CTM NEEDO Kaycee Salzer (Larsen & Toubro)
22.	Cable Trays (Factory Fabricated) / Raceways		Profab Engineer SPC Maheshwari Electrtricals

			Zeniya Electech Pvt. Ltd.
23.	Sealed Maintenance Free Batteries		Amar Raja Exide Hitachi Shinkobe
24	Battery Charger		ChhabiElectricals Volstat
25.	Timer		ABB Schneider Electric Siemens

APPENDIX-II

LIST OF BUREAU OF INDIAN STANDARDS CODES

All equipment, supply, erection, testing and commissioning shall comply with the requirements of Indian Standards and code of practices given below as amended uptodate. All equipment and material being supplied by the contractor shall meet the requirements of IS. Tarrif advisory committee's regulation (fire insurance), electrical inspectorate and Indian Electricity rules and other Codes / Publications as given below:

1. Pipes and Fittings

IS : 458	Specification for precast concrete pipes (with and without reinforcement)
IS : 651	Salat glazed stone ware pipes and fittins.
IS : 1239 (Part 1)	Mild steel, tubes, tubulars and other wrought steel fittings: Part 1 Mild Steel tubes.
IS : 1239 (Part 2)	Mild Steel tubes, tubulars and other wrought steel fittings: Part 2 Mild Steel tubulars and other wrought steel pipe fittings.
IS : 1536	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage.
IS : 1537	Vertically cast iron pressure pipes for water, gas and sewage.
IS : 1538	Cast Iron fittings for pressure pipes for water, gas and sewage.
IS : 1729	Sand Cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 1879	Malleable cast iron pipe fittings.
IS : 1978	Line pipe
IS : 1979	High test line pipe.
IS : 2501	Copper tubes for general engineering purposes
IS : 2643 (Part 1)	Dimensions for pipe threads for fasterning purposes: Part 1 Basic profile and dimensions.
IS : 2643 (Part 2)	Dimensions for pipe threads for fastening purposes: Part 2 Tolerances.

IS : 2643 (Part 3)	Dimensions for pipe threads for fastening purposes: Part 3 Limits of sizes.
IS : 3468	Pipe nuts.
IS : 3589	Seamless or electrically welded steel pipes for water, gas and sewage (168.3 mm to 2032 mm outside diameter).
IS : 3989	Centrifugally cast (sun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 4346	Specifications for washers for use with fittings for water services.
IS : 4711	Methods for sampling steel pipes, tubes and fittings.
IS : 6392	Steel pipe flanges
IS : 6418	Cast iron and malleable cast iron flanges for general engineering purposes.
IS : 7181	Specification for horizontally cast iron double flanged pipe for water, gas and sewage.

2. <u>Valves</u>

IS : 778	Specification for copper alloy gage, globe and check valves for water works purposes.
IS : 780	Specification for sluice valves for water works purposes (50 mm to 300 mm size).
IS : 1703	Specification copper alloy float valves (horizontal plunger type) for water supply fittings.
IS : 2906	Specification for sluice valves for water works purposes (350 mm to 1200 mm size)
IS : 3950	Specification for surface boxes for sluice valves.
IS : 5312 (Part 1)	Specification for swing check type reflux (non return) valves : part 2 Multi door pattern.
IS : 5312 (Part 2)	Specification for swing check type reflux (non return) valves : part 2 Multi door pattern.
IS : 12992 (Part 1)	Safety relief valves, spring loaded : Design
IS : 13095	Butterfly valves for general purposes.

3. Sanitary Fittings

IS : 771 (Part 1 to 3)	Specification for glazed fire clay sanitary appliances.
IS : 774	Specification for flushing cistern for water closets and urinals (other than plastic cistern)
IS : 775	Specification for cast iron brackets and supports for wash basins and sinks
IS : 781	Specification for cast copper alloy screw down bib taps and stop valves for water services.
IS : 1700	Specification for drinking fountains.
IS : 2548 (Part 2)	Specification for plastic seats and covers for water closets: Part 1 Thermoset seats and covers.
IS : 2556 (Part 1)	Specification for vitreous sanitary appliances (Vitreous china) : Part 1 General requirement.
IS : 2556 (Part 2)	Specification for vitreous sanitary appliances (vitreous china): Part 2 Specific requirements of wash-down water closets.
IS : 2556 (Part 3)	Specification for vitreous sanitary appliances (vitreous china): Part 3 Specific requirements of squatting pans.
IS : 2556 (Part 4)	Specification for vitreous sanitary appliances (vitreous china) : part 4 specific requirements of wash basins.
IS : 2556 (Part 6 Sec 2)	Specification for vitreous sanitary appliances (vitreous china) : part 6 Specific requirements of urinals, section 2 half stall urinals.
IS : 2556 (Part 6 Sec 4)	Specification for vitreous sanitary appliances (vitreous china) : Part 6 specific requirements of urinals, section 4 partition slabs.
IS : 2556 (Part 6 Sec 5)	Specification for vitreous sanitary appliances (vitreous china) : Part 6 Specific requirements of urinals, section 5 waste fittings.
IS : 2556 (Part 6 Sec 6)	Specification for vitreous sanitary appliances (vitreous china) : Part 6 Specific requirements of urinals, section 6 water spreaders for half stall urinals.
IS : 2556 (Part 7)	Specification for vitreous sanitary appliances (vitreous china) : Part 7 Specific requirements of half round channels.

IS : 2556 (Part 8)	Specification for vitreous sanitary appliances (vitreous china) : Part 8 Specific requirements of siphoning wash down water closets.
IS : 2556 (Part 11)	Specification for vitreous sanitary appliances (vitreous china):Part 11 Specific requirements for shower rose.
IS : 2556 (Part 12)	Specification for vitreous sanitary appliances (vitreous china) : Part 12 Specific requirements of floor traps.
IS : 2556 (Part 15)	Specification for vitreous sanitary appliances (vitreous china) : Part 15 Specific requirements of universal water closets.
IS : 2692	Specification for ferrule for water services
IS : 2717	Glossary of terms relating to vitreous enamelware and ceramic metal systems
IS : 2963	Specifications for waste plug and its accessories for sinks and wash basins.
IS : 3311	Specification for waste plug and its accessories for sinks and wash basins.
IS : 5961	Specification for cast iron gratings for drainage purposes.
IS : 6249	Specification for gel-coated glass fibre reinforced polyester resin bath tubs.
IS : 6411	Specification for gel-coated glass fibre reinforced polyester resin bath tubs.
IS : 8931	Specification for copper alloy fancy single taps, combination tap assembly and stop valves for water services.
IS : 9758	Specification for flush valves and fitting for water closets and urinals.

4. Water Quality Tolerance

IS : 3025 (Parts 1 to 44)	Method of sampling and test (physical and chemical) for water and waste water.
IS : 4764	Tolerance limits for sewage effluents discharged into inland surface waters.
IS : 10500	Drinking Water

5. Pumps & Vessels

IS : 1520	Specification for horizontal centrifugal pumps for clear cold fresh water.
IS : 2002	Steel plates for pressure vessels for intermediate and high temperature service includng boilers.
IS : 2825	Code for unfired pressure vessels.
IS : 4648 (Part 1)	Code of practice for lining of vessels and equipment for chemical processes Part 1 : Rubber lining.
IS : 5600	Specification for sewage and drainage pumps
IS : 8034	Specification for submersible pump sets for clear, cold, fresh water.
IS : 8418	Specification for horizontal centrifugal self priming pumps.

6. <u>General</u>

SP : 6 (1)	Structural Steel Sections
IS : 325	Three Phase Induction Motors
IS : 554	Dimensions for pipe threads where pressure tight joints are required on the threads.
IS : 694	PVC insulated cables for working voltagesupto& including 1100 V.
IS : 779	Specification for water meters (domestic type).
IS : 782	Specification for caulking load.
IS : 800	Code of practice for general construction in steel
IS : 1068	Electroplated coatings of nickel plus chromium and copper plus nickel plus chromium.
IS : 1172	Code of Basic requirements for water supply drainage and sanitation.
IS : 1367 (Part 1)	Technical supply conditions for threaded steel fasteners : Part 1 introduction and general information.
IS : 1367 (Part 2)	Technical supply conditions for threaded steel fasteners : Part 2 product grades and tolerances.
IS : 1554 (Part 1)	PVC insulated (heavy duty) electric cables : Part 1 for working voltages upto and including 1100 V.

IS : 1554 (Part 2)	PVC insulated (heavy duty) electric cables : Part 2 for working voltages from 3.3 KV upto and including 11 KV.
IS : 1726	Specification for cast iron manhole covers and frames.
IS : 1742	Code of practice for building drainage.
IS : 2064	Selection, installation and maintenance of sanitary appliance code of practice.
IS : 2065	Code of practice for water supply in buildings.
IS : 2104	Specification for water meter for boxes (domestic type)
IS : 2373	Specification for eater meter (bulk type)
IS : 2379	Colour code for identification of pipe lines.
IS : 2527	Code of practice for fixing rainwater gutters and down pipes for roof drainage.
IS : 2629	Recommended practice for hot dip galvanizing on iron and Steel.
IS : 3114	Code of practice for laying of cast iron pipes
IS : 4111 (Part 1)	Code of practice for ancillary structures in sewerage system : Part 1 manholes.
IS : 4127	Code of practice for laying glazed stoneware pipes.
IS : 4853	Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes.
IS : 5329	Code of practice for sanitary pipe work above ground for buildings.
IS : 5455	Cast iron steps for manholes.
IS : 6159	Recommended practice for design and fabrication of material, prior to galvanizing.
IS : 7558	Code of practice for domestic hot water installations.
IS : 8321	Glossary of terms applicable to plumbing work.
IS : 8419 (Part 1)	Requirements for water filtration equipment : Part 1 Filteration medium sand and gravel.

IS : 8419 (Part 2)	Requirements for water filtration equipment : Part 2 under drainage system.
IS : 9668	Code of practice for provision and maintenance of water supplies and fire fighting.
IS : 9842	Preformed fibrous pipe insulation.
IS : 9912	Coal tar based coating materials and suitable primers for protecting iron and steel pipe lines.
IS : 10221	Code of practice for coating and wrapping of underground mild steel pipelines.
IS : 10446	Glossary of terms relating to water supply and sanitation.
IS : 11149	Rubber Gaskets
IS : 11790	Code of practice for preparation of butt-welding ends for pipes, valves, flanges and fittings.
IS : 12183 (Part 1)	Code of practice for plumbing in multistoried buildings : Part 1 water supply.
IS : 12251	Code of practice for drainage of building basements.
IS : 5572	Code of practice for sanitary pipe work.
BS : 6700	Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their cartilages.
BS : 8301	Code of practice for building drainage.
BSEN : 274	Sanitary tap were, waste fittings for basins, bidets and baths. General technical specifications.

TECHNICAL SPECIFICATIONS

SECTION-01: SANITARY FIXTURES & FITTINGS

1. SCOPE

The scope of this section consists of but is not necessarily limited to supply, installation, testing and commissioning of following items:

a. Sanitary appliances and fixtures for toilets.

b. Chromium plated brass fittings

c. Stainless steel sinks

d. Accessories e.g. towel rods, toilet paper holders, soap dish, liquid soap dispensers, towel rails, coat hooks etc.

e. Hand driers, drinking water fountains etc.

Whether specifically mentioned or not the Contractor shall provide for all appliances and fixtures all fixing devices, nuts, bolts, screws, hangers as required.

All exposed pipes within toilets and near appliances/fixtures shall be of chromium plated brass or copper unless otherwise specified.

2. GENERAL REQUIREMENT

Sanitary appliances and fixtures for toilets, chromium plated brass fittings, stainless steel sinks, bathroom accessories like towel rods, toilet paper holders, soap dish, liquid soap dispensers, towel rails coat hooks etc and mirrors, hand driers, drinking water fountains etc as listed in the relevant items in the Schedule of Quantities shall be supplied free of cost by the Owner's Site Representative. The rates shall be inclusive of accessories (in such case) required for installation. All sanitary fixtures and fittings shall received from the Owner's Site Representative and thereafter be stored under covered roof and handled carefully to prevent any damage by the Contractor.

All appliances, fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the Schedule of Quantities, specifications, drawings. Accessories shall include proper fixing arrangements, brackets, nuts, bolts, washers, screws and required connection pieces.

The sanitary fixtures and fittings shall be installed at the correct assigned position as shown on the drawings and as directed by the Architect / Owner's Site Representative and shall fully meet with the aesthetic and symmetrical requirements as demanded by the Architect / Interior Designer

All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per Architect requirements. Wherever necessary, the fittings shall be centered to dimensions and pattern as called for.

Fixing screws shall be half round head chromium plated (CP) brass screws, with CP brass washers unless otherwise specified.

Fixtures shall be installed by skilled workman with appropriate tools according to the best trade practice.

All appliances, fittings and fixtures shall be fixed in a neat workmanlike manner true to level and to heights shown on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling, plaster, paint, insulation or terrace shall be made good by the Contractor at his own cost. Fixtures shall be mounted rigid, plumb and true to alignment.

All materials shall be rust proofed; materials in direct or indirect contact shall be compatible to prevent electrolytic or chemical (bimetallic) corrosion.

Wall flanges shall be provided on all walls, floors, columns etc. wherever supply and disposal pipes pierce through them. These wall caps shall be or chromium plated brass fittings and the receiving pipes and shall be large enough to cover the punctures properly.

Sanitary appliances, subject to the type of appliance and specific requirements, shall be fixed in accordance with the relevant standards and the following:

i. Contractor shall, during the entire period of installation and afterwards protect the appliances by providing suitable cover or any other protection so as to absolutely prevent any damage to the appliances until handing over (The original protective wrapping shall be left in position for as long as possible)

ii. The appliances shall be placed in correct position or marked out in order that pipe work can be fixed or partially fixed first.

iii. The appliance shall be fixed in a manner such that it will facilitate subsequent removal if necessary.

iv. The appliance shall be securely fixed. Manufacturer's brackets and fixing methods shall be used wherever possible. Compatible rust-proofed fixings shall be used. Fixing shall be done in a manner that minimizes noise transmission.

v. Appliances shall not be bedded (e.g. WC pans, pedestal units) in thick strong mortar that could crack the unit (e.g. ceramic unit)

vi. Pipe connections shall be made with demountable unions. Pipe work shall not be fixed in a manner that it supports or partially supports and appliance.

vii. Appliances shall be fixed true to level firmly fixed to anchor or supports provided by the manufacturer and additional anchors or supports where necessary.

Sizes of sanitary fixtures given in the Specifications or in the Schedule of Quantities are for identification with reference to the catalogues of make considered. Dimensions of similar models of other makes may very within ± 10% and the same shall be provided and no claim for extra payment shall be entertained NOR shall any payment be deducted on this account.

The contractor shall fix all plumbing fittings such as water faucets, shower fittings, mixing valves etc. in accordance with manufacturer's instructions and connect to piping system. The contractor shall supply all fixing materials such as screws, rawl plugs, unions, collars, compression fittings etc., as required.

Joints / gaps between all sanitary appliances / fixtures and the floor / walls shall be caulked with an approved mildew resistant sealant, having antifungal properties, of colour and shade to match that of the appliances / fixture and the floor / wall to the extent possible.

2. 1 Water Closet

Water Closet shall be wash down or symphonic wash down type floor or wall mounted set, as shown in the drawings, designed for low volume flushing from 2-4 litres of water, flushed by means of a porcelain flushing cistern or an exposed or concealed type (as detailed in the drawings or as directed by the Owner's Site Representative). Flush pipe / bend shall be connected to the WC by means of a suitable rubber adaptor. Wall hung WC shall be supported by CI floor mounted chair which shall be fixed in a manner as approved by the Owners Site Representative.

Each WC set shall be provided with approved quality of seat, rubber buffers and chromium plated hinges. Seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the WC.

Each WC shall be provided with 110 mm dia (OD) PVC Pan connector connecting the ceramic outlet of WC to CI pipe.

2. 2 Urinals

Urinals shall be lipped type half stall with glazed vitreous China of size as called for in the Bill of Quantities.

Half stall urinals shall be provided with 15mm dia CP spreader, 32mm dia CP domical waste and CP cast brass bottle trap with pipe and wall flange and shall be fixed to wall by CI brackets, CI wall clips and CP brass screws as recommended by manufacturer complete as directed by the Owner's Site Representative.

Flushing for urinals shall be by means of no hand operation, infrared electric flush valve with complete kit of plumbing, electrical and electronic items, infrared photo cells, solenoid valve transformer and electrical connection. The automatic flush sensor plate shall be flush and press fitted and be of high quality mirror polish finish. Each urinal shall be provided with one flush valve unit.

Flush pipes shall be GI pipes concealed in wall chase but with chromium plated bends at inlet and outlet.

Urinal Partitions

Urinal partitions shall be white glazed vitreous china of size specified in the Schedule of Quantities.

Porcelain partitions shall be fixed at proper heights with CP brass bolts, anchor fasteners and MS clips as recommended by the manufacturer and directed by the Owner's Site Representative.

2.3 Cisterns

Low level flushing cistern (exposed or concealed) shall be provided for WC in specified toilets. Contractor shall install cistern in accordance to the manufacturer's specification to the satisfaction of the Owner Site Representative.

2.4 Wash Basin

Wash basins shall be white glazed vitreous china of size, shape and type specified in the Schedule of Quantities.

Each basin shall be provided with painted MS angle or CI brackets and clips and the basin securely fixed to wall/counter slab. Placing of basins over the brackets without secure fixing shall not be accepted. The MS angle shall be provided with two coats of red oxide primer and two coats of synthetic enamel paint of make , brand and colour as approved by the Owner's Site Representative. The cost of fixing the basin shall be inclusive of supply and installation of brackets as described above.

Each basin shall be provided with 32mm dia CP waste with overflow, pop-up waste or rubber plug and CP brass chain as specified in the Schedule of Quantities.

Each basin shall be provided with hot and cold water mixing fitting or as specified in the Schedule of Quantities.

2.5 Sinks

Sinks shall be stainless steel or any other material as specified in the Schedule of Quantities.

Each sink shall be provided with painted MS or CI brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable painted angle iron brackets or clips as recommended by the manufacturer. Each sink shall be provided with 40mm dia CP waste and rubber plug with CP brass chain as given in the Schedule of Quantities. The MS angle shall be provided with two coats of red oxide primer and two coats of synthetic enamel paint of make, brand and colour as approved by the Owner's site representative.

Sanitary fittings for sinks shall be deck mounted or wall mounted CP swivel faucets with or without hot and cold water mixing fittings as specified in the

Schedule of Quantities. Installation of fittings shall be measured and paid for separately.

2.6 Toilet Paper Holder

Toilet paper holder shall be white glazed vitreous china or chrome plated of size, shape and type specified in the Schedule of Quantities.

Porcelain toilet paper holder shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2 coarse sand) and fixed in relation to the tiling work.

The latter (chrome) shall be fixed by means of screws/capping having finish similar to the toilet paper holder in wall/temper partitions with raw l plugs or nylon sleeves. When fixed on timber partition, it shall be fixed on a solid wooden base member provided by the Owner's Site Representative.

2.7 Liquid Soap Dispenser

Liquid Soap Dispenser shall be wall/counter mounted suitable for dispensing liquid soaps, lotions, detergents. The cover shall lock to body with concealed locking arrangement, opened only be key provided.

Liquid soap dispenser body and shank shall be of high impact resistance material. The piston and spout shall be stainless steel with 1 litre capacity polyethylene container.

The valve shall operate with less than 2.27 Kg (5 lbs) of force.

2.8 Hand Drier

The hand drier shall be no touch operating type with solid state time delay to allow user to keep hand in any position.

The hand drier shall be fully hygienic, rated for continuous repeat use (CRU).

The rating of hand drier shall be such that time required to dry a pair of hands up to wrists is approximately 30 seconds.

The hand drier shall be of wall mounting type suitable for 230 V, single phase, 50 Hz, AC power supply.

3. TOILETS FOR THE DISABLED

Where specified, in washroom facilities designed to accommodate physically disabled, accessories shall be provided as directed by the Owner's Site Representative.

Stainless steel garb brass of required size suitable for concealed or exposed mounting and opened non-slip gripping surface shall be provided in all washroom. The flushing cistern/valve shall be provided with chromium plated long handles.

4. MOCKUP AND TRIAL ASSEMBLY

The installation of the Sanitary fixtures and fittings shall be as per the shop drawings approved by the Architect/Consultant.

The contractor shall have to assemble at least one set of each type of sanitary fixtures and fittings in order to determine precisely the required supply and disposal connections. Relevant instructions from manufacturers shall be followed as applicable. This trial assembly shall be developed to determine the location of puncture holes, holding devices etc. which will be required for final installation of all sanitary fixtures and fittings. The above assembly shall be subject to final approval by the Architect / Interior Designer.

The fixtures in the trial assembly can be re-used for final installation without any additional payments for fixing or dismantling of the fixtures.

5. SUPPORTING AND FIXING DEVICES

The contractor shall provide all the necessary supporting and fixing devices to install the sanitary fixtures and fittings securely in position. The fixing devices shall be rigidly anchored into the building structure. The devices shall be rust resistant and shall be so fixed that they do not present an unsightly appearance in the final assembly. Where the location demands, the Architect may instruct the contractor to provide chromium plated or other similarly finished fixing devices. In such circumstances the contractor shall arrange to supply the fixing devices and shall be installed complete with appropriate vibration isolating pads, washers and gaskets.

6. FINAL INSTALLATION

The contractor shall install all sanitary fixtures and fittings in their final position in accordance with approved trial assemblies and as shown on drawings. The installation shall be complete with all supply and waste connections. The connection between building and piping system and the sanitary fixtures shall be through proper unions and flanges to facilitate removal/replacement of sanitary fixtures without disturbing the built in piping system. All unions and flanges shall match in appearance with other exposed fittings.

Fixtures shall be mounted rigid, plumb and to alignment. The outlets of water closet pans and similar appliances shall be examined to ensure that outlet ends are butting on the receiving pipes before making the joints. It shall be ensured that the receiving pipes are clear of obstruction. When fixtures are being mounted, attention shall be paid to the possibility of movement and settlement by other causes. Overflows shall be made to ensure that necessary anchoring devices have been provided for supporting water closets, wash basins, sinks and other appliances.

7. PROTECTION AGAINST DAMAGE

The contractor shall take every precaution to protect all sanitary fixtures against damage, misuse, cracking, staining, breakage and pilferage by providing proper wrapping and locking arrangement till the completion of the installation. At the

time of handing over, the contractor shall clean, disinfect and polish all the fixtures and fittings. Any fixtures and fittings found damaged, cracked chipped stained or scratched shall be removed and new fixtures and fittings free from defects shall be installed at his own cost to complete the work.

8. MEASUREMENT

8.1 Rate for fixing only of sanitary fixtures accessories, CP fittings shall etc. include all items, and operations stated in the respective specifications and bill of quantities and nothing extra is payable.

8.2 Rates for all items under specifications para above shall be inclusive of cutting holes and chases and making good the same, CP screws, nuts, bolts and any fixing arrangements required and recommended by manufacturers, testing and commissioning and making good to the satisfaction of the Owner's Site Representative.

9. TESTING

All appliances, fixtures and fittings shall be tested before and after installation. Water seals of all appliances shall be tested. The contractor shall block the ends of waste and ventilation pipes and shall conduct an air test.

END OF SECTION – I

SECTION-02 : WATER SUPPLY

1. SCOPE

The scope of this section comprises the supply, installation, testing and commissioning of piping network for water supply for internal & external services as follows:

a Municipal / Tanker Water supply.

b. Drinking Water Supply.

c. Flushing Water Supply

d. External water supply

e. Connection to various mechanical equipments to be supplied and installed by the other specialist contractors.

The Contractor shall make all necessary application and arrangements for his work to be inspected by the Local Authorities.

The Contractor shall be solely responsible for obtaining the Authorities approval of his works prior to the handing over of the complete water supply / distribution installation to the Owner.

2. PIPING MATERIALS

The piping system shall consist of CPVC SDR 11.0 piping from 15 mm to 50 mm & Schedule 40 from 65 mm to 150 mm for cold water supply & schedule 80 from 65 mm to 150 mm for hot water supply.

For any internal works, the CPVC pipes and fittings shall be embedded in the wall chase or run on the floor/ceiling unless otherwise specified. No unsightly exposed runs shall be permitted.

A. CPVC Pipes & Fittings

The pipes shall be CPVC (Chlorinated Poly Vinyl Chloride) material for hot & cold water supply piping system with pipes as per CTs SDR -11 at a working pressure of 320 PSI at 23 deg C and 80 PSI at 82 deg.C, using solvent welded CPVC fittings i.e. Tees, Elbows, Couples, Unions, Reducers, Brushing etc. including transition fittings (connection between CPVC & Metal pipes / GI) i.e. Brass adapters (both Male & Female threaded and all conforming to ASTM D-2846 with only CPVC solvent cement conforming to ASTM F-493, with clamps / structural metal supports as required /directed at site including cutting chases & fitting the same with cement concrete / cement mortar as required, including painting of the exposed pipes with one coat of desired shade of enamel paint. All termination points for installation of faucets shall have brass termination fittings. Installation shall be to the satisfaction of manufacturer & Project Manager. Pipes from 65 mm to 150 mm dia shall be Schedule 40 for CWC & Schedule 80 for HWS / HWR.

i. Joining Pipes & Fittings

a. Cutting:

Pipes shall be cut either with a wheel type plastic pipe cutting or hacksaw blade and care shall be taken to make a square cut which provides optimal bonding area within a joint.

b. Deburring / Beveling:

Burrs and fittings should be removed from the outside and inside of pipe with a pocket knife or file otherwise burrs and fittings may prevent proper contact between pipe and fittings during assembly.

c. Fitting preparation:

A clean dry rag/cloth should be used to wipe dirt and moisture from the fitting sockets and tubing end. The tubing should make contact with the socket wall 1/3 or 2/3 of the way into the fitting socket.

d. Solvent Cement Application:

Only CPVC solvent cement confirming to ASTM-F493 should be used for joining pipe with fittings. An even coat of solvent cement should be applied on the pipe end and a thin coat inside the fitting socket, otherwise too much of cement solvent can cause clogged water ways.

e. Assembly:

After applying the solvent cement on both pipe and fitting socket, pipe should be inserted into the fitting socket within 30 seconds, and rotating the pipe ¼ to ½ turn while inserting so as to ensure even distribution of solvent cement with the joint. The assembled system should be held for 10 seconds (approximately) in order to allow the joint to set up.

An even bead of cement should be evident around the joint and if this bead is not continues remake the joint to avoid potential leaks.

Set & Cure times:

Solvent cement set and cure times shall be strictly adhered to as per the below mentioned table.

Minimum Core prior to pressure testing at 150 PSI

Ambient Temperature during Core period	**Pipe Size**	
	½ " - 1"	**1.¼" - 2"**
Above 15 deg. C	1 Hr	2 Hrs
4-15 deg.C	2 Hrs	4 Hrs
Below 4 deg C	4 Hrs	8 Hrs

Special care shall be exercised when assembling flow guard systems in extremely low temperature (below 4°C) or extremely high temperature (above 45°C) In extremely hot temperatures, make sure that both surfaces to be joined are till wet with cement solvent when putting them together.

f. Testing

Once an installation is completed and cored as per above mentioned recommendations, the system should be hydrostatically pressure tested at 150 psi(10 Bar) for one hour. During pressure testing, the system should be fitted with water and if a leak is found, the joint should be cut out and replacing the same with new one by using couplers.

ii. Transition of Flow guard CPVC to Metals

When making a transition connection to metal threads, special Brass / plastic transition fitting (Male and female adapters) should be used. Plastic threaded connections should not be over torqued Hard tight puts one half turn should be adequate.

iii. Threaded Sealants

Teflon tape shall be used to make threaded connections leak proof.

iv. Solvent Cement

Only CPVC solvent cement conforming to ASTMF 493 should be used for joining pipe with fittings and valves. Flow guard CPVC cement solvent have a minimum shelf life of 1 year. Aged cement solvent will often change colour or being to thicken and become gelatinous or jelly like and when this happens, the cement should not be used. The cement solvent should be used within 30 days after opening the company's seal and tightly close the seal after using in order to avoid its freezing. The freezed cement solvent should be discarded immediately and fresh one should be used. The CPVC solvent cement usage should be adhered to as given in table below

Diameter of pipe in inch (flow guard)	½"	¾"	1"	¼"	1½"	2"
Approx. nos. of joints which can be mode per litre of solvent cement.	200 Nos	180 Nos	150 Nos	130 Nos	100 Nos	70 Nos

v. Hangers and supports

For Horizontal runs, support should be given at 3 foot (90 cm) intervals for diameters of one inch and below and at 4 foot (1.2m) intervals for larger sizes.

Hangers should not have rough or sharp edges which come in contact with the tubing.

Supports should be as per the below mentioned table:

Size of Pipe	**21°C**	**49°C**	**71°C**	**82°C**
Inch	**Ft.**	**Ft.**	**Ft.**	**Ft.**
½"	5.5	4.5	3.0	2.5
¾"	5.5	5.0	3.0	2.5
1"	6.0	5.5	3.5	3.0
1¼"	6.5	6.0	3.5	3.5
1½"	7.0	6.0	3.5	3.5
2"	7.0	6.5	4.0	3.5

SCHEDULE - 40							
Recommended Support spacing (in feet)							
Nom. Pipe Size		**Temperature ^{o}C**					
(In)	**(mm)**	**23**	**38**	**49**	**60**	**71**	**82**
2 ½	65	7 ½	7	7	6 ½	6	3 ½

3	80	8	7	7	7	6	3 ½
4	100	8 ½	7 ½	7 ½	7	6 ½	4
6	150	9 ½	8	8	7 ½	7	4 ½
8	200	9 ½	8	8	7 ½	7	5

SCHEDULE - 80							
Recommended Support spacing (in feet)							
Nom. Pipe Size		**Temperature ^{o}C**					
(In)	**(mm)**	**23**	**38**	**49**	**60**	**71**	**82**
2 ½	65	8	7 ½	7 ½	6 ½	4 ½	4
3	80	8	8	7 ½	7	4 ½	4
4	100	9	9	8 ½	7 ½	5	4 ½
6	150	10	9 ½	9	8	5 ½	5

B. Galvanised Iron Pipes & Fittings

The pipes shall be galvanised mild steel welded (ERW) or (HFW) screwed and socketed conforming to the requirements of IS: 1239. The Galvanising shall conform to IS:4736, the zinc coating shall be uniform, adherent reasonably smooth and free from such imperfections as flux, ash and drop inclusions, bare patches, black spots, pimples, lumpiness, runs, rust strains, bulky white deposits and blisters. The pipes and sockets shall be cleanly finished, well galvanised in and out and free from cracks, surface flaws laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut cleanly, and square with the axis of the pipe.

The fittings shall be malleable iron and comply with all the requirements of the pipes. The sizes of pipes and fitting is specified in the schedule of quantities.

Laying and Jointing of GI Pipes

The galvanised pipes and fittings shall run in wall chase or ceiling or as specified. The fixing shall be done by means of standard pattern holder bat clamps keeping the pipes about 1.5 cm clear of the wall where to be laid on surface. Where it is specified to conceal the pipes, chasing may be adopted for pipes fixed in the shafts, ducts etc. there should be sufficient space to work on the pipes with the usual tools. As far as possible, pipes may be buried for short distances provided adequate protection is given against damage and where so required special care to be taken at joints. Where directed by the Owner's Site Representative, pipe sleeves shall be fixed at a place the pipe is passing through a wall or floor for reception of the pipe and allow freedom for expansion and contraction and other movements. In case of pipe is embedded in walls or floors it shall be painted with anticorrosive bitumastic paints of approved quality. Under the floors the pipes shall be laid in layer of sand filling.

Galvanised iron pipes shall be jointed with threaded and socket joints, using threaded fittings. Care shall be taken to remove any burr from the end of the pipes after threading. Teflon tape, White lead or an equivalent jointing compound of proprietary make shall be used, according to the manufacturer's instructions, with a grommet of a few strands of fine yarn while tightening. Compounds containing red lead shall not be used because of the danger of contamination of water. Any threads exposed after jointing shall be painted with bituminous paint to prevent corrosion.

3. PIPING INSTALLATION SUPPORT (VALID FOR GI PIPING ONLY)

Tender drawings indicate schematically the size and location of pipes. The Contractor, on the award of the work, shall prepare detailed working drawings, showing the cross-sections, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air valves, and all pipe supports. He must keep in view the specific openings in buildings and other structure through which pipes are designed to pass.

Piping shall be properly supported on , or suspended from , on stands, clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchor, clamps and hangers, and be responsible for their structural stability.

Pipe work and fittings shall be supported by hangers or brackets so as to permit free expansion and contraction. All accessories and ancillaries of support system such as brackets, saddles, clamps, hangers etc. shall be hot dip galvanized after fabrication. Further to permit free movement of common piping, support shall be from a common hanger bar, fabricated from galvanised steel sections.

Pipe hangers shall be provided at the following maximum spacings:

Pipe Dia (mm)	**Hanger Rod Dia (mm)**	**Spacing between Supports (m)**
Up to 25	6	2
32 to 50	10	2.7
80 to 100	12	2.7
125 to 150	16	3.6
200 to 300	19	5.3

Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. 14 gauge metal sheet shall be provided between the insulation and the clamp, saddle or roller, extending atleast 15 cm. on both sides of the clamps, saddles or roller.

All pipe work shall be carried out in a proper workman like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation with other agencies work, so that area can be carried out in one stretch.

Cut-outs in the floor slab for installing the various pipes area are indicated in the drawings. Contractor shall carefully examine the cut-outs provided and clearly point out wherever the cut-outs shown in the drawings, do not meet with the requirements.

Pipe sleeves, larger diameter than pipes, shall be provided wherever pipes pass through walls and slab and annular space filled with fiberglass and finished with retainer rings.

The contractor shall make sure that the clamps, brackets, saddles and hangers provided for pipe supports are adequate or as specified / approved by Consultants. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required.

All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reduces shall be used for the piping to drain freely. In other locations, concentric reduces may be used.

All buried pipes for CWS shall be cleaned and coated with two coats of bitumen and then wrapped with two layers of 400 micron polythene sheet coating.

Automatic air valves shall be provided at all high points in the piping system for venting. All valves shall be of 15mm pipe size and shall be associated with an equal

size isolation ball valve. Automatic air valves shall also be provided on hot water risers.

Discharge from the air valves shall be piped through a galvanized steel pipe to the nearest drain or sump. All pipes shall be pitched towards drain points.

Pressure gauges shall be provided as shown on the approved drawings and include in Bill of Quantities. Care shall be taken to protect pressure gauges during pressure testing.

Temperature gauge as specified shall be provided at the hot water supply and return and as shown on drawings and included in Bill of Quantities.

4. FERRULES

The ferrules for connection with main shall generally conform to IS:2692. It shall be of non-ferrous materials with a bell mouth cover and shall be of nominal bore as specified. The ferrule shall be fitted with a screw and plug or valve capable of completely shutting of the water supply to the communication pipe, as and when required.

4.1 Fixing Ferrules

For fixing ferrule in cast iron mains, the empty main shall be drilled and tapped at 45 deg to the vertical and the ferrule screwed in. The ferrule must be so fitted that no portion of the shank shall be left projecting within the main into which it is fitted.

5. WATER METERS

Water meters of approved make and design shall be supplied for installation at locations as shown. The water meters shall meet with the approval of local supply authorities. Suitable valves and chambers or wall meter box to house the meters shall also the be provided along with the meters.

The meters shall conform to Indian Standard IS: 779 and IS:2373. Calibration certificate shall be obtained and submitted for each water meter.

Provision shall also be made to lock the water meter. The provision shall be such that the lock is conveniently operated from the top. Where the provision is designed for use in conjunction with padlocks, the hole provided for padlocks shall be a diameter not less than 4mm.

5.1 Installation of Water Meter and Stop Cock

The G.I. lines shall be cut to the required lengths at the position where the meter and stop cock are required to be fixed. Suitable fittings shall be attached to the pipes. The meter and stop cock shall be fixed in a position by means of connecting pipes, jam nut and socket etc. The stop cock shall be fixed near the inlet of the water meter. The paper disc inserted in the ripples of the meter shall be removed. And the meter installed exactly horizontal or vertical in the flow line in the direction shown by the arrow cast on the body of the meter. Care shall be taken that the factory seal of the meter is not disturbed. Wherever the meter shall be

fixed to a newly fitted pipe line, the pipe line shall have to be completely washed before fitting the meter.

6. TESTING

The Contractor shall notify the Architect three days in advance of any test so that the Architect can witness the tests if he so wishes.

All water supply system shall be tested to hydrostatic pressure test of at least one and a half (1.5) times the maximum pressure but not less than 10Kg/Sq.cm for a period of not less than 8 hours. All leaks and defects in joints revealed during the testing shall be rectified and got approved at site by retest. Piping required subsequent to the above pressure test shall be retested in the same manner.

System may be tested in sections and such sections shall be entirely retested on completion.

The Contractor shall make sure that proper noiseless circulation of fluid is achieved through the entire piping network of the system concerned. In case of improper circulation, the contractor shall rectify the defective connections. He shall bear all expenses for carrying out the above rectifications including the tearing up and refinishing of floors and walls as required.

In addition to the sectional testing carried out during the construction, contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and fixtures shall be made good by the contractor during the defects liability period without any cost.

After commissioning of the water supply system, contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

A test register shall be maintained and all entries shall be signed and dated by Contractor(s) and Owner's site representative.

7. DISINFECTION OF PIPING SYSTEM AND STORAGE TANKS

Before commissioning the water supply system, the contractor shall arrange to disinfect the entire system as described in the succeeding paragraph.

The water storage tanks and pipes shall first be filled with water and thoroughly flushed out. The storage tanks shall then be filled with water again and disinfecting chemical containing chlorine added gradually while tanks are being filled to ensure thorough mixing. Sufficient chemical shall be used to give water a dose of 50 parts of chlorine to one million parts of water.

If ordinary bleaching powder is used, the proportions will be 150 gm of power to 1000 liters of water. The power shall be mixed with water in the storage tank. If a proprietary brand of chemical is used, the proportions shall be specified by the manufacturer. When the storage tanks are full, the supply shall be stopped and all the taps on the distributing pipes are opened successively working progressively away from the storage tank. Each tap shall be closed when the water discharged

begins to smell of chlorine. The storage tank shall then be filled up with water from supply pipe and added with more disinfecting chemical in the recommended proportions. The storage tank and pipe shall then remain charged at least for three hours. Finally the tank and pipes shall be thoroughly flushed out before any water is used for domestic purpose.

The pipe work shall be thoroughly flushed before supply is restored.

8. STERILIZATION OF MAIN

After the pipe work has been tested and approved, but before it is coupled, it shall be sterilized with a solution of chloride of lime.

9. CUTTING CHASES IN MASONARY WALLS

Cold water distribution pipes to fixtures and equipment exposed to view in the bathrooms, kitchens, and sanitary compartments shall be chased into walls or floors or placed in wall cavities. The Contractor shall be responsible for cutting all notches, chases, and recesses in walls and floors and only a diamond cutter shall be used. The maximum size of conduit or pipe permitted to be concealed in floor slabs shall be 32 mm diameter unless otherwise approved by the Architect.

The chases upto 7.5 x 7.5 cm shall be made in the walls for housing GI pipes etc. These shall be provided in correct positions as shown in the drawings or directed by the Architects. Chases shall be made by chiselling out the masonry to proper line and depth. After the pipes etc are fixed in chases, the chases shall be filled with cement mortar 1:2:4 or as may be specified, and made flush with the masonry surface. The concrete surface shall be roughened with wire brush to provide a key for plastering.

Where pipes pass through beams or structural walls, subject to the approval of the Structural Consulting Engineer, the Contractor shall ensure that sizes and locations of openings required are formed in when the relevant beams or walls are cast.

10. VALVES

All valves (gate, globe, check, safety) shall be of gun metal suitable for the particular service as specified. All valves shall be of the particular duty and design as specified. Valves shall either be of screwed type or flanged type, as specified, with suitable flanges and non-corrosive bolts and gaskets. Tail pieces as required shall be supplied along with valves. Gate, globe and check valves shall conform to Indian Standard IS:776 and non-return valves and swing check type reflux to IS:5312.

Sluice valves, where specified shall be flanged sluice valves of cast iron body. The spindle, valve seat and wedge nuts shall be gunmetal. They shall generally have non-rising spindle and shall be of the particular duty and design as specified. The valves shall be supplied with suitable flanges, non-corrosive bolts and asbestos fibre gaskets. Sluice valves shall conform to Indian standard IS:780 and IS:2906.

Ball valves with floats to be fixed in storage tanks shall consist of cast brass lever arm having copper balls (26 SWG) screwed to the arm integrally. The copper ball shall have bronze welded seams. The closing/opening mechanism incorporating the piston and cylinder shall be non-corrosive metal and include washers. The size and construction of ball valves and float shall be suitable for desired working pressure operating the supply system. Where called for brass valves shall be supplied with brass hexagonal back nuts to secure them to the tanks and a socket to connect to supply pipe.

Globe valves on Hot-water line shall be union bonnet with stem/disc and body seat ring of SS. Suitable for temperature upto 80° C.

S.No.	Type of Valve	Size	Construction	Ends
a.	Isolating Valve	15 mm to 50 mm 65 mm and above	Gun Metal Gun Metal	Screwed Flanged
b.	Sluice Valve & Butterfly Valve	65 mm and above	Cast Iron	Flanged
c.	G.M. non return valve	15 mm to 50 mm 65 mm above	Gun Metal Gun Metal	Screwed Flanged
d.	Flap Type – Non return valve	65 mm and above	Cast Iron	Flanged

All valves shall be suitable for the working pressure involved.

10.1 Pressure Gauge

The pressure gauge shall be constructed of die cast aluminium and stove enamelled. It shall be weather proof with an IP 55 enclosure. It shall be a stainless steel Bourden tube type pressure gauge with a scale range from 0 to 16 Kg / cm square and shall be constructed as per IS:3524. Each pressure gauge shall have a siphon tube connection. The shut off arrangement shall be by Ball Valve.

Calibration certificate shall be obtained and submitted for each pressure gauge.

11. WATER FITTINGS

Unless otherwise specified all Gunmetal fittings such as gate, globe, check & safety valves shall be fitted in pipe line in workman like manner. Necessary unions shall be provided on both ends of the valves for easy replacement. The joints between fittings and pipes shall be leak-proof when tested to desired pressure rating. The defective fittings and joints shall be replaced or redone.

12. CONNECTIONS TO VARIOUS MECHANICAL EQUIPMENT SUPPLIED BY OTHER AGENCIES

All inlets, outlets, valves, piping and other incidental work connected with installation of mechanical equipment supplied by other agencies all be carried out by the contractor in accordance with the drawings, requirements for proper performance of equipment, manufacturers instructions and the directions of the Owner's site representative / Architect. The equipments to be supplied by the other agencies consist mainly for Kitchen, Back-of-the-House area and other

similar areas. The work of connections to the various equipments shall be effected through proper unions and isolating valves. The work of effecting connections shall be executed in consultation with and according to the requirement of equipment suppliers, under the directions of the Owner's site representative / Architect. The various aspects of connection work shall be executed in a similar way to the work of respective trade mentioned elsewhere in these specifications.

13. CONNECTIONS TO RCC WATER TANKS

The contractor shall provide all inlets, outlets, washouts, vents, ball cocks, overflows control valves and all such other piping connections including level indicator to water storage tanks as called for. All pipes crossing through RCC work shall have puddle flanges fabricated from MS/GI pipes of required size and length and welded to 6/8 mm thick MS plate. All puddle flanges must be fixed in true alignment and level to ensure further connection in proper order.

Full way gate valves of a approved make shall be provided as near the tank as practicable on every outlet pipe from the storage tank except the overflow pipe. Overflow and vent pipes shall terminate with mosquito proof grating.

The overflow pipe shall be so placed to allow the discharge of water being readily seen. The overflow pipe shall be of size as indicated. A stop valve shall also be provided in the inlet water connection to the tank. The outlet pipes shall be fixed approximately 75mm above the bottom of the tank towards which the floor of the tank is sloping to enable the tank to be emptied for cleaning.

The floor and the walls of the tank shall be tiled with glazed tiles upto the overflow level. Alternatively food grade epoxy to be applied.

Tiling of Walls

The floor and the walls of the tanks shall be tiled with glazed tiles up to the overflow level. Alternatively food grade epoxy to be applied to the floor and the walls of the tanks.

14. MEASUREMENTS

The length above ground shall be measured in running meter correct to a cm for the finished work, which shall include pipe and fittings such as coupling , bends, tees, elbows, reducers, crosses, plugs, sockets, nipples and nuts, unions. Deductions for length of valves shall be made. Rate quoted shall be inclusive of all fittings, clamps, cutting holes chased and making good the same and all items mentioned in the specifications and Bill of Quantities.

All pipes below ground shall be measured per linear meters (to the nearest cm) and shall be inclusive of all fittings e.g. coupling, tees, bends, elbows, unions, deduction for valves shall be made rate quoted shall be inclusive of all fittings, excavation, back filling and disposal of surplus earth, cutting holes and chase and making good all item mentioned in Bill of Quantities.

15. PIPE PROTECTION
(FOR COLD WATER PIPES BURIED IN TRENCHES / GROUND / EARTH)

All buried pipes shall be cleaned with zinc chromate primer and bitumen paint, wrapped with three layers of fiber glass tissue, each layer laid in bitumen and placed on concrete blocks with PUF saddles dipped in bitumen at every 2 meters. The pipes where laid under floor shall be encased with 100 mm thick jamuna sand all around in addition to protective coating as described above. Alternatively pypcoat / coatek insulation for protection of pipe would also be acceptable as per final approval of project engineer / consultant.

16. THRUST BLOCKS

In case of bigger pipes (80 mm dia and above), thrust blocks of cement concrete 1:2:4 (1 cement: 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) shall be constructed on all bends as directed by the Owner's site representative.

17. MASONRY CHAMBER

i. All masonry chambers for stop cocks, sluice valves and meter etc. shall be built as per supplied drawings.

ii. The excavation for chambers shall be done true to dimension and level indicated on plans or as directed by the Owner's site representative.

iii. Concrete shall be of cement concrete 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 40 mm nominal size.

iv. Brick shall be of class designation 75 in cement mortar 1:5 (1 cement : 5 fine sand)

v. Inside Plastering not less than 12 mm thick shall be done in cement mortar 1:3 (1 cement : 3 fine sand) finished with a floating coat of neat cement.

18. SHIFTING OF EXCAVATED SURPLUS MATERIAL

Contractor shall make his own arrangement to shift the surplus excavated material within the site limits as directed by Owner's site representative at free of cost within time limit.

END OF SECTION – II

SECTION-03: INTERNAL DRAINAGE (SOIL, WASTE, VENT & RAIN WATER PIPES)

1. SCOPE

The scope of this section comprises the supply, installation, testing and commissioning of internal drainage services.

Work under this section shall consist of furnishing all labour, materials, equipments and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes and fittings as required by the drawings, and given in the schedule of quantities.

2. BASIC PIPING SYSTEM

Soil, waste and vent pipes in shafts, ducts and in concealed areas i.e. false ceilings etc. shall consist of upvc pipes & fittings as called for. In general wastes and vents smaller than and upto 50mm dia shall be of upvc pipe.

The soil pipes shall be circular with a minimum diameter of 100mm. Pipes shall be fixed by means of stout GI clamps in two sections, bolted together, built into the walls, wedged and neatly jointed as directed and approved by the Owner's site representative / Architect. All bends, branches, swan neck and other parts shall conform to the requirement and standards as described for the pipes. Pipes shall be rested against the walls on suitable wooden cradles. Local authority regulations applicable to the installations shall be strictly followed.

Where indicated, the soil pipes shall be continued upwards without any diminution in its diameter, without any bend or angle to the height shown in the drawings. Joints throughout shall be made with molten lead as described under jointing of cast iron pipes. Soil pipes shall be painted as provided under `painting'. The soil pipes shall be covered on top with upvc terminal outlets as directed and approved. All vertical soil pipes shall be firmly fixed to the walls with properly fixed clamps, and shall as far as possible be kept 50mm clear of wall. Waste pipes and fittings shall be of upvc pipes. Pipes shall be fixed, jointed and painted as described in installation of soil, waste & vent pipes.

Every waste pipe shall discharge above the grating of properly trapped gully. The contractor will ensure that this requirement is adequately met with. Wherever floor traps are provided, it shall be ensured that atleast one wash is connected to such floor traps to avoid drying of water seal in the trap. Ventilating pipes shall be of upvc steel pipes, conforming to the requirements laid down earlier. Anti-syphon vent pipes/relief vent pipes where called for on the drawings shall be of upvc pipes as specified. The pipes shall be of the diameter shown on the drawings.

All traps on branch soil and waste pipes shall also be ventilated at a point not less than 75mm or more than 300mm from their highest part and on the side nearest to the soil pipe or waste pipes.

Access doors for fittings and clean outs shall be so located that they are easily accessible for repair and maintenance. Any access panel required in the civil structure, false ceiling or marble cladding etc. shall be clearly reported to the Owner in the form of shop drawings so that other agencies are instructed to provide the same.

All the fittings used for connections between soil, waste and ventilation pipes and branch pipes shall be made by using pipe fittings with inspection doors for cleaning. The doors shall be provided with 3mm thick rubber insertion packing and when closed and bolted shall be air and water tight.

Where soil, waste and ventilating pipes are accommodated in shafts ducts, adequate access to cleaning eyes shall be provided.

Head (starting point) of drains and sewage / waste water sumps (as and where applicable) having a length of greater than 4 m upto it connection to the main drain or manhole shall be provided with a 80 / 100 mm vent pipe.

3.1 UPVC Pipes and Fittings

The pipes shall be round and shall be supplied in straight lengths with socketed ends. The internal and external surfaces of pipes shall be smooth, clean, free from groovings and other defects. The ends shall be cleanly cut and square with the axis of the pipe. The pipes shall be designed by external diameter and shall conform to IS:4985-1981. The pipes shall be of Class-III; 6 Kg/sqm pressure rating.

Fittings

Fittings shall be of the same make as that of pipes, injection moulded and shall conform to Indian Standard.

Laying and Jointing

The pipes shall be laid and clamped to wooden plugs fixed above the surface of the wall. Alternatively plastic clamps of suitable designs shall be preferred. Provision shall be made for the effect of thermal movement by not gripping or disturbing the pipe at supports between the anchors for suspended pipes. The supports shall allow the repeated movements to take place without abrasion.

Jointing for UPVC pipes shall be made by means of solvent cement for horizontal lines and 'O' rubber ring for vertical line. The type of joint shall be used as per site conditions / direction of the Owner's site representative. Where UPVC pipes are to be used for rain water pipes, the pipe shall be finished with GI adopter for insertion in the RCC slab for a water proof joint complete as directed by Owner's site representative.

Supports

UPVC pipes require supports at close intervals. Recommended support spacing for unplasticised PVC pipes is 1400 mm for pipes 50 mm dia and above. Pipes shall be aligned properly before fixing them on the wooden plugs with clamps. Even if the wooden plugs are fixed using a plumb line, pipe shall also be checked for its alignment before clamping, piping shall be properly supported on, or suspended from clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers and be responsible for their structural sufficiency. Pipe supports shall be primer coated with rust preventive paint.

Repairs

While temporary or emergency repairs may be made to the damaged pipes, permanent repairs shall be made by replacement of the damaged section. If any split or chip out occur in the wall of the pipe, a short piece of pipe of sufficient length to cover the damaged portion of the pipe is cut. The sleeve is cut longitudinally and heated sufficiently to soften it so that it may be slipped over the damaged hard pipe.

4. INSTALLATION OF SOIL, WASTE & VENT PIPES

Soil, waste & vent pipes in shafts under the floors / suspended below slab shall consist of Upvc pipes as described earlier. Waste pipes from bottle trap to floor/urinal traps for wash basin, urinal and sink shall be upvc pipes and fittings.

All Horizontal pipes running below the slab and along the ceiling, shall be fixed on structural adjustable clamps, sturdy hangers of the design as called for in the drawings. The pipes shall be laid in uniform slope and proper levels. All vertical pipes shall be truly vertical fixed by means of stout clamps in two sections, bolted together, built into the walls, wedged and neatly jointed. The branch pipes shall be connected to the stack at the same angle as that of fittings. All connections between soil, waste and ventilating pipes and branch pipes shall be made by using pipe fittings with inspection doors for cleaning. Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts. Where the horizontal run off the pipe is long or where the pipes cross over building expansion joints etc. suitable allowance shall be provided for any movements in the pipes by means of expansion joint etc. such that any such movement does not damage the installation in any way.

All upvc pipes and fittings shall be jointed with drip seal / Best Quality pig lead free from impurities confirming to IS 27.

Before jointing, the interior of the socket and exterior of the spigots shall be thoroughly cleaned and dried. The spigot end shall be inserted into the socket right up to the back of the socket and carefully centered by two or three laps of threaded spun yarn, twisted into ropes of uniform thickness, well caulked into the back of the socket. No piece of yarn shall be shorter than the circumference of the pipe. The jointed pipe line shall be at required levels and alignment. The reminder of the socket is left for the lead caulking. Where the gasket has been tightly held, a jointing ring shall be placed round the barrel against the face of the socket. Molten Lead shall be poured to the remainder of the socket.

The depth of the lead joints for the cast iron pipes shall be 45mm for the pipes upto 100mm dia and 50mm for the pipes beyond 100mm dia respectively.

The joint shall not be covered till the pipe line has been tested under pressure. Rest of pipe line shall be covered so as to prevent the expansion and contraction due to variation in temperature.

<u>Rainwater Pipes</u>

All open terraces shall be drained by rain water down takes.

Rainwater down takes are separate and independent of the soil and waste system and will discharge into the underground storm water drainage system of the complex.

Rainwater in open courtyards shall be collected in catch basins and connected to the Storm Water Drains.

Any dry weather flow from waste appliances, e.g. AHU's pump rooms, waste water sumps shall connected to sewers after traps and not in the storm water drainage systems.

Balcony / Planter drainage

Whereverrequired, all balconies, terraces, planters and other frontal landscape areas will be drained by vertical down takes or other type of drainage system shown on the drawings and directed by the Project Manager.

6. TRAPS

6.1 Floor Traps

Floor traps where specified shall be siphon type full before P or S type cast iron having a minimum 50 mm deep seal. The trap and waste pipes when buried below ground shall be set and encased in cement concrete blocks firmly supported on firm ground or when installed on a sunken RCC structural slab. The blocks shall be in 1:2:4 mix (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size).

Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 30 x 30 cms of the required depth.

6.2 Floor Trap Inlet /Hopper

Bath room traps and connection shall ensure free and silent flow of discharging water. Where specified, contractor shall provide a special type of floor inlet fitting fabricated from upvc pipe, with one, two or three inlet sockets on side to connect the waste pipe. All joint between waste hopper and upvc inlet socket shall be drip seal/Lead Caulked. Inlet shall be connected to a upvc "P" trap. Floor trap inlet and the traps shall be set in cement concrete blocks where burried in floors without extra charge. Floor trap for the shower cubicle shall suit site and as per the approval of Owner's site representative.

6.3 Floor Trap Grating

Floor and urinal traps shall be provided with 100 – 150 mm square or round stainless steel gratings, with frame and rim of approved design and shape or as specified in the schedule of quantities approved by the Owner's site representative.

6.4 Cleanout Plugs

6.4.1 Floor Clean Out Plug

Clean out plug for soil, waste or rain water pipes laid under floors shall be provided near pipe junctions bends, tees, "Y" and on straight runs at such intervals as required as per site conditions. Cleanout plugs shall terminate flush with the floor level. They shall be threaded and provided with key holes for opening. Cleanout plugs shall be cast brass suitable for the pipe dia. With screwed to a GI socket. The socket shall be drip seal joined/ Lead Caulked to the drain pipes.

6.4.2 Cleanout on Drainage Pipes

Cleanout plugs shall be provided on head of each drain and in between at locations indicated on plans or directed by Owner's site representative. Cleanout plugs shall be of size matching the full bore of the pipe but no exceeding 150 mm dia CO plugs on drains of greater diameters shall be 150 mm dia. Fixed with a suitable reducing adapter.

Floor cleanout plugs shall be cast brass.

Cleanouts provided at ceiling level pipe shall be fixed to a CI flanged tail piece. The cleanout doors shall be specially fabricated from light weight galvanized sheets and angles with hinged type doors with fly nuts, gasket etc. as per drawing.

7. PIPE SLEEVES

Pipe sleeves, next larger diameter than pipes shall be provided wherever pipes pass through walls & slabs and annular space filled with fiberglass & finished with retainer rings. All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burrs removed before laying. Open ends of the pipe shall be closed as the pipe is installed to avoid entrance of foreign matter.

8. PIPE PROTECTION

Cast iron soil and waste pipes under floor in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1:2:4 mix (1 cement : 2 coarse sand : 4 stone aggregate of 12 mm size) 10 cm bed and around. When pipes are running well above the structural slabs, the encased pipes shall be supported with suitable cement concrete pillars of required height and size at intervals directed by the Project Manager.

9. CUTTING AND MAKING GOOD

Pipes shall be fixed and tested as building proceeds. The contractor shall provide all necessary holes, cutouts and chases in structural members as building work proceeds. Wherever holes are cut or left originally they shall be made good with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size) or cement mortar 1:2 (1 cement : 2 coarse sand). Cured and the surface restored to original condition.

10. PAINTING

Soil, waste, vent and rain water pipes in exposed location, in shafts and pipe space shall be painted with two or more coats of ready mix oil paint to give an even shade. Before painting all dust and extraneous matter shall be removed.

Paint shall be of approved quality and shade. Where directed by the Owner's site representative pipes shall be painted in accordance with approved pipe colour code.

Pipe in chase shall be painted with two coats of bitumen paint, covered with polythene tape and a final coat of bitumen paint. Exposed pipes shall be painted with synthetic enamel paint after removing dust and extraneous matter.C.I. Soil

and waste pipes below ground and covered in cement concrete shall not be painted.

11. TESTING

Testing shall be done in accordance with IS:1172 and IS:5329 except as may be modified herein under.

Entire drainage system shall be tested for water tightness and smoke tightness during and after completion of the installation. No portion of the system shall remain untested. Contractor must have adequate number of expandable rubber bellow plugs, manometers, smoke testing machines, pipe and fitting work tests,

All materials obtained and used on site must have manufacturer's hydraulic test certificate for each batch of materials used on the site.

Before use at site all CI pipes shall be tested by filling up with water for at least 30 minutes. After filling, pipes shall be struck with a hammer and inspected for blow holes and cracks. All defective pipes shall be rejected and removed from the site within 48 hours. Pipes with minor sweating may be accepted at the discretion of the Project Manager.

Soil and waste pipes shall be tested in sections after installation, by filling up the stack with water. All openings and connections shall be suitably plugged as approved by the Project Manager. The total head in the stack shall be 4.5 m at the highest point of the section under test. The period of test shall be minimum for 30 minutes or as directed by the Project Manager. If any leakage is visible, the defective part of the work shall be cut out and made good.

On completion of the work the entire installation shall be tested by smoke testing machine. The test shall be conducted after the plumbing fixtures are installed and all traps have water seal or by plugging the outlets with bellow plugs. Apply dense smoke keeping the top of stack open and observe for leakages. Rectify or replace defective sections.

After the installation is fully complete, it should be tested by flushing the toilets, running atleast 20% of all taps simultaneously and ensuring that the entire system is self draining, has no leakages, blockages etc. rectify and replace where required.

A test register shall be maintained and all entries shall be signed and dated by the Contractor and the Project Manager or his representative.

All pipes in wall chase or meant to be encased or burried shall be hydro tested before the chase in plastered or the pipe encased or burried.

END OF SECTION – IIII

SECTION-04: EXTERNAL DRAINAGE (SEWAGE & STORM WATER DISPOSAL)

1. SCOPE

The scope of this section comprises the supply, installation, testing and commissioning of external drainage & sewage disposal services.

1.1 General Scheme

The contractor shall install a drainage system to effectively collect; drain and dispose all soil and waste water from various parts of the buildings, appurtenances and equipment. The piping system shall finally terminate and discharge into the STP (if STP is not available then discharges into external municipal). The piping work mainly consists of laying of upvc pipes, and cast iron soil pipes as called for on the drawings. All piping shall be installed at depth greater than 80 cm below finished ground level. The disposal system shall include construction of gully traps, manholes, intercepting chambers as indicated. The piping system shall be vented suitably at the starting point of all branch drains, main drains, the highest/lowest point of drain and at intervals as shown. All ventilating arrangements shall be unobstructive and concealed. The work shall be executed strictly in accordance with IS: 1742. The sewage system shall be subject to smoke test for its soundness as directed by the Project Manager. Wherever the sewerage pipes run above water supply lines, same shall be completely encased in cement concrete 1:2:4 all round with the prior approval of the Project Manager.

Without restricting to the generality of the foregoing, the drainage system shall inter-alia include:

a. Sewer lines including earth work for excavation, disposal, back filling and compaction, pipe lines, manholes, drop connections and connections to the municipal or existing sewer.

b. Storm water drainage, earth works for excavation, disposal, backfilling and compaction, pipe lines, manholes, catch basins and connections to the existing municipal storm water drain or connected as indicated by the Project Manager.

1.2 General Requirements

All materials shall be new and of quality conforming to specifications and subject to the approval of the Owner's site representative. Wherever particular makes are mentioned, the choice of selection shall remain with the Architect / Consultant / Owner's site representative.

Drainage lines and open drains shall be laid to the required gradients and profiles.

All drainage work shall be done in accordance with the local municipal bye-laws.

Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority.

Location of all manholes, etc shall be got confirmed by the Project Manager before the actual execution of work at site. As far as possible, no drains or sewers shall be laid in the middle of road unless otherwise specifically shown on the drawings or directed by the Project Manager in writing.

All materials shall be rust proofed; materials in direct or indirect contact shall be compatible to prevent electrolytic or chemical (bimetallic) corrosion.

2. TRENCHING FOR PIPES AND DRAINS

2.1 General

All the material shall be new of best quality conforming to specifications and subject to the approval of the Architects. Drainage lines shall be laid to the required gradients and profiles. All drainage work shall be done in accordance with the local municipal by-laws.

Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority. Location of all manholes, catch basins etc. shall be finalized and shown in approved shop drawings before the actual execution of work at site. All work shall be executed as directed by the Project Manager.

2.2 Alignment & Grade

The sewer and storm water drainage pipes shall be carefully laid to levels and gradients shown in the plans and sections but subject to modifications as shall be ordered by the Architects from time to time to meet the requirements of the works. Great care shall be taken to prevent sand etc. from entering the pipes. The pipes between two manholes shall be laid truly in straight lines without vertical or horizontal undulations. The body of the pipes shall rest on an even bed in the trench for its length and places shall be excavated to receive collar for the purpose of jointing. No deviations from the lines, depths of cuttings or gradients as called for on the drawings shall be permitted without the written approval of the Architect. All pipes shall be laid at least 60cms below the finished ground level or as called for on the drawings.

2.3 Setting out Trenches

The contractor shall set out all trenches, manholes, chambers and such other works to true grades and alignments as called for. He shall provide the necessary instruments for setting out and verification for the same. All trenches shall be laid to true grade and in straight lines and as shown on the drawings. The trenches shall be laid to proper levels by the assistance of boning rods and sight rails which shall be fixed at intervals not exceeding 10 meters or as directed by the Project Manager.

2.4 Trench Excavation

The trenches for the pipes shall be excavated with bottoms formed to level and gradients as shown on the drawings or as directed by the Project Manager. In soft and filled in ground, the Project Manager may require the trenches to be excavated to a greater depth than the shown on the drawings and to fill up such additional excavation with concrete (1:4:8) consolidated to bring the excavation to the required levels as shown on the drawings.

All excavations shall be properly protected where necessary by suitable timbering, piling and sheeting as approved by the Project Manager. All timbering and sheeting when withdrawn shall be done gradually to avoid falls. All cavities be

adequately filled and consolidated. No blasting shall be allowed without prior approval in writing from the Architect. It shall be carried out under thorough and competent supervision, with the written permission of the appropriate authorities taking full precautions connected with the blasting operations. All excavated earth shall be kept clear of the trenches to a distance equal to 75 cms.

2.5 Timbering of Sewer and Trenches

The Contractor shall at all times support efficiently and effectively the sides of all the trenches and other excavations by suitable timbering, piling and sheeting and they shall be close timbered in loose or sandy starta and below the surface of the sub soil water level.

All timbering, sheeting and piling with their wallings and supports shall be of adequate dimensions and strength and fully braced and strutted so that no risk of collapse or subsidence of the walls of the trench shall take place.

The Contractor shall be held responsible and shall be accountable for the sufficiency of all timbering, bracings, sheeting and piling used and also for, all damage to persons and property resulting from improper quality strength placing, maintaining or removing of the same.

2.6 Shoring of Buildings

The Contractor shall shore up all buildings, walls and other structures, the stability of which is liable to be endangered by the execution of the work and shall be fully responsible for all damages to persons or property resulting from any accident.

2.7 Obstruction Road

The contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and sufficient space shall then be left for public and private transit. He shall remove the materials excavated and bring them back again when the trench is required to be refilled. The contractor shall obtain the consent of the Project Manager in writing before closing any road to vehicular traffic and the foot walks must be clear at all times.

2.8 Protection of Pipes etc

All pipes, water mains, cables etc. met in the course of excavation shall be carefully protected and supported. Care shall be taken not to disturb the cables, the removal of which shall be arranged by the contractor with the written consent from the Project Manager.

2.9 Trench Back Filling

Refilling of the trenches shall not be commenced until the length of pipes therein has been tested and approved. All timbering which may be withdrawn safely shall be removed as filling proceeds. Where the pipes are unprotected by concrete hunching, selected fine material shall be carefully hand-packed around the lower half of the pipes so as to buttress them to the sides of the trench.

The refilling shall then be continued to 150mm over the top of the pipe using selected fine hand packed material, watered and rammed on both sides of the pipes with a wooden hammer. The process of filling and tamping shall proceed evenly in layers not exceeding 150mm thickness, each layer being watered and consolidated so as to maintain an equal pressure on both sides of the pipe line. In gardens and fields the top solid and turf if any, shall be carefully replaced.

2.10 Contractor to restore settlement and Damages

The contractor shall at his own costs and expenses, make good promptly during the whole period for the works in hand if any settlement occurs in the surfaces of roads, beams, footpaths, gardens, open spaces etc. in the public or private areas caused by his trenches or by his other excavations and he shall be liable for any accident caused thereby. He shall also, at his own expense and charges, repair (and make good) any damage done to building and other property. If in the opinion of the Project Manager he fails to make good such works with all practicable dispatch, the Project Manager shall be at his liberty to get the work done by other means and the expenses thereof shall be paid by the contractor or deducted from any money that may be or become due to him or recovered from him by any other manner according to the laws of land.

The contractor shall at his own costs and charges provide places for disposal of all surplus materials not required to be used on the works. As each trench is refilled, surplus soil shall be immediately removed, the surface shall be properly restored and roadways and sides shall be left clear.

2.11 Removal of Water from Sewer, Trench etc.

The contractor shall at all times during the progress of work keep the excavations free from water which shall be disposed by him in a manner as will neither cause injury to the public health nor to the public or private property nor to the work completed or in progress nor to the surface of any road or streets, nor cause any interference with the use of the same by the public.

If any excavation is carried out at any point or points to a greater width of the specified cross section of the sewer with its cover, the full width of the trench shall be filled with concrete by the contractor at his own expense and charges to the requirements of the Project Manager.

2.12 Removal of Filth

All night soil, filth or any other offensive mater met with during the execution of the works, shall not be deposited on the surface of any street or where it is likely to be a nuisance or passed into any sewer or drain but shall be immediately, after it is taken out of any trench, sewer or cess pool, put into the carts and removed to a suitable place to be provided by the Contractor.

2.13 Width of Trench

The Project Manager shall have power by giving an order in writing to the Contractor to increase the maximum width/depth for excavation and backfilling in trenches for various classes of sewer, manholes and other works in certain length to be specifically laid down by him, where on account of bad ground on other unusual conditions, he considers that such increased width/depths are necessary in view of the site conditions.

3. PIPING MATERIAL

3.1 UPVC Pipes and Fittings

The pipes shall be round and shall be supplied in straight lengths with socketed ends. The internal and external surfaces of pipes shall be smooth, clean, free from groovings and other defects. The ends shall be cleanly cut and square with the axis of the pipe. The pipes shall be designed by external diameter.

3.1.1 Fittings

Fittings shall be of the same make as that of pipes, injection moulded and shall conform to Indian Standard.

3.1.2 Laying in Trenches

UPVC pipes shall be laid on cement concrete bed of width 300mm over the outside diameter of pipe, and 100 mm thickness. Fine sand shall be carefully filled around the lower half of the pipes so as to buttress them to the sides of the trench.

The filling shall then be continued to 150mm over the top of the pipe using fine sand, watered and rammed on both sides of the pipes. The process of filling and ramming with fine hand picked material shall proceed evenly in layers not exceeding 150mm thickness, each layer being watered and consolidated so as to maintain an equal pressure on both sides of the pipe line.

3.2 S.W. Gully Trap

Gully trap shall be stoneware conforming to IS:651. These shall be sound and free from visible defects such as fire cracks, or hair cracks. The glaze of the traps shall be free from cracks. They shall give a sharp clear note when struck with light hammer. There shall be no broken blisters. Each gully trap shall have one CI grating of square size corresponding to the dimensions of inlet of gully trap. It will also have a water tight CI cover with frame inside dimensions 300 x 300mm the cover weighing not less than 4.5 kg and the frame not less than 2.7kg. The grating cover and frame shall be of good casting and shall have truly square machined seating faces.

3.2.1 Fixing of S.W. Gully Trap

The excavation for gully traps shall be done true to dimensions and levels as indicated on plans or as directed by the Project Manager /Consultant / Architect. The gully traps shall be fixed on cement concrete foundation 65cm square and not less than 10cm thick. The mix for the concrete will be 1:4:8. The jointing of

gully outlet to the branch drain shall be done similar to the jointing of S.W. Pipes described earlier. After fixing and testing gully and branch drain, a brick work of specified class in cement mortar 1:5 shall be built with a half brick masonry work round the gully trap from the top of the bed concrete upto ground level. The space between the chamber and trap shall be filled in with cement concrete 1:3:6. The upper portion of the chamber i.e. above the top level of the trap shall be plastered inside the cement mortar 1:3 finish with a floating coat of neat cement. The corners and bottom of the chamber shall be rounded off so as to slope towards the grating.

CI cover with frame 300 x 300 mm (inside) shall then be fixed on the top of the brick masonry with cement concrete 1:2:4 and rendered smooth. The finished top cover shall be so as to prevent the surface water from entering the gully trap.

3.2.3 Measurements

Gully traps shall be measured by the number and rate which shall include all excavation, foundation, concrete, brick masonry, cement plaster inside and outside, C I grating and sealed cover and frame.

4. CONSTRUCTION OF MANHOLE

Where manholes are to be constructed, the excavation, filling back and ramming, disposal of surplus earth, preparation of bottom and sides etc. shall be carried out as described earlier under trench excavation. Manhole shall be sized and depths as called for in the drawings and Bill of Quantities.

The manhole shall be built on a base concrete 1:3:6 of 150mm thickness for manholes upto 1500mm depth and 250mm thickness for manholes from 1500 to 2500mm depth and 300mm thickness manholes of depth greater than 2500mm. Reinforcement as shown shall be provided in the base slabs.

The walls shall be of brick work of thickness as shown in drawings built in cement mortar 1:5. The joints of brick work shall be raked and plastered internally in cement mortar 1:3 (at least 12 mm thick) and finish with a coat of neat cement, external plaster shall be rough plaster in 1:3, PCC benching &semi circular channels of the same diameter as the pipes shall be provided and finished with neat cement coating.

Above the horizontal diameter, the sides of channel shall be extended vertically to the same level as the crown of the outgoing pipe and the top edge shall be suitably rounded off. The branch channels shall also be similarly constructed with respect to the benching but at their junction with the main channel an appropriate fall suitably rounded off in the direction of flow in the main channel shall be given. All manholes / sumps shall be provided with poly propylene coated steel reinforced foot rest. The polypropylene shall confirm to ASTM D-4101 specification, injection moulded around 12 mm dia IS-1786 grade FE-415 steel reinforcing bar. These rungs shall be set at 30cms interval in two vertical runs at 380mm apart horizontally. The top rung shall be 450mm below the manhole cover. Unless otherwise mentioned, manholes shall be constructed to

the requirements of Indian Standard IS:4111 (Part I). All manholes shall be constructed so as to be water tight under test. All angles shall be rounded to a 75mm radius with cement plaster 20mm thick. The benching at the side shall be carried out in such a manner so as to provide no lodgment for any splashing in case of accidental flooding. Manhole cover with frame shall be of cast iron of an approved make. The covers and frame shall generally be double seal as specified in the Bill of Quantities.

4.1 Measurements

Manhole shall be measured in numbers as indicated in the Bill of Quantity. The depth of manhole shall be measured from invert of channel to the top of manhole cover.

Manhole with depth greater than specified under the main item shall be paid for under `Extra Depth' and shall include all items as given for manholes depth will be measured to the nearest cm. Depth of the manholes shall be measured from top of the manhole cover to bottom of channel. The following are inclusive in the cost of manhole viz;

i. Bed concrete

ii. Brick work.

iii. Plastering (inside & outside)

iv. R C C top slab, benching and channeling including drop connections.

v. Supply and fix foot rests.

vi. Keeping holes and embedding pipes for all the connections.

vii. Excavation, refilling, necessary de-watering and disposing off surplus soil to a places as directed by Project Manager.

viii. Curing.

ix. Cost of angle frame and embedding the frame in concrete bed.

x. Testing.

xi. De-watering of chambers.

4.2 Drop Connection

Drop connection shall be provided between branch sewer and main sewer in the main sewer itself in steep ground when the difference in invert level of two exceeds 60 cms of the required sizes. Drop connections from gully traps to main sewer in rectangular shall be made inside the manholes and shall have CI special types door bend on to top and heel rest bend at bottom connected by a CI pipe. The pipe shall be supported by holder bat clamps at 180 cms intervals with atleast

one clamp for each drop connection. All joints shall be lead caulked joints 25mm deep.

Drop connections from branch sewer to main sewer shall be made outside the manhole wall with CI / CI class LA pipe, connection, vertical pipe and bend at the bottoms. The top of the tee shall be finished upto the surface level and provided with a CI hinges type frame and cover 30cms x 30cms. The connection and tee upto the surface chamber of the tee.

Drop connection made from vertical stacks directly into manholes shall not be considered as drop connections.

4.3 Making Connections

Contractor shall connect the new sewer line to the existing manhole by cutting the walls benching and restoring them to the original condition. A new channel shall be cut in the benching of the existing manhole for the new connection. Contractor shall remove all sewage and water if encountered in making the connection without additional cost.

5. TESTING

All rights of the sewer and drain shall be carefully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out from manhole to manhole. All pipes shall be subject to a test pressure of 1.5 meter head of water.

The test pressure will however, not exceed 6 meters head at any point.
The pipes shall be plugged preferably with standard design plugs or with rubber plugs on both sides, the upper end shall, however, be connected to a pipe for filling with water and getting the required head poured at one time.

Sewer lines shall be tested for straightness by :

i. Inserting a smooth ball 12 mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar projecting at the joints the ball shall roll down the invert of the pipe and emerge at the lower end.

ii. Means of a mirror at one end a lamp at the other end. If the pipe is straight the full circle of light will be seen otherwise obstructions or deviations will be apparent.

iii. The contractor shall give a smoke test to the drain and sewer at his own expense and charges, if directed by the Owner's site representative.

END OF SECTION – IV

1. PUMPS AND WATER TREATMENT EQUIPMENT

1.1 Work under this sub-head consists of furnishing all labour, with appropriate T&P scaffolding & staging as required to completely install pumping system for various water supply services and water treatment as per drawings, specified hereinafter and given in the Bill of Quantities.

1.2 Without restricting to the generality of the foregoing, the work of pumps and water treatment equipment shall include the followings:

a) Domestic water supply Pumping System.
b) Level Control & indication System
c) Motor control panels, power and control cabling and allied electrical works.
d) Pipes, valves, accessories, hangers, supports, delivery and suction feeders and connection to proposed pipe work.

2. RE-LIFT WATER SUPPLY PUMPSETS

2.1 Water supply pumps shall be suitable for clean water. Pumps shall be single or multistage, mono block horizontal/vertical, centrifugal pumps with cast iron/stainless steel body and stainless steel/bronze impeller, stainless steel shaft and coupled to a TEFC electric motor by means of a flexible coupling or as specified in bill of quantities. Each pump should operate a curve 10m below specified head.

2.2 Pump and motor shall be mounted on a common M.S. structural or C.I. base plate or as required as per site conditions.

2.3 Each pump shall be provided with a totally enclosed fan cooled induction motor of required H.P. and RPM specified in the bill of quantities and as per requirement.

2.4 Each pumping set shall be provided with a 150mm dia or of suitable size gunmetal "Bourden" type pressure gauge with gunmetal isolation cock and connecting piping.

2.5 Each pump shall be provided with vibration-eliminating pads as suitable for each pump.

2.6 Each pump-set shall be provided with flow measuring meter with bypass arrangement as per requirements and instructions of the engineer-in-charge. (Flow meter items shall be paid for separately as per relevant BOQ item).

2.7 All water supply pumps shall be provided with mechanical seals, of required specifications.

2.8 Installation

Pump shall be installed as per manufacturer's recommendations. Pump sets shall be mounted on machinery isolation cork or any other equivalent vibration isolation fitting. The vibration isolation pads, foundation bolts etc. shall be supplied by the Contractor. Contractor shall ensure that the foundation bolts are correctly embedded.

Pump-sets shall preferably be factory aligned, wherever necessary, site alignment shall be done by competent persons.

2.9 Testing

Contractor shall submit all the performance curves of the pumps supplied by them. They shall also check the capacity and total head requirements of each pump to match their own piping and equipment layout. On completion of the entire installation, pumps shall be tested, wherever possible, for their discharge, head, flow rate, B.H.P. Where it is not possible at least the discharge, head and B.H.P. (as measured on the input side) shall be field tested. Test results shall correspond to the performance curves.

2.10 Painting

After complete installation and testing, pumps accessories and fittings shall be given two coats, three mils each of approved finishing paint.

3. PIPING

3.1 Pipes for suction and delivery shall be galvanized steel pipes (heavy duty) confirming to I.S:1239 upto 150mm dia and as per I.S:3589 for dia 200mm and above or as specified in bill of quantities. . Galvanising shall conform to IS 4736. Pipes and fittings shall be jointed with screwed/flanged joints, flanges either screwed or welded complete and jointed with 3mm thick rubber gasket as per requirements complete with nuts, bolts and washers etc.

3.2 Gate valve and check valve above 65mm dia shall be C.I. double flanged conforming to I.S:780 manufactured by the reputed manufacturers or C.I. double flanged butterfly valves as specified in bill of quantities or elsewhere or as per approval of Engineer-in-charge.

3.3 Full way and check valves 65mm dia and below shall be gunmetal tested to 20Kg/cm^2 pressure certified and conforming to I.S:778.

3.4 Suction strainer or foot valves shall be C.I., confirming to I.S:4038 - 1979, as specified in bill of quantities.

3.5 Joints

All pipes and fittings shall be provided with flanged joints, with flanges either screwed or welded complete and jointed with 1.5mm thick gasket complete with nuts, bolts and washers etc. Welded joints shall not be permitted for domestic water supply pumping systems or wherever potable water quality is required.

4. PIPING INSTALLATION

4.1 Clamps

G.I. pipes shall be supported by G.I. clamps of design approved by Engineer-in-charge. Pipes in wall chases shall be anchored by iron hooks. Pipes at ceiling level shall be supported on structural clamps fabricated from M.S. structural works.

4.2 Unions

Contractor shall provide adequate number of unions on all pipes to enable easy dismantling later when required. Unions shall be provided near each gunmetal valve, stop cock, or check valve and on straight runs as necessary at appropriate locations as required and / or directed by Engineer-in-charge.

4.3 Flanges

The M.S flanges shall confirm to I.S:6392-1971 and shall be galvanized. Flanged connections shall be provided on pipes as required, all equipment connections as necessary and required or as directed by Engineer-in-charge. Connections shall be made by the correct number and size of the bolts and made with 3mm thick insertion rubber washer. Bolt hole dia for flanges shall conform to match the specification.

4.4 Piping layout shall take due care for expansion and contraction in pipes.

4.5 All pipes using screwed fittings shall be accurately cut to the required sizes. Care shall be taken to remove burr from the end of the pipe after cutting by a round file. Genuine red lead with grumet and a few strands of fine hemp shall be applied and threaded in accordance with IS: 554. Open ends of the piping shall be locked as the pipe is installed to avoid entrance of foreign matter. Wherever reducers are to be made in horizontal runs, eccentric reducers shall be used if the piping is to drain freely, in other locations, concentric reducers may be used.

4.6 Contractor shall provide suitable cement concrete, anchor blocks of adequate dimensions as per spacing mentioned above & at all bends, tee connection and other places required and necessary for overcoming pressure thrusts in pipes wherever pipes are installed on-ground / underground. Anchor blocks shall be of cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size).

4.7 Drain shall be provided at all low points in the piping system and shall be of the following sizes:

Mains	Drains
Upto 300mm dia	25mm dia
Over 300mm dia	40mm dia

Drains shall be provided with forged brass ball valve of equal size. Drains shall be piped through equal size G.I. pipe to the nearest drain or floor waste or as shown on the drawings. Piping shall be pitched towards drain points.

4.8 Vibration Elimination

Piping installation shall be carried out with vibration elimination fittings wherever required.

4.9 Testing

All piping shall be tested to hydrostatic test pressure of minimum 10 kg/cm^2 or 1.5 times the design pressure whichever is higher for a period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Engineer-in-charge.

4.10 Painting

(a) After the piping has been installed, tested and run for at least ten days. The piping shall be given two finish coats, 3 mils each of approved color.

(b) The direction of flow of fluid in the pipes shall be visibly marked in white arrows or as directed by the Engineer-in-charge.

5. VALVES & ACCESSORIES

5.1 Sluice / Gate Valves

Sluice Valves above 65 mm (inside screw and non raising screw type) shall be of Cast Iron body and Gunmetal seat with double flanged ends and valve wheel. They shall conform to type PN 1.6 of IS:780. Sluice valves upto 65mm (outside screw raising spindle type) shall be of Gunmetal Full way Valve with wheel tested to 20 Kg./cm2 class-II as per I.S: 778 with female screwed ends. Valve wheels shall be of right hand type and have an arrow head engraved or cast thereon showing the direction for turning open and close.

5.2 Butterfly Valves

5.2.1 The Butterfly Valve shall be suitable for waterworks. The Valves conforming to IS : 13095 shall be provided. All valves shall be suitable to withstand the pressure in the system and rating shall be PN 1.6. All valves shall be right handed (i.e. handle or key shall be rotated clock wise to close the valve).

5.2.2 The direction of opening and closing shall be marked and an open / shut indicator fitted.

5.2.3 The material of valves shall be as under:-

Body	-	Cast iron
Disc	-	Ductile Iron
Seat	-	EPDM/Nitrile rubber
Shaft	-	Stainless Steel

5.2.4 The Valve shall be fitted between two flanges on either side of pipe flanges. The Valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakages.

5.3 Non-Return Valve

Non-return valves shall be of Cast Iron body and Stainless Steel seat. They shall conform to API-594 and have companion flanges. They shall be Dual Plate Type suitable for both horizontal and vertical installation. An arrow mark in the direction of flow shall be marked on the body of the valve.

5.4 Air Release Valve

Air valves shall be provided at all high points in the piping system for air vent of the double float type, with G.M. body, vulcanite balls, rubber sealing, etc. Air valves shall be of the sizes specified and shall be associated with an equal size forged ball valve.

5.5 Ball Valve

5.5.1 The Ball Valve shall be made from forged brass and tested to 20 Kg/cm^2 pressure. The valve shall be internally threaded to receive pipe connections.

5.5.2 The Ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body bonnet gasket and gland packing shall be of Teflon.

5.5.3 The handle shall be of chrome plated steel with PVC jacket. The handle shall also indicate the direction of 'open' and 'closed' situations. The gap between the ball and the Teflon packing shall be sealed to prevent water seeping upto 14 Kg / cm^2 pressure.

5.5.4 The handle shall also be provided with a lug to keep the movement of the ball valve within 90 degree.

5.6 Strainer

Strainers shall be preferably of the approved type with fabricated steel bodies designed to the test pressure of 10 Kg/ cm^2. Strainers shall be fabricated by minimum 1.2 mm thick stainless steel sheet with 3 mm dia. perforation holes. Strainers shall be provided with flanges or threaded sockets as required. They shall be designed so as to enable blowing out accumulated dirt and facilitate removal and replacement of screen without disconnection of the main pipe.

5.7 Pressure Gauges

Pressure gauges shall be of 150mm dia. dial and of appropriate range and be complete with shut off gauge valve etc. duly calibrated before installation. Care shall be taken to protect pressure gauges during pressure testing.

5.8 Flexible Connection for Pumps

All suction and delivery lines shall be provided with double flanged reinforced neoprene / Stainless Steel flexible pipe connectors. Connectors should be suitable for a working pressure of each pump. Length of the connector shall be as per specified or as per manufacturer's details.

END OF SECTION – V

ANNEXURE C: MEP SPECIFICATIONS

PART 4 : LIFT

PROPOSED CONSTRUCTION OF THE NEW CHANCERY AND OFFICIAL RESIDENCE

IN NEW DELHI INDIA

TENDER DOCUMENTS

ELEVATOR SYSTEM

(Special Conditions &Technical Specification)

Date: - 01/05/2025

ARCHITECT

SPACE ARCHITECTURE STUDIO
V-12/23, DLF- PHASE-III
Gurgaon, Haryana - 122002.
Off Ph: +91-124-4734320
contact@studiosas.in

SERVICES CONSULTANT

MULTIPLE SERVICES CONSULTANTS

235/B, Rajpur Khurd Extention
Chattarpur, New Delhi-110068
PH : - 8920228058/8920225677
Email: -narendra@msc-mep.com

SPECIAL CONDITIONS

1. GENERAL STANDARDS

These standards are intended to describe a quality elevator system using all new equipment, parts, materials, components installation, and service techniques.

1.1 Standards and Design Criteria

The following elevator standards and design criteria are for the guidance of the elevator system contractor in understanding features and facilities, and the quality of after sales services required for the Projects.

The elevator contractor shall regard these standards and specifications describing a complete, functioning system with necessary intelligence, flexibility and riding comfort provided herein. Nothing in these specifications shall be taken to state or imply "work by others" except where specifically so mentioned. The contractor shall, at the time of tender, clearly indicate features and facilities which he is unable to provide along with alternate system he wants to offer to satisfy the client's requirements. Such features & facilities shall be clearly identified at the time of submitting his offer. In case there are options beyond the requirements that the contractor can offer, the additional cost of all such items of materials, equipment, and labour shall also be identified separately.

2. GOVERNING CODES AND PERMITS

Elevator equipment shall be furnished and installed in accordance with A.N.S.I./ A.S.M.E. A17.1/ CENEN 81-1 Japanese Codes including latest supplement. The Elevator Contractor shall inform the owning Company of any intended or required departures from the code requirements described above.

No degradation of ANSI/ ASME/ CENEN 81-1 requirements is acceptable simply on the basis of the local code requirement. It is acceptable only when the ANSI/ ASME/ CENEN 81-1&2 code is in direct conflict with local code requirements and where the latter is more stringent than the former.

3. PROJECT EXECUTION AND MANAGEMENT

General Outline of Works

This section includes the design, manufacture, delivery at site, installation, testing and commissioning of Lift Cars, associated motors and lifting gear in accordance with the materials specified herein and including the requirements as described in Specification and the associated Contract Drawings. The scope of work shall also involve certain related work items as identified and set out elsewhere, which shall apply to all lifts.

The lift Contractor shall be responsible for ensuring the installation carried out is in accordance with the code requirements and for providing all necessary warranties and guarantees on the date of taking over by the Employer.

The lift contractor is responsible for the complete installation and performance of the works within the confines of the lift shaft, pit, lift cab enclosure.

Specifications, covers the engineering, design, fabrication, manufacture, shipment, installation, inspection and testing of the elevating devices broken down as in technical data sheets.

The Contractor shall ensure that senior planning and erection personnel from his organisation are assigned exclusively for this project. They shall have minimum 10 years' experience in this type of installation. The Contractor shall appoint one erection engineer and one senior supervisor posted at site on full time basis.
For quality control and monitoring of workmanship, contractor shall assign at least one full time engineer who would be exclusively responsible for ensuring strict quality control, adherence to specifications and ensuring top class workmanship for the installation.

Supply all labour, materials, manufacturing plant, equipment, design services, engineering, field labour, testing and inspection services, plus undertake all adjustments, tuning, set up and carry out all operations and procedures as required to complete electric traction lifts, and service lift works as shown on contract.
The contractor shall arrange to have mechanised and modern facilities of transporting material to place of installation for speedy execution of work.

The terms “left hand” and “right hand” when used in these specification, shall be based upon the following operations

4. GUARANTEE, MAINTENANCE

4.1 Guarantee

The elevator contractor shall guarantee all equipment parts, materials and workmanship furnished for the installation. The elevator contractor warrants for a period of 24 months from the date of acceptance to replace all failed part or parts exhibiting unusual wear and tear during guarantee period and shall be replaced without any cost to the Owner, such replacement shall be factory approved new, equal or better than original. All labour, tools, materials, transportation, insurance, etc. required in performance of guarantee shall be at the elevator contractor’s expense.

4.2 Maintenance

The elevator contractor shall maintain the elevator system in a first class and safe manner during guarantee period. Such maintenance shall be for the entire elevator system except when failure occurs due to work performed by others. Responsibility entails daily inspection by the supervisor/ technician and unlimited call back service including nights, weekends and holidays.

Apart from the above this maintenance shall include 1 visit by Engineer per week for the first 6 months from the date of acceptance of the elevator system. Call back service shall be provided for emergencies, and responded within 2 Hrs.

Engineer’s Visits for the next 18 months shall be not less than 1 per fortnight with visit timings adjusted so as not to coincide with the busiest usage period. Call back service shall be responded within 2 hours and service involving more than one stalled or erratic elevator shall be immediately provided regardless of the time of day or night. Emergency call back service for trapped passengers shall be responded to within 10 minutes. There shall be no compensation for call back service regardless of the hour/ day, etc.

The elevator contractor shall maintain the elevator system in a professional, first class manner and keep and maintain elevator machine room and equipment in a neat workman like order.

The contractor shall anticipate demand on supplies and parts and keep an inventory of a reasonable number of spare parts, at his own cost, on site in a self-provided lockable metal cabinet.

5. SHOP DRAWINGS

5.1 All the shop drawings shall be prepared on computer through AutoCAD System based on Architectural Drawings, site measurements and Interior Designer’s Drawings. Within eight weeks of the award of the contract, contractor shall furnish, for the approval of the Architect/ Consultant, two set of detailed shop drawings of all equipment and materials including layouts for all accessories and any other requirement to be fabricated or purchased by the contractor.

5.2 These shop drawings shall contain all information required to complete the Project as per specifications and as required by the Architect/ Consultant/ Owner’s site representative. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors.
Each shop drawing shall contain tabulation of all measurable items of equipment/ materials/ works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings.

Each item of equipment/ material proposed shall be a standard catalogue product of an established manufacturer strictly from the manufacturers listed in Appendix-III.

When the Architect/ Consultant makes any amendments in the above drawings, the contractor shall supply two fresh sets of drawings with the amendments duly incorporated along with check print, for approval. The contractor shall submit further six sets of shop drawings to the Owner’s site representative for the exclusive use by the Owner’s site representative and all other agencies. No material or equipment may be

delivered or installed at the job site until the contractor has in his possession, the approved shop drawing for the particular material/ equipment/ installation.

5.3 Shop drawings shall be submitted for approval sufficiently in advance of planned delivery and installation of any material to allow Architect/ Consultant ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved programme.

5.4 Manufacturers drawings, catalogues, pamphlets and other documents submitted for approval shall be in four sets. Each item in each set shall be properly labeled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.

5.5 Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supersede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract.

5.6 Where the contractor proposes to use an item of equipment, other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundation, wiring or any other part of the mechanical, electrical or architectural layouts; all such re-design, and all new drawings and detailing required therefore, shall be prepared by the contractor at his own expense and gotten approved by the Architect/ Consultant/ Owner's site representative.

6. MANUFACTURERS INSTRUCTIONS

Where manufacturer has furnished specific instructions, relating to the material and equipment used in this project, covering points not specifically mentioned in these documents, manufacturer's instructions shall be followed in that case.

7. ON SITE TRAINING

Upon completion of all work and all tests, the Contractor shall furnish necessary operators, labour and helpers for operating the entire installation for a period of thirty (30) working days of ten (10) hours each, to enable the Owner's staff to get acquainted with the operation of the system. During this period, the contractor shall train the Owner's personnel in the operation, adjustment and maintenance of all equipment installed**.**

8. INSPECTION AND TESTING

The Owner may carry out inspection and testing at manufacturer's works for this contract. No equipment shall be delivered without prior written confirmation from the Owner's site Engineer. In case factory inspection is carried out then all travelling and lodging expenses for two persons one from owner and one from consultants shall be borne by the Contractor, also all expenses related to testing shall be to Contractor account. Tests on site of completed works shall demonstrate the following:

That the equipment installed complies with specification in all respect and is of the correct rating for the duty and site conditions.

That all items operate efficiently and quietly to meet the specified requirements. That all circuits are fully protected and that protective devices are properly co-ordinated.

That all non-current carrying metal parts are properly and safely grounded in accordance with the specification and appropriate Codes of Practice.

The contractor shall provide all necessary instruments and labour for testing, shall make adequate records of test procedures and readings, shall repeat any tests requested by the Owner and shall provide test certificate signed by an authorised person. Such test shall be conducted on all materials and equipment and tests on completed work as called for by the Owner at contractor's expenses unless otherwise called for.

If it is proved that the installation or part thereof is not satisfactorily carried out then the contractor shall be liable for the rectification of the same. Owner Site Engineer's decision as to what constitutes a satisfactory installation shall be final.

All tests shall be carried out as mutual agreement with the Owner/ Consultants.

9. PAINTING

All exposed metalwork furnished under these specifications, unless otherwise specified, shall be shop primed and properly painted. Shop coats of paint that have become marred during shipment or erection, shall be cleaned off with mineral spirits, wire brushed and spot painted over the affected areas, then coated with enamel paint to match the finish over the adjoining shop painted surface.

10. IMPORT LICENSE

Should any import license be required for import of any component, the contractor shall make his own arrangement for the same. The Owners shall not undertake any responsibility for import of components and all payments shall be made in Indian rupees only.

11. DEVIATIONS

Contractor shall stipulate the deviations, if any, from these Technical Specifications, and reason thereof

12. STRUCTURAL REQUIREMENTS

Contractor shall clearly indicate the structural and electrical requirements for the installation of elevator. Machine room, shaft and pit shall be provided by the Owners through other agency. Other preparation work and all items of supply and installation in the hoistway shall be the responsibility of the contractor.

13. EXCLUSIONS

Any items excluded from the offer, but functionally required, shall be clearly defined and listed by the tenderers, giving description of the items, quantity and estimated cost and the reason for excluding the items.

14. TOOLS AND TACKLES

All tools, tackles, supports, scaffolding and staging etc. required for erection and assembly of the equipment and installation covered by the contract shall be provided by the Contractor himself. In addition, the contractor at his cost shall also provide all other materials such as foundation bolts, nuts etc. required for the installation of the equipment.

15. TESTING AND HANDING OVER

i. The Contractor shall carry out test run of the installation in the presence of representatives of the Owner, to establish satisfactory functioning of the installation.

ii. The Installations shall be handed over to the Owner's site representative after satisfactory testing along with six sets of completion documents each consisting of :

a. Detailed equipments data and catalogues.

b. Manufacturer's maintenance chart including check chart and Lubrication chart.

c. Set of "AS INSTALLED DRAWINGS" showing layouts, equipments details, electrical power & control wiring diagrams etc.

d. Test Certificates for major equipments.

e. Certificates of approval from Statutory and/ or Local Authorities for the operating and maintenance of the installation and equipment, wherever such approval or certification is required. (Lift inspector's certificate/ license).

f. Certificate from the Engineer that the contractor has cleared the site of all debris and litter caused by him during the Construction.

g. Measurement details of vibrations with recently calibrated accelero meter.

iii. Submission of the above documents shall form a precondition for the final acceptance of the installation and final payment.

iv. Upon handing over, the Owner's site representative shall issue to the contractor the necessary certificate of acceptance.

v. Warranty of materials shall be started from 24 months from the date of acceptance by the owner.

vi. Upon completion of the installation, following tests shall be carried out.

a. Levelling Test
b. Safety Gear Test
c. Contract Speed
d. Lift Balance
e. Car & Landing door interlocks
f. Operation of Controllers and
g. Normal & final terminal stopping switches.

16. PERFORMANCE REQUIREMENT

The contractor shall maintain the following performance requirements of the Equipment, as applicable, and as designated in the Annexure to the Conditions of Contract

a. Floor-to floor times are measured from the time the doors start to close, including a typical one – floor travel and until the lift is stopped level with the next successive floor, either up or down, and the doors 3/ 4 open.

b. Door opening times are measured from the start of the car doors opening until the doors are in the fully open position.

c. Door closing times are measured from the start of the car doors closing until doors are in the fully closed position.

d. Stopping accuracy shall be measured under all load conditions.

e. Variance from rated speed, regardless of load, shall not exceed ± 3 % for electric traction lifts and ± 5% for electric hydraulic lifts.

f. Motion and Vibration Control: Lift ride quality shall be maintained and adjusted to meet the performance requirements of the following parameters where these values are set out.

i. Horizontal acceleration measured in the centre of the lift car floor in the side-to-side and front, to back directions during all riding conditions shall not exceed specified amounts.

ii. Vertical acceleration and deceleration shall be constant and not exceed the specified amount.
iii. Sustained jerk shall not exceed 2.0 m/ sec^3.

It shall be the contractors responsibility to ensure continued lift guide rail alignment and that all parts relative to ride quality are maintained and adjusted to take normal building movement.

g. Noise Control.

Lifts: Measured noise levels at the centre of the car caused by the lift's operation, 1m above the car floor, in a moving car outside the leveling zone shall not exceed the amount stated, and under any condition including ventilation blower on highest speed. Noise levels during door operation shall not exceed the amount stated.

h. Downtime and Hall Call Response Times.

Where applicable additional performance parameters concerned with "Downtime" and "hall call response times" are given. Any penalties pertaining to non-accomplishment of these parameters are also stated.

In accomplishing the above requirements, the Contractors shall maintain a comfortable ride with smooth acceleration, retardation and a soft stop. Door operation shall be quiet and positive with smooth checking at the extremes of travel. Performance requirements indicated are minimum standards and are not the sole criteria for judging the Contractor's performance.

17. LIFT RIDE QUALITY

The Contractor shall at no additional cost measure lift car ride quality annually for all lifts indicated, with specified ride quality parameters and forwarded printed results to the Owner's representative. These tests shall determine the level of horizontal and vertical acceleration together with the noise level within each lift as defined.

18. UPTIME GUARANTEE

The contractor shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the defects liability period shall get extended by a month for every month having shortfall.

19. WORK BY OTHER AGENCIES

The following associated civil and electrical work shall be carried out by the main contractor through other Agencies:

a. **Hoist Way**: Hoist way shall be made properly framed and enclosed, including a pit of proper depth with drainage provision and waterproofing. The hoist way and pit walls shall be duly treated and painted. Support for buffer spring by M.S. channel shall also be provided.

Smooth, vertical & painted/ whitewash hoistway shall be provided by the civil contractor.

b. **Hoist way Guard**: Provision shall be made during construction for proper guarding and protection of hoist way and temporary barricading of hoist way en-trances prior to the commencement of installation. It shall be the responsibility of lift contractor after award of work.

c. **Power and Light**: Power/ light shall be provided :-

i. Power in the machine room for the lift machine with one isolating switch including common earth for entire system.

ii. Proper lighting and air conditioning of machine room.

iii. Lighting of the lift shaft (Bulkhead at every floor level, power point (16 A) at every floor and in the lift pit.

d. **Fire Extinguisher**: Fire extinguisher in the machine room shall be provided.

e. If required, Interior decoration of cabins shall be done by others.

Except for items of exclusion mentioned above, all items/ materials/ equipments required for completion and functioning of the installation in all respect are deemed to be included in the scope of this work whether specifically mentioned or not.

20. MISCELLANEOUS

The following shall be in the scope of the successful elevator contractor and it shall be his responsibility to arrange all the items in order to complete the installation.

i. Scaffolding

ii. All minor builder works such as chipping of surfaces, cutting and finishing of walls/ floors/ partitions etc. shall be responsibility of elevator contractor.

iii. All steel items included except architraves foundation & support and lifting beam in the machine room

iv. Stainless Steel Jamb Panel & sill Angles.

21. QUALITY ASSURANCE PROGRAM & TEST PROCEDURE FOR ACCEPTANCE

Following test procedures shall be carried out prior to acceptance of elevator system.

a. Test to determine that the insulation resistance between power and control lines and earth is as per specified IS codes.

b. Test to determine that the earthing of all conduit, switch, casings and similar metal works is continuous and of low resistance.

c. Test to determine that the motor, brake, control equipment and door locking devices and limit switches function correctly.

d. Brake to be tested to check whether it can sustain a car at rest with 25% of contract load.

e. Test to determine that the lift car rises and lowers smoothly at the rated load.

f. Test to determine that the lift car achieves the specified speed.

g. Test to determine that the safety gear stops the car with the rated load.

h. Test for rated power against actual power consumption under full load.

i. Check for current drawn by each elevator during starting and full load operation.

j. Sound level check for motors.

k. Visual inspection for all components.

l. The contractor shall guarantee the smooth and noiseless performance of the elevator System as per IS-1860 -–1980 & IS-6620-1972 (Reaffirmed 1991).

Besides the above, contractor shall submit his standard quality assurance programme and test acceptance procedures for reference of Owner's site representative/ Consultant.

22. ALL INCLUSIVE MAINTENANCE CONTRACT

a. Routine Preventive Maintenance Schedule to be submitted

i. Schedule to cover manufacturer's recommendation and/ or common engineering practice (for all plant and machinery under contract).

ii. Plant and machinery history card giving full details of equipment and frequency of checks and overhaul.

iii. Monthly status report.

b. Uptime during maintenance contract

i. 98% uptime of all systems under contract.

ii. Up time shall be assessed every month and in case of shortfall during any month the contract shall be extended by a month.

iii. There shall be no reimbursement for the extended period.

iv. Break-downs shall be attended to within two hours of reporting.

c. Manpower

i. Adequate number of persons to the satisfaction of the Owner's site representative shall be provided including relievers.

ii. Statutory requirements of EPF, ESIC and other applicable labour legislations to be complied with; and monthly certification to that effect to be submitted.

iii. Duty allocation and Roaster control shall be contractor's responsibility.

iv. No overtime shall be payable by Owner for any reason whatsoever.

d. Shut Downs

i. Routine shut downs shall be permitted only with prior permission.

ii. Contractor shall be at liberty to carry out routine maintenance as and when required but with prior permission of the Owner.

e. Payment Terms

i. Quarterly payment at the beginning of each quarter on pro-rata basis for 3 years**.**

A P P E N D I X – I

LIST OF APPROVED MAKES FOR EQUIPMENT & MATERIALS

S. No.	Details of Materials / Equipment	Manufacturer's Name
1.	Moulded Case Circuit Breaker (MCCB)	Schneider Electric (NX) Larsen & Toubro (D-sine) ABB (T – Max) Siemens (3VL)
2.	Miniature Circuit Breaker (MCB)	Legrand Hager (L&T) ABB Siemens Schneider Electric (MG)
3.	Residual Current Circuit Breaker (RCCB)	Legrand Hager (L&T) ABB Siemens Schneider Electric (MG)
4.	Power/Aux. Contactor	Schneider Electric (MG) -Telemechnaic L&T -MNX ABB-A range Siemens-Sinext GE-(CL)
5.	PVC insulated XLPE aluminium \ copper conductor armoured / unarmoured MV Cables upto 1100 V grade	Finolex Ravin Cables RPG Cable Skytone Universal
6.	Cable Glands Double Compression with earthing links	Braco Comet (Comex) Hex Brass
7.	Bimettalic Cable Lug	Braco Comet Dowell's (Biller India) Hex Brass (Copper Alloy India)
8.	PVC insulated copper conductor stranded flexible wires (FRLS)	Skytone KEI Polycab
9.	Mettalic Conduit (ISI approved)	AKG BEC NIC
10.	Fastners	Hilti
11.	Welding Rods	Advani

S. No.	Details of Materials / Equipment	Manufacturer's Name
12.	Paints	ICI Asian Shalimar
13.	Travelling Cables	Usha Martin
14.	Structural Support (MS Works)	Tata SAIL

LIST OF INDIAN STANDARDS

1.	Code of Practice for installation, operation and maintenance of electric passenger & goods lifts.	:	IS-14665 (Part 2) Sec-1 : 2000
2.	Code of practice for installation, operation and maintenance of electric service lift.	:	IS-14665 (Part 2) Sec-2 : 2000
3.	Safety Rules Section-1 Passenger and Good lifts	:	IS-14665 (Part 3) Sec-1 : 2000
4.	Safety Rules Section-2 – Service Lifts	:	IS-14665 (Part 3) Sec-2 : 2000
5.	Outline dimension for electric lifts.	:	IS-14665 (Part-1) : 2000
6.	Inspection Manual for Electric Lifts	:	IS-14665 (Part 5) : 1999
7.	Electric Traction Lifts – Components	:	IS-14665 (Part 4) Sec-1 to 9 : 2001
8.	Specification for lifts cables.	:	IS-4289 (Par-1) : 1984 Reaffirmed 1991
9.	Specification for hot rolled and slit steel tee bars.	:	IS-1173-1978 Reaffirmed 1987
10.	Method of loading rating of worm gear.	:	IS-7443-1974Reaffirmed 1991
11.	Code of practice for selection of standard worn and helical gearbox.	:	IS-7403-1974Reaffirmed 1991
12.	Isometrics screw threads.	:	IS-4218-(Part-II)1976 Reaffirmed 1996
13.	Degree of protection provided by enclosure for low voltage switchgear and control gear.	:	IS-13947
14.	Classification of insulating materials for electrical machinery and apparatus in relation to their thermal stability in service.	:	IS-1271-1985 Reaffirmed 1990
15.	Code of practice for earthing.	:	IS-3043-1987
16.	Electrical installation Fire Safety of Building.	:	IS-1646-1997
17.	PVC insulated electric cable for working voltage upto and including 1100 volts.	:	IS-694-1990
18.	Code of practice for electrical wiring and installation	:	IS-732-1989
19.	PVC insulated (Heavy Duty) electric cables for working voltage upto and including 1100 volts.	:	IS-1554-1988 (Part-1)
20.	Flexible steel conduits for electrical wiring	:	IS-3480-1966
21.	Accessories for rigid steel conduit for electrical wiring	:	IS-3837-1976
22.	Boxes for the enclosure of electrical accessories	:	IS-5133-1969 (Part 1)
23.	Guide for safety procedures and practices in electrical work.	:	IS-5216-1982 (Part-1)
24.	Conductors for insulated electric cables and flexible cordes	:	IS-8130-1984
25.	Miniature Circuit Breakers	:	IS-8828-1996

26.	Rigid steel conduits for electrical wiring (Second revisions)	:	IS-9537-1981
27.	Methods of test for cables	:	IS-10810-1998
28.	Earth Leakage Circuit Breakers.	:	IS-12640-1988
29.	Moulded Case Circuit Breakers	:	IS-13947-1993
30.	General requirement for switchgear and control gear for voltage not exceeding 1000 volts.	:	IS-13947-1993
31.	Code of Practice for Hoistway door locks.	:	IS-7754
32.	Design, installation, testing & operation of lifts, escalators & moving parts.	:	IS-1735
33.	Degree of protection provided by enclosure for LV switchgear & control gear.	:	IS-2147
34.	Designed and manufacture for car hydraulic Lift	:	95/16/CE
35.	Harmonized Norm for car hydraulic Lift	:	EN 81-2
36.	Electromagnetic Compatibility for car hydraulic Lift	:	89/336/CEE
37.	Test Certificate CE Type	:	ATI/LD-VB/M012/99 (institution registered 0053)

LIST OF ACT / BYE LAWS

The lift installations shall also be governed by the following Acts/Bye-laws/Codes as amended upto date in addition to the codes specified in the tender:

1. National Building Code of India - 2005
2. Indian Electricity Act - 1910
3. Indian Electricity Rule - 1956
4. Local Lift Act
5. Building Bye-Laws
6. Local Fire Prevention and Fire Safety Rule

A P P E N D I X – II

SAFETY ASPECTS & PROCEDURES

1. Since lift installation consists of a number of electrical and mechanical components having linear / rotary motions, utmost caution should be exercised while working and all safety precautions shall be rigorously followed.

2. Only authorised persons shall be allowed to work on lift installations and officer (s) empowered for such authorisation shall keep proper record thereof during the tests; inspection and maintenance.

3. If during erection any safety or protection device is inoperative, special care must be taken to avoid accidents on this account

4. Supply at main incoming circuit breaker shall be switched off before examining any part of the equipment. Whether during periodical inspection, or while carrying out any work on the equipments (including using the winding handle at times of mains failures) unless power is particularly required for particular operation or tests on the lifts, the breaker shall be locked in OFF position.

5. Whenever the car needs to be moved by use of winding handle in the machine room;

   a. Power at incoming shall be switched off before applying the handle.

   b. Power shall be restored only after this handle is removed from winding shaft and brakes are applied.

6. The landing and car buttons shall be kept out of circuit by switching on the 'Maintenance Switch' located on the top of the lift car during maintenance operators. Whenever maintenance switch is not provided emergency stop switch inside car and or attendant control switch should be used.

7. Before carrying out any repair work it shall be ensured that none of the electro-mechanical door locks are short-circuited either from the controller or at the landings.

8. As a general precaution, facial plate between the door header and the corresponding upper landing sill on each floor must be provided.

9. Scaffolding steel cap lock system to be installed. No ballies / Bamboo scaffolding to be used.

10. No. LPG (Domestic) to be used for any purpose.

11. Safety nut to be used as per requirement of site.

12. Electrical Safety:

    a. All electrical equipment must be properly earthed.

    b. Rubber Gove and rubber shoes / boots of correct proper ladder to enter lift pit.

13. Proper ladder to enter lift pit.

14. Welding work precaution to be ensured.

15. Welding work precaution to be ensured

16. Safety audit to be done to ensure safety of workers

17. No cable / wire to lie on ground or drawn along steel cup lock system

18. ISMB for lift machine must rest on hard bed

19. PPE's : Safety belt / helmet /shoe to be used by all

20. Work to be done on flat platforms and Jali to be provided on scaffolding

21. First aid & medical facilities must be ensured at site

22. No combustible materials, garbage, scrap to be kept at site lift shaft / lift pit

23. Adequate numbers of Fire Extinguishers and sand buckets to be provided at site

24. Survey to be done on all lift pits to ensure that loose material / blocks steel reinforcement pre-cutting to of RCC wall etc. are not in the Pit

25. Power / light source should be above the pit level

26. Water barrier to all lift pits so that water inflow into pits can be stopped. If due to some reason or somehow water has been stored at the basement or floor level/pit then dewatering / removal through pumping shall be in the scope of the contractor.

TECHNICAL SPECIFICATIONS

A. PASSENGER & SERVICE ELEVATOR

1. PASSENGER & SERVICE ELEVATOR

Elevator shall include all elements conforming to specifications or as amended herein. Elevator and covered by this specification shall be provided, installed, tested, commissioned, certified and approved as per statutory requirements by Lift Inspectorate.

Notes:

a. One Fireman's switch at ground floor for each bank of elevator shall be provided.

b. Emergency light of adequate illumination level shall be provided in all lift cars. It shall be operated by self-contained nickel cadmium batteries completed with self-maintained trickle charger. The battery shall be able to maintain the full illumination continuously for a period not less than two hours.

c. Provision of at least 250 Kg weight for interior finishes shall be kept for passenger elevator. In case interior-finishing materials in cab exceed this provision, then the elevator contractor shall clearly identify the loss of carrying capacity, if any. Recess in platform of 25 mm shall be provided in floor for receiving stone flooring in the passenger elevator.

d. All elevators shall be hooked to the Building Management System (BMS) including all necessary cabling, software and hardware. Elevator supplier shall co-ordinate with BMS vendor for the software compatibility between BMS & elevator system.

e. Elevator and their installation shall conform to governing codes for fire safety, as per N.F.P.A. 101.

2. CONTROLLER

Machine switches shall be provided in metal cabinet housing. Controller shall be equipped with modular electronic boards. Motherboard shall cover all basic functions. Interface capability for remote monitoring shall be by potential free contact. Interface for interfiling operation shall be by contact mats.

Controller shall have the following functions

- Directional settings
- Supervision of power supply voltage
- Motor protection against overheating.
- Fault indicator by means of display
- Control of safety contacts
- Asymmetric relay.
- Protection for over-current, earth fault, over-voltage, single phasing including phase reversal also.

3. HOIST GEAR

Hoisting machines for passenger elevator shall be of gearless type operating at speed as per Datasheets

4. EMERGENCY CRANKING

The hoisting machines shall be provided with a set of special tools including a hand crank to allow release of hoist brake and provide for manual movement of the car in case of emergency. These tools shall be hung up on a tool board fitted to a wall in the elevator machine room, with instructions for their use clearly written on the board both in English and the local language. The elevator system supplier shall qualify his bid with respect to manual cranking.

An automatic switch shall be provided to interrupt power to the elevator mains. Upon withdrawal of crank and manual resetting of power monitor switch, power shall be restored.

5. BRAKE

Brakes with non-asbestos lining shall be spring loaded and shall close and open electrically. Brake shall be applied using variable input frequency to insure smooth stopping.

6. AUTOMATIC SELF-LEVELING

The elevator shall be provided with automatic self-leveling feature that shall bring the elevator car level to within ±3 mm for passenger / service elevator and ± 5 mm for elevator of the landing floor regardless of load or direction of travel. The automatic self-leveling feature shall compensate for over travel and rope stretch.

7. HOISTWAY MATERIALS

Hoist way materials shall be non-flammable except traveling cable which shall be flame resistant. All other electrical cables shall also be flame resistant and housed in metal conduit or other metal enclosures.

8. HOISTWAY ENTRANCES & CAR DOOR

All landing hoistway entrance door shall have center opening horizontal sliding type doors suitable for a clear opening as indicated in Technical Data for each type of elevator and shall include flush doors of hollow metal construction, extruded aluminium sill with anti-slip grooving and hanger supports and hanger cover shall be provided. Exposed surfaces of doors and frames shall be finished as directed by the Interior Designer.

Sheave type two point suspension ball bearing door hangers and tracks shall be furnished for each hoistway opening. Sheaves shall not be less than 58 mm diameter and adjustable ball bearing rollers shall take the up thrust of the doors.

Each car and hoistway door leaf shall be fitted with minimum two no. Teflon or nylon gibes as bottom door stabilizers.

9. CAR AND HOISTWAY DOOR OPERATOR

For each elevator door, an electric VVVF door operator or PWM DC door operator shall be furnished to simultaneously open the car and hoistway doors when the car is at a landing. The doors shall be closed simultaneously by motor power. Emergency key provision shall be made to open doors at all landing from outside of the hoistway.

In the event of interruption of electric power or failure of the door operator, it shall not be possible to open the car door manually from within the car.

An electric contact for the car door shall be provided which shall prevent elevator movement away from the landing unless the door is in the closed position. Each hoistway door shall be equipped with a positive electromechanical interlock and auxiliary door closing device so that the elevator can be operated only after the interlock circuit is established.

The doors shall open automatically while the car is leveling at the respective landing. The doors shall automatically close after a predetermined time interval has elapsed, but the momentary pressure of the "door open" button provided in the car shall reverse the motion, reopen the doors, and reset the time interval unless overridden by the electronic door monitor.

10. PHOTO ELECTRIC DOOR MONITORS

An Electronic Door Monitor device shall be installed on each passenger elevator. This device shall monitor traffic across the threshold of the door and shall initiate door closing 2 seconds after interruption, thus overriding door open period. There shall be no dead zone in the entire opening which is not monitored by the device.

11. DOORS

Doors, threshold and door hangers shall be, as a system, fire rated for not less than 1.0 hours.

12. DOOR OPEN CLEARANCE

Clear door opening on passenger service elevator shall be as indicated in technical data. Any other dimension requires Owners approval. Finishes shall be as specified under finishes.

13. CAR TOP STATION

A car top operating station shall comprise of key operated switch and constant pressure up/down buttons which shall be provided on each elevator. Car shall respond to up/down command at inspection speed. The elevator contractor shall provide electrical fixture of 28 watt enclosed fluorescent or enclosed 2 x 18 Watt compact fluorescent switched from car top station.

14. SHEAVES

Sheaves shall be machined, balanced and shall maintain cable / sheave ratio well within requirements. Lubrication points shall be extended to a location that is easily accessible.

15. CARFRAME AND SAFETY

A car-frame fabricated from formed or structural steel members shall be provided with adequate bracing to support the platform and car enclosures. The car safety shall be integral with car-frame or shall be mounted on the bottom members of the car-frame, and shall be of the flexible guide clamp type designed to stop and hold a fully loaded car which exceeds descending speed. Safeties shall conform to ANSI/ASME/CENEN-81 or local codes if more stringent.

16. SPEED GOVERNOR

The car safety shall be operated by a mechanical centrifugal speed governor located in the machine room at the top of the hoistway. The governor shall actuate a switch when excessive descending speed occurs, disconnecting power to the hoist motor and applying the brake prior to deployment of the safeties. Governor sheave in elevator pit shall be enclosed in a wire cage to a height of 2.40 m.

17. WIRING

All wiring and electrical interconnections shall comply with governing codes. Wiring shall be PVC insulated 1100-volt grade flame retardant and shall run in metal conduit, tubing or approved electrical raceways. Travelling cables shall be flexible and suspended to relieve strain on individual conductors. A minimum of 10% spare conductors shall be provided in travelling cable.

18. VOLTAGE FLUCTUATIONS

All electrical equipments supplied by the lift contractor shall withstand an incoming supply voltage fluctuations of +10% - 10%.

19. HOISTWAY OPERATING DEVICES

Redundant series wired terminal stopping devices shall be provided to slow down and stop the car automatically at the terminal landings. Resetting a tripped device shall be done manually only.

20. PIT SWITCH

An emergency stop switch shall be located in the pit which when operated shall stop the car regardless of position in the hoistway.

21. BUFFERS

Buffers shall be provided in the pit in compliance with ANSI/ASME/CENEN-81 or local code if more stringent. Clearance from underside of car resting on a fully compressed buffer shall be not less than 1.20m. Buffer shall be designed for design speed + 15%. Oil buffers shall be provided for the passenger

elevator for speeds of more than 1.75 mps and spring buffers for lower speeds or in case of specifically asked for in technical data. The oil buffers shall be self-resetting type and shall be provided with means for determining the oil level.

22. GUIDE RAILS

Steel guide rails shall be installed to guide the car and counterweight, erected plumb and securely fastened to the building structure, fitted to ensure smooth joints. The guide rail shall be minimum 16 mm, tongued and grooved type.

23. GUIDES

Rubber encased coil spring tension adjusted roller guides shall be provided for passenger elevator with speed of 1.75 mps or greater, mounted on top and bottom of the car frame, and on top and bottom of the counterweight frame to engage their respective guide rails. Service elevator low speed elevator can have sliding guides on car and counterweights.

24. CABLE ANCHOR

Cable shall conform to ANSI/ASME/CENEN-81 and shall anchor to the frame by means of an equalizing device to insure uniform cable loading. Cable safety shall conform to ANSI/ASME/CENEN-81 or governing code if available.

25. TRAVELLING CABLE

Travelling cable shall be secured to the cars underside. Cable shall be clear of all obstructions while car is in motion. Cable jacket shall be suitable for immersion in water, salt water and oil. Jacket shall minimize strain on conductor. Travelling cable shall have 4 cores spare after providing for music, car access control, phone, TV, etc

26. INTERLOCKS

Hoistway openings shall be provided with electro-mechanical locks.

27. COMPENSATING ROPE

Compensating ropes shall be furnished and installed for all elevator with speed over 2.0 m/sec, and travel in excess of 30 m, to compensate for the shifting weight of the hoist ropes. A device shall be provided to tie the car and counterweight together to limit the jump of the car or counterweight. Compensating chain where provided shall be enclosed in a plastic flame resistant jacket to minimize noise.

28. COUNTERWEIGHT

A structural steel frame with cast iron or steel plate filler weights shall be furnished to provide proper counterbalance for smooth operation.

29. COUNTERWEIGHT GUARD

A metal counterweight guard shall be furnished and installed at the bottom of the hoistway, and shall wrap around counterweight rails for a height of no less than 1.80 m in order to protect accidental contact.

30. ROPES

Hoist ropes shall be traction steel of size, construction and number to insure proper operation of the elevator gives satisfactory and safety assurance. Governor ropes shall be steel. All ropes shall consist of at least eight strands wound about a hemp core center. All ropes shall conform to ANSI/ASME/EN-81 or more governing codes or regulations. The minimum factor of safety for ropes shall be 10.

31. PLATFORM

The car platform shall be of Aluminium/ Stainless steel plate as asked for in the BOQ. The entire platform shall rest on rubber pads, so designed to form an isolating cushion between the car and car frame. Platform deflection shall be limited to maximum 3 mm under maximum normal operating conditions. Platform shall conform to ANSI/ASME/EN-81 or more stringent local codes.

32. HEAVY LOADING PLATFORM (SERVICE ELEVATOR)

The platform shall be provided with slip resistant Aluminium/Stainless Steel chequered plate flooring. The platform shall be arranged to accommodate one-piece load lf mechanical / electrical equipment, etc.

33. OVER-LOAD FEATURE

Elevator shall be fitted with the load-weighing feature to illuminate "Over-Load" and defeat the car's operating circuits when car load reaches 110% or more of rated load. Car platform may require stiffening to minimize margin of error resulting from excessive deflection. Overload feature and / or circuit defeat for elevator shall conform to governing code.

34. CAR SPEED

Car speed shall be based on the travel distance and number of floors. This has been specified in Schedule of Quantities.

35. SYSTEM PERFORMANCE

The bidder shall do the traffic analysis and submit the same with his tender. The study shall confirm that under normal operating conditions, maximum waiting time at any landing shall not exceeds 35 seconds, if not possible contractor shall propose most economical modification to achieve that.

36. ACCELERATION / DECELERATION

Acceleration / Deceleration shall be linear and smooth. Stops shall be without cable oscillations. Acceleration & Declaration shall be site adjustable.

37. NOISE LEVELS (PASSENGER ELEVATOR)

Noise from moving equipment including door operation, car motion, fan, etc. shall not intrude into adjoining spaces by more than 20 dB and adjoining occupied areas by not more than 10 dB. (All octave bands).

Noise level inside the car shall not exceed 50 dB. Without car cabin fan running.

Noise level inside the car shall not exceed 55 dB. In case of door opening / closing. The noise level shall be measured at 'Zero Activity'.

38. LATERAL QUAKING & VERTICAL VIBRATIONS

Lateral quaking and vertical vibrations should not exceed 20 gal and 85 dB respectively. Contractor to demonstrate these parameters at site with performance analyzer.

39. EMERGENCY CAR LIGHTING & INTERCOM

Provision shall be made in the car for lighting, low speed and low noise fan, status indication and communication. Wiring cabling for the above facilities shall be provided along with travelling cable. Elevator contractor shall provide and install hand free communication unit above the car operation panel. Other units shall be installed in the control room and the machine room. Fan shall be low noise and shall be approved by the Architect / Consultant. Speaker shall be provided for emergency announcement and background music.

40. CAR POSITION INDICATOR (PASSENGER CARS)

Scrolling alphanumeric car position indicator shall be installed above each operating panel. The position of the car in the hoistway shall be shown by illuminating the corresponding landing at which the car is stopped or passing.

41. LIGHTING

The cab manufacturer shall make all provisions for installation of lighting fixtures specified by interior designer, including integration of emergency lighting fixtures.

42. HALL BUTTONS (ALL CARS)

For elevator hall buttons shall be provided at each terminal landing. A single micro movement push button shall be provided at top most and the lowest floor landing, two micro movement buttons on a single plate shall be provided at each intermediate floor. When a hall call is registered by momentary pressure on a landing button, that button shall become illuminated and remain illuminated until the call is answered.

43. CALL BUTTON

Selection for call button for passenger car shall be as per Architect selection. elevator call buttons shall be as per manufacturer's standard product. The catalogues of the buttons offered shall be submitted along with the tenders.

44. FIXTURE FINISHES

The metal faceplates of the signal and operating fixtures in the cars and at the landings, along with the metal accessories in the cars, shall be hairline stainless steel or as selected by the Architect. Push button fixtures at the landings shall be of design approved by the Architect. All fixtures form and finishes, etc. shall be subject to the Architect's and interior designer's approval.

45. CAB CLADDING AND FINISHES

45.1 Flooring shall be of 5 mm thick Aluminium\steel chequered plate as specified in the datasheet with all seams for liquid tightness. Walls shall be of stainless steel sheet. Interior finishes shall be brushed stainless steel to full height.

45.2 Passenger Elevator

Flooring shall be stainless steel chequered plate with all welded seams for liquid tightness. Flooring shall have 25 – 30 mm drop for flooring by others. Walls and the interior of the car shall be out of specified options.

46. AUTOMATIC ELEVATOR RETRIEVAL SYSTEM

All elevators shall be equipped with automatic elevator retrieval system, which shall, upon signal from the central fire alarm system or manually operated key switch, cause all elevators to be dispatched automatically to the ground floor. Elevator shall, open their doors and remain at the ground floor.
All floor and car buttons shall be rendered ineffective until the system is manually reset. A smoke detector shall be placed in close proximity to each elevator bank on the ground floor. If this device senses smoke, system shall land elevator at a preselected, alternate, landing floor. A key operated switch shall be provided at the ground floor to activate and reset the retrieval system manually.

i. Emergency operation shall return the elevator to a designated floor, most commonly, the Lobby, by means of a signal from the automatic fire alarm system.

ii. On initiation from the fire alarm system, control panel, all elevator travelling away from the lobby floors shall stop and reverse without opening their doors indicating fire mode-operation to passengers, ignoring all car and hall calls and express to the lobby or assigned floor.

iii. Cars traveling toward lobby shall express to lobby ignoring all car and hall calls. Cars parked on intermediate floors shall close their doors and express to lobby. Cars parked at lobby shall open their doors ignoring car and hall calls. All hall and car buttons shall extinguish and shall accept no further hall or car registration.

iv. All elevator shall, in addition and where allowed by code, be provided with a key operated switch for use by in-house fire brigade.

v. The elevator contractor shall coordinate and cooperate with the fire detection & alarm system supplier / installer for his system interfacing responsibilities.

vi. Actuation of fire mode shall put all car functions as described here under fireman control by means of a key switch.

vii. Hall button giving car call indication shall cause the doors to close.

viii. Applying constant pressure to the door open button shall cause door to begin to open. Releasing the button before door is fully open shall cause the door to close.

ix. Hall buttons shall be rendered inoperative.

x. Car position indicator shall indicate floor when car is within door operating range, and if in motion it shall indicate nearest floor by flashing. When a car is within operating zone, the position indicator shall light uninterrupted.

xi. All electrical door safety locks shall remain effective.

xii. Car position, direction of travel and floor conditions shall be displayed on the car position monitor in the lobby, and at elevator system monitor in engineering room.

xiii. Returning the car to the designated landing floor, deactivating the lobby switch shall render the car to original pre fire mode condition.

xiv. Resetting the Fire Alarm contacts in the car-monitoring panel shall restore the system to normal condition.

47. INSPECTION OPERATION – ALL ELEVATOR

A switch shall be provided in the car to permit operation of the elevator from top of the car for inspection purposes, with car and hall buttons inoperative. Car shall travel at inspection speed not exceeding 0.5 m/sec. Motion of car shall require constant pressure to directional button.

48. INDEPENDENT SERVICE (ALL CARS)

A key operated switch shall be provided in the car operating station which, when actuated, shall disconnect the elevator from the hall buttons and permit operation from the car buttons only.

49. HOIST GEAR

The hoisting machine shall be gearless type for speed more than 1.75 m / sec and geared type for speeds of 1.5 m/sec or lower with motor, brake and traction drive sheave compactly mounted on a continuous bedplate and set on steel beams. Sound isolating pads shall be installed beneath the machine bed-plate to reduce vibration or air borne noise.

The hoisting machine shall be single worm geared traction type with motor, brake, gearing and driving sheave assembled on a steel base plate. The motor shall be reversible type particularly designed for elevator service with high starting torque and low starting current. Sound reducing material shall be installed under machine.

The machine shall be located directly above the hoistway. Foundation bolts shall be provided by the elevator contractor for building into the foundation furnished by others. Suitable beams shall be furnished for mounting deflector pulleys, if required by the elevator contractor.

Requirements for permanent lifting hooks hoisting beams and access hatches shall be indicated on the drawings by the elevator system, supplier / installer.

50. PASSENGER ELEVATOR

Passenger elevator shall conform to all details in these standards stipulated, unless otherwise differently arranged hereunder.

50.1 **Elevator Cab**

Cab dimensions shall be as detailed under technical data of this tender.
The car sill shall be flush with finished floor. Sill to sill space shall be as per manufacturer's standard and not exceeding 25 mm. Cab height shall be as per technical data indicated in the tender.

50.2 **Car Platform**

Shall conform to ANSI/ASME/CENEN-81 specifications. To suppress the noise and drumming effects, the floor must be stiffened and preferably lined with fire retarded plywood or other material which will suit the proposed finish. All finishing materials shall be fireproof or fire resistant conforming to applicable codes.

The platform shall be mounted on rubber pads supported on an auxiliary steel frame fastened to the car frame. This arrangement shall form an isolating cushion between the car and frame for vibration and load weighing transducers.

50.3 **Car Doors**

Car doors shall, unless specifically stated, be center parting, automatic power operated, variable frequency door operator or PWM DC door operator and electronic door detector. Infrared light beams shall be provided to act as a safety curtain across the door entrance to monitor the door closing and function as a safety edge infra-red light system to initiate door closure about 2 seconds after last light beam interruption. Light sensor shall override designated "door open period" on top and intermediate floors and shall on the lower level be inactive until the car has been designated as "next up" and given signal to close its doors.

Car doors shall be hung plumb and even, to within 1 mm. with minimum number of 4 gibbs per leaf. Floor gibbs shall be well fitted so as to prevent popping noise as a car passes structural members, or car in motion in a shared shaft, etc. Hoistway doors shall be hung plumb and show a maximum of 6 mm joint at sides, top and bottom and 2 mm at centre joint. Narrow door frame or jamb panel shall be supplied by elevator contractor. A soft chime shall ring prior to doors closing and opening.

50.4 **Door Operation.**

Upon the car reaching landing in response to a hall or car call, a soft chime in the car shall sound. Door opening shall commence when the car is 25 mm from the dispatch. Door open period shall be adjustable to within a range of + 1 second.
Door-open-period on all floors except lobby floor shall be shortened to the extent that door closure will commence 2 seconds (field adjustable) following the sensor beam interruption by the last boarding or disembarking passenger. This period shall be adjustable to 1.5 seconds ± 1.0 seconds. Normal door-open-period at lobby floor shall be monitored by the car's CPU. Door closure shall override "door-open-period" where car loading has reached by pass limit, or when another car approaches the lobby floor.

a. Doors shall be arranged to remain open for a time period sufficient to meet handicapped requirements. (Optional).

b. The time interval for which the elevator doors remain open when a car stops at a landing shall be independently adjustable for response to car calls and response to hall calls.

c. An approved positive interlock shall be provided for each hoistway entrance which shall prevent operation of the elevator unless all doors for that elevator are secured and shall maintain the doors in their closed position while the elevator is away from the landing. Emergency access to the hoistway as required by governing codes shall be provided.

50.5 **Monitor Door Operation**

Stopping in response to hall or car call, doors shall be normally kept open for a predetermined period of time. With Monitor operation, the door-closing period is automatically shortened to approximately 1.0 seconds. Time open period feature must be field adjustable. Door open period shall be increased when the light ray senses a passenger leaving or entering the car.

51. CAR OPERATING PANEL

The car-operating panel shall contain a bank of micro movement illuminated buttons marked to correspond to the landings serviced. It shall include a series of push buttons corresponding to the floors served, along with an emergency stop and switches required. Operating panel shall incorporate the following: floor buttons, door open/close, emergency stop/alarm, and up/down in manual mode, man/auto key switch and seismic operation.

The emergency alarm button shall be connected to the 12-volt rechargeable battery circuit. A locked compartment integral with operating panel shall contain:

a. Auto/manual/inspection key operated switch.

b. Up/down button.

c. Fan switches

d. Synthesized voice announcements

On sounding of general fire alarm, the elevator shall if in motion, express to the ground floor. If stopped, the elevator shall open its doors and remain there until reset. Emergency talk-back system shall be provided, installed in integral cabinet and connected to the EPABX by the low tension contractor.

All Passenger Elevator of 13-passenger capacity and above shall be provided with 2 Nos. Car operating panels and elevator with 1 No. Car Operating Panel.

52. AUTOMATIC LOAD BYPASS

Transducers in the car platform shall monitor passenger load which shall override "pre-programmed door open period" and is patch the loaded car from the low terminal. The load-weighing device shall also function in the same manner on all intermediate and top floors and in addition shall express to the next car call and ignore all hall calls. Hall calls which are bypassed shall not be canceled. The automatic load bypass device shall be field adjusted for 50% - 75% of rated load.

52.1 **Operation – One Car Simplex (Passenger or Service)**

52.1.1 Operation shall be automatic by means of the car and landing buttons. Stops registered by the momentary actuation of the car or landing buttons shall be made in order in which the landings are reached in each direction of travel after the buttons have been actuated. All stops shall be subject to the respective car or landing button being actuated sufficiently in advance of the arrival of the car at that landing to enable the stop to be made. The direction of travel for an idle car shall be established by the first car or hall button actuated.

52.1.2 "UP" landing calls shall be answered while the car is travelling in the up direction and "DOWN" landing calls shall be answered while the car is travelling down. The car shall reverse after the uppermost or lowermost car or landing call has been answered, and proceed to answer calls and landing calls registered in the opposite direction

52.1.3 If a car without registered car calls arrive at a floor where both up and down hall calls have registered, it shall initially respond to the hall call in the direction that the car was travelling. If no car call or hall call is registered for further travel in that direction, the car shall close its doors and immediately reopen them in response to the hall call in the opposite direction. Direction lanterns shall indicate the changed direction and initiate gong when the doors reopen.

52.2 **Operation**

52.2.1 **Collective Selective Group Control for Passenger Elevator**

The elevator system shall have UP and DOWN buttons at each landing to select the desired direction of travel. The microprocessor-based controller to memorize all car and landing calls, and the system shall answer all registered calls sequentially & preferably in the current direction of movement.

i. Each of the landing call shall be automatically allocated to the best placed (nearest car travelling in the same direction).Control to be designed such that cars are effectively spaced to give even service.

ii. Optimized response to hall calls shall be achieved by computing a relative system response (RSR) time for each registered hall call. The computation of each car's RSR time to a call shall be based on, but not limited to, such relevant factors as distance, service to previously assigned car and hall calls, car load, direction, door and car motion status, and coincidence of car and hall calls. The car with the least RSR shall have such a call assigned to it.

iii. RSR computations for each hall call shall be repeated several times a second and the hall call assignment might be changed if a more suitable car is found available.

iv. All cars to be parked at ground floor when there are no unanswered calls.

v. A car arriving at a floor to park shall not open its doors. Cars shall open their doors only when stopping in response to a car or hall call.

vi. If for any reason the doors are prevented from closing and the car is unable to respond to a call, it shall lose its assignment and the call shall be transferred to the other car.

vii. When a car is filled to a predetermined load setting, it shall no longer stop for hall calls. Any registered hall call shall remain registered for the next elevator to respond.

viii. When the independent service switch in the car operation station is actuated, that elevator shall be disconnected from the hall button riser/s and operate independently from car buttons only.

53. EXPANDED LOBBY ZONE ARRANGEMENT FOR HEAVY DOWN PERIOD

The group supervisory control system shall be arranged to include a number of consecutive floors above the main floor as part of the lowest zone. Upon completion of travel within the expanded lobby zone, the car assigned to that zone shall return to a predesignated floor.

53.1 Car to Lobby Operation

Provide a key operated switch for each elevator at the main floor which, when actuated, shall cause the corresponding elevator to make a trip to the lobby as soon as the car is available for response to the special call.

53.2 Next Car Up

"Next Car Up" shall be indicated by flashing of lantern for the car so designated at the lobby. Other cars shall remain parked with doors closed until each car, in turn, is assigned as "Next Car Up".

53.3 Express Feature

Express feature shall be extended to hall call of 30 seconds or longer due to bypassed floors.

53.4 Express Priority Service (Optional)

53.4.1 A key switch and signal light shall be provided at each selected landing for providing an express priority service to each such landing. The control system shall compute the relative response times (RST) of all available designated elevator to service the call, based on the position and direction of the elevator relative to the priority floor, and also based on its door status, and select the car which has the shortest predictable response time (SPRT).Each car may be assigned to only one priority call at a time, and all cars which are designated to provide express priority service which are in service, and which have not already been selected and assigned to a call, may be selected simultaneously. The cars that are to provide express priority service shall be designated by contract.

53.4.2 should the selected car fail to respond to its assigned priority call within an allowable time interval (due to unpredictable circumstances, such as the failure of its doors to close), selection shall automatically be passed on to another car, based on the aforementioned computations.

53.4.3 Each selected car shall cancel all registered car calls and bypass all hall call on its way to its assigned priority landing. When the car arrives at the priority landing, it shall remain with doors open for a predetermined period of time. If not placed in service the doors shall close, and the car shall automatically return to normal operation.

53.4.4 The signal lights shall be illuminated while a car is responding to a priority call, and shall be extinguished when the car has opened its doors at its assigned priority landing.

54. DESPATCH SYSTEM

The dispatch system shall be microprocessor based. The system's main computer shall communicate with each car's computer. Microprocessor shall be intelligent in that it learns traffic patterns and applies best solution to each traffic condition, as determined by shortest predictable response. The CPU shall monitor demand on the system and shall execute the most economical assignment of cars.

55. ELEVATOR CAB

Car shall be detailed by the Architect or Interior Designer.

The cab manufacturer shall make provisions for ventilation inlets at the bottom of the cab (concealed from Passenger's view) and exhaust fan (concealed) at ceiling.
The car sill shall be flushed with finished floor. Sill to sill space shall not exceed 25 mm. Cab height, conditions permitting, shall be as per specification. The elevator contractor shall coordinate with electrical contractor to provide normal and emergency power and lighting to each elevator.

56. BUILDING AUTOMATION SYSTEM REQUIREMENTS

The Elevator Panel should have the following Provisions

a. It shall be able to accept signal from the Fire Alarm Panel in case of fire and automatically ground the elevator on receipt of this signal.

b. Potential free contact to indicate elevator trip status.

   i. Potential free contact to indicate elevator alarm status.

   ii. Potential free contact to indicate Emergency Activation Switch status.

FAS contractor shall provide necessary cabling up to Elevator Panel and termination shall be done by Elevator contractor.

Software Interface.

The Lift microprocessor panel should be compatible with BAS and should be able to communicate with the BAS in any of the following standard protocol like MODBUS, LONWORKS, BACNET etc. In case of multiple lifts having individual microprocessor panels it should be possible to network all microprocessors panels and be connected to a master controller. BAS communication cable can be integrated directly to the master controller or in case master controller is not available it should be possible to integrate each Microprocessor controller to the BAS system. It should be possible to monitor the following data points through software integration.

a. Elevator car position.

b. Fire Emergency signal monitoring.

c. Elevator Atendant Mode.

d. Elevator Alarm Mode.

In case of fire it should be possible to control the life through software interface. All necessary hardware including interface card and accessories necessary for integration with the BAS system has to be provided by BAS contractor.

57. ADDITIONAL INFORMATION

Tenderer shall enclose with their offer the following additional information:

i. List of installation of 1.0 mps & above installation completed by the tenderer during the last 5 years.

ii. Details of "In-House" facilities for testing and inspection of elevator materials.

iii. Details of service facilities in India.

iv. Confirm that elevator may be operated on DG sets and provide power characteristic to design the generator capacity.

Tenderers shall submit details / samples / photographs / catalogues for following. These shall be relevant to the project and the contractor shall indicate which of these are being offered in the bid.

i. Hall Lantern

ii. Car Operating Panel.

iii. Hall Buttons

iv. Group Indication panel.

v. Option for stainless steel finishes

vi. Option for MS Powder coated finishes

ANNEXURE-I: TECHNICAL DATA SHEET FOR ELEVATOR SYSTEM

S. No.	Description	Lift-PL-1 (STAFF LIFT)	Lift-PL-2 (H.C. LIFT)	Lift-PL-3 (H.C. Resi. LIFT)	Dumb weighter
1	Type of Elevator	Passenger	Passenger	Passenger	-
2	Operation	Simplex	Simplex	Simplex	Simplex
3	Control	ACVVVF	ACVVVF	ACVVVF	Manual
4	Operation W/ WO Attendant	W/WO	W/WO	W/WO	
5	Door Opening	Central	Central	Central	Shutter down to up
6	Capacity				
	a. Rated Load (KG)	1020	680	544	50
	b. WEIGHT of Material for Interior of the Car	200 kg	200 kg	200 kg	20
	c. No. of Persons	15	10	8	-
7	Machine	Gearless	Gearless	Gearless	-
8	Speed (MPS) Rated	1.0	1.0	1.0	0.25
9	Travel	Base., Gr.,1,2,3 & Terrace Floor	Base. & 3rd Floor	Base., Gr., 1 & Terrace Floor	Ground & First
10	Rise in Meters	18.095 m	14.315 m	12.580 m	4.080
11	Stops and Openings				
	a. No. of Stops	6	2	4	2
	b. No. of Openings	6	2	4	2
	c. Same Side	Yes	No	Yes	Yes
	d. Opposite Side	No	Yes	No	no
12	Available Hoise way Size (W x D) Inside Dimensions)	2050 mm x 1775 mm	1950 mm x 1800 mm	1760 mm x 1580 mm	850mmx8750mm
13	Car Size (W & D) (inside dimensions) – to be Confirmed by Vendor	1500 mm x 1600 mm	1200 mm x 1400 mm	1000 mm x 1300 mm	450mmx450mm
14	Door Operation	Automatic panel with Centre opening ACVVVF Motor Door operator with electronic / infrared sensor door detector	Automatic panel with Centre opening ACVVVF Motor Door operator with electronic / infrared sensor door detector	Automatic panel with Centre opening ACVVVF Motor Door operator with electronic / infrared sensor door detector	Manual Shutter Door, down to up
15	Car and Hoistway Entrance (W & H)	900 mm x 2100 mm	900 mm x 2100 mm	800 mm x 2100 mm	450mmx600mm
16	Height of Lift Car (H)	2400 mm	2400 mm	2400 mm	600mm
17	Machine Room height	MRL	MRL	MRL	MR
18	Pit Depth:	1500 mm	1500 mm	1500 mm	50MM
19	Available Overhead	4080 mm	4080 mm	4080 mm	1500
20	Noise Level in Cabin (Running Car)	55 db (A)	55 db (A)	55 db (A)	55 db (A)

21	Car Enclosure/Finish	SS hairline finish stainless Steel finish	SS hairline finish stainless Steel finish	SS hairline finish stainless Steel finish	SS hairline finish stainless Steel finish
22	Door Cladding	Scratch Free Stainless steel hair line finish	Scratch Free Stainless steel hair line finish	Scratch Free Stainless steel hair line finish	Scratch Free Stainless steel hair line finish
23	Flooring	25mm recessed for stone	25mm recessed for stone	25mm recessed for stone	25mm recessed for stone
24	Cooling in Elevator	Blower mounted on roof with two side ducts.	Blower mounted on roof with two side ducts.	Blower mounted on roof with two side ducts.	NA
25	SIGNALS				
a	Micro motion Hall Button With LCD display	Yes	Yes	Yes	Micro motion Hall Button With LCD display
b	Car Operating Panel	one side	one side	one side	NA
c	Electro Luminescent Display In The Car Where It Shall Act As Per Assignment, Indicator, Car Position & Direction Indicator	Yes	Yes	Yes	NA
d	Digital Hall Position Indicators At All Floors	Yes	Yes	Yes	NA
e	Battery Operated Alarm Bell & Emergency Light	Yes	Yes	Yes	Yes
f	Overload Warning Indicator In Car	Yes	Yes	Yes	Yes
g	Built-In Intercom for Three Way Communication (connection with EPBAX)	Yes	Yes	Yes	NA
h	Fireman's Switch on Ground Floor	Yes	Yes	Yes	NA
i	ARD/ Emergency Landing	Yes	Yes	Yes	NA
n	Hand rails (as per manufacturer)	Yes	Yes	Yes	NA
o	Car Chime	Yes	Yes	Yes	NA
p	Extended Door Hold	NA	NA	NA	NA
q	Car management System	Yes	Yes	Yes	NA
n	Hand rails (as per manufacturer)	Yes	Yes	Yes	NA
o	Car Chime	Yes	Yes	Yes	NA
p	Extended Door Hold	NA	NA	NA	NA
r	LED illuminated sign of "Lift out of order coming up simultaneously at all floors.	Yes	Yes	Yes	NA
26	Provisions for physically handicapped.	Braille inscription, height of highest button within reach of wheeled chair person	Braille inscription, height of highest button within reach of wheeled chair person	Braille inscription, height of highest button within reach of wheeled chair person	NA
27	Car top safety barrier	On three sides of car top to height of 800mm to as	On three sides of car top to height of 800mm to as protection	On three sides of car top to height of 800mm to as protection	NA

		protection			
28	CCTV system: CCTV camera inside lift car along with trailing cable upto last landing (controller) for connection with central CCTV system	IP based CCTV Wiring provision	IP based CCTV Wiring provision	IP based CCTV Wiring provision	NA
29	Motor – Following to be confirmed by Vendor				NA
a	Motor rating (HP/ kW)	Must be clearly identified by Bidders	Must be clearly identified by Bidders	Must be clearly identified by Bidders	NA
	No. of starts/ Hour withstand	Must be clearly identified by Bidders	Must be clearly identified by Bidders	Must be clearly identified by Bidders	NA
c	Starting / Full Load Current	Must be clearly identified by Bidders	Must be clearly identified by Bidders	Must be clearly identified by Bidders	NA
d	Start / Hour Permissible and Temperature Rise over ambient	Must be clearly identified by Bidders	Must be clearly identified by Bidders	Must be clearly identified by Bidders	NA
e	Motor Insulation Class	Must be clearly identified by Bidders	Must be clearly identified by Bidders	Must be clearly identified by Bidders	NA
29	Electrical consumption	Must be clearly identified by Bidders	Must be clearly identified by Bidders	Must be clearly identified by Bidders	NA
a	100% load per Hr.	Must be clearly identified by Bidders	Must be clearly identified by Bidders	Must be clearly identified by Bidders	NA
b	50% load per Hr.	Must be clearly identified by Bidders	Must be clearly identified by Bidders	Must be clearly identified by Bidders	NA
c	25% load per Hr.	Must be clearly identified by Bidders	Must be clearly identified by Bidders	Must be clearly identified by Bidders	NA
30	Buffers	Spring/oil filled type	Spring/oil filled type	Spring/oil filled type	NA
31	Potential free contacts for BMS compatibility On/Off Trip, Alarm Status, Level Indicator, Elevator's Call	YES	YES	YES	NA
32	Key card access	Yes	Yes	Yes	NA
33	Dome Camera	Yes	Yes	Yes	NA

ANNEXURE C: MEP SPECIFICATIONS

PART 5 : FIRE FIGHTING

PROPOSED CONSTRUCTION OF THE NEW CHANCERY AND OFFICIAL RESIDENCE

IN NEW DELHI INDIA

TENDER DOCUMENTS

FIRE FIGHTING SYSTEM

(Special Conditions &Technical Specification)

Date: - 26/02/2025

ARCHITECT

SPACE ARCHITECTURE STUDIO
V-12/23, DLF- PHASE-III
Gurgaon, Haryana - 122002.
Off Ph: +91-124-4734320
contact@studiosas.in

MEP SERVICES CONSULTANTS

235/B, Rajpur Khurd Extention
Chhatarpur,New Delhi-110068
PH : - 8920228058/8920225677
Email:-msc@msc-mep.com

SPECIAL CONDITIONS

1. GENERAL

These special conditions are intended to amplify the General Conditions of Contract, and shall be read in conjunction with the same. For any discrepancies between the General Conditions and these Special Conditions, the more stringent shall apply.

2. SCOPE OF WORK

The general character and the scope of work to be carried out under this contract is illustrated in Drawings, Specifications and Schedule of Quantities. The Tenderer shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the OWNER's site representative. The tenderer shall furnish all labour, materials and equipment (except those to be supplied by the OWNER) as listed under Schedule of Quantities and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete Fire Fighting system as described in the Specifications and as shown on the drawings. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract. The Fire Fighting System shall comprise of following:

a. Fire fighting pumps, equipment and electrical panel including connection to various equipment.

b. Fire Hydrant System

c. Sprinkler System

d. Hand Held Fire extinguishing System

e. Approval from Local Authorities

f. Wiring & earthing from MCC panels to various fire fighting system, control wiring & interlocking.

g. Cutting holes, chases & like through all types of walls / floors and finishing for all services crossings, including sealing, frame woriks, fire proofing, providing sleeve, cover plates, making good structure and finishes to an approved standard.

h. Balancing, testing & commissioning of the entire fire fighting system.

i. Test reports, list of recommended spares, as-installed drawings, operation & maintenance manual for the entire fire fighting system.

j. Training of Owner's staff.

3. ASSOCIATED CIVIL WORKS

Following civil works associated with Fire Fighting installation are excluded from the scope of this contract. These shall be executed by other agencies in accordance with approved shop drawings and under direct supervision of the Fire Fighting tenderer.

a. RCC foundation for machines, pumps & large equipment with angle iron frame work at the edges to protect these from damage.

b. RCC work for water tanks.

c. PCC foundation blocks with angle iron frame work edging for all motor control centre.

d. Water proofing of floors.

e. Masonry drains channels and sumps in plant room.

4. ASSOCIATED SERVICES WORKS

4.1 All **ELECTRICAL WORKS** are excluded from the scope of this contract. However, the plumbing contractor for connections to be provided for motors.

a. The plumbing contractor within 10 days of issue of LOI shall furnish an electrical load diagram showing the position of the loads.

5. BUILDING AUTOMATION SYSTEM

(No additional cost shall be paid for providing the interfacing).

The scope of Fire Fighting Tenderer shall include the following for the interface to Building Automation System.

a. Sockets / Nipples including shut-off valve for mounting sensors / transmitters on pipe lines.

b. It is to be clearly understood that the final responsibility for the sufficiency, adequacy and conformity to the contract requirements, of the Fire Fighting system, lies solely with the tenderer.

6. PROJECT EXECUTION AND MANAGEMENT

The Tenderer shall ensure that senior planning and erection personnel from his organisation are assigned exclusively for this project. They shall have minimum 10 years experience in this type of installation. The Tenderer shall appoint one Project Director holding senior management position in the organisation. He shall be assisted on full time basis by a minimum of two erection engineers & two senior supervisors. The entire staff shall be posted at site on full time basis.

The project management shall be through modern technique. Erection engineer and supervisors shall be provided with mobile communication system so that they can always be reached.

For quality control & monitoring of workmanship, tenderer shall assign at least one full-time engineer who would be exclusively responsible for ensuring strict quality control, adherance to specifications and ensuring top class workmanship for the installation.

The Tenderer shall arrange to have mechanised & modern facilities of transporting material to place of installation for speedy execution of work.

7. INSPECTION AND TESTING

The owner shall carry out inspection and testing at manufacturer's works for items covered under this contract. No equipment shall be delivered without prior written confirmation from Project Manager. In case factory inspection is carried out then all travelling and lodging expenses shall be borne by OWNER for maximum two persons. All expenses related to testing shall be to Contractor account. Tests on site of completed works shall demonstrate the following, among other things.

That the equipment installed complies with specification in all respects and is of the correct rating for the duty and site conditions.

That all items operate efficiently and quietly to meet the specified requirements

The contractor shall provide all necessary instruments and labour for testing, shall make adequate records of test procedures and readings, shall repeat any tests requested by the Project Manager and shall provide test certificate signed by a properly authorized person Such test shall be conducted on all materials and equipments and tests on completed work as called for by the Project Manager at contractor’s expenses unless otherwise called for.

If it is proved that the installation or part thereof is not satisfactorily carried out, then the contractor shall be liable for the rectification and retesting of the same as called for by the Project Manager whose decision as to what constitutes a satisfactory test shall be final.

The above general requirements as to testing shall be read in conjunction with any particular requirements specified elsewhere. All tests shall be carried out by a test house approved by the Project Manager.

8. BYE-LAWS AND REGULATIONS

The installation shall be in conformity with the Bye-laws, Regulations and Standards of the local authorities concerned, in so far as these become applicable to the installation. But if these Specifications and Drawings call for a higher standard of materials and / or workmanship than those required by any of the above regulations and standards, then these Specifications and Drawings shall take precedence over the said regulations and standards. However, if the Drawings and specifications require something which violates the Bye-laws and Regulations, then the Bye-laws and Regulations shall govern the requirement of this installation.

9. FEES AND PERMITS

The tenderer shall obtain all permits / licenses and pay for any and all fees required for the inspection, approval and commissioning of their installation. However, all receipted amount shall be reimbursed on production of proof of payment.

10. DRAWINGS

The Fire Fighting Drawings listed under Appendix-I, issued with tenders are diagrammatic only and indicate arrangement of various systems and the extent of work covered in the contract. These Drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. Under no circumstances shall dimensions be scaled from these Drawings. The architectural/interiors drawings and details shall be examined for exact location of sprinklers, hydrants, equipments, drainage piping etc.

The tenderer shall follow the tender drawings in preparation of his shop drawings, and for subsequent installation work. He shall check the drawings of other trades to verify spaces in which his work will be installed.

Maximum headroom and space shall be maintained at all points. Where headroom appears inadequate, the tenderer shall notify the Architect / Consultant / OWNER's site representative before proceeding with the installation. In case installation is carried out without notifying, the work shall be rejected and tenderer shall rectify the same at his own cost.

The tenderer shall examine all architectural, structural, plumbing, electrical and other services drawings and check the as-built works before starting the work, report to the OWNER's site representative any discrepancies and obtain clarification. Any changes found essential to coordinate installation of his work with other services and trades, shall be made with prior approval of the Architect/Consultant/ OWNER's site representative without additional cost to the OWNER. The data given in the Drawings and Specifications is as exact as could be procured, but its accuracy is not guaranteed.

11. TECHNICAL DATA

Each tenderer shall submit alongwith his tender, the technical data for all items listed in Appendix-IV in the indicated format. Failure to furnish complete technical data with tenders may result in summary rejection of the tender.

12. SHOP DRAWINGS

All the shop drawings shall be prepared on computer through Autocad System based on Architectural Drawings, site measurements and Interior Designer's Drawings. Within four weeks of the award of the contract, tenderer shall furnish, for the approval of the Architect/Consultant, two sets of detailed shop drawings of all equipment and materials including layouts for Plant room, Pump room showing exact location of supports, flanges, bends, tee connections, reducers, detailed piping drawings showing exact location and type of supports, valves, fittings etc; external insulation details for pipe insulation etc; electrical panels inside/outside views, power and control wiring schematics, cable trays, supports and terminations.

These shop drawings shall contain all information required to complete the Project as per specifications and as required by the Architect/Consultant/OWNER's site representative. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other tenderers. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the

completion of all shop drawings. Minimum 12 sets of drawings shall be submitted after final approval along with Pan Drive.
Each item of equipment/material proposed shall be a standard catalogue product of an established manufacturer strictly from the manufacturers and quoted by the tenderer in technical data.

When the Architect/Consultant makes any amendments in the above drawings, the tenderer shall supply two fresh sets of drawings with the amendments duly incorporated alongwith check prints, for approval. The tenderer shall submit further twelve sets of shop drawings to the OWNER's site representative for the exclusive use by the OWNER's site representative and all other agencies. No material or equipment may be delivered or installed at the job site until the tenderer has in his possession, the approved shop drawing for the particular material/equipment/installation.

Shop drawings shall be submitted for approval four weeks in advance of planned delivery and installation of any material to allow Architect/Consultant ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved programme.

Manufacturers' drawings, catalogues, pamphlets and other documents submitted for approval shall be in four sets. Each item in each set shall be properly labelled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.

Samples of all materials like valves, pipes etc. shall be submitted to the OWNER's site representative prior to procurement. These will be submitted in two sets for approval and retention by OWNER's site representative and shall be kept in their site office for reference and verification till the completion of the Project. Wherever directed a mockup or sample installation shall be carried out for approval before proceeding for further installation.

Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supercede the contract requirements, nor does it in any way relieve the tenderer of the responsibility or requirement to furnish material and perform work as required by the contract.

Where the tenderer proposes to use an item of equipment, other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundation, piping, wiring or any other part of the mechanical, electrical or architectural layouts; all such re-design, and all new drawings and detailing required therefore, shall be prepared by the tenderer at his own expense and gotten approved by the Architect/Consultant/ OWNER's site representative. Any delay on such account shall be at the cost of and consequence of the Tenderer.

Fire Fighting Tenderer shall prepare coordinated services shop drawings based on the drawings prepared by Electrical, HVAC & Low Voltage Tenderers to ensure adequate clearances are available for installation of services for each trade.

Where the work of the tenderer has to be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the OWNER's site representative, the tenderer shall prepare composite working drawings and sections at a suitable scale, not less than 1:50, clearly showing how his work is to be installed in relation to the work of other trades. If the Tenderer installs his work before coordinating with other trades, or so as to cause any interference with work of other trades, he shall make all the necessary changes without extra cost to the OWNER.

Within two week of approval of all the relevant shop drawings, the tenderer shall submit four copies of a comprehensive variation in quantity statement, and itemized price list of recommended (by manufacturers') imported and local spare parts and tools, covering all equipment and materials in this contract. The Project Manager shall make recommendation to OWNER for acceptance of anticipated variation in contract amounts and also advise OWNER to initiate action for procurement of spare parts and tools at the completion of project.

13. QUIET OPERATION AND VIBRATION ISOLATION

All equipment shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the OWNER's site representative. In case of rotating machinery sound or vibration noticeable outside the room in which it is installed, or annoyingly noticeable inside its own room, shall be considered objectionable. Such conditions shall be corrected by the Tenderer at his own expense. The tenderer shall guarantee that the equipment installed shall maintain the desired NC levels.

14. ACCESSIBILITY

The Tenderer shall verify the sufficiency of the size of the shaft openings, clearances in cavity walls and suspended ceilings for proper installation of his piping and other ancillaries. His failure to communicate insufficiency of any of the above, shall constitute his acceptance of sufficiency of the same**.** The Tenderer shall locate all equipment which must be serviced, operated or maintained in fully accessible positions. The exact location and size of all access panels, required for each concealed valve or other devices requiring attendance, shall be finalized and communicated in sufficient time, to be provided in the normal course of work. Failing this, the Tenderer shall make all the necessary repairs and changes at his own expense. Access panel shall be standardised for each piece of equipment / device / accessory and shall be clearly nomenclatured / marked.

15. MATERIALS AND EQUIPMENT

All materials and equipment shall conform to the relevant Indian Standards and shall be of the approved make and design. Makes shall be strictly in conformity with list of approved manufacturers as per Appendix - III.

16. MANUFACTURERS INSTRUCTIONS

Where manufacturer has furnished specific instructions, relating to the material and equipment used in this project, covering points not specifically mentioned in these documents, such instructions shall be followed in all cases.

17. ELECTRICAL INSTALLATION

The electrical work related to Fire Fighting services is excluded from the scope of the tenderer. The termination of the cable to the various motors shall be carried out by the contractor.

18. BALANCING, TESTING AND COMMISSIONING

Balancing of all water systems and all tests as called for the Specifications shall be carried out by the tenderer through a specialist group, in accordance with the Specifications and ASPE / ASHRAE Guide lines and Standards. Performance test shall consist of three days of 10 hour each operation of system for each season. Cost of performance witness test of major equipment such as pumps, etc. at factory with two personnel from OWNERs / Consultant shall be included.

The installation shall be tested again after removal of defects and shall be commissioned only after approval by the OWNER's site representative. All tests shall be carried out in the presence of the representatives of the Architect/Consultant and OWNER's site representative.

19. COMPLETION DRAWINGS

Tenderer shall periodically submitt completion drawings as and when work in all respects is completed in a particular area. These drawings shall be submitted in the form of two sets of floppies / CD's and four portfolios (300 x 450 mm) each containing complete set of drawings on approved scale indicating the work as - installed. These drawings shall clearly indicate complete plant room layouts, piping layouts, location of wiring and sequencing of automatic controls, location of all concealed piping, valves, controls, wiring and other services. Each portfolio shall also contain consolidated control diagrams and technical literature on all controls. The tenderer shall frame under glass, in the plant room, one set of these consolidated control diagrams.

20. OPERATING INSTRUCTION & MAINTENANCE MANUAL

Upon completion and commissioning of part Fire Fighting system **t**he tenderer shall submit a draft copy of comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the tenderer shall submit four (4) complete bound sets of typewritten operating instructions and maintenance manuals; one each for retention by Consultant and OWNER's site representative and two for OWNERs Operating Personnel. These manuals shall also include basis of design, detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for 4 year period of maintenance of each equipment.

"*Preventive Maintenance Schedule for each equipment / panel shall be submitted along with Operation and Maintenance Manual".*

21. ON SITE TRAINING

Upon completion of all work and all tests, the Tenderer shall provide necessary operators, labour and helpers for operating the entire installation for a period of fifteen (15) working days of ten (10) hours each, to enable the OWNER's staff to get aquainted with the operation of the system. During this period, the tenderer shall train the OWNER's personnel in the operation, adjustment and maintenance of all equipment installed**.**

22. MAINTENANCE DURING DEFECTS LIABILITY PERIOD

22.1 Complaints

The Tenderer shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 10 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

22.2 Repairs

All equipment that require repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs for one year concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free-of-charge to the OWNER.

23. UPTIME GUARANTEE

The tenderer shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall be extended by a month for every month having shortfall. In case of shortfall beyond the defects liability period, the contract for Operation and Maintenance shall get extended by a month for every month having the shortfall and no reimbursement shall be made for the extended period.

The Tenderer shall provide log in the form of diskettes and bound printed comprehensive log book containing tables for daily record of all pressures, power consumption. Starting and stopping times forvarious equipment, daily services rendered for the system alarms, maintenance and record of unusual observations etc. Tenderer shall also submit preventive maintenance schedule.

Each tenderer shall submit along with the tender, a detailed operation assistance proposal for the OWNER's site representatives/Consultant's review. This shall include the type of service planned to be offered during Defects Liability Period and beyond. The operation assistance proposal shall give the details of the proposed monthly reports to the Management.
The tenderer shall include a list of other projects where such an Operation Assistance has been provided.

A P P E N D I X – I(A)

LIST OF APPROVED MAKES FOR EQUIPMENT & MATERIALS PLUMBING SYSTEM

S. No.	Details of Materials / Equipment	Manufacturer's Name
1.	Fire / Sprinkler Main Pump / Jockey	Kirloskar Lubi Wilo - Mather & Platt
2.	Diesel Engine	Cummins Greaves Koel
3.	Motor	ABB Bharat Bijlee Kirloskar Siemens
4.	M.S. Pipes (IS : 1239 / IS : 3589)	Tata Steel Jindal (Hissar)
5.	Standard M.S. Fittings	Seamless Fittings Pipeline Products
6.	DI / CI / Forged Steel Fittings	Jainsons Industries VS BM Fittings Bharat Forge
7.	C.I. (Class L.A.) Pipes	Electro Steel Culcutta IISCO NECO Kesoram Calcutta
8.	DI MH Cover & Frame	Kartar Pipe and fittings NECO Raj Iron Foundry, Agra
9.	Paints	Asian Paints Berger ICI Shalimar Paints
10.	Double / Single Headed Landing Valve	Safeguard Flameguard Minimax Exflame Omex
11.	Fire Hose	Safeguard Flameguard Minimax Exflame Omex

S. No.	Details of Materials / Equipment	Manufacturer's Name
12.	First Aid Hose Reel (LPCB Approved)	Safeguard Flameguard Minimax Exflame Omex
13.	Branch Pipe	Safeguard Flameguard Minimax Exflame Omex
14.	Fireman Axe	Safeguard Flameguard Minimax Exflame Omex
15.	Installation Control Valve	Victaulic Tyco Viking HD
16.	Sprinkler Heads	Victaulic Tyco Viking Reliable
17.	Flexible Drop Connection (UL Listed)	Victaulic Newage Tyco Easyflex
18.	Fire Extinguishers	Safeguard Flameguard Minimax Exflame Omex
19.	Water Flow Switch	Honeywell Potter System Sensor Indfoss
20.	Pipe Protection Wrapping	IWL - Pypkote Rustech – Coatek STP
21.	Pipe clamp & supports	Chilly Euroclamp Kanwal
22.	GM / Forged Brass Valves	CIM Sant Honeywell Zoloto
23.	Sluice Valves	AIP Kirloskar Kalpana

S. No.	Details of Materials / Equipment	Manufacturer's Name
24.	Butterfly Valve	Zoloto Audco AIP Honeywell Sant
25.	Check Valve – Wafer Type	Zoloto Audco AIP Honeywell Sant
26.	Check Valve – Dual Plate	Zoloto Audco AIP Honeywell Sant
27.	Pressure Reducing Valve (Listed)	Tyco Victaulic
28.	Air Release Valve	CIM Sant Honeywell Zoloto
29.	Ball Float Valve	Esseti HBD Zoloto
30.	Y Strainer	Emerald AIP Sant Zoloto
31.	Hose Reel Drum (ISI marked)	Safeguard New Age Minimax Lifeguard Safex
32.	Siamese breaching connection/Fire service inlet draw out connection	Safeguard New Age Minimax Lifeguard Safex
33.	Inspector's test assembly	Victaulic Giacomini Viking
34.	Fire Buckets	Safeguard New Age Minimax Lifeguard Safex
35.	Mechanical Seal	Burgmann Sealol
36.	Couplings	Lovejoy

		Dunlop

S. No.	Details of Materials / Equipment	Manufacturer's Name
37.	Pressure Gauge	Emerald Fiebig H Guru
38.	Level Controller & Indicator (Water)	Auto Pump Cirrus Engineering Technika Techtrol
39.	Welding Rods	ADOR Esab
40.	Fastner	Fisher Hilti
41.	Fire Sealant	Birla 3 M Hilti Promat
42.	Tamper switch	Honeywell Infoss Potter System Sensor
43.	Foot valve	Kirloskar Normex

A P P E N D I X – I (B)

(As per Approved Electrical make list)

LIST OF APPROVED MAKES FOR EQUIPMENT & MATERIALS ELECTRICAL SYSTEM

S.No.	Details of Materials / Equipment		Manufacturer's Name
1.	Motor Control Centre		Zeniya Electech Pvt. Ltd. Gemtech Power Control Pvt. Ltd. SPC Elecrotech Ltd Advance Panel and switchgear Pvt. Ltd Core metal kraft Ltd.
2.	Moulded Case Circuit Breaker (MCCB)		Schneider Electric (NX) Lauritz Knudsen (D-Sine) Legrand ABB C&S
3.	Motor Protection Circuit Breaker(MPCB)		Schneider Electric (NX) Lauritz Knudsen (D-Sine) Legrand ABB C&S
4.	Miniature Circuit Breakers (MCB)		Schneider Electric (NX) Lauritz Knudsen (D-Sine) Legrand ABB C&S
5.	Residual Current Circuit Breaker (RCCB)		Schneider Electric (NX) Lauritz Knudsen (D-Sine) Legrand ABB C&S
6.	Power/Aux. Contactor / Capacitor Duty Contactor		Schneider Electric (MG) Lauritz Knudsen Legrand ABB
7.	Change Over Switch		HPL – Socomec
8.	Control Transformer/Potential Transformers		Automatic Electric Pragati Precise
9.	Current Transformer (Epoxy Cast Resin)		Automatic Electric Pragati Precise
10.	Protection Relay		ABB Larsen&Toubro Siemens
11.	Indicating Lamps LED type and Push Button		Vaishno Electricals Larsen & Toubro (ESBEE) Schneider Electric Siemens

S.No.	Details of Materials / Equipment		Manufacturer's Name
12.	Overload relays with built in Single Phase preventer		ABB Lauritz Knudsen Schneider Electri Siemens
13.	a. Electronic Digital Meters (A/V/PF/Hz/KW/KWH) with LED Display		Schneider Electric Trinity Enersole
14.	PVC insulated XLPE aluminium/copper conductor armoured MV Cables upto 1100 V grade		RR KABEL Ravin Cable KEI
15.	LT Jointing Kit / Termination		Birla-3M Raychem Safe Kit
16.	Cable Glands Double Compression with earthing links		Baliga Lighting Comet
17.	Bimettalic Cable Lug		Comet Dowell's (Biller India) Hax Brass (Copper Alloy India)
18.	PVC Conduit & Accessories (ISI approved)		AKG BEC
19	PVC insulated copper conductor stranded flexible wires		RR KABLE KEI Batra Henlay APAR
20.	Mettalic / GI Conduit (ISI approved)		AKG BEC
21.	Selector Switch, Toggle switch		CTM NEEDO Kaycee Salzer (Larsen & Toubro)
22.	Cable Trays (Factory Fabricated) / Raceways		Profab Engineer SPC Maheshwari Electrtricals Zeniya Electech Pvt. Ltd.
23.	Sealed Maintenance Free Batteries		Amar Raja Exide Hitachi Shinkobe
24	Battery Charger		ChhabiElectricals Volstat
25.	Timer		ABB Schneider Electric Siemens

A P P E N D I X – IV
SCHEDULE OF TECHNICAL DATA

1. FIRE PROTECTION SYSTEM

1.1 FIRE PUMPS & MOTOR

1.1.1 Electrical Driven Main Fire & Sprinkler Pumps

Make / Manufacturer	:
Quantity	:
Liquid Handed	:
Liquid Temp deg.C	:
Special Gravity of Liquid	:
Suction	:
Rated Discharge	:
Actual Discharge	:
Model	:
Horizontal / Design	:
Speed / No. of Stages	:
Impeller Dia (Maximum)	:
Suction / Delivery Size	:
Efficiency at Rated Capacity & Head	:
KW required at rated capacity & head	:
Shut Off Head	:

Material of Construction

Pump Casing	:
Impeller	:
Pump Shaft	:
Shaft Sleeve	:
Casing Wearing Ring	:
Base Plate	:
Mechanical Seal	:
Make of Mechanical Seal	:
A Wheather pump is capable of discharging 150% of rated capacity at a head not less than 65% of rated head.	:

Whether automatic priming arrangement included :

Description of Motors

Make :

Model No. :

Type :

Frame size :

Speed (RPM) :

Rated Capacity (Power) :

Full load current :

Enclosure :

Coupling / Pulley :

Class of Insulation

Size of Foundation

For complete coupled set mounted over MS base frame :

1.1.2 Diesel Engine Driven Pump

Make / Manufacturer :

Quantity :

Liquid Handed :

Liquid Temp deg.C :

Special Gravity of Liquid :

Suction :

Rated Discharge :

Actual Discharge :

Model :

Horizontal / Design :

Speed / No. of Stages :

Impeller Dia (Maximum) :

Suction / Delivery Size :

Efficiency at Rated Capacity & Head :

KW required at rated capacity & head :

Shut Off Head :

Material of Construction

Pump Casing	:
Impeller	:
Pump Shaft	:
Shaft Sleeve	:
Casing Wearing Ring	:
Base Plate	:
Mechanical Seal	:
Make of Mechanical Seal	:
Wheather pumps is capable of discharging 150% of rated capacity at a head not less than 65% of rated head.	:
Whether automatic priming arrangement included	:

Description of Engine

Make	:
Model No.	:
Type	:
Frame size	:
Speed (RPM)	:
Rated Capacity (Power)	:
Full load current	:
Enclosure	:
Coupling / Pulley	:
No of Cylinder	:
Fuel Pump & Water pump detail	:
Engine Cooling & Oil System	:
Diesel Oil tank capacity	:
Fuel Oil storage shall ensure working of pump for number of hours	:

Size of Foundation

For complete coupled set mounted over MS base frame	:

1.1.3 Jockey Pump

(Please submit separate data sheet for each type of pump)

Liquid Handed	:
Liquid Temp deg.C	:
Special Gravity of Liquid	:
Suction	:
Rated Discharge at Low Zone Head	:
Rated Discharge at High Zone Head	:
Actual Discharge at Low Zone Head	:
Actual Discharge at High Zone Head	:
Model	:
Horizontal / Design	:
Speed / No. of Stages	:
Impeller Dia (Maximum)	:
Suction / Delivery Size	:
Efficiency at Rated Capacity & Head	:
KW required at rated capacity & head	:
Shut Off Head	:

Material of Construction

Pump Casing	:
Impeller	:
Pump Shaft	:
Shaft Sleeve	:
Casing Wearing Ring	:
Base Plate	:
Mechanical Seal	:
Make of Mechanical Seal	:

Description of Motor

Make	:
Model No.	:
Type	:
Frame size	:

	Speed (RPM)	:
	Rated Capacity (Power)	:
	Full load current	:
	Enclosure	:
	Coupling / Pulley	:
	Size of Foundation For complete coupled set mounted over MS base frame	:

1.1.4 **Booster pump (Please submit separate data sheet for each type of pump)**

	Liquid Handed	:
	Liquid Temp deg.C	:
	Special Gravity of Liquid	:
	Suction	:
	Rated Discharge	:
	Actual Discharge	:
	Model	:
	Horizontal / Design	:
	Speed / No. of Stages	:
	Impeller Dia (Maximum)	:
	Suction / Delivery Size	:
	Efficiency at Rated Capacity & Head	:
	KW required at rated capacity & head	:
	Shut Off Head	:
	Material of Construction	
	Pump Casing	:
	Impeller	:
	Pump Shaft	:
	Shaft Sleeve	:
	Casing Wearing Ring	:
	Base Plate	:
	Mechanical Seal	:
	Make of Mechanical Seal	:

Description of Motor

Make :

Model No. :

Type :

Frame size :

Speed (RPM) :

Rated Capacity (Power) :

Full load current :

Enclosure :

Coupling / Pulley :

Size of Foundation

For complete coupled set mounted over MS base frame :

1.2 PIPING

15 NB TO 50 NB :

15 TO 50 NB Fittings :

65 NB TO 150 NB Pipes

65 NB TO 150 NB Fittings

200 NB ONWARDS Pipes

200 NB ONWARDS Fittings

Flanges

Gaskets

1.3 HYDRANT VALVES

1.3.1 Technical Specifications :

Item :

Working Pressure :

Code for Design Mft. :

1.3.2 Construction Features

Type of Stem

Type of Inlet

Type of Outlet

Flange Drilling

1.3.3 Material of Construction

Body and Bonnet :

Stop Valve, Valve Seat :

Check nut & gland nut :

1.4 PRESSURE GAUGE

1.4.1 Technical Specifications

Working Pressure :

Code for Design Mft. :

Scale range :

1.4.2 Construction Features

Case :

Pointer :

Dial Size :

Dial Lettering :

Process Connection :

1.4.3 Material of Construction

Case :

Movement :

Block :

1.5 PRESSURE SWITCHES

1.5.1 Technical Specifications

Item :

Working Pressure :

Scale range :

1.5.2 Construction Features

Protection :

Cable Entry :

Process Connection :

Repeatability :

Switch

Type :

No. of contacts :

Contact Rating :

1.5.3 Material of Construction

Enclosure :

Pressure element :

Wetted part :

1.6 SPRINKLERS

1.6.1 Technical Specifications :

Response Type :

K factor :

Temperature Rating :

Working Pressure :

1.6.2 Construction Features

Diameter of bulb :

Location :

Installation :

1.7 DRENCHER

1.7.1 Technical Specifications :

Type :

K factor :

Temperature Rating :

Working Pressure :

1.7.2 Construction Features

Location :

Installation :

2. ELECTRICAL ACCESSORIES

2.1 MAKE OF THE FOLLOWING

a.	Motor Control Centre (Electrical Panel)	:
b.	Vacuum circuit breaker	:
c.	Air circuit breaker	:
d.	MCCB	:
e.	MCB	:
f.	Rotary switch	:
g.	Soft Starter	:
h.	Auto-transformer Starter	:
i.	Automatic Star Delta Starter	:
j.	Direct on line Starter	:
k.	Contactor	:
l.	Current Transformer (cast resin type)	:
m.	Single phase preventor	:
n.	Push Button	:
o.	Change over switch	:
p.	Ammeter & Voltmeter KWH meter	:
q.	Relay	:
r.	Indication lamp	:
s.	Cables	:
t.	Wires	:
u.	Variable Frequancy Drive.	:

A P P E N D I X – V

LIST OF BUREAU OF INDIAN STANDARDS CODES

All equipment, supply, erection, testing and commissioning shall comply with the requirements of Indian Standards and code of practices given below as amended upto date. All equipment and material being supplied by the tenderer shall meet the requirements of IS. Tarrif advisory committee's regulation (fire insurance), electrical inspectorate and Indian Electricity rules and other Codes / Publications as given below:

1. **General**

SP : 6 (1)	Structural Steel Sections
IS : 27	Pig Lead
IS : 325	Three Phase Induction Motors
IS : 554	Dimensions for pipe threads where pressure tight joints are required on the threads.
IS : 694	PVC insulated cables for working voltages upto & including 1100 V.
IS : 779	Specification for water meters (domestic type).
IS : 782	Specification for caulking load.
IS : 800	Code of practice for general construction in steel
IS : 1068	Electroplated coatings of nickel plus chromium and copper plus nickel plus chromium.
IS : 1172	Code of Basic requirements for water supply drainage and sanitation.
IS : 1367 (Part 1)	Technical supply conditions for threaded steel fasteners: Part 1 introduction and general information.
IS : 1367 (Part 2)	Technical supply conditions for threaded steel fasteners: Part 2 product grades and tolerances.
IS : 1554 (Part 1)	PVC insulated (heavy duty) electric cables: Part 1 for working voltages upto and including 1100 V.
IS : 1554 (Part 2)	PVC insulated (heavy duty) electric cables: Part 2 for working voltages from 3.3 KV upto and including 11 KV.
IS : 1726	Specification for cast iron manhole covers and frames.
IS : 1742	Code of practice for building drainage.
IS : 2064	Selection, installation and maintenance of sanitary appliance code of practice.
IS : 2065	Code of practice for water supply in buildings.
IS : 2104	Specification for water meter for boxes (domestic type)
IS : 2373	Specification for eater meter (bulk type)
IS : 2379	Colour code for identification of pipe lines.
IS : 2629	Recommended practice for hot dip galvanizing on iron and Steel.
IS : 3114	Code of practice for laying of cast iron pipes

IS : 4111 (Part 1)	Code of practice for ancillary structures in sewerage system: Part 1 manholes.
IS : 4127	Code of practice for laying glazed stoneware pipes.
IS : 4853	Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes.
IS : 5329	Code of practice for sanitary pipe work above ground for buildings.
IS : 5455	Cast iron steps for manholes.
IS : 6159	Recommended practice for design and fabrication of material, prior to galvanizing.
IS : 7558	Code of practice for domestic hot water installations.
IS : 8321	Glossary of terms applicable to plumbing work.
IS : 8419 (Part 1)	Requirements for water filtration equipment: Part 1 Filteration medium sand and gravel.
IS : 8419 (Part 2)	Requirements for water filtration equipment: Part 2 under drainage system.
IS : 9668	Code of practice for provision and maintenance of water supplies and fire fighting.
IS : 9842	Preformed fibrous pipe insulation.
IS : 9912	Coal tar based coating materials and suitable primers for protecting iron and steel pipe lines.
IS : 10221	Code of practice for coating and wrapping of underground mild steel pipelines.
IS : 10446	Glossary of terms relating to water supply and sanitation.
IS : 11149	Rubber Gaskets
IS : 11790	Code of practice for preparation of butt-welding ends for pipes, valves, flanges and fittings.
IS : 12183 (Part 1)	Code of practice for plumbing in multistoried buildings : Part 1 water supply.
IS : 12251	Code of practice for drainage of building basements.
IS : 5572	Code of practice for sanitary pipe work.
BS : 6700	Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their cartilages.
BS : 8301	Code of practice for building drainage.
BSEN : 274	Sanitary tap were, waste fittings for basins, bidets and baths. General technical specifications.

2. **Pipes and Fittings**

IS : 458	Specification for precast concrete pipes (with and without reinforcement)
IS : 651	Salat glazed stone ware pipes and fittins.
IS : 1239 (Part 1)	Mild steel, tubes, tubulars and other wrought steel fittings: Part 1 Mild Steel tubes.
IS : 1239 (Part 2)	Mild Steel tubes, tubulars and other wrought steel fittings: Part 2 Mild Steel tubulars and other wrought steel pipe fittings.

IS : 1536	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage.
IS : 1537	Vertically cast iron pressure pipes for water, gas and sewage.
IS : 1538	Cast Iron fittings for pressure pipes for water, gas and sewage.
IS : 1729	Sand Cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 1879	Malleable cast iron pipe fittings.
IS : 1978	Line pipe
IS : 1979	High test line pipe.
IS : 2501	Copper tubes for general engineering purposes
IS : 2643 (Part 1)	Dimensions for pipe threads for fasterning purposes: Part 1 Basic profile and dimensions.
IS : 2643 (Part 2)	Dimensions for pipe threads for fastening purposes: Part 2 Tolerances.
IS : 2643 (Part 3)	Dimensions for pipe threads for fastening purposes: Part 3 Limits of sizes.
IS : 3468	Pipe nuts.
IS : 3589	Seamless or electrically welded steel pipes for water, gas and sewage (168.3 mm to 2032 mm outside diameter).
IS : 3989	Centrifugally cast (sun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 4346	Specifications for washers for use with fittings for water services.
IS : 4711	Methods for sampling steel pipes, tubes and fittings.
IS : 6392	Steel pipe flanges
IS : 6418	Cast iron and malleable cast iron flanges for general engineering purposes.
IS : 7181	Specification for horizontally cast iron double flanged pipe for water, gas and sewage.

3. **Valves**

IS : 778	Specification for copper alloy gage, globe and check valves for water works purposes.
IS : 780	Specification for sluice valves for water works purposes (50 mm to 300 mm size).
IS : 1703	Specification copper alloy float valves (horizontal plunger type) for water supply fittings.
IS : 2906	Specification for sluice valves for water works purposes (350 mm to 1200 mm size)
IS : 3950	Specification for surface boxes for sluice valves.
IS : 5312 (Part 1)	Specification for swing check type reflux (non return) valves : part 2 Multi door pattern.
IS : 5312 (Part 2)	Specification for swing check type reflux (non return) valves : part 2 Multi door pattern.
IS : 12992 (Part 1)	Safety relief valves, spring loaded : Design

IS : 13095	Butterfly valves for general purposes.

4. **Pumps & Vessels**

IS : 1520	Specification for horizontal centrifugal pumps for clear cold fresh water.
IS : 2002	Steel plates for pressure vessels for intermediate and high temperature service includng boilers.
IS : 2825	Code for unfired pressure vessels.
IS : 4648 (Part 1)	Code of practice for lining of vessels and equipment for chemical processes Part 1 : Rubber lining.
IS : 5600	Specification for sewage and drainage pumps
IS : 8034	Specification for submersible pump sets for clear, cold, fresh water.
IS : 8418	Specification for horizontal centrifugal self priming pumps.

5. **Fire Fighting Equipment**

TAC	Tariff Advisory Committee fire protection manual Part-I.
TAC	Rules of Tariff Advisory Committee for automatic sprinkler system.
NFPA : 12 , 1993	Standards on Carbon Dioxide Extinguishing System
IS : 636	Non-percolating flexible fire fighting delivery hose.
IS : 884	Specification for first aid hose reel for fire fighting.
IS : 901	Specification for couplings, double male and double female, instantaneous pattern for fire fighting.
IS : 902	Suction hose couplings for fire fighting purposes.
IS : 903	Specification for fire hose delivery couplings, branch pipe, nozzles and nozzle spanner.
IS : 904	Specification for 2-way and 3-way suction collecting heads for fire fighting purposes.
IS : 907	Specification for suction strainers, cylindrical type for fire fighting purposes.
IS : 908	Specification for fire hydrant, stand post type.
IS : 909	Specification for underground fire hydrant, sluice valve type.
IS : 910	Specification for portable chemical foam fire extinusiher.
IS : 933	Specification for portable chemical foam fire extinguisher.
IS : 1648	Code of practice for fire safety of building (general) : Fire fighting equipment and its maintenance.
IS : 2171	Specification for portable fire extinguishers dry powder (catridge type)
IS : 2190	Selection, installation and maintenance of first aid fire extinguishers – Code of practice.
IS : 2871	Specification for branch pipe, universal, for fire fighting purposes.

IS : 2878	Specification for fire extinguishers, carbon dioxide type (portable and trolley mounted).
IS : 3844	Code of practice for installation and maintenance of internal fire hydrants and hose reel on premises.
IS : 5290	Specification for landing valves.
IS 5714	Specification for coupling, branch pipe, nozzle, used in hose reel tubing for fire fighting.
IS : 8423	Specification for controlled percolation type hose for fire fighting.
IS : 10658	Specification for higher capacity dry powder fire extinguisher (trolley mounted).
IS : 11460	Code of practice for fire safety of libraries and archives buildings.
IS : 1309	External hydrant systems – Provision and maintenance – Code of practice.
IS : 5514 (Parts 1 to 7)	Reciprocating internal combustion engines : Performance.

TECHNICAL SPECIFICATIONS

SECTION-01 :: BASIS OF DESIGN

1. BASIS OF DESIGN

The Fire Fighting System for the project is designed keeping in view the following:

1.1 Provision of fire fighting appurtenance such as sprinklers, fire hydrants, hose reel, and portable extinguishers.

1.2 Landscape layout.

The execution of works and materials used shall be as per the latest relevant I.S. specifications.

Wherever reference has been made to Indian Standard or any other specifications, the same shall mean to refer to the latest specification irrespective of any particular edition of such specification being mentioned in the specifications below or Schedule of Quantities.

2. CONCEPT OF THE SYSTEM

The following services are envisaged for the complex:

2.1 Fire Fighting system for the Complex comprising of Hydrant, Hose Reels, Sprinklers and portable fire extinguishers.

3. WATER STORAGE & DISTRIBUTION SYSTEM

3.1 **Water Requirement**

The water requirement for the project is proposed to be based on the provisions of IS:1172 and prevalent practice. The estimated requirement of water per day for the Complex based on the number of users and other services.

3.2 **Source of Water**

It is expected that part of the daily domestic water requirement for the Building shall be through municipal mains supply. Since it is unlikely that municipality would be able to meet the entire daily requirement, supply will have to be supplemented by having provision of existing of tubwell. Provision of tanker water fill feasibility shall also be made.

3.3 **Appurtenant**

Following components shall be included in the water supply system for efficient functioning:

i. Automatic air vent at each of the high point (Air Valve)

ii. Drain valve at each of the low point (Scour Valve)

iii. Pressure Release valve where abnormally high pressure is to be reduced.

iv. Flow meter.

v. Pressure Gauge.

vi Anchor block / thrust block.

4. 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 Owner's Site Representative. All materials and/or Workmanship which in the opinion of the Owner's Site Representative / Architect / Consultant is defective or unsuitable shall be removed immediately from the site and shall be substituted with proper materials and/or workmanship forthwith.

5. MATERIALS

All materials shall be best of their kind and shall conform to the latest Indian Standards.

All materials shall be of approved quality as per samples and approved by the Owner's Site Representative / Architect / Consultants.

As and when required by the Owner's Site Representative / Consultant, 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 Owner's Site Representative / Consultant, 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 Owner's Site Representative / Consultant. To prove that the materials used are as specified the contractor shall furnish the Owner's Site Representative with original vouchers on demand.

SECTION-2 :: FIRE PROTECTION SYSTEM

1. SCOPE

The scope of this section consists of but is not necessarily limited to supply, installation, testing and commissioning of the fire protection system. The philosophy of the system is as follows :

a. The Fire Suppression System shall comprise the Fire Hydrants System, the Sprinkler System (Wet type), Hand Appliances.

b. Water from the underground RCC Fire Water Storage Tanks, shall be supplied for the uses listed below.

   i. Fire Hydrant System (Pressurised) both for the external hydrants, the internal landing valves and the hose reels at landings.

   ii. Sprinkler System (Wet Type)

c. The Hydrant System and the Sprinkler System, under normal conditions, shall be lowest pressurized by means of the electric motor driven Jockey Pump.

d. The Hydrant System shall be provided with two pump sets, one of which will be diesel engine driven and the other electric motor driven.

e. The Sprinkler System shall be provided with an electric motor driven pump set.

f. The piping and valve connections shall be done so that the water from the discharge of the Hydrant Pump sets is able to supply water, automatically to the Sprinkler System whenever, the Sprinkler Pump is unable to maintain the pressure or fails and not vice versa.

g. The starting and stopping of the Jockey pump shall be automatic based on the pressure switches at preset low and high pressure.

h. The electric motor driven Hydrant Pump starts automatically at a preset pressure by means of a pressure switch. As soon as the Hydrant Pump starts, the Jockey Pump Stops. If for any reason the electric motor driven Hydrant Pump does not start at the preset pressure or is unable to maintain the pressure, the diesel engine driven Hydrant Pump starts at the preset pressure.

i. The Hydrant Pump, whether electric motor driven or the diesel engine driven shall be stopped only manually.

j. The Sprinkler Pump shall be started automatically at a preset pressure but shall be stopped only manually.

k. Contract shall ensure that all false ceiling voids generator than 800 mm are provided with sprinkler.

l. Tenderer shall ensure Hydro Testing for the complete system.

m The Tenderer shall obtain the necessary approval of the drawings and the schemes from the local authority / TAC as called for. The tenderer shall also take care of any other requirement so that insurance cover can be obtained, if required at minimum premium at a later date.

n. The tenderer shall design and after approval of Project Manager display near each staircase landing at floor levels, a glass covered framed floor plan clearly showing the locations of all landing valves, hose reels, hand appliances, as well as the DO's and DON'T's for the personnel and the exit direction in case of an emergency. The dimensions of the floor plan, its scale, lettering size, colour scheme etc shall be as directed by the Project Manager.

2. PIPE WORK

2.1 General Requirements

All materials shall be of the best quality conforming to the specifications and subject to the approval of the Consultants.

Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

Pipes shall be securely fixed to walls and ceilings by suitable clamps and supports (galvanised after fabrication) at intervals specified. Only approved type of anchor fasteners shall be used for RCC slabs and walls / floors etc.

Valves and other appurtenances shall be so located that they are easily accessible for operations, repairs and maintenance.

Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workman like manner.

Pipe accessories such as gauges, meters, control devices, etc. shall have the same working pressure rating as the associated pipework. All pipework shall be free from burrs, rust and scale and shall be cleaned before installation. All personnel engaged on welding operations must possess a certificate of competence issued by an acceptable / recognized authority.

2.2 Piping

Pipes of following types are to be used:

Mild steel black pipes as per IS:1239 heavy grade(for pipes of sizes 150 mm N.B. and below) suitably lagged on the outside to prevent soil corrosion. M.S. pipes buried below ground shall also be suitably be lagged with 2 layers of 400 microne polythene sheet over 2 coats of bitumen.

Steel pipelines upto 150 mm dia shall be as per IS: 1239, Part-II (heavy grade) while pipelines above 150 mm dia shall be as per I.S.:3589.

All pipe clamps and supports shall be fabricated from MS steel sections and shall be factory galvanised before use at site. Welding of galvanised clamps and supports shall not be permitted.

Pipes shall be hung by means of expandable anchor fastener of approved make and design. The hangers and clamps shall be fastened by means of galvanised nuts and bolts. The size/diameter of the anchor fastener and the clamps shall be suitable to carry the weight of water filled pipe and dead load normally encountered.

Hangers and supports shall be throughly galvanised after fabrication. The selection and design of the hanger & support shall be capable of carrying the sum of all concurrently acting loads. They shall be designed to provide the required supporting effects and allow pipeline movements as necessary. All guides, anchor braces, dampener, expansion joint and structural steel to be attached to the building/structure trenches etc. shall be provided. Hangers and components for all piping shall be approved by the Consultants.

The piping system shall be tested for leakages at 2 times the operating pressure or 1.5 time shut-off pressure, which ever is highest including testing for water hammer effects.

Flanged joints shall be used for connections for vessels, equipment, flanged valves and also on two straight lengths of pipelines of strategic points to facilitate erection and subsequent maintenance work.

For pipes under ground installation the pipes shall be buried at least one meter below ground level and shall have 230 mm x 230 mm masonry or concrete supports at least 300 mm high at 3m intervals. Masonry work to have plain cement concrete foundation (1 cement: 4 coarse sand : 8 stone aggregate) of size 380x380x75 thick resting on firm soil.

Mains below ground level shall be supported at regular intervals not exceeding 3.0 metres and shall be laid at least 2.0 metre away from the building.

2.3 **Piping Installation & Support**

Tender drawings indicate schematically the size and location of pipes. The Tenderer, on the award of the work, shall prepare detailed working drawings, showing the cross-sections, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air valves, and all pipe supports. He must keep in view the specific openings in buildings and other structure through which pipes are designed to pass.

Piping shall be properly supported on , or suspended from , on stands, clamps, hangers as specified and as required. The Tenderer shall adequately design all the brackets, saddles, anchor, clamps and hangers, and be responsible for their structural stability.

Pipe work and fittings shall be supported by hangers or brackets so as to permit free expansion and contraction. Risers shall be supported at each floor with Galvanised steel clamps. To permit free movement of common piping support shall be from a common hanger bar fabricated from Galvanised steel sections.

Pipe hangers shall be provided at the following maximum spacings:

Pipe Dia (mm)	**Hanger Rod Dia (mm)**	**Spacing between Supports (m)**
Up to 25	6	2
32 to 50	10	2.7
80 to 100	12	2.7
125 to 150	16	3.6
200 to 300	19	5.3

The end of the steel rods shall be threaded and not welded to the threaded bolt.

All pipe work shall be carried out in a proper workman like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation with other agencies work, so that area can be carried out in one stretch.

Cut-outs in the floor slab for installing the various pipes area are indicated in the drawings. Tenderer shall carefully examine the cut-outs provided and clearly point out wherever the cut-outs shown in the drawings, do not meet with the requirements.

Pipe sleeves, larger diameter than pipes, shall be provided wherever pipes pass through walls and slab and annular space filled with fibreglass and finished with retainer rings.

The tenderer shall make sure that the clamps, brackets, saddles and hangers provided for pipe supports are adequate or as specified / approved by Consultants. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required.

All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reduces shall be used for the piping to drain freely. In other locations, concentric reduces may be used.

Automatic air valves shall be provided at all high points in the piping system for venting. All valves shall be of 15mm pipe size and shall be associated with an equal size gate valves. Automatic air valves shall be provided on hot water risers.

Discharge from the air valves shall be piped through a pipe to the nearest drain or sump. All pipes shall be pitched towards drain points.

Pressure gauges shall be provided as shown on the approved drawings. Care shall be taken to protect pressure gauges during pressure testing.

2.4 **Pipe Fittings**

Pipe fittings mean tees, elbows, couplings, unions, flanges, reducers etc and all such connecting devices that are needed to complete the piping work in its totality.

Forged steel fittings of approved type with "V" groove for welded joints. Forged steel fittings shall be screwed type only and shall be used for pipes of 50 mm dia & below.

Fabricated fittings shall not be permitted for pipes diameters 50mm and below.

When fabricated fittings are used, they shall be fabricated, welded in workshops. They shall be inspected by Project Manager before dispatch from the workshop. The welding procedures of the workshop should have been approved by the rules for sprinkler system and applicable to hydrant and sprinkler system. For "T" connection, pipes shall be drilled and reamed. Cutting by gas or electrical welding shall not be permitted.

2.5 **Jointing**

2.5.1 Welded Joints**:**

Joints between MS pipes and fittings shall be made with the pipes and fittings having "V" groove and welded with electrical resistance welding in an approved manner. But welding without "V" groove shall not be permitted.

All joints in the pipe line with screwed fittings shall be seal welded after testing and the weld plus the adjoining portion shall be given two coats of zinc rich primer.

2.5.2 Flanged Joints (65 Mm Dia And Above)

Flanged joints with flanges conforming to IS: 6392 shall be provided on

a. Straight runs at intervals not exceeding 25-30m on pipe lines of 50 mm dia and above and as directed by the Project Manager.

b. For jointing all types of valves, appurtenances, pumps, connections with other type of pipes, to water tanks and other places necessary and as required for good engineering practice and as shown/noted on the drawings.

c. Flanges shall be with GI bolts and nuts and 3mm insertion gasket of natural rubber conforming to IS: 11149.

2.5.3 Unions (Upto 50 Mm Dia)

Approved type of dismountable unions shall be provided on pipe lines of 40 mm dia and smaller dia, in locations similar to those specified for flanges.

3. AIR VESSEL

The air vessel shall be provided to compensate for slight loss of pressure in the system and to provide an air cushion for counter-acting pressure, surges, whenever the pumping sets come into operation. Air vessel shall conform to IS: 3844. It shall be normally half full of water, when the system is in normal operation. Air vessel shall be fabricated with 8 mm thick M.S. plate with dished ends and suitable supporting legs. It shall be provided with one 100 mm dia flanged connection from pump, one 25 mm drain with valve, one water level gauge and 25 mm sockets for pressure switches. The air vessel shall be tested to pressure for 12 hours at 2 times the operating pressure or 1.5 times the shut-off.

4. AIR CUSHION TANK

Every wet riser shall be provided with an air cushion tank at its top most point. The air cushion shall be provided with an automatic air release cock, 20 mm dia drain pipe, drain valve and shut off valve.

5. FIRE BRIGADE CONNECTION

The storage tank shall be provided with a 150 mm fire brigade pumping connection to discharge at least 2275 litres /minimum into it. This connection shall not be taken directly into the side of the storage tank, but arranged to discharge not less than 150 mm above the top edge of the tank such that the water flow can be seen. The connection shall be fitted with stop valve in a position approved by the Project Manager. An overflow connection discharging to a drain point shall be provided from the storage tank.

The fire brigade connection shall be fitted with four numbers of 63mm instantaneous inlets in a glass fronted wall box at a suitable position at street level, so located as to make the inlets accessible from the outside of the building. The size of the wall box shall be adequate to allow hose to be connected to the inlets, even if the door cannot be opened and the glass has to be broken. Each box shall have fall of 25mm towards the front at its base and shall be glassed with wired glass with ”FIRE BRIGADE INLET” painted on the inner face of the glass in 50 mm size block letter. Each such box shall be provided with a steel hammer with chain for breaking the glass.

In addition to the emergency fire brigade connection to the storage tank, a 150mm common connection shall be taken from the four 63mm instantaneous inlets direct to hydrant main so that the fire brigade may pump to the hydrants in the even of the hydrant pumps being out of commission. The connection shall be fitted with a sluice valve and reflux valve. Location of these valve shall be as per the approval of the Project Manager.

Two way collecting head with two numbers 63 mm instantaneous type inlets shall be connected to the sprinkler header. All other details shall be as described above.

6. SYSTEM DRAINAGE

The system shall be provided with suitable drainage arrangement with drain valves complete with all accessories.

7. VALVE CHAMBERS

Provision of suitable brick masonary chambers in cement mortar 1:5 (1 cement : 5 coarse sand) on cement concrete foundations 150 mm thick 1:5:10 mix (1 cement:5 fine sand : 10 graded stone aggregate 20 mm nominal size) with 15 mm thick cement plaster inside and outside finished with a plaster inside and outside finished with a floated coat of neat cement inside with cast iron surface box approved by fire brigade including excavation, back-filling complete shall be made.

8. VALVES

8.1 Sluice Valves

Sluice valves shall be double flanged valves with cast iron body. The spindle, wall seat and wedge nuts shall be of bronze. They shall generally have non-rising spindle and shall be of the particular duty and design called for.

The valves shall be supplied with suitable flanges, non- corrosive bolts and asbestos fibre gaskets. Sluice valves shall conform to Indian Standard IS : 780-1969 and IS : 2906.

8.2 Butterfly Valve

The butterfly valve shall be suitable for waterworks and rated for 300 P.S.I

The body shall be of cast iron to IS :210 in circular shape and of high strength to take the water pressure . The disc shall be heavy duty cast iron with anti corrosive epoxy or nickel coating.

The valve seat shall be of high grade elastomer or nitrile rubber. The valve is closed position shall have complete contact between the seat and the disc throughout the perimeter. The elastomer rubber shall have a long life and shall not give away on continuous applied water pressure. The shaft shall be EN 8 grade carbon steel.

The valve shall be fitted between two flanges on either side of pipe flanges. The valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakages.

8.3 **Ball Valve**

The ball valve shall be made forged brass and suitable for test pressure of pipe line. The valve shall be internally threaded to receive pipe connections.

The ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body-bonnet gasket and gland packing shall be of Teflon.

The handle shall be provided with PVC jacket. The handle shall also indicate the direction of 'open' and 'closed' situations. The gap between the ball and the teflon packing shall be sealed to prevent water seeping.

The handle shall also be provided with a lug to keep the movement of the ball valve within 90°. The lever shall be operated smoothly and without application of any unnecessary force.

8.4 **Gun Metal Valves**

Gun metal Valves shall be used for smaller dia pipes, and for threaded connections. The Valves shall bear certification as per IS: 778

The body and bonnet shall be of gun metal to IS: 318. The stem gland and gland nut shall be of forged brass to IS : 6912. The hand wheel shall be of cast iron to IS: 210.

The Hand wheel shall be of high quality finish to avoid hand abrasions. Movement shall also be easy. The spindle shall be non rising type.

8.5 **Non-Return Valve**

Non-Return valves shall be cast iron double flanged with cast iron body and gunmetal internal parts conforming to IS: 5312.

8.6 **Pressure Relief Valve**

Each System shall be provided with a Pressure Relief Valves. The Valve shall be spring actuated and set to operate as per field requirement. The Valve shall be constructed of bronze and provided with an open discharge orifice for releasing the water. The Valve shall be open lift type.

9. PRESSURE SWITCH

The pressure switches shall be employed for starting and shutting down operation of pumps automatically, dictated by line pressure. The Pressure Switch shall be diaphragm type. The housing shall be die cast aluminium, with SS 316 movement, pressure element and socket. The set pressure shall be adjustable.

The Switch shall be suitable for consistent and repeated operations without change in values. It shall be provided with IP:55 water and environment protection.

10. PRESSURE GAUGE

Pressure gauge shall be provided near all individual connections of the hydrant system with isolation valves and near each flow switch assembly of the sprinkler system. Pressure gauge shall be 50 mm dia gunmetal bourdon type with gunmental isolation ball valve, tapping and connecting pipe and nipple. The gauge shall be installed at appropriate height for easy readability.

11. PAINTING

All Hydrant and Sprinkler pipes shall be painted with post office red colour paint. All M S pipes shall first be cleaned thoroughly before application of primer coat. After application of primer coat two coats of enamel paint shall be applied. Each coat shall be given minimum 24 hours drying time. No thinners shall be used. Wherever required all pipe headers shall be worded indicating the direction of the pipe and its purpose such as "TO RISER NO.1" etc.

Painting shall be expertly applied; the paint shall not over run on surfaces not requiring painting such as walls, surfaces etc. Nuts and bolts shall be painted black, while valves shall be painted blue.

12. EXCAVATION

Excavation for pipe lines shall be in open trenches to levels and grades shown on the drawings or as required at site. Pipe lines shall be burried with a minimum cover of 1 meter or as shown on drawings.

Wherever required Tenderer shall support all trenches or adjoining structures with adequate timber supports, shoring and strutting.

On completion of testing in the presence of the Project Manager and pipe protection, trenches shall be backfilled in 150 mm layers and consolidated.

Tenderer shall dispose off all surplus earth as directed by the Project Manager.

13. ANCHOR / THRUST BLOCK

Tenderer shall provide suitably designed anchor blocks in cement concrete/steel support to cater to the excess thrust due to work hammer and high pressure

Thrust blocks shall be provided at all bends, tees and such other location as determined by the Project Manager.

Exact location, design, size and mix of the concrete blocks/steel support shall be as shown on the drawings or as directed by the Project Manager prior to execution of work.

14. FIRE HYDRANTS

14.1 External Hydrants

a. Tenderer shall provide external hydrants. The hydrants shall be controlled by a cast iron sluice valve. Hydrants shall have instantaneous type 63mm dia outlets. The hydrants shall be single outlet conforming to IS: 908 with CI duck foot bend and flanged riser or required height to bring the hydrant to correct level above ground.

b. Tenderer shall provide for each external fire hydrant one number of 63mm dia. 15 m long controlled percolation hose pipe with SS male and female instantaneous type couplings machine wound with GI wire (hose to IS:636 type certification), SS branch pipe with nozzle to IS:903. This shall be measured and paid for separately.

c. Each external hydrant hose cabinet shall be provided with a drain in the bottom plate.

d. Each external hydrant hose cabinet containing items as above shall also be provided with a nozzle spanner and a Fireman's Axe. This shall be measured and paid for separately.

e. Each hose cabinet shall be conspicuously painted with the letters "FIRE HOSE".

14.2 Internal Hydrants

a. Tenderer shall provide on each landing and other locations as shown on the drawings single headed SS landing valve with 80 mm dia inlet as per IS:5290, with shut off valves having cast iron wheels as shown on the drawings. Landing valve shall have flanged inlet and instantaneous type outlets as shown on the drawings.

b. Instantaneous outlets for fire hydrants shall be standard pattern and suitable for fire hoses.

c. Tenderer shall provide for each internal fire hydrant station one numbers of 63 mm dia. 15 m long ruberized fabric lined hose pipes with SS male and female instantaneous type coupling machine would with GI wire (hose to IS:636 type 2 and couplings to IS:903 with IS certification), fire hose reel, SS branch pipe with nozzle to IS:903. This shall be measured and paid for separately.

d. Tenderer shall provide standard fire hose reels of 20mm dia high pressure thermoplastic hose 36.5 m long with SS nozzle, all mounted on a circular hose reel of heavy duty mild steel construction having cast iron brackets. Hose reel shall be connected directly to the wet riser with an isolating valve. Hose reel shall conform to IS:884 and shall be mounted vertically . This shall be measured and paid for separately.

e. Each internal hydrant hose cabinet shall be provided with a drain in the bottom plate. The drain point shall be lead away to the nearest general drain.

f. Each internal hydrant hose cabinet containing items as above shall also be provided with a nozzle spanner and a Fireman's Axe. The cabinet shall be recessed in the wall as directed. This shall be measured and paid for separately.

g. Each hose cabinet shall be conspicuously painted with the letters "FIRE HOSE".

14.3 **Hose Reel**

Hose reel shall conform to IS : 884, heavy duty, 20 mm dia length shall be 36 metre long fitted with gun metal chromium plated nozzle, mild steel pressed reel drum which can swing upto 170 degree with wall brackets of cast iron finished with red and black enamel complete.

14.4 **Fire Hose**

All hose pipes shall be of 63 mm diameter RRL/ CP as required, conforming to IS : 636 or IS : 8423. The hose shall be provided with copper alloy delivery coupling. The hose shall be capable of withstanding a bursting pressure of 35.7 Kg/Sq.cm without undue leakage or sweating. Hose shall be provided with instantaneous spring-lock, type couplings.

14.5 **Branch Pipe, Nozzle**

Branch pipes shall be of SS with loaded tin bronze ring at the discharge and to receive the nozzle and provided at the other with a leaded tin bronze ring to fit into the instantaneous coupling. Nozzle shall be of spray type of diameter of not less than 16 mm and not more than 25 mm. Nozzle shall be of loaded tin bronze branch pipe and nozzle shall be of instantaneous pattern conforming to Indian Standard - 903.

14.6 **Hose Cabinet**

Hose cabinet shall be provided for all internal and external fire hydrants. Hose cabinets shall be fabricated from 16 gauge MS powder coated sheet of fully welded constrcution with hinged double front door partially glazed (3 mm glass panel) with locking arrangement, stove enamelled fire red paint (shade No. 536 of IS:5) with "FIRE HOSE" written on it prominently (size as given in the schedule of quantities). Cabinet surfaces in contact with the walls shall not be powder coated but instead given two coats of anti-corrosive bitumastic paint.

14.7 **Internal Hose Cabinet**

Hose cabinet shall be of glass fronted with hinged door & lock. The cabinet shall be made of 16 gauge thick MS sheet and spray painted to shade No. 536 of IS:5. The hose cabinet shall be of size to accommodate the following:

i. Landing Valves (Single headed)
ii. Hose pipe
iii. Hose reel (36.5 mtr.)
iv. Branch pipes, nozzles (1 sets)
v. Fire man's axe and hand appliances

14.8 **External Hose Cabinet**

The hose cabinet shall be of size to accommodate the following:

i. Singl headed yard hydrant valve
ii. Hose pipe (2 length of 15 m)
iii. Branch pipes, nozzles (1 sets)
iv. Fire man's axe

15. SPRINKLER SYSTEM

15.1 General Specification

The scope of work shall include supply, commissioning, testing of the system as a whole. The sprinkler heads are to be fixed into heavy quality black steel pipes, conforming to IS 1239 or any other approved specification. The size of pipe will vary from 20 mm to 150mm to suit the hydraulics of the system. The System shall conform to CFO Rules for the installation of sprinkler systems in general for 'Ordinary Hazard' category-in respect of design, density and spacing of sprinkler heads.

Reduction in pipe sizes shall not be made by use of bushings. All piping shall be done by means of welding, screwed & flanged jointing as per codes.

Due care shall be taken that sprinklers are not applied with paint at the time of applying paint to piping and fittings.

All control, drain, test and alarm valves shall be provided with signs to identify their purposes, functions, direction of flow the satisfaction of the Consultants.

15.2 Quartzoid Bulb Automatic Sprinkler

Sprinkler heads shall be made of brass/quartzoid bulb sufficiently strong, in compression to withstand any pressure, surge or hammer likely to occur in the system. The yoke & body shall be made of high quality gun metal brass with arms streamlined to ensure minimum interference with the spread of water. The deflector of suitable design shall be fitted to give even distribution of water over the area commanded by the sprinkler.

The bulb shall contain a liquid having a freezing point below any natural climatic figure and a high coefficient of expansion. The temperature rating of the sprinkler shall be stamped on the deflector & the colour of the liquid filled in the bulb shall be according to the temperature rating as per HFPA standard. The sprinkler heads shall be of type & quality approved by the local fire brigade authority. The inlet shall be screwed.

The sprinklers shall have 15mm nominal size of the orifice for ordinary hazard.

The orifice size shall be marked on the body or the deflector of the sprinkler.

Metal guards for protection of sprinkler against accidental or mechanical damage shall be provided as desired by the Project Manager.

Tenderer shall submit detailed submittal and discharge spray pattern for the Sprinkler for the approval of consultant.

15.2.1 Operating Temperature

The Operating temperature, at which the quartzoid bulb of the sprinkler head shall actuate, shall be 68 degree C or as specifically mentioned.

15.2.2 Sprinkler Installation

Sprinkler heads shall be located in positions shown on the drawings. While slight relocation may result from building construction features or interference from other services, the maximum spacing between sprinkler heads and coverage area shall not exceed those stipulated in the TAC regulations and the NFPA 13-1994 Rules.

Allowance shall be made for such relocations within a radius of 1500 mm of the indicated positions without additional cost. The Fire Protection Services Trade shall co-ordinate with the ceiling Trade to set out the sprinkler locations to suit the site location of the unit grid. In general, all sprinklers shall be located at the centre of the ceiling unit and a provision of about 10% more sprinklers and pipework than required in TAC and NFPA Rules shall be included in this sub-contract. Chrome plated wire mesh guards shall be used to protect the sprinkler heads which are liable to accidental or mechanical **(at no extra cost)** damage.

15.3 **Flow Requirements**

The flow requirement for sprinkler heads shall be specifically approved for the designated area of installation.

15.4 **Orifice Plates**

For restricting pressure at lower levels in the sprinkler system, orifice plates of appropriate sizes shall be fitted at different floor levels, at the branching points from Riser Main.

The Diameter of such orifice shall not be less than 50% of the dia of pipe into which it is to be fitted, which shall not be less than 50mm dia. These orifice plates must be of stainless steel with plain central hole without burrs, and the thickness shall be 3mm for pipe size upto 80 mm, 6 mm for pipes from 80 to 125 mm dia and 9 mm for pipes greater than 125 mm dia. Such orifice plate must have a projecting identification tag.

The orifice plate shall fitted not less than two pipe internal diameters down stream of the outlet from any elbow or brand.

Tenderer shall submit the design and identify location on drawing before installation.

15.5 **Installation Control Valves**

Each installation shall be provided with a set of installation control valves comprising:-

a. An Alarm Valve.

b. A Water Motor Alarm & Gong.

c. Installation valves shall be installed on the sprinkler circuits as shown on the drawings.

d. Tenderer shall submit detailed shop drawings showing the exact location, details of installation of the valves/alarm in all respects.

e. Installation valve shall comprise of a cast iron body with gunmetal trim, and double seated clapper check valves, pressure gauges, test valve and orifice assembly and drain valve with pressure gauges, turbine water gong including all accessories necessary and required and as supplied by original equipment manufacturer and required for full and satisfactory performance of the system. A cast iron isolation valve with lock and chain at the inlet of the installation valve shall be provided.

15.6 **Inspection And Test Valve Assembly**

Inspection and testing of the automatic starting of the sprinkler system shall be done by providing an assembly consisting of gunmetal valves, gunmetal sight glass, bye-pass valve and orifice assembly as per approved drawing.

15.7 **Flow Switch**

Flow switch shall have a paddle made of flexible and strudy material of the width to fit within the pipe bore. The terminal box shall be mounted over the paddle/ pipe through a connecting socket. The Switch shall be potential free in either N O or N C position as required. The switch shall be able to trip and make / break contact on the operation of a single sprinkler head. The terminal box shall have connections for wiring to the Annunciation Panel. The flow switch shall have connections for wiring the seat shall be of S.S to the Annunciation Panel. The flow switch shall have IP: 55 protection.

The flow switches work at a triggering threshold bandwith (flow rate) of 4 to 10 GPM. Further, it shall have a ‘Retard’ to compensate for line leakage or intermittend flows.

15.8 **The Main Stop Valve**

These shall be of cast iron body of requisite size. When closed, these will shut off supply of water to the installation.

A location plate must be fixed on the outside or an external wall, as near to the main stop valve as possible, bearing the following words on raised letters or other approved type letter.

i **Sprinkler Stop Valve Inside :** The word `sprinkler stop valve' shall be in letters of at least 35mm and the word "INSIDE" at least25mm in height. The words shall be painted white on black back ground.

ii All stop valves shall be right handed i.e. they shall be so constructed that in order to shut the valve the spindle shall turn from left to right. There shall be an indicator which will show whether the valve is open or shut.

15.9 **Pipes For Drainage:**

Sprinkler pipes shall be so installed that the system can be thoroughly drained. As far as possible all pipes shall be arranged to drain to the installation drain valve as shown in the drawing for ordinary hazard system.

In the case of basement & other areas where sprinkler pipe-work is below the installation drain valve & in other trapped points in the system, auxiliary valves of the following sizes shall be provided.

-20 mm valves for pipes upto 50mm dia.
-25 mm valves for 80mm dia pipe.
-50 mm valves for pipes larger than 80mm dia.

15.10 **System Design**

The entire sprinkler installation shall be designed to make it a hydraulically balanced system. The pressure requirement at typical floors shall be designed between 2.5 bar and 3.5 bar.

16 HAND HELD FIRE EXTINGUISHERS

16.1 **Hand Appliances**

16.1.1 Scope

Work under this section shall consist of furnishing all labour, materials, appliances and equipment necessary and required to install fire extinguishing hand appliances as per relevant specification of various authorities.

Without restricting to the generality of the foregoing, the work shall consists of the following:

Installation of fully charged and tested fire extinguishing hand appliances of A B C powder type as required and specified in the drawings and schedule of rates.

16.2 **General Requirements**

Hand appliances shall be installed in easily accessible locations with the brackets fixed to the wall by suitable anchor fasteners.

Each appliance shall be provided with an inspection card indicating the date of inspection, testing, change of charge and other relevant data.

All appliances shall be fixed in a true workmanlike manner truly vertical and at correct locations.

Distribution / installation of fire extinguisher to be in accordance to IS:2190.

16.3 **Measurement**

Fire extinguishers shall be counted in numbers and include installation of all necessary items required as given in the specifications.

16.4 **ABC Type Dry Powder Extinguisher**

The Extinguisher shall be filled with ABC grade 40, Mono Ammonium Phosphate 40% from any approved manufacturer.

The capacity of the extinguisher when filled with Dry Chemical Powder (First filling) as per IS 4308, Part II, shall be 5 Kg +/-2% or 10 Kg +/- 3%.

The distribution of fire extinguishers to be as per IS 2190 - 1992

It shall be operated upright, with a squeeze grip valve to control discharge. The plunger neck shall have a safety clip, fitted with a pin, to prevent accidental discharge. It shall be pressurised with Dry Nitrogen, as expellant. The Nitrogen to be charged at a pressure of 15 Kg/cm^2

Body shall be of mild steel conforming to relevant IS Standards. The neck ring shall be also mild steel and welded to the body. The discharge valve body, shall be forged brass or leaded bronze, while the spindle, spring and siphon tube shall be of brass. The nozzle shall be of brass, while the hose shall be braided nylon. The body shall be cylindrical in shape, with the dish and dome welded to it. Sufficient space for Nitrogen gas shall be provided inside the body, above the powder filling.

The Neck Ring shall be externally threaded - the threading portion being 1.6 cm. The filler opening in the neck ring shall not less than 50 mm. Discharge nozzle shall be screwed to the hose. The design of the nozzle shall meet the performance requirement, so as to discharge at least 85% of contents upto a throw of 4 mtrs, continuously, at least for 15 seconds. The hose, forming part of discharge nozzle, shall be 500 mm long, with 10 mm dia internally for 5 Kg capacity and 12 mm for 10 Kg capacity. It shall have a pressure gauge fitted to the valve assembly or the cylinder to indicate pressure available inside. The extinguisher shall be treated with anti-corrosive paint, and it shall be labelled with words ABC 2.5 cm long, within a triangle of 5 cm on each face. The extinguisher body and valve assembly shall withstand internal pressure of 30 Kg/cm^2 for a minimum period of 2 minutes. The pressure gauge shall be imported and suited for the purpose.

16.5 **Water Type Extinguisher (Gas Pressure Type)**

The Extinguishing medium shall be primarily water stored under normal pressure, the discharge being affected by release of Carbon Dioxide Gas from a 120 gms cylinder.

The capacity of Extinguisher, when filled upto the indicated level, shall be 9 ltr +/- 5%

The skin thickness of the Cylinder shall be minimum 4.0 mm, fabricated from Mild Steel sheet, welded as required, with dish and dome, being of same thickness, and of size not exceeding the diameter of body. The diameter of body to be not less than 150 mm and not exceeding 200 mm. The neck shall be externally threaded upto a minimum depth of 16 mm, and leaded tin bronze.

The cap shall be of leaded tin bronze, and screwed on the body upto a minimum of 1.6 cm depth, with parallel screw thread to match the neck ring. The siphon tube to be of brass or G.I. and the strainer of Brass. The cartridge holder, knob, discharge fittings and plunger to be of Brass/Leaded tin bronze, and plunger of stainless steel, spring of stainless steel. The cap to have handle fixed to it. The discharge hose shall be braided nylon, of 10 mm dia and 600 mm long, with a nozzle of brass fitted at end.

The extinguisher shall be treated for anti-corrosion internally and externally, and externally painted with Fire Red paint. The paint shall be stove enamelled/powder coated. The cartridge shall be as per IS, and have 60 gm net carbon dioxide gas for expelling. The extinguisher, body and cap shall be treated to an internal hydraulic pressure of 25 Kg/cm2. It shall have external marking with letter A, of 2.5 cm height, in block letters within a triangle of 5 cm each side. The extinguisher shall be upright in operation, with the body placed on ground and discharge tube with nozzle held in one hand to give a throw of not less than 6 mtr, and continue so for atleast 60 secs. The extinguisher body shall be clearly marked with ISI stamp (IS 940).

16.6 **Carbon Dioxide Extinguisher**

The Carbon Dioxide Extinguisher shall be as per IS: 2878

The body shall be constructed of seamless tube conforming to IS:7285 and having a convex dome and flat base. Its dia shall be maximum 140 mm, and the overall height shall not exceed 720 mm.

The discharge mechanisim shall be through a control valve conforming to IS:3224. The internal syphon tube shall be of copper aluminium conforming to relevant specifications.

Hose Pipe shall be high pressure braided Rubber hose with a minimum burst pressure of 140 Kg/cm2 and shall be approximately 1.0 meter in length having internal dia of 10 mm. The discharge horn shall be of high quality unbreakable plastic with gradually expanding shape, to convert liquid carbon dioxide into gas form. The hand grip of Discharge horn shall be insulated with Rubber of appropriate thickness.

The gas shall be conforming to IS:307 and shall be stored at about 85 Kg/cm2. The expansion ratio between stored liquid carbon dioxide to expanded gas shall be 1:9 times and the total discharge time (effective) shall be minimum 10 secs and maximum 25 secs.

The extinguisher shall fulfill the following test pressures:
Cylinder: 236 Kg/cm2
Control Valve: 125 Kg/cm2

Burst Pressure of Hose: 140 Kg/cm2 minimum

It shall be an Upright type. The cylinder, including the control valve and high pressure Discharge Hose must comply with relevant Statutory Regulations, and be approved by Chief Controller of Explosives, Nagpur and also bear IS marking.

The Extinguisher including components shall be IS marked.

17. FIRE PUMPS AND ALLIED EQUIPMENTS

17.1 Scope

Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install electrically operated and diesel driven pumps and as required by drawings and specified hereinafter or given in the schedule of rates.

a. Electrically operated pumps with motors and diesel engine driven pumps with diesel engine, common base plates, coupling, coupling guard and accessories.

b. Automatic starting system with all accessories, wiring and connections and pressure switches.

c. Motor control centre.

d. Annunciation system with all accessories wiring and connections.

e. Pressure gauges with isolation valves and piping, bleed and block valves.

f. Suction strainers and accessories.

g. Vibration eliminator pads and foundation bolts.

h. Leak-off drain shall be led to the nearest floor drain.

17.2 General Requirements

Pumps shall be installed true to levels on suitable concrete foundations. Base plate shall be firmly fixed by properly grouted foundation bolts.

Pumps and motors shall be truly aligned by suitably instruments. Record of such alignment shall be furnished to the Project Manager.

All pump connections shall be standard flanged type with number of bolts as per relevant standard requirement for the working pressure. Companion flanges shall be provided with the pumps.

Manufacturers' instructions regarding installation, connections and commissioning shall be strictly followed.

Tenderer shall provide necessary test certificates, type test certificates, performance curves and NPSH curves of the pumps from the manufacturer when called for.
The tenderer shall provide facilities to the Project Manager and Consultant for inspection of equipment during manufacturing and also to witness various tests at the manufacturer's works without any cost to the Project Manager or Consultant.

Seismic isolation and clamping for each pump and flexible connection on the suction as well as the discharge side shall be provided.

The tenderer shall submit with this tender a list of recommended spare parts for three years of normal operation and quote the prices for the same as a seprate submittal / annexure.

17.3 **Electric Fire Pump**

General
The electric fire pump shall be suitable for automatic operation complete with necessary electric motor and automatic starting gear, suitable for operation on 415 volts, 3 phase, 50 Hz. A.C. system. Both the motor and the pump shall be assembled on a common base plate, fabricated M.S. channel type or cast iron type.

Drive
The pump shall be direct driven by means of a flexible coupling. Coupling guard shall also be provided.

17.4 **Fire Pump**

The fire pump shall be horizontally mounted centrifugal type. It shall have a capacity to deliver flow as specified, and developing adequate head so as to ensure a minimum pressure of 3.5 Kg/Sq.cm at the highest and the farthest outlet.

The pump shall be capable of giving a discharge of not less than 150 per cent of the rated discharge, at a head of not less than 65 per cent of the rated head. The shut off head shall be within 120 per cent of the rated head.

The pump casing shall be of cast iron to grade FG 200 to IS: 210 and parts like impeller, shaft sleeve, wearing ring etc. shall be of non-corrosive metal like bronze/brass/gun metal. The shaft shall be of stainless steel. Provision of mechanical seal shall also be made.

Bearings of the pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water. The pump shall be provided with a plate indicating the suction lift, delivery head, discharge, speed and number of stages. The pump casing shall be designed to withstand 1.5 times the working pressure.

Provision of Jockey Pump for low and high zone shall be made. The pump shall be vertical SS type and of detail as in schedule of quantity. Tenderer shall verify that the capacity of the Jockey pump shall not be less than 3% (Minimum 180 LPM) and not more than 10% of the installed pump capacity.

Motor
The motor shall be squirrel cage A.C. induction type suitable for operation on 415 volts 3 phase 50 Hz. system. The motor shall be totally enclosed fan cooled type conforming to protection clause IP 55. The class of insulation shall be F. The synchronous speed shall be 1500 RPM as specified. The motor shall be rated for continuous duty and shall have a horse power rating necessary to drive the pump at 150 per cent of its rated discharge with at least 65 per cent rated head. The motor shall conform to I.S.325-1978.

Motor Starter
The motor starter shall be as per detail in MCC. The unit shall include suitable current transformer and ammeter of suitable range on one line to indicate the current. The starter shall not incorporate under voltage, no voltage trip overload or SPP.

The starter assembly shall be suitably integrated in the power and control panel for the wet riser system & sprinkler system.

17.5 **Diesel Fire Pump**

General

The diesel pump set shall be suitable for automatic operation complete with necessary automatic starting gear, for starting on wet battery system and shall be complete with all accessories. Both engine and pump shall be assembled on a common base plate.

Drive

The pump shall be only direct driven by means of a flexible coupling. Coupling guard shall also be provided. The speed shall be 1500 RPM as specified.

Fire Pump

The fire pump shall be horizontally mounted centrifugal type. It shall have a capacity to deliver as specified, and developing adequate head so as to ensure a minimum pressure of 3.5 Kg/Sq.cm at the highest and the farthest outlet. The pump shall be multi stage as specified. The pump shall be capable of giving a discharge of not less than 150% of the rated discharge at a head of not less than 65% of the rated head. The shut off head shall be within 120% of the rated head.

The pump casing shall be of cast iron to grade FG 200 to IS 210 and parts like impeller, shaft sleeves, wearing-ring etc. shall be of non-corrosive metal like bronze/brass/gun metal. The shaft shall be stainless steel. Provision of mechanical seal shall also be made.

The pump casing shall be designed to withstand 1.5 times the working pressure.

Bearing of pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water.

Diesel Engine

Engine Rating - The engine shall be cold starting type without the necessity of preliminary heating of the engine cylinders or combustion chamber (for example, by wicks, cartridge, heater, plugs etc.). The engine shall be multi cylinder/vertical 4 stroke cycle, aircooled, diesel engine, developing suitable HP at the operating speed specified to drive the fire pump. Continuous capacity available for the load shall be exclusive of the power requirement of auxiliaries of the diesel engine, and the after correction for altitude, ambient temperature and humidity for the specified environmental conditions. This shall be at least 20% greater than the maximum HP required to drive the pump at its duty point.

It shall also be capable of driving the pump at 150% of the rated discharge at 65% of rated head. The engine shall be capable of continuous non-stop operation for 8 hours and major overhaul shall not be required before 3000 hours of operation. The engine shall have 10% overload capacity for one hour in any period of 12 hours continuous run. The engine shall accept full load within 15 seconds from the receipt of signal to start. The diesel engine shall conform to BS 649/IS 1601/IS 10002, all amended up to date.

a. **Engine Accessories** - The engine shall be complete with the following accessories:-

Fly wheel dynamically balanced.
Direct coupling for pump and coupling guard.
Corrosion Resistor.
Air cleaner.
Fuel service tank support, and fuel oil filter with necessary pipe work.
Elect. Starting battery (2X24 v).
Exhaust silencer with necessary pipe work.
Governor.

Instrument panel housing all the gauges, including Tachometer, hour meter and starting switch with key (for manual starting).

Necessary safety controls.

b. Fuel System - The fuel shall be gravity fed from the engine fuel tank to the engine driven fuel pump. The engine fuel tank shall be mounted either over or adjacent to the engine itself or suitably wall mounted on bracket. The fuel filter shall be suitably located to permit easy servicing.

All fuel tubing to the engine shall be with copper, with flexible hose connections where required. Plastic tubing shall not be permitted.

The fuel tank shall be of welded steel construction (3 mm. thick) and of capacity sufficient to allow the engine to run on full load for at least 8 hours. The tank shall be complete with necessary wall mounted supports, level indicator (protected against mechanical injury) inlet, outlet, overflow connections and drain plug and piping to the engine fuel tank. The outlet shall be so located as to avoid entry of any sediment into the fuel line to the engine.

As semi rotary hand pump for filling the daily service tank together with hose pipe 5mtr.long with a foot valve etc. shall also form part of the scope of supply.

c. Lubricating Oil System- Forced feed Lub. Oil system shall be employed for positive lubrication. Necessary Lub. oil filters shall be provided, located suitably for convenient servicing.

d. Starting System- The starting system shall comprise necessary batteries (2x24v), 24 volts starter motor of adequate capacity and axle type gear to match with the toothed ring on the fly wheel. Bi metallic relay protection to protect starting motor from excessively long cranking runs suitably integrated with engine protection system shall be included within the scope of the work.

The capacity of the battery shall be suitable for meeting the needs of the starting system.

The battery capacity shall be adequate for 10 consecutive starts without recharging with cold engine under full compression.

The scope shall cover all cabling, terminals, initial charging etc.

e. Exhaust System - The exhaust system shall be complete with silencer suitable for outdoor installation, and silencer piping including bends and accessories needed for a run of 15 metre from the engine manifold.(Adjustment rates for extra lengths shall also be given).The total back pressure shall not exceed the engine manufacture's recommendation. The exhaust piping shall be suitably supported.

f. Engine shut down mechanism- This shall be auto/ manually operated and shall return automatically to the starting position after use.

g. Governing System- The engine shall be provided with an adjustable governor to control the engine speed within 5% of its rated speed under all conditions of load up to full load. The governor shall be set to maintain rated pump speed at maximum pump load.

h. **Engine Instrumentation**- Engine instrumentation shall include the following:-

i) Lub. oil pressure gauge.
ii) Lub. oil temperature gauge.
iii) Water pressure gauge.
iv) Water temperature gauge.
v) Tachometer.
vi) Hour meter.

The instrumentation panel shall be suitably resident mounted on the engine.

Engine Protection Devices- Following engine protection and automatic shut down facilities shall be provided:-

i) Low lub.oil pressure.
ii) High cooling water temp.
iii) High lub.oil temperature.
iv) Over speed shut down.

i. Pipe Work - All pipe lines with fittings and accessories required shall be provided for fuel oil, lub.oil and exhaust systems, copper piping of adequate sizes, shall be used for Lub.oil and fuel oil. M.S. piping will be permitted for exhaust.

j. Anti Vibration Mounting- Suitable vibration mounting duly approved by Project Manager shall be employed for mounting the unit so as to minimise transmission of vibration to the structure. The isolation efficiency achievable shall be clearly indicated.

k. Battery Charger-Necessary float and boost charger shall be incorporated in the control section of the power and control panel, to keep the battery in trim condition. Voltmeter to indicate the state of charge of the batteries shall be provided.

17.6 Pump Sets Assembly

On the main fire sprinkler and hydrant headers near pump sets a 150 mm dia by-pass valve located in an accessible location shall be provided along with a rate of flow rotameter calibrated in 1 pm and able to read 200% of the rated pump capacity. The delivery shall be connected to the fire tank.

Each and every pump set assembly shall be provided with suction valve (only for positive suction head), discharge valve, non-return valve and 150 mm dia Bourdon type pressure gauge with isolation valve.

17.7 Flexible Connectors

On all suction and delivery lines double flanged reinforced neoprene flexible pipe connectors shall be provided. Connectors should be suitable for maximum working pressure of each pipe line on which it is mounted and tested to a test pressure of 1:5 time the operating pressure. Length of the connector shall be as per manufacturers standard.

17.8 Interlocking

The following inter-locking between the two main fire pumps (i.e. wet riser pump & sprinkler pump), the jockey pump and the diesel engine driven pump.

Only one category of pumps will work at a time i.e. either jockey pump or main fire pumps (wet riser and sprinkler, both the wet riser and sprinkler can come up at a time) or diesel driven pump.

	JOCKEY PUMP	**WET RISER PUMP**	**DIESEL DRIVEN PUMP**
i.	ON	OFF	OFF
ii.	OFF	ON	OFF
iii.	OFF	OFF	OFF
iv.	OFF	ON	OFF
v.	OFF	OFF	ON
vi.	OFF	OFF	ON
vii	OFF	ON	ON

17.9 Annunciation Panel

One solid state electronic annunciation panel, fully wired with visual display and audible alarm unit shall be provided to indicate:

a. Flow condition in any flow switch indicating the area of distress and fire alarm.
b. Starting and stopping of each hydrant pump.
c. Starting and stopping of each jockey pump.
d. Starting and stopping of each sprinkler pump.
e. Failure of Hydrant / Sprinkler pump to start.
f. High level in fire water storage tank compartment.
g. Low level in fire water storage tank compartment.
h. Low level in HSD day tank of the fire pump.

The panel shall be factory fabricated, wired and tested. All details shall be submitted with the tender.

The annunciation panel shall be located in the security office / reception on the ground floor or as instructed by the Project Manager.

17.10 Vibration Isolation

The pumpset shall be mounted on rolled steel channels and 150 mm thick inertia block spring and ribbed neoprene vibration isolation mounting shall support the inertia block onto a 100 mm thick concrete

plinths. The spring mountings shall have a maximum deflection of15 mm. Reference shall be made to the section on “Nose and Vibration” for further technical requirements.

SECTION-3 :: ELECTRICAL INSTALLATION

1. SCOPE

The scope of this section comprises of fabrication, supply, erection, testing and commissioning of Motor Control Centre (MCC), wiring and earthing of all air-conditioning equipment, components and accessories.

2. GENERAL

Work shall be carried out in accordance with the accompanying specifications and shall comply with the latest relevant Indian Standards and Electricity Rules and Regulations.

All motor control centres shall be CPRI approved and shall be suitable for operation on 3 phase/single phase 415/230 volts, 50 cycles power supply system.

3. CONSTRUCTIONAL FEATURES

The Motor Control Centre (MCC) electrical panels shall be sheet steel cabinet for indoor installation, dead front, floor mounting/wall mounting type and shall be 3b construction. The control panel shall be totally enclosed, completely dust and vermin proof and shall be with hinged doors with Neoprene gasket. Control panel shall be suitable for the climatic conditions as specified in Specifications. Steel sheets used in the construction of Control panel shall be 2 mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded, all welding, slag shall be rounded off and welding pits wiped smooth with plumber metal. The general construction shall confirm to relevant BIS Codes.

All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with wing nuts. Self threading screws shall not be used in the construction of Control panels. A base channel of 75 mm x 40 mm x 5 mm thick shall be provided at the bottom for floor mounted panels. Minimum clearance of 275 mm shall be provided between the floor of control panel and the lowest unit.

The control panel shall be of adequate size with a provision of 25% spare space to accommodate possible future breakers. Breakers shall be arranged in multi-tier. Knockout holes of appropriate size and number shall be provided in the Motor Control Centre in conformity with the location of cable/conduit connections. Removable sheet steel plates shall be provided at the top to make holes for additional cable entry at site if required.

Every cabinet shall be provided with Trifoliate or engraved metal name plates. All panels shall be provided with circuit diagram mounted on inside of door shutter protected with Hylam sheet. All live accessible connections shall be shrouded and shall be finger touch proof and minimum clearance between phase and earth shall be 20 mm and phase to phase shall be 25 mm.

4. WIRING SYSTEM

All L T power cabling between MCC and motors shall be carried out with 1100 volts grade PVC insulated, overall PVC sheathed aluminium conductor armoured cables, Cables shall be sized by applying proper derating factor. All control wiring shall be carried out by using PVC insulated copper conductor wires in conduits. Minimum size of control wiring shall be 1.5 sq mm. Minimum size of conductor for power wiring shall be 4 sq. mm 1100 volts grade PVC insulated copper conductor wires in conduit.

5. CIRCUIT COMPARTMENT

Each circuit breaker, contactor and relay shall be housed in a separate compartment and shall have steel sheets on top and bottom of compartment. Sheet steel hinged lockable door shall be duly interlocked with the breaker in the “ON” position. Safety interlocks shall be provided to prevent the breaker from being drawn-out when the breaker is in ‘ON’ position. The door shall not form an integral part of the draw-out portion of the panel. Sheet steel barriers shall be provided between the tiers in a vertical section.

6. INSTRUMENT ACCOMMODATION

Adequate space shall be provided for accommodating instruments, indicating lamps, control contactors and control MCBs. These shall be accessible for testing and maintenance without any

danger of accidental contact with live parts of the circuit breaker and bus bar `ON' lamps shall be provided on all outgoing feeders.

7. BUS BAR CONNECTIONS

Bus bar and interconnections shall be of high conductivity electrolytic aluminium complying with requirement of grade E91E of IS:5082-1981 and shall be of rectangular cross section suitable for carrying the rated full load current and short circuit current without overheating of phase and neutral bus bar and shall be extendable on either side. Bus bar and interconnections shall be insulated with heat shrinkable sleeve and shall be colour coded and shall be supported on glass fiber reinforced thermosetting plastic insulated supports at regular intervals to withstand the force arising from in case of short circuit in the system. All bus bar shall be provided in a separate chamber and all connections shall be done by bolting. Additional cross sectional area shall be added to the bus bar to compensate for the holes. All connections between bus bar and breaker shall be through solid aluminium strips of proper size to carry full rated current as per approved for construction shop drawing and insulated with insulating sleeves. Bus bar shall be rated for current density of 1.0 amps/mm^2 cross section area.

8. TEMPERATURE - RISE LIMIT

Unless otherwise specified, in the case of external surface of enclosures of bus bar trunking system which shall be accessible but do not need to be touched during normal operation, an increase in the temperature rise limits of 25° C above ambient temperature shall be permissible for metal surface and of 15° C above ambient temperature for insulating surfaces as per relevant IS Codes.

9. CABLE COMPARTMENTS

Cable compartment of adequate size shall be provided in the control panel for easy clamping of all incoming and outgoing cables entering from the top/bottom. Adequate supports shall be provided in cable compartment to support cables as per approved for construction shop drawing.

10. MOULDED CASE CIRCUIT BREAKER (MCCB)

All MCCB's shall be motor duty and Current Limiting type, and comprise of Quick Make - break switching mechanism, preferably Double Break Contact system, arc extinguishing device and the tripping unit shall be contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses. All MCCB's shall be capable of defined Variable overload adjustment. All MCCB's rated 200 Amps and above shall have adjustable Magnetic short circuit pick up.

The trip command shall override all other commands. MCCB shall employ maintenance free double break contact system to minimise the let thru' energies and capable of achieving discrimination upto full short circuit capacity of downstream MCCB. The manufacturer shall provide both discrimination tables and let thru energy curves.

The breaking capacity of MCCB's shall be asked for in the schedule of quantities. The breaking capacities specified will be ICU=ICS i.e type-2. Co-ordination as per relevant IS and IEC Codes.

The MCCB's shall be provided with rotary handle operating mechanism. The handle position shall give positive indication of 'ON', 'OFF' or 'Tripped' thus qualifying to Disconnection as per the IS/IEC indicating the true position of all the contacts. In case of 4 pole MCCB the neutral shall be defined and capable of offering protection.

11. MINIATURE CIRCUIT BREAKER (MCB)

Miniature Circuit Breaker shall comply with relevant IS Codes and shall be quick make and break type for 230/415 VAC 50 Hz application with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be less than 10 KA at 415 VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting type (Class-3). MCBs shall be classified (B,C,D ref IS standard) as per their Tripping Characteristic curves defined by the manufacturer. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values.

The housing shall be heat resistant and having a high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection. All DP, TP and TPN miniature circuit breakers shall have a common trip bar independent to the external operating handle.

12. PAINTING

All sheet steel work shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphating, passivaiting (seven tank processing) and then painted with electrostatic paint (Powder coating). The shade of colour of panel inside/outside shall be as per relevant BIS code.

13. LABELS

Engraved PVC labels shall be provided on all incoming and outgoing feeder. Circuit diagram showing the arrangements of the circuit inside the control panel shall be pasted on inside of the panel door and covered with transparent plastic sheet.

14. METERS

i. All voltmeters and indicating lamps shall be through MCB's.

ii. Meters and indicating instruments shall be plug type.

iii. All CT's connection for meters shall be through Test Terminal Block (TTB).

iv. CT ratio and burdens shall be as specified on the Single line diagram.

15. CURRENT TRANSFORMERS

Current transformers shall be provided for Control panels carrying current in excess of 60 amps. All phase shall be provided with current transformers of suitable VA burden with 5 amps secondaries for operation of associated metering.

The CTs shall confirm to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitable to a terminal block which shall be easily accessible for testing and terminal connections. The protection CTs shall be of accuracy class 5P10 and measurement CTs shall be of accuracy class I.

16. SELECTOR SWITCH

Where called for, selector switches of rated capacity shall be provided in control panels, to give the choice of operating equipment in selective mode.

17. STARTERS

Each motor shall be provided with a starter of suitable rating. Starters shall be in accordance with relevant IS Codes. All Star Delta and ATS Starters shall be fully automatic.

18. CONTACTOR

Contactor shall be built into a high strength thermoplastic body and shall be provided with an arc shield for quick arc extinguishing. Silver alloy tips shall be provided to ensure a high degree of reliability and endurance under continuous operation. The magnet system shall consist of laminated yoke and armature to ensure clean operation without hum or chatter.

Starters contactors shall have 3 main and 2 Nos. NO / NC auxiliary contacts and shall be air break type suitable for making and breaking contact at minimum power factor of 0.35. For design consideration of contactors the starting current of connected motor shall be assumed to be 6 times the full load current of the motor in case of direct-on-line starters and 3 times the full load current of the motor in case of Star Delta and Reduced Voltage Starters. The insulation for contactor coils shall be of Class "E".

Coil shall be tape wound vacuum impregnated and shall be housed in a thermostatic bobbin, suitable for tropical conditions and shall withstand voltage fluctuations. Coil shall be suitable for 220/415±10% volts AC, 50 cycles AC supply.

19. THERMAL OVERLOAD RELAY

Thermal over load relay shall have built in phase failure sensitive tripping mechanism to prevent against single phasing as well as on overloading. The relay shall operate on the differential system of protection to safeguard against three phase overload, single phasing and unbalanced voltage conditions.

Auto-manual conversion facility shall be provided to convert from auto-reset mode to manual-reset mode and vice-versa at site. Ambient temperature compensation shall be provided for variation in ambient temperature from -5° C to +55°C.

All overload relays shall be of three element, positive acting ambient temperature compensated time lagged thermal over load relays with adjustable setting. Relays shall be directly connected for motors upto 35 HP capacity. C.T. operated relays shall be provided for motors above 35 HP capacity. Heater circuit contactors may not be provided with overload relays.

20. TIME DELAY RELAYS

Time delay relays shall be adjustable type with time delay adjustment from 0-180 seconds and shall have one set of auxiliary contacts for indicating lamp connection.

21. INDICATING LAMP AND METERING

All meters and indicating lamps shall be in accordance with IS:1248 and IS-1258. The meters shall be flush mounted type. The indicating lamp shall be of low wattage. Each MCC and control panel shall be provided with voltmeter 0-500 volts with three way and off selector switch, CT operated ammeter of suitable range with three nos. CTS of suitable ratio with three way and off selector switch, phase indicating lamps, and other indicating lamps as called for. Each phase indicating lamp shall be backed up with 5 MCB. Other indicating lamps shall be backed up with fuses as called for in Schedule of Quantities.

22. TOGGLE SWITCH

Toggle switches, where called for in Schedule of Quantities, shall be in conformity with relevant IS Codes and shall be of 5 amps rating.

23. PUSH BUTTON STATIONS

Push button stations shall be provided for manual starting and stopping of motors / equipment Green and Red colour push buttons shall be provided for 'Starting' and 'Stopping' operations. 'Start' or 'Stop' indicating flaps shall be provided for push buttons. Push Buttons shall be suitable for panel mounting and accessible from front without opening door, Lock lever shall be provided for 'Stop' push buttons. The push button contacts shall be suitable for 6 amps current capacity.

24. CONDUITS

Conduits and Accessories shall conform to relevant Indian Standards. Wall thickness shall be 16 gauge upto 32 mm dia and 14 gauge above 32 mm dia conduit. Screwed G.I.conduits shall be used. Joints between conduits and accessories shall be securely made, to ensure earth continuity. All conduit accessories shall be threaded type only. All raw metal shall be painted with bitumastic paint.

Only approved make of conduits and accessories shall be used.

Conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of the manufacturer.

Maximum permissible number of 650/1100 volt grade PVC insulated wires that may be drawn into rigid non metallic or GI Conduits are given below:

Size of wires Nominal Cross Section Area (Sq. mm.)	Maximum number of wires within conduit size(mm)				
	20	25	32	40	50
1.5	5	10	14	--	--
2.5	5	8	12	--	--
4	3	7	10	--	--
6	2	5	8	--	--
10	--	3	5	6	--
16	--	2	3	--	6
25	--	--	2	4	6
35	--	--	--	3	5

25. CABLES

M.V. Cables shall be PVC insulated aluminium conductor and armoured cables conforming to IS Codes. Cables shall be armoured and suitable for laying in trenches, ducts, and on cable trays as required. M.V. Cables shall be termite resistant. Cable glands shall be double compression glands. Control cables and indicating panel cables shall be multi core PVC insulated copper conductor and armoured cables.

26. CABLE LAYING

Cable shall be laid in accordance with IS code of Practice. Cables shall be laid on 14 gage factory fabricated perforated galvanized sheet steel cable trays, and cable drops / risers shall be fixed to ladder type cable trays factory fabricated out of galvanized steel angle. Access to all cables shall be provided to allow cable withdrawal / replacement in the future. Where more than one cable is running on a cable tray, one dia spacing shall be provided between cables to minimise the loss in current carrying capacity.

Cables shall be suitably supported with Galvanized saddles when run on walls / trays. When buried, they shall be laid in 350 mm wide and 750 mm deep trench and shall be covered with 250 mm thick layer of soft sifted sand & protected with bricks/tiles. Special care shall be taken to ensure that the cables are not damaged at bends. The radius of bend of the cables when installed shall not be less than 12 times the diameter of cable.

27. WIRE AND WIRE SIZES

1100 volts grade PVC insulted copper conductor wires in conduit shall be used.

For all single phase/ 3 phase wiring, 1100 volts grade PVC insulated copper conductor wires shall be used. The equipment inside plant room shall be connected to the control panel by means of insulated copper conductor wires of adequate size in exposed conduits. Final connections to the equipment shall be through wiring enclosed in galvanized flexible conduits rigidly clamped at both ends and at regular intervals. An isolator shall be provided near each motor/equipment wherever the motor/equipment is separated from the supply panel through a partition barrier or through ceiling construction. PVC insulated copper conductor wires shall be used inside the control panel for connecting different components and all the wires inside the control panel shall be neatly dressed and plastic beads shall be provided at both the ends for easy identification of control wiring.

The minimum size of control wiring shall be 1.5 sq. mm PVC insulated stranded soft drawn copper conductor wires drawn through conduit to be provided for connecting equipment and control panels.

Power wiring, cabling shall be of the following sizes:

i.	Upto 5 HP motors/ 5 KW heaters	3 x 4 sq. mm copper conductor wires.
ii.	From 6 HP to 10 HP motors 6 KW to 7.5 KW heaters	3 x 6 sq. mm copper conductor wires
iii.	From 12.5 HP to 15 HP wires	2 Nos. 3 x 6 sq. mm copper conductor wires
iv.	From 20 HP to 25 HP motors	2 Nos. 3 x 10 sq. mm copper conductor wires
v.	From 30 HP to 35 HP motors	2 nos.3x 16 sq.mm aluminium conductor armoured cable.
vi.	From 40 HP to 50 HP motors	2 Nos. 3x25 sq.mm aluminium conductor armoured cable.
vii.	From 60 HP to 75 HP motors	1 No. 3 x 70 sq. mm aluminium conductor armoured cable.
viii.	100 HP motors conductor	1 No. 3 x 150 sq. mm. aluminium armoured cable
ix.	200 HP motor conductor	2 No. 3 x 150 sq. mm.aluminium armoured cable.

All the switches, contactors, push button stations, indicating lamps shall be distinctly marked with a small description of the service installed. The following capacity contactors and overload relays shall be provided for different capacity motors or as per manufacturer's recommendation.

	TYPE OF STARTER	CONTACTOR CURRENT CAPACITY	OVERLOAD RELAY RANGE
5 HP Motors	D O L	16 amps	6-10 amps
7.5 HP motors	D O L	16 amps	9-15 amps
10 HP Motors	D O L	25 amps	9-15 amps
12.5 HP Motors	Star Delta	16 amps	9-15 amps
15 HP Motors	Star Delta	25 amps	9-15 amps
20 HP Motors	Star Delta	32 amps	14-23 amps
25 HP Motors	Star Delta	32 amps	14-23 amps
200 HP Motors DOL		325 amps	CT Operated relay

Two speed motors when specified, shall be provided with DOL starter irrespective of it rating.

28. EARTHING

Earthing shall be provided in accordance with relevant BIS Codes and shall be copper strips /wires .The main panel shall be connected to main earthing system of the power supply. All single phase metal clad switches and control panels be earthed with minimum 3 mm diameter copper conductor wire. All 3 phase motors and equipment shall be earthed with 2 numbers distinct and independent copper wires / tapes as follows:

i.	Motor upto and including 10 HP rating.	2 Nos. 3 mm dia copper wires.
ii.	Motor 12.5 HP to 40 HP capacity	2 Nos. 4 mm dia copper wires
iii.	Motor 50 to 75 HP capacity.	2 Nos. 6 mm dia copper
iv.	Motor above 75 HP.	2 Nos. 25 mm x 3 mm copper tapes.

All switches shall be earthed with two numbers distinct and independent copper wires' tapes as follows:

i.	3 phase switches and control panels upto 60 amps rating.	2 nos. 3 mm dia copper wires.
ii.	3 phase switches, and control panels 63 amps to 100 amps rating.	2 Nos. 4 mm dia copper wires.
iii.	3 phase switches and control panels 125 amps to 200 amps rating.	2 Nos. 6 mm dia copper wires.
iv.	3 phase switches, control panels, bus ducts, above 200 amps rating.	2 Nos. 3 mm x 25 mm copper tapes.

The earthing connections shall be tapped off from the main earthing of electrical installation. The overlapping in earthing strips at joints where required shall be minimum 75 mm. These straight joints shall be rivetted with brass rivets & brazed in approved manner. Sweated lugs of adequate capacity and size shall be used for all termination of wires. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substance, and properly tinned.

29. DRAWINGS

Shop drawings for control panels and for wiring of equipment showing the route of conduit & cable shall be submitted by the contractor for approval of Architect/Consultant before starting the fabrication of panel and starting the work. On completion, four sets of complete "As-installed" drawings incorporating all details like, conduits routes, number of wires in conduit, location of panels, switches, junction/pull boxes and cables route etc. shall be furnished by the Contractor.

30. TESTING

Before commissioning of the equipment, the entire electrical installation shall be tested in accordance with relevant BIS codes and test report furnished by a qualified and authorised person. The entire electrical installation shall be gotten approved by Electrical Inspector and a certificate from Electrical Inspector shall be submitted. All tests shall be carried out in the presence of Project Manager. Testing of the panels shall be as per relevant BIS Codes :

31. PAINTING

All sheet steel work shall undergo a process of degreasing, thorough cleaning, and painting with a high corrosion resistant primer. All panels shall then be baked in an oven. The finishing treatment shall be by application of powder coating of approved shade.

32. MEASUREMENT OF ELECTRICAL CONTROL PANELS

Panels shall be counted as number of units. Quoted rates shall include as lumpsum (NOT measurable lengths) for all internal wiring, power wiring and earthing connections from the control panel to the starter and to the motor, control wiring for interlocking, power and control wiring for automatic and safety controls, and control wiring for remote start/stop as well as indication as per the specifications. The quoted rate of panel shall also include all accessories, switchgear, contactors, indicating meters and lights as per the Specifications and Schedule of Quantities.

33. RUBBER MAT

Rubber mat shall be provided in front to cover the full length of all panels. Where back space is provided for working from the rear of the panel, rubber mat shall also be provided to cover the full length of panel.

SECTION-4 :: COMMISSIONING & GUARANTEE

1. SCOPE OF WORK

Work under this section shall be executed without any additional cost. The rates quoted in this tender shall be inclusive of the works given in this section.

Contractor shall provide all tools, equipment, metering and testing devices required for the purpose.

On award of work, Contractor shall submit a detailed proposal giving methods of testing and gauging the performance of the equipment to be supplied and installed under this contract.

All tests shall be made in the presence of the Architect or his representative or any inspecting authority. At least five working days notice in writing shall be given to the inspecting parties before performing any test.

Water flow rates of all equipment and in pipe lines through valves shall be adjusted to design conditions. Complete results of adjustments shall be recorded and submitted.

Contractor shall ensure proper balancing of the hydraulic system and for the pipes / valves installed in his scope of work by regulating the flow rates in the pipe line by valve operation. The contractor shall also provide permanent Tee connection (with plug) in water supply lines for ease of installing pressure gauge, temperature gauge & rota meters. Contractor shall also supply all required pressure gauge, temperature gauge & rotameter for system commissioning and balancing. The balancing shall be to the satisfaction of Consultant / Project Manager.

Three copies of all test results shall be submitted to the Engineer in A4 size sheet paper within two weeks after completion of the tests.

2. PRECOMMISSIONNIG

On completion of the installation of all pumps, piping, valves, pipe connections, insulation etc. the Contractor shall proceed as follows:

a. Prior to start-up and hydraulic testing, the Contractor shall clean the entire installation including all fitments and pipe work and the like after installation and keep them in a new condition. All pumping systems shall be flushed and drained at least once through to get rid of contaminating materials. All pipes shall be rodded to ensure clearance of debris, cleaning and flushing shall be carried out in sections as the installation becomes completed.

b. All strainers shall be inspected and cleaned out or replaced.

c. When the entire systems are reasonably clean, a pre-treatment chemical shall be introduced and circulated for at least 8 hours. Warning signs shall be provided at all outlets during pre-treatment. The pre-treatment chemical shall:

- Remove oil, grease and foreign residue from the pipe work and fittings;
- Pre-condition the metal surfaces to resist reaction with water or air.
- Establish an initial protective film;
- After pre-treatment, the system shall be drained and refilled with fresh water and left until the system is put into operation.
- Details and procedures of the pre-treatment shall be submitted to the Architect for approval.

d. Check all clamps, supports and hangers provided for the pipes.

e. Check all the equipment, piping and valves coming under hot water system and operate each and every valve on the system to see if the valves are functioning properly.Thereafter conduct & hydro test of the system as for (b) above.

f. Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specification. If any leakage is found, rectify the same and retest the pipes.

Fire Protection System

a. Check all hydrant valves by opening and closing : any valve found to be open shall be closed.

b. Check all the piping under hydro test.

c. Check that all suction and delivery connections are properly made for all pump sets.

d. Check rotation of each motor after decoupling and correct the same if required.

e. Test runs each pump set.

f. All pump sets shall be run continuously for 8 hours (if required with temporary piping back to the tank).

Commissioning and Testing

a. Pressurise the fire hydrant system by running the jockey pump and after it attains the shutoff pressure of the pump , then

b. Open bypass valve and allow the pressure to drop in the system. Check that the jockey pump cuts-in and cuts-out at the preset pressure. If necessary adjust the pressure switch for the jockey pump. Close by-pass valve.

c. Open hydrant valve and allow the water to below into the fire water tank in order to avoid wastage of water. The main fire pump shall cut-in at the preset pressure and shall not cutout automatically on reaching the normal line pressure. The main fire pump shall stop only by manual push button. However the jockey pump shall cut-out as soon as the main pump starts,

d. Switch off the main fire pump and test check the diesel engine driven pump in the same manner as the electrically driven pump,

e. When the fire pumps have been checked for satisfactory working on automatic controls, open fire hydrant valves simultaneously and allow the hose pipes to discharge water into the fire tank to avoid wastage.

f. Check each landing valve, male and female couplings and branch pipes, for compatibility with each other. Any fitting which is found to be incompatible and do not fit into the other properly shall be replaced by the Contractor. Each landing valve shall also be checked by opening and closing under pressure.

g. Check all annunciations by simulating the alarm conditions at site.

Sprinkler System

a. Start the sprinkler pump and develop the required pressure in the sprinkler pipes.

b. Open the test valve to test the automatic starting of the pump. If necessary , make necessary adjustments in the setting of pressure switch. The sprinkler water gong alarm shall also operate when the test valve is open. This operation is to be done for each and every section of the sprinkler system and the alarm for each section (via flow switch) shall be checked for operation.

c. After satisfactory operation of the pump the Contractor shall set up mock fire and test the system.

d. Check all annunciations by simulating the alarm conditions at site.

3. STATUTORY AUTHORITIES' TESTS AND INSPECTIONS

As and when notified in writing or instructed by the Architect, the Contractor shall submit shop drawing and attend all tests and inspections carried out by Local Fire Authorities, Water Authority and other Statutory Authorities, and shall forthwith execute free of charge any rectification work ordered by the Architect as a result of such tests and inspections where these indicate non-compliance with Statutory Regulations. Some of these tests may take place after the issue of Practical Completion of the Main Contract and the Contractor shall make all allowances in this respect.

The Contractor shall be responsible for the submission of all necessary forms and shop drawings to the Statutory Authorities which shall conform in layout to the latest architectural plans submitted to and kept by these Authorities.

The submission shall comply with the requirements set forth in the current Codes of Practice and circular letters of the Statutory Authorities. The shop drawings to be submitted shall be forwarded to the Architect for checking before submission.

The Contractor shall allow for at least two submissions of complete sets of shop drawings to the Authorities, one to be made within six months after the award of the Contract but not less than six weeks before the inspection. The Architect may at his discretion instruct the Contractor for additional submissions to the Local Authorities whenever necessary.

The Contractor shall notify the Architect at least seven days in advance of his application for local Authority tests and inspections. On receipt of a confirmed date for test and inspection the Contractor shall inform the Architect without delay.

4. FINAL ACCEPTANCE TESTS

Following commissioning and inspection of the entire installation, and prior to issue of the Completion Certificate, the Contractor shall carry out final acceptance tests in accordance with a programme to be agreed with the Architect.

Should the results of the acceptance tests show that plant, systems and/or equipment fail to perform to the efficiencies or other performance figures as given in this Specification, the Contractor shall adjust, modify and if necessary replace the equipment without further payment in order that the required performance is obtained.

Where acceptance tests are required by the relevant Authorities having jurisdiction, these tests shall be carried out by the Contractor prior to the issue of Completion Certificate to the acceptance of the Authorities.

5. REJECTION OF INSTALLATION / PLANT

Any item of plant or system or component which fails to comply with the requirements of this Specification in any respect whatsoever at any stage of manufacture, test, erection or on completion at site may be rejected by the Architect either in whole or in part as he considers necessary/appropriate. Adjustment and/or modification work as required by the Architect so as to comply with the Authority's requirements and the intent of the Specification shall be carried out by the Contractor at his own expense and to the satisfaction of the Authority/Architect.

After works have been accepted, the Contractor may be required to carry out assist in carrying out additional performance tests as reasonably required by the Architect/Employer.

6. WARRANTY AND HANDOVER

The Contractor shall warrant that all plant, materials and equipment supplied and all workmanship performed by him to be free from defects of whatsoever nature before handover to the Owner.

7. HANDING OVER OF DOCUMENTS

All testing and commissioning shall be done by the Contractor to the entire satisfaction of the Owner’s site representative and all testing and commissioning documents shall be handed over to the Owner’s site representative.

The Contractor shall also hand over all maintenance and operation manuals, all certificates and all other documentation as per the terms of the contract to the Owner's site representative.

8. PIPE COLOUR CODE:

S.No.	Pipe Lines	Ground / Base Colour	First Colour Band	Second Colour Band
1.	Fire System	Post Office Red		

9. CHECK LIST FOR COMMISSIONING

Fire Protection System

a. Check all hydrant & other valves by opening and closing. Any valve found to be open shall be closed.

b. Check all clamps, supports and hangers provided for the pipes.

c. All the pump sets shall be run continuously for 30 minutes (with temporary piping back to tank from the nearest hydrant, using canvas hose pipes).

d. Fire Hydrant System - Pressurise the fire hydrant system by running the jockey pump and after it attains the shutoff pressure of the pump, then

Open bypass valve and allow the pressure to drop in the system. Check that the jockey pump cuts-in and cuts-out at the preset pressure. If necessary adjust the pressure switch for the jockey pump. Close by-pass valve.

Open hydrant valve and allow the water to flow into the fire water tank in order to avoid wastage of water. The main fire pump shall cut-in at the preset pressure and shall not cutout automatically on reaching the normal line pressure. The main fire pump shall stop only by manual push button. However the jockey pump shall cut-out as soon as the main pump starts,.

Operate booster pump continuously for 30 minutes with piping back to underground tanks from the hydrant nearest to plant room.

Check each landing valve, male and female couplings and branch pipes, for compatibility with each other. Any fitting which is found to be incompatible and do not fit into the other properly shall be replaced by the Contractor. Each landing valve shall also be checked by opening and closing under pressure.

Check air cushion tanks on the terrace for proper functioning.

ANNEXURE C: MEP SPECIFICATIONS

PART 6 : SEWAGE TREATMENT PLANT

PROPOSED CONSTRUCTION OF THE NEW CHANCERY AND OFFICIAL RESIDENCE

IN NEW DELHI INDIA

TENDER DOCUMENTS

SEWAGE TREATMENT PLANT SYSTEM
(Special Conditions &Technical Specification)

Date: - 18/02/2025

ARCHITECT

SPACE ARCHITECTURE STUDIO
V-12/23, DLF- PHASE-III
Gurgaon, Haryana - 122002.
Off Ph: +91-124-4734320
contact@studiosas.in

SERVICES CONSULTANT

MULTIPLE SERVICES CONSULTANTS

235/B, Rajpur Khurd Extention
Chhatarpur, New Delhi-110068
PH : - 8920228058/8920225677
Email: -msc@msc-mep.com

SPECIAL CONDITIONS

1. SCOPE OF WORK

The general character and the scope of work to be carried out under this contract is illustrated in Drawings, Specifications and Schedule of Quantities. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Client's site representative. The contractor shall furnish all labour, materials and equipment (except those to be supplied by the Client) as listed under Schedule of Quantities and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete Sewage Treatment Plant as described in the Specifications. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract. There is two type system - STP is proposed for Chancery Building and Bio-digester is proposed for Residence Building.

a. The Sewage Treatment Plant shall comprise of following:

a. Screen chambers with SS Screen

b. Sewage Equalization Tank

c. Moving Bed Bio Reactor Tanks

d. Oil and Grease Trap

e. Tube Settler Tank

f. Clear Water tank

g. Sludge holding Tank

h. Treated Water Tank

i. UV Unit

j. Electrical Panel, Cabling (Power & Control), Earthing

k. Tertiary Treatment

l. Ozonator

m. Centrifuge

n. Other Miscellaneous Items.

o. Approval from Local Authorities

p. Cutting holes, chases & like through all types of walls /floors and finishing for all services crossings, including sealing, cover plates, making good structure and finishes to an approved standard.

q. Balancing, testing & commissioning of the entire STP.

r. Every day's Test reports (During commissioning and for 3 month after commissioning), list of recommended spares, as-installed drawings, operation & maintenance manual for the entire STP contract.

s. Training of Client's staff.

b. Bio-digester Plant shall comprise of following:

a. Screen chambers with SS Screen

b. Screening Bars

c. Bio-digester Tanks (Part of civil)

d. Other Miscellaneous Items.

e. Approval from Local Authorities

f. Cutting holes, chases & like through all types of walls /floors and finishing for all services crossings, including sealing, cover plates, making good structure and finishes to an approved standard.

g. Training of Client's staff.

2. ASSOCIATED CIVIL WORKS

Following civil works associated with Sewage Treatment Plant are excluded from the scope of this contract. These shall be executed by other agencies in accordance with approved shop drawings of and under direct supervision of the Sewage Treatment Plant contractor.

a. Water proofing of floors.

b. Civil works for construction of various compartments of STP.

3. ASSOCIATED SERVICES WORKS

3.1 All associated **ELECTRICAL WORKS** listed below are excluded from the scope of this contract. These shall be installed by other agencies in accordance with approved shop drawings of and under direct supervision of the Sewage Treatment Plant tenderer.

Providing power supply with earthing at the incoming of control panel in plant room.

3.2 **BUILDING AUTOMATION SYSTEM**
(No additional cost shall be paid for providing the interfacing).

The scope of Sewage Treatment Plant Tenderer shall include the following for the interface to Building Automation System.

a. Sockets /Nipples including shut-off valve for mounting sensors/transmitters on pipe lines.

b. It is to be clearly understood that the final responsibility for the sufficiency, adequacy and conformity to the contract requirements, of the Sewage Treatment Plant system, lies solely with the tenderer.

4. PROJECT EXECUTION AND MANAGEMENT

The Contractor shall ensure that senior planning and erection personnel from his organization are assigned exclusively for this project. They shall have minimum 10 years' experience in this type of installation.

The Contractor shall arrange to have mechanized & modern facilities of transporting material to place of installation for speedy execution of work.

5. BYE-LAWS AND REGULATIONS

The installation shall be in conformity with the Bye-laws, Regulations and Standards set up by the Central Pollution Control Board (CPCB), in so far as these become applicable to the installation. If these Specifications and Drawings call for a higher standard of materials and / or workmanship

than those required by any of the above regulations and standards, then these Specifications and Drawings shall take precedence over the said regulations and standards. However, if the Drawings and specifications require something which violates the Bye-laws and Regulations, then the Bye-laws and Regulations shall govern the requirement of this installation.

6. PERMITS

The contractor shall obtain all permits/ licenses required for the inspection, approval and commissioning of their installation.

7. DRAWINGS

Refer to the site plan for the location of the STP and Bio digester. The capacity is mentioned in the BOQ.

8. TECHNICAL DATA

Each tenderer shall submit along with his tender, the technical data for all items listed in Appendix-I. Failure to furnish complete technical data with tenders may result in summary rejection of the tender.

9. SHOP DRAWINGS

All the shop drawings shall be prepared on computer through AutoCAD System based on Architectural Drawings, site measurements. Within One week of the award of the contract, contractor shall furnish, for the approval of the Construction Manager / Architect /Consultant, five sets of detailed shop drawings of all equipment and materials including layouts for Sewage Treatment Plant, Typical drawings showing exact location of supports, flanges, bends, tee connections, reducers, detailed piping drawings showing exact location and type of supports, valves, fittings etc; electrical panels inside / outside views, power and control wiring schematics, cable trays, supports and terminations. This shop drawing should contain the relevant IS annexure.

9.1 These shop drawings shall contain all information required to complete the Project as per specifications and as required by the Construction Manager / Architect / Consultant / Client's site representative. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings.

Each item of equipment/material proposed shall be a standard catalogue product of an established manufacturer conforming to the relevant codes.

When the Construction Manager / Architect /Consultant makes any amendments in the above drawings, the contractor shall supply two fresh sets of drawings with the amendments duly incorporated along with check prints, for approval. The contractor shall submit further ten sets of shop drawings to the Client's site representative for the exclusive use by the Client's site representative and all other agencies. No material or equipment may be delivered or installed at the job site until the contractor has in his possession, the approved shop drawing for the particular material / equipment / installation.

9.2 Shop drawings shall be submitted for approval four weeks in advance of planned delivery and installation of any material to allow Construction Manager / Architect / Consultant ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved program.

9.3 Manufacturers drawings, catalogues, pamphlets and other documents submitted for approval shall be in four sets. Each item in each set shall be properly labeled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause

number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.

9.4 Samples of all materials like valves, pipes, control wires etc shall be submitted to the Client's site representative prior to procurement. These will be submitted in two sets for approval and retention by Client's site representative and shall be kept in their site office for reference and verification till the completion of the Project. Wherever directed a mockup or sample installation shall be carried out for approval before proceeding for further installation.

9.5 Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supercede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract.

9.6 Where the contractor proposes to use an item of equipment, other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundation, piping, wiring or any other part of the mechanical, electrical or architectural layouts; all such re-design, and all new drawings and detailing required therefore, shall be prepared by the contractor at his own expense and gotten approved by the Construction Manager / Architect / Consultant / Client's site representative. Any delay on such account shall be at the cost of and consequence of the Contractor.

9.7 Where the work of the contractor has to be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the Client's site representative, the contractor shall prepare composite working drawings and sections at a suitable scale, not less than 1:50, clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordinating with other trades, or so as to cause any interference with work of other trades, he shall make all the necessary changes without extra cost to the Client.

9.8 Within one week of approval of all the relevant shop drawings, the contractor shall submit four copies of a comprehensive variation in quantity statement, and itemized price list of recommended (by manufacturers) imported and local spare parts and tools, covering all equipment and materials in this contract. The Construction Manager shall make recommendation to Client for acceptance of anticipated variation in contract amounts and also advise Client to initiate action for procurement of spare parts and tools at the completion of project.

10. QUIET OPERATION AND VIBRATION ISOLATION

The installation shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Client's site representative. In case of rotating machinery sound or vibration noticeable outside the room in which it is installed, or annoyingly noticeable inside its own room, shall be considered objectionable. Such conditions shall be corrected by the Contractor at his own expense. The contractor shall guarantee that the equipment installed shall maintain the specified Noise Control levels.

11. ACCESSIBILITY

The Contractor shall verify the sufficiency of the size of the shaft openings, clearances in cavity walls and suspended ceilings for proper installation of his piping and other ancillaries. His failure to communicate insufficiency of any of the above, shall constitute his acceptance of sufficiency of the same**.** The Contractor shall locate all equipment which must be serviced, operated or maintained in fully accessible positions. The exact location and size of all access panels, required for each concealed, valve or other devices requiring attendance, shall be finalized and communicated in sufficient time, to be provided in the normal course of work. Failing this, the Contractor shall make all the necessary repairs and changes at his own expense. Access panel shall be standardized for each piece of equipment / device / accessory and shall be clearly nomenclatured / marked.

12. MATERIALS AND EQUIPMENT

12.1 Quality

All materials and equipment used in work shall be new and of best available quality conforming to the relevant Indian Standard Specifications and to these specifications. Owners reserve the right to reject any item which in their assessment is second hand

12.2 Manufacturers Instruction

Where manufacturers have furnished specific instructions, relating to the materials used in this job, covering points not specifically mentioned in these documents, manufacturers' instructions shall be brought to the notice of the Owners / Architects for further instructions in the matter.

13. COMPLETION CERTIFICATE

On completion of the Electrical installation for STP works, a certificate shall be furnished by the contractor, counter signed by the licensed supervisor, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local authority.

The contractor shall be responsible for getting the entire electrical installation for Sewage Treatment Plant duly approved by the local authorities concerned, and shall bear expenses if any, in connection with the same.

14. BALANCING, TESTING AND COMMISSIONING

Balancing of all water systems and all tests as called for the Specifications shall be carried out by the contractor through a specialist group, in accordance with the Specifications and Manual on Sewage & Sewage Treatment – Published by CPHEEO Guide lines and Standards. Performance test shall consist of seven days of 10 hour each operation of system for each season. All the chemicals, sludge/cow dung etc. required for balancing period will be arranged by the contractor at their own cost. MSDS for the chemicals will be provided by the contractor before usages of chemical.

The installation shall be tested again after removal of defects and shall be commissioned only after approval by the Client's site representative. All tests shall be carried out in the presence of the representatives of the Construction Manager / Architect /Consultant and Client's site representative. After commissioning, the results shall be submitted for scrutiny in quadruplicate.

15. COMPLETION DRAWINGS

Contractor shall periodically submit completion drawings as and when work in all respects is completed in a particular area. These drawings shall be submitted in the form of two sets of CD's and four portfolios (300 x 450 mm) each containing complete set of drawings on approved scale indicating the work as - installed. These drawings shall clearly indicate the following:

15.1 Complete plant room layouts, piping layouts, location of all concealed piping, valves.

15.2 Complete wiring diagram, control diagram, as installed and scheduled showing all connections in the complete electrical system in the location.

15.3 Single line diagram, power schematic, control schematic with detailed bill of materials, showing makes, types and description of all components and accessories.

15.4 Sequencing of automatic controls and other services.

Each portfolio shall also contain technical literature on all controls. The contractor shall frame under glass, in the plant room, one set of these consolidated control and Prescribe & Instruction diagrams.

16. OPERATING INSTRUCTION & MAINTENANCE MANUAL

Upon completion and commissioning of part Sewage Treatment Plant the contractor shall submit a draft copy of comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the contractor shall submit four (4) complete bound sets of typewritten operating instructions and maintenance manuals; one each for retention by Consultant and Client's site representative and two for Clients Operating Personnel. These manuals shall also include basis of design, detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for 4 year period of maintenance of each equipment. These manuals shall include:

a. Description of the work carried out / installed.

b. Operating instructions.

c. Maintenance instructions including procedures for preventive maintenance.

d. Manufacturers catalogues.

e. Spare parts list.

f. Trouble shooting charts.

g. Drawings

h. Type and routine test certificates of major items.

Details of all the bought out item should be part of this maintenance manual.

17. ON SITE TRAINING

Upon completion of all work and all tests, the Contractor shall furnish necessary operators, labor and helpers for operating the entire installation for such periods so as to enable the Client's staff to get acquainted with the operation of the system. During this period, the contractor shall train the Client's personnel in the operation, adjustment and maintenance of all equipment installed**.**

18. MAINTENANCE DURING DEFECTS LIABILITY PERIOD

18.1 Complaints

The Contractor shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 10 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

18.2 Repairs

All equipment that requires repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free-of-charge to the Client. The defects liability period shall be two years.

19. UPTIME GUARANTEE

The contractor shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall get extended by a month for every month having shortfall and no reimbursement shall be made for the extended period.

20. PARTIAL ORDERING

Client through the Construction Manager / Architect /Consultant/ Client's site representative reserves the right to order equipment and material from any and all alternates, and /or to order high side and /or low side equipment and materials or parts thereof from one or more tenderers.

21. DEFECTS LIABILITY PERIOD

Defects liability period for the complete system shall be for a minimum of 24 Months from the date of commissioning or handover whichever is later.

22. LIST OF APPROVED MAKES

All materials shall adhere to IS codes and also satisfy all IGBC requirements for energy consumption and flow rates including all pumps being 5 star BE rated.

A P P E N D I X – I

LIST OF BUREAU OF INDIAN STANDARDS CODES

All equipment, supply, erection, testing and commissioning shall comply with the requirements of Indian Standards and code of practices given below as amended upto date. All equipment and material being supplied by the contractor shall meet the requirements of IS, Pollution Control Board, electrical inspectorate and Indian Electricity rules and other Codes / Publications as given below:

1. General

Manual on Sewage & Sewage Treatment	CPH EEO; Govt. of India.
SP : 6 (1)	Structural Steel Sections
IS : 325	Three Phase Induction Motors
IS : 554	Dimensions for pipe threads where pressure tight joints are required on the threads.
IS : 694	PVC insulated cables for working voltages upto & including 1100 V.
IS : 779	Specification for water meters (domestic type).
IS : 782	Specification for caulking load.
IS : 800	Code of practice for general construction in steel
IS : 1726	Specification for cast iron manhole covers and frames.
IS : 2379	Color code for identification of pipe lines.
IS : 2629	Recommended practice for hot dip galvanizing on iron and Steel.
IS : 3114	Code of practice for laying of cast iron pipes
IS : 4111 (Part 1)	Code of practice for ancillary structures in sewerage system : Part 1 manholes.
IS : 5329	Code of practice for sanitary pipe work above ground for buildings.
IS : 5455	Cast iron steps for manholes.
IS : 6159	Recommended practice for design and fabrication of material, prior to galvanizing.
IS : 8321	Glossary of terms applicable to plumbing work.
IS : 8419 (Part 1)	Requirements for water filtration equipment : Part 1 Filtration medium sand and gravel.
IS : 8419 (Part 2)	Requirements for water filtration equipment : Part 2 under drainage system.
IS : 10221	Code of practice for coating and wrapping of underground mild steel pipelines.
IS : 10446	Glossary of terms relating to water supply and sanitation.
IS : 11149	Rubber Gaskets

2. Pipes and Fittings

IS : 1239 (Part 1)	Mild steel, tubes, tubulars and other wrought steel fittings : Part 1 Mild Steel tubes.
IS : 1239 (Part 2)	Mild Steel tubes, tubulars and other wrought steel fittings : Part 2 Mild Steel tubulars and other wrought steel pipe fittings.
IS : 1536	Centrifugally cast (spun) iron pressure pipes for water, gas and Sewage.
IS : 1537	Vertically cast iron pressure pipes for water, gas and Sewage.
IS : 1538	Cast Iron fittings for pressure pipes for water, gas and Sewage.
IS : 1729	Sand Cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 1879	Malleable cast iron pipe fittings.
IS : 2643 (Part 1)	Dimensions for pipe threads for fastening purposes : Part 1 Basic profile and dimensions.
IS : 2643 (Part 2)	Dimensions for pipe threads for fastening purposes : Part 2 Tolerances.
IS : 2643 (Part 3)	Dimensions for pipe threads for fastening purposes : Part 3 Limits of sizes.
IS : 3468	Pipe nuts.
IS : 3589	Seamless or electrically welded steel pipes for water, gas and Sewage (168.3 mm to 2032 mm outside diameter).
IS : 3989	Centrifugally cast (sun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 4346	Specifications for washers for use with fittings for water services.
IS : 4711	Methods for sampling steel pipes, tubes and fittings.
IS : 6392	Steel pipe flanges
IS : 6418	Cast iron and malleable cast iron flanges for general engineering purposes.
IS : 7181	Specification for horizontally cast iron double flanged pipe for water, gas and Sewage.

3. Valves

IS : 778	Specification for copper alloy gage, globe and check valves for water works purposes.
IS : 780	Specification for sluice valves for water works purposes (50 mm to 300 mm size).
IS : 1703	Specification copper alloy float valves (horizontal plunger type) for water supply fittings.
IS : 2906	Specification for sluice valves for water works purposes (350 mm to 1200 mm size)
IS : 3950	Specification for surface boxes for sluice valves.
IS : 5312 (Part 1)	Specification for swing check type reflux (non return) valves : part 2 Multi door pattern.
IS : 5312 (Part 2)	Specification for swing check type reflux (non return) valves : part 2 Multi door pattern.
IS : 12992 (Part 1)	Safety relief valves, spring loaded : Design
IS : 13095	Butterfly valves for general purposes.

A P P E N D I X – II

SCHEDULE OF TECHNICAL DATA

1. SEWAGE PUMP & CLEAR WATER PUMP (Submit separate technical data sheet)

Pump	:
Make	:
Type & Model	:
Discharge in LPS/ GPM	:
Head (Meters of WC)	:
Shut off head (Meters of WC)	:
Efficiency (%)	:
No. of stages	:
Suction end I.D.	:
Delivery end I.D.	:
Details of N.P.S.H.	:
Solid Handling size.	:
Vibration Isolation Detail	:
Skid Details	:
Operating Weight	:
Overall Dimension	:
Mechanical Seal Detail	:
MATERIAL	:
Body	:
Impeller	:
Shaft	:
Type of Impeller	:
Is it suitable for direct coupling	:
MOTOR	:
Make	:
Model	:
Power Requirement (HP/KW)	:
R.P.M.	:
Rating	:
Over Load Capacity	:
Class of Insulation	:
Details of additional protection in winding	:
Motor efficiency	:
Sound Level	:
If it suitable for direct coupling to pump ?	:
Type of rotary movement	:
Method of starting	:

Size and type of cable for connections :

2. TERTIARY TREATMENT

2.1 FILTER FEED PUMPS

Pump

Make :

Type & Model :

Discharge in LPS/ GPM :

Head (Meters of WC) :

Shut off head (Meters of WC) :

Efficiency (%) :

No. of stages :

Suction end I.D. :

Delivery end I.D. :

Details of N.P.S.H. :

Vibration Isolation Detail :

Skid Details :

Operating Weight :

Overall Dimension :

Mechanical Seal Detail :

MATERIAL

Body :

Impeller :

Shaft :

Type of Impeller :

Is it suitable for direct coupling :

MOTOR :

Make :

Model :

Power Requirement (HP/KW) :

R.P.M. :

Rating :

Over Load Capacity :

Class of Insulation :

Details of additional protection in winding :

Sound Level :

If it suitable for direct coupling to pump ? :

Type of rotary movement :

Method of starting :

Size and type of cable for connections :

3. <u>FILTER (Submit separate data sheet for various types of filters)</u>

Material of Construction :

Diameter :

Height on straight :

Filtering media :

Shell thickness :

Dish end thickness :

Service flow rate :

Design pressure :

Back wash duration :

Back wash flow rate :

Pressure drop across the filter :

Maximum inlet turbidity (NTU) :

Turbidity in filtered water :

4. <u>CHLORINATION SYSTEM</u>

PUMP:

Pump model :

Pump Type :

Make :

Material of construction :

Flow rate :

TANK:

Capacity :

Material of Construction :

5. AIR BLOWER

Blower type	:
Service	:
Blower model	:
Flow Direction	:
Qty.	:
Operation	:
Capacity (fad)	:
Inlet Pressure	:
Differential Pressure	:
Sound Level	:
Power consumption	:
Motor rating	:
Inlet temperature	:
Outlet temperature	:
Power transmission	:
Specific gravity	:
Inlet & outlet size	:
Material of construction	:
Casing & End Cover	:
Rotors with integral shaft	:
Timing gears	:
Side plats, covers & pulley	:
Sealing	:

6. HYDRAULIC TYPE FILTER PRESS

Name of the Equipment	:
Type of Element	:
Mechanism	:
Drainage Surface	:
Type of Plate shifting	:
Size	:
No. of Plates	:
No. of Chambers	:
Wet Cake Holding Cap.	:
Operation Pressure (Bar)	:
Max. Operating Temp.	:
Bare Weight	:
Required Floor area	:

7. FINE BUBBLE DIFFUSER

Model	:
Shape of Aerator	:
Size of Bubble	:
Type of Bubble	:
Bubble Size	:
MOC of Membrane	:
Detail of Fittings per Aerator	:
MOC of Membrane Support	:
MOC of Clamp	:
MOC of End connector	:
Size of End connector	:
Temperature Tolerance	:
Effective Surface area of Membrane per aerator	:
Air flow through rate	:

8. COARSE BUBBLE DIFFUSER

Model	:
Shape of Aerator	:
Size of Bubble	:
Type of Bubble	:
Bubble Size	:
MOC of Membrane	:
Detail of Fittings per Aerator	:
MOC of Membrane Support	:
MOC of Clamp	:
MOC of End connector	:
Size of End connector	:
Temperature Tolerance	:
Effective Surface area of Membrane per aerator	:
Air flow through rate	:

9. HYDROPNEUMATIC PUMPS (VFD)

Pump

Make	:
Type & Model	:
Discharge in LPS / GPM	:
Head (Meters of WC)	:
Shut off Head (Meters of WC)	:
Efficiency (%)	:
No. of Stages	
Suction End I.D.	:
Delivery End I.D.	:
Details of N.P.S.H.	:
Vibration Isolation Detail	:
Skid Details	:
Operating Weight	:
Overall Dimension (MM)	:

Mechanical Seal Detail :

Material

Body :

Impeller :

Type of Impeller

Shaft :

Is it suitable for direct coupling :

Motor :

Make :

Model :

Power Requirement (HP / KW) :

R.P.M. :

Rating :

Over Load Capacity :

Class of Insulation :

Details of Additional protection in winding :

Motor Efficiency :

It it suitable for direct coupling to pump? :

Type of rotary movement :

Method of Starting :

Size and type of cable for connections. :

Number of variable frequency drive :

Detail of VFD :

Pressure Vessel

Make

Model Number

Material of construction (Vessel/Bladder)

Dimension

Overall capacity

Cut-in/Cut-out setting

Capacity at specified cut-in/cut-out

1. ELECTRICAL ACCESSORIES

Make of the following:

a.	Motor Control Centre (Electrical Panel)	:
b.	MCCB	:
c.	Motor	:
d.	MPCB	:
e.	MCB	:
f.	Rotary switch	:
g.	Soft Starter	:
h.	Timer	:
i.	Automatic Star Delta Starter	:
j.	Direct on line Starter	:
k.	Contactor	:
l.	Current Transformer (cast resin type)	:
m.	Single phase preventor	:
n.	Push Button	:
o.	Change over switch	:
p.	Ammeter & Voltmeter KWH meter	:
q.	Relay	:
r.	Indication lamp	:
s.	Cables	:
t.	Wires	:

TECHNICAL SPECIFICATIONS

SECTION-1: BASIS OF DESIGN

1. The capacity/ rating of pumps and equipment etc. shall hold good for the capacity as defined in the Schedule of Quantities and shall be good for meeting the treated parameters requirement as follows:

   a. Permissible limit as prescribed in IS:2490 (Part-I) - 1974 and environment (Protection) Rules 1986.

   b. Water (Prevention and Control of Pollution) Act, 1977 & 1978.

   c. Environment (Protection) Act, 1986.

   d. Environment (Protection) Rules, 1986.

   e. Hazardous Wastes (Management & Handling) Rules, 1989.

   f. Manufacturer, Storage and Import of Hazardous Chemicals Rules, 1989.

   g. Manufacturer use import and storage and hazardous Micro-Organizers, Genetically Engineered organizations or Cell Rules, 1989.

   h. Manual on Sewage & Sewage treatment - CPHEEO

   i. The Public Liability Insurance Act, 1991.

   j. All standards as laid down by Central Pollution Control Board and any other relevant statutory authority.

   k. 100% recycle of waste water and removal of sludge in cake from, no water to be discharged outside the premises.

SECTION-2 : SEWAGE TREATMENT PLANT (MBBR Based)

1. GENERAL

The Sewage Treatment Plant shall be compact, odour free and shall consume low power.

Plant shall be installed below ground level or at any desirable depth and shall generate minimum amount of excess sludge. Waste water after treatment below shall be suitable for irrigation and flushing water requirement.

Parameters for design of Sewage Treatment Plant:

Daily Average Flow	**80 cum/day**
Nature of Effluent	**Domestic Sewage**
pH	5.5 to 8.5
BOD5	200-250 mg/l
Suspended Solids	250-350 mg/l
COD	450 – 650 Mg / L
Oil & Grease	50 Mg / L
Coliform	< 10^6 – 10^7 (Assumed)
Total Nitrogen	< 35 PPM
T-Phosphorus	<10 PPM

Standards of the Effluent Discharge after treatment shall be as follows

Parameters	Value
pH	7.0 – 8.0
BOD5	Less than 10 Mg /L
Suspended Solids	Less than 10 Mg / L
COD	Less than 60 Mg / L
Oil & Grease	Less than 2 Mg / L
Coliform count	< 10^3 at the CCT outlet
Total Nitrogen	< 2 PPM
T-Phosphorus	<2 PPM
Hardness	<50 mg/l
Alkalinity (Calcium Carbonate)	200mg/l

2. PROCESS DESCRIPTION

The Sewage Treatment Plant (STP)

The Sewage Treatment Plant (STP) is envisaged as a state-of-the-art plant, based on an advanced biological treatment process followed by disinfection, so that the treated wastewater will be rendered safe for use in irrigation.

The sewage treatment plant is based on a Moving Bed Bioreactor (MBBR) of 12 KLD. It is incorporated as a compact packaged treatment process capable of BOD removal efficiency of 95-99%, ensuring treated sewage BOD5 <10mg/l and TSS <5mg/l.

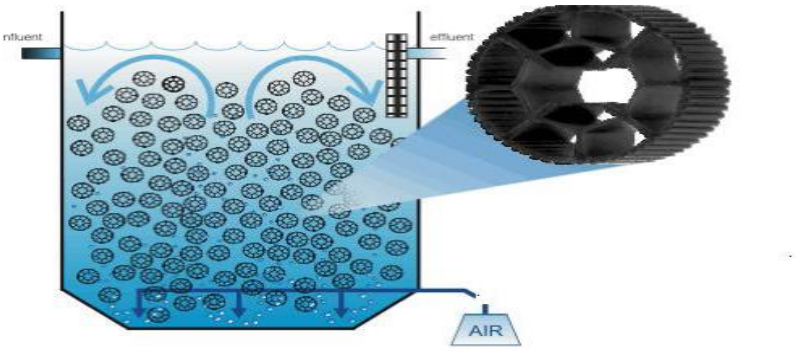
BRIEF OF TECHNOLOGY (MBBR)

Moving Bed Bio Reactor (An Advanced Biological Treatment Process)

The MBBR process is an attached growth aerobic biological treatment. It employs RING PAC MEDIA, neutrally buoyant biofilm carrier elements, achieving outstanding BOD/COD removal from a compact bioreactor.

Media provides a high surface-to-volume ratio, allowing a high concentration of biological growth within protected media. The process eliminates the need for activated sludge recycle and minimizes sludge production.

Fluidized Ring Pac media provides a highly oxygenated environment, leading to very high BOD reduction rates.



FEATURES AND BENEFITS OF MBBR TECHNOLOGY

FEATURES	BENEFITS
Attached Growth Process	No sludge recycle, No MLSS monitoring, Low sludge production
High Bio-Film Surface Area	High loading rates, Compact plants, Small footprint
Fluidized Bed	Non-clogging design, Better oxygen transfer, Reduced power consumption, Low maintenance

TREATMENT PROCESSES AND UNIT OPERATIONS

The sewage will be treated in three stages: **Primary Treatment, Secondary Treatment, and Tertiary Treatment (including disinfection).**

The STP shall be a compact, smell-free, low power consumption package.

PROCESS DESCRIPTION

After preliminary screening and oil removal, the sewage flows to the Equalization Tank.

Next, the sewage is transferred to an Anoxic Tank, designed for denitrification. In this tank, nitrate is biologically reduced to nitrogen gas by denitrifying bacteria under anoxic (oxygen-free) conditions. The tank is equipped with an agitator to maintain uniform mixing.

An Anoxic Recirculation System is provided to recycle part of the nitrate-rich mixed liquor from the MBBR outlet back to the anoxic tank, enhancing nitrate removal efficiency.

From the Anoxic Tank, sewage flows into the Moving Bed Bio Reactor (MBBR), promoting aerobic digestion of BOD and COD using fine bubble diffused aeration.

Post-biological treatment, sewage enters the Secondary Settling Tank equipped with tube deck media for solid-liquid separation.

The clarified sewage passes to the Chlorine Contact Tank for disinfection via hypochlorite dosing.

Following disinfection, water is collected into the UF Feed Tank ensuring buffer storage before ultrafiltration. The water undergoes filtration through Dual Media Filter, Activated Carbon Filter, Ultrafiltration System, and UV disinfection.

UNIT OPERATIONS

Primary Treatment:

- Screening
- Oil & Grease Removal
- Equalization

Secondary Treatment:

- Anoxic Tank with Agitator
- Anoxic Recirculation System
- MBBR Tanks
- Secondary Settling Tank
- Chlorine Contact Tank
- UF Feed Tank

Tertiary Treatment:

- Dual Media Filtration
- Activated Carbon Filtration
- Ultrafiltration
- UV Disinfection

SLUDGE DISPOSAL

Sludge from the Secondary Settling Tank is transferred to the Sludge Holding Tank. Part of it is recycled initially to the MBBR reactor for stabilization.

Further, sludge is dewatered using a Filter Press:

- Sludge is pumped into the filter press for solid-liquid separation.
- Filtrate is returned to the Equalization Tank.
- Dewatered sludge cake is collected for disposal or greenbelt use.

The filter press provides efficient volume reduction and improves housekeeping.

CONTROL PHILOSOPHY

The STP includes necessary automation with level controllers, auto-operation of pumps, manual control of tertiary systems, and safety features for trouble-free operations.

DESIGN PARAMETERS

Parameters	Inlet	Tertiary Outlet	Post UF Outlet
pH	6.5-8.5	6.5-8.5	6.5-8.5
COD (mg/l)	Up to 400	<150	<50
BOD (mg/l)	Up to 250	<30	<10
Suspended Solids (mg/l)	Up to 100	<100	<10
TDS (mg/l)	Up to 1000	1000	1000
Oil & Grease (mg/l)	Up to 20	<10	<10
Color	Objectionable	Unobjectionable	Unobjectionable

3. EQUIPMENT

The following give the minimum requirements of the different components of the system. The figures indicated are for contractor's references. It shall be the Contractor's responsibility to select equipment for the plant proposed by them so that the capacities and performance of the Sewage Treatment Plant meet with the criteria set out in this specification.

All equipment and components of the system shall be robust construction and shall be corrosion resistant.

3.1 Coarse Screening Equipment

Bar screen shall be of 304 stainless steel construction. Drip trays shall be provided for holding and drainage of the screenings. A manual by-pass screen of 30mm opening with stainless steel drip tray shall be provided. An isolation valve shall be provided to divert the flow to the by- pass screen when the screen requires service.

3.2 Air Blowers

Air blowers shall be provided in duplicate (i.e. one duty and one standby). Blowers shall be either of positive displacement or centrifugal with pressure vessel type complete with motor, base-plate, inlet filter, intake silencer and off-load starting system outlet silencer, anti-vibration damper, flexible coupling, filter restriction indicator, non-return valve, pressure relief valve, V-belt system or direct drive coupling. The casing rotor shall be of cast iron construction. Bearings and gears shall be grease lubricated. Motor speed shall be 1500 rpm.

The size and performance of the air blower shall be so selected that it can provide a minimum air flow rate 0.5 l /sec / diffuser to 1*l*/sec/diffuser maximum, and to maintain a minimum of 2.0mg/ℓ dissolved oxygen in the aeration tanks in operation.

3.3 Air Diffusers

Air diffusers shall be made to provide a uniform distribution of fine bubble air release performance in the system. The air diffuser shall be either made of elastomeric rubber membrane or composed of crystalline fused aluminum oxide with a suitable ceramic bonding material.

Membrane endurance shall be more than 180,000 expansion/contraction cycles.

Diffuser shall be of self-cleaning, non-clog disc or dome-shaped type. Oxygen transfer efficiency shall not be less than 20% at 3.5m submergence in clear water. Alternatives may be offered for consideration.

Diffuser hold down assemblies shall consist of a retainer bolt, a matching washer and gasket. Sealing gasket shall be composed of solid neoprene rubber and shall be conform to ASTM D-2000 and shall be suitable for withstanding the effects of wastewater high temperature up to 120°C.

The Contractor shall submit calculation to justify the diffuser selection and air requirement during the detailed design.

3.4 Sewage Pumps

Working and standby Sewage pumps shall be provided.

Each shall be of submersible type c/w guide base to facilitate case of removal, lift chain and automatic discharge connection. Pump casing and impeller shall be of cast iron material. Shaft shall be of stainless steel material.

3.5 Sludge Pumps

Two numbers of sludge transfer and disposal pumps (one duty and one standby) shall be provided.

Each shall be screw type and automatic discharge connection. The material construction shall be the same as the sewage pumps and feed to filter press for final disposal.

3.6 UV Treatment

UV unit shall be complete with reactor, cabinet housing, cabinet cooling, treatment chamber, electrical panel, temperature safety control, lamp out alert, UV radiometer along with UV monitoring system and UV monitoring readout panel. The UV Dosage should be > 60,000 uW – Sec / sq.cm. The lamps should be selected based upon the flow requirement of respective unit. The treated water after the secondary settling tank shall be passed through UV unit for disinfection purpose.

3.7 Tertiary Treatment

This tertiary treatment shall be provided for the sewage used for irrigation and flushing system.

The tertiary treatment plant shall comprise of the pressure sand filters and activated carbon filters. This shall be sized to accommodate 100% of the sewage discharge flow rate and shall achieve the performance as outlined and described in Design Criteria.

Details of the equipment layout proposal shall be submitted for review by the Construction Manager with tender documents.

3.8 Electrical Control

The operation of the treatment process shall be fully automatic.

A completely assembled and pre-wired control panel with mimic diagram consisting of weatherproof cabinet shall be furnished. The control panel shall contain all metering and status indicators, motor starters, program timbers, on-off-auto change-over switches and duty selectors for equipment.

Proper control sequence shall be designed according to system requirement and manufacturer standards,

3.9 Other Equipment

Any other necessary accessories, such as buffer, riser, scrum removal devices, partition, control panel, collection devices, etc. for all the tanks and pumps (where necessary) shall be provided in order to provide a fully working systems.

3.10 Piping Materials

SS 304	-	Submerged air piping
MS epoxy	-	Air piping and pumped effluent riser (Non submerged)
PVC piping	-	Pumped effluent (submerged) & tank overflow pipe line.
GI (Heavy)	-	Interconnecting pipe line after delivery header of pump / filter.
		Nut bolts should be of SS for all the equipments.

3.11 Valves

The Contractor shall supply and install all isolating valves and control valves as indicated on the drawings and as required for the proper and efficient operation and maintenance of the entire systems.

All valves supplied shall be suitable for the working pressure and test pressure of the system as specified elsewhere in this specification.

Regulating valves shall be of similar materials as that specified for cast iron gate valves.
All regulating valves shall be lock shield type.
All valves shall be full line size.

Each valve shall have a purpose made reference number plate for label engraved or stamped indicating the manufacturer's catalogue number, pressure and temperature ratings. Valves shall be arranged so that clockwise rotation of the spindle will close the valve.

Furnish all valves and accessory materials necessary in the piping whether or not shown on drawings as flows.

All valves shall be packed with an approved packing and threads shall be coated with oil and graphite. Packing should be replaced when found deteriorated on site.

Where possible locate all valves at convenient positions of operation from the floor with valve stems upright.

Valves that are flanged shall have flanges to the table specified for the pipe work.

Plastic or metal plates (rustless) shall be provided to indicate the open / close status as well as the use of each valve in the pump and tank rooms.

4. PIPE SUPPORTS

4.1 General Support

Tender drawings indicate schematically the size and location of pipes. The Contractor, on the award of the work, shall prepare detailed working drawings, showing the cross-sections, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air valves, and all pipe supports. He must keep in view the specific openings in buildings and other structure through which pipes are designed to pass.

Piping shall be properly supported on, or suspended from , on stands, clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchor, clamps and hangers, and be responsible for their structural stability.

Pipe work and fittings shall be supported by hangers or brackets so as to permit free expansion and contraction. Risers shall be supported at each floor with Galvanised steel clamps. To permit free movement of common piping support shall be from a common hanger bar fabricated from Galvanised steel sections.

Piping shall be supported from the building structure, which shall support the sum of the load of a water-filled pipe and a minimum of 120 kg applied at the point of hanging.

All piping brackets shall be constructed as shown on the standard detail drawings.

Vertical pipe work shall be supported at intervals of at least one per floor level.

Horizontal pipe work shall also be supported by adjustable flat iron or clevis type hangers hung by hot rolled steel rods of the following diameters and spacing subject to the Construction Manager / Architect's approval:

Nominal Pipe Size	Distance between Supports	Diameter of Rod
25 mm	1.8 m	10
32 mm	2.4 m	10
40 mm	2.7 m	10
50 mm	2.7 mm	10

65-80 mm	3.0 m	12
100 mm	3.0 m	16
150-200 mm	3.6 m	18

The end of the steel rods shall be threaded and not welded to threaded bolt.

Hangers shall be supported by means of approved fasteners. Wood plugs shall not be used. Unless allowed by the structural engineer, power fixings may be used for pipe work of diameter less than 50 mm. Expansion fasteners may be used for vertical pipe work under 100 mm diameter.

All pipe work shall be carried out in a proper workman like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation with other agencies work, so that area can be carried out in one stretch.

Requirement of Cut-outs in the structural slab or wall for installing the various pipes shall be clearly identified in the detailed shop drawing to be prepared by the STP contractor.

Pipe sleeves, larger diameter than pipes, shall be provided wherever pipes pass through walls and slab and annular space filled with fibreglass and finished with retainer rings.

The contractor shall make sure that the clamps, brackets, saddles and hangers provided for pipe supports are adequate or as specified / approved by Consultants. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required.

All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reduces shall be used for the piping to drain freely. In other locations, concentric reduces may be used.

Automatic air valves shall be provided at all high points in the piping system for venting. All valves shall be of 15mm pipe size and shall be associated with an equal size gate valves.

Discharge from the air valves shall be piped through a pipe to the nearest drain or sump. All pipes shall be pitched towards drain points.

Pressure gauges shall be provided as shown on the approved drawings. Care shall be taken to protect pressure gauges during pressure testing.

5. INSTALLATION

The Contractor shall check the associated civil work prior to the installation of any item of machinery and advise the Construction Manager, in writing, of any deviation of such work from the specified details.

The machinery shall be accurately installed to correct dimensions, alignments, levels, etc., all as indicated on the final drawings. The machinery shall be mounted on flat steel packing pieces of thickness suitable to take up variations in level of the concrete foundations. Suitable packing pieces shall be located adjacent to each holding down bolt and shall be properly bedded by grinding the concrete surface to a smooth, level finish. The machinery shall be aligned and leveled and the nuts of the holding down bolts tightened with a spanner of normal length. The base plates shall be packed with grout after the machinery has been run and checked by the Construction Manager for stability and vibration.

Installation shall include the provision and fixing of all necessary holding down bolts, washers, nuts etc.

The length of all bolts shall be such that when fitted with a nut and tightened the threaded portion of the bolts shall protrude from the top face of the nut by a distance not exceeding half the bolt diameter. Exposed bolt heads and nuts shall be hexagonal.

All equipment and materials of the same type shall be products of the same manufacturer. Locally made equipment will not be accepted unless otherwise specified.

All similar items of plant and their component part shall be completely interchangeable. Spare parts shall be manufactured from materials similar to the originals and shall fit all similar items of plant. Where machining may be needed before fitting renewable parts, the machining fits with their tolerance shall be shown on the drawings accompanying the instruction manuals.
All motors and/or revolving parts shall be truly balanced both statically and dynamically so that when running at normal speeds and any load up to the maximum there shall be no significant vibration due to lack of balance. All parts which can be worn or damaged by dust shall be totally enclosed in dust-proof housings.

6. MAINTENANCE FACILITIES

Permanent work platform and catwalk shall be designed by the Contractor and provided by the Contractor for access to elevated equipment. The catwalk and platform for access shall allow a minimum width of 750 mm.

Catwalk to maintenance platform shall be provided with railings and guards designed for safe movement of personnel in a restricted space including provision for gaining access and to accommodate maintenance personnel.

Hand railing and guards shall be designed by the Contractor and provided by the Contractor for all concrete tanks to allow safe movement of personnel.

Permanent I-beams, lifting eyes, etc. shall be provided by the Contractor over major equipment which requires lifting for overhaul and maintenance.

Waterproof power sockets required for servicing shall be provided by the Contractor. The number and locations shall be proposed by the Contractor and approved by the Construction Manager / Engineer. Power supply to these sockets shall be taken from control panel of the sewage treatment system.

The design of all permanent work platforms, hand rails, etc. shall be submitted to the Construction Manager / Client's representative for approval. The loading and fixing method of lifting facilitate shall also be submitted to the Construction Manager / Engineer for approval and checking within 4 weeks on award of Contract or receipt of letter of intent.

7. TESTING

The performance of the system shall be demonstrated by taking hourly samples of the raw sewage and final sewage over a twelve hour period. The sample shall be taken at periods approximately the flow rates specified by the plant. The sample shall be combined and a 5-day BOD shall be run, the results of which must verify the capacity of the treatment plant prior to acceptance.

8. TRAINING

Provided training facilities courses to ensure that the employer's staff associated with the project may acquire full knowledge and appreciation of all aspects of the design, day-to-day operation, breakdown and routine maintenance, and fault diagnosis of all plant, equipment and systems.

Training to the employer's staff shall be held as appropriate at the Contractor's or manufacturer's premises and on site. A detailed syllabus for each of the training courses specified or proposed and the timing of the courses shall be submitted for approval. The Contractor shall recommend the desirable qualifications and experience of the trainees to optimally benefit from the courses.

The Contractor shall be deemed to have include in his tender price the cost of providing training facilities as specified.

In addition to the above, the Contractor shall submit to the Construction Manager a list describing such other spares and special tools, their number, price and where appropriate the anticipated frequency of replacement as soon as is practicable.

SECTION-3: ELECTRICAL INSTALLATION

1. SCOPE

The scope of this section comprises of fabrication, supply, erection, testing and commissioning of Motor Control Centre (MCC), wiring and earthing of all Sewage Treatment Plant equipment, components and accessories.

2. GENERAL

Work shall be carried out in accordance with the accompanying specifications and shall comply with the latest relevant Indian Standards and Electricity Rules and Regulations.

All motor control centers shall be CPRI approved and shall be suitable for operation on 3 phase / single phase 415/230 volts, 50 cycles power supply system.

3. CONSTRUCTIONAL FEATURES

The Motor Control Centre (MCC) electrical panels shall be sheet steel cabinet for indoor installation, dead front, floor mounting/wall mounting type. The control panel shall be totally enclosed, completely dust and vermin proof and shall be with hinged doors with Neoprene gasket. Control panel shall be suitable for the climatic conditions as specified in Specifications. Steel sheets used in the construction of Control panel shall be 2 mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded, all welding, slag shall be rounded off and welding pits wiped smooth with plumber metal. The general construction shall confirm to relevant BIS Codes. Each panel should have padlocking facility to be available for each feeders/ isolaters. All PCC's and MCC's should conform to 3b construction.

All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with wing nuts. Self threading screws shall not be used in the construction of Control panels. A base channel of 75 mm x 40 mm x 5 mm thick shall be provided at the bottom for floor mounted panels. Minimum clearance of 275 mm shall be provided between the floor of control panel and the lowest unit.

The control panel shall be of adequate size with a provision of 25% spare space to accommodate possible future breakers. Breakers shall be arranged in multi-tier. Knockout holes of appropriate size and number shall be provided in the Motor Control Centre in conformity with the location of cable/conduit connections. Removable sheet steel plates shall be provided at the top to make holes for additional cable entry at site if required.

Every cabinet shall be provided with Trifoliate or engraved metal name plates. All panels shall be provided with circuit diagram mounted on inside of door shutter protected with Hylam sheet. All live accessible connections shall be shrouded and shall be finger touch proof and minimum clearance between phase and earth shall be 20 mm and phase to phase shall be 25 mm.

4. WIRING SYSTEM

All power cabling between MCC and motors shall be carried out with 1100 volts grade PVC insulated, overall PVC sheathed aluminum/Copper conductor armored cables, Cables shall be sized by applying proper derating factor. All control wiring shall be carried out by using PVC insulated copper conductor wires in conduits. Minimum size of control wiring shall be 2.5 sq mm. Minimum size of conductor for power wiring shall be 4 sq. mm 1100 volts grade PVC insulated copper conductor wires in conduit.

5. CIRCUIT COMPARTMENT

Each circuit breaker, contactor and relay shall be housed in a separate compartment and shall have steel sheets on top and bottom of compartment. Sheet steel hinged lockable door shall be duly interlocked with the breaker in the "ON" position. Safety interlocks shall be provided to prevent the breaker from being drawn-out when the breaker is in 'ON' position. The door shall not form an integral part of the draw-out portion of the panel. Sheet steel barriers shall be provided between the tiers in a vertical section.

6. INSTRUMENT ACCOMMODATION

Adequate space shall be provided for accommodating instruments, indicating lamps, control contactors and control MCBs. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker and bus bar `ON' lamps shall be provided on all outgoing feeders.

7. BUS BAR CONNECTIONS

Bus bar and interconnections shall be of high conductivity electrolytic aluminum complying with requirement of grade 91E of IS:5082-1981 and shall be of rectangular cross section suitable for carrying the rated full load current and short circuit current without overheating of phase and neutral bus bar and shall be extendable on either side. Bus bar and interconnections shall be insulated with heat shrinkable sleeve and shall be colour coded and shall be supported on glass fiber reinforced thermosetting plastic insulated supports at regular intervals to withstand the force arising from in case of short circuit in the system. All bus bar shall be provided in a separate chamber and all connections shall be done by bolting. Additional cross sectional area shall be added to the bus bar to compensate for the holes. All connections between bus bar and breaker shall be through solid aluminium strips of proper size to carry full rated current as per approved for construction shop drawing and insulated with insulating sleeves. Bus bar shall be rated for current density of 1.0 amps/mm^2 cross section area.

8. TEMPERATURE - RISE LIMIT

Unless otherwise specified, in the case of external surface of enclosures of bus bar trunking system which shall be accessible but do not need to be touched during normal operation, an increase in the temperature rise limits of 25° C above ambient temperature shall be permissible for metal surface and of 15° C above ambient temperature for insulating surfaces as per relevant Codes.

9. CABLE COMPARTMENTS

Cable compartment of adequate size shall be provided in the control panel for easy clamping of all incoming and outgoing cables entering from the top/bottom. Adequate supports shall be provided in cable compartment to support cables as per approved for construction shop drawing.

10. MOULDED CASE CIRCUIT BREAKER (MCCB)

All MCCB's shall be motor duty and Current Limiting type, and comprise of Quick Make - break switching mechanism, preferably Double Break Contact system, arc extinguishing device and the tripping unit shall be contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses. All MCCB's shall be capable of defined Variable overload adjustment. All MCCB's rated 200 Amps and above shall have adjustable Magnetic short circuit pick up.

The trip command shall override all other commands. MCCB shall employ maintenance free double break contact system to minimise the let thru' energies and capable of achieving discrimination upto full short circuit capacity of downstream MCCB. The manufacturer shall provide both discrimination tables and let thru energy curves. The breaking capacity of MCCB's shall be asked for in the schedule of quantities. The breaking capacities specified will be as per relevant codes.

The MCCB's shall be provided with rotary handle operating mechanism. The handle position shall give positive indication of 'ON', 'OFF' or 'Tripped' thus qualifying to Disconnection as per the IS/IEC indicating the true position of all the contacts. In case of 4 pole MCCB the neutral shall be defined and capable of offering protection.

11. MINIATURE CIRCUIT BREAKER (MCB)

Miniature Circuit Breaker shall comply with relevant IS Codes and shall be quick make and break type for 230/415 VAC 50 Hz application with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be less than 10 KA at 415 VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting type (Class-3). MCBs shall be classified (B,C,D ref IS standard) as per their Tripping Characteristic curves defined by the manufacturer. The MCB

shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values.

The housing shall be heat resistant and having high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection. All DP, TP and TPN miniature circuit breakers shall have a common trip bar independent to the external operating handle.

12. PAINTING

All sheet steel work shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphating, passivaiting (seven tank processing) and then painted with electrostatic paint (Powder coating). The shade of colour of panel inside/outside shall be as per relevant BIS code.

13. LABELS

Engraved PVC labels shall be provided on all incoming and outgoing feeder. Circuit diagram showing the arrangements of the circuit inside the control panel shall be pasted on inside of the panel door and covered with transparent plastic sheet.

14. METERS

i. All voltmeters and indicating lamps shall be through MCB's.
ii. Meters and indicating instruments shall be flush type.
iii. All CT's connection for meters shall be through Test Terminal Block (TTB).
iv. CT ratio and burdens shall be as per IS code and equipment rating for individual feeder wherever applicable a per standards.

15. CURRENT TRANSFORMERS

Current transformers shall be provided for Control panels carrying current in excess of 60 amps. All phase shall be provided with current transformers of suitable VA burden with 5 amps secondaries for operation of associated metering.

The CTs shall confirm to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitable to a terminal block which shall be easily accessible for testing and terminal connections.

16. SELECTOR SWITCH

Where called for, selector switches of rated capacity shall be provided in control panels, to give the choice of operating equipment in selective mode.

17. STARTERS

Each motor shall be provided with a starter of suitable rating. Starters shall be in accordance with relevant IS Codes. All Star Delta and DOL starters shall be fully automatic.

18. CONTACTOR

Contactor shall be built into a high strength thermoplastic body and shall be provided with an arc shield for quick arc extinguishing. Silver alloy tips shall be provided to ensure a high degree of reliability and endurance under continuous operation. The magnet system shall consist of laminated yoke and armature to ensure clean operation without hum or chatter.

Starters contactors shall have 3 main and 2 Nos. NO / NC auxiliary contacts and shall be air break type suitable for making and breaking contact at minimum power factor of 0.35. For design consideration of contactors the starting current of connected motor shall be assumed to be 6 times the full load current of the motor in case of direct-on-line starters and 3 times the full load current of the motor in case of Star Delta Starters. The insulation for contactor coils shall be of Class "E".

Coil shall be tape wound vacuum impregnated and shall be housed in a thermostatic bobbin, suitable for tropical conditions and shall withstand voltage fluctuations. Coil shall be suitable for 220/415±10% volts AC, 50 cycles AC supply.

19. THERMAL OVERLOAD RELAY

Thermal over load relay shall have built in phase failure sensitive tripping mechanism to prevent against single phasing as well as on overloading. The relay shall operate on the differential system of protection to safeguard against three phase overload, single phasing and unbalanced voltage conditions.

Auto-manual conversion facility shall be provided to convert from auto-reset mode to manual-reset mode and vice-versa at site. Ambient temperature compensation shall be provided for variation in ambient temperature from -5° C to +55°C.

All overload relays shall be of three elements, positive acting ambient temperature compensated time lagged thermal over load relays with adjustable setting. Relays shall be directly connected for motors upto 35 HP capacity. C.T. operated relays shall be provided for motors above 35 HP capacity.

20. TIME DELAY RELAYS

Time delay relays shall be adjustable type with time delay adjustment from 0-180 seconds and shall have one set of auxiliary contacts for indicating lamp connection.

21. INDICATING LAMP AND METERING

The meters shall be flush mounted type. The indicating lamp shall be of low wattage. Each MCC and control panel shall be provided with voltmeter 0-500 volts with three way and off selector switch, CT operated ammeter of suitable range with three nos. CTS of suitable ratio with three way and off selector switch, phase indicating lamps, and other indicating lamps as called for. Each phase indicating lamp shall be backed up with MCB.

22. TOGGLE SWITCH

Toggle switches, where called for in Schedule of Quantities, shall be in conformity with relevant IS Codes and shall be of 5 amps rating.

23. PUSH BUTTON STATIONS

Push button stations shall be provided for manual starting and stopping of motors / equipment Green and Red colour push buttons shall be provided for 'Starting' and 'Stopping' operations. 'Start' or 'Stop' indicating flaps shall be provided for push buttons. Push Buttons shall be suitable for panel mounting and accessible from front without opening door, Lock lever shall be provided for 'Stop' push buttons. The push button contacts shall be suitable for 6 amps current capacity.

24. CONDUITS

Conduits and Accessories shall conform to relevant Indian Standards. Wall thickness shall be 16 gauge upto 32 mm dia and 14 gauge above 32 mm dia conduit. Screwed GI conduits shall be used. Joints between conduits and accessories shall be securely made, to ensure earth continuity. All conduit accessories shall be threaded type only. All raw metal shall be painted with bitumastic paint.

Only approved make of conduits and accessories shall be used.

Conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of the manufacturer.

Maximum permissible number of 650/1100 volt grade PVC insulated wires that may be drawn into rigid nonmetallic or GI Conduits are given below:

Size of wires Nominal Cross Section Area (Sq. mm.)	Maximum number of wires within conduit size(mm)				
	20	25	32	40	50
1.5	5	10	14	--	--
2.5	5	8	12	--	--
4	3	7	10	--	--
6	2	5	8	--	--
10	--	3	5	6	--
16	--	2	3	--	6
25	--	--	2	4	6
35	--	--	--	3	5

25. CABLES

MV Cables shall be PVC insulated copper conductor and armoured cables conforming to IS Codes. Cables shall be armoured and suitable for laying in trenches, ducts, and on cable trays as required. M.V. Cables shall be termite resistant. Cable glands shall be double compression glands with earthing facility. Control cables and indicating panel cables shall be multi core PVC insulated copper conductor and armoured cables.

Power cabling shall be of the following sizes:

i. Upto 5 HP motors 3 x 4 sq. mm copper conductor cable.

ii. From 6 HP to 10 HP motors 3 x 6 sq. mm copper conductor cable.

iii. From 12.5 HP to 15 HP wires 2 No. 3 x 6 sq. mm copper conductor cable.

iv. From 20 HP to 25 HP motors 2 No. 3 x 10 sq. mm copper conductor cable.

The minimum size of control wiring shall be 1.5 sq. mm PVC insulated stranded soft drawn copper conductor wires drawn through conduit to be provided for connecting equipment and control panels.

All the switches, contactors, push button stations, indicating lamps shall be distinctly marked with a small description of the service installed. The following capacity contactors and overload relays shall be provided for different capacity motors or as per manufacturer's recommendation.

	TYPE OF STARTER	CONTACTOR CURRENTCAPACITY	OVERLOAD RELAY RANGE
5 HP Motors	D O L	16 amps	6-10 amps
7.5 HP motors	Star Delta	16 amps	9-15 amps
10 HP Motors	Star Delta	25 amps	9-15 amps
12.5 HP Motors	Star Delta	16 amps	9-15 amps
15 HP Motors	Star Delta	25 amps	9-15 amps
20 HP Motors	Star Delta	32 amps	14-23 amps
25 HP Motors	Star Delta	32 amps	14-23 amps

Two speed motors when specified, shall be provided with DOL starter irrespective of it rating.

26. CABLE LAYING

Cable shall be laid in accordance with IS code of Practice. Cables shall be laid on 14 gage factory fabricated perforated galvanized sheet steel cable trays, and cable drops / risers shall be fixed to ladder type cable trays factory fabricated out of galvanized steel angle. Access to all cables shall be provided to allow cable withdrawal / replacement in the future. Where more than one cable is

running on a cable tray, one dia spacing shall be provided between cables to minimise the loss in current carrying capacity. Cables shall be suitably supported with Galvanized saddles when run on walls / trays. When buried, they shall be laid in 350 mm wide and 750 mm deep trench and shall be covered with 250 mm thick layer of soft sifted sand & protected with bricks/tiles. Special care shall be taken to ensure that the cables are not damaged at bends. The radius of bend of the cables when installed shall not be less than 12 times the diameter of cable.

Allowable specification of cable tray:

Width: 150mm, 300mm, 450mm, 600mm. Height: 100mm. Length: 2500mm.

27. EARTHING

Earthing shall be provided in accordance with relevant BIS Codes and shall be copper strips / wires. The main panel shall be connected to main earthing system of the power supply. All single phase metal clad switches and control panels be earthed with minimum 3 mm diameter copper conductor wire. All 3 phase motors and equipment shall be earthed with 2 numbers distinct and independent copper wires / tapes as follows:

i.	Motor upto and including 10 HP rating.	2 Nos. 3 mm dia copper wires.
ii.	Motor 12.5 HP to 40 HP capacity	2 Nos. 4 mm dia copper wires

All switches shall be earthed with two numbers distinct and independent copper wires' tapes as follows:

i.	3 phase switches and control panels upto 60 amps rating.	2 nos. 3 mm dia copper wires.
ii.	3 phase switches, and control panels 63 amps to 100 amps rating.	2 Nos. 4 mm dia copper wires.
iii.	3 phase switches and control Panels 125 amps to 200 amps rating.	2 Nos. 6 mm dia copper wires.

The earthing connections shall be tapped off from the main earthing of electrical installation. The overlapping in earthing strips at joints where required shall be minimum 75mm. These straight joints shall be riveted with brass rivets & brazed in approved manner. Suitable lugs of adequate capacity and size shall be used for all termination of wires. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substance, and properly tinned. Earthing should not be connected to base bolts of motor or terminal block covers. Door earthing should be provided in control panel.

28. TESTING

Before commissioning of the equipment, the entire electrical installation shall be tested in accordance with relevant BIS codes and test report furnished by a qualified and authorized person. The entire electrical installation shall be gotten approved by Electrical Inspector and a certificate from Electrical Inspector shall be submitted. All tests shall be carried out in the presence of Construction Manager.

29. MEASUREMENT OF ELECTRICAL CONTROL PANELS

Panels shall be counted as number of units. Quoted rates shall include as lumpsum (NOT measurable lengths) for all internal wiring, power wiring and earthing connections from the control panel to the starter and to the motor, control wiring for interlocking, power and control wiring for automatic and safety controls, and control wiring for remote start/stop as well as indication as per the specifications. The quoted rate of panel shall also include all accessories, switchgear, contactors, indicating meters and lights as per the Specifications and Schedule of Quantities.

30. RUBBER MAT

1100 Volt grade and IS approved rubber mat shall be provided in front to cover the full length of all panels. Where back space is provided for working from the rear of the panel, rubber mat shall also be provided to cover the full length of panel.

SECTION-4 : BIO DIGESTER

1. GENERAL

The Bio-Digester shall be compact & odour free and shall consume no power.

Bio-digester shall be installed below ground level and shall generate minimum amount of excess sludge. Waste water after treatment below shall be suitable for irrigation and flushing water requirement.

2. Design Parameters:

- C/N ratio 20 to 30,
- Hydraulic retention time 1 to 30 days,
- PH 6.5 to 8,
- Temperature 15 to 45°C,
- mixing ratio 10 to 20 %.
- Acti-zyme loading suitable 3 m3/day.

SECTION-5 : TESTING, COMMISSIONING AND HAND OVER

1. GENERAL

The entire works included in this Contract shall be fully tested in stages as the work proceeds and on completion of work as applicable.

The Contractor shall provide during normal working hours, all necessary labours, instruments, equipment, materials, fuel, power and manufacturer's representatives, to carry out such tests as may be necessary to satisfy the Construction Manager / Architect that the installation meets the requirement and intent of the Specification as well as such tests required by Local Authorities.

All tests shall be made in the presence of the Construction Manager / Consultant/ Client's representative or any inspecting authority. At least seven working days' notice in writing shall be given to the inspecting parties before performing any test.

Three copies of all test results shall be submitted to the Construction Manager in A4 size sheet paper within two weeks after completion of the tests.

Tests described hereinafter and including all tests prescribed by the Authority having jurisdiction shall be carried out. Any tests proved unsatisfactory shall be repeated to the satisfaction of the inspecting parties.

The Contractor shall provide skilled technicians/engineer to commission the plant and associated controls to the satisfaction of the Construction Manager / Consultant/ Client's representative. The technicians/ engineers will be required to demonstrate the correct procedures in starting and stopping the plant, running the various items of equipment under automatic and manual control and the correct maintenance of the plant.

Water flow rates of all equipment shall be adjusted to design conditions. Complete results of adjustments shall be recorded and submitted.

2. FACTORY TESTS

Main Switchboard

The following tests shall be performed in the presence of the Construction Manager / Consultant/ Client's representative:

- Inspection of switchboard including wiring, electrical and mechanical connections;
- Mechanical tests;
- Primary and secondary injection tests to commission and calibrate all measuring, protection and control circuits and associated components;
- Continuity and dielectric tests;
- Power frequency and pressure test;
- Functional check of all control wiring.

Valves, Cocks and Fittings

Type-Test' and approval certificate for pressure test and compliance with the regulations laid down by the local Water Authority / Construction Manager / Consultant / Client's representative.

3. ON-SITE TESTING AND COMMISSIONING

Two months prior to completion of the Contract Works, the Contractor shall liaise with the Main Contractor and the Electrical Contractors and submit for the Construction Manager / Consultant/ Client's representative approval a detailed programme for conducting on-site acceptance tests and commissioning.

The Contractor shall start up, operate, test and adjust the systems in accordance with the agreed programme. The setting shall be supervised by the manufacturer's representative, who shall remain on site until the equipment is operating satisfactorily and accepted by the Construction Manager / Architect. The Contractor shall advise and co-ordinate with the manufacturer's representatives so that all testing is carried out according to the agreed programme.

The whole installation shall be given the following tests to bring the systems into running order. The Construction Manager / Consultant/ Client's representative shall be given reasonable notice together with a copy of recorded test results, generally not less than seven (7) days, regarding the nature of tests, the time and location. Acceptance tests will only be witnessed by the Construction Manager / Consultant/ Client's representative when the submitted tests results are found satisfactorily.

All instruments, tools, material and labour required to perform these tests shall be provided by this Contractor.

Before the tests are carried out, the Contractor shall remove connected equipment and components which are liable to damage under test, and shall provide and fix all the necessary gauges, blanking flanges, etc.

Prior to the system start-up, the following inspection, tests and pre-commissioning treatment shall be carried out by the Contractor:

a. Tanks and Level Switches

Check sides and edges of sectional tanks for distortion. The tanks shall be thoroughly cleaned with water and drained before sewage supply will feed in.

Also before sewage supply will feed in, the level switch shall be simulated for the various cut-in and cut-out settings.

b. Pressure Switches

The testing equipment arrangement for pressure switches and pressure gauges shall be as shown on the drawings or of an approved equivalent.

The pressure gauges to be tested shall be connected as shown on the drawing in lieu of the pressure switch. The gauges to be tested shall be regarded acceptable when the pressure readings of all three gauges are the same throughout the jacking pressure range varied by applying the hand pump.

c. Hydrostatic Tests

All parts of the water circuit shall be filled with water before hydrostatic pressure testing, and pump running tests for verification of pressure and flow rate, are conducted.

The hand jacking pump shall be applied to increase the system pressure to 2 times the working pressure or 1.5 times the working pressure plus 3.5 bar whichever is the lower but in any case not less than 7 bar. The pressure shall be maintained for a period not less than 24 hours.

Where any section of pipe work or equipment is found to be unable to withstand the maximum pipe work test pressure, it shall be isolated during the pipe work test then that section of pipe work or equipment shall be made good and re-tested at the appropriate test pressure.

The working pressure for various systems shall be as shown on the drawings.

d. House drains shall be hydrostatically tested to a water head of 1.2 m at the high end and not more than 2.4 at the low end and shall show no appreciable loss of water after elapse of two hours.

In every test, water used shall be left in the pipes until they are covered with earth or other trench filling material to a depth of at least 1 m over the top of pipes and until permission is given by the Construction Manager / Consultant/ Client's representative for the water to be released. If after the Construction Manager / Consultant/ Client's representative has approved the sewer or pipeline and has given permission for the trenches to be refilled the pipes become damaged and loses water from any cause and/or admit subsoil water, the Contractor shall uncover the pipes and make good the defect made good and the pipes retested as before and all at the Contractor's expense.

e. Cleaning, Flushing and Pre-Treatment

Prior to start-up and hydraulic testing, the Contractor shall clean the entire installation including all fitments and pipework and the like after installation and keep them in a new condition. All pumping systems shall be flushed and drained at least once through to get rid of contaminating materials. All pipes shall be rodded to ensure clearance of debris, cleaning and flushing shall be carried out in sections as the installation becomes completed. All strainers shall be inspected and cleaned out or replaced.

When the entire systems are reasonably clean, a pre-treatment chemical shall be introduced and circulated for at least 8 hours. Warning signs shall be provided at all outlets during pre-treatment. The pre-treatment chemical shall:

- Remove oil, grease and foreign residue from the pipework and fittings;
- Pre-condition the metal surfaces to resist reaction with water or air;
- Establish an initial protective film;
- After pre-treatment, the system shall be drained and refilled with fresh water and left until the system is put into operation.
- Details and procedures of the pre-treatment shall be submitted to the Construction Manager / Consultant/ Client's representative for approval.

f. Electrical Tests

Electrical tests shall comply with the current edition of IEEE regulations and requirements enforced by Local Authorities.

Electrical insulation tests shall apply to busbars, isolators and other equipment and wiring where applicable. A 500V DC instrument shall be used to check the insulation resistance. The reading shall not be less than 50 mega-ohms in all instances.

Function simulation tests shall be performed to ensure that the systems have been installed to the control requirements as described in the Specification therein.

g. Pump Drives

The direct coupling of the pump drives shall be dismantled before the pump motor control panel is energized.

The Contractor shall demonstrate to the Construction Manager/ Consultant/ Client's representative of acceptable clearances of the coupling alignment for ensuring satisfactory power transmission.

The coupling shall not be re-mated again till the correct motor rotation has been demonstrated with power drawn from the energized pump motor control panel.

h. Pump Operating Test

The Contractor shall ensure to the satisfaction of the Construction Manager / Consultant/ Client's representative that the installation or portion thereof which has been set to work complies with all requirements including the following:

That the plant and apparatus shall be of robust construction and of capacity for the duty specified.

That all valves, switches, controls and the like are properly regulated and capable of proper operation and in the case of valves are capable of being shut-off.

That all apparatus shall be silent.

That all instruments are correctly calibrated and read accurately.

That all services are tested in accordance with the details of the relevant clauses of this Specification.

4. STATUTORY AUTHORITIES' TESTS AND INSPECTIONS

As and when notified in writing or instructed by the Construction Manager / Consultant/ Client's representative , the Contractor shall submit shop drawing and attend all tests and inspections carried out by Local Pollution Control Board Authorities, Water Authority and other Statutory Authorities, and shall forthwith execute free of charge any rectification work ordered by the Construction Manager / Consultant/ Client's representative as a result of such tests and inspections where these indicate non-compliance with Statutory Regulations. Some of these tests may take place after the issue of Practical Completion of the Main Contract and the Contractor shall make all allowances in this respect.

The Contractor shall be responsible for the submission of all necessary forms and shop drawings to the Statutory Authorities which shall conform in layout to the latest architectural plans submitted to and kept by these Authorities.

The submission shall comply with the requirements set forth in the current Codes of Practice and circular letters of the Statutory Authorities. The shop drawings to be submitted shall be forwarded to the Construction Manager / Consultant/ Client's representative for checking before submission. The Contractor shall allow for at least two submissions of complete sets of shop drawings to the Authorities, one to be made within four months after the award of the Contract but not less than six weeks before the inspection. The Construction Manager / Consultant/ Client's representative may at his discretion instruct the Contractor for additional submissions to the Local Authorities whenever necessary.

The Contractor shall notify the Construction Manager / Consultant/ Client's representative at least seven days in advance of his application for local Authority tests and inspections. On receipt of a confirmed date for test and inspection the Contractor shall inform the Construction Manager / Consultant/ Client's representative without delay.

5. PRELIMINARY COMMISSIONING CHECKS

Ensure that all equipment is thoroughly cleaned, lubricated and checked for serviceability before setting to work. Particular attention is drawn to the removal of building debris from the pipe work systems.

Special attention is drawn to the need for thoroughly flushing out all pipe work systems to ensure that all foreign matter is removed.

All automatic controls and safety devices shall be inspected and checked for service ability before the working fluid or electricity is applied to the system.

6. COMMISSIONING

When the various installations have been completed and the preliminary commissioning checks carried out, the Contractor shall set to work, regulate and calibrate all system in the entire installation. Special attention shall be paid to the following items:

That all valves, switches, controls, etc. are regulated and capable of proper operation and in the case of isolation valves that they are capable of tight shut off.

That all apparatus is silent in accordance with the requirements of this Specification.

That all instruments are correctly calibrated and read accurately.

That all services are tested in accordance with the details in the relevant clauses of this Specification.

Operate pumps, pressure reducing sets, etc. to ensure that all control systems are functioning correctly and are properly set, sequenced or interlocked.

7. FINAL ACCEPTANCE TESTS

Following commissioning and inspection of the entire installation, and prior to issue of the Completion Certificate, the Contractor shall carry out final acceptance tests in accordance with a programme to be agreed with the Construction Manager / Consultant / Client's representative.

Should the results of the acceptance tests show that plant, systems and/or equipment fail to perform to the efficiencies or other performance figures as given in this Specification, the Contractor shall adjust, modify and if necessary replace the equipment without further payment in order that the required performance is obtained.

Where acceptance tests are required by the relevant Authorities having jurisdiction, these tests shall be carried out by the Contractor prior to the issue of Completion Certificate to the acceptance of the Authorities.

8. REJECTION OF PLANT

Any item of plant or system or component which fails to comply with the requirements of this Specification in any respect whatsoever at any stage of manufacture, test, erection or on completion at site may be rejected by the Construction Manager / Consultant / Client's representative either in whole or in part as he considers necessary/appropriate. Adjustment and/or modification work as required by the Construction Manager / Consultant / Client's representative so as to comply with the Authority's requirements and the intent of the Specification shall be carried out by the Contractor at his own expense and to the satisfaction of the Authority / Construction Manager / Consultant/ Client's representative.

After works have been accepted, the Contractor may be required to carry out assist in carrying out additional performance tests as reasonably required by the Construction Manager / Client's representative / Consultant.

9. HANDING OVER OF DOCUMENTS

All testing and commissioning shall be done by the Contractor to the entire satisfaction of the Construction Manager and all testing and commissioning documents shall be handed over to the Construction Manager.

The Contractor shall also hand over all maintenance and operation manuals, all certificates and all other documentation as per the terms of the contract to the Construction Manager.

ANNEXURE C : MEP SPECIFICATIONS

PART 7 : STACKED PARKING

Data Sheet Wöhr Combilift 542-2,0

Suitable for condominium and office buildings.
For permanent use only!*

* In case of short time user (e.g. for offices, hotels, a.s.o.) technical adjustments are required. Please contact WÖHR!

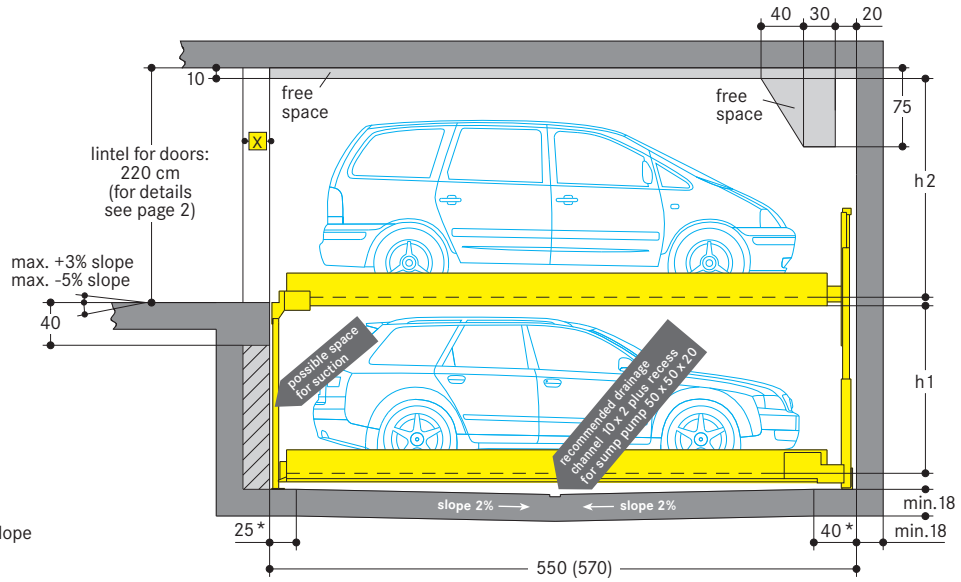
Platforms are in horizontal position to drive on.

Load per platform max. 2000 kg (load per wheel max. 500 kg)

Special reinforced units for higher platform loadings are available (see 542-2,6).

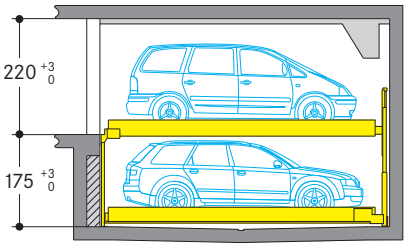
X = Door offset (see page 2 for details)

Dimensions



* in this zone, 0% of downward/upward slope in longitudinal and cross direction

Standard type 542 · 2000 kg

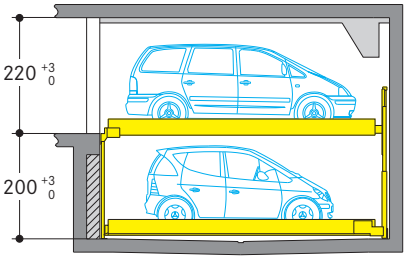


	car height	distance
EL*	saloon cars/vans up to 200 cm and max. 2000 kg	h2 = 205
LL*	saloon/estate cars up to 150 cm	h1 = 155

* EL = entrance level, LL = lower level

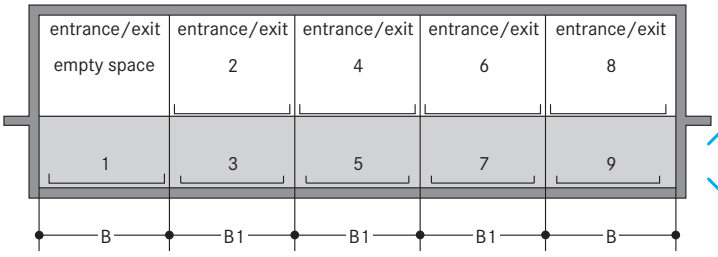
Please attend to restricted car heights on lower platforms!

Comfort type 542 · 2000 kg



	Fahrzeughöhe	Abstand
EL	saloon cars/vans up to 200 cm and max. 2000 kg	h2 = 205
LL	saloon/estate cars up to 175 cm	h1 = 180

Width dimensions



Space required B	Space required B1	gives clear platform width
260	250	230
270	260	240
280	270	250
290	280	260
300	290	270

One entry/exit is required on entrance level for each grid.

Notes

1. Pits must always be protected by a sliding shutterdoor (even in underground garages).
2. Arrangements start with 2 grids for 3 cars, 3 grids for 5 cars.
3. Car length max. 500 cm with an installation length of 540 cm, car width 190 cm. In case of special platform widths narrower than 230 cm respectively, the maximum vehicle width is reduced accordingly.
4. For very large cars an installation length of. 570 cm is recommended. This length offers larger safety distances for potential future developments or projects with short term parkers such as hotels or similar.
5. It is not possible to have channels or undercuts and/or concrete haunches along the pit floor-to-wall joints. In the event that channels or undercuts are necessary, the system width needs to be reduced or the pit needs to be wider.
6. The manufacturer reserves the right to modify or alter above specifications.

Wohr Parking Systems Pvt. Ltd.
Gat No.1098, Urawade Road, Pirangut,
Tal. Mulshi, Dist. Pune - 412 115
Maharashtra, India +91 206 674 8848
www.wohrparking.in

Doors

According EN 14010, the Combilift 542 must be closed with shutterdoors. The door controls are integrated in the overall system. That means:

a) The doors are electro-mechanically interlocked

b) The doors can only be opened when the selected parking place has reached the entry/exit position

c) Any pits are closed in the entrance area

Local requirements for electrical doors in respect to technology, maintenance, revision are not subject of our supply, which are according to European standard

Door types:

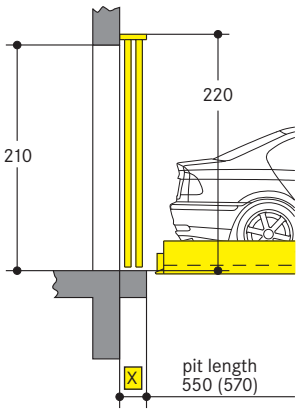
Manually operated sliding shutterdoors

- for underground garages in galvanised steel
- above ground with powder coated metal sheets (RAL 7030)

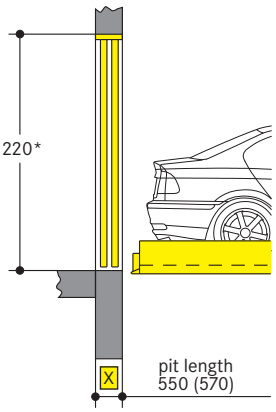
Alternatively, sliding shutterdoors may be supplied with electrical drive.

Installation:
Behind the building pillars with door offset

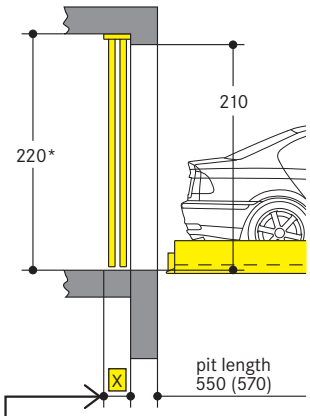
Section



Installation:
Below the lintel between the building pillars



Installation:
In front of the building pillars

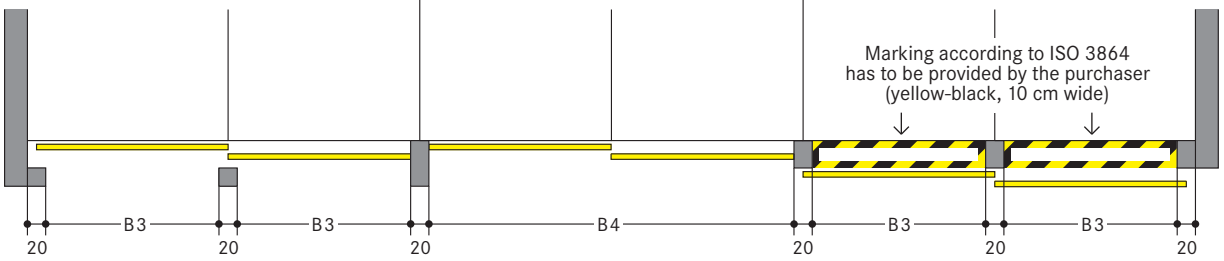


With installation in front of the pillars, the driving aisle is measured from the door.

X = 25 cm for manually operated sliding shutterdoors

X = 35 cm for automatic shutterdoors

Ground plan



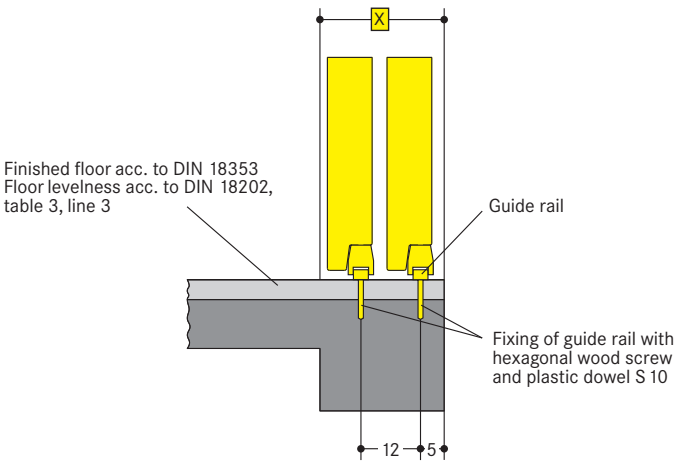
* The lintel of 220 cm is absolutely necessary. If differing heights additional fixings are required at additional charge. If no lintel is provided, the gates need to be fitted onto a steel frame (subject to surcharges).

Space required B3	Space required B4	Gives clear platform width
230	480	230
240	500	240
250	520	250
260	540	260
270	560	270

Floor guide for sliding shutterdoors

Floor levelness in door guide range must be conformity with DIN 18202, table 3, line 3.

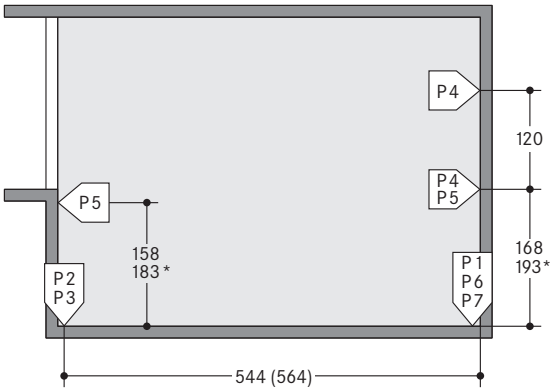
Hole depth for dowels approx. 8 cm.
Remark: When screed is applied in the door area to obtain floor levelness, the hole depth should be increased by screed thickness (max. 40 mm).



Width dimensions and statics

All dimensions shown are minimum. Constructional tolerances must be taken into consideration. **All dimensions in cm.**

Section



( ) dimensions in brackets for longer units

* dimensions for comfort type

P1 = +42,0 kN [1)]
P2 = +29,0 kN
P3 = +15,0 kN
P4 = ± 5,0 kN
P5 = ± 2,5 kN
P6 = ±15,0 kN
P7 = ± 8,0 kN

[1)] all static loadings include the weight of the car

Bearing loads are transmitted by wall plates with min. 30 cm² surface and to the floor by base plates with min. 350 cm² surface.

Wall and base plates will be fixed by heavy duty anchor bolts to a drilling depth of 10-12cm. When fixing to the waterproof concrete floors chemical anchors are employed (to be advised by Wöhr).

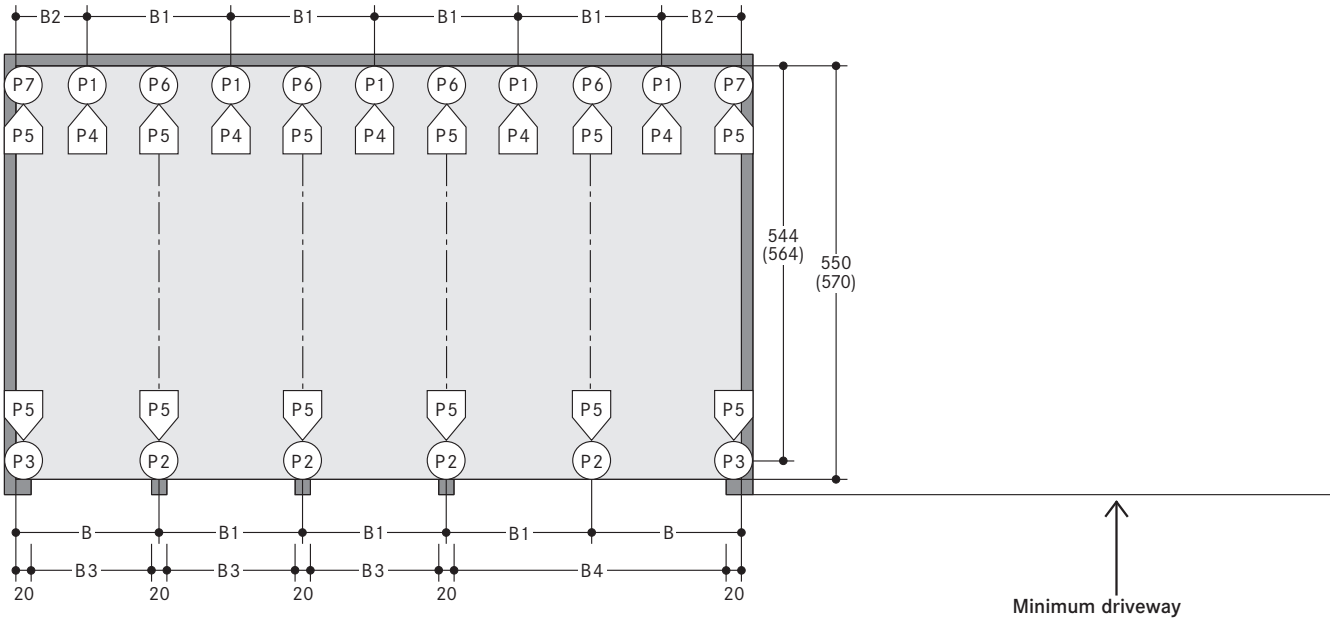
Base plate thickness min. 18 cm. Rear wall and base plate must be formed of concrete and must have a flat surface without protrusions.

Concrete quality according to the static requirements of the building, but for the dowel fastening we require a concrete quality of min. C20/25.

The specified lengths to the support points are mean values. Please contact Wöhr Agent for exact positions for any variations on the standard units.

Please contact Wöhr Agent for clarify the door widths/widths of columns. Grid width of 250 / 260 / 270 / 280 / 290 cm must be observed.

Ground plan



Space required					gives clear
B	B1	B2	B3	B4	platform width
260	250	135	230	480	230
270	260	140	240	500	240
280	270	145	250	520	250
290	280	150	260	540	260
300	290	155	270	560	270

Notice:

If the width of the pillars is more than 20 cm, than the width of the drive through will be reduced accordingly to the above mentioned width dimensions. In order to avoid this we recommend to extend the measures between the pillars (B3 and B4) accordingly. Please contact WÖHR.

Combilift 542-2.0 | 01.2019 | © Wohr Parking Systems Pvt. Ltd.

Hydraulic power packs

For the accommodation of the hydraulic power packs an additional space is required which will be determined during the verifications of the drawings, e.g. in a wall recess.
Dimensions:
length = 100 cm
height = 140 cm
depth = 35 cm

Electrical data

Main electrical supply 230/400V, 50 Hz, 3 phase. Power consumption 1.5/3.0 kW. Fuse or automatic circuitbreaker 3 x 16 A slow blow acc. to DIN VDE 0100 p. 430 and main supply line 5 x 2,5 mm² to the switch cabinet, provided by client. In compliance with the DIN EN 60204 standard provisions, all systems must be connected directly on site with an earthed equipotential bonding. The lead-out connection must be at a 10 m distance!

Switch cabinet

1. Main switch is installed well accessible at driveway in a height of 160 cm to 190 cm.
2. The switch cabinet must be installed visible and near by the system. Area for installation has to be provided by the client. The size of the switch cabinet is 80 x 110 x 21 cm.
3. The wall opening of 15 cm diameter is required between the switch cabinet and the system itself. Please contact Wöhr Agent to clarify.
4. The control is designed to operate between +5° and +40°C. Atmospheric Humidity: 50% at +40°C. If the local circumstances differ from the above please contact Wöhr (if necessary, the switch cabinet has to be provided with a heating).
5. If the system is installed outside the switch cabinet needs to be inside a sun-/water-/wind proof box. In front of the switch cabinet an area of 100 cm is required to work.

General product information

The entrance level parking place row has one place less than the lower level. This empty space always stays on entrance floor level.
The platforms at the entrance floor level are shifted sideways by one space so that the empty space is above the lower level platform to be raised.
This movement is initiated automatically when the desired place is selected via keyboard.

Hotel garage

If used by hotel guests, the installation requires special planning and construction. Please ask for details.

Noise protection

Basis is the German DIN 4109 “Noise protection in buildings”.

With the following conditions required 30 dB (A) in rooms can be provided:

- noise protection package from our accessory
- insulation figure of the construction of min. R'_W = 57 dB
- walls which are bordering the parking systems must be done as single wall and deflection resistant with min. m’= 300 kg/m²
- solid ceiling above the parking systems with min. m’= 400 kg/m²

At differing constructional conditions additional sound absorbing measures are necessary.

The best results are reached by separated sole plates from the construction.

Increased noise protection:

If increased noise protection must be provided planning has to be confirmed on a project basis by Wöhr (further building measures are required).

Temperature

The installation is designed to operate between +5°and +40°C. Atmospheric Humidity: 50% at +40°C. If the local circumstances differ from the above please contact Wöhr.

Numbering of the parking spaces

1. The empty space of the Combilift is always on the left in the entrance level.
2. The numbering is as follows:

EG		2	4	6	8
UG	1	3	5	7	9

3. The numbering for each system starts with 1 as above.
4. Different numbering of parking spaces is possible at extra cost (software changes are necessary).

Illumination

Illumination has to be considered acc. to local requirements by client.

Free spaces

Special drawings for free spaces to accommodate air ducts or other pipes can be requested at Wöhr Agent!

Railings

If walkways are arranged directly to the side or behind the systems, railings have to be provided by client acc. to local requirements, height min. 200 cm – this is applicable during the construction phase too.

Drainage

We recommend providing gutter in the pit centre and connecting the gutter either to a gully or a drainage pit 50 x 50 x 20 cm. If the pump sump is not accessible for manual drainage, the client must provide a pump on site to empty the pump sump. Lateral slope only within the gutter.

To prevent hazards for the ground water, we recommend giving the pit floor an oil-resistant coating as a means of protecting the environment.
If this is to be connected to the sewage system, it is advisable to provide oil and/or petrol seperators.

Maintenance

Regular maintenance by qualified personnel can be provided by means of an Annual Service Contract.

Protection against corrosion

Independent of a maintenance workings has to be carried out acc. to Wöhr Cleaning and Maintenance Instruction regularly.

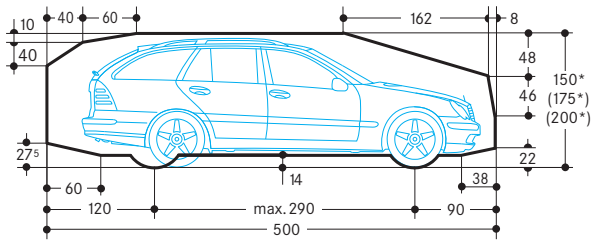
Clean up galvanized parts and platforms of dirt and road salt as well as other pollution (corrosion danger)!

Pit must be always ventilated and dearated well.

Dimensions

All dimensions shown are minimum. Construction tolerances must be taken into consideration. All dimensions in cm.

Clearance profile (standard saloon/estate car)



* The total car height includes roof rail and antenna fixture and must not exceed the mentioned max. height dimension.

Notes

We recommend providing wiring conduits leading to operating panels, particularly in above-ground garages.

The wiring conduits should placed 120 cm above entrance level in a support in the middle of the area.

Combilift 542-2.0 | 01.2019 | © Wohr Parking Systems Pvt. Ltd.