TECHNICAL SPECIFICATION

VOLUME – 2

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TECHNICAL SPECIFICATIONS

GENERAL

i. The detailed specifications given hereinafter are for the items of works described in the schedule of quantities attached herein & shall be guidance for proper execution of work to the required standards.

ii. It may also be noted that the specification are of generalized nature & these shall be read in conjunction with the description of item in schedule of quantities & drawings. The work also includes all minor details of construction which are obviously & fairly intended & which may not have been referred to in these documents but are essential for the entire completion in accordance with standard Engineering practice.

iii. Unless specifically otherwise mentioned, all the applicable codes & standards published by the Indian standard Institution & all other standard which may be published by them before the date of receipt of tenders, shall govern in all respects of dosing workmanship quality & propitious of materials & methods of testing, method of measurements etc. Wherever any reference to any Indian Standard specifications occurs in the documents relating to this contract, the same shall be inclusive of all amendments issued to or revisions thereof, if any, up to the date of receipt of tenders.

iv. In case there is no I.S.I specification for the particular work, such work shall be carried out in accordance with the instructions in all respects, & requirements of the Engineers-in-Charge. Wherever any reference to any Indian standard specification occurs in the documents relating to this contract, the same shall be inclusive of all amendment issued there to or revisions thereof, if any, up to the date of receipt of tenders.

v. The work shall be carried out in a manner complying in all respects with the requirements of relevant bye-laws of the Municipal Committee/Municipal Corporation/Development Authority/Improvement Trust under the jurisdiction of which the work is to be executed or as directed by the Engineer-in-Charge and, unless otherwise mentioned, nothing extra shall be paid on this account.

vi. Samples of various materials, fitting etc. proposed to be incorporated in the work shall be submitted by the contractor for approval of the Engineers-in-Charge before order for bulk supply is placed.

vii. The contractor shall take instructions from the Engineer-in-Charge regarding collection and stacking of materials in any place. No excavated earth or building materials shall be stacked on areas where other buildings, roads, services, compound walls etc. are to be constructed.

viii. The contractor shall maintain in perfect condition all works executed till the completion of the entire work allotted to him. Where phased delivery is contemplated, this provision shall apply to each Phase.

ix. The contractor shall give a performance test of the entire installation(s) as per standard specifications before the work is finally accepted & nothing extra whatsoever shall be payable to the contractor for the test.

x. The contractor shall clear the site thoroughly of all scaffolding materials & rubbish etc. left out of his work & dress the site around the building to the satisfactions & his decision in writing shall be final & binding on all concerned.

xi. **Post construction inspection and testing:** After completion of the work and during maintenance period liability of the contractor, the work shall also be subjected to 'Post construction inspection and testing'. In case the materials or articles incorporated in the work are found to be inferior, though the sample collected for the same might have been passed at the time of execution, it shall be the responsibility of the contractor to replace the same at his own cost, failing which the Department may rectify the same at the risk and cost of the contractor or Department may

accept the work as sub-standard, and cost be adjusted from the outstanding security deposit, as per the terms and conditions of the contract for the work.

xii. The Dean (I.P.S.), shall be the sole deciding authority as to the meaning, interpretations and implications for various provisions of the specifications and his decision in writing shall be final and binding on all concerned.

xiii. In case any different or discrepancy between the specification & the description in the schedule of quantities, the schedule of quantities shall take precedence. In case of any difference or discrepancy between specification & drawing, the specification shall take precedence.

II – LIST OF INDIAN STANDARDS::

Following are the various pertinent Indian Standards, relevant to buildings work :

(All Latest Versions of I.S. codes shall be referred)

I. S. CODE NO.	S U B J E C T
SECTION "B" – ELECTRICAL WORKS	
IS : 374	Ceiling fans and regulators (3rd revision)
IS : 694	PVC insulated Electric cable for working voltage upto and including 1100 volts.
IS : 732	Code of practice for electrical wiring and installation
IS : 1293	Three pin plugs and sockets outlets rated voltage upto and including 250 volts and rated current upto and including 160 amps.
IS : 1554 (Part - I)	PVC insulated (Heavy Duty) electric cables for working voltages upto and including 1100 volts.
IS : 1646	Electrical installation fire safety of buildings (general) Code of practice.
IS : 1885	Glossary of items for electrical cables and conductors
IS : 1913	General and safety requirements for fluorescent lamps luminaries Tubular.
IS : 2309	Protection of building and allied structures against lightning
IS : 2551-	Danger notice plate.
IS : 3043	Code of practice for earthing.
IS : 3427	AC Metal enclosed switch gear and control gear for rated voltages above 1 KV and upto and including 52 KV.
IS : 3480	Flexible steel conduits for electrical wiring.
IS : 3837	Accessories for rigid steel conduit for electrical wiring.
IS : 4146	Application guide for voltage transformers
IS : 4615	Switch socket outlets.
IS : 5133 (Part -I)	Boxes for the enclosure of electrical accessories.
IS : 5216 (Part-I)	Guide for safety procedures and practices in electrical work.
IS : 5424	Rubber mats for electrical purposes.
IS : 5578 & 11353	Marking and arrangement of bus bars
IS : 8130	Conductors for insulated electric cables and flexible cords
IS : 8828	Miniature Circuit Breakers
IS : 9537	Rigid Steel Conduits for electrical wiring (Second Revisions)
IS : 10810	Methods of test for cables.

IS : 12640	Earth Leakage Circuit Breakers
IS : 13947	Moulded Case Circuit Breakers
IS : 13947	Degree of protection provided by enclosures for LV switchgear and control gear.
IS : 13947	General requirement for switchgear and control gear for voltage not exceeding 1000 Volts.
IS : 15652	Insulating materials for electrical purposes.
IS : 1651 & 1652	Stationary cells and batteries lead acid type.

I. S. CODE NO.	**Reaffirmation**	**Subject**
SECTION "C" – PUBLIC HEALTH WORKS		
27 -1992	**Reaffirmed 2002**	Specifications for Pig Lead
269-1989	**Reaffirmed 2004**	Specifications for 33 grade Ordinary Portland Cement
407-1981	**Reaffirmed 2001**	Brass tubes for General purposes
456-2000	-	Code of practice for Plain & Reinforced concrete.
458-2003	-	Specifications for Concrete Pipes.
554-1999	**-**	Dimensions for pipe thread where pressure tight joints are required.
636-1988	**Reaffirmed 2003**	Fire fightinghose ,rubber lined or fabric reinforced rubber lined woven –jacketed
638-1979	**Reaffirmed 2003**	Sheet rubber jointing & rubber insertion jointing
651-1992	**Reaffirmed 2003**	Specifications for Salt glazed stoneware pipes & fittings.
771 (Pt. I &VII)		**Glazed Fire Clay Sanitary Appliances.**
771-1979 (Pt. I)	**Reaffirmed 2003**	General requirements
771-1985 (Pt. II)	**Reaffirmed 2003**	Specific requirements of kitchen & laboratory sinks
771-1979 (Pt. III/ Sec 1)	**Reaffirmed 2003**	Specific requirements of urinals (section 1-Slab urinals)
771-1985 (Pt. III/ Sec2)	**Reaffirmed 2000**	Specific requirements of urinals (section 2-Stall urinals)
771-1979 (Pt. IV)	**Reaffirmed 2003**	Specific requirements of postmortem slabs.
771-1979 (Pt. V)	**Reaffirmed 2003**	Specific requirements of shower trays
771-1979 (Pt. VI)	**Reaffirmed 2003**	Specific requirements of bed pan sinks
771-1981 (Pt. VII)	**Reaffirmed 2003**	Specific requirements of slop sinks
774-1984	**Reaffirmed 2000**	Flushing cistern for water closet and urinals.
775-1970	**Reaffirmed 2000**	Cast iron brackets and supports for wash basin and sink.
778-1984	**Reaffirmed 2000**	Specifications for copper alloy gate & Globe check valves for water works
779-1994	**Reaffirmed 2004**	Water meters (domestic type)
781-1984	**Reaffirmed 2001**	Specifications for cast copper alloy screw down bib taps & stop cocks for water services

782-1978	**Reaffirmed 2003**	Specification for Caulking lead.
783-1985	**Reaffirmed 2001**	Code of practice for laying concrete pipes.
784-2001	**Reaffirmed 2002**	Pre-stressed concrete pipes.
884-1985	**Reaffirmed 2000**	Fire aid hose reel for fire fighting (for fixed installation)
901 -1988	**Reaffirmed 2003**	Specification for couplings, double males & double female, instantaneous pattern for Fire Fighting
902 -1992	**-**	Specification for suction hose couplings for Fire Fighting purposes.
903 -1993	**Reaffirmed 2003**	Couplings for fire hose delivery, branch pipe, nozzles specification
904 -1983	**Reaffirmed 2000**	Specification for 2 way and 3 way suction collecting heads for Fire Fighting purposes.
905 -1980	**Reaffirmed 2002**	Specification for delivery breechings, dividing and collecting instan-taneous pattern for Fire Fighting
906 -1988	**Reaffirmed 2000**	Specification for revolving branch pipe for Fire Fighting
907 -1984	**Reaffirmed 2000**	Specification for suction strainer, cyclindrical type for Fire Fighting purposes.
908-1975	**Reaffirmed 2000**	Fire Hydrants, Stand post type
909-1992	**Reaffirmed 2002**	Specifications for underground fire hydrants, sluice valve type
940 -1989	**-**	Portable Fire Extinguisher, water Type (Gas Cartridge) - Specification
941-1985	**Reaffirmed 2000**	Specification for Blower and Exhauster for Fire Fighting.
1172-1993	**Reaffirmed 2002**	Code of basic requirements for water supply, drainage and sanitation
1200-1979 (Pt. 16)	**Reaffirmed 2002**	Method of measurements for Laying of water and sewer lines including appurtenant items.
1200-1981 (Pt. 19)	**Reaffirmed 2002**	Method of measurements for Water supply, plumbing and drains.
1230		Specifications for CI Rain Water pipes
1239-2004 (Pt I)		Specifications for Mild steel tubes
1239-1992 (Pt. II)	**Reaffirmed 2002**	Specifications for Mild steel Tubular & other wrought steel pipe fittings
1300-1994	**Reaffirmed 2000**	Phenolic moulding material specification
1536-2001	**-**	Specifications for Centrifugally cast iron (spun) pressure pipes for water, gas and sewage
1537-1976	**Reaffirmed 2000**	Specifications for Vertically cast iron pressure pipes for water, gas and sewage
1538-1993	**Reaffirmed 1999**	Cast iron fittings for pressure pipes for water, gas and sewage
1700-1973	**Reaffirmed 2003**	Drinking fountains
1701-1960	**Reaffirmed 2003**	Combination valve , mixing valves
1703-2000		Ball valve (horizontal plunger type) including floats for water supply.
1711-1984	**Reaffirmed 2000**	Self closing taps.

1726-1991	**Reaffirmed 2003**	Cast iron manhole covers and Frames.
1729-2002	**-**	Cast /ductile iron drainage pipes & fittings for over ground NP pipeline S/S series.
1742-1983	**Reaffirmed 2002**	Code of practice for building drainage
1795-1982	**Reaffirmed 2000**	Pillar taps for water supply purposes
1879		Malleable Cast Iron Pipe Fittings
1978-1982	**Reaffirmed 2002**	Specification for line pipe (M S Seamless)
1979-1985	**Reaffirmed 2002**	Specification for high test line pipe
2065-1983	**Reaffirmed 2001**	Code of practice for water supply in buildings.
2097 -1983	**Reaffirmed 2000**	Specification for foam making branch pipe.
2104-1981	**Reaffirmed 2003**	Water meter boxes (domestic type)
2171 – 1999	**-**	Specification for portable fire extinguisher, dry powder (Cartridge Type)
2190-1992	**Reaffirmed 2002**	Code of practice for selection ,installation& maintenance of portable first-aid fire extinguishers
2267-1995	**Reaffirmed 2000**	Polystyrene moulding and extension materials – specification
2326-1987	**Reaffirmed 2003**	Automatic flushing cistern for urinals
2373		Specification for Water Meter (Bulk type)
2379-1990	**Reaffirmed 2000**	Colour code for identification of pipe lines.
2401-1973	**Reaffirmed 2003**	Code of practice for selection, installation & maintenance of domestic water meters
2470 (Pt. I to II)	**-**	Code of practice for installation of septic tanks
2470-1985 (Pt. I)	**Reaffirmed 2001**	Design criteria & construction
2470-1985 (Pt. II)	**Reaffirmed 2001**	Secondary Treatment & disposal of septic tank effluent
2527-1984	**Reaffirmed 2000**	Code of practice for fixing rain water gutters and down pipes for roof drainage.
2546 -1974	**Reaffirmed 2000**	Specification for galvanized Mild Steel Fire bucket.
2548-1996(Pt. I)	**Reaffirmed 2002**	Plastic water closet seats and covers.
2548-1996(Pt. II)	**Reaffirmed 2002**	Plastic water closet seats and covers.
2556 (Pt. 1 to XV)	**-**	Specification for Vitreous (Vitreous China) sanitary appliances.
2556-1994 (Pt.1)	**Reaffirmed 2004**	General requirements
2556-1994 (Pt.2)	**Reaffirmed 1999**	Specific requirements of wash down water-closets
2556-2004 (Pt.3)	**-**	Specific requirements of squatting pans
2556-2004 (Pt. 4)	**-**	Specific requirements of wash basins
2556-1994 (Pt.5)	**Reaffirmed 2004**	Specific requirements of laboratory sinks
2556-1995(Pt.6)	**Reaffirmed 2003**	Specific requirements of urinals & partition plate
2556-1995 (Pt.7)	**Reaffirmed 2003**	Specific requirements of accessories for sanitary appliances

2556-1995 (Pt.8)	**Reaffirmed 1998**	Specific requirements of pedestal close coupled & wash down and siphonic water closets
2556-2004 (Pt.9)	**-**	Specific requirements of pedestal type bidets
2692-1989	**Reaffirmed 2003**	Specification for Ferrules for water services.
2800-1991 (Pt. I)		Construction of tube well
2800-1979 (Pt. II)		Testing of tube well
2871-1983	**Reaffirmed 2000**	Specification for Branch pipe, universal, for fire fighting purposes
2878 -2004	**-**	Fire Extinguisher, Carbon Dioxide Type (Portable and Trolley Mounted) – Specification.
2951 (Pt. I to II)	**-**	Recommendation for estimate of flow of liquids in closed conduits.
2951-1965 (Pt. I)	**Reaffirmed 2003**	Head loss in straight pipes due to frictional resistance
2951-1965 (Pt. II)	**Reaffirmed 2003**	Head loss in valves & fittings.
3006-1979	**Reaffirmed 2003**	Specification for Chemically resistant glazed S.W. pipes and Fitting
3076-1985	**Reaffirmed 2003**	Low density polyethylene pipes for potable water supply
3114-1994	**Reaffirmed 2004**	Code of practice for laying of Cast Iron pipes.
3311-1979	**Reaffirmed 2003**	Waste plug & its accessories for sinks & wash basins.
3328-1993	**Reaffirmed 2003**	Quality tolerances for water for swimming pools
3389-1994	**Reaffirmed 2000**	Urea formaldehyde moulding materials
3486-1966	**Reaffirmed 2000**	Specification for Cast iron spigot and socket drain pipes
3489-1985	**Reaffirmed 2000**	Specifications for enameled steel bath tubs
3589-2001	**-**	Specifications for steel pipes for water & sewage (168.3 to 2540 mm outside dia.)
3597-1998	**-**	Method of test for concrete pipes.
3844-1989	**Reaffirmed 2000**	Code of practice for installation and maintenance of internal fire hydrants Hose Reels in premises.
3950-1979	**Reaffirmed 2003**	Specification for Surface boxes for sluice valve.
3989-1984	**Reaffirmed 2000**	Centrifugally cast (spun) iron spigot and socket soil, waste and ventilating pipes, fittings & accessories.
4038-1986	**Reaffirmed 2000**	Foot valves for water works purposes.
4111 (Pt. I to V)		Code of practice for ancillary structures in sewage system.
4111-1986 (Pt. I)	**Reaffirmed 2001**	Manholes
4111-1985 (Pt. II)	**Reaffirmed 2001**	Flushing tanks
4111-1985 (Pt. III)	**Reaffirmed 2001**	Inverted syphon
4111-1968 (Pt. IV)	**Reaffirmed 2001**	Pumping stations & pumping mains (rising mains)
4111-1993 (Pt. V)	**Reaffirmed 2004**	Tidal out-falls
4120-1967	**Reaffirmed 2000**	Tubs and baths.

4127-1983	**Reaffirmed 2001**	Code of practice of laying of glazed stone ware pipes.
4308 -2003	**-**	Dry Chemical Powder for Fighting B & C class Fires– Specification.
4350-1967	**Reaffirmed 2001**	Specification for concrete porous pipes for under drainage.
4733-1972	**Reaffirmed 1992**	Methods of sampling &test for sewageeffluents
4736-1986	**Reaffirmed 2001**	Specificationfor hot–dipzinccoatingonmild steel tubes.
4854 (Pt. I to III)		Glossary terms for valves and their parts
4854-1969 (Pt. I)	**Reaffirmed 1999**	Screw down stop, check & gate valves & their parts
4854-1968 (Pt. II)	**Reaffirmed 1999**	Plug valves & cocks & their parts
4854-1974 (Pt. III)	**Reaffirmed 1999**	Butterfly valves
4927-1992	**Reaffirmed 2002**	Unlined flax canvass hose for fire fighting
4947 -1985	**Reaffirmed 2000**	Specification for gas cartridge for use in Fire extinguishers.
4984-1995	**Reaffirmed 2002**	Specifications for HDPE pipes for water supply
4985-2000	**-**	Specifications for unplasticised PVC pipes for potable water supplies
5290-1993	**Reaffirmed 2003**	Specifications for Landing valves.
5312 (Pt. I)		Swing check type reflux (non return) valves
5312-1984 (Pt. I)	**Reaffirmed 2000**	Reflux (non return) valves – single door pattern
5329-1983	**Reaffirmed 2001**	Code of Practice for sanitary pipe work above ground for building
5330-1984	**Reaffirmed 2000**	Criteria for design for anchor blocks for penstocks with expansions joints.
5382-1985	**Reaffirmed 2003**	Specifications for rubber sealing rings for water, gas & sewer mains
5455-1969	**Reaffirmed 2003**	Cast iron steps for manholes
5600-2002	**-**	Specifications for Sewage and drainage pumps
5611-1987	**Reaffirmed 2002**	Code of Practice for waste stabilization ponds (Facultative type)
5714-1981	**Reaffirmed 2002**	Specifications for Hydrant stand-pipe for fire fighting
5822-1994	**Reaffirmed 2004**	Code of Practice for laying of welded steel pipes for water supply
5961-1970	**Reaffirmed 2003**	Specifications for Cast Iron grating for drainage purposes
6234 -2003	**-**	Portable fire Extinguisher water Type (Stored Pressure) – Specification.
6279-1971	**Reaffirmed 2001**	Equipment for grit removal
6280-1971	**Reaffirmed 2001**	Sewage screens
6295-1986	**Reaffirmed 2001**	COP for water supply & drainage in high altitude & / or subzero region
6392-1971	**Reaffirmed 1998**	Steel pipe flanges
6411-1985	**Reaffirmed 2000**	Specifications for gel coated glass fiber reinforced polyester resin bath tubs
6418-1971	**Reaffirmed 2000**	Cast Iron & malleable flanges for general engg. Purpose
6494-1988	**Reaffirmed 2000**	COP for water proofing of under ground water tanks & swimming

		pools
6587-1987	**Reaffirmed 2003**	Specifications for Spun hemp yarn
7181-1986	**Reaffirmed 2000**	Horizontally Cast Iron Double Flanged pipe for water, gas & sewage.
7231-1994	**Reaffirmed 2004**	Specifications for Plastic Flushing Cisterns for w.c.& urinals
7558-1974	**Reaffirmed 2001**	Code of Practice for domestic hot water installations
7634 (Pt. I to III)		Code of Practice for Plastic pipe work for potable water supplies
7634-1975 (Pt. I)	**Reaffirmed 2002**	Choice of materials & general recommendations
7634-1975 (Pt. II)	**Reaffirmed 2002**	Laying & jointing polyethylene (PE) pipes
7634-2003 (Pt. III)	**-**	Laying & jointing unplasticised PVC pipes
7740-1985	**Reaffirmed 2001**	Code of Practice for road gullies
7834 (Pt. I to VIII)		Injection moulded PVC socket fittings with solvent cement joints for water supplies
7834 -1987(Pt.I)	**Reaffirmed 2003**	General requirements
7834-1987 (Pt.II)	**Reaffirmed 2003**	Specific requirements for 45 0 elbows
7834-1987 (Pt. III)	**Reaffirmed 2003**	Specific requirements for 90 0 elbows
7834-1987 (Pt. IV)	**Reaffirmed 2003**	Specific requirements for 90 0 tees
7834-1987(Pt.V)	**Reaffirmed 2003**	Specific requirements for 45 0 tees
7834-1987 (Pt. VI)	**Reaffirmed 2003**	Specific requirements for sockets
7834-1987(Pt. VII)	**Reaffirmed 2003**	Specific requirements for unions
7834-1987 (Pt. VIII)	**Reaffirmed 2003**	Specific requirements for caps
8008 (Pt. I to VII)		Injection moulded HDPE fittings for potable water supplies
8008-2003 (Pt. I)	**-**	General requirements for fittings
8008-1976 (Pt. II)	**Reaffirmed 1997**	Specific requirements for 90 0 bends
8008-2003 (Pt. III)	**-**	Specific requirements for 90 0 tees
8008-2003 (Pt. IV)	**-**	Specific requirements for reducers
8008-2003 (Pt. V)	**-**	Specific requirements for ferrule reducers
8008-2003 (Pt. VI)	**-**	Specific requirements for pipe ends
8008-2003 (Pt. VII)	**-**	Specific requirements for sandwich flanges
8090-1976	**Reaffirmed 2000**	Coupling, branch pipe, nozzle used in hose reel tubing for fire fighting
8329-2000	**-**	Centrifugally cast (spun) ductile iron pressure pipes & fittings for water, gas & sewage
8413 (Pt. I)		Requirements for biological treatment equipment
8413-1977 (Pt. I)	**Reaffirmed 2001**	Trickling Filter
8718-1978	**Reaffirmed 2000**	Specifications for vitreous enameled steel kitchen sinks
8727-1978	**Reaffirmed 2000**	Specifications for vitreous enameled steel wash basin

8835-1978	**Reaffirmed 1999**	Guideline for planning and design of surface drains.
8931-1993	**Reaffirmed 2003**	Specifications for copper alloys Fancy single taps, combination tap assembly & stop valves for water services
9140-1996	**Reaffirmed 2002**	Method of sampling of vitreous & fire clay sanitary appliances
9293-1991	**Reaffirmed 1996**	Specifications for flax canvas
9338-1984	**Reaffirmed 2000**	Specifications for Cast Iron screw down stop valves and stop & check valves for water works purposes
9668-1990	**Reaffirmed 2000**	Code of practice for provision & maintenance of water supplies for Fire Fighting
9739-1981	**Reaffirmed 2003**	Specifications for Pressure reducing valves for Domestic water supply system.
9758-1981	**Reaffirmed 2003**	Flush valves and Fittings for water closets and urinals
9762-1994	**Reaffirmed 2004**	Specifications for polyethylene floats for float valves
9763-2000	**-**	Specifications for Plastic Bib taps, pillar taps, angle valves and stop valves for hot &cold water service.
9972 -2002	**-**	Specification for Automatic sprinkler Heads for Fire Protection Service.
10221-1982	**Reaffirmed 1997**	Code of practice for coating and wrapping of underground M.S. steel pipeline,
10500-1991	**Reaffirmed 2003**	Specification of Drinking water
11108 -1984	**Reaffirmed 2000**	Specification for portable fire Extinguisher Halon 1211 Type.
11189-1985		Method of tube well development
11606 -1986	**Reaffirmed 2000**	Method for sampling of cast iron pipes and fittings.
11632 -1986		Rehabilitation of Tube well
12183-1987 (Pt. I)	**Reaffirmed 2004**	Code of practice for Plumbing in multistoried buildings (for water supply)
12231 -1987	**Reaffirmed 2003**	UPVC pipes for section & delivery lines of agricultural pumps– Specification.
12235 -1986	**Reaffirmed 1998**	Method of test for UPVC pipe for potable water supply
12288 -1987	**Reaffirmed 2002**	Code of practice for use and laying of Ductile Iron pipes.
12469 -1988	**Reaffirmed 2002**	Specifications for pumps
12592-2002	**-**	Precast concrete frame & cover (SFRC frame & cover)
12701-1996	**Reaffirmed 2002**	Specifications for rotational moulded polyethylene water storage tanks
12709 -1994	**Reaffirmed 2004**	Glassfiber reinforce plastic(GRP) pipes, joints & fittings for use for potable water supply – Specification.
12818 -1992	**Reaffirmed 2002**	Spn. for UPVC ribbed screen casing & plain casing pipes for bore / tube well
12820 -1989	**Reaffirmed 1999**	Dimensional Requirements of Rubber Gaskets for Mechanical Joints & push in joints for use with Cast Iron Pipes & fittings for carrying water, Gas &sewarge.
13095 -1991	**Reaffirmed 2003**	Butterfly valves for general purposes

13114 -1991	**Reaffirmed 2003**	Spn. for forged brass gate, globe & check valves for water works purposes
13382-2004	**-**	Cast Iron specials for mechanical & push-on flexible joints for pressure pipelines for water, gas & sewage
13592-1992	**Reaffirmed 2002**	Specifications for PVC soil, waste & rain water (SWR) including ventilation pipes
13593 -1992	**Reaffirmed 2002**	UPVC pipes fittings for use with section and delivery lines for Agricultural pumps – Specification.
13916 – 1994	**Reaffirmed 2004**	Code of practice for installation of GRP piping system.
13983-1994	**Reaffirmed 2004**	Specifications for stainless steel kitchen sinks & drain boards for domestic purpose
14333-1996	**Reaffirmed 2001**	Specification for HDPE pipes for sewerage system.
14402-1996	**Reaffirmed 2001**	GRP pipes, joints & fittings – Specification.
14735-1999	**Reaffirmed 2004**	UPVC injection moulded fittings for UPVC – SWR pipes – Specifications.
14845-2000	**Reaffirmed 2004**	Resilient seated cast iron air relief valves for water works purposes – Spn
14846-2000	**-**	Specifications for sluice valve for water works purposes (50 to 1200 mm size)
15265 – 2003	**-**	Specifications for flexible PVC pipes or polymer reinforcement thermo plastic hoses for suction and delivery lines for Agricultural pumps.
15328 – 2003	**-**	UPVC non pressure pipes for use in underground drainage and sewerage system – Specifications.

SECTION 'B'- ELECTRICAL WORK

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 / non metallic (Rigid heavy Duty ISI -marked fire retarded FRST 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 switch boxes 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 painted 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.

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 mentiond 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 be by means of hexagon check nuts & spring washer on both sides of the conduit. The joints in conduits shall be free 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 continous 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.

PVC conduit shall be used for all concealed / embedded installation.

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 jointed 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.

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 Enameling /Galvanising of

the Conduit is not damaged.

1.6 Fixing of Conduits

All conduits, shall be installed so as to avoid 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 on 5mm thick GI spacers 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.

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.

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.

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 alongwith the laying of recessed conduit.

1.10 Conductors

All PVC insulated copper conductor flexible FRLS, as specified in SOQ, 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 DrawingConductors

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.

Condutors 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 licence 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 licence 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 Nos. earth wires of proper rating shall be provided alongwith 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 SubDBs, 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.

2 SWITCHES, RECEPTACLES (MODULAR), LIGHTING FIXTURES & LIGHTING CONTROL EQUIPMENT

2.1. Switches

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 on each switch shall be restricted to maximum 800 watts & maximum 1500 watts per circuit. All wiring accessories shall be BIS approved. Perfect alignment shall be maintained while fixing of the back boxes.

2.2 Socket Outlet

Socket outlets shall be of the three pin. 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 alongwith 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 alongwith 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.

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.

2.3 Lighting Fixtures & Accessories

The light fixtures and fittings shall be 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.

2.3.1 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.

2.3.2 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:

General and safety requirements for Luminaires :

Part-1 Tubular flourescent lamps	-	IS – 1913 (Part-1)
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
Electronic Ballasts for fluorescent lamps – General & Safety requirement	-	IS – 13021 (Part-1)
Electronic Ballasts for fluorescent lamps – Performance requirement	-	IS – 13021 (Part-2)
Ballast for HP MV lamps	-	IS - 6616
Tubular Fluorescent lamps	-	IS - 2418 (Part-1 to 4)
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)
Particular requirement – Flood Lighting	-	IS – 10322 (Part-5/Sec-5)
High pressure mercury vapourlamps	-	IS – 9900 (Part-1)
Tungsten filament general electric lamps	-	IS - 418

2.3.3 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.

c). All fittings shall be supplied complete with lamps. All mercury vapour and sodium vapour lamp fittings shall be complete with accessories like ballasts, power factor improvement capacitors, starters, etc. Out door type fittings shall be provided with weather proof junction boxes (IP-55) and IP-54 Control gear boxes. All fluorescent and CFL fittings shall be provided with electronic ballast as per schedule of quantities.

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 hardwares 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-enamelled 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.

i) Metal used in BODY of lighting fixtures shall be not less than 22 SWG or heavier if so required to comply with specification of standards. Sheet steel reflectors shall have a thickness of not less than 20 SWG. The metal parts of the fixtures shall be completely free from burns and tool marks. Solder shall not be used as mechanical fastening device on any part of the fixture.

j) All Light Fitting in Dining Area, Kitchen Area shall be Suspendended type as per the drawings & site requirement.

2.3.4. Light Fittings – Special Requirements

Lighting Fixtures & Accessories

The light fixtures and fittings shall be pre-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.

2.3.1 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.

2.3.2 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:

General and safety requirements for Luminaires :

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)

2.3.3 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.

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

c). All fittings shall be supplied complete in all respect

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 hardwares 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 or anodised as required. The surface shall be scratch resistant and shall show no sign of cracking or flaking

i) Metal used in body of lighting fixtures shall be not less than 22 SWG or heavier if so required to comply with specification of standards. The metal parts of the fixtures shall be completely free from burns and tool marks. Solder shall not be used as mechanical fastening device on any part of the fixture.

2.3.4. LED Light Fittings – Special Requirements

Mechanical specifications

LED luminaries of Single piece Die Cast Aluminium alloy Housing having high conductivity acting as heat sink, with Powder coating with distortion free, clear, Heat Resistant Toughened UV stabilized Glass in the front which shall

be fixed to the housing
Suitable rust - proof screws for fixing of the heat resistant toughened glass / hanging arrangement. The luminaries assembly and manufacturing process for the LED source assembly in modules/ arrays shall be designed to assure all internal components are adequately supported to withstand sudden impacts and mechanical shock and vibration from any sources.

2.3.5 Inbuilt protections:
a) Over Voltage Protection
b) Transients (Surge Voltage & Current)

2.3.6 Compliance to the following standards:
i. EN 60598 (General Requirements & Tests)
ii. Transient voltages, Voltage dips and fluctuations' shall conform to EN61547 or equivalent.
iii. EN 61000 - 3 - 3 (Flicker)
iv. EN 55015 (RFI < 30 MHz)

2.4 Lighting Control Equipment

2.4.1 General
The lighting control system shall be centralized or decentralized based on a project requirement every device should be microprocessor based, addressable entity.

PIR Occupancy Sensor
The PIR Occupancy Sensor shall detect passive infrared energy for control of any number of independent electrical loads. The light level shall be adjustable from the front of the unit and shall be used to disable the Occupancy Sensor. Timer settings shall be adjustable from 1 second to 18 hours, in one-second increments. A weatherproof version shall be available for outdoor or industrial use.

In the event of power cycling, a non-volatile memory (NVM) shall be incorporated to retain all address and switching information.

The Supply Voltage to each PIR Sensor shall be 36VDC @ 18mA. No additional 240V supply shall be required for the unit to operate.

The unit shall have suitable operating temperatures between 0-50 Degree C.

The unit shall be suitable for wall or ceiling mounting, up to mounting heights of 2.4m.

The Indoor unit shall have a field of view of 90 degrees. The outdoor unit shall have a field of view of 110 degrees.

The Indoor unit shall have an effective detection area of 6m x 6m. The outdoor unit shall have an effective detection area of 18m radius x 110 degrees.

The Indoor unit shall have 12 overlapping detection zones. The outdoor unit shall have 18 long range, 16 intermediate range, 10 short range and 4 ultra short-range detection zones.

Ultrasonic Occupancy Sensor
The unit shall be an active device utilizing Doppler wave technology as its means of detection. The unit shall

include two air transducers to provide volumetric occupancy detection.

The unit shall be suitable for occupancy detection of larger areas, typically 12m x 12m and 2.7m mounting height. The unit shall include its own independent 240V power supply and shall require a socket outlet adjacent to installation point (typically in the lighting wiring loom). To enable the unit to communicate with the control system network, an Auxiliary Switch Input Unit shall be utilized. Each auxiliary unit will allow control of up to four detectors.

The unit will have easily accessible sensitivity adjustment that can be used to accommodate various room sizes.

The unit will have an indicator LED for walk-testing the unit.

The unit shall be ceiling mounted and a 360-degree field of view.

The unit shall utilize an ultrasonic frequency of 32.7 kHz.

The unit shall have suitable operating temperatures between 0-50 Degree C.

Combined Technology Ultrasonic/PIR Occupancy Sensor

The unit shall consist of two air transducers and four PIR detectors with a special lens to provide both volumetric and line of sight detection.

The unit shall be suitable for occupancy detection of larger areas, typically 15m x 15m and 2.7m mounting height. The unit shall include its own independent 240V power supply and shall require a socket outlet adjacent to installation point (typically in the lighting wiring loom). To enable the unit to communicate with the control system network, an Auxiliary Switch Input Unit shall be utilized. Each auxiliary unit will allow control of up to four detectors.

The unit shall be ceiling mounted and a 360-degree field of view.

The unit will have easily accessible sensitivity adjustment that can be used to accommodate various room sizes.

The unit will employ programmable walk-testing LED indicators: Red LED for Passive Infrared and Green LED for Ultrasonic modes.

The unit shall utilize an ultrasonic frequency of 32.7 kHz.

The unit shall have suitable operating temperatures between 0-50 Degree C.

Ultrasonic Occupancy Sensor for Corridors and Hallways

The unit shall be suitable for occupancy detection of Corridors and Hallways, typically up to 4.6m x 30m and 2.7m mounting height. The unit shall include its own independent 240V power supply and shall require a socket outlet adjacent to installation point (typically in the lighting wiring loom). To enable the unit to communicate with the control system network, an Auxiliary Switch Input Unit shall be utilized. Each auxiliary unit will allow control of up to four detectors.

The unit shall be ceiling mounted and a 360 degree field of view.

The unit will have an indicator LED for walk-testing the unit.

The unit shall utilize an ultrasonic frequency of 32.7 kHz.

The unit shall have suitable operating temperatures between 0-50 Degree C.

2.5 Lighting Control Equipment Product Specifications(Option-II)

2.5.1 Lighting control modules for On/Off switching shall be:
DIN rail mounted consisting of two (2), four (4) or eight (8) or (12) individually programmable integral relays (contactors). The relay shall guarantee a life of >100000 switch operations as per IEC 60947. Relay modules requiring external 220V supply in addition to bus connection shall not be acceptable.

The output states of each of these relays shall be displayed on the front via true mechanical indication. LED status indicators shall not be acceptable. Each of these relays shall be latch-on type with manual operation (override) possible even without power to the system & without having to remove the cover of the control module.

In the event of power failure or bus wiring failure or control module failure, each of the relays shall attain a pre-programmed fail-safe position ('On', 'off' or 'as it is Last status') at the time of commissioning.

The actuators shall be with integrated current detection feature. This functionality shall allow for the monitoring of the load current, and operating hours for load management .It shall be possible to set threshold values of the current in order to detect any lamp failures for facilities management.

The control modules shall be capable of being programmed with different applications to suit site requirements for e.g. staircase lighting function that switches 'Off' the relays after a preprogrammed time from the time it has switched 'On'. The application for which a relay has been programmed shall apply irrespective of the signal from which it is controlled.

Each of the relays shall be capable of being programmed with its own 'On' and 'Off' delays that shall be applicable irrespective of the signal from which the relays are controlled.

The control modules shall receive its operating power supply from the same bus cable without any other power supply. It should not operate on any 220/240 V AC supply to avoid possible fire hazards. Relay modules with additional power supply to feed other devices in the network shall not be acceptable.

There shall be DIN rail mounted Dimmer modules to allow for dimming of the related lighting loads. The Dimmer modules shall be shall be selected in accordance with the type of light fittings to allow dimming of all type of light.

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.

3.2 Material
The MV cables shall be cross linked polyethylene (XLPE)\ PVC core insulated, extruded PVC inner sheathed and extruded HR PVC / FRLS PVC outer sheath of 1100 volts grade as asked for in the schedule of quantities. Cables

shall be of copper and or aluminium conductor as mentioned BOQ.

3.3 TechnicalRequirements:

3.3.1 All XLPEAluminium/Copper Power cables shall be 1100 Volts grade, multi core constructed as per IS : 7098 Part-I of 1988 as follows :

a) Stranded Aluminium /Copper conductor as specified in BOQ.

b) Cores laid up

c) The inner sheath should be bonded over with thermo-plastic material for protection against mechanical and electrical damage.

d) Armoring should be provided over the inner sheath to guard against mechanical damage. Armouring should be Galvanised steel wires or galvanisedsteel strips. (In single core cables used in A.C. system armouring should be non-magnetic hard aluminium Wires/Strips. Round steel wires should be used where diameter over the inner sheath does not exceed 13 mm; above 13 mm flat steel armour should be used. Round wire of different sizes should be provided against specific request.)

e) The outer sheath should be specially formulated heat resistant black PVC compound conforming to the requirement of type ST2 of IS : 5831-1984 extruded to form the outer sheath.

3.3.2 Conductor shall be of electrolytic Aluminium/Copper conforming to IS : 8130 and are compact circular or compact shaped.

3.3.3 Insulation shall be of XLPE type as per latest IS general purpose insulation for maximum rated conductor temperature 70 degree centigrade.

3.3.4 In Inner sheath laid up cores shall be bonded over with thermoplastic material for protection against mechanical and electrical damage. Inner sheath shall be extruded type only.

3.3.5 Insulation, inner sheath and outer sheath shall be applied by extrusion process only.

3.3.6 Armouring shall be of galvanised steel wire/flat.

3.3.7 Repaired cables shall not be used.

3.3.8 Current ratings of the cables shall be as per IS : 3961.

3.3.9. The XLPE insulated cables shall conform to latest revision of IS and shall be read along with this specifications. The Conductor shall be stranded Aluminium/Copper circular/ sector shaped and compacted. In multi core cables the core shall be identified by red, yellow, blue and black coloring of insulation.

3.3.10 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.

3.3.11 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.

3.3.12 Cables shall be supplied in non returnablewooden 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.

3.3.13 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

3.4 Inspection

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

3.5 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 apportioning 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.

3.6 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.

3.7 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.

3.8 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

3.9 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.

3.10 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.

3.10.1 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 manufacturer's. All cables shall be laid with minimum one diameter gap and shall be clamped at every metre 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 upto one meter on all joints, terminations and both sides of the wall crossings by "VIPER CABLE RETARD".

3.10.2 Laying of Cables in Ground

The width of trench for laying single cable shall be minimum 350 mm. Where more than one cable is to be laid in horizontal formation, the width of the trench shall be workout by providing 200 mm gap between the cables, except where otherwise specified. There shall be clearance of 150 mm between the end cable and the side wall of the trench. The minimum depth of the cable trench shall not be less than 750 mm for single layer of cables. When the cables are laid in more than one tier the depth of the trench shall be increased by 300 mm for each additional tier.

Excavation of trenches : The trenches shall be excavated in reasonably straight lines. Wherever there is a change in direction, suitable curvature shall be provided. Where gradients and changes in depth are unavoidable, these shall be gradual. The excavated soil shall be stacked firmly by the side of the trench such that it may not fall back into the trench. The bottom of the trench shall be levelled and shall be made free from stone, brick bats etc. The trench shall then be provided with a layer of clean, dry sand cushion of not less than 100 mm in depth. Prior to laying of cables, the cores shall be tested for continuity and insulation resistance. The cable drum shall be properly mounted on jacks, at a suitable location, making sure that the spindle, jack etc. are strong enough to carry the weight of the drum and the spindle is horizontal. Cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains. The entire drum length shall be laid in one stretch. However, where this is not possible the remainder of the cable shall be removed by `Flaking' i.e. by making one long loop in the reverse direction. After the cable has been uncoiled and laid into the trench over the rollers, the cable shall be lifted off the rollers beginning from one end by helpers standing about 10 meters apart and laid in a reasonably straight line. Cable laid in trenches in a single tier formation shall have a cover of clean, dry sand of not less than 150 mm. above the base cushion of sand before the protective cover is laid. In the case of vertical multi-tier formation after the first cable has been laid, a sand cushion of 300 mm

shall be provided over the initial bed before the second tier is laid. Finally the cables shall be protected by second class bricks before back filling the trench. The buried depth of uppermost layer of cable shall not be less than 750mm.

Back Filling : The trenches shall be back filled with excavated earth free from stones or other sharp edged debris and shall be rammed and watered, if necessary, in successive layers not exceeding 300 mm. Unless otherwise specified, a crown of earth not less than 50 mm in the centre and tapering towards the sides of the trench shall be left to allow for subsidence.

3.11 Cablesinside 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.

3.12 Route Marker

Route marker shall be provided along straight runs of the cables not exceeding 30 meters also for change in the direction of the cable route and underground joints.

Route marker shall be of cast iron painted with aluminum paint. The size of marker shall be 100 mm dia with “Cable” and voltage grade inscribed on it.

3.13 Cable Trays

Ladder and perforated type Cable Trays shall be of Hot dip Galvanized bolted type and factory fabricated out of CRCA sheet with standard accessories like tee, bends, couplers etc. for different loads and number and size of cables as given below :

Cable trays shall be galvanized as per Specification given under 3.14.

a. 1500 mm wide
Runners 25 x 100 x 25 x 3 mm
Rungs 2# 20 x 40 x 20 x 3 mm 250 mm C/C
Suspenders 2 Nos. 40 x 40 x 5 mm GI angle 1500 mm C/C with base support of 40x 40 x 5mm GI angle.

b. 1200 mm wide
Runners 25 x 100 x 25 x 3 mm
Rungs 2# 20 x 40 x 20 x 3 mm 250 mm C/C
Suspenders 2 Nos. 40 x 40 x 5 mm GI angle 1500 mm C/C with base support of 40x 40 x 5mm GI angle.

c. 1000 mm wide
Runners 25 x 100 x 25 x 3 mm
Rungs 2# 20 x 40 x 20 x 3 mm 250 mm C/C
Suspenders 2 Nos. 40 x 40 x 5 mm GI angle 1500 mm C/C with base support of 40x 40 x 5mm GI angle.

d. 750 mm wide
Runners 20 x 75 x 20 x 2.5 mm
Rungs 20 x 30 x 20 x 2.5 mm 250 mm C/C
Suspenders 2 Nos. 32 x 32 x 5 mm GI angle 1800 mm C/C with base support of 40x 40 x 5mm GI angle.

e. 600 mm wide

Runners 20 x 75 x 20 x 2.5 mm
Rungs 20 x 30 x 20 x 2.5 mm 250 mm C/C
Suspenders 2 Nos. 32 x 32 x 5 mm GI angle 1800 mm C/C with base support of 40x 40 x 5mm GI angle.

f. 450 mm wide
Runners 20 x 75 x 20 x 2.5 mm
Rungs 20 x 30 x 20 x 2.5 mm 250 mm C/C
Suspenders 2 Nos. 25 x 25 x 4 mm GI angle 1800 mm C/C with base support of 40x 40 x 5mm GI angle.

g. Supply and fixing of perforated type cable trays of the following sizes of pre-galvanized iron.

i. 600 x 40 x 40 x 2 mm thick
i. 450 x 40 x 40 x 2 mm thick
i. 300 x 40 x 40 x 2 mm thick
ii. 150 x 40 x 40 x 2 mm thick

Note : Suitable length of 10 mm dia GI rod suspenders at 1800 mm interval shall be included in the item for perforated type cable tray.

3.14 Specification for Hot DipGalvanizing Process
(for Mild Steel Used For Earthing, Cable Trays Or Junction Boxes For Electrical Installation.)

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.

3.15 Fire retardant Cable Paint &FireBarrier
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/

3.15.1 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.

3.15.2 Fire Barrier sheet for floor and wall sealing

The framing & fixing part of fire barrier sheet shall be very simple & directly fixed around walls & floors by help of anchored bolts & washer. For 2 hour fire rating the fire barrier sheet shall be minimum 7.62 mm thick and shall be cut as per the profile of penetration and opening. The small gap left around the penetration shall be closed with fire rated soft &mouldable putty. Fire barrier must be design on the intumescent technology to seal larger penetration through the fire rated walls &floors.Fire barrier must be a composite construction with the quality incorporated with organic/ inorganic fire resistive elastomeric sheet with specific gravity of 1.6 gm/ cubic centimeter.

3.16 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 resistance test.
c) Earth test.(in armoured cables)
d) 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 resistance test.
c) 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/Boards shall be suitable for operation on 3 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 shall be 2 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 totally enclosed, 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 of 275 mm 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 name plates. 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 tinned 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. Bus bars 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 bars 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 Tinned copper 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, maximium 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.

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 of 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 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.

4.4.1 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 Thermal-magnetic shall have adjustable thermal for overload and fixed magnetic for short-circuit protection.
  - Microprocessor MCCBs shall be equipped with microprocessor based trip units having complete LSIG protections.
  - 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

4.4.2 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.

4.4.3 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 shall have LSI protection. Also wherever specified in BOQ ground fault protection shall be integral part of the microprocessor based release and neutral CT shall be provided incase of Triple pole breaker. Adjustable Overload, Short circuit and earth fault protection with time delay shall be provided.
- The trip command shall override all other commands.

4.5 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 satandrd 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 co-ordinated 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 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)

4.6 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 a 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.

Coordination Study in LV Network

LV Switchgear Manufacturer shall submit coordinated & Discriminated solution for LV Network protection devices i.e. **ACB, MCCB, MPCB &**MCB for all Incoming and outgoing devices for all Panels/ DB`s as per BOQ with the help of published discrimination tables. Total discrimination shall be provided up to the short circuit breaking capacity of most down stream circuit Breakers .

4.7 ResidualCurrent Circuit Breaker CurrentOperated 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 electro motive 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 a 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.

4.8 Earthing

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

4.9 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 BOQ confirming to IS Code No.5.

4.10 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.

4.11 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.

4.12 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/ Flame Retardent resin filled Nylon type robust to withstand thermal and dynamic stresses during short circuits. Metering CTs, shall have inbuilt busbar mounting arrangement. Secondary terminals of CTs shall be brought out suitable to a terminal block which shall be easily accessible for testing and terminal connections. The secondary terminal should be covered with insulation cap/cover so that there should not be any possibility of touching the live terminal. The protection CTs shall be of accuracy class 5P10 and measurement CTs shall be of accuracy class I.

4.13 Potential Free Contacts

Potential free contacts shall be provided for connection to Building Automation System in panels indicated in

Schedule of Quantities.

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

Final Distribution Boards (FDBs) shall be suitable for operation on 3 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 (for residential project FDB shall be of minimum 1.2 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:

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

4.1.1.2 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 busbars in the FDB shall be insulated type.

4.1.1.3 Service cable /enterconnection shall be part of the Distribution Boards.

4.1.1.4 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.

4.1.1.5 Degree of protection shall be IP-42 for indoor application, IP-65 for kitchen & laundry and IP-65 for outdoor application.

4.1.1.6 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.

4.1.1.7 Phase segregation to be maintained in all three phase distribution boards.

4.1.1.8 Earthing shall be provided in each FDB's.

4.1.2 **Miniature Circuit Breaker (MCB)**

For specifications refer Section 4A, clause 4.7

4.1.3 **Residual Current Circuit Breaker Current Operated Type (RCCB)**

For specifications refer Section 4A, clause 4.8

4.1.4 **Earthing**

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

4.1.5 **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 of Siemens gray paint shade no. RAL-7032 of IS Code No.5.

4.1.6 **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.

4.1.7 **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

4.1.8 **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. EARTHING

5.1 Earthing

The system shall be TNS with four wire supply system (R,Y,B,N and 2 Nos. E) brought from the main L T Panel. All the non-current carrying metal parts of electrical installation and all metal conduits trunking, cable sheaths, 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.

5.2 EarthingConductors

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

5.3 Sizing of EarthingConductors

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 80 Sq.mm. If the area of the largest current carrying conductor or bus bar exceeds 160 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 upto 15 amps shall be earthed with PVC insulated copper wire.

5.4 Connection of EarthingConductors

Main earthing conductors shall be taken from the earth connections at the main L T 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, or its distribution panel. Metal conduits, cable sheathing andarmouring 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 in effective electrical contact with a run of metallic conduit shall not be considered as a part 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.

5.5 Prohibited Connections

Neutral conductor, sprinkler pipes, or pipes conveying gas, water or inflammable liquid, structural steel work, 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 L T 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 exceed 1 ohm. 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.

5.6 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.

5.7 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.

5.8 Resistance to Earth

The resistance of earthing system shall not exceed 1 ohm.

5.9 Specification for Hot DipGalvanizing 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.

(Note : Please specify only one type as per project requirement)

5.10 Earthing Electrode

Conventional Plate electrode

Copper Earth Electrode

Earthing electrode shall be600 x 600 x 3.15 mm thick tined copper plate electrode, with 2 Nos 50 x 6 mm copper 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 as per IS3043 with C I heavy duty / chequered plate manhole cover with frame painted with bitumastic paint and packing with mixture of charcoal and common salt around plate electrode including digging of pit upto permanent moisture level and as per soil condition but not less than 3 meters and back filling as required.

GI Earth Electrode

Earthing electrode shall be 600 x 600 x 6.3 mm thick GI plate electrode, with 2 nos. 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 as per IS3043 with 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 upto permanent moisture level but not less than 3 meters and back filling as required.

6. LIGHTNING PROTECTION SYSTEM(EARLY STREAMER EMISSION TYPE BASED ON FRENCH STANDARD NFC 17-102)

6.1 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 shall complies in accordance with NFC 17-102 standard and shall be installed strictly to the manufacturer's instructions.

The advanced lightning protection system shall include components as follows:
ESE Air terminal
Mechanical supports
Down-conductors
Performance Recording Equipment
A low impedance Grounding system.

6.2 Standards

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

- NFC-17-102
- IEC 61204

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.

6.3 Air Terminal

The air termination shall be of the type that responds dynamically to the appearance of a lightning down leader by creating free electrons between outer surfaces and an earthed central finial rod.

The Air terminal shall work under **Early Streamer Emission (ESE) Technology** and the attractive radius of the air termination shall be traceable to known and acceptable lightning research and statistics.

The Lightning conductor shall deliver a unique gain time in efficiency, anticipating the natural formation of an upward leader. The Air terminal generates a leader that propagates rapidly to capture the Lighting stroke and conduct it towards the ground.

Arcing is not to be continuous and shall only occur during the progress of the lightning leader.

The air termination shall not cause high frequency radio interference except during the millisecond intervals associated with the progress of the lightning leader and during the main return strike of lightning events in the region.

The materials of the air termination shall be non-corroding in normal atmosphere.

The air termination shall not be dependent upon batteries or external power supplies for any part of its operation.

The Height of the air terminal support mast shall be minimum 2mts and the height will be increased as per the coverage design.

The support shall be securely installed and guy wires shall be used where necessary to enable the air termination and mast system to withstand maximum locally recorded wind velocities.

6.4 Down Conductor

In order to reduce probability of damage it is often necessary to have several parallel current paths. As recommended by IEC 62305 & IS 2309 equal spacing of down conductors , 25 x 3 mm Copper \ AL \ GI external strip, is preferred around the building perimeter or 1C x copper conductor special cable offered by LA supplier (recommended when laid in shaft within building). Two down conductors shall be used in case of the structure height is above 28mts and both shall be connected with maintenance-free Grounding system down conductor shall be connected directly to the air termination.

The down conductor shall be installed in accordance with the manufacturer's instructions and shall not be subject to sharper bends.

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

Each down conductor shall be directly connected at the dedicated earthing pit and the dedicated earth pit shall be connected to the other earth pits in the earthing grid.

6.5 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 shall 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'C to + 60'C.

6.6 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 shall be used to achieve low ground resistance. Provided the materials are mixed and installed strictly in accordance with the manufacturer's instructions.

6.7 Lightning and Surge Voltage Protection

6.7.1 Scope

This specification describes the electrical and mechanical requirements for a high energy Transient Voltage Surge Suppressor (TVSS).The specified TVSS/SPD system shall be connected in parallel to the facility's electrical main incoming (main LT panel) as well as final distribution boards, shall provide effective high energy surge current diversion, and shall be suitable for application in ANSI/IEEE C62.41 Category A, B and C environments or IEC 61643-1 Class I, II and III

6.7.2 Codes & Standards

The specified system shall be designed, manufactured, tested and installed in compliance with the following codes and standards:

IEC 61643-1: Surge Protective Devices connected to low voltage power distribution systems.
Underwriters Laboratories: (UL 1449, 2nd edition) Standard for Transient Voltage Surge Suppressors. International Standards Organization (ISO) Company certified ISO9001 for manufacturing, design and service and the applicable portions of the American National Standards Institute and Institute of Electrical and Electronic Engineers standards (ANSI/IEEE 1100 ,C62.11, C62.41, C62.45)

6.7.3 Electrical Requirements

A. Nominal system operating voltage

The single phase TVSS system shall be suitable for installations operating between 220VAC and 240VAC.

The three phase TVSS system shall be suitable for installations operating between 380VAC to 415VAC, Star (Y) Configuration: 3 Phase 4 Wire Plus Ground or Delta Configuration: 3 phase 4 wire including Ground.

B. Maximum Continuous Operating Voltage (MCOV):

The maximum continuous operating voltage of the complete TVSS, as well as all components in the suppression path shall be greater than 125% of the nominal system operating voltage to ensure the ability of the system to withstand temporary RMS over voltages (swell conditions).

C. Operation Frequency:

The operating frequency range of the system shall be 50 or 60 Hz.

D. Protection Modes:

Note: L = Line, G = Ground, N = Neutral

The SPD shall provide protection in all modes (L-N or L-L, L-G and N-G where applicable)

E. Surge Current Capacity:

Location	Class	Surge Current
Main Service Entrance	Class C	200/400 KA
Main Distribution Feeders	Class B	100/160 KA
Sub distribution Panels	Class A	50 KA

F. Short-circuit Withstand Capability:

The TVSS shall be able to carry the power short circuit current until it is interrupted by external over-current disconnect or by the backup over current protection. The minimum Short Circuit Withstand of the TVSS shall be according to the table below:

Class	Minimum Short Circuit Withstand Capability
Class C	200KA
Class B	35 to 65KA
Class A	14KA

G. Over current Protection (fusing)
All components, including suppression, filtering, and monitoring components, shall be individually fused at the component level with the fuses rated so as not to impede maximum specified surge current capacity. The fuse shall be capable of opening in less than one millisecond and clear both high and low impedance faults.

H. Clamping Voltage:
The TVSS shall able to clamp the voltage:

System Voltage	Max Let Through Voltage
120, 120/208 or 120/240	400 volts
208, 240, 277, 230/400 or 277/480	800 volts
346, or 346/600	1200 volts
480	1500 volts
600	2000 volts

I. Response Time:
The typical response time of all suppression components shall be <0.5 ns.

J. Noise Attenuation
The filter shall provide insertion loss with a maximum of 40dB to 50dB from 10 kHz to 100 MHz with data obtained utilizing the 50 ohm Insertion Loss Methodology from MIL-STD-220A.

6.7.4 Environmental Requirements

A. Operating Temperature:	-40 to +85 C (-40 to +187 F)
B. Relative humidity:	0% to 95%
C. Audible Noise:	The unit shall not generate any appreciable noise. 40 DB for RFI and EMI noise attenuation
D. Operating Altitude:	0 to 14,000 feet above sea level.
E.Magnetic Fields:	The unit shall not generate any appreciable magnetic fields, and shall suitable for use directly inside computer rooms.
F.Connection type-	Parallel
G.Protectionlvl in kV –	based on level of protection
H.Status indication –	LED type dry contacts

7. CABLING FOR DATA SYSTEM

7.1 Scope

This document defines the cabling system and subsystem components to include cable, termination hardware, supporting hardware, and miscellany required to supply, and to install a complete cabling infrastructure supporting data and video. The intent of this section is to provide pertinent information to allow the vendor to bid the labor, supervision, tooling, materials, and miscellaneous mounting hardware and consumables to install a complete system. However, it is the responsibility of the vendor to propose any, and, all items required for a complete system whether or not it is identified in the specification, drawings and bill of materials attached to this specification.

7.2 Applicable Documents

The cabling system described in this specification is derived in part from the recommendations made in industry standard documents. The list of documents below (or the latest revisions) has bearing on the desired cabling infrastructure are incorporated into this specification by reference:

1) This Technical Specification and Associated Drawings
2) ANSI/TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard – March 2001
4) ANSI/EIA/TIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces - February, 1998
5) ANSI/EIA/TIA-606 Administration Standard for the Telecommunications Infrastructure of Commercial

Buildings - February, 1993

6) ANSI/TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications - August, 1994

7.3 Cabling System and Component Specifications

7.3.1 UTP Cabling System

7.3.1.1 Unshielded twisted pair cabling system, TIA / EIA 568-B.1 addendum Category 6 Cabling system

Networks Supported	10 / 100 Ethernet, 155 Mbps ATM, 1000 Mbps IEEE 802.3ab Ethernet, and proposed Cat 6 Gigabit Ethernet
Warranty	25-year systems warranty; Warranty to cover Bandwidth of the specified and installed cabling system, and the installation costs
Performance characteristics to be provided along with bid	Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR for 4-connector channel

7.3.1.2 Unshielded Twisted Pair, Category 6, TIA / EIA 568-B.2

Material:	
Conductors	23 AWG solid bare copper or better
Insulation	Polyethylene
Jacket	Flame Retardant PVC
Pair Separator	Cross-member fluted Spline.
Approvals	UL Listed ETL verified to TIA / EIA Cat 6
Operating temperature	-20 Deg. C to +60 Deg. C
Frequency tested up to	Minimum 600 MHz
Packing	Box of 305 meters
Delay Skew	45ns MAX.
Impedance	100 Ohms + / - 15 ohms, 1 to 600 MHz.
Performance characteristics to be provided along with bid	Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR

7.3.2 UTP Jacks

Type	**PCB based, Unshielded Twisted Pair, Category 6, TIA / EIA 568-B.2**
Durability	
Modular Jack	750 mating cycles
Wire terminal	200 termination cycles
Accessories	Strain relief and bend-limiting boot for cable Integrated hinged dust cover
Materials	
Housing	Polyphenylene oxide, 94V-0 rated
Wiring blocks	Polycarbonate, 94V-0 rated
Jack contacts	Phosphorous bronze, plated with 1.27micro-meter thick gold
Approvals	UL listed
Performance	Attenuation, NEXT, PS NEXT, FEXT and Return Loss

Characteristics to be provided with bid	

7.3.3 UTP Jack Panels

Type	**24-port, PCB based, Unshielded Twisted Pair, Category 6, TIA / EIA 568-B.2**
Ports	24
Port arrangement	Modules of 6-ports each, arranged 1port x 6.
Category	Category 6
Circuit Identification Scheme	Icons on each of 24-ports
Port Identification	9mm or 12mm Labels on each of 24-ports (to be included in supply)
Height	1 U (1.75 inches)
Durability	
Modular Jack	750 mating cycles
Wire terminal (110 block)	200 termination cycles
Accessories	Strain relief and bend limiting boot for cable
Materials	
Housing	Polyphenylene oxide, 94V-0 rated
Wiring blocks	Polycarbonate, 94V-0 rated
Jack contacts	Phosphhorous bronze, plated with 1.27micro-meter thick gold
Panel	Black, powder coated steel
Approvals	UL listed
Termination Pattern	TIA / EIA 568 A and B;
Performance Characteristics to be provided along with bid	Attenuation, NEXT, PS NEXT, FEXT and Return Loss

7.3.4 Faceplates

Type	**1-port, White surface box**
Material	ABS / UL 94 V-0
No. of ports	One

7.3.5 Workstation / Equipment Cords

Type	**Unshielded Twisted Pair, Category 6, TIA / EIA 568-B.2**
Conductor	24 AWG 7 / 32, stranded copper
Length	7-feet
Plug Protection	Matching colored snag-less, elastomer polyolefin boot
Warranty	25-year component warranty
Category	Category 5
Plug	
Housing	Clear polycarbonate
Terminals	Phosphor Bronze, 50 micron gold plating over selected area and gold flash over remainder, over 100 micron nickel underplate
Load bar	PBT polyester
Jacket	PVC

Insulation	Flame Retardant Polyethylene

7.3.6 Fiberoptic Cable

Cable Type	**6-core, Multimode, 10G Ethernet OM3, Armored, loose-tube, Gel Filled**
Fiber type	50 / 125, Laser Grade, 250 micron primary coated buffers
No. of cores	6
Cable Construction	BELLCORE GR 20 / IEC 794-1
Attenuation	
@850nm	3.5 dB / KM
@1300nm	1.5 dB / KM
Bandwidth	
@850nm	1500 MHz-KM
@1300nm	500 MHz-KM
Network Support	
10 / 100 Ethernet	2000m
155 Mbps ATM	2000m
1000 Base SX	900m
1000 Base Lx	550m without Mode Conditioning launch patch cord.
Tensile rating	1200N
Maximum Crush resistance	3000N
Operating Temperature	-40 Degree C to +60 Degree C
Armor	Corrugated Steel tape Armor

Note: For Composite fiber optic cables, the above specifications for SM and MM fibers apply.

7.3.7 Fiber Optic Connectors

Connector Type	**SC-Style, Simplex**
Operating temperature	-40 Degree C to +85 Degree C
Durability & color	
MM connectors	500 cycles, Beige
SM connectors	220 cycles, Blue
Ferrules	Pre-radiused Ceramic Ferrules
Attenuation	Not more than 0.75 dB per mated pair

7.3.8 Fiber Optic Patch panels

Fiber optic patch panel	**19-inch, Rack mounted Fiber optic patch panel**
Height	3 U, 5.25 inches
# of fibers	48,96,192
# of OSP Cables for termination	Minimum 2
Grounding	2 Nos. of earthing lugs, pre-loaded
Cable Management rings	Front and rear cable management rings, pre-loaded

# of 6-port / 12-port adapter plates	8 / 8 Max.

Fiber optic patch panel	**19-inch, Rack mounted Fiber optic patch panel**
Height	1 U, 1.75 inches
# of fibers	18,36,72
# of OSP Cables for termination	Minimum 2
Grounding	2 Nos. of earthing lugs, pre-loaded
Cable Management rings	Front and rear cable management rings, pre-loaded
# of 6-port / 12-port adapter plates	3 / 3 Max.

7.3.9 Fiber Optic Adapter plates

Fiber Optic adapter plate	**6-port, SC-Style, MM**
Attenuation	Max of 0.75 dB per mated pair

7.3.10 Fiber Optic Patch Cord.

Fiber Optic Patch Cords	**50/ 125 Ethernet Patch Cord**
Bandwidth	
@850nm	500 MHz-KM
@1300nm	500 MHz-KM
Insertion Loss	Less than 0.5 dB

7.4 Warranty

Owner seeks warranty for the installed cable plant from the OEM equipment supplier. Bidder shall ensure that the OEM norms for supply, installation, testing and documentation as specified by the OEM supplier shall be adhered to, provided those are in line with TIA / EIA standards and Owner requirement specifications. The warranty shall be provided by the OEM vendor to Owner and shall be administered in India. The duration of the warranty shall be for a minimum of 25 years and shall cover the system performance, application assurance and the costs of the supply of components and installation.

SECTION 'C'- PLUMBING WORK

1.0. GENERAL INSTRUCTIONS

1.1. GENERAL INSTRUCTIONS: The detailed specifications given hereinafter are for the items of works described in the schedule of quantities attached herein, and shall be guidance for proper execution of work to the required standards. **It may also be noted that the specifications are of generalised nature and these shall be read in conjunction with the description of item in schedule of quantities and drawings.** The work also includes all minor details of construction which are obviously and fairly intended and which may not have been referred to in these documents but are essential for the entire completion in accordance with standard Engineering practice.

Unless specifically otherwise mentioned, all the applicable codes and standards published by the Indian Standard Institution and all other standards which may be published by them before the date of receipt of tenders, shall govern in all respects of design, workmanship, quality and properties of materials and methods of testing, method of measurements etc. Wherever any reference to any Indian Standard Specification occurs in the documents relating to this contract, the same shall be inclusive of all amendments issued theirto or revisions thereof, if any, upto the date of receipt of tenders. In case there is no I.S.I. specification for the particular work, such work shall be carried out in accordance with the instructions in all respects, and requirements of the Engineer-in-Charge. The work shall be carried out in a manner complying in all respects with the requirements of relevant bye-laws of the Municipal Committee/Municipal Corporation/Development Authority/Improvement Trust etc. under the jurisdiction of which the work is to be executed or as directed by the Engineer-in-Charge and, unless otherwise mentioned, nothing extra shall be paid on this account.

Samples of various materials, fittings etc. proposed to be incorporated in the work shall be submitted by the contractor for approval of the Engineer-in-charge before order for bulk supply is placed.

The contractor shall take instructions from the Engineer-in-Charge regarding collection and stacking of materials in any place. No excavated earth or building materials shall be stacked on areas where other buildings, roads, services, compound walls etc. are to be constructed.

The contractor shall maintain in perfect condition all works executed till the completion of the entire work allotted to him. Where phased delivery is contemplated, this provision shall apply to each phase.

The contractor shall give a performance test of the entire installation(s) as per standard specifications before the work is finally accepted and nothing extra whatsoever shall be payable to the contractor for the test.

The contractor shall clear the site thoroughly of all debris, surplus excavated materials and rubbish etc. left out of his work and dress the site around the building to the satisfaction of the Engineer-in-Charge before the work is considered as complete.

The Chief Engineer, DCSE, DAE, shall be the sole deciding authority as to the meaning, interpretations and implications for various provisions of the specifications and his decision in writing shall be final and binding on all concerned.
In case any difference or discrepancy between the specifications and the description in the schedule of quantities, the schedule of quantities shall take precedence. In case of any difference or discrepancy between specifications and drawing, the specifications shall take precedence. In case any difference or discrepancy between the specifications for Civil works and specification for Public Health Engg. works, specifications for Civil works shall take precedence.

1.1.1. PRECAUTIONS While carrying out pipe line work in case the contractor encounter any interference with other services such as cables, conduits etc, he shall take sufficient precautions in order to prevent any damage to them. If any damage occurs, it shall be rectified to its original condition at his own cost to the satisfaction of the officers concerned with such services.

The contractor shall ensure that all inserts, pipe lines embedded in structural members or sleeves are placed in position in co-ordination with civil work.

All public health engineering services shall be handed over to Engineer-in-charge complete in all respects on completion of the work. Incomplete work will not be taken over. Any loss or damage to these services due to any reasons by anybody whatsoever before handing over will be at contractor's risk and cost. Any damage to any structural/finishing work done during the testing or rectification shall be made good by the contractor at his own cost and risk.

1.0. SANITARY INSTALLATIONS

1.1. EUROPEAN WATER CLOSET :

1.1.1. GENERAL: The item pertains for providing white or colour glazed vitreous chinaware European water closet with seat and cover of size and colour as specified in the schedule including fixing.

1.1.2. MATERIAL: European type water closet shall be wash down pattern unless otherwise specified. Water closet shall be vitreous china conforming to IS 2556 (Part-I & II). The closet shall be of one piece construction with holes to mount on wall. Closet shall have an integral flushing rims of self draining type. Each water closet shall have an integral trap with `P` outlet and trap shall be uniform and smooth in order to enable an efficient flush. Plastic seat and cover shall be of black colour or as specified, they shall have conformity to IS2548 Part I&II.

1.1.3. FIXING: The water closet pan shall be placed in position as shown in the drawing. If the pan trap is damaged during handling or fixing, it shall be replaced by the contractor at his own cost. The pan, soil pipe shall be jointed in 1:1 Cement Mortar with hemp yarn caulked. The gap between W.C. and wall shall be finished with white/matching cement and sand as directed. Seat and cover shall be fixed to the Pan by two corrosion resistance hinge with 65 mm shank and threaded to within 25 mm from of flange. Seat shall be fixed in level by providing the washers of rubber with non ferrous or stainless steel washer to bolt.

1.1.4. THE RATE INCLUDES FOR :

1. European type water closet with an integral `P` or `S` trap, plastic seat cover, etc. jointing in 1:1 cement mortar with hemp yarn caulked.

2. Cutting hole in wall / slab / beam etc. wherever required. and making all damages good to original condition after completion of work

3. Testing the entire system and rectification of defect if any.

4. All necessary labour, material and use of tools.

1.1.5. MODE OF MEASUREMENT: The measurement shall be for each unit of W.C. fixed.

1.1.6. MODE OF PAYMENT: The contract rate shall be for each unit of W.C. fixed.

1.2. WASH BASIN

1.2.1. GENERAL The item pertains for providing colour or white glazed vitreous above counter chinaware wash basin of size and colour as specified in the schedule including fixing.

1.2.2. MATERIAL: Wash basins shall be of above counter vitreous china conforming to IS : 2556(Part-IV) as specified shall be of one piece construction including combined over flow, basin shall be provided with single or double tap holes of size 28 mm square or 30 mm rounded. Each basin shall have circular waste hole or 5 sq.cm slot type over flow. The basin shall be rest on counter top.

1.2.3. FIXING The wash basin shall be fixed in position as indicated in the drawing. Basin shall be rest on granite or Marble counter which is embedded in wall with opening for wash basin drain pipe through it..

The wall plaster on seat shall be cut to rest over the bottom edge of the basin so as not to leave any gap for water seepage through between wall plaster &edge of basin. The gap between basin and wall shall be finished with white matching cement.

1.2.4. THE RATE INCLUDES FOR:

1. Counetr top Wash Basin as required.
2. Cutting hole in wall / slab / beam etc. wherever required. and making all damages good to original condition after completion of work.
3. All necessary material, labour and use of tools.

1.2.5. MODE OF MEASUREMENT: The measurement shall be for each unit of wash basing fixed.

1.2.6. MODE OF PAYMENT: The measurement shall be for each unit of wash basin fixed.

1.3. URINAL

1.3.1. GENERAL: The item pertains for providing colour or white glazed vitreous chinaware urinal in single or range (1,2 & 3) and size as specified in the schedule with necessary fittings and appliances including fixing.

1.3.2. MATERIAL :

1.3.2.1. BOWL TYPE (WITH FLUSHING RIM) : Urinal basin shall be flat back or corner wall type lipped in front. The vitreous china conforming to IS 2556 (Part VI). Urinal shall have and integral flushing rim and inlet or supply horn for connecting flush pipe. Flushing rim and inlet shall be of the self draining type. At bottom of basin and outlet horn for connecting outlet shall be provided. The inside surface of the urinal shall be uniform and smooth throughout to ensure efficient flushing.

1.3.2.2. CP BRASS FLUSH PIPE: The flushing arrangement to urinals for single or in range shall be of CP brass with CP brass spreader of 15 mm dia conforming to IS : 407. The capacity of flush pipe for urinal in a range shall be as follows :

	Capacity of flush tank	Size of C.P. brass Flush pipe

		Main	Distribution
One	5 litres	15mm	15 mm
Two	10 litres	20 mm	15 mm
Three	10 litres	25 mm	15 mm

1.3.3. FIXING :

1.3.3.1. BOWL TYPE FLAT BACK URINAL WITHOUT FLUSHING RIM (Single or Range): Urinal shall be fixed in position by using rawl plug, wooden plug, C.P screws etc. It shall be fixed at height of 65 cm from the standing level to the top of the lip of urinal or as directed by the Engineer-in-charge. Each urinal shall be connected with 32 mm size waste pipe which shall discharge into channel or a floor trap.

1.3.3.2. CP BRASS FLUSHING ARRANGEMENT : The flushing arrangement to urinal in single or range shall be of CP brass from 25 mm dia to 15 mm dia and CP brass spreader of 15 mm size to each urinal including the cost of CP brass elbows, tees, coupling, crosses, clamps, clips, union CP brass check nut and screws etc. CP brass

1.3.4. THE RATE INCLUDES FOR :

1. Glazed Urinals (single or in range) and CP brass pipe flushing arrangement including the cost of jointing material.
2. Cutting hole wherever required and making all damage good to original condition after completion of work.
3. Testing the entire system and rectification of defects if any.
4. All necessary materials, labour and use of tools.

1.3.5. MODE OF MEASUREMENT: The measurement shall be for each unit of urinal set (single or range) fixed.

1.3.6. MODE OF PAYMENT: The contract rate shall be for each unit of urinal set (single or range) fixed.

1.4. MARBLE PARTITION

1.4.1. GENERAL : The item pertains for providing marble partition of size and colour as specified in the schedule including fixing

1.4.2. MATERIAL : The partition shall be of 20 mm thick marble slab of size as specified in the schedule. it shall be polished on both sides with exposed to proper shape the exposed edges of Marble shall be made smooth corners rounded. Cracked or damaged marble slab shall not be used in the work and shall be replaced if any by the contractor at his own cost and charges +/-3mm tolerance shall be permissible for thickness of slab.

1.4.3. FIXING : Partition shall be fixed vertically in position as indicated in the drawing at proper height. 100 mm wide chases shall be cut in the wall and the partition shall embedded at least 50 mm in the wall using 1:2:4 cement concrete. After fixing the partition slab, the chases cut in the wall shall be made good to original condition.

1.4.4. THE RATE INCLUDES FOR

1. Marble partition slab including cost of cement concrete, cement mortar etc.

2. All necessary labour, material and use of tools.

1.4.5. MODE OF MEASUREMENT : The measurement shall be for each unit of marble partition fixed.

1.4.6. MODE OF PAYMENT The contract rate shall be for each unit of marble partition fixed.

1.5. PVC FLOOR TRAP WITH PVC OR SS GRATING:

1.5.1. GENERAL : The item pertains for providing PVC floor trap with PVC OR SS grating of size as specified in the schedule including fixing.

1.5.2. MATERIAL : The trap shape be of PVC of 100 mm dia. or as specified in the schedule with hinged type dome shaped grating of chromium plated brass or stainless steel as specified.

1.5.3. FIXING : The trap shall be laid to the correct alignment and to required slope. The trap shall be fixed on 80 mm thick bed or 1:2:4 cement concrete. The caulking shall be done using 1:1 cement concrete. The caulking shall be done using 1:1 cement mortar and hemp yarn.

1.5.4. THE RATE INCLUDES FOR :

1. PVC Floor trap, grating, concrete, cement mortar etc.
2. Caulking with 1:1 cement mortar with hemp yarn.
3. All necessary labour, material and use of tools.

1.5.5. MODE OF MEASUREMENT : The measurement shall be for each unit of floor trap fixed.

1.5.6. MODE OF PAYMENT : The contract rate shall be for each unit of floor trap fixed.

1.6. TOILET PAPER ROLL HOLDER :

1.6.1. GENERAL : The item includes providing white or colour glazed vitreous chinaware toilet roll holder of size as mentioned in the schedule including fixing.

1.6.2. MATERIAL : The toilet paper roll holder shall be of CP brass or vitreous china on specified and of size and design as approved by the Engineer-in-charge. Toilet paper roll holder shall conform as per IS standard and should have ISI mark.

1.6.3. FIXING : Toilet paper roll holder shall be fixed in position by means of C.P brass covers and rawl plug embedded in the wall. Vitreous china toilet paper roll holder shall fixed into the wall with 1:2 cement mortar. The pocket shall be cut in wall for toilet paper roll holder if not left finishing the gap with white/matching cement.

1.6.4. THE RATE INCLUDES FOR :

1. Toilet paper roll holder, cement, sand, curing etc.
2. Cutting the pocket if they are not left.
3. All necessary labour, material and use of tools.

1.6.5. MODE OF MEASUREMENT : The measurement shall be for each unit of toilet paper roll holder fixed.

1.6.6. MODE OF PAYMENT : The contract rate shall be for each unit of toilet paper roll holder fixed.

1.7. PVC WATER INLET CONNECTION :

1.7.1. GENERAL : The item pertains to providing colour or white PVC water inlet connection for cistern and wash basins.

1.7.2. MATERIAL :PVC water inlet connection shall conform to IS specifications and shall be of standard pattern with nylon insulation of minimum 450 mm long with CP brass check nut at both the end and shall be able to withstand the testing pressure of 1 MPa (10 kg/sq.cm.)

1.7.3. FIXING : The PVC water inlet connection shall be fixed in position as indicated in the drawing or as directed by the Engineer-in-charge for flushing cistern and wash basins.

1.7.4. THE RATE INCLUDES FOR :

1. Supplying and fixing of PVC water inlet connection.
2. All necessary labour, material and use of tools.

1.7.5. MODE OF MEASUREMENT : The measurement shall be for each unit of water inlet connection fixed.

1.7.6. MODE OF PAYMENT : The contract rate shall be for each unit of PVC water inlet connection fixed.

1.8. LIQUID SOAP DISPENSER :

1.8.1. GENERAL: The item includes prdg. CPliquid soap dispenser of shape as mentioned in the schedule including fixing.

1.8.2. MATERIAL : Liquid Soap Dispenser shall be CPand from list of approved make.

1.8.3. FIXING : The liquid soap dispenser shall be fixed to proper height and level as indicated in drawing with 40 mm long CP brass screws, wooden rawl plug, drilling hole etc. and making good the wall to original condition after fixing.

1.8.4. THE RATE INCLUDES FOR :

1. Liquid soap dispenser with CP brackets CP screws etc.
2. All necessary labour, material and the use of tools.

1.9. 2 WAY BIB TAP, STOP COCK & ANGLE STOP COCKS:

1.9.1. GENERAL : The item pertains to provide chromium plated 2 Way brass bib tap and stop cock and angle stop cocks, free flanges (if joined to concealed pipe) including fixing

1.9.2. MATERIAL :2 wayBib cock (Bib tap) is drawn off tap with a horizontal inlet and free out let and a stop cock is a valve with a suitable means of connections for insertion in a pipe line for controlling or stopping the flow. These shall be of size 15 mm size or as specified and shall be of screw down type. The closing device shall work by means of disc. carrying a renewable non-metallic washer with shuts against the water pressure on a seating right angles to the axis of the threaded spindle which operates it. The handle shall be crutch, butterfly or fancy design type securely fixed to the spindle. The tap shall open anti clock wise direction.

Brass bib taps 2 way and stop cocks and angle stop cocks shall conform to IS 781, they shall be polished bright. The minimum finished weight of different sizes of bib tap weight of 15 mm size bib tap and stop cock shall be as per table given below. They shall be sound and free from taps, blow hole and fitting. Internal & External surface shall be clean, smooth and free from sand and neatly dressed. Taps shall be nickel chromium plated and thickness of coating shall not be less than service grade No.2 of IS 4827 and plating shall be capable of taking high polish which shall not be easily tarnished.

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MINIMUM FINISHED MASS OF BIB TAPS AND STOP VALVES AS PER IS 781:1984 (Reaffirmed 2001)

	Minimum Finished Mass			
	bib taps	**S**top Valves		
		Internally threaded	Externally threaded	Mixed end
1	**2**	**3**	**4**	**5**
Mm	kg	kg	kg	Kg
8	0.250	0.220	0.250	0.235
10	0.330	0.330	0.350	0.325
15	0.400	0.330	0.400	0.365
20	0.750	0.675	0.750	0.710
25	1.250	1.180	1.300	1.250
32	-	1.680	1.800	1.750
40	-	2.090	2.250	2.170
50	-	3.700	3.850	3.750

Every tap complete with its component shall with stand an internally applied hydraulic pressure of 2 MPa (20 kg/sq.cm) maintained for a period of 2 minutes during the period it shall neither leak nor sweat. Leaky joint shall be remade to make it leak proof without any extra cost from contractor.

1.9.3. **FIXING :**Bib tap 2way, stop cock shall be fixed to the pipe line with C.P. brass or G.I. specials, if required or as ordered by Engineer-in-charge. Jointing shall be done with white zinc, spun yarn etc. A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tightness.

1.9.4. **THE RATE INCLUDES FOR :**

1. Bib tap 2 way and stop cock, special etc.
2. All necessary labour, material and the use of tools.

1.9.5. **MODE OF MEASUREMENT :**The measurement shall be for each unit of bib tap and stop cock fixed.

1.9.6. MODE OF PAYMENT : The contract rate shall be for each unit of bib tap or stop cock angle stop cock fixed.

1.10. PILLAR TAP : (Non fancy & Fancy Type)

1.10.1. GENERAL : The item pertains to provide chromium plated brass pillar tap including fixing.

1.10.2. MATERIAL : The pillar tap shall be 15 mm nominal size or as specified in the schedule. Fancy type pillar tap shall be of C.P. brass approved quality and shall conform to I.S. 8931. Non fancy pillar tap shall be chromium plated-brass and shall conform to IS 1795. The nominal size of Pillar tap shall be 15 mm or as specified.

Casting of Pillar tap shall be sound and free from laps, blow hole and pitting. External and internal surface shall be clean, smooth and free from sand and be neatly dressed. All the parts fitted to pillar tap shall be axial, parallel and cylindrical with surfaces smoothly finished. The minimum of finish weight of Pillar tap shall not be less than 650 grams (body weight 250 gms, washer plate loose valve 150 gms and back nut 40 gms. Thickness of C.P coating shall not be less than service grade no.2 of IS 4827 and plating should be capable of taking high polish which shall not easily tarnish or scale.

1.10.3. TESTING: Pillar tap shall withstand and internally applied hydraulic pressure of 2 MPa (20 kg/sq.cm) for period of 2 minutes during which period, it shall neither leak nor sweat. Leaky joint shall be remade to make it leak proof without any extra cost from the contractor.

1.10.4. FIXING: Pillar tap shall be fixed to the pipe line as indicated in the drawing with necessary special as required or as ordered by Engineer-in-charge. Jointing shall be done with white zinc, spun yarn etc. A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tightness.

1.10.5. THE RATE INCLUDES FOR :

1 Pillar tap including fixing.
2 All necessary labour, material and the use of tools.

1.10.6. MODE OF MEASUREMENT : The measurement shall be for each unit of pillar tap fixed.

1.10.7. MODE OF PAYMENT : The contract rate shall be for each unit of pillar tap fixed.

1.11. WASTE COUPLING :

1.11.1. GENERAL : The item pertains to provide chromium plated brass waste coupling including fixing.

1.11.2. MATERIAL : Waste Coupling shall confirm to IS 3311.Waste fittings shall be of CP with thickness of CP coating not less than service Grade No.2 of IS 4827 which is capable of receiving polish and will not easily scale off. The fitting shall conform in all respect to IS 2963 and shall sound, free from laps below, holes and fittings and other manufacturing defects. External and internal surface shall be clean and smooth. They shall be neatly dressed. The waste fitting for wash basin shall be of nominal size of 32 mm and for sink shall be nominal size 50 mm.

1.11.3. FIXING : Waste coupling shall be fixed to wash basin, sink or urinal as ordered with necessary specials. Jointing shall be done with white zinc, yarn etc. A few turns of fine hemp yarn dipped in the linseed oil shall be taken over the threaded ends to obtain complete water tightness. Leaky joint shall be remade to make it leak proof.

1.11.4. THE RATE INCLUDES FOR :

1. Waste coupling with necessary specials.
2. All necessary labour, material and the use of tools.

1.11.5. MODE OF MEASUREMENT : The measurement shall be for each unit of waste coupling fixed.

1.11.6. MODE OF PAYMENT : The contract rate shall be for each unit of waste coupling fixed.

1.12. BOTTLE TRAP :

1.12.1. GENERAL : The item pertains to provide chromium plated brass bottle trap including fixing.

1.12.2. MATERIAL : Bottle trap shall be of C.P with thickness of CP coating not less than service grade No. 2 of IS 4827 which is capable of receiving polish and will not easily scale off. The fitting shall conform in all respect of IS 2963 and shall be sound, free from laps below, holes and fittings and other manufacturing defects. External and internal surface shall be clean and smooth. They shall be neatly dressed and be truly machined so that nut smoothly moves on the body. The Bottle trap for wash basin shall be of nominal size of 32 mm and for sink shall be nominal size 50 mm.

1.12.3. FIXING : Bottle trap shall be fixed to wash basin, sink or urinal as indicated in the drawing with necessary specials or as ordered by the Engineer-in-charge. Jointing shall be done with white zinc, spun yarn etc. A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tightness. Leaky joint shall remade to make it leak proof.

1.12.4. THE RATE INCLUDES FOR :

1. Bottle trap with necessary specials.
2. All necessary labour, material and the use of tools.

1.12.5. MODE OF MEASUREMENT : The measurement shall be for each unit of bottle trap fixed.

1.12.6. MODE OF PAYMENT : The contract rate shall be for each unit of bottle trap fixed.

1.13. CONCELED / OPEN FLUSHING CISTERN :

1.13.1. GENERAL : The item pertains to provide white or colourPVC conceled / Open flushing cistern with all inside syphonic fitting including fixing.

1.13.2. MATERIAL : The flushing cistern shall be manually of rates high level or low level as specified for water closets and urinals.

Cisterns shall be of PVC for Flushing Type and IS 2326 for Automatic flushing cistern and Plastic (IS 7231). Cistern shall be mosquito proof. All working parts shall be designed to operate smoothly and efficiently. the cistern shall have removable covers which shall fit closely on it and be screwed against top displacement and side displacement where operating mechanism is attached to the cover. This may be made in two section, but the section supporting the mechanism shall be securely fitted or screwed to the body. The outlet fitting of the cistern shall be securely connected to the cistern. The nominal internal diameter of the cistern outlet shall not be less than 32 mm and 38 mm for high level and low level respectively. Length of outlet cistern shall be 37 +/-2 mm. Ball valve shall be screwed type 15 mm in diameter and shall confirm of IS 1703. The flat shall be made of polyethylene as specified in IS 9762. A high

levelcistern is intended to operate with minimum height of 125 cm and a low level cistern with maximum height of 30 cm between the top of the pan and under side of the cistern. A G.I chain strong enough to sustain a sudden applied pull of 10 kg or a dead load of 50 kg without any apparent or permanent deformation of the chain rings shall be attached to the ring or hook of the level manually operated high level C.I cistern. In case of low level cistern handle shall be of CP brass. In case of Plastic cistern, operation of cistern shall be through Push Button at the top or on side for dual system and beyond plastic handle.

The discharge rate of the cistern as per IS 774 shall be 10 +/-.5 litres 6 second and 5 +/-.5 litres in 3 second for cistern capacity 10 ltrs. and 5 ltrs. respectively. Flush pipe shall be of class `B` G.I pipe of 32 +/-mm diameter for high level. Polyethylene flush pipe shall be low density confirming to IS 3076 or high density confirming to IS 4984 or UPVC pipe confirming to IS 4965 of 40 mm outer diameter. Over flow pipe shall be of PVC with mosquito proof jalli of 15 mm dia.

1.13.3. FIXING: The chinaware flushing cistern shall be placed over a pair of C.I. brackets. C.P. brass flush pipe shall be fixed to cistern incase of open and for conceled cistern it will installed in wall with protection jail and with water supply inlet and outlet connection to W.C. pan using check nut, spun yarn, cement mortar etc.

The PVC flushing cistern shall be placed or fixed as recommended by the manufacturer, PVC flush pipe of specified diameter shall be fixed to cistern and W.C. pan by using check nut, white zinc, spun yarn, cement mortar etc.

1.13.4. THE RATE INCLUDES FOR :

1. Supply and fixing flush tank, flush pipe and over flow pipe.
2. Painting all the metallic parts with two coats of flat oil paint over a coat of primer.
3. Cutting hole in wall / slab / beam etc. wherever required and making good the same to original condition after fixing.
4. Cost of jointing materials such as zinc, spun yarn, cement mortar 1:1 etc.
5. Testing the entire system and rectification of defects, if any.
6. All necessary materials, labour and use of tools.

1.13.5. MODE OF MEASUREMENT : The measurement shall be for each unit of flushing cistern fixed as a whole.

1.13.6. MODE OF PAYMENT : The contract rate shall be for each unit flushing cistern fixed as a whole.

1.14. BRACKET :

1.14.1. GENERAL : The item pertains to provide a pair of bracket for wash basin, sink, flushing cistern etc. including fixing.

1.14.2. GENERAL : The item pertains to provide a pair of bracket for wash basin, sink, cistern etc, including fixing.

1.14.3. FIXING : Brackets shall be embedded into or fixed to the wall with plugs, screws, nails etc. Hole shall be made in the wall, if they are not left for fixing the brackets and shall be made good after fixing. The gap shall be filled with 1:2 cement mortar and finishing shall be done with white / matching colour cement.

1.14.4. THE RATE INCLUDES FOR :

1. Supplying and fixing the brackets.
2. Painting brackets with two coats of flat oil paint over a coat of primer.
3. Cutting hole in wall beam etc. wherever required and making good the same to original condition after fixing.
4. All necessary materials, labour and use of tools.

1.14.5. MODE OF MEASUREMENT : The measurement shall be for each pair of bracket fixed included in the items of sink, wash basin, cistern etc. as specified in schedule of quantities.

1.14.6. MODE OF PAYMENT : The contract rate shall be for each pair of bracket fixed.

2.0 WATER SUPPLY SYSTEM

2.1 PVC PIPING WORK FOR WATER SUPPLY :

2.1.1 GENERAL : The item includes supplying of CPVC pipes with fittings of specified diameter including laying, fixing, cutting, joining, painting etc. for vent, over flow, waste water pipe line etc.

2.1.2 MATERIAL : The pipes and fittings shall conform CPVC pipes and fittings shall be free from cracks, flaws and defects and shall be able to withstand a pressure as mentioned in the schedule of quantities.

2.1.3 EXAMINING : Before laying the pipe line, it shall be first examined for damages and cracks, No cracked or damaged pipe and fittings shall be used in the work and they shall be removed from the site by the contractor at his own cost and charge.

2.1.4 CLEANING : All the pipes and fittings shall be thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside and out side surfaces.

2.1.5 FIXING : The pipe line shall be fixed in position as shown in the drawing or as directed by the Engineer-in-charge. The pipe shall be fixed with suitable PVC clamps, The clamps shall be fixed into the wall with G.I. nails not less than 40 mm long and wooden gutties.

Spacing between clamps for fixing internal piping shall be as given below :

	For Horizontal Runs	For Vertical Runs
20 mm	700 mm	1050 mm
25 mm	750 mm	1125 mm
32 mm	825 mm	1240 mm
40 mm	975 mm	1460 mm
50 mm	975 mm	1460 mm

2.1.6 MAKING JOINT : The jointing of pipes and fittings generally shall be done with approved make cement solvent including making surface rough. The pipe shall be cut to desired length. Care shall be taken that that profile or cut surfaces shall not be changed and the fibrous material shall be removed with scraper or knife.

2.1.7 DETACHABLE JOINT : Detachable joints shall be made where pipes of different materials have to be jointed or as specified in the schedule. The flanges are first pushed over the pipe ends and jointing shall be made by cement solvent.

2.1.8 PAINTING : If mentioned in schedule of work, the exposed pipe line shall be painted with two coats of approved oil paint of matching colour over a coat of primer. Underground pipe line shall not be painted.

2.1.9 THE RATE INCLUDES FOR :

1. Supplying of PVC pipes and fittings of specified diameter.
2. Laying and cutting the pipe wherever necessary and wastage.
3. Fixing the pipe line with G.I. clamps not less than 2 mm thick and G.I./M.S. nails length not less than 40mm or with PVC clamps, screws, wooden gutties etc.
4. Making the solution joint, painting the pipe line if mentioned in schedule of quantities.
5. In case of underground piping, dewatering till completion of work.
6. All necessary materials, labour and use of tools.

2.1.10 MODE OF MEASUREMENT : The measurement shall be for unit running meter length of pipe line laid of fixed. The measurement shall be taken along the center line of pipe. No measurement shall be recorded separately for fittings, making joint, painting if mentioned in schedule of work and testing.

2.1.11 MODE OF PAYMENT: Unit length of pipe line laid or fixed.

2.2 GUN METAL/ BRASS COPPER ALLOY FULL WAY VALVE :

2.2.1 GENERAL : The item includes provision of full way (gate or globe) valve of specified diameter as mentioned in the schedule including fixing. Full way valve is a valve suitable for controlling or stopping the flow in water supply lines.

2.2.2 MATERIAL :

Full way valve shall be of either Brass fitted with a cast iron hand wheel or Gun metal fitted with a C.I. hand wheel or copper alloy as the case may be and shall be of Gate valve type opening full way and of the size as specified conforming to IS 778. The weight of the full way gate valve shall be as per the table given below with a tolerance of 5 percent.

	Flanged arch (Kg)	Screwed arch (Kg)
15	1.021	0.567
20	1.503	0.680
25	2.495	1.077
32	3.232	1.559
40	4.082	2.268
50	6.691	3.232
65	10.149	6.804
80	13.381	8.845

2.2.3 FIXING : The valves shall be fixed in position in the pipeline as shown in the drawing or as directed with necessary socket or union, nuts etc. The screwed, flanged joint shall be made with few turns of fine hemp yarn dipped in linseed oil taken over the threaded ends to obtain complete water tightness.

2.2.4 TESTING : The joints shall be tested to a hydraulic pressure of 1 MPa (10 kg/cm^2) along with the testing of pipe line.

2.2.5 THE RATE INCLUDES FOR :

1. Valve, G.I. fittings, hemp yarn, linseed oil, zinc, fixing and testing.
2. All necessary labour, materials and use of tools.

2.2.6 MODE OF MEASUREMENT : The measurement shall be for each unit valve of specified diameter fixed.

2.2.7 MODE OF PAYMENT : The contract rate shall be for each unit of valve of specified diameter fixed. No extra payment shall be made for G.I. fittings used in fixing of the valve.

3.0. DRAINAGE SYSTEM

3.1. UPVC-SWR PIPING WORK :

3.1.1. GENERAL : The item includes supplying of UPVC soil, waste and rain water (SWR) and ventilation pipes with fittings of specified diameter including laying, fixing, cutting, joining, painting if required etc.

3.1.2. MATERIAL : The pipes shall conforming to IS 13592, UPVC -SWR (Type 'A' or 'B' as specified) and fittings conforming to IS 13591 shall be free from cracks, flaws and defects and shall be U. V. stabilized and able to withstand a pressure as mentioned in the schedule of work. Rubber sealing rings conforming to IS 5382 with lubricant for sliding socket joints as mentioned in the schedule of work.

3.1.3. EXAMINING : Before laying the pipe line, it shall be first examined for damages and cracks, No cracked or damaged pipe and fittings shall be used in the work and they shall be removed from the site by the contractor at his own cost and charge.

3.1.4. CLEANING : All the pipes and fittings shall be thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside and out side surfaces.

3.1.5. LAYING : The pipes shall be carefully laid straight to the correct alignment in gradients as indicated in the drawing. All the pipe shall be used in standard length as far as possible. Cut length may be used only where it is necessary to make up exact length.

The entire length of pipe shall be evenly supported on bed of the trench through out. Care shall be taken to prevent any sand, earth or other materials from entering into the pipes during laying. At the end of day's work the open end shall be suitably plugged.

3.1.6. FIXING : The pipe line shall be fixed in position as shown in the drawing or as directed by the Engineer-incharge. The pipe shall be fixed with G.I. clamps not less than 2.0 mm thick of with suitable UPVC clamps/clips, The clamps/clips shall be fixed into the wall with G.I. nails not less than 40 mm long and wooden gutties keeping the pipe about 15 mm clear of the wall.

3.1.7. MAKING JOINT : The jointing of pipes and fittings generally shall be done with approved make cement solvent including making surface rough or rubber sealing rings with lubricant for sliding socket joints . The pipe shall be cut to desired length. Care shall be taken that that profile or cut surfaces shall not be changed and the fibrous material shall be removed with scraper or knife.

3.1.8. DETACHABLE JOINT : Detachable joints shall be made where pipes of different materials have to be jointed or as

specified in the schedule. The flanges are first pushed over the pipe ends and jointing shall be made by cement solvent.

3.1.9. PAINTING : In case of underground piping, the pipe line shall be painted with two coats of approved oil paint of matching colour over a coat of primer.

3.1.10. THE RATE INCLUDES FOR :

1. Supplying of UPVC-SWR pipes and fittings of specified diameter.
2. Laying and cutting the pipe wherever necessary and wastage.
3. Fixing the pipe line with G.I. clamps not less than 2mm thick and G.I./M.S. nails length not less than 40mm or with UPVC clamps, screws, wooden gutties etc.
4. Making the solution joint and painting if mentioned in schedule of work the pipe line.
5. In case of underground pipes , dewatering if necessary till completion of work.
6. All necessary materials, labour and use of tools.

3.1.11. MODE OF MEASUREMENT : The measurement shall be for unit running meter length of pipe line laid of fixed. The measurement shall be taken along the center line of pipe. No measurement shall be recorded separately for fittings, making joint, painting if mentioned in schedule of work and testing.

3.1.12. MODE OF PAYMENT : The contract rate shall be for unit running meter length of pipe line laid or

3.2. <u>PVC PIPING WORK :</u>

3.2.1. GENERAL : The item includes supplying of PVC pipes with fittings of specified diameter including laying, fixing, cutting, joining, painting etc. for vent, over flow, waste water pipe line etc.

3.2.2. MATERIAL : The pipes and fittings shall conform to series IV of IS 4985, PVC pipes and fittings shall be free from cracks, flaws and defects and shall be able to withstand a pressure as mentioned in the schedule.

3.2.3. EXAMINING : Before laying the pipe line, it shall be first examined for damages and cracks, No cracked or damaged pipe and fittings shall be used in the work and they shall be removed from the site by the contractor at his own cost and charge.

3.2.4. CLEANING : All the pipes and fittings shall be thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside and out side surfaces.

3.2.5. LAYING The pipes shall be carefully laid straight to the correct alignment in gradients as indicated in the drawing. All the pipe shall be used in standard length as far as possible. Cut length may be used only where it is necessary to make up exact length.

The entire length of pipe shall be evenly supported on bed of the trench through out. Care shall be taken to prevent any sand, earth or other materials from entering into the pipes during laying. At the end of day's work the open end shall be suitably plugged

3.2.6. FIXING : The pipe line shall be fixed in position as shown in the drawing or as directed by the Engineer-incharge. The pipe shall be fixed with G.I. clamps not less than 2.0 mm thick of with suitable UPVC clamps/clips, The clamps/clips shall be fixed into the wall with G.I. nails not less than 40 mm long and wooden gutties keeping the pipe about 15 mm

clear of the wall.

3.2.7. MAKING JOINT :. The jointing of pipes and fittings generally shall be done with approved make cement solvent including making surface rough or rubber sealing rings with lubricant for sliding socket joints . The pipe shall be cut to desired length. Care shall be taken that that profile or cut surfaces shall not be changed and the fibrous material shall be removed with scraper or knife.

3.2.8. DETACHABLE JOINT : Detachable joints shall be made where pipes of different materials have to be jointed or as specified in the schedule. The flanges are first pushed over the pipe ends and jointing shall be made by cement solvent.

3.2.9. PAINTING : If mentioned in schedule of work, the pipe line shall be painted with two coats of approved oil paint of matching colour over a coat of primer.

3.2.10. TESTING :TESTING : The joints shall be tested to a hydraulic pressure of 1 MPa (10 kg/cm^2) along with the testing of pipe line.

3.2.11. THE RATE INCLUDES FOR :

1. Supplying of PVC pipes and fittings of specified diameter.
2. Laying and cutting the pipe wherever necessary and wastage.
3. Fixing the pipe line with G.I. clamps not less than 2mm thick and G.I./M.S. nails length not less than 40mm or with PVC clamps, screws, wooden gutties etc.
4. Making the solution joint and painting the pipe line if mentioned in schedule of work.
5. In case of underground piping, dewatering if necessary till completion of work.
6. All necessary materials, labour and use of tools.

3.2.12. MODE OF MEASUREMENT : The measurement shall be for unit running meter length of pipe line laid of fixed. The measurement shall be taken along the center line of pipe. No measurement shall be recorded separately for fittings, making joint, painting and testing.

3.2.13. MODE OF PAYMENT : The contract rate shall be for unit running meter length of pipe line laid or fixed.

3.3. <u>BALL VALVE :</u>

3.3.1 GENERAL : The item includes providing horizontal type ball valve with PVC or copper float of size as mentioned in the schedule including fixing.

3.3.2. MATERIAL : Horizontal plunger type ball valve with PVC or copper float shall be conforming to IS 1703. The lever shall be of brass and may be made in one piece and the diameter of the lever rod shall not be less than the diameter of the thread for boss of ball. Float shall be watertight and non-absorbent and shall not contaminate water. Adhesives for joining the part shall not be used. The minimum thickness for copper sheet of copper float shall be 0.45 mm up to 115 mm diameter and
0.55 mm for ball over 115 mm diameter. Valve shall be tested in closed position to the hydraulic pressure of 2 MPa for a minimum period of 2 minutes without leakage and sweating.

3.3.3. MINIMUM MASS : The minimum mass of finished ball valve and float of different size and class shall be as per Table

No. 8 of IS 1703.

3.3.4. FIXING : Valve shall be fixed in position as indicated in the drawing with necessary socket, union nuts etc. as per site requirements. A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tight joint. Leaking joint if any shall be rectified to make it leak proof.

3.3.5. TESTING : Testing shall be done along with the testing of pipe line, Separate testing if required shall be done as per ISI norms.

3.3.6. THE RATE INCLUDES FOR :

1. Supply of specified diameter ball valve with copper or PVC float & brass lever arm, hemp yarn, linseed oil, zinc etc.
2. All necessary materials, labour and use of tools.

3.3.7. MODE OF MEASUREMENT : The measurement shall be for each ball valve fixed.

3.3.8. MODE OF PAYMENT : The contract rate shall be for each ball valve fixed.

SECTION 'D'- HVAC WORKS
TECHNICAL SPECIFICATIONS

1. VARIABLE REFRIGERANT FLOW / VOLUME

VRF / VRV

General Description

1 All Variable Refrigerant Volume Air Conditioners shall be totally Factory assembled, charged with refrigerant, wired, piped and tested at the factory by OEM.

2 The System shall comprise of Air Cooled scroll, rotary, inverter / digital compressors type Outdoor units, and a variety of indoor units connected by Common Refrigerant Piping,refnets,piping, etc and Power and Control Cabling.

3 All bolts, nuts, screws, washers, plates, etc and all other fittings on all VRV system components shall be plated or passivated to resist corrosion.

VRV/ VRF System

1. The VRV System shall provide stable, trouble free and safe operations, and provide flexibility in operation of Indoor Units with independent control of each Indoor Unit, including stepless partial operation.
2. It shall be possible to switch on only those Indoor Units that require Cooling in individual Areas, zones or shops.
3. The capacity of Indoor and Outdoor Units shall be matched, sleeplessly, and shall include multi Compressor cut off / speed control, by pass or any other means of capacity Control for stable operations of System.
4. The System shall be capable of automatic operation even with varying Outdoor and Indoor requirements and make up of low Outdoor Temperatures to achieve lower Power Consumption, without any manual adjustments.
5. All Systems shall be modular in nature, and easily upgradeable / inter connectable for larger capacities.
6. Units shall have hermetically sealed Scroll Compressors, to ensure high EER.
7. The refrigerant gas shall be necessarily R 410a
8. All Units shall be Air Cooled type.
9. The System shall incorporate all required controls for parallel operation of Compressors, Condensers, Fans, and Indoor Units as well as Refrigerant liquid control.

Power Supply

1. All the units shall be suitable for operation with 415V± 10%, 50Hz ± 3%, 3 phase A.C. supply.

Out Door Units

The Condenser coil shall be Air-cooled type with copper tubes and aluminum fins. The condenser coils shall be of adequate size and shall have an integral sub cooler circuit for sub cooling of the liquid. Condenser coil shall have a refrigerant side working pressure of 400 psig with anti-corrosive treatment.

Condenser shall have multiple piping and cabling connection option. Pump down facility should be provided in the refrigerant system by providing good quality hand / shut off valves to avoid loss of Refrigerant gas during maintenance. The condenser fans shall be propeller type, with aluminum blades, low speed, and low vibration levels and quite in operation with IP 55 Protection.

All the compressors of the outdoor units must be hermetically sealed scroll type. Each module of outdoor unit must have separate 1 No. of inverter compressor, suitable to operate at heat load proportional to indoor requirement.

"Anti-Corrosive" treatment (Blue Fins) for Al fins of Condenser Coils is mandatory and shall carry warranty of at least Five (5) years. The treatment should be suitable for areas of high pollution and salt laden air.

The outdoor units must be suitable for more than 150 Meter Refrigerant piping between outdoor unit & the farthest indoor units and total piping of 300 Meter for all the indoor units. Allowable level difference between outdoor unit & indoor units shall be 50 Meter in case of outdoor unit on top & 40 Meter in case of outdoor unit at bottom. Allowable level difference between various indoor units connected to one out door unit shall be up to 15 m.

Back up operation, in case of failure of one of the compressors of outdoor unit, for single module outdoor units or failure of one of the modules in case of multiple modules outdoor units shall be possible. The VRV outdoor unit shall always be supplying at least 33% of back up operation, of the full load capacity.

The outdoor unit shall employ system of equal run time for all the compressors, inverter or on/ off type, within each out door unit – Single Module or Multi Module.

Starter for the Outdoor Unit compressor shall "Direct on Line" type. Inverter compressor of the unit shall start first & at the minimum frequency, to reduce the inrush current during starting.

Refrigerant control in the outdoor unit shall be through Electronic Expansion Valve. Complete refrigerant circuit, oil balancing/ equalizing circuit shall be factory assembled & tested.

The outdoor units shall confirm to Technological Guideline for Harmonic Suppression – JAEG 9702-1995. High Harmonic Environmental Target Level for Power Distribution system shall be 5%.

Indoor Units

Cassette:

The unit must have in built drain pump, suitable for vertical lift of 750 mm. The unit casing shall be Galvanized Steel Plate. Indoor unit must be insulated with sound absorbing thermal insulation material, Polyurethane foam. The noise level of unit at the highest operating level shall not exceed 45 dB (A), at a vertical distance of 1.5 m from the grille of the unit. Unit shall have provision of connecting fresh air without any special chamber & without increasing the total height of the unit (288 mm maximum). The unit shall be supplied with suitable decorative panel.

The unit shall be supplied with Resin Net filter with Mold Resistance. The filter shall be easy to remove, clean & reinstall. The unit will be connected in series to a suitable out door unit & it must be possible to operate the unit independently, through corded/ cordless remote specified in the "Bill of quantities".

The unit shall be supplied with following from the factory
- Operation Manual
- Installation Manual
- Paper pattern for installation
- Drain hose/ Clamp metal/ Washer fixing plate/ Sealing pads/ Clamps/ Screws/
- Washer for hanging bracket/ Insulation for fitting

Hi wall:

With decorative look to match with the interior Layout of Corded Remote type complete
In PVC construction. Evaporating unit comprising of DX Cooling coils, blower, electric motor, insulated sandwiched drain Tray, and junction box for electrical connections, 20 micron HDPE washable filter etc.

Remote controls:

Wireless / Corded:

Wired / Cordless remote controller shall be supplied as specified in the "Bill of Quantities"

The controller must have large crystal display screen, which displays complete operating status. The digital display must allow setting of temperature with 1° C interval.

Remote shall be able to individually program by timer the respective times for operation start and stop within a maximum of 72 hours

Remote must be equipped with thermostat sensor in the remote controller that will make possible more comfortable room temperature control The remote shall be able to monitor room temperature & preset temperature by microcomputer& can select cool/ heat operation mode automatically. The remote must constantly monitor malfunctions in the system & must be equipped with a "self-diagnosis function" that let know by a message immediately when a malfunction occurs.

In case of corded remote it shall be possible to wire the remote up to 500 RMT.

Group /Central Remote controller / I touch Manager:

Central Control unit shall be suitable for on / OFF and Temperature control of Zones including scheduling, Malfunction and status display shall be available. It should be Compatible with BMS of standard makes. Setting of address for each unit should be automatic and need not be programmed.

Following functions shall be possible
Control Max 64 Groups (128 indoor units)
Zone control
Malfunction code display
All the functions available with wired remote controller It should be possible to wire the remote to 1000m
Central Controller shall be compactable to connect with Fire Detection System

Refrigerant Piping & Insulation:

All refrigerant piping shall be in high grade copper 18 Gauge (1.21 mm) including all connections, Tees, Reducers, etc. Required nos. of Refrigerant joints with insulation should be provided for uniform flow of refrigerant through all Indoor units.
All refrigerant piping shall be insulated with suitable thickness of Closed Cell Elastomeric thermal Insulation material. All joints on the insulation should be sealed with good quality sticking compound. All joints should be covered with 2" wide Aluminum tape. Outersurface of the insulation should come with aluminum foil cladding.

Entire Refrigerant piping inside the building should be installed on the wall / ceiling with proper clamping arrangement and refrigerant piping outside the building (i.e. on Terrace, Shafts) should be properly clamped on MS / GI brackets on the wall of duct / shaft.

Sufficient valving shall be included to allow compressors to be removed for service & to allow the refrigerant to be pumped in to and contained in the condenser. The unit shall be equipped with a liquid line shut off valve, filter drier, liquid line sight glass, and solenoid valve & insulation where required to prevent condensation forming.

Electrical Work:

The electrical work will be carried out as per IE rules. The Employer will provide incoming cable with earthling for each outdoor unit. The further distribution of control cabling and earthling of GI shall be carried out by the contractor.

Drain Piping:

Condensate from the Indoor unit shall be drained through properly installed drain piping designed to prevent any accumulation of condensate in the drain pan. Drain piping shall be made of rigid PVC pipe of 6 Kg/cm sq. pressure rating with water tight threaded connections. Leading from the Indoor unit to a suitable drain point. Complete drain piping shall be made leak proof and water tight by means of precise installation and the use of leak proof sealant / adhesives.

2. VENTILATION AND EXHAUST

Scope:

1. Scope of work under this section comprises the supply, erection, testing and commissioning of the ventilation / exhaust system of the capacities set forth in the Schedule of Equipment.

2. All fans shall be static and dynamically balanced.

Cabinet Supply/Exhaust Units:

1. Units shall be complete factory assembled, tested and of approved manufacturers.

2. Casing shall be of heavy gauge galvanized sheets, ribbed and reinforced with access provided by hand holes and casing panels.

3. Fans shall be driven by an electric motor as specified in the Schedule of Equipment. Motor ratings are only tentative and where a fan requires a higher capacity motor, the Contractor shall clearly point out the requirements and make his offer accordingly. Motor ratings shall be at least 5% over transmission losses.

4. Fan shall have limit switch with Aluminium wire guard to shut off the fan.

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Testing And Balancing

1. After the installation of the entire system is completed in all respects, system shall be tested & balanced for required performance. Fan shall be tested for the performance and test results shall be furnished.

Painting

1. On completion of the erection and testing, fans shall be painted with the two coats of an appropriate paint of approved color.

FILTERS :

1. Filters shall be non-flammable 90% efficiency down to 10 microns. Filters shall be cleaned by dusting or reverse air-blown.

Installation:

The concrete foundations required for the fans shall be prepared by the Owner to the drawings supplied by the Contractor. However, the Contractor shall supply all foundation bolts, base plate, wherever required, vibration eliminators, etc. and shall also ensure that all the above accessories are placed securely in proper position while the foundation is cast.

Vibration eliminators shall be provided with an efficiency of not less than 80%.

Fan inlet and outlet connections shall be by means of flexible canvas connections.
Fan belt drive shall be complete with belts, belt, sheaves and suitable belt guard.

Testing:

1. Fan shall be tested for the performance and test results shall be furnished as given in Section TEST READINGS'.

Painting:

1. On completion of the erection and testing, fans shall be painted with the two coats of an appropriate paint of approved color.

3. SHEET METAL WORK

Option – I (Factory Fabrication As Per Smacna Standards)

Scope

The scope of this section comprises supply fabrication, installation and testing of all sheet metal / aluminum 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

Duct Materials

Raw Materials

Galvanizing shall be Class VII – light coating of zinc, nominal 180gm/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.

Gauges, Bracing By Size Of Ducts

All ducts shall be fabricated from galvanized steel / aluminum of the following thickness, as indicated as below :

For Ducts with external SP upto 250 Pa (To be used for Hotels & Commercial Projects)

Rectangular Ducts G. S.	Pressure 250 Pa		
	Duct Section Length 1.2 m (4 ft)		
Maximum Duct Size	Gauge	Joint Type	Bracing Spacing
1–750 mm	26	C & S/ SS	Nil
751 – 1000 mm	26	4 Bolt Transverse Duct Connector-(TDC) / Slip-on E	Nil
1001 – 1200 mm	24	4 Bolt TDC / Slip-on E	Nil
1201 – 1500 mm	24	4 Bolt TDC / Slip-on F	Nil
1501 – 1800 mm	22	4 Bolt TDC / Slip-on H	Nil
1801 – 2100 mm	20	4 Bolt TDC / Slip-on I	Zeebar Stiffener 1-S

2101 – 2700 mm	18	4 Bolt TDC / Slip-on I	Zeebar Stiffener 1-S

OR

For Ducts with External SP upto 500 Pa (For Hospital & Clean room jobs, where AHU SP is specified as 75 mm and above. Not Suitable for OTs)

Rectangular Ducts G. S.	External Pressure 500 Pa		
	Duct Section Length 1.2 m (4 ft)		
Maximum Duct Size	Gauge	Joint Type	Bracing Spacing
1–600 mm	26	C & S/ SS	Nil
601-750 mm	26	4 Bolt Transverse Duct Connector- (TDC) / Slip-on E	Nil
751-1000 mm	24	4 Bolt TDC / Slip-on F	Nil
1001-1200 mm	22	4 Bolt TDC / Slip-on G	Nil
1201-1300 mm	20	4 Bolt TDC / Slip-on H	Nil
1301-1500 mm	18	4 Bolt TDC / Slip-on H	Zeebar Stiffener 1-S
1501-1800 mm	18	4 Bolt TDC / Slip-on I	Zeebar Stiffener 1-S
1801-2100 mm	18	4 Bolt TDC / Slip-on J	Zeebar Stiffener 2-S
2101-2250 mm	18	4 Bolt TDC / Slip-on J	Zeebar Stiffener 2-S
2251-2400 mm	18	4 Bolt TDC / Slip-on J	Zeebar Stiffener 2-S
2401-2700 mm	18	4 Bolt TDC / Slip-on J	Zeebar Stiffener 2-S

'C'-cleat; 'S'-S cleat; 'SS'-Standing S cleat;

*Distance of reinforcement/bracing from each joint. Bracing material to be same as of material used for joining of duct sections.

For Aluminum Ducts Material Shall Be One Commercial Gauge Higher With 22 G as Minimum

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.
3. All edges to be machine treated using lock formers, flanges and rollers for turning up edges.

Duct Construction

All ducts shall be fabricated and installed in workmanlike manner, conforming to relevant SMACNA codes.

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.

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 airtightness.

All ducts up to 75cms width within conditioned spaces shall have slip and drive (C & S/SS) joints. The internal ends of slip joints shall be in the direction of airflow. Care should be taken to ensure that S/SS 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.

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.

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.

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.

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.

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.

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:

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

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.

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.

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.

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.

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.

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.

Duct shall not rest on false ceiling and shall be in level from bottom. Taper pieces shall taper from top.

Dampers

a. Dampers : All duct dampers shall be opposed blade louver dampers of robust 16 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.

Supply And Return Air Grilles

Supply &return air grilles shall be of either steel oraluminum sections as specified in schedule of quantities. Steel construction registers shall have primer Coat finish whereas extruded aluminum grilles / registers shall be either Anodizedor Powder Coated as specified inSchedule of Quantities. These registers shall have individually adjustable

louversboth horizontal and vertical. Supply air registers shall beprovided with key operated opposed blade extruded aluminumvolume control damperanodized in matt black shade.

The grilles / 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 3.8 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 besuitable for concealed fixing. Volume control dampers of extruded aluminumanodized 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 softcontinuous 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 up to 30 degree deflection downwards. Bars shall hold deflection settings under allconditions 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 anodizedaluminum in mat black shade.

f. In case of continuous grilles / diffusers, dummy grilles shall be blanked-off using GI sheet duly painted black.

g. All square / rectangular diffusers, slot diffusers to have insulated plenum installed above dampers from OEM factory & not to be constructed at site.

Documentation & Measurements For Ducting

All ducts fabricated and installed should be accompanied and supported by proper documentation viz:

a) Bill of material/Packing list for every duct section supplied.

Measurement sheet covering each fabricated duct piece showing dimensions and external surface area along with summary of external surface area of duct gauge-wise.

Each and every duct piece to have a tag number, which should correspond to the serial number, assigned to it in the measurement sheet. The above system will ensure speedy and proper site measurement and verification.

Unless otherwise specified, measurements for ducting for the project shall be on the basis of centerline measurements described herewith

Ductwork shall be measured on the basis of external surface area of ducts. Duct measurements shall be taken before application of the insulation. The external surface area shall be calculated by measuring the perimeter comprising overall width and depth, including the corner joints, in the center of each duct section, multiplying with the overall length from flange face to flange face of each duct section and adding up areas of all duct sections. Plenums shall also be measured in a similar manner.

For tapered rectangular ducts, the average width and depth shall be considered for perimeter, whereas for tapered circular ducts, the diameter of the section midway between large and small diameter shall be adopted, the length of tapered duct section shall be the centerline distance between the flanges of the duct section.

For special pieces like bends, tees, reducers, branches and collars, mode of measurement shall be identical to that described above using the length along the centerline.

The quoted unit rate for external surface of ducts shall include all wastage allowances, flanges and gaskets for joints, nuts and bolts, hangers and angles with double nuts for supports, rubber strip 5mm thick between duct and support, vibration isolator suspension where specified or required, inspection chamber/access panel, splitter damper with quadrant and lever for position indication, turning vanes, straightening vanes, and all other accessories required to complete the duct installation as per the specifications. These accessories shall NOT be separately measured nor paid for.

b. Special Items for Air Distribution shall be measured bythe cross-section area perpendicular to air flow, as identified herewith:

i. Grilles and registers - width multiplied by height, excluding flanges. Volume control dampers shall form part of the unit rate for registers and shall not be separately accounted.

II. Flexible connection - shall be measured by their cross sectional area perpendicular to the direction of air flow. Quoted rates shall include the necessary mounting arrangement, flanges, nuts and bolts and treated-for-fire requisite length of canvas cloth.

Testing And Balancing

After the installation of the entire air distribution systemis completed in all respects, all ducts shall be tested for air leaks by visual inspection as per SMACNA standards.

The entire air distribution system shall be balanced using an anemometer. Measured air quantities at fan discharge and at various outlets shall be identical to or less/excess than 5 percentin excess of those specified and quoted. Branch duct adjustments shall be permanently marked after air balancingis completed so that these can be restored to their correctposition if disturbed at any time. Complete air balance report shall be submitted for scrutiny and approval, and four copies of the approved balance report shall be provided with completion documents.

Option- II (Site Fabrication)

AIR DISTRIBUTION

(AS PER " BIS" STANDARD)

1 SCOPE

The scope of this section comprises supply fabrication installation and testing of all sheet metal / aluminum ducts, supply installation testing and balancing of all grilles registers and diffusers, in accordance with these specifications

and the general arrangement shown on the Drawings.

2 DUCT MATERIALS

All ducts shall be fabricated from galvanized steel sheets /aluminum sheets of the following thickness as indicated in Schedule of Quantities.

	G S S
Rectangular ducts up to 75 cm	24 gage
Rectangular ducts 76 to 150 cm	
And all round ducts.	22 gage
Rectangular ducts 151 to 225 cm	20 gage
Rectangular ducts greater than 225 cm	18 gage

1. Sheet metal ducts shall be fabricated out of galvanized steel sheets. Fabrication of ducts shall be through well conditioned Triplex lockformer or multiple lock formers, conforming to relevant BIS Codes. Sheets used shall be produced by Hot Dip Process and galvanizing shall be Class VII - Light Coating of zinc, Nominal 180 gm /Sq m surface area.

2. Samples of sheet from each lot selected at random by Owner's site representative shall be subject to approval & gotten tested for thickness and zinc coating at contractor's expenses.
3. All ducts shall be fabricated and installed in workmanlike manner, generallyconforming to relevant BIS Codes. Round exposed ducts shall be die-formed for achieving perfect circle configuration.

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.

b. Ducts shall be straight and smooth on the inside withneatly finished joints. All joints shall be made air tight.

c. All exposed ductsup to 60 cm width within conditionedspaces shall have slip joints - or flanged joints. The internal ends of slip joints shall be in the direction of air flow. 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. Air-turns (Vanes) shall be installed in all bends and duct collars designed to permit theair 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 gage GSS / 16 gauge aluminum, thoroughly stiffened with 25 mm x 25 mm x 3 mm galvanized steel angle braces and fitted with all necessary inspection doors as required, to give access to all parts of the apparatus. Doors shall be not less than 45 cm x 45 cm in size.

g. Plenums shall be panel type and assembled at site. Fixing of galvanized angle flanges on duct pieces shall be with rivets heads inside i.e. towards G S sheet and riveting shall be done from outside.

h. Self adhesive rubber lining minimum 5 mm thick instead of felt shall be used between duct flanges and between duct and duct supports inall ducting installation.

4. 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 meetwith 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 duct work 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 under ducts at no greater than 2 meter centre. All vertical duct work shall be supported by structural members on each floor slab. Duct supports may be through galvanised steel insert platesleft in slab at the time of slab casting. Galvanizedsteel cleat with a hole for passing the hanger rods shall be welded to the plates. Trapeze hanger formed of galvanized steel rods and angles/ channels shall be hung through these cleats. Wherever use of metal insert plates isnot 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.

e. Ducting over furred ceiling shall be supported from theslab above, or from beams, after obtaining approval of Owner's site representative. In nocase shall any duct besupported from false ceiling hangers or be permitted torest on false ceiling. All metal work in dead or furreddown spaces shall be erected in time to occasion no delay to other Contractor's work in the building.

Where ducts pass through brick ormasonry openings, it shall be provided with 25 mm thick TF quality expanded polystyrene around the duct and totally covered with fire sealant such as fire barrier mortar for complete sealing.

h. All ducts shall be totally free from vibration under all conditions of operation. Whenever duct work 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 flame retardant, water proof, silicon rubber impregnated flexible connection at least 10 cm long securely bonded and flange bolted on both sides. Sleeve shall be made smooth and the connecting duct work 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.

j. Duct shall not rest on false ceiling and shall be in level from bottom. Taper pieces shall taper from top.

Dampers

a. Dampers: All duct dampers shall be opposed blade louver dampers of robust 16 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 operableand accessible through suitableaccessdoorin the duct. Every damper shallhave 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.

Supply And Return Air Grilles

Supply &return air registers shall be of either steel oraluminum sections as specified in schedule of quantities. Steel construction registers shall have primer Coat finish whereas extruded aluminum Grilles shall be either Anodizedor Powder Coated as specified inSchedule of Quantities. These registers shall have individually adjustable louversboth horizontal and vertical. Supply air Grilles shall beprovided with key operated opposed blade extruded aluminumvolume control damperanodized in matt black shade.

The Grilles 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 3.8 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 besuitable for concealed fixing. Volume control dampers of extruded aluminumanodized 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 Grilles 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 Grilles shall have a softcontinuous 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. Grilles / Registers specified with individually adjustable bars shall have adjustable pattern as each grille bar shall be pivot able to provide pattern with 0 to +45 degree horizontal arc and up to 30 degree deflection downwards. Bars shall hold deflection settings under allconditions 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.

f. In case of continuous grilles / diffusers, dummy grilles shall be blanked-off using GI sheet duly painted black.

g. All square / rectangular diffusers, slot diffusers to have insulated plenum installed above dampers from OEM factory & not to be constructed at site.

Measurements For Ducting

Unless otherwise specified, measurements for ducting for the project shall be on the basis of centre-line measurements described herewith :

a. Duct Work shall be measured on the basis of external surface area of ducts. Duct measurements shall be taken before application of the insulation. The external surface area shall be calculated by measuring the perimeter comprising overall width and depth, including the corner joints, in the centre of each duct section, multiplying with the overall length from flange face to flange face of each duct section and adding up areas of all duct sections. Plenums shall also be measured in similar manner.

For tapered rectangular ducts, the average width and depth shall be considered for perimeter, whereas for tapered circular ducts, the diameter of the section midway between large and small diameter shall be adopted, the length of tapered duct section shall be the centre line distance between the flanges of the duct section.

For special pieces like bends, tees, reducers, branches and collars, mode of measurement shall be identical to that described above using the length along the centre line.

The quoted unit rate for external surface of ducts shall include all wastage allowances, flanges and gaskets for joints, nuts and bolts, hangers and angles with double nuts for supports, rubber strip 3 mm thick between duct and support, vibration isolator suspension where specified or required, inspection chamber / access panel, splitter damper with quadrant and lever for position indication, turning vanes, straightening vanes, and all other accessories required to complete the duct installation as per the Specifications. These accessories shall NOT be separately measured nor paid for.

b. Special Items for Air Distribution shall be measured by the cross-section area perpendicular to air flow, as identified herewith :

i. Grilles and registers - width multiplied by height, excluding flanges. Volume control dampers shall form part of the unit rate for registers and shall not be separately accounted.

ii. Flexible connection - shall be measured by their cross sectional area perpendicular to the direction of air flow. Quoted rates shall include the necessary mounting arrangement, flanges, nuts and bolts and treated-for-fire requisite length of canvas cloth.

Testing And Balancing

After the installation of the entire air distribution system is completed in all respects, all ducts shall be tested for air leaks by visual inspection as per BIS standards.

The entire air distribution system shall be balanced using an anemometer. Measured air quantities at fan discharge and at various outlets shall be identical to or less/excess than 5 percent in excess of those specified and quoted. Branch duct adjustments shall be permanently marked after air balancing is completed so that these can be restored to their correct position if disturbed at any time. Complete air balance report shall be submitted for scrutiny and approval, and four copies of the approved balance report shall be provided with completion documents.

4. ELECTRICAL INSTALLATION

Scope

Scope of this section comprises the supply and installation of all electrical equipment such as motors, motor control centres, starters, cables, interlocks, etc. as required.

Codes, Standards and Statutory Regulations

Codes, standards and statutory regulations to be used for design and constructions are given below. In general all equipment, material as well as design and constructions shall be in accordance with the latest issues of Indian and relevant standards currently in force. The installation shall be carried out in accordance with the Indian Electricity Act and Rules.

Electric Supply System/Rated Voltage

415 volts, 3 phase, 4 wire, 50 Hz with solidly grounded neutral.

Variation in electric supply under which motor shall be operated continuously without any adverse effect will be as follows :

a) Voltage : +/- 5%

b) Frequency : +/- 5% variation

c) Any combination of voltage and frequency.

Equipment and Materials

All equipment shall be as per specifications, and/or drawings supplied along with the tender documents. Equipment/materials shall be suitable for local climatic conditions as specified in the tender.

All equipment shall be of robust construction. Enclosure of equipment shall be dust, damp and vermin proof. Equipment for outdoor installation shall have weather proof enclosures requiring no further protection by the purchaser.

Approval

The Contractor shall be responsible for obtaining approval of drawings from statutory/local authority as required.

Motor Control Centre

Motor control centre shall consist of incoming switch fuse units/isolator and a starter mounted inside the wall or floor mounting type cubicle made out 2 mm thick MS sheet. Anti corrosion and phosphatising treatment shall be given to the sheets by a standard 5 tank/7 tank process.

All feeders shall be provided with two position (on-off) isolators, load break and quick make and break type. All isolators shall be suitable for front of board operation. Isolators for motor feeders shall preferably be of the 'motor duty' type i.e. capable of interrupting the locked rotor current of induction motors, which will be 6/8 times the full load current.

Isolators shall be interlocked with door to prevent opening or closing of the door in the closed ('ON') position of the isolator, in case of compartmental type of feeders. All live terminals on the isolators shall be adequately shrouded to prevent accidental contact and danger to the personnel.

Caution name plate "CAUTION LIVE TERMINALS" shall be provided at all points where the terminals are likely to remain live and isolation if possible only at remote ends e.g. Incoming Terminals of Incomer.

Fuses & Fuse Fittings

All fuses shall be of the non-deteriorating, high rupturing capacity, link, mounted in suitable fuse carriers or fuse bases.

Contactors

1. Contactors shall be magnetic, air break type, generally in accordance with BS 775/IS 2959.

2. All contactors in power circuits of motor starters or other feeders shall be adequately rated for the duty required and operating conditions. Minimum rating shall, however, not be less than 16 amps.

3. Contactor coils shall preferably be of draw out type for easy replacement. Coil voltage shall be 220V AC. Contactor coils shall operate satisfactorily between 110% and 85% of the nominal coil voltage. Drop off voltage for AC coils shall be between 80% and 45% of the nominal voltage.

4. Making and breaking capacities of the contactors shall be suitable for AC2 and AC3 categories of duty as per IS 2959 unless the contactors are required for special duty such as inching or plugging duty or capacitor duty, in which case, they will be suitably rerated.

5. Each contactor shall be provided with 4 normally open and 4 normally closed auxiliary contacts or as required by the control scheme. If necessary, auxiliary relays or contactors may be provided to obtain necessary number of auxiliary contacts. Auxiliary contacts shall preferably be convertible from NO to NC and vice versa.

Protective Devices

All feeders shall be protected by appropriate protective devices such as fused, combined bimetallic thermal overload and single phasing preventer relays.

Single phasing preventer relays (SPPRS) shall operate on the principle of unbalanced currents due to single phasing. BMR's and SPPRs shall preferably have a change over contact which can be converted from hand reset to self reset and vice versa and used for contactor control as well as alarm/indication.

Current transformer, when specified, shall be of bar primary, ring type or wound type, and in accordance with IS 2705 or BS 2046 or BS 81. Class and ratio of CTs shall be specified. VA burden of CTs shall be suitable for the load burden.

Ammeters (144 square) voltmeters, PF meters, Run Hour meters and Kilowatt Hour meters shall be provided and shall be of industrial grade accuracy, suitable for flush mounting and in accordance with IS 1248. Suitable selector switches shall be provided in conjunction with ammeters and voltmeters.

Indicating Neon lamps used shall be of low voltage, low burden type with series resistor to increase lamp life and to protect equipment from short circuits caused by broken filaments. Lamp covers shall be provided with interchangeable colored lenses of Perspex or equivalent unbreakable materials. Lenses should not get discolored in course of time, due to the heat generated by the lamps. Name plates showing the condition indicated by the lamp shall be affixed near to the lamps.

Rating of terminal blocks for power and control circuits shall be at least 30 Amps and 15 Amps respectively. Terminals in control circuits shall be suitable for receiving one conductor per terminals of specified sizes. Terminals for power circuits shall be designed for receiving aluminum conductors and shall be screw clamp type or equal. Terminals for control circuit shall be suitable for receiving copper conductors. Star/Lock/Shake proof or Spring Washers shall be provided to prevent

sparking due to vibrations. Special terminals with copper strips mounted on insulating supports may be provided for large cables. Where terminals, suitable extension bars with off- set may be provided.

Location of controls for motor starters or other feeders shall be specified. Normally one 'stop' push button with stay-put feature (lockable) and one reset push button for hand resetting of BMR shall be provided on the door of the compartment. Colors used for push buttons shall be as follows :

Stop push button - Red

Start push button - Green

Reset push button - Black

(Note: In case 'Stop', and 'Reset' are combined, only red colors will be used.) Name plates indicating the function of the push button shall be affixed near to the push buttons.

Wiring

Internal wiring of MCCs for power and control shall be carried out with copper conductor PVC insulated cables of PVC covered copper/ aluminum tapes.

Wiring of components mounted on doors shall be carried out with single strand 2.5 sq. mm copper conductor flexible cables. Wires and cables shall be neatly arranged and bunched together with suitable clamps made of insulating material. Wire harnesses shall be adequately supported along the MCC metal work.

Identification ferrules or tags shall be attached to each wire at each point connection.

Sizes of conductors for power wiring shall be determined by the manufacturers on the basis of full load current under specified conditions, protective fuse rating and appropriate rating factors as applicable. Minimum size of conductor shall be 2.5 sq. mm Minimum size of conductor for control wiring shall be 1.5 sq. mm.

The following color code shall be used for determining the colors of wires used for internal wiring. Manufacturer shall obtain specific approval of the purchases, if this color coding cannot be observed for any reason whatsoever :

Earth - Green
Neutral - Black

230V, A.C. phase - Red/Yellow/Blue,
To neutral Black

All wiring shall be carried out in accordance with approval and certified panel wiring diagrams. Vendor shall check all wiring from point to point for correctness. All wires shall be numbered and the numbers shall be indicated on the relevant drawings.

Earthling

All metal work of the MCC and non-current carrying metallic parts of the equipment in the MCC shall be securely bonded together by adequate means e.g. use of earthling washer for bolted connections or tapped holes for mechanical connections. One copper earth bus running through the entire length of the MCC shall be provided preferably along with the terminal chambers. Size of the earth bus shall be such as to withstand phase to earth or 2 phases to earth short circuit

for one second. The minimum size of the bulbar shall be 25 x 3 mm. The terminals complete with hardware and cable sockets shall be provided on the earth bus for connection to external system.

Name Plates and Labels

1. One name plate giving designation of the MCC shall be affixed prominently on to the MCC. (Details of designation will be given). Each feeder shall also be labeled giving following details :

   i) Feeder No.
   ii) Feeder Designation (Eqpt.Ref.No.etc.)
   iii) Description
   iv) Rating (HP/KW/Amps)

2. All components whether mounted inside the MCC or on the door shall be permanently and clearly labeled with their reference number and/or letter or their function (rating of fuse shall form part of the fuse designation).

3. Labels for feeder designation shall be of laminated plastic or rear engraved Perspex with white letters on black background.

4. Labels for feeder designation shall be fixed on the doors on respective feeders with chrome-plated self tapping screws. Designation labels shall be identical in size to permit interchanging if required later.

Miscellaneous

All hardware used shall be plated or passivated to resist corrosion. Type of plating or passivation shall be subject to the approval of the Consultant. All fixing screws shall preferably be raised head type.

Drawings

1. Contractor shall furnish the following to the Consultant for his approval before commencement of fabrication :

   a. General Arrangement Drawing showing overall dimensions, arrangement of feeders, foundation plan, positions of cables entries, weight of MCC and sections in which MCC will be dispatched.

   b. Single Line Diagram for the MCC showing rating of various components used for all feeders complete with feeder numbers, designations, descriptions, ratings, etc.

   c. Schematic and panel wiring diagrams for all feeders.

   d. Terminal plan for MCC, showing feeder numbers, terminal numbers and terminal markings.

1. After the final approval, six prints and one clear film reproducible of each of the above drawings shall be furnished.

2. The Contractor shall note that he shall bear full responsibility for any error, discrepancies, omissions, etc. in the drawings irrespective of whether such drawings have been approved or not. Approval of drawings shall not relieve the Contractor of his liability to complete the work in accordance with the specifications and other conditions of contract nor shall it exonerate the vendor from any of his guarantees.

Testing and Inspection

1. The following tests shall be carried out on the Motor Control Centres after completion of all work :

i) All power and control circuits for MCCs shall be tested for insulation resistance with a 500 volt megger, before and after the high voltage test.

ii) High voltage test shall be carried out on all power and control circuits at 2000 volts A.C. voltage applied for one minute.

iii) Low voltages continuity test on all power circuits shall be carried out from busbars to the outgoing terminals of each feeder with switches and contactors in closed position.

iv) All control circuits and operations of equipment for all feeders shall be checked with only control supply made available to ensure satisfactory opera-tion of all equipment such as push buttons, BMR reset, indicating lamps, timing relays, etc. All contactor coils shall be checked for presence of humming or chattering. Special requirements for various feeders indicated in the purchase data sheets shall also be checked.

v) Earth continuity test shall be carried out with a low voltage supply of not more than 6 volts, between various non- current carrying metallic parts of equipment, steel work, etc. and the earth bus provided in the MCC.

vi) Operation of all instruments and meters provided on the MCC shall be checked.

2. All the tests listed above shall be carried out in the present of Owner's representative, during final inspection. Contractor shall provide all facilities such as power supply, testing instruments and apparatus required for carrying out the tests.

3. Contractor shall give a notice of not less than two weeks for inspection and testing by the Owner's representative.

Electric Motors

Rating & Duty

1. Rating of the motors shall be as indicated in the Schedule of Equipment. Where the equipment supplied needs a higher rated motor, the Contractor shall clearly point out and motors shall be offered accordingly.

2. All motors shall be rated for continuous duty at maximum output.

3. Rated voltage for three phase motors shall be 415 volts.

Design Features

1. Motor body shall be of close grained cast iron construction and shall be provided with lifting hooks or eye bolts. The motor along with the fan and half coupling shall be dynamically balanced.

2. Fan provided for fan cooled motor shall be non-directional type.

Enclosure/Protections

1. Enclosure for motors shall be totally enclosed fan cooled (TEFC) unless otherwise specified - SPDP motors shall be used only where the desired output is not obtainable in a TEFC frame.

2. All outdoor motors shall be TEFC weather proof type.

3. Degree of protection for all motors shall be IP 44 as per IS 491.

4. Two earthing terminals comprising terminals studs, two plain washers, one spring washer and nut shall be provided on opposite sides of the frame. Studs shall be suitable to receive appropriate size of earth conductor.

Bearings

All motors shall have ball and/or roller bearings with limit lubricators.

Terminal Box

1. Terminal box shall be of ample size, suitable for termination of aluminum conductor cables (with cable sockets) which may be substantially derated for conditions of installation.

2. Motor terminals shall be of stud type, substantially designed and well insulated from the frame. Each terminal shall be complete with two flat washers one lock nut.

3. Number of terminals shall be as given below :

4. Squirrel Cate Motors upto 3.7 Kw - 3 Nos.

   Squirrel Cage Motors upto 3.7 Kw
   (with tinned copper links for
   delta connection) - 3 Nos.

   Slip Ring Motors - 3 Nos.

5. Terminal boxes of all motors shall be rotable in steps of 90 degrees, without disturbing the motor winding connections to the terminal block. Separate terminal box shall be provided for connections to anti-condensation heaters in case of motors about 50 HP. If heater terminals are provided in the main terminal box, then insulating barrier shall be provided between them with caution name plate affixed on the terminal box. "CAUTION - LIVE HEATER TERMINALS."

6. Separate terminal boxes for starter and motor leads to be provided for slip ring motors. Where it is not feasible, an approved type of insulating barrier to be provided.

Temperature Rise

The temperature rise of motors when tested in accordance with IS 325 shall not exceed the limits specified therein.

Starting of Motors

1. All squirrel cage motors shall be suitable for full voltage starting. Motors of 10 HP and above will generally be started with star/delta or auto transformer starters which, in addition to protective devices, shall be provided with single phasing preventer.

2. Starting current at full voltage of slip ring motors shall be limited by the rotor resistance starter. Motor manufacturer shall furnish appropriate value of external resistance required to limit the starting current as well as to obtain the required torque. However, starting current with slip rings shorted shall not exceed 600% of full load current. Starting

current of squirrel cage motors with full voltage starting shall not exceed 600% of the full load current with tolerance specified in IS 325.

3. Starting torque of squirrel cage motor started on full voltage shall not be less than 200% of the full load torque. Pull out torque of motors shall not be less than 200% of the full load torque.

Insulation

1. All motors shall have Class 'D/F' insulation unless the ambient temperature or other conditions necessitate another class of insulation.

All materials used in the construction of motors shall be non-hygroscopic.

Painting

All motors shall be painted in an approved manner using two priming coats and two finish coats. The final color shall be to the Owner's requirements.

Performance Particulars

1. Following performance particulars for all motors to be furnished well in advance before finalizing orders for motors :

a) Make

b) Type

c) Enclosure

d) Class of Insulation

e) Temperature Rise above 40 Deg.C ambient

f) Rated Output

g) Speed

h) No load current

i) Full load current

j) Locked rotor current

k) Starting torque (DOL)

l) Efficiency at full load, 3/4 load, 1/2 load

m) Power factor at full load, 3/4 load, 1/2 load

n) Details of rating for space heater

o) Max. Size of aluminum conductor cable which could be connected to motor

p) Rotor current at rated output

q) Value of rotor resistance for different torque values

MV Distribution Boards

Construction

1. The salient features of constructions panels shall be as follows :

2. Sheet Steel - 2 mm thick for frames, cable gland plates and equipment mounting plates and 1.6 mm thick for front and rear doors and covers

3. Welded construction, with shipping section bolted together. All such joints to gasketted. Lifting lugs to be provided.

4. The cubicles shall be totally dust and vermin proof conforming to IP 54 of IS 2147.

5. All doors to be hinged type except busbar chamber covers which shall be bolted type. The panel shall be of flush front design, suitable for access from front and rear.

6. The construction shall be such as to facilitate easy extension at both ends.

7. The design shall be such as to have individual feeders in separate compartments, with proper barriers between adjacent feeders, busbar chamber and cable box chambers.

Painting

1. All sheet steel work shall be properly cleaned and degreased. Rust and scale shall be removed by picking and phosphatising. After phosphatising, two coats of primer shall be applied followed by two coats of finishing synthetic enamel paint of approved shade as per IS-5. The painting shall be stove enameled.

Air Circuit Breakers

1. The circuit breaker shall be air-break, horizontal draw-out feature shall show 3 positions viz. SERVICE, TEST and ISOLATED. These positions along with 'OPEN' and 'CLOSE' positions shall be visibly marked.

2. All positions shall have provisions for locking. The ACB shall have shutter assembly and arc-chutes and mechanical trip features.

3. The ACB shall have 6 NO + 6 NC auxiliary contacts rated at 10 A, 240 V, AC.

4. 'RED' and 'GREEN' indicating lamps shall be provided on the cubicle.

5. The ACB door shall not have any lamps or instruments. All such accessories shall be mounted on a separate compartment.

6. The ACB shall have proper interlocks such that it cannot be 'plugged in or out'' 'SERVICE' position, if the breaker is in

'ON' condition. It shall not be possible to operate as circuit breaker unless it is properly engaged in any of the three positions.

7. The ACB shall have series CI operated over- current and short-circuit releases with facilities to mount the under voltage and shunt-trip releases.

8. The operating mechanism shall be independent, manual spring charged stored energy type. The mechanism shall ensure quick-break, quick make action and the ACB shall be trip-free in operation.

Air Break Switches

1. The air break switches shall be of AC23, (heavy) duty, quick make-quick break, fault- make type as per IS 4047. The contacts shall be silver plated.

2. The switches shall be capable of withstanding the mechanical and thermal stresses produced by overloads and short circuits.

3. All switches of all ratings shall have inter- locks with the compartment doors. Switches of 250 A and above shall be lockable in the 'OFF' position. All live parts shall be shrouded. It shall be possible to intention- ally defeat the interlocks if required.

4. 'RED' indicating lamp shall be provided for 'ON' indication.

Fuses:

All fuses shall be of HRC cartridge fuse-link type having a certified rupturing capacity of not less than 46 KA at 415 volts AC. The HRC fuses shall conform to IS 9224 1979. All fuses shall have visible indication to indicate 'Blown' condition.

HRC Fuse Carriers

1. The HRC fuse carriers/bases shall be of high grade phenolic moldings. The contacts shall be silver plated and the contact blocks shall be suitable to receive the rated conductors of aluminum.

2. The fuse carriers shall have an aperture to view the conditions of HRC fuse mounted inside.

Contactors

1. The motor starter contactors shall be of the electro-magnetic, double-break, non-gravity type rated for uninterrupted duty suitable for operation under AC 3 utilization category as per IS 2959. The contacts shall be silver plated.

2. 2 NO and 2 NC auxiliary contacts shall be included.

3. The operating coils shall have Class 'E' insulation of wire and shall be suitable for operation of any specified control supply system.

Thermal Overload Relays

1. The thermal overload relays shall be 3 element, positive action, ambient temperature compensated with a time lag and adjustable settings. The setting range shall be selected in accordance with the ratings of the motor.

2. The relay shall be self-reset/hand reset as called for in the case of hand-reset, the reset button shall be fixed on the compartment door.

3. The relay shall have at least one 'NC' and one 'NO' or one change-over contact.

Moulded Case Circuit Breakers

1. The moulded case circuit breakers, MCCBs shall be provided where certified. The MCCBs shall conform to the latest applicable IS 2516-1977.

2. For AC Circuits the MCCBs shall be triple pole construction and shall have independent manual opening and closing mechanism. The mechanism shall be quick-make and quick-break type and the breakers shall be trip-free in operation. The 'ON'. 'OFF' and 'TRIP' mechanism shall be clearly indicated.

3. Bolted type neutral link to be provided with TP MCCB.

4. It shall be possible to mount accessories on the MCCBs like shunt-trip and under voltage release, alarm contacts, etc.

5. The MCCBs shall have thermal/static trip devices.

6. The MCCBs shall have rupturing capacities as specified in BOQ/Single Line Diagram.

Miniature Circuit Breakers

1. The MCBs shall be of single pole, double pole, triple pole or four pole as required. The MCBs shall be of magnetic type with a maximum rupturing capacity of 9 KA at 415 V.

Current Transformers

1. The CTs shall be of dry type and shall have short-time withstand rating equal to the short-time withstand rating of the associated switchgear for 1 second.

2. The measuring instrument CTs shall be of 15 VA, minimum accuracy class 1.0 and an instrument safety factor of 5.

3. The protection relay CTs shall be of 15 VA, minimum accuracy class 5P and an accuracy limit factor of 10.

Indicating Instruments and Meters

1. Electrical indicating instruments shall be 72 mm/96 mm/144 mm square size, suitable for flush mounting.

2. The zero adjustment shall be done from outside the cover.

3. The dials to be parallax free with black numerals on a white dial.

Indicating Lamps

1. Indicating lamps shall be of the filament type and of low watt consumption, provided with series resistors and HRC fuse link for promotion.

2. The lens shall be easily replaceable from the front.

Control and Selector Switches

1. The control and selector switches shall be of rotary type, adequately rated for the application but with a minimum

rating of 10 Amps at 240 V AC and 1 Amp at 220 V DC. The plates shall have clear position markings.

2. The control switches shall have pistol grip handles spring return to normal. The selector switches shall have oval knobs and shall be contact stay-put type.

Push Buttons

1. The push buttons shall be of the momentary contact, push to actuate rated for 10 A at 240 V AC and 1 A 220 V DC. The 'START' push buttons shall be green and shrouded. The 'STOP' push button shall be red and unshrouded. All other push buttons shall be black.

2. The elements shall be enclosed with 1 'NO' and 1 'NC' contacts. It should be possible to add on easily extra elements to increase the number of 'NO' and 'NC' contacts.

Main and Auxiliary Buses

1. The busbars shall be of high conductivity aluminum alloy of E91E grade. The busbar shall be of uniform cross-section throughout the length of the panels.

2. All main and auxiliary busbars shall be insulated with sleeves. The sleeves shall be of high dielectric strength, non-corrosive and of phase and neutral colors.

3. The busbars shall be supported on cast epoxy/ resin/DMC/Fiberglass insulators and the spacing of the supports shall be such as to withstand the stresses of the short circuit currents. The busbar spacing's shall be adequate for 3 phase voltage upto 600 V.

4. The busbar shall be a chosen for specific current ratings with a minimum density of 1 amp for sq.mm area.

Internal Wiring

1. All internal wiring shall be carried out with 1100 V/650 V grades PVC insulated, stranded conductor copper wires. The minimum size of wires shall be 2.5 sq.mm copper and for CTs also 2.5 sq.mm copper.

2. All individual control and CTs wiring shall be labeled with engraved identifications ferrules, yellow in color with black letters.

3. All wiring shall be terminated on stud type terminal blocks through crimping sockets. No more than one connection shall be made on any one terminal block.

4. All spare auxiliary contacts of contactors and relays shall be wired to control terminal blocks.

Terminal Blocks

1. Terminal blocks for power and control shall be of reputed make stud type, with washers, nuts and lock-nuts. All adjacent terminals shall have insulating barriers.

2. All power terminal blocks shall be appropriately rated for current with a minimum of 30 Amps. The control terminal blocks shall be rated for a minimum of 10 A and suitable for at least 2 conductors each of 2.5 sq.mm.

3. All sets of power and control power terminal blocks shall be identified with engraved plastic labels, black background

and white letters.

Identification Labels

1. All labels shall be black plastic with white engravings of letters of minimum 6 mm sizes.

Earthing

1. All switchgears shall have continuous run of earth busbar. The size and materials of the earth bus- bar shall be specified.

Tariff Advisory Committee and CPRI Tested

The switchgear shall be approved by the Tariff Advisory Committee (for Fire Insurance) and CPRI tested for short circuit test and enclosure test.

Tests

1. High Voltage test at 2.5 KV.
2. Power and Control Circuits Continuity Tests.
3. Insulation Resistance Test with 1000 V Meggar.
4. Operational Test.
5. Three Sets of Test Certificates to be submitted.

Drawings

1. Three sets of general arrangement drawings and wiring diagrams of all types of feeders shall be submitted.

Control Stations

1. Control station shall be of cast iron or cast aluminum enclosures, consisting of 'START' and 'STOP' push buttons and shall have stayput feature of twist unlock type.

Cable and Accessories

1. All cables shall be heavy duty PVC insulated armoured and PVC sheathed of 1.1 KV grade. Aluminum conductor cables shall be used for power and copper conductor cables shall be used for control wiring.

Glands

1. Glands used for termination shall be compression type. Cable glands shall be with single/double seal and cone and clamp for armoured clamping.
2. For safe and indoor areas, glands with single seal and for outdoor installation and hazardous areas, gland with double seals will be used. For use in corrosive areas, glands shall be coated with rust proofing lacquer after installation and provided with PVC hoods.
3. Cable lugs shall be of Dowell or equivalent approved make, suitable for connection of aluminum conductor cables. The cable lugs shall be of tinned copper and of soldering type for solid conductor cables. For stranded conductor cables, crimping type, tinned copper cable lugs shall be used.

Conduits and Accessories

Conduits wherever used with prior approval of the Contractor shall be of GI heavy gauge/black enamelled/PVC. All accessories, such as junction boxes, shall be duly approved by competent authorities. Terminal blocks of adequate rating are to be provided in the junction boxes.

Saddles

Saddles to be used for cleating cables or conduits shall be fabricated from MS or aluminum strips or any other approved material and shall be painted and dried before installation with chemical works type paint.

Cable Tags and Identification Ferrules

Cable tags and identification ferrules provided on cable cores/wires shall be of PVC/plastic. Cable tags shall be provided at every 15 meters and at all bends or change in routes.

Structural Steel

This shall include MS angles, channels, flats, etc. required for fabrication of cable trays, local supports for cables, control stations, etc. All steel sections shall be new and conform to IS 226.

Miscellaneous Materials

These shall include solders, fluxes, adhesive insulating tapes, PVC sleeves, petroleum conducting jelly, etc.

Earthing Material

Copper strips or wires of suitable sections shall be used for earthing in accordance with IS 3403.

All 3 phase 415 Volts equipment shall be earthed at two points and all single phase equipment at one point.

Painting

All metal work and metal parts of the MCC shall be thoroughly cleaned to remove ruse, scale grease or any other matter. Suitable anti-corrosion treat- ment such as phosphatising shall be given to the metal work. All exposed surfaces of the metal work shall then be given a priming coat of zinc chromate or equivalent and finished with two coats of paint of specified shade.

Drawing

Contractor shall submit 3 copies of control of schematic wiring diagram for refrigeration unit showing all protections and interlocks for Consultant's review and approval. After the final approval six prints and one clear reproducible of each drawing shall be furnished.

Installation

Motor Control Centres

Motor Control Centres shall be installed on welded construction channel framework. Framework shall be properly grouted by means of foundation bolts or anchor fasteners.

Cable Laying

As far as possible, cable shall be run in built up trenches and on walls/ceiling. Cables shall be dressed and clamped to the wall/ceiling by means of GI strap saddles of minimum 3 mm thickness. Cables shall be kept away from wall ceiling by saddle bars of at least 6 mm thickness. Cables running in built-up trenches shall also be properly clamped when cable run is on side walls of trench. Cable entry into the building shall be through suitable GI pipes or hume pipes or trenches. All cable entry openings into the buildings shall be properly sealed with cold setting, PVC compound or other approved materials.

Cable Termination

PVC cables shall be terminated with compression type glands. For outdoor installation double seal compression glands shall be used. All cables shall be connected by means of suitable crimping type cable lugs. All connections shall be secure and vibration proof. All contact surface shall be coated with petroleum conducting jelly before connections are made.

Earthing

All metallic frame work and non-current carrying metallic parts and enclosures of electrical equipment such as MCCB, motors, control station, etc. shall be bonded to one another and earthed by means of two separate earth conductors and connected to the plant earthing system.

Motors

All motors shall be installed on a common foundation with the driver equipment coupled through flexible couplings or belt drive.

Leveling and alignment of motor and driven equipment to be carried out as per IS 900 to avoid undue strain on motors.

Insulation resistance of motor shall be measured before commissioning. In no case insulation resistance should be less than one meg ohm. If it is less than one meg ohm motor should be dried out as per procedure laid on IS 900. Pre-commissioning mechanical checks shall be carried out as per IS 900.

Cable termination and earthing of motors shall be carried out by Electrical Contractor.

On commissioning of motor, any defects like excess current, bearings getting hot, undue vibration or noise etc. are observed, it will have to be made good by the Contractor without any extra cost.

Testing and Commissioning

Operation Test

1. Energise only control circuits and carry out closing and tripping operations. (Where AC supply derived from main supply is used for operation, the switchgear bus may be energised). Check tripping of circuit breakers by manual operation of protective relay contacts. Check operation of mechanical closing and tripping devices. Check lockout conditions for closing of circuit breakers by simulating the required conditions. Check control, indications, sequence interlocks and alarms.

2. Polarity and connections of instrument transformers check for correctness of CT and PT connections provided with transformer. Check electrical continuity of secondary circuits with ELV tester. Adjust spacing of arcing horns/rod gaps.

3. Check operation of instruments, meters, relays and tripping of circuit breakers by primary/secondary injection as specified. This test will be carried out only if specifically called for by Contract Documents.

4. Check continuity of power circuits and earth continuity of all non-current carrying metallic parts with a low voltage (6V or less) continuity tester.

5. Carry out IIV test on power and control circuits if specifically called for in Contract Documents.

Motors

Check equipment for free movement of rotor and play, lubrication and for any other mechanical defects and direction of rotation.

Check commutators, slip rings, brushes, brush- holders, etc. for satisfactory conditions. Insulation test of motors between winding and ground. Use 500 V megger for MV motors and 1000 V megger for HV motors. Check electrical continuity with ELV tester.

Control Cables

Carrying insulation test on all power and control circuits. Check all equipment for satisfactory operation and correct wiring.

Wiring

1. Insulation test between phases, between each phase and neutral and between each phase/neutral and ground.

2. DC High Voltage Test on HV Cables in accordance with the relevant Indian Standards and Code of Practice. This test shall be carried out on cables, installed in final position and all joints and terminations have been made. The cables, however, may not be connected to the equipment so that the equipment may not be subjected to the test voltage.

3. In case of lighting wiring, insulation test shall be carried out on lighting feeders with branch circuits open. Branch circuits shall be tested separately with lampholders, plug receptacles and lighting fittings in position but without lamps. In case of lighting circuits with lamp ballasts and glow starters insulation resistance may be measured between phase and ground only.

4. In case of directly buried cables, insulation resistance of cables shall be measured before and after the back filling. Test all receptacles for correct phase sequence.

Earthing System

Continuity test for earth continuity conductors with ELV tester.

Operation test

After successful completion of the above tests, operational tests shall be carried out by the Contractor for checking the connections done by him and satisfactory operation of all the equipment supplied by him. This test shall be carried out initially without energising power circuits. Various control conditions shall be similated for the purpose of this test. Any defects detected during the tests such as blown fuses, damage to devices, shall be rectified by the Contractors, free of cost.

TECHNICAL DATA FOR ALL MAJOR EQUIPEMENTS

Technical data shall be furnished as follows:

1.0 VRV / VRF

a) Manufacturer
b) Type of Unit -
c) Overall dimensions
d) Operating weight
e) Approx. noise level (db)
f) Capacity in HP – IDU

g) Total static pressure (ins W.G.)

Cooling Coils:

a) Coil fin material
b) Fin thickness
c) No. of fins
d) No. of rows deep
e) Tube dia. (ins)

Filter Section:

a) Pressure drop through filter when new (ins. WG)
b) Efficiency

2.0 **Ventilation & Exhaust Fans**:

a) Manufacturer
b) Fan discharge position
c) Speed (rpm)
d) Fan dia.
e) C.F.M.
f) Motor (hp) and make
g) Static pressure (ins. WG)
h) Balance (static and/or dynamic)

4.0 **Controls**:

a) Manufacturer
b) Thermostat type
c) Humidistat type
d) Damper motor type

5.0 **Electric Motors**:

a) Manufacturer
b) Type of motor and frame reference
c) Rated output (hp)
d) Range of working voltage
e) No. of phases and phase connections
f) Nominal frequency

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g) Rated speed (rpm)
h) Rated current (amps)
i) Class of insulation
j) Temperature rise with cooling air at 40 Deg.C
k) Efficiency and power factor

6.0 **Switch Gear**:

A. Circuit Breakers

a) Manufacturer
b) Symmetrical short circuit at 415 volts
c) Normal current (amps)
d) O/L and E/F trip

MODE OF MEASUREMENT

1 **Piping**

Measurement of all piping shall be on the basis of centre-line measurement described below:

Piping shall be measured in units of length along the centre line of installed pipes including all pipe fittings, wastage, allowances, Pipe / Puf supports, flanges, gaskets, nuts & bolts, unions, bands, elbows, tees, concentric / eccentric reducers, inspection pieces, expansion loops, etc. The above accessories shall be measured as part of piping length along the centre line of installed pipes, and no special multiples of pipe lengths for accessories shall be permitted.

Only refnet joints as Tees and Y joints shall be paid sepearately as they are not part of refrigerant piping.

All painting, labling, shall form part of the cost of equipment, piping, etc. No separate payment shall be admissible.

2 **Sheet Metal Work**

Sheet metal work shall be on the basis of measurement described below :

All Sheet metal ducting complete with ducts, supports, hangers, vibration isolation pads, turning vanes, girth angles, flanges, gaskets& food grade sealant, access panels erected in position shall be measured externally on the finished areas of the ducting and paid per unit area.

All manual control / splitter dampers sections with operating linkages, supporting, etc shall be included in the duct area. The price of dampers shall have to be included in the sheet metal installed ducting price. No separate payment shall be admissible.

Tapered rectangular ducts width & depth shall be considered for perimeter whereas for tapered circular ducts the diameter of the section midway between large & small diameter shall be adopted. The length of tapered duct section shall be the centre line distance between the flanges of the duct section.

The quoted unit rate for external surface of ducts shall include all wastage, allowances where specified or required, inspection chambers / access panel with splitter damper and quadrant / lever for position indication and other accessories. These accessories shall not be separately measured nor paid for.

The measurement of ducts shall be carried out before applying insulation.

3 **Grilles / Diffusers**

Air distribution items shall be measured by the cross section area.

Grilles / Diffusers, Linear diffusers (to be measured in Rmt / nos.) fire dampers, shall be measured based on cross-sectional area including flanges, mounting arrangements, nuts & bolts (inspection pieces / door with electrical actuator & panel for fire damper), aluminum opposed blade volume control dampers shall form part of supply air diffusers and shall

not be separately measured nor paid for. Flexible insulated fibre glass ducting to be measured in Rmt, same as sheet metal ducting with all accessories. Curvature / Round grilles to be also measured in Rmt.

4 **Electrical installation**

Cost of motors, electrical panel, power and control wiring with GI tray, safeties, installation, all accessories shall be included in the cost of driven equipment (wherever indicated with equipment). Power cables, cable tray & earthing to be measured in Rmt. Cable terminations in double compression gland to be measured in numbers.

Panel shall be counted as no. of units. Quoted rates shall include as lumpsum and not measurable length. All internal & power wiring, earthing connections from the control panel to the starter and motor / control wiring for interlocking, safety controls, control wiring for remote start / stop and automation as well as indication as per the specifications. The quoted rate of panel shall also include all accessories, switchgears, contactors indicating lights, meters, Safety controls & interlocking, VFDs as per the specification and schedule of quantities.

The unit rate for cables include the cost of cables & clamps & GI tray installation, testing & commissioning, cable markers, ceiling support. No payment shall be made for left out and installed cut cable pieces.

The rates for cable termination work shall include the cost of copper / aluminum lugs of suitable size, Ni-Cd double compression cable glands etc.

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. Cost to be included in panel cost.

6 **General Notes**

i) Cost of painting, galvanization of all equipment, piping, etc. shall be included in each item, and no extra shall be paid.

ii) MS Structural work except mentioned above to be measured in Kgs.

TECHNICAL SPECIFICATION FOR FIRE ALARM SYSTEM

(Life Safety System)

1.1 General

This performance specification provides the minimum requirements for the Fire Alarm System (Life Safety System). The system shall include, but not limited to all equipment, materials, labor, documentation and services necessary to furnish and install a complete, operational system to include but not limited to the following functions:

Smoke and fire detection.
Sprinkler suppression system monitoring
Off-premise notification.
Smoke control.
Releasing Service
One-way voice communication notification system.
Two-way voice communication system.

1.2 Materials & Equipment

All equipment and components shall be the approved manufacturer's current model. The materials, appliances, equipment and devices shall be listed by a nationally recognized approvals agency like UL864/FM/EN54 for use as

part of a protected premises protective signaling (fire alarm) system and smoke control system. The authorized representative of the manufacturer, to be designated as the contractor, shall be responsible for the satisfactory installation of the complete system. The contractor shall provide, from the acceptable manufacturer's current product lines, equipment and components, which comply, with the requirements of these specifications. Equipment or components, which do not provide the performance and features, required by these specifications are not acceptable, regardless of manufacturer. Strict conformance to this specification is required to ensure that the installed and programmed system will function as designed, and will accommodate the future requirements and operations of the building owner. All specified operational features must be met without exception. All equipment and components shall be the manufacturer's current model. The contractor shall be responsible for the satisfactory installation of the complete system. All control panel assemblies and connected field appliances shall be provided by the same system supplier, and shall be designed and tested to ensure that the system operates as specified. The system shall utilize electronically addressable, microprocessor-based detectors as described in this specification. The equipment to be supplied will be considered only if it meets all sections of the performance specification.

The supplier shall submit a point-by-point statement of compliance for all sections in this specification. The statement of compliance shall consist of a list of all paragraphs within these sections. Where the proposed system complies fully with the paragraph, as written, placing the word "comply" opposite the paragraph number shall indicate such. Where the proposed system does not comply with the paragraph as written, and the supplier feels the proposed system will accomplish the intent of the paragraph, a full description of the function as well as a full narrative description of how its proposal will meet its intent shall be provided. Any submission that does not include a point-by-point statement of compliance as described herein shall be disqualified. Where a full description is not provided, it shall be assumed that the proposed system does not comply. The Contractor shall furnish all labor, services and materials necessary to furnish and install a complete, functional fire alarm system (System). The System shall comply in respects with all pertinent codes, rules, regulations and laws of the Authority, and local jurisdiction. The System shall comply in all respects with the requirements of the specifications, manufacturer's recommendations and Underwriters Laboratories (UL) listings.

It is further intended that upon completion of this work, the Owner/Consultant be provided with:

a. Complete information and drawings describing and depicting the entire system(s) as installed, including all information necessary for maintaining, troubleshooting, and/or expanding the system(s) at a future date.

b. Complete documentation of system(s) testing.

c. Certification that the entire system(s)

1.3 <u>CODES & LISTING:</u>

The equipment and installation shall comply with the current and latest edition of the following codes and listing :

A) National Fire Protection Association (NFPA) - USA:

NFPA 13	Sprinkler Systems
NFPA 16	Foam/Water Deluge and Spray Systems
NFPA 17	Dry Chemical Extinguishing Systems
NFPA 17A	Wet Chemical Extinguishing Systems
NFPA 2001	Clean Agent Extinguishing Systems
NFPA 72	National Fire Alarm Code
NFPA 76	Telecommunication Facilities

NFPA 318 Clean Room Applications
NFPA 101 Life Safety Code
NFPA 90A Air conditioning & ventilation system

Listed

B) Underwriters Laboratories Inc. (UL) - USA:

UL 268 Smoke Detectors for Fire Protective Signaling Systems
UL 864 Control Units for Fire Protective Signaling Systems **9th Edition**
UL 268A Smoke Detectors for Duct Applications
UL 521 Heat Detectors for Fire Protective Signaling Systems
UL 464 Audible Signaling Appliances
UL 38 Manually Actuated Signaling Boxes
UL 346 Water flow Indicators for Fire Protective Signaling Systems
UL 1971 Visual Notification Appliances
UL 228 Door Holders
UL 1481 Power Supply for fire protective signaling system.
UL 1711 Amplifiers for Fire Protective Signaling Systems.
UL 1635 Digital Alarm Communicator System Units
Factory Mutual (FM) Approval

ADDENDUMS thereafter in UL Code for Fire Detection(2007).
UL 9th Schedule Certification
International Standards Organization (ISO)
ISO-9000
ISO-9001
European Union (EU)
EMC Directive 89/336/ EEC
Electromagnetic Compatibility Requirements

C) LOCAL CODES
NATIONAL BUILDING CODES
IS-2189

D) European Standards

EN54

E) German Standards

VDS

2.0 Panel Components & Functions

The control panel(s) shall be a multi-processor based networked system designed specifically for fire, one-way and two-way emergency audio communications, smoke control, extinguishing agent releasing system if necessitated, with integration modules for BMS or any third party control/annunciation. The control panel shall be UL/FM listed The control panel shall include all required hardware, software and site specific system programming to provide a complete and operational system. The control panel(s) shall be designed such that interactions between any applications can be configured, and modified . The control panel(s) operational priority shall assure that life safety takes precedence among the activities coordinated by the control panel.

The network of control panels shall include the following features:

Ability to download all network applications and firmware from the configuration computer from the configuration computer from a single location on the system.

Provide electronic addressing of analog/addressable devices.

Provide an operator interface control/display that shall annunciate, command and control system functions.

Provide an internal audible signal with different programmable patters to distinguish between alarm, supervisory, trouble and monitor conditions.

Provide a discreet system control switch provided for reset, alarm silence, panel silence, drill switch, previous message switch, next message switch and details switch.

Provide system reports that provide detailed description of the status of system parameters for corrective action or for preventative maintenance programs. Reports shall be displayed by the operator interface or capable of being printed on a printer.

Provide an authorized operator with the ability to operate or modify system functions like system time, date, passwords, holiday dates, restart the system and clear control panel event history file.

Provide an authorized operator to perform test functions within the installed system.

The control panel shall contain a standby power supply that automatically supplies electrical energy to the system upon primary power supply failure. The system shall include a charging circuit to automatically maintain the electrical charge of the battery.

2.1 Operator's Interface

The system shall be designed and equipped to receive, monitor, and annunciate signals from devices and circuits installed throughout the building. Standard LED annunciator may be combined in common enclosures provided that the groups of LED's comprising each of the required annunciator are separated from one another (Detection, Supervisory, Status, and Security) and clearly labeled. A minimum 640-character LCD display shall be part of the main control panel for easy alarm reading and understanding. Receipt of alarm, trouble, and supervisory signals shall activate integral audible devices at the control panel(s) and at each remote annunciation device. The integral audible devices shall produce a sound output upon activation of not less than 85 dBA at 10 feet.

The annunciator shall contain the following system status indicators:

LCD character Backlit Liquid Crystal Display
System Normal Indicator
System Common Alarm Indicator
System Common Trouble Indicator
System Common Supervisory Indicator
System Ground Fault Indicator
System Common Security Indicator

2.2. Audio

The system shall be capable of delivering multi-channel audio messages simultaneously over copper and/or fiber media. All audio messages and live pages shall originate at the one-way audio control unit. The one-way audio control unit shall store pre-recorded audio messages digitally. These messages shall be automatically directed to various areas in a facility under program control. The system shall support remote cabinets with zoned amplifiers to receive, amplify and send messages through speakers over supervised circuits. The one-way emergency audio

control shall provide control switches to direct paging messages as follows:

"All Call" to direct the page messages to all areas in the facility, overriding all other messages and tones.

"Page to Evacuation Area" to direct the message to the evacuation area(s), overriding all other messages and tones.

"Page to Alert Area" to direct page messages to the area(s) receiving the alert message and tones, overriding all other messages and tones..

"Page to Balance Building" to direct page messages to the areas) in the facility NOT receiving either the evacuation area or alert area messages.

"Page by Phone" switch to select the firefighters telephone system as the source for paging.

The system shall be capable of delivering multiple audio messages simultaneously over copper and / or fiber media. All audio messages and live pages shall originate at the one-way emergency audio control unit. The one-way emergency audio control unit shall store pre-recorded audio messages digitally. These messages shall automatically direct to various areas in a facility under program control. The system shall support remote panels with zoned amplifiers to receive, amplify and distribute messages through speakers over supervised circuits. The two-way voice communications control unit shall provide two-way communications between remotely located phones and the command center. The control unit shall provide the ability to individually select and display each two-way voice communication circuit support up to five (5) remote telephones in simultaneous two-way voice communications.

Audio Amplifiers (Multi-Channel)

Provide as minimum one twenty (20) watt (Maximum capacity should be decided as per site requirement). audio amplifier per paging zone. The system software shall be capable of selecting the required audio source signal for amplification. To enhance system survivability, each audio amplifier shall automatically provide a local 3-3-3 1000 Hz temporal pattern output upon loss of the audio communications with the one-way audio control unit, during an alarm condition. Audio amplifiers shall be power limited and protected from short circuits conditions on the audio circuit wiring. Each amplifier output shall include a dedicated, selectable 25/70 Vrms output. Provide a standby audio amplifier that will automatically sense the failure of a primary amplifier, and replace the function of the failed amplifier.

2.4 Power Supply

System power supply(s) shall provide multiple powers limited 24 VDC output circuits as required by the panel. Upon failure of normal (AC) power, the affected portion(s) of the system shall automatically switch over to secondary power without losing any system functions. Each system power supply shall be individually supervised. Power supply trouble signals shall identify the specific supply and the nature of the trouble condition.

All standby batteries shall be continuously monitored by the power supply. Low battery and disconnection of battery power supply conditions shall immediately annunciated as battery trouble and identify the specific power supply affected. All system power supplies shall be capable of recharging their associated batteries, from a fully discharged condition to a capacity sufficient to allow the system to perform consistent with the requirements of this section, in 48 hours maximum.

All AC power connections shall be to the building's designated emergency electrical power circuit and shall meet

the requirements of NFPA 72 - The AC power circuit shall be installed in raceway. The power circuit disconnect means shall be clearly labeled FIRE ALARM CIRCUIT CONTROL and shall have a red marking. The location of the circuit disconnect shall be labeled permanently inside the each control panel the disconnect serves.

Power supply for all input & output devices to be driven from main Fire Alarm Panel.

2.8 Field Mounted System Components

Intelligent Smoke Detectors: (Optional)

General

The smoke detector shall have inbuilt microprocessor and shall be capable of taking an independent alarm decision. Minimum to 125 intelligent smoke detectors should connect to one loop. Each intelligent addressable smoke detector's sensitivity shall be capable of being programmed electronically from Control Panel without any extra tools as most sensitive, more sensitive, normal, less sensitive or least sensitive. In addition to the five sensitivity levels the detector shall provide a pre-alarm sensitivity setting, which shall be settable in 5% increments of the detector's alarm sensitivity value. The detector should continue to give TRUE alarms even if the loop controller on the main panel fails.

An alternate alarm sensitivity level shall be provided for each detector, which can be set to any of the five (5) sensitivity settings manually or automatically using a time of day event. In addition to the five alternate sensitivity levels the detector shall provide an alternate pre-alarm sensitivity setting, which shall be settable in 5% increments of the detector's alternate alarm sensitivity value The detector shall be able to differentiate between a long drift above the pre-alarm threshold and fast rise above the threshold.

The detector's sensing element reference point shall automatically adjust, compensating for background environmental conditions such as dust, temperature, and pressure. Periodically, the sensing element real-time analog value shall be compared against its reference value. The detector shall provide a maintenance alert signal that 75% to 99% compensation has been used. The detector shall provide a dirty fault signal that 100% or greater compensation has been used.

The system shall allow for changing of detector types for service replacement purposes without the need to reprogram the system. The replacement detector type shall automatically continue to operate with the same programmed sensitivity levels and functions as the detector it replaced. System shall display an off-normal condition until the proper detector type has been installed or change in the application program profile has been made.

Multi-sensor Photo Thermal Detector : (Optionals)

The multi-sensor or multi-tech smoke detector which will have both photoelectric as well as thermal detection elements shall have inbuilt microprocessor, and shall be capable of taking an independent alarm decision. The scattering of smoke particles shall activate the photo sensor. Each intelligent addressable smoke detector's sensitivity shall be capable of being programmed electronically from Control Panel without any extra tools as: most sensitive, more sensitive, normal, less sensitive or least sensitive. In addition to the five sensitivity levels the detector shall provide a pre-alarm sensitivity setting, which shall be settable in 5% increments of the detector's alarm sensitivity value. The detector should continue to give TRUE alarms even if the loop controller on the main panel fails.. Alarm condition shall be based upon the combined input from the photoelectric, and thermal detection elements. Each detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each

smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings. Each detector microprocessor shall contain an environmental compensation algorithm that identifies and sets ambient "environmental thresholds approximately six times an hour.. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 75% and 100% of the allowable environmental compensation value.

4D/Laser Photo Detector. (Optionals)

The 4D/Laser/equivalent detector shall have the ability to have the sensitivity of 0.08 OBS/FTor better. The detector shall have inbuilt microprocessor and shall be capable of taking an independent alarm decision. It shall be possible to automatically change the sensitivity of individual analog/addressable detectors for the day and night periods. Each detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings. Each detector microprocessor shall contain an environmental compensation algorithm that identifies and sets ambient environmental thresholds approximately six times an hour. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 75% and 100% of the allowable environmental compensation value.The laser photo detector shall not require other cleaning requirements than those listed in NFPA 72. Replacement, refurbishment or specialized cleaning of the detector head shall not be required.The laser photo detector shall include two bicolor LEDs that flash green in normal operation and turn on steady red in alarm.

INTELLEGENT THERMAL DETECTOR: (Optionals)

The heat detector shall have a thermal sensing element /circuit. The detector shall have inbuilt microprocessor, not microcontroller and shall be capable of taking an independent alarm decision. Detectors shall be rated at 15°F (9°C) per minute rate-of-rise and 135°F (57°C) fixed temperature The detector shall be capable of being addressed electronically from control panel without any extra tool.

ADRESSABLE BEAM DETECTOR: (Optionals)

The addressable optical beam detector or projected beam smoke detector shall be used for detection in large volumes and double heights. The set shall consist of a transmitter, receiver and control electronics. The transmitter shall project a modulated infrared light beam to the receiver. If there is smoke in the beam path, the receivers signal shall be reduced by the value proportional to the density of the smoke. If the signal is reduced to a level between the obscuration threshold and 93% for 8-10 seconds, the fire alarm relay shall be activated. The alarm obscuration threshold shall be set at 25%, 35% or 50% obscuration depending on the application. The typical coverage shall be equal or more than 100 m x 15.25 m.

SMOKE DETECTOR – PHOTOELECTRIC

The detectors shall be use the photo electric (light scattering) principal to measure smoke density. Provide analog/addressable photoelectric smoke detectors at the locations shown on the drawings. The detector shall have the ability to set the sensitivity and alarm verification of each of the individual detectors on the circuit. It shall be possible to automatically change the sensitivity of individual analog/addressable detectors for the day and night periods. Each smoke detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings. Each detector microprocessor shall contain an environmental compensation algorithm that identifies and sets ambient environmental thresholds approximately six times an hour. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 75% and 100% of the allowable environmental compensation value.

Detector Bases:

The bases shall be easy to install and mount and shall be of standard type or isolator base type or sounder base type. The sounder base shall be used where local or group alarm signaling is required. The sounder base emits a audible alarm when there is fire. The base shall, contain no electronics and support all series detector types.

3.0 Manual Stations

The fire alarm station shall be of polycarbonate construction and incorporate an internal toggle switch. A locked test feature shall be provided. The station shall be finished in red with silver "PULL IN CASE OF FIRE" lettering.

3.1 Sounders/Hooters with Strobe

Electronic sounders shall operate on 24 VDC nominal. Electronic sounders shall be field programmable without the use of special tools, at a sound level of at least 90 dBA measured at 10 feet from the device and shall be flush or surface mounted as shown on plans. They Shall produce broad band directional sound to guide occupants to safe exists even in complete darkness. Strobe lights shall meet the requirements of the ADA, UL Standard 1971, be fully synchronized, and shall meet the following criteria: The maximum pulse duration shall be 2/10 of one second. Equivalent alternate type will be also acceptable

Strobes shall provide synchronized flash output, that shall be switch selectable for output values of 15cd, 30cd, 75cd & 110cd. Wattage and candela settings shall be visible with the cover installed. When the cover is installed, no mounting hardware shall be visible. In and out screw terminals shall be provided for all wiring.

3.2 Intelligent Modules

The personality of multifunction modules shall be programmable at site to suit conditions and may be changed at any time using a personality code downloaded from the Analog Loop Controller. The modules shall have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The module shall be capable of storing up to 24 diagnostic codes, which can be retrieved for troubleshooting assistance. Input and output circuit wiring shall be supervised for open and ground faults.

Control Relay Module:

The Control Relay Module shall provide one form "C" dry relay contact rated at 2 amps @ 24 Vdc to control external appliances or equipment shutdown. The control relay shall be rated for pilot duty and releasing systems. The position of the relay contact shall be confirmed by the system firmware.

Dual Input Module:

The Dual Input Module shall provide two (2) supervised Class B input circuits each capable of a minimum of 4 personalities, each with a distinct operation. The dual input module shall support the following circuit types:

- Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
- Normally-Open Alarm Delayed Latching (Water flow Switches)
- Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
- Normally-Open Active Latching (Supervisory, Tamper Switches

Dual Input Signal Module:

The Dual Input (Dual Riser Select) Signal Module shall provide a means to selectively connect one of two (2) signaling circuit power risers to one (1) supervised output circuit. The dual input signal module shall support the following operation:

Audible/Visible Signal Power Selector (Polarized 24 Vdc @ 2A, 25 Vrms @ 50w or 70 Vrms @ 35w of Audio)

Isolator Module:
Provide intelligent fault isolators modules. The Isolator Module shall be capable of isolating and removing a fault from a class A data circuit while allowing the remaining data loop to continue operating.

Monitor Module:
The Monitor Module shall be factory set to support one (1) supervised Class B Normally-Open Active Non-Latching Monitor circuit.

Single Input Module:
The Single Input Module shall provide one (1) supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation. . The single input module shall support the following circuit types:

- Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
- Normally-Open Alarm Delayed Latching (Water flow Switches)
- Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
- Normally-Open Active Latching (Supervisory, Tamper Switches)

Single Input Signal Module :
The Single Input (Single Riser Select) Signal Module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation. When selected as a telephone power selector, the module shall be capable of generating its own "ring tone". The single input signal module shall support the following operations:

- Audible/Visible Signal Power Selector (Polarized 24 Vdc @ 2A, 25Vrms @50w or 70 Vrms @ 35 Watts of Audio)
- Telephone Power Selector with Ring Tone (Fire Fighter's Telephone)

3.3 Power Supply

Standby power supply shall be an electrical battery with capacity to operate the system under maximum supervisory load for 24 hours and capable of operating the system for fifteen (15) minutes of evacuation alarm on all devices, operating at maximum load. The system shall include a charging circuit to automatically maintain the electrical charge of the battery. The system shall automatically adjust the charging of the battery to compensate for temperature.

3.5 Sequence of Operations

General - Audio
Upon alarm activation of any area smoke detector, heat detector, manual pull station, sprinkler water flow, the following functions shall automatically occur:

The internal audible device shall sound at the control panel or command center.

Display the alarm event on the graphical workstation. The LCD Display shall indicate all applicable information associated with the alarm condition including: zone, device type, device location and time/date. All system activity/events shall be documented on the system printer. Any remote or local annunciator LCD/LED's associated with the alarm zone shall be illuminated.

The following audio messages and actions shall occur simultaneously:

An evacuation message shall be sounded on fire floors (zones) immediately above and below (adjacent to) the fire floor (zone),on the floor in fire condition. It is the intent of this message to advise occupants hearing this message that they are near danger and should leave the building via the stairs (nearest exit) immediately.

Activate visual strobes on the fire floors (zones) immediately above and below (adjacent to) the fire floor (zone) . The visual strobe shall continue to flash until the system has been reset. The visual strobe shall not stop operating when the "Alarm Silence" is pressed. An alert message shall be sounded on the remainder of building. It is the intent of this message to advise occupants to prepare for evacuation if necessary. An instructional message shall be sounded in the stairwells instructing occupants to move carefully and quickly down the stairs to exit the building and to exit to a safe floor if you encounter smoke in the stairwell.

An instructional message shall be sounded in the elevator cabs. It is the intent of this message to advise elevator occupants that an emergency exists, the elevator has been directed to the ground floor, and that occupants should quickly exit the building. An instructional message shall be sounded in the lobby. It is the intent of this message to advise lobby occupants to leave the lobby and clear the area for arriving firefighters. An instructional message shall be sounded in the concourses connected to the building's lobby. It is the intent of this message to prevent new entries into the lobby by advising occupants not to attempt to enter the lobby of the affected building.

Provide selective paging to each individual floor (zone). In addition to the message/channels detailed above, a dedicated page channel shall be capable of simultaneously providing live voice instructions without interrupting any of the messages listed above shall be provided.

Transmit signal to the building automation system.
Transmit signal to the central station with point identification.
Activate automatic smoke control sequences.
All automatic events programmed to the alarm point shall be executed and the associated outputs activated.
All stairwell/exit doors shall unlock throughout the building.
All self-closing fire/smoke doors held open shall be released.
Direct the closed circuit TV cameras to the alarm event and start video recording.

Supervisory Operation
Upon supervisory activation of any sprinkler valve supervisory switch, fire pump off-normal, clean agent fire suppression system trouble, the following functions shall automatically occur:

The internal audible device shall sound at the control panel or command center.
Display the event on the graphical workstation and display a pictorial image.

The LCD display shall indicate all applicable information associated with the supervisory condition including; zone, device type, device location and time/date. All system activity/events shall be documented on the system printer.

Any remote or local annunciator LCD/LED's associated with the supervisory zone shall be illuminated. Transmit signal to the central station PC with point identification.

Trouble Operation
Upon activation of a trouble condition or signal from any device on the system, the following functions shall

automatically occur:

The internal audible device shall sound at the control panel or command center.

Display the event on the graphical workstation and display a pictorial image.

The LCD keypad display shall indicate all applicable information associated with the trouble condition including; zone, device type, device location and time/date. All system activity/events shall be documented on the system printer.

Any remote or local annunciator LCD/LED's associated with the trouble zone shall be illuminated. Transmit signal to the central station PC with point identification.

Monitor Activation
Upon activation of any device connected to a monitor circuit, the following functions shall automatically occur:

The internal audible device shall sound at the control panel or command center

Display the event on the graphical workstation and display a pictorial image.

The LCD display shall indicate all applicable information associated with the status condition including; zone, device type, device location and time/date.

All system activity/events shall be documented on the system printer

Any remote or local annunciator LCD/LED's associated with the status zone shall be illuminated.

4.0 Notification Appliance Circuits

All notification appliance circuits shall have a minimum circuit output rating of: 2 amps @ 24 vdc; 50 watts @ 25V audio, and 35 watts @ 70V audio. The notification circuits shall be power limited. Non-power limited circuits are not acceptable

4.6 Training

The System Supplier shall schedule and present a minimum of 8 hours of documented formalized instruction for the building owner, detailing the proper operation of the installed System.The instruction shall be presented in an organized and professional manner by a person trained in the operation and maintenance of the equipment and who is also thoroughly familiar with the Installation. The instruction shall cover the schedule of maintenance required by NFPA 72 and any additional maintenance recommended by the system manufacturer.

5.0 SYSTEM OPERATION – FUNCTIONAL SPECIFICATIONS AND PRODUCTS

5.1 **General:** The system shall be integrated into a comprehensive system, to provide the functional performance

described as follows:

5.1.1 Fire Detection and Alarm System

5.1.1.1 The fire detection and alarm system shall monitor and display the activation of each device in the system, such as heat detector, smoke detector, manual break-glass unit, sprinkler water flow switch, sprinkler valve tamper switch, hose reel water flow switch and hose reel valve tamper switch or any other input device which may be required.

5.1.1.2 The system shall initiate output functions such as automatic alarm annunciation via speakers, fans shutdown, automatic notification to the Fire main control PC and activation of audible hooters/directional sounders/strobes.

5.1.1.3 The system shall be of the addressable intelligent type, completely supervised, such that a break in any wire (loop) shall not prevent any device from operating. The system shall be of the type such that each device connected to the system shall be provided with unique address and separately identified at the Main control panel (MCP).

5.1.1.4 The wiring shall be monitored against faults such as opens, shorts, earth's or data transmission failure. Detection addressable loops, capable of handling minimum of 250 addressable points shall return to the control panel.

5.1.2 Emergency Paging And Voice Alarm

5.1.2.1 The system shall permit communication in the form of paging from the main control panel and telephone switchboard to any floor or group of floors simultaneously. The system shall be capable of manual operation or automatic operation initiated by the fire alarm system. Speakers shall be located as required to achieve acceptable audibility in all Communication addressable loops will be supervised and therefore return to the control panel.

5.2 Scope

5.2.1 The appropriate authorities shall approve the exact location.

5.2.2.2 photoelectric type smoke detector shall be with integral microprocessor and shall be capable of taking an independent alarm decision. In case of the failure of the main loop controller the detector shall be capable of operating in standalone mode or degrade mode and continue to take decisions

5.2.3 Heat detectors of the fixed temperature (57 deg.C) type or rate of rise of temperature type shall be used in areas environmentally unsuited for smoke detectors such Kitchens, Valet Laundries, Emergency Generator rooms,

5.2.5 Break-glass stations (manual fire alarm stations) shall be located on the occupied side of the door to each exit stair and at intermediate locations as required (Maximum distance between pull stations shall not exceed 60 m). .

5.3 System Operation

5.3.1 The system shall be arranged for categories of alarm inputs and provide output functions appropriate to each of the categories;

5.3.1.1 Supervisory Monitor input : The following inputs shall be considered supervisory monitoring functions:

5.3.2.1 Sprinkler system shut off valve tamper switch.

5.3.2.2 Removal of a smoke detector from its base.

5.3.2.4 Wiring faults.

5.3.3 Activation of a supervisory monitoring device shall provide the following indications:

5.3.3.1 The MCP and remote annunciators shall indicate shall indicate an audible and visual "TROUBLE" condition. In addition, the "trouble alarm" shall be displayed on the graphic display unit for the type of alarm.

5.3.3.2 Printer shall print clear next message on the event log indication the device, which initiated a trouble alarm.

5.3.3.3 An alarm signal shall be automatically sent to the local control room as well as REMOTE control room if designed This may be accomplished by means of an web server /Netcom/ digital dialer.

5.3.3.4 In case of fire all lift call and door buttons and signals shall become inoperative, lifts serving that floor shall be signaled to immediately return to the ground floor or as designated by the local Fire department and be held for the exclusive use of the Fire Brigade. Should such an alarm occur on the ground floor, the lifts shall be signaled to return to an alternate floor which is not in alarm.

5.3.3.5 Signals shall be sent directly to heating, ventilating and air conditioning fan motor controllers for status monitoring circuits to confirm the operation of the fan systems.

5.3.3.6 The details of the fan control sequence shall be as follows:

5.3.3.7 All fans serving the areas affected by the alarm condition shall shutdown.

5.3.3.8 Smoke extraction fan system shall have to be started

5.3.3.9 Stair pressurization fans shall be started.

5.4.1.1 Signals shall be transmitted to the paging system to display zone in alarm.

5.4.1.2 The printer shall print a clear text message on the event log printer The printer shall print the device information indicating clearly in plain language which device is in alarm, the time, and the date associated with the alarm. The printer shall print all follow-up information regarding this alarm, such as acknowledge, reset etc.

5.4.1.3 All access control doors shall be released in case of fire condition shall allow for more than one floor at a time to be displayed.

FAS Cables: (FRLS rated)

2 x 1.5 sq mm annealed tinned copper(ATC) conductor PVC sheathed FRLS armoured Multi strand cables as per specifications given below;

i) Cable Type : Signal

: Armored FRLS

	:	Multistrand Conductors
	:	Twisted pair
ii) Conductor	:	Conductor dia - 0.2mm
	:	No. of Strands - 48
	:	ATC
	:	Resistance per Km. (Max. 25 Ohms)
iii) Individual Insulation	:	PVC Type as per IS - 5831
	:	Insulation Thickness nominal : 0.6mm
iv) Total Cores	:	No. of Pairs 1 (One) laid in sequence
	:	Colour code: **Red**
v) Overall Sheath	:	Thickness - 1.8mm
	:	Material - PVC type as per IS - 5831
	:	Outer dia - 10.5mm dia min

APPENDIX "A"

LIST OF APPROVED MAKE / MODEL
PREAMBLE:

1) All materials shall conform to relevant technical specifications of Volume – 2 of the Tender document. The materials shall be further subjected to tests in the recognized laboratories at the sole discretion of the Engineer-in-Charge and shall be at contractor's cost.

2) Materials bearing appropriate IS marking and having valid licence for last 3 years shall be given preference while selecting for the work.

3) In case of materials which are not widely available with IS marking in the market but conform to the technical specifications mentioned in the Tender Documents, the same shall be procured from any of the manufacturer listed below after prior written approval of the EIC.

4) Reinforcement steel shall be procured from any vendors who have the license for at least last 5 years for manufacture of BIS or Tor allies, subject to prior written approval of the EIC. Steel samples of all the lots procured shall be subject to testing through recognized laboratories and shall be at contractor's cost.

5) Cement for work shall have relevant IS marking and every lot shall be subject to tests in the recognized laboratories and shall be at contractor's cost.

6) EIC can approve any other brand subject to verification of the adherence to the relevant technical specifications.

A. Electrical Work

Sr. No.	Details of Materials / Equipment	Manufacturer's Name
1	LT Panel and Motor Control Centre.	Sterling & Wilson / Arrow Engineers / Abak / Shivam Electricals
2	Sandwiched Construction Busduct and Rising Mains	Control & Switchgear / Intraco BKS (Marketed by Larsen & Toubro) / Schneider Electric / Legrand
3	Final Distribution Board	Hager / Legrand
4	Motor Starter	L & T / Schneider / Siemens
5	Air Circuit Breaker (3/4 Pole)	Larsen & Toubro (U-Power) / Schneider Electric (Master Pact NW) / Siemens (3WL) / Legrand (DMX^3)
6	Moulded Case Circuit Breaker (MCCB)	Schneider Electric / Larsen & Toubro / Siemens / Legrand / Hager
7	Miniature Circuit Breakers (MCB)	Legrand / Havels/ MK
8	Residual Current Circuit Breaker (RCCB)	Legrand / Havels/ MK
9	Change Over Switch	Havells / HPL – Socomec / Larsen & Toubro / Cummins
10	Current Transformer (Epoxy Cast Resin)	Automatic Electric / Indcoil / Pragati

Sr. No.	Details of Materials / Equipment	Manufacturer's Name
11	Control Transformer/Potential Transformers	Automatic Electric / Indcoil / Pragati
12	Protection Relay	
	a. Numeric Type	Larsen & Toubro / Siemens
	b. Electromagnetic Type	Larsen & Toubro
13	Indicating Lamps LED type and Push Button	Larsen & Toubro (ESBEE) / Schneider Electric / Teknik
14	Overload relays with built in Single Phase preventer	Larsen & Toubro / Schneider Electric / Siemens
15	a. Electronic Digital Meters (A/V/PF/Hz/KW/KWH) with LED/ Display	L & T / Schneider Electric (Conzerve) / Secure
16	PVC insulated XLPE aluminium / copper conductor armoured MV Cables upto1100 V grade	Finolex / KEI / Havells / CCI
17	LT Jointing Kit / Termination	3M / Raychem / REPL
18	Cable Gland (Double Compression type)	Comet / Cosmos
19	Bimettalic Cable Lug	Comet / Cosmos / Dowell's (Biller India)
20	PVC insulated copper conductor stranded flexible wires (FRLS) -	Finolex / R R Kabel / Havells
21	Conduit	
	a. Mettalic / GI Conduit (ISI approved)	AKG / BEC / Vimco
	b. PVC Conduit & Accessories (ISI approved)	Precision / Modi
	c. Flexible GI Conduit	Flexicon / PLICA India Pvt. Ltd.
22	Switch & Socket	Legrand ARTEOR / MK – Wrap around plus / Crabtree Verona
23	Terminal Blocks	Connect Well / Elmex
24	Industrial Socket	Legrand / Hager
	a. Splash Proof	MDS Legrand / Schneider Electric
	b. Metal Clad	HANSEL / MDS
25	Ceiling Fan	Crompton Greaves High Speed / Havells Pacer

Sr. No.	Details of Materials / Equipment	Manufacturer's Name
26	Lighting Fxiture	Philips / Wipro/Tulip/ Focus/ Trilux
27	Timer Hot-dip Galvanized	Larsen & Toubro / Schneider Electric
28	Cable Trays (Factory Fabricated) / Raceways / GI Trunking	MK (raceway) / Asian Ancillary Corporation / Profab Engineer / OBO Bettermann
29	UPVC Wall trunking	MK / Legrand / OBO Bettermann
30	Lighting Poles (Polygonal GI poles)	Bajaj Electricals
31	Fire Sealant &Fire Retardant Paint	3 M India Ltd. / HILTI
32	Standalone emergency light fixture	Legrand / PHILIPS
33	Power/Aux. Contactor	Larsen & Toubro / Schneider Electric / Siemens
34	Motor Protection Circuit Breaker(MPCB)	Larsen & Toubro / Schneider Electric / Siemens
35	Selector Switches	Kaycee /Salzer (Larsen & Toubro)
36	Lighting Poles	Bombay Tubes and Poles / Bajaj Electricals / HOMDEC Lighting / Keselec / K-Lite
37	Fire Sealant &Fire Retardant Paint	3 M India Ltd. / HILTI / OBO Bettermann / Promat
38	Lightning Protection System	ABB – Pulsar / Indelec/ Nimbus
39	Lighting & Surge Voltage Protection	ASCO / Hager (Marketed by L&T) / Indelec / OBO Bettermann / Schneider Electric
40	HDPE underground cable duct	Rex Polyextrusion / Tirupati Plasomatics / Duraline
Sr. No.	**Details of Materials / Equipment**	**Manufacturer's Name**
41	RCC Hume Pipes – NP2 Class	Dhere / K K / INDIAN HUME PIPE / Pranali
42	Welding Rod	Advani / Esab
43	Alarm Annunciator	Advani Oralikon / Larsen & Toubro / Minilec
44	G. I. & M.S. Pipe upto 200 MM Dia.	Jindal / Tata Steel
45	G. I. & MS PIPES above 200 mm dia factory rolled	Jindal / SAIL

46	GI Pipe Fittings	Unik / Zoloto M
47	HRC Fuse & Fuse fittings	L & T / Siemens
48	Insulating Rubber Mats	Commercial Enterprises / DL Miller & Co. Ltd. / Premier Polyfilm Ltd. / RMG Polyvinyl India Ltd.
STRUCTURED CABLING SYSTEM (VOICE / DATA)		
1	Cat-6 Cable, Wires& Fiber Optic Cable	Molex / Legrand / Systemax
2	Patch Cords, patch panels, cross connect, data outlet, LIUs, Pigtails, Splice Holders	Molex / Legrand / Systemax
3	Main Distribution Frame for voice, Telephone Tag blocks	Krone / ITL
4	Telephone Armoured Cables	Finolex / ITL / Polycab
5	Data Switches, receiver , media converter	3-Com / CISCO / HP
6	Racks for Data Switches / Patch Panels	HCL / Rittal / Valrack / Legrand

Note :

- **In case of LAN & Telephone works, all the passive components shall be of one make or else 100% compatibility shall be ensured. Required certification for compatibility from component manufacturer to be furnished on demand of Engineer-in-Charge**

B. Public Health Work

Sr. No.	Details of Materials / Equipment	Manufacturer's Name
1	Vitreous chinaware water closet, Flush Tank, Wash Basin, Soap dish, Urinals, Toilet paper roll holder, Sink etc.	Jaquaror approved eq.
2	CP brass fittings & fixtures such as Bib tap, Stop cock, Pillar tap, waste coupling, Bottle Trap etc.	Kingston, Jaquar, GEM, L&K, MARC, ParkoEss-Ess or approved eq.
3	Seat & cover for EWC	Commander, Hindustan, Capri, Supreme or approved eq.
4	Jet Spray	Jaquar
5	WC Connectors	Prince / Supreme
6	Toilet Paper Holder	Jaquar
7	Glass, Mirror	Modi Guard, Saint Gobin, Float glass or appr. eq.
8	Stainless steel Sink	Nirali, Neelkanth, AMC, Jayna or approved eq.
9	Urinal Sensors	Jaquar
10	Floor Drain Fixture, Rain Water Outlets	ACO / GMGR / Geberit / Viega / Jaquar
11	G.I / M.S Pipes	ITC, TATA, Zenith, Ambika, Surya, Khandelwal, Jindal, Hissar / AST Pipes / Hitech / Swastik or approved eq.
12	G.I Malleable fittings	PEC, MJM, Unik, Zoloto, 'R'/ Jain Sons / Kirti or approved eq.
13	C.P. Grating for Floor Trap	Chilly / GMGR / Neer
14	GM or copper alloy Gate / Peet / Globe / Check valve	Neta, Sant, Kingston, NEW, Leader, Zoloto, GG
15	Ball Valve	MBM, Sant, Techno, A.I (JS), Zoloto or approved eq.
16	GM / Forged Brass Ball Valves	CIM / Danfoss / Jayhiwa / Kitz / RB / Sant / Tiemme / TSB
17	Air Valve / Kinetic Air Valve	Durga, BSJShau, VKE, Sant, Hawa, IVC, Mayur, BJC
18	Water meter	Capston, Keycee, Paramount or approved eq.
19	Sluice valve / Foot valve (swing& lift type)	BSJ-Shau, Mayur, Upadhyay, Minoti, Effco, Kartar, KPM, IVC, Leader, Durga, Kirloskar.
20	C.I Water quality pipes	Electrosteel, KDUL, Kesoram or approved eq.

21	C.I Soil quality pipes	A-1, Neco, Rifco, SRIF or approved eq.
22	C.I Frame & Cover	A-1, Neco, Rifco, SRIF, Kajeco or approved eq.
Sr. No.	**Details of Materials / Equipment**	**Manufacturer's Name**
23	S.W Pipe & Gully Trap	Kashmira, Rajura, Girco, Perfect, C.I.or approved eq.
24	RCC Hume pipe	IHP, Pranali, Premier, Shreeji, Pragati, Usha, JSP or app. eq
25	SFRC frame & cover / gratings	Bharat, Shreeji, SS, KK or approved eq.
26	HDPE Pipe	Prince, Goutam, Duraline ,Kimplas,/ Reliance or approved eq.
27	SS Pipes	Remi / Viega
28	SWR-PVC pipe & fittings	Prince, Premium, Supreme, Finolex, Kissan, Perfect Potteries, JABALPUR or approved eq.
29	Water supply – PVC pipes & fittings	Prince, Premium or approved eq.
30	Pig Lead	Hindustan Zinc
31	PVC flushing Cistern	Commander, Hindustan, Duralite or approved eq.
32	Pressure Gauge	Pie-big, Guru or approved eq.
33	Foot Valve (Ball type)	Normex
34	SBR / EPDM Gaskets	Prabhat, Orient, Paul, Durable or approved eq.
35	C.I fittings / Specials	Kejriwal, Upadhyay, Orient, Durga or approved eq.
36	Flush Valves	Jaguar, Parko,Orient or approved eq.
37	Electronic flush Valve for Urinal	Cera, Parryware, Jaguar, Utech, Robo, Angus, Askon Engineers / Euronics / Toshi / UTEC System or approved eq.
38	Check Valve – WaferType	Advance / Danfoss / Kirloskar / Jayhiwa
39	Check Valve – Dual Plate	Advance / SKS
40	Check Valve Forged Screwed	CIM / Leader / RB / Sant / TBS / Zoloto
41	Check Valves (slim type)	Zoloto, Intervalve or approved eq.
42	Butterfly Valve	Audco, C&R, Intervalve, Keystone, IVC, Durga, Danfoss / Honeywell / Jayhiwa or approved eq.
43	Ball Valve (15 to 40 mm)	CIM, Sant or approved eq.
44	Pressure Reducing Valve	Fouress / Honeywell / RB / SKS / OR / Zoloto
45	Cockroach trap	Chilly
46	CI double flanged non-return valve	Kirloskar, IVC, Leader, or approved eq.
47	Cast Iron Pipes & Fittings Manhole covers and frames	

	As per IS:3989 (Pipes & Fittings)	Kapilash
	As per IS:1729 (Manhole covers and frames)	Raj Iron Foundry Agra
Sr. No.	**Details of Materials / Equipment**	**Manufacturer's Name**
	As per IS:1536 (CIClassLA Pipes)	IISCO / NECO
48	D.I. Manhole Covers & Frames	Kartar valves & fittings
49	CILA fittings	Kartar valves & fittings
50	Suspended Manhole and Gully Trap	Patel Pattern
51	Drip Seal	ACQUA Bond / Vinod Cement Co. Chandigarh
52	GI pipe sealent	Henkel - LOCTITE 55
53	Pipe clamp & supports	Chilly / Euroclamp / Easyflex / Gripple
54	D. I. Pipes	Electro Steel / Jindal / LancoKalahasthi
55	Copper Pipes & Fitting	Flowflex – Rajco / Viega – Max flow
56	UPVC Pipe	Astral / Finolex / Supreme
57	CPVC pipes	Ajay / Ashirwad / Astral
58	PB Pipe	Flexalen – Thermaflex / George Fisher
59	Solenoid Valve	Avcon / Danfoss
60	Thermostatic valve	Oventrop
61	Air Release Valve	Arco / CIM / Fouress OR / SKS
62	Ball Float Valve	Esseti / HBD / Zoloto
63	NRV – Ball type – Sewage application	Danfoss / Silverspark
64	Y Strainer CI	Emerald / Sant / SKS / Zoloto
65	Self-Priming Pumps	Johnson / Kirloskar
66	Drinking Water Cooler	Blue Star / Usha / Voltas
67	Anti-Vibration Mounting & Flexible Connections	Cori / Dunlop / Flexionics / Kanwal Industrial Corporation / Resistoflex / VIMPA
68	Pressure Gauge	Emerald / Fiebig / H Guru / Wika
69	Water Meter (Mechanical Type)	Actaris / Kranti / Kent
70	Electronic Flow Meter	Krohne (Forbes Marshall) / Rockwin
71	Level Controller & Indicator (Water)	Auto Pump / Cirrus Engineering / Elegent Controls / Technika / Techtrol
72	Paints	Asian Paints / Berger / ICI / Shalimar Paints

73	MH / Water Tank Plastic Steps	KGM / Patel / Pranali Industries
74	Fastner	Fisher / Hilti
75	Fire Sealant	Birla 3 M / Hilti / Promat / STI (USA)/ Fire master
Sr. No.	**Details of Materials / Equipment**	**Manufacturer's Name**
76	Manhole (Prefabricated)	OK Play / Supreme
77	Temperature Sensor/ Gauge	Forbes Marshall / Danfoss / Wika
78	Kitchen Hot Zone Suppression System	Ansul (Tyco) / Amerex India

C. HVAC WORKS

Details of Materials / Equipment	Manufacturer's Name
VRF	i) Mitsuibishi
(VRF Manufacturer has to submit the Derating & Simulation Curves for Entire System in requested format)	ii) Toshiba
	iii) Daikin
	iv) HITACHI
Axial/SISW/Cabinet Inline Fans	i) Aldes ii) Systemair iii) KRUGER
Mixed Flow Inline Fans	i) Aldes ii) Systemair iii) KRUGER
Drain pump	i) Aspen ii) Posseidon
Sheet Metal Ducting	
Sheets	i) SAIL ii) Jindal
Fabricator	i) Zeco iii) Asawa iii) Alphaduct
Air filters	i) Fab Tech ii) Dyna Filters iii) Airtech
Grilles , Diffusers , jet nozzles	i) Air products ii) CPV iii) Systemair
Constant Airflow Regulator	i) Aldes ii) Trox
Pre-insulated – PIR ducting	i) Alp ii) PAL iii) Asawa

Piping		
Copper piping	i) ii) iii)	Mandev tubes Rajco Mexflow
Gauges	i) ii) iii)	H Guru Fiebeg Mercer
Thermometers (Dial type)	i) ii) iii)	H Guru Star Scientific Mercer
Flexible Bellows	i) ii) iii)	Resistoflex Kanwal Cori
Insulation		
Duct Insulation	i) ii) iii)	Armaflex K Flex Aerofoam
Pipe insulation	i) ii) iii)	Armaflex K Flex Aerofoam
Anchor Fastener/Duct & Pipe Supports	i) ii) iii)	Mupro Gripple Fischer
Welding Rod	i) ii) iii)	Esab L & T Advani Oerlikon
VFD	i) ii) iii) iv)	Danfoss ABB Mitsubishi VTS
Air Cooled DX Units	i) ii) iii)	Carrier Mitsubishi Daikin
Vibration Isolators	i) ii)	Cori Resistoflex
Electrical		
Electrical Panel	i) ii)	Arrow Elecmec

	iii) iv)	Motvic Equivalent
MV Switchgear		
a) Air Circuit Breakers	i) ii) iii) iv) v) vi)	ABB – Emax L & T – C Power / U Power Schneider – Masterpact Siemens – 3 WL Legrand C & S – (WiNmaster)
b) Moulded case circuit breakers	i) ii) iii) iv) v) vi)	ABB L & T Schneider Siemens Legrand C & S
c) Motor Protection Unit Breaker (MPCB)	i) ii) iii) iv) v)	Schneider Electric Siemens Legrand ABB C & S
d) Miniature Circuit Breaker (MCB)	i) ii) iii) iv)	Hager (Larsen & Toubro) MDS Legrand Schneider Electric – (Multi 9) Siemens
e) RCCB/RCBO	i) ii) iii) iv)	Hager (Larsen & Toubro) MDS Legrand Schneider Electric – (MG) Siemens
f) Power / Aux. Contactor	i) ii) iii)	Schneider Electric (Telemechanique) Siemens ABB
g) Switch fuse units, isolators	i) ii) iii) iv)	L & T Siemens G E Power Controls Indo Asian
h) Contactors	i) ii) iii) iv)	ABB Schneider Siemens L & T
i) Protection Relay	i)	ABB

Numeric Type	ii) iii) iv)	Siemens Schneider L & T
j) Indicating Lamps LED type and Push Button	i) ii) iii) iv)	Vaishno Schneider Electric Siemens Teknik
k) Overload relays with built in single Phase preventer	i) ii) iii) iv)	ABB Schneider Electric Siemens L & T
l) Electronic Digital Meters & load Manager (A/V/PF/Hz/KW/KWH)with LED Display	i) ii) iii) iv) v)	HPL L & T MECO Secure Conzerv
m) Overloads	i) ii) iii) iv)	ABB L & T Siemens Schneider
n) Automatic Transfer switches	i)	ASCO Automatic Switch co (USA)
LT cables	i) ii) iii) iv) v) vi)	RPG KEI Finolex Polycab Rallison Gloster
Cable end termination	i) ii) iii)	Comet Dowells Jainson
Cable trays	i) ii) iii) iv)	Indiana Profab Asian Ancillary Corporation Equivalent
Conduit wiring a) Steel	i) ii) iii) iv)	BEC AKG Supreme Sudhakar
b) PVC	i) ii)	Precision Supreme
	iii)	AKG

c) Wires	i) Finolex ii) Havells iii) Polycab
Motor	i) ABB ii) Siemens iii) C & G
Sensors & Instrumentation	i) Honeywell ii) Omnicron iii) Siemens iv) Ambetronics
SEQUENTIAL CONTROLLERS	i) Aircon Controls ii) Proton

Note : Preference will be given to use maximum number of available components from any one of the selected manufacturer for the project.

D. FIRE ALARM WORKS

Sr. No.	**Details of Materials / Equipment**	**Manufacturer's Name**
	FIRE ALARM SYSTEM	
1.	Fire Alarm System and All Accessories	Bosch/ GE Edwards / Honeywell / Siemens / Hochiki/ Simplex
2.	Public Address System and All Accessories	Bosch / Cooper / Honeywell
3.	Sealed maintenance free batteries	Exide/ GS Batteries (Japan Storage Co Ltd.) / Hitachi
4.	Communication Cable - **Indigenous**	Finolex / Lappkabel / Polycab / RR Kabel
5	Communication Cable - **Imported**	Belden / Comscope- USA / Southwest wire & Cable / Volex
6.	Personal Computer	Dell / Hewlet Packard / IBM / Wipro
7.	Color Monitor	LG / Philips / Samtron / Samsung

APPENDIX "B"

CEMENT CONSUMPTION COEFFICIENTS (Derived on the basis of CPWD AOR)

Sr. No	Brief Description of Item	Unit	Cement	
			kg	Bags
	Part-I-SANITARY INSTALLATIONS			
1	Fixing I.W.C. or European or pedestal type w.c.with flushing cistern and brackets, slush pipe with fittings and clamp including making good the walls and floors.	Each	**5.0**	**0.10**
2	Fixing 32 mm φ flush pipe	Each	**1.0**	**0.02**
3	Fixing w.c. pan only + a pair of foot rests.	Each	**2.5+0.5**	**0.06**
4	**Fixing flat back or wall type, lipped front, urinal basin :**			
	a) One urinal with 5 litrecistern	Each	**2.5**	**0.05**
	b) Two urinal with 10 litre cistern	Each	**4.0**	**0.08**
	c) Three urinal with 10 litre cistern	Each	**6.7**	**0.13**
	d) Four urinal with 15 litre cistern	Each	**9.5**	**0.19**
	e) Urinal basin only	Each	**1.0**	**0.02**
5	**Fixing stall urinals**			
	a) Single stall urinal with 5 litrecistern	Each	**5.1**	**0.10**
	b) Two stall urinal with 10 litre cistern	Each	**10.2**	**0.20**
	c) Three stall urinal with 10 ltr. Cistern	Each	**15.3**	**0.31**
	d) Four stall urinal with 15 ltr. cistern	Each	**20.3**	**0.41**
	e) Stall urinal only	Each	**2.0**	**0.04**
6	Fixing lavatory basin/ sink with brackets & making good the walls	Each	**2.5**	**0.05**
7	Fixing wash basin/ kitchen sink	Each	**1.5**	**0.03**
8	Fixing T.W.draining board with brackets and making good the walls	Each	**1.4**	**0.03**
9	Fixing M.S. holder bat clamp in C.C. 1:2:4 block/ M.S. stay and clamp for C.I. pipe	Each	**0.5**	**0.01**
10	Fixing S.C.I trap with grating including making good the walls and floors	Each	**2.5**	**0.05**
11	Cutting chase in B.W. for fixing S.C.I. pipe & making good the B.W. in In C.M. 1:3			
	a) 100 mm dia	Each	**5.0**	**0.10**

	b) 50 mm dia	Each	**3.33**	**0.07**
12	Fixing square mouth S.W. gully trap with C.I. grating and B.M. Chamber	Each	**23.0**	**0.46**
13	Providing and fixing M.S. foot rests with 200 x 200 x 100 mm C.C. 1:3:6 block	Each	**0.88**	**0.018**
14	Fixing C.I. Steps (Rungs)	Each	**1.0**	**0.02**

Sr. No	Brief Description of Item	Unit	Cement	
			kg	Bags
1	**Part-II-WATER SUPPLY SYSTEM** Constn.of BM valve chambers 1.0 M depth ,230 mm thick b.m. in cm 1:4 over 150 mm thick CC 1:2:4 bed also for capping and bearing Course on the top of masonry wall, 150 mm offset cp in cm1:3 mixed Withw.p.comp.@ 2% by wt. Of cement , 20 mm thick both on int.&ext.surfaces, int. surfaces finished smooth with a floating coat of neat cement and ext.surfaces finished rough with wooden float , providing 100 mm thick RCC slab casted in G. M.S.angle box frame.			
a	Chamber 1 M. x 1 M. clear int.dim. without s.b.	Each	**493.00**	**9.86**
b	Chamber 1 M. x 1 M. clear int.dim. with s.b.	Each	**493.00**	**9.86**
c	Extra depth for V.C.over item No: (a&b).	RM	**236.50**	**4.73**
d	Chamber 1.2 M. x 1.2 M. clear int.dim. without s.b.	Each	**592.00**	**11.84**
e	Chamber 1.2 M. x 1.2 M. clear int.dim. with s.b.	Each	**592.00**	**11.84**
f	Extra depth for V.C.over item No: (d&e).	RM	**274.00**	**5.48**
2	Prov.Valvechamber(suitable for C.I. Frame & cover) of following int.dim.,230 mm b.m.in CM 1:4, over a 150 mm th. CC1:4:8 bed with 150 mm offset from all finished faces also for capping and bearing course on the top of masonry wall, 15 mm thick c.p.in cm1:3 with w.p.comp.@ 2% by wt.of cement on int.&ext.surfaces, all int.surfaces finished smooth with a floating coat of neat cement and ext.surfaces finished rough with wooden float.			
A	**Valve chamber of internal dimension 300x300 mm upto following depth.**			
a	Valve chamber of 300mm depth.	Each	**76.00**	**1.52**
b	Valve chamber of 450mm depth.	Each	**90.00**	**1.80**
B	**Valve chamber of internal dimension 450x450 mm upto following depth.**			
a	Valve chamber of 300mm depth.	Each	**98.50**	**1.97**
b	Valve chamber of 450mm depth.	EachE	**116.00**	**2.32**
c	Valve chamber of 600mm depth.	ach	**133.50**	**2.67**
C	**Valve chamber of internal dimension 600x600 mm upto following depth.**			
a	Valve chamber of 300mm depth.	Each	**121.50**	**2.43**
b	Valve chamber of 450mm depth.	EachE	**143.00**	**2.86**
c	Valve chamber of 600mm depth.	ach	**164.50**	**3.29**

Sr. No	Brief Description of Item	Unit	Cement	
			kg	Bags
3	Prov. Valve chamber (suitable for SFRC cover) of following int.dim.,230 mm b.m. in CM 1:4, over a 150 mm th. CC1:4:8 bed with 150 mm offset from all finished faces also for capping and bearing course on the top of masonry wall, 15 mm thick c.p.in cm1:3 with w.p.comp.@ 2% by wt.of cement on int.& ext. surfaces, all int.surfaces finished smooth with a floating coat of neat cement and ext.surfaces finished rough with wooden float, supplying & placing SFRC cover.			
A	**Valve chamber of internal dimension 300x300 mm upto following depth.**			
	Valve chamber of 300mm depth.			
a	Valve chamber of 450mm depth.	Each	**76.00**	**1.52**
b	**Valve chamber of internal dimension 450x450 mm upto following depth.**	Each	**90.00**	**1.80**
B	Valve chamber of 300mm depth.			
	Valve chamber of 450mm depth.	Each	**98.50**	**1.97**
a	Valve chamber of 600mm depth.	EachE	**116.00**	**2.32**
b	**Valve chamber of internal dimension 600x600 mm upto following depth.**	ach	**133.50**	**2.67**
c	Valve chamber of 300mm depth.			
C	Valve chamber of 450mm depth.	Each	**121.50**	**2.43**
	Valve chamber of 600mm depth.	EachE	**143.00**	**2.86**
a		ach	**164.50**	**3.29**
b				
c				
4	**Fixing G.I. pipe on wall including making good the walls (Note: 1 HaM = 100 M)**			
	a) 15 mm φ	HaM	**5.0**	**0.10**
	b) 20 mm φ	HaM	**6.0**	**0.12**
	c) 25 mm φ	HaM	**7.0**	**0.14**
	d) 32 mm φ	HaM	**7.5**	**0.15**
	e) 40 mm φ	HaM	**8.0**	**0.16**
	f) 50 mm φ	HaM	**8.0**	**0.16**
	g) 80 mm φ	HaM	**9.0**	**0.18**
	h) 100 mm φ	HaM	**10.0**	**0.20**
	i) 150 mm φ	HaM	**12.50**	**0.25**

Sr. No	Brief Description of Item	Unit	Cement	
			kg	Bags
	Part-III-SEWERAGE SYSTEM			
1a	Const.ofrect.inspect.chambers of int.size 900 mm x 600 mm at bottom and int.size 900x450mm at top for depth upto 600mm & brick masonry in cm 1:2, 230 mm th.wallincl.making brick tapering for log.walls for 450mm depth meas.from top of frame & cover, over 150mm thick CC1:2:4 with 150mm offset from all outer fini.wallsurfaces,also for benching ,20mm th.c.p.in cm 1:1 with w.p.comp. @2% by wt.ofcem.on int.& ext. surfaces, int.surfaces and channel finished smooth with floating coat of neat cement and ext.surfaces finished rough with wooden float.	Each	312.50	6.25
1b	Extra over item 4(a) for depth beyond 600 mm initial depth upto a depth of 1500 mm. all as per specification and as directed.	RM	357.50	7.15
2a	Const.of circular manhole of 1200 mm int.dia.at bottom and 540/600 mm at top for 1500 mm ini.depth& b.m.in cm 1:2, 230 mm th.wall for 1400 mm depth meas.from top of frame & cover of M.H.in conical shape and remaining ht. Const.345mm th.in cyl.shape over a 300 mm th.CC 1:2:4 bed with 300mm offset from outer finished wall surface,also for bench., 20mm th.plaster in cm1:1 with w.p.comp.@2% by wt.ofcem.on int.&ext.surfaces,int.surfaces and channel finished smooth with floating coat of neat cement and ext.surfaces finished rough with wooden float.			
(i)	Top internal dia 540mm to suit MD & HD frame & cover.	Each	1063.50	21.27
(ii)	Top internal dia 600mm to suit EHD frame & cover.	Each	1074.00	21.48
2b	Extra over item 5(a) for a depth beyond 1500 mm initial depth &upto a depth of 2300 mm.	RM	534.00	10.68
3a	Const.of circular manhole of 1500 mm int.dia.at bottom and 540/600 mm at top for 2300 mm ini.depth& b.m.in cm 1:2, 230 mm th.wall for 2000 mm depth meas.from top of frame & cover of M.H.in conical shape and remaining ht. Const.345mm th.in cyl.shape over a 300 mm th.CC 1:2:4 bed with 300mm offset from outer finished wall surface,also for bench., 20mm th.plaster in cm1:1 with w.p.comp.@2% by wt.ofcem.on int.&ext.surfaces,int.surfaces and channel finished smooth with floating coat of neat cement and ext.surfaces finished rough with wooden float.			

(i)	Top internal dia 540mm to suit MD & HD frame & cover.	Each	**1685.50**	**33.71**
Sr. No	**Brief Description of Item**	**Unit**	**Cement**	
			kg	**Bags**
(ii)	Top internal dia 600mm to suit EHD frame & cover.	Each	**1702.00**	**34.04**
3b	Extra over item 6(a) for a depth beyond 2300 mm initial depth.	RM	**635.00**	**12.70**
4	Constn.ofb.m.drop pipe cleaning chamber of intl.size 300x300 mm for depth of 300 mm from top of cover & frame above S.W. drop pipe in b.m., in c.m.1:2 and 230mm thk.wall over 150mm offset from all outer finished wall surfaces of the chamber, p.& f. suitable MD precast SFRC cover 100 mm thk.CC 1:2:4 coping at top of b.m., 20mm cem.plastering in cm1:1, mixed with w.p.comp.@ 2% by wt.ofcem.intl.&extl.surfaces of the chamber, all inside surfaces finishing smooth with floating coat of neat cement and extl. Surfaces finishing rough with wooden float.	Each	**138.50**	**2.77**
5	P.&f.dropconnect.forini.depth of 600mm including p.&l. followiing dia. S.W. pipe & specials including p.&f.bends, tees, crosses (double tees) plugs, caps etc., including jointing the joints with hemp yarn and C.M. 1:1,including encasing the pipes with CC 1:2:4 such that shape of the cross sect.through encased pipe shall be square of side length equal to o.d.of pipe plus 300mm.			
	a) 150mm nom. dia.	Each	**76.00**	**1.52**
	b) Extra depth over item 8(a) beyond 0.60 M initial depth	RM	**69.50**	**1.39**
	c) 230mm nom.dia.	Each	**88.50**	**1.77**
	d) extra depth over item 8© beyond 0.60 M initial depth	RM	**91.50**	**1.83**
	e) 300mm nom.dia.	Each	**95.00**	**1.90**
	f) extra depth over item 8(e) beyond 0.60 M initial depth	RM	**112.50**	**2.25**
6	P.&f.precast (SFRC) MH frame & covers conf.to IS 12592 of following sizes approved by BMC/CIDCO/E-I-C, tested as per IS 1726 (Part-I)1974 incl.cost of necessary steel reinf.,CC1:2:4 for fixing frame, for bed block (bearing course) and capping including necessary form work and cm1:2 for fixing the frame & for plast.expsosedsurf.of CC surf.of bed block (b.c.) & capping fini. Smooth with floating coat of neat cement.			
	a) SFRC rect.frame for IC of size o/s 1130mm x 680mm, i/s clear opening 900mmx 450mm and RCC cover for IC of size 1000 mm x 550 mm			

	i) Medium Duty (Grade MD-10) frame sect.size 110mm wide x105 mm deep and cover thick. 50mm	Each	**80.40**	**1.608**
Sr. No	**Brief Description of Item**	**Unit**	**Cement**	
			kg	**Bags**
	ii)Heavy Duty (Grade HD-20) frame sect.size 115mm wide x150 mm deep and cover thick. 95mm	Each	**72.00**	**1.44**
	b) SFRC circular frame& cover			
	i) Medium Duty (Grade MD-10) SFRC frame of out. Dia. 840mm, clear intl.dia. 530mm, frame sect.size 155mm wide x115mm deep, SFRC manhole cover of 630mm dia. And 65 mm thick.	Each	**47.80**	**0.956**
	ii) Heavy duty (Grade HD-20)SFRC frame of out.dia. 940mm, clear intl.dia. 540mm deep, frame sect.size 200 mm wide x150mm deep, SFRC manhole cover of 630mm dia. And 95 mm thickn.	Each	**32.70**	**0.654**
	iii) Extra Heavy duty (Grade EHD-35) SFRC frame of out.dia. 940mm, clear intl.dia. 540mm deep, frame sect.size 200 mm wide x175 mm deep, SFRC manhole cover of 780mm dia. And 120 mm thick.	Each	**30.00**	**0.60**
7	P.&F.air tight C.I. frame & cover of size and number as specified in schedule, for M.H. & I.C. each weighing ranging from 100 to 300 Kgs. Including cost of CC 1:2:4 for bed block (bearing course) and capping, fixing frame including necessary form work, 1:2 cement mortar for fixing frame and smooth cement finished plaster over exposed concrete surfaces of bed block (bearing course) and capping.			
	a) C.I. rect. frame & cover for IC of int.size 900 x450mm			
	i) Medium Duty (Grade MD-10)	Each	**89.35**	**1.787**
	ii)Heavy Duty (Grade HD-20)	Each	**87.10**	**1.742**
	b) SFRC circular frame& cover of in t. 560mm dia.			
	i) Medium Duty (Grade MD-10)	Each	**48.75**	**0.975**
	ii)Heavy Duty (Grade HD-20)	Each	**44.85**	**0.897**
8	P & F approved quality S.W. sewer trap of following sizes including placing the trap in position inside the manhole, embedding in C.C. 1:2:4, finishing the joints and rectifiying the leakages.			
	a) 100mm dia	Each	**6.50**	**0.13**

	b) 150mm dia	Each	**11.00**	**0.22**
	c) 200mm dia	Each	**16.50**	**0.33**
Sr. No	**Brief Description of Item**	**Unit**	**Cement**	
			kg	**Bags**
	d) 230mm dia	Each	**19.50**	**0.39**
	e) 250mm dia	Each	**24.00**	**0.48**
	f) 300mm dia	Each	**31.00**	**0.62**
9	Making connections with the existing chamber or manhole including breaking the brick masonry wall re-doing the same to the original condition after the connection by adding approved w.p.comp. to the mortar.			
	a) 100mm dia	Each	**3.70**	**0.074**
	b) 150mm dia	Each	**5.30**	**0.106**
	c) 200mm dia	Each	**7.00**	**0.14**
	d) 230mm dia	Each	**8.00**	**0.16**
	e) 250mm dia	Each	**11.50**	**0.23**
	f) 300mm dia	Each	**14.50**	**0.29**
	g) 350mm dia	Each	**17.50**	**0.35**
	h) 400mm dia	Each	**20.50**	**0.41**
	i) 450mm dia	Each	**23.50**	**0.47**
	NOTE FOR S.W. PIPES: -			
	1. To arrive the cement consumption of different proportion of cement mortar, consider 2/3 rd consumption for cm1:2 & 1/2 consumption for cm1:3 of the given consumption of cm 1:1			
10	P & L following dia.best quality s.g.S.W.pipe conf. IS 651-1980 with ISI mark and approved make, lowering and laying the pipe line in trenches for all depth including aligning & jointing with hemp yarn and finishing with cm 1:1 mixed with w.p. comp, curing, testing the line.			
	a) 100mm dia. ---------- 0.6m length	RM	**2.00**	**0.040**
	b) 150mm dia. ---------- 0.6m length	RM	**3.00**	**0.060**
	c) 200mm dia. ---------- 0.6m length	RM	**4.35**	**0.087**

	d) 230mm dia. ---------- 0.6m length	RM	**4.85**	**0.097**
	e) 250mm dia. ---------- 0.6m length	RM	**5.50**	**0.110**
Sr. No	**Brief Description of Item**	**Unit**	**Cement**	
			kg	**Bags**
	f) 300mm dia. ---------- 0.6m length	RM	**6.50**	**0.130**
	g) 350mm dia. ---------- 0.6m length	RM	**7.80**	**0.156**
	h) 400mm dia. ---------- 0.6m length	RM	**9.15**	**0.183**
	i) 450mm dia. ---------- 0.6m length	RM	**9.75**	**0.195**
	j) 500mm dia. ---------- 0.6m length	RM	**13.50**	**0.270**
	k) 600mm dia. ---------- 0.6m length	RM	**16.80**	**0.336**
	NOTE FOR RCC / CC SPUN PIPES: -			
	1. To arrive the cement consumption of different proportion of cement mortar, consider 2/3 rd consumption for cm1:2 & 1/2 consumption for cm1:3 of the given consumption of cm 1:1			
	2. Pipes of 300mm dia.and above 3.0m,3.5m4.0m in length may also be available except "NP1" class pipes.			
	3. The cement consumption for "P1" class pipe (which is available in the range of 80mm to 1200mm dia.) can be taken similar to "NP2" class pipe			
11	Supplying, lowering, laying, CC class "NP1" spun pipes of following class conforming to IS-458 with necessary collars or spigot socket, laid to correct grade and levels at all depth, including cutting to lengths, jointing with rubber ring or with hemp yarn and cement mortar 1:1, caulking the joints, and finishing, curing, testing etc. complete as per specifications.			
	a) 80mm dia. ---------- 1.0m length	RM	**0.62**	**0.012**
	b) 100mm dia. ---------- 1.0m length	RM	**0.71**	**0.014**
	c) 150mm dia. ---------- 1.0m length	RM	**0.86**	**0.017**
	d) 200mm dia. ---------- 1.0m length	RM	**1.06**	**0.021**
	e) 225mm dia. ---------- 1.0m length	RM	**1.17**	**0.023**
	f) 250mm dia. ---------- 1.0m length	RM	**1.26**	**0.025**

Sr. No	Brief Description of Item	Unit	Cement	
			kg	Bags
	g) 300mm dia. ---------- 1.0m length	RM	**1.96**	**0.039**
	h) 350mm dia. ---------- 1.0m length	RM	**2.65**	**0.053**
	i) 400mm dia. ---------- 1.0m length	RM	**3.34**	**0.067**
	j) 450mm dia. ---------- 1.0m length	RM	**4.03**	**0.081**
12	Supplying, lowering, laying, RCC spun pipes of following class conforming to IS-458 with necessary collars or spigot socket, laid to correct grade and levels at all depth, including cutting to lengths, jointing with rubber ring or with hemp yarn and cement mortar 1:1, caulking the joints, and finishing, curing, testing etc. complete as per specifications.			
A	**class - NP2 RCC**			
	a) 80mm dia. ---------- 2.0m length	RM	**0.55**	**0.011**
	b) 100mm dia. ---------- 2.0m length	RM	**0.75**	**0.015**
	c) 150mm dia. ---------- 2.0m length	RM	**0.90**	**0.018**
	d) 200mm dia. ---------- 2.0m length	RM	**1.15**	**0.023**
	e) 225mm dia. ---------- 2.0m length	RM	**1.18**	**0.024**
	f) 250mm dia. ---------- 2.0m length	RM	**1.35**	**0.027**
	g) 300mm dia. ---------- 2.5m length	RM	**1.50**	**0.030**
	h) 350mm dia. ---------- 2.5m length	RM	**2.20**	**0.044**
	i) 400mm dia. ---------- 2.5m length	RM	**2.80**	**0.056**
	j) 450mm dia. ---------- 2.5m length	RM	**3.60**	**0.072**
	k) 500mm dia. ---------- 2.5m length	RM	**3.90**	**0.078**
	l) 600mm dia. ---------- 2.5m length	RM	**4.80**	**0.096**

Sr. No	Brief Description of Item	Unit	Cement	
			kg	Bags
	m) 700 mm dia.---------- 2.5m length	RM	**5.55**	**0.111**
	n) 800 mm dia.---------- 2.5m length	RM	**6.30**	**0.126**
	o) 900 mm dia.---------- 2.5m length	RM	**7.35**	**0.147**
	p) 1000 mm dia.---------- 2.5m length	RM	**8.25**	**0.165**
	q) 1100 mm dia.---------- 2.5m length	RM	**9.15**	**0.183**
	r) 1200 mm dia.---------- 2.5m length	RM	**10.20**	**0.204**
	s) 1400 mm dia.---------- 2.5m length	RM	**11.30**	**0.226**
	t) 1600 mm dia.---------- 2.5m length	RM	**12.80**	**0.256**
	u) 1800 mm dia.---------- 2.5m length	RM	**14.40**	**0.288**
	v) 2000 mm dia.---------- 2.5m length	RM	**16.00**	**0.320**
	w) 2200 mm dia.---------- 2.5m length	RM	**17.60**	**0.352**
B	**class-NP3 RCC**			
	a) 80 mm dia. ---------- 2.0 m Length	RM	**0.55**	**0.011**
	b) 100 mm dia.---------- 2.0 m Length	RM	**0.70**	**0.014**
	c) 150 mm dia.---------- 2.0 m Length	RM	**0.85**	**0.017**
	d) 200 mm dia.---------- 2.0 m Length	RM	**1.15**	**0.023**
	e) 225 mm dia.---------- 2.0 m Length	RM	**1.20**	**0.024**
	f) 250 mm dia.---------- 2.0 m Length	RM	**1.74**	**0.0347**
	g) 300 mm dia.---------- 2.5 m length	RM	**1.74**	**0.0348**
	h) 350 mm dia.---------- 2.5 m length	RM	**2.85**	**0.057**
	i) 400 mm dia.---------- 2.5 m length	RM	**3.80**	**0.076**
	j) 450 mm dia.---------- 2.5 m length	RM	**4.15**	**0.083**
	k) 500 mm dia.---------- 2.5 m length	RM	**4.45**	**0.089**
	l) 600 mm dia.---------- 2.5 m length	RM	**5.26**	**0.105**

Sr. No	Brief Description of Item	Unit	Cement	
			kg	Bags
	m) 700 mm dia.---------- 2.5 m length	RM	**5.95**	**0.119**
	n) 800 mm dia.---------- 2.5 m length	RM	**6.75**	**0.135**
	o) 900 mm dia.---------- 2.5 m length	RM	**7.45**	**0.149**
	p) 1000 mm dia.---------- 2.5 m length	RM	**8.65**	**0.173**
	q) 1100 mm dia.---------- 2.5 m length	RM	**9.35**	**0.187**
	r) 1200 mm dia.---------- 2.5 m length	RM	**10.10**	**0.202**
	s) 1400 mm dia.---------- 2.5 m length	RM	**11.70**	**0.234**
	t) 1600 mm dia.---------- 2.5 m length	RM	**13.20**	**0.264**
	u) 1800 mm dia.---------- 2.5 m length	RM	**14.70**	**0.294**
	v) 2000 mm dia.---------- 2.5 m length	RM	**16.35**	**0.327**
	w) 2200 mm dia.---------- 2.5 m length	RM	**17.95**	**0.359**
	x) 2400 mm dia.---------- 2.5 m length	RM	**19.55**	**0.391**
	y) 2600 mm dia.---------- 2.5 m length	RM	**21.15**	**0.423**
C	**class-P2RCC**			
	a) 80 mm dia. ---------- 2.0 m Length	RM	**0.55**	**0.0110**
	b) 100 mm dia. ---------- 2.0 m Length	RM	**0.75**	**0.0150**
	c) 150 mm dia. ---------- 2.0 m Length	RM	**0.90**	**0.0180**
	d) 200 mm dia. ---------- 2.0 m Length	RM	**1.15**	**0.0230**
	e) 225 mm dia. ---------- 2.0 m Length	RM	**1.20**	**0.0240**
	f) 250 mm dia. ---------- 2.0 m Length	RM	**1.74**	**0.0347**
	g) 300 mm dia.---------- 2.5 m length	RM	**1.74**	**0.0348**
	h) 350 mm dia.- .---------- 2.5 m length	RM	**2.44**	**0.0488**
	i) 400 mm dia. .---------- 2.5 m length	RM	**3.15**	**0.0630**
	j) 450 mm dia. .---------- 2.5 m length	RM	**3.85**	**0.0770**

Sr. No	Brief Description of Item	Unit	Cement	
			kg	Bags
	k) 500 mm dia. .---------- 2.5 m length	RM	**4.37**	**0.0873**
	l) 600 mm dia.---------- 2.5 m length	RM	**5.39**	**0.1077**
	m) 700 mm dia.---------- 2.5 m length	RM	**5.95**	**0.1190**
	n) 800 mm dia.---------- 2.5 m length	RM	**6.78**	**0.1355**
	o) 900 mm dia.---------- 2.5 m length	RM	**7.63**	**0.1526**
	p) 1000 mm dia.---------- 2.5 m length	RM	**8.45**	**0.1689**
D	**class-P3 RCC**			
	a) 80 mm dia. ---------- 2.0 m Length	RM	**0.28**	**0.0055**
	b) 100 mm dia.---------- 2.0 m Length	RM	**0.75**	**0.0150**
	c) 150 mm dia.---------- 2.0 m Length	RM	**0.90**	**0.0180**
	d) 200 mm dia.---------- 2.0 m Length	RM	**1.21**	**0.0242**
	e) 225 mm dia.---------- 2.0 m Length	RM	**1.32**	**0.0263**
	f) 250 mm dia.---------- 2.0 m Length	RM	**1.43**	**0.0286**
	g) 300 mm dia.---------- 2.0 m Length	RM	**1.83**	**0.0365**
	h) 350 mm dia.---------- 2.0 m Length	RM	**2.50**	**0.0500**
	i) 400 mm dia.---------- 2.0 m Length	RM	**3.18**	**0.0636**
	j) 450 mm dia.---------- 2.0 m Length	RM	**4.20**	**0.0840**
	k) 500 mm dia.---------- 2.0 m Length	RM	**4.65**	**0.0930**
	l) 600 mm dia.---------- 2.0 m Length	RM	**5.55**	**0.1110**
	m) 700 mm dia.---------- 2.0 m Length	RM	**6.45**	**0.1289**
	n) 800 mm dia.---------- 2.0 m Length	RM	**7.35**	**0.1469**
	Part-IV – STORM WATER DRAINS & CHAMBERS			
1a.	Construction of storm water chambers of internal sizes 600 mm x 600mm x x 600mm initial depth, 450 thk. Wall in R.R.masonry in CM 1:6, 150mm thick bedding in CC1:4:8,50mm thk benching, 80mm high haunching in CC1:2:4, also for100mm thick capping & bearing course plastering in cm 1:4,20mm thick	Each	**269.00**	**5.38**

	on sides of drain, 12mmthick ontop& base in cm1:4,finished smooth with neat cement ,supplying & placing medium duty (MD) RCC precast perforated cover 750mm x 600mm x75mm .etc complete and as directed by engineer in charge.			
b	Extra over item (a) over 0.6 m initial depth.	RM	**181**	**3.62**
2a.	Constn.of storm water chambers of internal sizes 600mm x1050mm x 900mm initial depth, 450 thk. Wall up to 700mm depth from top of chamber & remaining hight 600mm thk.in R.R.masonry in CM 1:6, 150mm thick bedding in CC1:4:8,50mm thk. Benching, 80mm high haunching,100mm thick capping & bearing course in CC1:2:4, plastering in cm 1:4,20mm thick on sides of drain, 12mmthick on top & base in cm1:4,finished smooth with neat cement ,supplying and placing medium duty (MD) RCC precast perforated cover 750mm x 600mm x75mm .etc complete and as directed by engineer in charge.	Each	**432.65**	**8.65**
b.	Extra over item (a) over 0.9 m initial depth.	RM	**316.80**	**6.34**

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 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 :

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 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 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 :

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 :

1.2. **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 Parts :

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

j. Automatic Star Delta Starter

k. Direct on line Starter

l. Contactor

m. Current Transformer (cast resin type)

n. Single phase preventor

o. Push Button

p. Change over switch

q. Ammeter & Voltmeter
KWH meter

r. Relay

s. Indication lamp

t. Cables

u. Wires

v. Variable Frequancy Drive.

2.2. ELECTRICAL TECHNICAL DATA SHEETS

For MCC +PDBs+MLDBs/SLDBs/DBs (To be filled by the bidders)

S.No.	Description	Recommended Specification	Confirmation by the Bidders
1	Type of Panel	a. MCC non drawout type compartmentalized. b. Panels non drawout type, non compartmentalized	
2	Type of Mounting	Free standing Floor Mounted	
3	Fault kA	50kA -1 Sec for MCC	
4	Thickness of CRCA sheets		
a	Structural members	3mm	
b	Covers and doors	2mm	
c	Base channel	MCC - ISMC 100	
d	Gland plate	3mm	
5a.	Painting/ Process	Synthetic Enamel Paint As per seven tank process Oven baked.	
b	Paint shade; a. Inside	RAL – 7032	

	b. Outside	RAL - 7032
6	Details of busbars	Electrolytic grade Copper of specified rating for details see constructional features mentioned in specifications
7	Cable Entry	For MCC & other Panels Top or Bottom depending upon location of Panel.
8	Enclosure Protection/ Ventilation	For MCC – IP -52 with louvers for Ventilation.
9	Control Wiring/ Power Wiring	Insulated 660Volts Cu wire.
a.	Voltage Circuit	1.5 sq mm
b.	Current Circuit	2.5 sq mm
c.	Minimum size of Power wiring CKt	16 sq mm
10	Maximum Operating Height	2100
11	Mounting height of Relays/Meters Control Switches	Range 350mm to 1900mm

LIST OF MAIN DOCUMENTS AND SUBMITTALS

PLUMBING & FIREFIGHTING WORKS

Sr.no.	Items	Clause No.	Remarks
1.	4-Copies of Proforma Invoice 4- sets of Technical Literature Packing Specifications		
2.	Performance Guarantee		
3.	All Permits / Licenses		
4.	Technical Data		
5.	Manufacturer's Drawings, Catalogues & Pamphlets & Other Documents		
6.	Variation in Quantity Statement.		
7.	Electrical Installation Certificate.		
8.	Operating Instructions& Maintenance Manual		
9.	Soft water & Power Requirement		
10.	Appendix - IV		
11.	Testing, Adjusting and Balancing		

Note : The above list is only for guide line of the contractor. The contractor shall thoroughly check all document and submittals required as per the tender document and submit them in time as per the requirement.