ITEM 15 J: TOILET PARTITION

GENERAL

General Requirements contain provisions and requirements essential to these Specifications; and apply to this section, whether or not referred to herein.

SCOPE OF WORK

Furnish and install toilet partitions as shown on drawings and as specified herein.

SUBMITTALS

1. Submit shop drawings indicating elevations of partitions, full scale sections, thickness and gauges of metal, fastenings, proposed method of anchoring, the size and spacing of anchors, details of construction, hardware, fittings, mountings, and other related items and installation details.

2. Submit sample one of each item of hardware, fittings, fastening, and each type of panel. The panel sample shall be cross-sectioned not less than 150 mm by 150 mm in size and shall show finish on base material and core of the panel.

3. Submit manufacturer's data literature for each item of hardware, fitting, fastening and each type of panel, complete with description of materials, finishes, and anchoring devices, and appurtenances.

4. Submit one sample of each color of partition for verification that products match the color indicated. Where colors are not indicated, submit the manufacturer's standard color samples for selection by the Architect.

DELIVERY AND STORAGE

Deliver materials to the site in original sealed containers or packages, bearing the manufacturer's name, brand designation, specification number, type, style and finish as applicable. Store and handle materials in a manner to protect them from damage.

MATERIALS

Toilet compartments/cubicles - comprising 12mm thk intermediate panels, doors, and partitions/compartments (compact laminated phenolic board) including door frame system urinal divider, cubicle divider, hardware and accessories in stainless finish and all other incidentals to complete.

Sizes, dimensions of doors, cubicles and dividers as shown on plans. Color shall be as selected by Architect.

All the accessories shall be of heat chemical and bacteria resistant.

All edges of doors and pilasters are chamfered and finish without any metal trimming.

EXECUTION

INSTALLATION

Installation of toilet partitions and urinal screens shall be in accordance with approved shop drawings and manufacturer's installation and directions.

ITEMS 15 K: PHOTOLUMINESCENT SIGNS AND MARKINGS

GENERAL

General Requirements contain provisions and requirements essential to these Specifications; and apply to this section, whether or not referred to herein.

SCOPE OF WORK

The work covered by this section consist of furnishing all labor, materials, equipment, tools and incidentals necessary to undertake, complete supply and install of photoluminescent signs and markers for the buildings as indicated on the drawings and as specified herein.

PHOTOLUMINESCENT SIGNS AND PATH MARKERS

Signs and markers are designed to be used in and about buildings to identify and ensure visibility escape routes for compliance with the performance based on Codes (Building & Fire Codes). The signs will be clearly visible and readily understandable under all conditions of foreseeable use, including emergency conditions.

SUBMITTAL

1. Shop drawings shall be submitted in advance to allow twenty eight days for review and approval. Shop drawings shall indicate materials and details of finishing works. The Contractor shall be responsible for all errors of detailing and fabrication, and for the correct finishing work items shown on the shop drawings.

2. The Contractor, before placing order for the finishing materials shall submit to the Project-In - Charged for approval representative samples of finishing materials. No placing of orders for material for finishing works shall be made without approval.

MATERIALS

Guidance Strip, 16mm-26mm

Exits Sign, 363mm x 183mm

Fire Exit Signage, 24meters Viewing Distance

Fire Extinguisher Signage, 200mm x 100mm

Fire Alarm Signage, 100mm x 100mm

Fire Hose Signage, 100mm x 100mm

Break Glass Signage, 100mm x 100mm

Evacuation Plan, 457mm x 610mm

Directional Pictogram, 392mm x 223mm

Step Edge Nosing, 50mm x 25mm

Handrail Marker, 16mm

EXECUTION

INSTALLATION

For versatility the signs and markers can be installed using fixers (screws) or adhesive tape.

The installation method used should be determined by the condition of installation surface screws should be used if there is any doubt about adhesion.

ITEM 15 L: SIGNAGES AND LOGO

SCOPE OF WORK

Furnish materials and perform labor to include miscellaneous works required for the installation of room identification for the toilets and port office.

SAMPLE AND SHOP DRAWINGS

The Contractor shall submit samples for approval by the Architect. Notify the Architect for any changes, clarifications and discrepancies.

For the room I.D. full size lettering layout and installation method shall be submitted to the Architect for approval before start of work.

MATERIAL REQUIREMENTS

1. PPA LOGO

    - 12.5mm thk. X 50mm thk. built-up Colored Acrylic Plastic Sheet for PPA Logo

2. ROOM MARKERS

    Black acrylic letters, 38mm (1-1/2") high on white acrylic background, 63mm (2-1/2") high, with clear acrylic cover. Lengths shall be as required by the full notation therein.

EXECUTION

WORKMANSHIP

Workmanship shall be executed in high quality comparable with artworks.

MOUNTING

For all mounted assemblies, appropriate mounting hardware and connectors which are concealed shall be sufficiently used.

Assemblies shall be mounted plumb, straight, level, and at prescribed heights.

INSTALLATION

Installation shall be done in a secure and permanent manner at prescribed heights and/or layout. The backwall shall not be mutilated. After the dowels are positioned, fill with expanding grout, or other approved fillers, and retouch, flashed to the backwall surface.

ITEM 15 M: CARPENTRY AND JOINERY WORKS

SCOPE OF WORK

The work shall consist of furnishing all tools, labor, equipment and materials, unless otherwise specified to complete all carpentry and joinery works shown on the Drawings and specified herein.

GENERAL REQUIREMENTS

a. Lumber Grades

Lumber shall be of the best grade available, of the respective kinds required for the various parts of work; well seasoned, thoroughly dry and free from loose or unsound knots, sap, shakes or other imperfections impairing its strengths, durability and appearance. All exposed woodwork shall be smooth by dressed and sandpapered unless otherwise indicated or specified. Framing lumber shall be of the rough dimensions unless otherwise shown on the drawings.

b. Substitution of Lumber

Any lumber equally good for the purpose intended maybe substituted for the kind specified, subject to prior written approval of the Engineer. Provided, however, that in the substitution of the cheaper kind of lumber than that specified, a reduction in the contract price equal to the difference in the costs of the two kinds of lumber shall be made.

c. Delivery and Storage

The Contractor shall deliver lumber to the site in undamaged condition. Lumber shall be stacked in such a manner as to insure proper ventilation and drainage, and shall be supported at least 150 mm above-ground. Lumber shall be protected against dampness before and after delivery, and enough protection under cover in well ventilated enclosure, not exposed to extreme changes of temperature and humidity; and in a manner as to provide air-circulation around all surfaces of each pile to insure thorough air-seasoning. Lumber or millwork in buildings shall not be finished until concrete, masonry work and plaster are dry. Lumber shall be delivered at least thirty (30) days before use.

d. Grading of Plywood

Each sheet of plywood shall bear the mark identifying the plywood as to wood species, glue type and grade.

MATERIALS

a. Lumber

Lumber for various uses shall be one of the species listed for the purpose indicated unless otherwise specified in the drawing. For any use not specified, the lumber shall be the best commercial grade normally used for the purpose, subject to the approval of the Engineer.

All framings shall be done as far as possible with carefully fitted mortise and tenon joints.

All doors, windows, transoms, or other opening where so indicated on plans, shall have frames and sills of the dimensions shown or as hereafter detailed, and all frames coming in contact with concrete shall be anchored by means of 20-d nails, spaced not more than 0.20m, apart, all around the contract surfaces. All frames shall be rabetted , molded and cut with saw and cut under for water drips.

SPECIE	U S E
Yakal	All door jambs, headers and transom bars, wood plates and all other woodwork in contact with concrete or masonry and where indicated.
Apitong (pressure treated)	All truss members and rafters and where indicated; all wood framings and carpentry, except when in contact with concrete.
Tanguile (Kiln dried)	All exterior and interior mill work, siding, finish and trim, frame work and all other wood works not specifically mentioned; except when in contact with concrete.

b. Plywood

Plywood shall conform to Commercial Standard PSI and shall be of local manufacture.

Plywood to be varnished shall be tanguile or kalantas veneers (as indicated), ribbon grained, water resistant, Class B and of the thickness indicated.

Plywood to be painted shall be tanguile veneer ordinary rotary-cut, water resistant, Class C and of thickness indicated.

Plywood exposed to the outside elements or where indicated shall be waterproof or marine plywood and of the thickness indicated.

c. Fastenings

Fastenings shall be common nails, glue or specified, flat-head wood screws (F.H.W.S.), rough-head wood screws (R.H.W.S.), bolts or lag screws where specified or called for shall be used. Conceal fastenings as much as possible; where not possible, locate them in inconspicuous places, where nailing is permitted through woodwork smooth-finished face, conceal nail heads.

1. Nails

   Shall be of the smooth shank, zinc coated, common wire nails of local manufacture, and of types and sizes best suited for the purpose.

2. Wood Screws

   Shall be brass or cadmium plated of the best available commercial quality, and of types and sizes suited for the purpose.

PRESSURE TREATED LUMBER

a. Preservative Treatment

All lumber indicated to be pressure treated, shall contain any of the following net retention of solid preservative.

a. Boliden Salts - 45.5 kg. dry chemical per cubic foot of wood
b. Wolman Salts - 0.31 kg. dry chemical per cubic foot of wood
c. Tenalith Salts - 0.34 kg. dry chemical per cubic foot of wood

The Contractor shall submit an affidavit signed by an official of the preservative treatment company to the Engineer. This affidavit shall indicate the net retention of solid preservatives obtained and shall certify that pressure treated lumbers have a moisture content that does not exceed 17 percent upon shipment from the treatment plant.

Where it is necessary to cut or bore pressure-treated lumber on the job, two coats of prepared concentrated preservatives solution shall be applied to the end-cut or bored surfaces.

ROUGH CARPENTRY

All work shall be well fitted, accurately set, and rigidly secured in place. Anchors and bolts (with nuts and washers) straps and tie rods shall be provided as required.

a. Cutting and Fitting

Cutting and fitting to accommodate other work shall be done in the required manner, and cut or damaged work shall be patched and made good.

b. Framing and Structural

Framing and structural lumber shall be well-seasoned, straight, square-edge stacks, and free from loose or unsound knots, bark edges or other defects that will impair its strength.

c. Plates for Walls and Partitions

Plates for walls and partitions shall be of the same width as the studs and shall form continuous horizontal ties.

Structural members shall not be cut, bored or notched for the passage of pipes or conduits without prior approval of the Engineer. All members damaged by such cutting or boring shall be reinforced by means of specially formed and approved sheet metal or steel shapes or remove or replaced with new member as directed.

Anchors, connectors and fastenings not indicated or specified otherwise shall be of the size and types necessary to suit the conditions encountered. Size, type and spacing of nails, screws or bolts for installation of manufactured building materials shall be as recommended by the product manufacturer unless indicated or specified otherwise.

Rough hardware, exposed to weather or in contact with exterior walls or masonry or slabs shall be zinc-coated except as specified otherwise.

All lumber surfaces in contact with concrete or masonry shall be given a brush coat of bituminous paint before installation.

JOINERY WORK

All lumber used for the joinery work shall be of the kinds and grades specified and shall be of the contours, patterns and profiles indicated.

All joints shall be made, installed tight and securely fastened in a manner approved by the Engineer. Exterior joints shall be mitered and interior angles coped. Panels shall be fitted to allow for shrinkage, avoid swelling, and insure that the work remain in place without warping, splitting and opening of joints.

Interior trims shall be approved standard stock moldings, except where special patterns or profiles are indicated.

Joints for cabinet work shall be glued in addition to nails or other fastening device required. Nailing shall be concealed where practicable. Where face nailing is used, nails shall be set for putty stopping.

All exposed surfaces shall be machined or hand sanded finished to an even smooth surface. No hammer marks or other unsightly marks shall be allowed on any wood panel or veneer.

ITEM 16 : PLUMBING AND SANITARY WORKS

SCOPE OF WORK

The work covered for this section shall consist of furnishing all labor, tools, equipment, materials, and incidentals necessary for the complete installation, testing, and operation of the plumbing and sanitary system within the buildings and premises in accordance with these Specifications and as shown on the drawings or as directed by the Engineer. The septic tank and its effluent and discharge pipelines shall be part of other sections of these specifications.

MATERIAL REQUIREMENTS

SUBMITTAL

1. The Contractor shall submit his work method statement with necessary shop drawings to the Engineer for approval twenty-eight (28) days before the start of the works.

   Shop drawings shall be dated and shall contain the name of the project and location of the subject item in the shop drawing which is to be installed.

   The Engineer will review and approve or return for correction all shop drawings with reasonable promptness. The Contractor shall make any corrections required and file with the Engineer three (3) corrected copies of the shop drawings.

2. The drawings shall indicate the general arrangement of all piping, however, where actual conditions necessitate re-arrangement in the opinion of the Contractor and/or the Engineer, the Contractor shall prepare and submit to the Engineer for approval, within twenty-eight (28) days before placing the order for materials, shop drawings of the proposed re-arrangement. Because of the small scale of the drawings, shop drawings to indicate all offsets, fittings and accessories shall be prepared. The Contractor shall carefully examine the drawings and shall carefully investigate actual structural and finish conditions affecting all his work.

3. The Contractor shall be responsible for the proper fitting of materials, equipment and accessories without substantial alteration and at no cost to the Employer.

4. The Contractor shall be responsible for the proper coordination of the work and shall provide all necessary clearance where necessary.

STANDARDS

Use of materials shall further be governed by other requirement imposed on other sections of these Specifications. Materials shall be subject to tests necessary to ascertain their fitness if the Engineer so requires. All works shall comply with the pertinent provisions of the Plumbing Code of the concerned city or town, the Code on Sanitation of the Philippines, and/or the National Plumbing Code of the Philippines.

MATERIALS

1. Identification of Materials

   Each length of pipe, fittings, traps, fixtures and devices used in the plumbing work shall have cast, stamped or indelibly marked on it, the approved manufacturer's trademark or name, the weight, type and class of product when so required by the standards mentioned above.

2. Alternative Materials

Use of any material not specified in this Specification may be allowed provided such alternate has been approved by the Engineer and provided further that a test, if required, shall be done by an approved agency in accordance with generally accepted standards.

3. Soil, Waste, Drain, Vent Pipes and Fittings

Soil, waste and vent pipes shall be unplasticized Polyvinyl Chloride (uPVC) pipes. Diameter shall be as indicated on the Drawings. It shall conform to ASTM D 1784 or ASTM D 2729.

Drainage pipes shall be reinforced concrete pipes (RCP), diameter shall be as indicated on the Drawings.

4. Jointing Material

The joint material for uPVC pipes shall be PVC solvent cement as recommended by the approved pipe manufacturer.

5. Water Supply Pipes

Water supply pipes shall be polypropylene random-80 (PPR-80) pipes PN 20 conforming to DIN Standards DIN 1988/DIN 8078. Jointing shall be fusion welded.

6. Cleanouts, Plugs and Tee

Cleanouts shall be of the same material as the pipe to be fitted. Cleanouts installed in connection with uPVC hubs and spigot pipes shall consist of a long sweep quarter bend of ¼ as shown on the drawings.

7. Pipe Sleeves

Pipe sleeves shall be installed and properly secured in place at all points where pipes passes through masonry or concrete. Pipe sleeves shall be uPVC pipe, Schedule 40.

8. Downspout

All downspouts shall be high-density polyethylene (HDPE) pipe, SDR 26 conforming to o ISO 4427 Plastics piping systems - Polyethylene (PE) pipes and fittings for water supply. Jointing shall be fusion welding

9. Splash Block

Provide splash blocks at the outlet of downspout emptying at grade which shall be made of pre-cast concrete, with smooth finished counter sunk dishes sloped to drain away from the building. Dimensions as shown on the Drawings.

10. Roof Strainers

The Contractor shall provide fittings and install 100mm G.I. mesh wire strainers where shown or indicated on the drawings and/or where the Engineer directs. Each strainer shall fit the size of the corresponding downspout which is to be installed.

11. Shower, Floor and Urinal Drain

Shower and floor drains shall be made of stainless steel non-tilting grate, perforated or slotted. Urinal drains shall be cast iron dome type drain.

12. Pipe hangers, Inserts and Support

a. Pipe hangers shall be wrought iron, malleable iron pipe hangers spaced not over 1.5 meters apart for uPVC pipes and 3.0 meters apart for iron pipes. Chain straps, perforated bars or wire hangers will not be permitted.

Hangers shall have short turnbuckles or other approved means of adjustment. Turnbuckles may be omitted on hangers where space does not permit their use. Trapeze hangers may be used in lieu of separate hangers for pipes running parallel to each other and close together.

b. Inserts shall be of cast iron or cast steel and shall be of a type to receive a machine bolt head or nut after installation.

c. Wrought iron clamps or collars shall be used to support vertical runs of pipes.

13. Unions

Union pipe 50mmØ and smaller shall be malleable iron. Union on water piping 63mmØ and larger shall be a flanged pattern and shall be of galvanized (zinc-coated) cast iron. Gaskets for flange unions shall be of the best quality fiber plastic or leather.

14. Valves

Valves shall be cast bronze of brass body. Chrome plated finish for all fixture taps and faucets and natural finish for all others, like hose bibbs, gate valves, and which are not tapped directly to a plumbing fixture. Concrete valve boxes shall be installed where required and will be of sufficient size for operating the valve.

15. Fixtures

a. Water Closets

All water closets for toilets as shown on the drawings shall be FLUSHOMETER VALVE TYPE, white with complete fittings and mounting accessories.

b. Lavatories

b. 1. Lavatory (Wall Hung)

Shall be vitreous china, wall-hung lavatory with rear overflow holes, fitting ledge suitable for single faucet holes on centers complete with faucet, standard fittings, trap and lavatory brackets, and other accessories.

b. 2. Lavatory (Countertop Lavatory)

Shall be vitreous china, oval or round shaped countertop lavatory with front overflow hole, complete with faucet, supply valve, and fittings with P-trap. Fitting ledge suitable for single hole on center.

c. Urinals

c. 1. Urinals for all comfort buildings shall be built-in urinal trough as shown on the drawings.

c. 2. Urinals shall be vitreous china, wall-hung washout urinal, flushing rim, integral trap, 19mm top and shall be provided with water saving flush system.

d. Service Sinks

Service sinks where indicated or shown on the Drawings shall be stainless steel, with single bowl and with complete U.S. or Japan imported fittings.

e. Slope Sinks

Slop sink shall be 24"x20" acid resisting enamel on Cast-Iron with concealed hanger and faucet.

Hose bibb shall be of brass finish.

f. Soap Holder

Soap holder and toilet paper holder shall be vitreous china, wall mounted. All toilet/bath rooms will be provided with soap holder, toilet paper holder and chrome plated towel racks.

g. Faucet for lavatory

Faucet for lavatory shall be in chrome-finish.

h. Bath and shower fitting

Bath and shower fitting shall be chrome-finish.

i. Towel Rail

Towel rail shall be tubular stainless steel, 2.7mmØ, and 0.54m long or as specified in the drawings.

j. Curtain rod

Curtain rod shall be tubular stainless steel, 19mmØ, or as specified in the drawings.

k. Grab Bar

Grab bar shall be tubular stainless steel, 25mmØ or as specified in the drawings.

l. Bidet Spray Combination

Installed in every cubicle near on the water closet, colored white or its equivalent

16. Concrete, Reinforcing Steel, Pipe and Steel Plate

Materials for wash pits, catch basins, and manholes shall conform to the requirements as

follows:

a. Concrete materials shall conform with the requirements in "Concrete Works" and shall be Class C concrete with a 28-day minimum compressive strength of 21 MPa (3,000 psi).

b. Reinforcing steel shall be as shown on the drawings and shall conform with the requirements of reinforcing steel bars in "Concrete Works."

c. Pipes shall be as shown on the drawings and shall comply with the relevant item of the particular pipe.

d. Steel plates shall be as shown on the Drawings and shall comply with Section "Steel and Metal Works".

18. Valve for Drinking Fountain

Valve where drinking fountain will be connected shall be polished brass pipe and shall have red enameled handle.

EXECUTION

All installation works shall be in conformity with the National Plumbing Code of the Philippines (NPCP).

EXCAVATION, TRENCHES AND BACKFILLING

1. Trenches for all underground pipelines shall be excavated to the required depth. The bottom of trenches shall be tamped hard and graded to secure the required fill. Bell holes shall be excavated so that pipes will rest on solid ground for their entire length.

Rocks where encountered, shall be excavated to a depth of 150mm below the bottom of the pipe and before the pipe is laid, the space between the bottom of the pipe and the rock shall be filled with sand. Sewer and water pipes shall be laid in separate trenches.

2. After pipelines have been tested, inspected and approved by the Engineer and prior to backfilling, all forms shall be removed and the excavation shall be cleaned of all trash and debris.

Materials for backfilling shall consist of acceptable excavated soil, borrow of sand, gravel or other materials approved by the Engineer and shall be free from trash, lumber or other debris. Backfilling shall be placed in horizontal layers not exceeding 150 mm in thickness and properly moistened to approximate optimum requirements. Each layer shall be compacted by hand or machine tamper or by other suitable equipment to a density that will prevent excessive settlement or shrinkage.

Backfilling shall be brought to a suitable elevation above grade to provide for anticipated settlement and shrinkage thereof.

Water pipes shall have a sand cushion 150mm below and above the pipes.

INSTALLATION OF SOIL, WASTE DRAINS OR VENT PIPES

1. Horizontal Drainage Pipe and Vent Piping

Horizontal waste pipes 75mmØ and smaller shall have a minimum grade of 6.5mm per

0.30m and for 100mmØ and larger, 3.2mm per 0.30m. All main vertical soil and waste stacks shall be extended full size above the roof line as vents, except where otherwise specifically shown.

Where practicable, two (2) or more vent pipes shall be connected together and extended as one pipe through the roof. Vent pipes in roof spaces shall be run as close as possible to the underside of roof with horizontal piping pitched to stacks using fittings as required without forming traps in pipes.

Vertical pipe vents may be connected to a vent line carrying other fixtures. The connection shall be at least 1.20m above the floor on which the fixtures are located to prevent the use of vent lines as waste. Horizontal waste lines receiving the discharge from two (2) or more fixtures shall be provided with vents, unless separate venting of fixtures is noted.

2. Fittings

All changes in pipe sizes on soil waste lines shall be made with reducing fittings or recessed reducers. All changes in direction shall be made by the appropriate use of forty five (45) degree wyes. Long sweep quarter bends or elbows may be used in soil and waste lines where the change in direction of flow is from the horizontal to the vertical and on the discharge from water closets.

Where it becomes necessary to use short radius fittings in any location, the approval of the Engineer shall be obtained before they are installed.

3. Joints

a. PVC Soil Pipe

All joints in uPVC soils, waste, and vent pipe shall be accomplished by the use of PVC solvent cement.

b. All joints for uPVC shall be accomplished by applying the manufacturer's recommended solvent before connection to the pipe.

4. Cleanouts

Cleanouts at the bottom of each soil stack, waste stack, and where else indicated shall be the same size at the pipe.

Cleanouts on floors shall be by uPVC plug adapter fit into the hub and fitted with uPVC screw plugged flush with the floor.

Cleanout shall be provided at every change in direction greater than 45 degrees.

5. Flashings

All pipes passing through the roof shall be provided with lead flashings. All flashings shall be built to 40 lbs. bituminous felts and shall extend up to the pipe and down-over to top of pipe at least 150mm and along the roof not less than 300mm and shall lap over flashing to make a weatherproof joint.

6. Traps

Each fixture and piece of equipment requiring connections to the drainage system, except fixtures with continuous waste, shall be equipped with a trap. Traps shall be

specified to be supplied with the fixtures. Each trap shall be placed as near to the fixtures as possible.
Traps installed on threaded pipes shall be recessed drainage pattern.

7. Pipe Sleeves, Hangers, and Supports

Pipe sleeves shall be installed and properly secured in place at all points where pipes pass through masonry or concrete except unframed floors on earth.

Pipes shall not be permitted to pass through footings or beams unless noted on the drawings.

Pipe sleeves in floors shall extend not less than 25mm and not more than 50mm above the finished floor. After installation of the pipe, the space around the pipe shall be packed with plastic material and made watertight. Flashing shields for sleeves passing through the waterproofing membrane shall be thoroughly mopped into the membrane. The space between the pipe and sleeves shall be made watertight by inserting approved sealing and caulking materials.

INSTALLATION OF WATER PIPES, FITTINGS, AND CONNECTIONS

1. Gate Valves and Outlets

Gate valves shall be installed close to the point of connection to the existing service line outside the building. The piping shall be extended to all fixture outlets and equipment from the gate valves. Outlets where indicated shall be capped or plugged and left ready for future connections.

2. Mains, Branches, and Runouts

All runs of piping shall be installed as shown on the drawings. The piping shall be cut accurately to measurements, and installed at the building site by the Contractor and shall be worked into place without springing or forcing. Care shall be taken not to weaken the structural portions of the buildings.

All pipes above ground shall be run parallel with the lines of the building unless otherwise shown on the drawings. Branch pipes from service lines may be taken off on top of mains, bottom of mains, or side of mains, using such cross-over fittings as may be required by structural or installation conditions.

All service pipes, valves, and fittings shall be kept at a sufficient distance from the other work to permit finished covering not less than 6.5mm from such other work and not less than 13mm between finished covering on different services. No water piping shall be buried in floors unless specifically indicated on the drawings or approved. Changes in pipe sizes shall be made with reducing fittings.

The use of long screws and bushings is prohibited.

3. Joints

Joints and connections in the plumbing system shall be gas-tight and watertight for the pressures required by the test.

After cutting and before threading all pipes shall be reamed and shall have burrs removed. All screwed joints shall be applied with an approved graphite compound or TEFLON tape to facilitate connections. Threads shall be full cut and not more than three threads on the pipe shall remain exposed.

Caulking of threaded joints or top to prevent leaks shall not be permitted.

Unions shall be provided where required for disconnection. Threaded swing bolts shall be used for branch connections to risers and mains.

4. Unions

Where required unions shall not be concealed in walls, ceilings or partitions.

5. Tests

The following tests shall be conducted by the Contractor at his expense under the supervision of the Engineer.

a. Tests for Drainage and Venting System

The entire drainage and venting system shall have necessary openings plugged to permit the entire system to be filled with water to the level of the highest vent stack above the roof. The system shall hold the water for 30 minutes with a drop not greater than 100mm.

b. Sterilization

The entire water supply piping system shall be sterilized with a solution containing not less than fifty (50) parts per million of available chlorine, either liquid chlorine or a solution of sodium hypochlorite. The sterilizing solution shall remain in the system for a period of not less than 8 hours during which time all valves and faucets shall be opened and closed several times. After sterilization, the solution shall be flushed from the system with clean water until the residual chloride content is not more than 0.2 parts per million.

c. Pressure Test for Water Lines

1. After the pipe has been installed, the joints are completed and with joints exposed for examination, all newly installed pipe or any valve section, thereof, shall be subjected to hydrostatic pressure one and one half (1½) the designed working pressure of the system or as specified by the Engineer.

2. The duration of each pressure test shall be at least 20 minutes unless otherwise specified by the Engineer.

3. Each section of the pipeline shall be slowly filled with water and the specified test pressure, measured at the point of lowest elevation, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. During the filling of the pipe and before applying the test pressure, all air shall be expelled from the pipeline. To accomplish this, tap shall be made if necessary, at the highest point of the pipe under test and after completion of the test, the taps shall be tightly plugged unless otherwise specified. During the test, all exposed pipes, fittings, valves, joint and couplings will be carefully examined. If found to be cracked or defective, they shall be removed and replaced by the Contractor with sound materials at his expense. The test shall then be repeated until satisfactory results are obtained.

d. Leakage Test for Water Lines

1. Leakage test shall be conducted after satisfactory completion of the pressure test and shall consist of an examination of all exposed joints for leakage as well as an overall leakage test of the completed pipeline.

2. The pressure to be maintained during the test shall be the designed working pressure of the system.

3. Leakage test shall be made only after a minimum of 24 hours after the pipe to be tested has been filled with water.

4. The duration of each leakage test shall be two hours unless otherwise specified by the Engineer.

5. Each section of pipeline shall be slowly filled with water and the specified test pressure, measured at the point of lowest elevation shall be applied by means of a positive displacement type pump and reservoir connected to the pipe in a manner satisfactory to the Engineer.

6. Before starting the leakage test, all air shall be expelled from the pipe. All exposed pipes, fittings, valves and joints shall be examined for leakage during the test.

7. Allowable leakage rate per 100 joints per inch of Pipe Diameter at Pressure Stipulated.

PRESSURE		LEAKAGE RATE	
psi	kg/cm^2	liters/hr.	liters/2 hrs.
50	3.50	1.45	2.90
75	5.30	1.75	3.50
100	7.00	2.05	4.10
125	8.80	2.30	4.60
150	10.50	2.50	5.00
200	14.00	2.90	5.80

e. Defective Work

1. If the inspection or test shows any defect, such defective work or material shall be replaced and the test shall be repeated until satisfactory to the Engineer.

2. All repairs to piping shall be made with new materials at the expense of the Contractor.

3. No caulking of screwed joints or holes will be accepted.

ASSEMBLY, INSTALLATION AND CONNECTION OF FIXTURES

Fixtures shall be supported and fastened in a satisfactory manner. Where secured to concrete or masonry work walls, fixtures and equipment shall be fastened with brass bolts or machine screws in lead-sleeve type anchorage units or with brass expansion bolts. Expansion bolts shall enter 7.5 cm into solid concrete or masonry works and shall be fitted with loose tubing or sleeves of proper length to bring expansion sleeves into the solid concrete masonry walls.

Where wood screws are used, screws shall go into solid pieces set between studs. Where

through-bolts are used, bolts shall be provided with plates or washers at back set, so that they will be concealed by plaster. Bolts and nuts shall be hexagonal and exposed nuts, cap nuts, and screw heads shall be provided with chromium plated brass washers.

PROTECTION OF FIXTURES

Pipe openings shall be closed with caps or plugs during installation. Fixtures shall be tightly covered and protected against dirt, water and chemical injury. At the completion of all works, all fixtures shall be thoroughly cleaned and delivered in a condition satisfactory to the Engineer.

FIXTURES AND FASTENING

All fixtures shall be supported and fastened in a satisfactory manner as follows:

1. Where secured to concrete or concrete hollow block walls, they shall be fastened with one quarter inch brass bolts with twenty threads to the inch and of sufficient length to extend at least 7.5 cm into solid concrete or hollow block work, fitted with loose tubing or sleeve insert and shall be securely anchored and installed flush with the finished wall and shall be completely concealed when the fixtures are installed.

2. Where through-bolts are used, they shall be provided with plates or washers back set so that heads, nuts and washers will be concealed by plaster. Bolts and nuts shall be hexagonal. Exposed bolts, nuts, capnuts and screw heads shall be provided with chromium plated brass washers.

GUARANTEE

Upon completion and before final acceptance of the equipment installation, the Contractor shall furnish the Engineer a written guarantee stating that all equipment installed under this Section free from defects. The guarantee shall be for a period of one (1) year from the date of final acceptance of the work. Any part of the equipment that becomes defective during the term of the guarantee shall be replaced, renewed and/or made good by the Contractor, at his own expense and in a manner satisfactory to the Engineer.

Guarantees made by the approved manufacturers or suppliers beyond one year, shall be transferred to PPA without any expense on his part.

CLEANING UP

Upon completion of the work, all parts of the installation shall be thoroughly cleaned of grease, metal cuttings and sludge which may have accumulated during the testing operation.

PLUMBING, FIXTURES AND TOILET ACCESSORIES INSTALLATION

All installation works shall be as shown on the drawings and shall conform to the applicable standards set forth by the Philippine National Plumbing Code. All fixtures shall be fastened and/or supported in accordance with the given requirements.

ITEM 17: SEWAGE WASTEWATER TREATMENT FACILITY

GENERAL

Supply and installation of full sewage treatment facility (STP) including pipings, pumps, and equipment applies to this section with all parts and scope of work specified herein.

SCOPE OF WORK

The scope of work is the design and construction of the 50 m^3/day sewage treatment plant, as follows:

a. Preparation of detailed design of the sewage treatment plant (STP), which should meet all relevant Philippine Standards and international safety standards including but not limited to the Effluent Standards of DENR, Occupational Safety and Health Code, National Structural Code of the Philippines, Philippine Electrical Code, National Plumbing Code, Construction Safety and Health Program, etc.

b. Secure necessary permits for the building, operation, and maintenance of STP.

c. Site preparation, including the necessary flood protection works.

d. Construction of STP and appurtenant facilities (e.g., pumping stations and sludge collector, etc.) to perform an adequate treatment of wastewater.

e. No less than eight months prior to the Contract Completion Date, the Contractor shall prepare and deliver to the Employer for its approval a training plan for the operation and maintenance.

f. Testing and commissioning of the STP and all its appurtenant facilities, including training and monitoring of the proposed plant's personnel and acquisition of discharge permit.

DESIGN BASIS

a. Design Flow

Wastewater	:	Domestic Sewage
Maximum Flowrate	:	50 m^3/day

b. Effluent Requirements

Classification	:	DENR DAO No. 2016-08, Marine Water Class SB
Biochemical Oxygen Demand, BOD5	:	≤ 30 mg/L
Chemical Oxygen Demand, COD	:	≤ 100 mg/L
Total Suspended Solids, TSS	:	≤ 50 mg/L
Oil and Grease	:	≤ 2 mg/L
pH	:	7.0 to 8.5
Nitrate as N, NO_3-N	:	≤ 10 mg/L DENR DAO2016-08
Ammonia as N, NH_3-N	:	≤ 0.05 mg/L
Phosphate	:	≤ 0.5 mg/L
Surfactants	:	≤ 0.3 mg/L
Fecal Coliform	:	≤ 100 MPN/100 mL
Total Coliform	:	≤ 3,000 MPN/100 mL

WARRANTY

PROJECT SPECIFICATIONS

The STP system should provide/present technologies most appropriate for the local needs, institutional capacities, environment, sustainability, operation and maintenance capacities, and process technology, which is designed to be a centralized STP capable of handling the wastewater generated in the Philippine Ports Authority (PPA) daily.

General Requirements:

i. The Contractor shall be wholly responsible for all aspects of the design and construction of the STP, including process, mechanical, electrical, control and automation, site development and civil works, and architectural and building services.

ii. The processes and installation design proposed and consequently constructed by the Contractor shall be compatible and integrated with existing facilities, and with the provision for an installation of a facility for water recycling and reuse to be combined with the system should the PPA decide to in the future.

iii. The STP shall be designed and constructed to be economical to operate and maintain, and the layout shall facilitate safe and easy access for operation and maintenance purposes.

iv. The STP shall be designed and constructed such that in the event of failure, or an emergency, the STP will revert to standby units or fall into a safe status, as appropriate, to allow the STP to operate continuously.

v. The STP shall be designed and constructed to provide effluent complying with DENR DAO2016-08 and the updated parameters of DAO 2021-19.

QUALITY

All facilities under this section shall be (1) of the design and manufacture that have been used in similar applications, and (2) demonstrate to the satisfaction of the Owner that the quality is equal to or better than the equipment specified herein. The equipment is guaranteed against defects in workmanship, materials, and operation for a period of not less than five (5) years.

PROCESS GUARANTEE

The Contractor shall guarantee that the process and output pass and are compliant with the Department of Environment and Natural Resources (DENR) DAO 2016-08 - Water Quality Guidelines (WGS) and General Effluent standards (GES), DENR DAO 2021-19 - Updated WGS and GES for Selected Parameters and any other existing environmental laws and regulations, for the plant's lifetime. The Contractor shall also comply with the DENR standards for energy efficiency, minimal sludge volume, and minimal chemical usage, and the plant should be future-proof.

ITEM 18 : WATER PUMPS, PRESSURE TANK AND STORAGE TANK

GENERAL

General Requirements contain provisions and requirements essential to these Specifications; and apply to this section, whether or not referred to herein.

SCOPE OF WORK

The work covered by this section consists of furnishing all labor, materials, equipment, tools, and incidentals necessary to undertake, a complete supply of overhead tank, water pump, and pressure tank for the building as indicated on the drawings and as specified herein.

Pressure Tank/ Water Pump

a. PRESSURE TANK

1. Location: Pump Room
   Tank Volume: 2000 liters
   Diameter: 110 cm.
   Height: 252 cm.
   Connectors: 50 mm
   Pressure: 10 bar

b. WATER PUMP

1. Location: Pump Room
   Description: Constant Pressure Booster Pump
   Function: Booster pump
   Power: 4.0 hp.
   Flowrate: 60-110 gpm @ 80-120 feet tdh
   Specs: 230 volts, 60 HZ

EXECUTION

All materials will be delivered and installed on site.

ITEM 19 : ELECTRICAL WORKS

GENERAL DESCRIPTION

The work to be done under this Item of Specifications consists of fabrication, furnishing, delivery and installation, complete with all details of electrical work, in the subject area and all work materials related to the proper completion of the installation, except for those parts of the work that are expressly stated to be performed by others. All works shall be in accordance with the governing Codes and Regulations and the Specifications, unless the same are inconsistent with such codes, etc., as may later govern. The requirements regarding the materials and equipment required for the complete installation of the work specified herein and indicated in the drawings. The Specifications are intended to provide a broad outline of the equipment required but are not intended to include all design details and construction specifications.

WORK INCLUDED

The work to be done under this Item shall include the furnishing of all tools, labor, supervision, equipment, fixtures and all necessary materials, each complete and in proper working condition unless one or other is specifically excluded or stated otherwise in these specifications but not limited to the following items of works.

a. All works and material for complete lighting and power systems including cables and conduits, circuit breakers, panel board and connection to all lighting fixtures and power outlets, air conditioning, switches, supports and accessories.

b. All steel support for conduits, wires, panel board, boxes, lighting fixtures, etc. as indicated or as required for the completion of the installation.

c. Termination of all electrical systems and the complete grounding system.

d. A complete testing and commissioning of all electrical and auxiliary systems. The Contractor shall provide all necessary testing instruments.

e. All items' incidentals to and or required for the proper completion such as painting of boxes, conduits and the likes.

f. Coordination with other companies/offices including handling of all material related to material testing and application of electrical permits at the expense of the Contractor.

g. Preparation of necessary shop drawings required for the proper execution of the works subject to the approval of the Engineer.

SUBMITTALS

Obtain approval before procurement, fabrication or delivery of items to the job site. Partial submittals will not be entertained and will be returned without review. Submittals shall include the manufacturer's name, trade name, place of manufacturer, catalogue model of number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference and technical society publication references, and other information necessary to establish contract compliance with each item to be furnished.

a. Shop Drawings

In addition to the requirements of the contract clauses, shop drawings shall meet the following requirements:

1. Drawings shall be a minimum of 210 mm x 297 mm in size or in size A3 size, except as specified otherwise.

2. Drawings shall include wiring diagrams and installation details indicating the proposed location layout and arrangement, control panels, accessories, and other items that must be shown to ensure a coordinated installation.

3. Wiring diagrams shall identify circuit termination and the internal wiring for each item of equipment and its interconnection.

4. Drawings shall indicate adequate clearances for operation, maintenance and replacement of equipment devices. If the layout is disapproved, revise the layout and resubmit.

b. Manufacturer's Data

Submittals for each manufactured item shall include manufacturer's descriptive literature, equipment drawings, diagrams, performance and characteristic curves and catalog cuts. Each submittal has the manufacturer's name, trade name, catalogue model or number, name plate data, size, layout dimensions, capacity, specification references and all other information necessary to establish contract compliance.

c. Standard Compliance

When material or equipment must conform to the standards of organizations such as American National Standard Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturer's Association (NEMA) and Underwriters Laboratories (UL), proof of such conformance shall be submitted to the Engineer for approval.

If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified in the individual sections. In lieu of the label or listing, the Contractor shall submit a certificate from an independent testing organization, which is competent to perform acceptable tests and is approved by the Engineer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard. For materials and equipment whose compliance with organizational standards or specifications is not regulated by an organization using its own listing or label as proof of compliance, a certificate of compliance from the manufacturer shall be submitted for approval.

The certificate shall identify the manufacturer, the product and the referenced standard and shall simply state that the manufacturer certifies that the product conforms to all requirements of the project specification and of the referenced standards listed.

DELIVERY AND STORAGE

Equipment and materials should be properly stored and adequately protected and carefully handled to prevent damage before and during installation. Equipment and materials shall be handled, stored and protected in accordance with the manufacturer's recommendations and as approved by the Engineer. Electrical conduits shall be stored to provide protection from the weather and accidental damage. Cables shall be sealed, stored and handled carefully to avoid damage to the outer

covering or insulation and damage from moisture and weather. Damaged or defective items shall be replaced with new items at no cost to the Owner.

CATALOGUED PRODUCTS

Materials and equipment shall be catalogued by products of manufacturers regularly engaged in production of such materials or equipment and shall be at manufacturer's latest standard design that complies with the specification requirements. When two or more units of the same type, class and size of equipment are required, these units shall be products of a single manufacturer; however, the component parts of the system need not be the products of the same manufacturer. Each major component of equipment shall have the manufacturer's name, address and the model of the serial number on a nameplate securely affixed in a conspicuous place, the name plate of the distributing agent will not be acceptable.

MANUFACTURERS' RECOMMENDATIONS

Where installation procedures or any parts thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendation prior to installation. The installation of the items shall not proceed until the recommendations are received. Failure to furnish recommendations shall be cause for the rejection of the equipment or materials.

WORKMANSHIP

The work throughout shall be executed in the best and most thorough manner under the direction of the Contractor and to the satisfaction of the Owner and Engineers, who will jointly interpret the meaning of the drawings and specifications and shall have the authority to reject any work materials which, in their judgment, are not in full accordance therewith

The Contractor shall have on file, for ready access and reference, a set of drawings indicating all work as actually installed incorporating in the same all changes and additions. Upon the termination of the Contract, he shall prepare a set of tracings indicating thereon the Electrical Work as actually and finally installed. These drawings shall be turned over to the Engineers.

The Contractor shall be responsible for keeping stocks of material and equipment stored at the premise in a neat and orderly manner. The exposed surfaces of wirings, conduit system or equipment which have become covered with dirt, plaster or other material during handling and construction shall be thoroughly cleaned by Contractor before such surfaces are prepared for final finish, painting or concealment within the building structure.

The Contractor shall employ skilled craftsmen experienced in installation of the types of electrical materials and equipment specified. Use specialized installation tools and equipment as applicable. Produce acceptance installation free of defects.

MATERIALS / TESTS

All materials to be installed shall be brand new and shall conform to specifications except as otherwise noted on the drawings. All materials where not specified shall be of the best of their respective kind. Samples of said material including its manufacturer's data shall be submitted for approval. Necessary tests on the installations shall be made by the Contractor in the presence of the Engineer. These tests shall include but are not limited to ground test, performance test, phase sequence test, etc. Records of approved tests result shall be relayed to the Engineer in writing. This Contractor shall within ten (10) days after the award of the contract, submit a list of materials he proposes to use. All materials installed without prior approval shall be at the risk of the Contractor.

COORDINATION / GUARANTEES / SUSPENSION OR DELAY

The Contractor shall be familiar with the specifications of the other trades and coordinate with them thoroughly so that he can arrange his work and dispose his materials without interfering the work of other Contractors. The Contractor shall guarantee that the electrical systems shall be free from all defects of workmanship and of materials, and that it will remain so for a period of one year from the date of acceptance by the Engineer. Any remedy to correct defects deemed to be caused by such shall be made at the expense of the Contractor.

The Contractor shall not suspend or delay the work without justifiable cause. Subsequent delays shall be deemed as sufficient cause for penalties or termination of contract in which the Engineer shall have the right to take over the work and all materials on the site and make arrangements necessary to complete the work. It shall be the sole responsibility of the Contractor to ensure that the Electrical sub-contractor conducts coordination of his activities to other trades.

SLEEVES / INSERTS / CUTTING / PATCHING

The Contractor shall provide all openings, sleeves, also inserts in walls, floors, and beams as required for his work. All unused openings should be grouted in. The Contractor shall do all patching requirements necessary, and these shall be done to exactly match the surrounding area without the evidence of alteration or patching.

TEMPORARY LIGHT AND POWER

The Contractor shall make all arrangements and pay for the provisions of the necessary electrical power of the type and capacity required for the performance of the work of all trades engaged in the construction of the building.

CODES, INSPECTION, PERMITS AND FEES

The work under this contract is to be installed according to the requirements of the latest edition of the Philippine Electrical Code, the rules and regulations of the local authorities of Surigao del Norte Electric Cooperative (SURNECO).

All necessary permits and electrical fees required for this work shall be obtained by and at the expense of the Contractor. The contractor shall furnish the Engineers and the Owner final Certificate Final Electrical Inspection (CFEI) and approval from the proper government authorities after completion of the work. The Contractor shall prepare all as built and all forms and documents required by the approving authorities.

Power service application including drawings for the work shall be obtained by and at the expense of the Contractor. The Contractor shall comply with all requirements of the utility company regarding service applications.

ELECTRICAL CHARACTERISTICS

The electrical characteristics for this project shall be 230V, three phase (3Ø) wire, and 60Hz or as per system requirements as shown in the plan.

CLEANING UP

The Contractor shall remove all dirt, debris, and rubbish and waste materials caused by him in the process of his work. He shall also remove all tools, temporary power installation, scaffolding and surplus materials after completion and acceptance of work.

MATERIAL REQUIREMENTS

NAMEPLATES

Provide laminated plastic nameplates for each panel board, switch, and device. Each nameplate inscription shall identify the function and when applicable, the position. The nameplate shall be melamine plastic, 3.2mm thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the black core. Minimum size of nameplates shall be 25mm x 38mm. Lettering shall be a minimum of 6mm, high normal block style.

EXECUTION

NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

INTERIOR WIRING SYSTEMS

SUBMITTALS

a. Shop Drawings: Submit for the following:

1. Location of panel boards and circuit breaker
2. Conduit support / hanger's installation drawing

b. Manufacturer's data: Submit for the following:

1. Circuit Breakers
2. Switches
3. Conduit and fittings (each type)
4. Device Plates
5. Insulated conductors
6. Utility / junction boxes
7. 3 Prong duplex Convenience Outlet with grounding
8. Floor Duplex Convenience Outlet
9. Weatherproof Convenience Outlet

PRODUCTS

CONDUIT AND FITTINGS

a. Conduit shall be polyvinyl-chloride conduit (PVC), where specified, shall be heavy wall, high impact resistant Schedule 40, with factory made bends, couplings and fittings. PVC cement for joints shall be of the same brand as for the PVC pipe.

b. No conduits shall be used in any system smaller than 20mm (1/2") diameter electric trade size, nor shall have more than four (4) 90-degree bends in any one run and where necessary, pull boxes shall be provided as directed.

c. No wire shall be pulled into any conduit until the conduit system is completed in all details, in the case of concealed work until all rough plastering masonry has been completed, and in the case of exposed work until the conduit work has been completed in every detail.

d. The ends of all conduits shall have been tightly plugged to exclude plaster, dust and moisture while the construction of the building is in progress. All conduits shall be reamed to remove all burrs.

OUTLETS, BOXES AND FITTINGS

a. All outlets of whatever kind, for all systems, there shall be provided a suitable fitting, which shall be either a box or other device especially designed to receive the type of fitting to be mounted thereon.

b. The Contractor shall consult with the Engineer as to the nature of the various fittings to be used before installing his outlet fittings, and shall conform strictly in the use of fittings, to the nature of the appliance to be mounted on them, so that the work, when the completed will be a finished design.

c. All outlets on concealed conduit work provide galvanized pressed steel outlet boxes on standard make. These boxes shall be in all cases standard and where such boxes are not available on the market, special boxes shall be secured by the Contractor at his owned expense. In general outlet boxes should be at least 100 mm diameter, 53mm deep and No. 16 minimum gauge.

JUNCTION AND PULL BOXES

a. Junction and pull boxes, of code gauge steel, galvanized shall be provided as indicated or as required for facilitating the pulling of wires and cables. Pull boxes as finished places shall be located and installed with permission and to the satisfaction of the Engineer.

b. All junction and pull boxes on exposed conduit work shall be provided with hubs for threaded pipe entry and covers provided with neoprene gaskets.

WIRES AND CABLES

a. All wires shall be copper, soft-drawn and annealed, shall be 100% conductivity, shall be smooth and true of a cylindrical form and shall be within the actual size called for.

b. All wires and cables shall comply with the requirements of the Underwriters Laboratories, the ASTM and ICEA as they apply to the particular usage.

c. Wires and cables for power and lighting system shall be plastic insulated for 600 volts working pressure type "THHN/THWN-2" unless otherwise noted on plans or specified.

d. Tag Marking

In general, branch circuit conductors and cables shall be properly marked by means of a printed tag taped on each wire indicating origin/load and or panel(s) where load is connected.

e. Splices and Termination Components

If applicable, for the wire connectors for the insulating tape. Connectors for 5.5 mm^2 and smaller diameter wires shall be insulated, pressure-type in accordance with (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

DEVICE PLATES

Provide one piece device plates for outlets and fittings to suit the devices installed. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel or cast metal having round or beveled edges. Plates on finished walls shall be satin finish stainless steel or brushed –finished aluminum, minimum 0.03 inch thick. Screws shall be machine type with countersunk heads in a color to match the finish of the plate. The use of sectional type device plates will not be permitted. Plates installed in wet locations shall be sealed in gaskets. Device plates for telephone and intercommunication outlets shall have a 3/8-inch bushed opening in the center.

WALL SWITCHES AND PLATES

Wall switches in general should be rated 10 amperes at 230 volts or with ampere and voltage ratings as required. Switches shall be flush mounting and of the rocker type, spring operated. The type of switches shall be tumbler operation, and the color, plating and appearance of wall plates shall be as selected by the Engineer. Appropriate samples shall be submitted prior to the purchase of wall switches and face plates.

WALL RECEPTACLE AND PLATES

a. Receptacle outlets shall be 15 amperes, 230 volts, 2 pole, 3 wire parallel slot, grounding type. Parallel slot outlet rated 15 amps. 125 v grounded type shall be acceptable for use with 230v system. Locking type and other special purpose outlets shall be as indicated in the plans.

b. Provide weatherproof receptacle plate cover for each convenience receptacle outlet indicated as weatherproof.

PANELS AND CABINETS

a. Standard panels and cabinets, as much as possible shall be used and assembled on the job. All panels shall be dead front construction, furnished with trims for flush or surface mounting. Cabinets shall be of code gauge steel with gutters at least 100mm wide and if necessary, it must be made wider. The trim for all panels shall be finished in industrial grey enamel over a coat of rust inhibitor.

b. Lighting panels shall be equipped with branch circuit breakers as required and mains as noted on Plans or Panel Schedule.

c. Panel board main bus work shall be ampacity rated to equal or exceed overcurrent protective device immediately ahead of it. All buss work shall be properly secured to withstand available short circuit forces at the location.

d. Distribution panels shall be of the same type as lighting panels except equipped with one pole, two poles and three poles air circuit breakers of sizes, voltages ratings and interrupting capacity as called for on plans.

INDIVIDUAL BREAKERS

a. Provide individual circuit breakers were indicated on plans. Voltage ratings shall be suitable in each case of service application. Enclosures shall be General Purpose, NEMA type I, except where specifically noted on plans or assembled on panel cabinets.

All protective devices should meet NEMA and U.L specifications. Short circuit rating shall be as indicated on the plan.

b. Circuit breakers shall consist of a quick-make, quick -break type entirely trip-free operating mechanism with contacts, arc-interrupter, and thermal magnetic trip unit for each pole, all enclosed in a molded-phenolic case. The thermal magnetic trip unit shall provide time-delayed overload protection, and in case of overload or short circuit current in any one pole the circuit trips instantaneously. Circuit breaker shall be trip indicating, when tripped position of breaker handle midway between "ON" and "OFF" positions.

c. All circuit breakers shall be bolt-on type unless noted otherwise.

d. All circuit breakers rated above 225 amps shall have interchangeable trip units. Unless otherwise specified, the minimum interrupting rating for 230 volts circuit breakers shall be 10,000 amperes.

PANELBOARD BUSES

All bus panels shall be copper support bus bars on bases independent of circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or lapping. Provide separate ground buss for connecting grounding conductors, bond to steel cabinet.

EXECUTION

INSTALLATION

a. Wiring Methods

Provide insulated conductors installed in conduits, except where specifically indicated or specified otherwise or required by PEC and NFPA to be installed otherwise. Provide insulated equipment grounding conductor in feeder and branch circuits, including lighting circuits. Provide insulated, conductor for grounding conductors installed in conduits or raceways.

b. Conduit Installation

Unless indicated otherwise, conceal conduit within finished walls, ceilings, and floors. Keep conduit a minimum of 150mm away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members were located above accessible ceilings and where conduit will be visible after completion of project. Run conduits in crawl space under slab as if exposed.

1. Where conduits rise through floor slabs, curved portion of bends shall not be visible above finish slab.

2. Conduit Support:

Conduit shall be supported by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded studs, or spring tension clamps on steelwork. Threaded C-clamps may be used on rigid steel conduits only. Do not weld conduits or pipe straps to steel structures. The load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceilings shall be vibration resistant and shock resistant. Holes cut to depths of more than 40mm in reinforced concrete beams or to depths of more than 20mm in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In

suspended-ceiling construction, run conduit above ceiling. Do not support the conduit by ceiling support system. Spring-steel fasteners may be used for lighting branch circuit conduits supports in suspended ceilings in dry locations.

3. Changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

4. The Contractor shall install pull wires in empty conduits in which wire is to be installed by others. The pull wire shall be 2.0mm^2 zinc- coated steel or plastic having not less than 91 kgs tensile strength. Leave not less than 300mm of slack at each end of the pull wire.

5. Conduit Installed in Concrete Floor Slabs

   Locate so as not to adversely affect structural strength of slabs. Install conduit within one-third of concrete slab. Do not stack conduits. Space conduits horizontally for at least three diameters, except in cabinet locations. Curved portions of bends shall not be visible above the finish slab. Increase slab thickness as necessary to provide minimum 25 mm cover over conduits. Where embedded conduits cross expansion joints, provide suitable watertight expansion fittings and bonding jumpers. Conduit larger than 25mm trade size shall be parallel with or at right angles to main reinforcement; when at right angles to the reinforcements, the conduit shall be closed to one of the supports of the slab.

6. Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by PEC and NFPA 70, where insulated bushings are used, and where bushing cannot be brought into firm contact with the box; otherwise, use minimum single locknut and bushing. Locknuts shall have sharp edges for digging into walls of metal enclosures. Install bushings at the ends of conduits and provide insulating type where required by PEC and NFPA 70.

7. Flexible Connection:

   Provide flexible connection of short length, 1.8 meters maximum for recessed and semi-recessed lighting fixtures.

c. Boxes, Outlets, and Supports

Provide boxes in wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when installed exposed up to 2.1meters above interior floors and walkways, or when installed in hazardous areas. Boxes in other locations shall be sheet steel; except that aluminum boxes may be used with aluminum conduit. Each box shall have the volume required by PEC and NFPA 70 for the number of conductors enclosed in the box. Boxes for mounting lighting fixtures shall not be less than 100 mm2 or octagonal, except that smaller boxes may be installed as required for fixture configurations as approved. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature. Fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports or make

adequate provisions for distributing load over ceiling support members. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. In open overhead spaces, cast boxes threaded to raceways need no separate support except were used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of box, and support raceway with approved type fastener maximum 600mm from the box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

1. Boxes for use with raceway systems shall be minimum 40mm deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 100mm2, except that 100 by 50mm boxes may be used where only one raceway enters outlet.

2. Pull Boxes:

   Pull boxes shall be constructed of not less than the minimum size required by PEC and NFPA 70 of code-gauge aluminum or galvanized sheet steel, except where cast-metal boxes are required in locations specified herein. Boxes shall be furnished with screw-fastened covers. Where several feeders pass through common pull boxes, the Contractor shall tag the feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

d. Mounting Heights

The Contractor shall mount panelboards, and circuit breakers, and main disconnecting panel so the height of the operating handle at its highest position is maximum 1.8 meters above floor. Mount lighting switches 1.4 meters above finished floor, receptacles 300mm above finished floor and other devices. The Contractor shall measure mounting heights of wiring devices and outlets to center of device or outlet.

e. Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made.

f. Splices

Make splices in accessible locations. Make splices in conductors 5.5 mm^2 and smaller diameter with insulated, pressure-type connector. Make splices in conductors 8.0 mm^2 and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

g. Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Plates shall be installed with alignment tolerance of 3mm. Use of sectional-type device plates is not permitted. Plates installed in wet areas must be gasketed.

h. Electrical Penetrations

Openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings shall be sealed to maintain fire resistive integrity as tested by ASTM E 814.

I. Grounding and Bonding

In accordance with PEC and NFPA 70. Ground all exposed, noncurrent-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and non-metallic raceways, and conductor of wiring systems. Make ground connection to driven ground rods on exterior of building. Where ground fault protection is employed, ensure that connection of ground does not interfere with correct operation of fault protection.

1. Grounding Conductor

   Provide grounding equipment in feeder and branch circuits, including lighting circuits. Grounding conductors shall be separated from electrical system neutral conductors. Provide insulated, conductor for grounding conductors installed in conduit or raceways.

2. Resistance

   Maximum resistance-to-ground of grounding system shall not exceed 10 ohms under normally dry conditions. Where the resistance obtained exceeds 10 ohms, contact the Engineer for further instructions.

FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give the Engineer five (5) working days notice prior to each test.

a. Devices Subject to Manual Operation

   Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

b. Test on 600-volt wiring

   Test 600 volt wiring to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 14mm^2 (6 AWG) and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 25,000 ohms.

c. Grounding System Test

   The Grounding system shall be tested to ensure continuity and resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod, tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to the Engineer and indicate location of rods as well as resistance and soil conditions at the time measurements were made.

INTERIOR LIGHTING

SUBMITTALS

Data, shop drawings showing mounting heights, and reports shall employ the terminology, classifications, and methods prescribed by the IES Lighting Handbook, as applicable, for the lighting system specified.

a. Manufacturer's Data

1. Recessed / Surface mounted type Pin Light 15–18-watt, COB type
2. Double head COB, recessed box type directional downlight daylight, 40 watts
3. Silicone flexible strip light, recessed mounted 7-10 watt / L.M.
4. LED Pendant Light, black hanging linear light with frosted glass cover (1200 x 70 x 40mm), 36 watts
5. LED Panel Light, recessed mounted type with frosted glass cover (1200 x 600 mm) daylight, 42 watts
6. LED Panel Light recessed mounted type with frosted glass cover (600 x 600 mm) daylight, 42 watts
7. Wall Lamp surface mounted with die cast aluminum and glass cover, 40 watts

PRODUCT

COB TYPE PIN LIGHT (RECESSED / SURFACE MOUNTED)

a. COB Type Pin Light

COB means (Chips on Board) LED is a new technology for LED light devices. The LEDs offer many advantages for common options. COB LEDs are basically multiple LED chips bonded directly to a substrate to form a single module. Since individual LEDs are used in a COB, the LED chips are not traditionally packaged. Moreover, LED chips can be mounted in such less space with the highest potential LED chips can be obtained. The COB LED package is energized, it appears more lighting panel with multiple individual lights when using several SMD LEDs mounted closely together.

The application of COB LED covers for a wide range that can be used for higher output of general lighting, for the primary use of solid-state lighting (SSL) in place of metal-halide lamps. The applications of COB LED such as high-bay lighting, streetlights, and high-output track lights and downlights.

DOUBLE HEAD COB DIRECTIONAL DOWNLIGHT

b. Double Head COB directional downlight

A double head COB directional downlight is a light fixture with two heads that can be adjusted to direct light downward. COB stands for Chip on Board, which refers to the technology that packs LED chips onto a small surface.

Features:

- Energy efficient: Uses less power than halogen bulbs
- Bright: Provides a high density of LEDs on a small surface
- Dimmable: Can be adjusted to different levels of brightness
- Easy to install: Can be recessed into a ceiling without the need for tools.

- Versatile: Can be used in many different spaces, including kitchens, hallways, and closets.

SILICONE FLEXIBLE STRIP LIGHT

c. Strip light

The LED strip light is a flexible circuit board that is populated with LEDs that can stick almost anywhere you want to add powerful lighting in a variety of colors and brightness's.

Product Benefits

- Flexible- LED strip lights are flexible and can be bent vertically up to 90 degrees.
- Color Options- LEDs can be manufactured to emit a variety of single colors and color changing options.
- Low Profile- LED strips can be installed in many tight spaces and can easily be hidden from view.
- Added- Protection - Additional environmental protection can be added to make the strips IP65 or IP68 rated (Dust/water resistant or dust/waterproof)
- Has life over 50,000 hours

Product Application

It can be used for many things such as:

- Cove illumination
- Signage lighting and Building outline
- Under Cabinet illumination
- Computer desk setup
- Behind the headboards or Television lighting
- Guidance lighting like stairs in Cinema

LED PENDANT LIGHT

d. LED Pendant Light

LED Pendant lights are also cost-effective and energy efficient. LED lights use 90% less energy than traditional halogen or incandescent bulbs, meaning you get more light for less money. If you have a small house or apartment, LED Pendant Lights are a classy way to conserve space while keeping your rooms warmly lit.

Its application:

The Pendant Lights fit very well in Residential, Offices, Restaurants, Stores, and Industrial Decorative Lighting.

LED PANEL LIGHT

e. LED Panel Light

LED Panel Light is the general lighting alternative for those who want to incorporate cost-efficiency, brighter lighting, and elegant design. Available in different sizes, shapes and color temperatures the LED panel is your "go to" lighting solution for that classy feel at a low price. Built within a sturdy case the array of LED diodes emit light in unison as they are concentrated; And bounced through layers of material which enhance and diffuse the light in uniformity. The housing not only ensures protection from adverse environmental conditions; but also serves as a heat sink to minimize thermal output keeping the area cool.

LED panel lights have a long lifespan (42 times longer than incandescent bulbs). It contains no harmful gases or toxins like its fluorescent counterparts. Whether you want to give that savvy look to your office; ensure excellent lighting for your school or even light up your home (kitchen, common rooms / living space and/or study) and achieve that luxurious feel your friends will surely envy, our LED panel lights are the perfect cost-effective, eco-friendly and energy efficient solution for you. Above all, LED Panel lights are the great application for hotels, offices, balconies, and many more.

LED Panel Light have a wide range of applications from lighting households, schools, and offices, illuminating covered parking lots, warehouses, cold storage rooms and practically anything that can fit the standard fluorescent lamp ballast/fixtures.

WALL LAMP

f. Wall Lamp Surface Mounted

LED Wall Lamp provides a beautiful touch as well as a functional necessity to hallway or walkway, garden walls, or even part in building front line lighting. This has been in style since the inception of outdoor lighting.

The LED wall lamp can do a lot more, not only provide illumination and safety; and they also create an air of sophistication and elegance throughout your home. Incredibly versatile!

RECESS AND FLUSH MOUNTED FIXTURES

The Contractor shall install the type of materials as shown on the approved plan.

EXECUTION

INSTALLATION

The electrical installation of interior lighting shall conform to the requirements of the approved plan.

GROUNDING

Ground non-current-carrying parts of equipment as specified in "Interior Wiring Systems." Where the copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

FIELD TESTS

The Contractor will provide electric power and apparatus / instruments required and carry out the field tests.

a. Operating Test

Upon completion of the installation, conduct an operating test to show that the equipment operates in accordance with the requirements of this section.

b Insulation Resistance Test

Perform as specified in "Interior Wiring Systems", both before and after connection of fixtures and equipment.

c. Ground Resistance Tests
Perform as specified in "Interior Wiring System."

ITEM 20 : GROUNDING SYSTEM AND LIGHTNING PROTECTION

GENERAL

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

1. American National Standards Institute (ANSI)

   ANSI C135.30 (1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

2. Institute of Electrical and Electronics Engineers (IEEE)

   IEEE Standard 81 (1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Potentials of a Ground System

3. National Fire Protection Association (NFPA)

   NFPA 70 (2007) National Electrical Code
   NFPA 780 (2007) Lightning Protection Code

4. Underwriters Laboratories (UL)

   UL Elec Const Dir (2007) Electrical Construction Materials Directory
   UL 96 (2005) Lightning Protection Components
   UL 96A (2007) Installation Requirements for Lightning Protection Systems
   UL 467 (2007) Grounding and Bonding Equipment

5. Institute of Integrated Electrical Engineer (IIEE)

   PEC (2002) Philippine Electrical Code

6. Philippine National Standard (PNS)

   BS (2002) Bureau of Standard

RELATED REQUIREMENTS

"Electrical General Requirements," applies to this section with additions and modifications specified herein.

System Requirements

Materials shall consist of standard products of a manufacturer regularly engaged in production of lightning protection systems and shall be manufacturer's latest UL approved design. The lightning protection system shall conform to PEC, NFPA 70, NFPA 780, UL 96 and UL 96A.

SUBMITTALS

1. Shop Drawings

Overall lightning protection system for each major component

2. Test Reports

Grounding system test
Lightning protection system inspection

3. Certificates

UL listing or label

QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" have been substituted for "should" wherever it appears.

1. Installation Drawings

a. Submit installation shop drawing for the overall lightning protection system. Drawings shall include physical layout of the equipment, mounting details, relationships with
b. other parts of the work, and wiring diagram.

b. Submit detail drawings for each major component to include manufacturer's descriptive and technical literature, catalogue cuts, and installation instructions.

2. UL Listing or Label

Submit proof of compliance, label of acceptable evidence. In lieu of label or listing, submit written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that items have been tested and conform to requirements and testing methods of Underwriters Laboratories.

SITE CONDITIONS

Contractors will become familiar with details of the work, verify dimensions in the field, and advise the Engineer of discrepancies before performing work. Deviations from contract drawings will not be made without prior approval of the Engineer.

MATERIAL REQUIREMENTS

MATERIALS

Do not use a combination of materials that form an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, provide conductors with protective coatings or oversize conductors. Where mechanical hazard is involved, increase conductor size to compensate for hazard or protect conductors by covering them with or tubing made of nonmagnetic material.

1. Main and Bonding Conductors

   NFPA 780 and UL 96

2. Copper

   Provide copper conductors on non-metallic stacks that do not weigh less than 144.83 kg per 300 meters and provide cable such that the size of any strand in the cable is not less than $2mm^2$.

COMPONENTS

1. Air Terminals

   Provide terminals in accordance with UL 96. Support air terminals by suitable brace, with guides, not less than one-half the height of the terminal. (15mmØ x 1000 m long)

2. Ground Rods

   Provide ground rods made of copper-clad steel conforming UL 467. Provide ground rods that are indicated on the approved plan. Do not mix ground rods of copper-clad steel, stainless steel, galvanized ferrous, or solid copper on the job. (15mmØ x 3.0m long)

3. Connections and Terminations

   Provide connectors for splicing conductors that conform to UL 96, class as applicable. Conductor connections can be made by clamps or welds (including exothermic). Provide style and size connectors required for the installation.

4. Connector Fittings

   Provide connector fittings for "end-to-end", "Tee", or "Y" splices that conform to NFPA 780.

5. Lightning Protection Components

   Provide bonding plates, air terminal supports, clips, and fasteners that conform to UL 96 classes as applicable.

EXECUTION

INTEGRAL SYSTEM

Lightning protection system consists of air terminals, down conductors, ground connections, ground electrodes and ground loop conductor. Electrically interconnect lightning protection system to form the shortest distance to ground. Do not use non-conducting parts of the structure as part of the building's lightning protection system. Conductors are required to be in protective sleeves.

1. Air Terminals

   Air terminal design and support conforming to NFPA 780. Rigidly connect terminals to, and make electrically continuous with, down conductors by means of pressure connectors or crimped joints of T-shaped malleable metal. Provide pressure connector or crimped joint with a dowel or threaded fitting to connect ground rod conductor with air terminal. Set air terminals at ends of structures not more than 610mm from ends of ridges. Where non-metallic spires are present, mount air terminal is to the side. In addition, where spires project

more than 3050mm above the building, conductors continue from air terminal to nearest down conductor securely connect thereto.

2. Down Conductors

Make down conductors electrically continuous from air terminals to grounding electrodes. An equally and symmetrically spaced down conductors about the perimeter of the structure. Protect conductors where necessary, to prevent physical damage or displacement to the conductor.

a. Ground Connections

Securely connect conductor forming continuations of down conductors from structure to grounding electrode in a manner to ensure electrical continuity between the two. Provide clamp type connections or welds (including exothermic) for continuation. Attach down conductor to ground rods by welding including exothermic, brazing, or clamping. Provide clamps suitable for direct burial. Protect ground connection from mechanical injury. In making ground connections, take advantage of all permanently moist places where practicable, although avoid such places when the area is wet with wastewater that contains chemical substances, especially those corrosives to metal.

b. Grounding Electrodes

Provide grounding electrode for down conductor. Extend driven ground rods into the existing undisturbed earth for a distance of not less 3050mm. Set ground rods less than 610mm nor more than 3050mm, from the structure. After the completed installation, measure the total resistance to ground using the fall-of-potential method described in IEEE Standard 81. Maximum resistance of a driven ground rod shall be 10 ohms, under normally dry conditions. Make connections between ground conductors and electrically ground continuous.

FIELD QUALITY CONTROL

1. Grounding System Test

Test the grounding system to ensure continuity and that resistance to ground is not more than 10 ohms. Test the ground rod for resistance to the ground before making connections to the rod. Tie the grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Include in the written report: locations of ground rods, resistance, and soil conditions at the time that measurements were made. Submit results of each test to the Engineer.

2. Lightning Protection System Inspection

Make visual inspections to verify that there are no loose connections which may result in high resistance joints and that conductor and system components are securely fastened to their mounting surfaces and are protected against accidental mechanical displacement.

ITEM 21 : BACKGROUND MUSIC / PUBLIC ADDRESS SYSTEM

GENERAL

Electrical General Requirements applies to this Item, with the additions and modifications specified herein.

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. The edition or the revised version of such codes and standards are current at the date twenty-eight (28) days prior to date of bid submission shall apply. During Contract execution, any changes in such codes and standards shall be applied after approval by the Owner. 1. Electronic Industries Alliance (EIA) EIA ANSI/EIA-310-D (1992) Racks, Panels, and Associated Equipment

2. Institute of Electrical and Electronics Engineers (IEEE)
   IEEE C62.41 (1991; R 1995) Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

3. National Fire Protection Association (NFPA)

   NFPA 70 (2007) National Electrical Code
   NFPA 72 (2002) National Fire Alarm Code

4. Underwriters Laboratories (UL)
   UL 1449 (2006) Transient Voltage Surge Suppressors

SUBMITTALS

The following shall be submitted.

1. Shop Drawings

   a. Detail Drawings

Detail drawings as specified.

2. Product Data

   a. Spare Parts

Spare parts data for each different item of material and equipment specified.

3. Test Reports

   a. Approved Test Procedures

   Test plan and test procedures for the acceptance tests. The test plan and test procedures shall explain in detail, step by step actions and expected results to demonstrate compliance with the requirements specified. The procedure shall also explain methods for simulating the necessary conditions of operation to demonstrate system performance.

b. Acceptance Tests

Test reports in booklet form showing all field tests performed to adjust each component and to prove compliance with the specified performance criteria, upon completion and testing of the installed system. The reports shall include the manufacturer, model number, and serial number of test equipment used in each test. Each report shall indicate the final position of controls and operating mode of the system.

4. Certificates

a. Components

Copies of current approvals or listings issued by UL, or other nationally recognized testing laboratory for all components.

5. Operation and Maintenance Data

a. Public Address System

SYSTEM DESCRIPTION

The Public Address System shall consist of an audio distribution network to include amplifiers, mixers, microphones, speakers, cabling, and ancillary components required to meet the required system configuration and operation.

1. Multi-Channel System with Paging

The system shall include microphones, microphone outlet receptacles, microphone inputs with preamplifiers, inputs for film sound, compact disc, magnetic tape, telephone, and program sources, single all channel paging, control for each input, power amplifying equipment, and accessories required to output the public address and paging audio signals through selected portions of the audio distribution network as indicated. The paging signal shall be replaced by zones channel all channels of the radio system output, when the paging function is activated.

2. Single-Channel System

The system shall control and amplify an audio program for distribution within the areas indicated. Components of the system shall include a mixer-preamplifier, mixer-amplifier; mike input expander, power amplifier, microphone, speaker system, compact disc, cassette/DVD player, AM-FM tuner, cabling and other associated hardware.

3. System Performance

The system shall provide even sound distribution throughout the designated area, plus or minus 3 dB for the 1/1 octave band centered at 4000 Hz. The system shall provide uniform frequency response throughout the designated area, plus or minus 3 dB as measured with 1/3-octave bands of pink noise at locations across the designated area selected by the Engineer. The system shall be capable of delivering 75 dB average program level with additional 10 dB peaking margin sound pressure level (SPL) in the area at an acoustic distortion level below 5 percent total harmonic distortion (THD). Unless otherwise specified the sound pressure reference level is 20 micro-Pascal (0.00002 Newton per square meter).

4. Detail Drawings

The Contractor shall submit detailed drawings consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, performance charts and curves, catalogue cuts, and installation instructions. Note that the contract drawings show layouts based on typical speakers. The Contractor shall check the layout based on the actual speakers to be installed and make necessary revisions in the detailed drawings. Detail drawings shall also contain complete point-to-point wiring, schematic diagrams and other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout of equipment and appurtenance, and equipment relationship to other parts of the work including clearances for maintenance and operation.

5. Spare Parts

The Contractor shall submit spare parts data for each different item of material and equipment specified, after approval of the detail drawings and not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

DELIVERY AND STORAGE

Equipment placed in storage until installation shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

VERIFICATION OF DIMENSIONS

The Contractor shall become familiar with the details of the work and working conditions, shall verify dimensions in the field, and shall advise the Engineers of any discrepancies before performing the work.

MATERIAL REQUIREMENTS

STANDARD PRODUCTS

Material and equipment to be provided shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate material and equipment that have been in satisfactory use for at least 2 years. All components used in the system shall be commercial designs that comply with the specified requirements. Equipment should be supported by a service organization that is within miles of the site.

1. Identical Items

Items of the same classification shall be identical. This requirement includes equipment, modules, assemblies, parts, and components.

2. Nameplates

Each major component of equipment shall have the manufacturer's name, address, model and catalogue number, and serial number on a plate secured to the equipment.

MIXER-PREAMPLIFIER (Optional)

Mixer-preamplifier shall as a minimum conform to the following specifications:

Rated Output : 18 dB

Frequency Response	:	Plus, or Minus 1 dB, 20 - 20,000 Hz
Distortion	:	Less than 0.5 percent, 20 - 20,000 Hz
Signal to noise	:	Microphone - 60 dB
Auxiliary	:	70 dB
Inputs	:	5-independent balanced low–impedance transformer-isolated
Input Sensitivity	:	Microphone - 0.003 volts, Auxiliary 0.125 volts, Magnetic Cartridge - 0.0005 volts
Input Channel Isolation	:	80 dB minimum
Tone Controls	:	Plus, or Minus 10 dB range at 50 and 15,000 Hz
Power Requirement	:	220-240 VAC, 60 Hz

POWER AMPLIFIERS

The power amplifier shall be provided with a nameplate indicating power rating to satisfy design, coverage, SPL requirements and reserve capacity requirements. Listed for Protective Signal Service and supervised in accordance with NFPA 72.
Power amplifiers as a minimum conform to the following specifications:

Rated power output	:	60, 125, 250 watts RMS
Frequency Response	:	Plus, or Minus 3 dB, 20-20,000 Hz
Distortion	:	Less than 2 percent at RPO, 600-13,000 Hz
Input Impedance	:	50 k ohm unbalanced
Output Impedance	:	Balanced 4 and 8 ohms
Output voltage	:	25 and 70.7 volts
Power Requirement	:	220-240 VAC, 60 Hz

MIXER AMPLIFIER (Optional)

Mixer amplifier shall as a minimum conform to the following specifications:

Rated Power Output (RPO)	:	35, 60, 125 watts RMS
Frequency Response	:	Plus, or Minus 3 dB, 20-20,000 Hz
Distortion	:	Less than 1% at RPO, 60 - 13,000 Hz
Inputs	:	2 microphones (high impedance or low impedance unbalanced 2 Aux. (high impedance)
Output Impedance	:	Balanced 4 and 8 ohms
Output Voltage	:	25 and 70.7 volts

Power Requirement	:	220-240 VAC, 60 Hz

MICROPHONE INPUT MODULES

Microphone input modules shall as a minimum conform to the following specifications:

Rated Outputs	:	0.25 volts into 10,000 ohms, 1.0 volts into 10,000 ohms
Frequency Response	:	Plus, or Minus 2 dB, 20 - 20,000 Hz
Distortion	:	Less than 0.5 percent 20 - 20,000 Hz
Inputs	:	4 transformers - coupled balanced 150 ohm
Input Sensitivity	:	0.003 volts
Input Channel Isolation	:	70 dB minimum

MICROPHONES

1. Desk Microphone

Microphones shall as a minimum conform to the following specifications:

Element	:	Dynamic
Pattern	:	Cardioid (Unidirectional)
Frequency Response	:	50 - 12,000 Hz
Impedance	:	Low impedance microphone (150-400 ohms)
Front to back Ratio	:	20 Db
Selector switches	:	Selector switches for zone shall be integral microphone or Separate console adjacent to microphone

2. Gooseneck Microphone

Gooseneck microphones meet the minimum requirements of the desk microphone. Microphones shall have push to the talk button. Gooseneck tube length shall be [305] [406] mm.

3. Microphone Jack

Each outlet for microphones shall consist of a standard outlet box, flush-mounted, and fitted with a three-pole, polarized, locking-type, female microphone jack and a corrosion resistant-steel device plate.

LOUDSPEAKERS

1. Cone Speaker (Optional)

The cone speaker shall as a minimum conform to the following specifications:

Application	:	Wall baffle, Ceiling
Frequency range	:	60 to 12,000 Hz
Power Rating	:	Normal - 7 watts / Peak - 10 watts
Voice Coil Impedance	:	8 ohms
Line Matching Transformer Type	:	25/ 70.7 volt line
Capacity	:	4 watts
Magnet	:	10 ounces or greater
Primary Taps	:	0.5, 1, 2 and 4 watts
Primary Impedance	:	25 volts - 1250, 625, and 312 ohms, 70.7 volts - 10k, 5k, and 2.5k ohms
Frequency Response	:	30 - 20,000 Hz
Insertion Loss	:	Less than 1 dB

2. Horn Speaker (Optional)

The horn speaker shall as a minimum conform to the following specifications:

Application	:	Indoor, Outdoor, and Weatherproof
Frequency Response	:	400 - 14,000 Hz
Power Taps	:	70 volt line - .9, 1.8, 3.8, 7.5, and 15 watts
Impedance	:	5000, 2500, 1300, 670, 330, 90, & 45 ohms
Power Rating	:	Normal - 7 watts / Peak - 15 watts
Dispersion	:	110 degrees

3. Dual Horn Speaker (Optional)

The dual horn speaker shall meet the minimum requirements of horn speaker except the dispersion shall be 100 degrees.

4. High Output Speaker Enclosures (Optional)

High Output speaker enclosures shall be of the tuned-port design for precise balancing and tuning of the speaker. The enclosures shall be constructed throughout of 19.1 mm high density board, with screwed and glued joints, durably braced, and padded with fiberglass where acoustically required. Speaker enclosures shall have a 25, 45-degree vertical dispersion and 90, 120 degrees horizontal dispersion. The effective length of throw shall be a minimum of 15, 40, and 60 m.

5. Wall Baffle Speaker Enclosures (Optional)

The wall baffle speaker shall be particle board construction covered with walnut laminate and complete with black cloth grille. Baffle shall feature 9.5 degree slope to provide directional sound dispersion offset in the direction of radiation. Wall baffle enclosure shall come equipped with a wall mounting bracket designed to assure rigid mounting to any flat surfaces.

6. **Ceiling Mounted Speaker**

The ceiling mounted speaker enclosure shall be constructed of heavy gauge cold steel with interior undercoating and 38 mm thick high-density fiberglass 24 kg per cubic meter. The unit shall be round, square and designed for recessed, surface installations which will be accomplished via standard screw torsion spring flange mounting. Recessed models shall have a rust-preventive, textured black coating and the surface mount unit finished in textured white. Enclosure shall include four triple compound conduit knockouts.

SPEAKER SWITCHING PANEL

1. Selector Switches

Zone control shall be provided for the paging function. The speaker switching panel shall contain at least double-pole, 4, 3 position push button selector switches and shall be rack-mounted, desk mounted, selector switches built in microphone to activate priority relays. Selector switches labelling shall be provided to identify the zones.

2. System Power supply

Power supply shall be provided for priority relays and controls, rack mounted and sized for a capacity equal to 200 percent of the as-built control system and shall operate at 24 Vdc. Input and output shall be protected to permit Class 2 wiring in accordance with NFPA 70.

AM/FM EQUIPMENT (Optional)

1. AM/FM Tuner

AM/FM tuner shall be rack-mounted and shall as a minimum conform to the following characteristics:

Tuning Range	:	AM - 540 to 1605 kHz / FM - 88 to 108 MHz
Selectivity	:	60 dB on FM / 40 dB on AM
Sensitivity	:	FM - 1.5 micro volts / AM - 2.0 micro volts
Capture Ratio	:	1.0 dB
Readout/Selection	:	Digital
Other features	:	Phased Lock Loop (PLL)
Power Requirement	:	220-240 VAC, 60Hz

2. AM/FM Antenna

The AM/FM antenna shall be roof-mounted, either combined or suitable for both AM and FM reception or separate AM and FM antennas and shall cover all frequency bands specified for radio tuners. The antenna system shall be coordinated with the TV system and other systems with antenna communication. The system shall be furnished completely with a transformer, insulators, crossover insulator, cable of proper length, lightning arresters, coupling transformers and divider network at the radio tuners.

COMPACT DISC/DVD PLAYER (Optional)

Compact Disc /DVD Player shall have three beam laser pickup, dual Digital-to-Analog converters, random access and random mode programmable playback. Compact Disc/ DVD Player shall have capability to play a minimum of 5, 6 discs automatically. It's compiled to the following requirements:

Frequency	:	10 - 20,000 Hz Plus or Minus 1 dB
Signal-to-Noise	:	Minimum of 100 Db
Dynamic Range	:	Minimum of 96 dB
Total Harmonic Distortion	:	Maximum of 0.005% at 1 KHZ
Channel Separation	:	Minimum 100 dB at 1 KHZ
Quantization	:	Minimum of 18 Bits Linear per channel
Conversion Rate	:	Minimum 8 x Oversampling
Disc Size	:	5 inch
Power Requirement	:	220-240 VAC, 60Hz

CASSETTE TAPE EQUIPMENT (Optional)

The dual cassette tape play deck shall as a minimum conform to the following specifications:

Frequency Response	:	Plus, or minus 3 dB, 20 - 20,000 Hz
Wow and Flutter	:	Less than 0.09 percent WRMS
Signal-to-Noise	:	74 dB
Noise Reduction System	:	Dolby B, C , S
Play Head	:	Hard Permalloy
Operation	:	Automatic Reverse
Power Requirement	:	220-240 VAC, 60 Hz

PRIORITY RELAYS AND CONTROLS

Priority relays and controls required to accomplish operations specified shall be provided. Relays shall be completely enclosed with a plastic dust cover for maximum protection against foreign matter and shall be plug-in type. Relays shall be provided with a diode wired across the relay coil for transient suppression and shall be installed utilizing factory prewired, rack mounted receptacle strips. Coil shall be maximum 24 volts dc.

SWITCHES AND CONTROLS

1. Radio System Control Switch

The loudspeaker in each room, or group of speakers in a room, shall be provided with a flush program channel selector rotating-switch knob. The switch shall be mounted at location and height above the floor and in accordance with Section 7.5 INTERIOR WIRING SYSTEM. A volume control shall be installed with a switch at each station and shall be of the auto transformer type and set so that the maximum volume is sufficient for the area while not disturbing adjacent areas. If music is turned down or off, the paging signal shall override controls except speakers designated for music only. Each device plate shall be satin finished; corrosion-resisting steel permanently marked to indicate the selected channel.

2. Remote Loudspeaker ON/OFF Switches

Remote switches shall be key-operated, toggle switch 2-pole, wall mounted, single gang type with engraved switch plates finished to match the approved finish of electrical wall switches. Low-voltage priority override relays shall be provided as part of the switches with all wiring to the racks to allow override of the ON/OFF switches for priority announcements.

3. Remote Loudspeaker Volume Controls

Remote volume controls shall be an auto transformer type with detected 3 dB steps and an OFF position. The controls shall be wall mounted in single gang outlet boxes and furnished with engraved switching plates finished to match the approved finish of electrical wall switches. Insertion loss of the controls shall not exceed 0.6 dB, and the power-handling capacities of the control shall be 10, 35, 75 watts. Low voltage priority override relays shall be furnished as part of these controls with all wiring to the racks to allow override of the volume controls for priority announcements.

EQUIPMENT RACKS

Equipment shall be mounted on 482.6 mm racks in accordance with EIA ANSI/EIA-310-D and located as shown on drawings. Ventilated rear panels, solid side panels, and solid top panels shall be provided. Equipment racks shall be provided with lockable front panels that limit access to equipment. The lockable front shall not cover items that require operator access such as AM/FM tuner, CD/DVD player, or tape player. Rack cooling shall be through [perforations or louvers in front panels to ensure adequate ventilation of equipment] [top rack mounted fan. The racks and panels shall be factory finished with uniform baked enamel over rust inhibiting primer.

CABLES

1. Speaker Cable

Cables shall be of the gauge required depending upon the cable run length. In no case shall cable be used which is smaller than 18 AWG. Insulation on the conductors shall be polyvinyl chloride (PVC) or an equivalent synthetic thermoplastic not less than 0.2 mm. Cables shall be jacketed with PVC, Fluor polymer compound. The jacket thickness should be 0.5 mm minimum.

2. Microphone Cable

The Microphone Cable conductor shall be stranded copper 20 AWG. Insulation on the conductors shall be polyvinyl chloride (PVC) or an equivalent synthetic thermoplastic not less than 0.2 mm. Cable shall be shielded 100% of aluminum polyester foil with a bare 22 gauge stranded soft copper drain conductor. Cables shall be jacketed with PVC, Fluor polymer compound. The jacket thickness should be 0.5 mm minimum.

3. Antenna Cable

Antenna coaxial cable shall have 75 ohms plus or minus 2 ohms. Attenuation of the coaxial cable span between the antenna and amplifier shall not exceed 2.5 dB at 108 MHz

TERMINALS

Terminals shall be solderless, tool-crimped pressure or type.

SURGE PROTECTION

1. Power Line Surge Protection

Major components of the system such as power amplifiers, mixer preamplifiers, and tuners, shall have a device, whether internal or external, which provides protection against voltage spikes and current surges originating from commercial power sources per IEEE C62.41 B3 combination waveform and NFPA 70. Fuses shall not be used for surge protection. The surge protector shall be rated for a maximum voltage of 350 volts ac (line to neutral) and 350 Volt ac (neutral to ground). Surge protection device shall be UL listed and labelled as having been tested in accordance with UL 1449.

2. Signal Surge Protection

Major components of the system shall have internal protection circuits which protect the component from mismatched loads, direct current, and shorted output lines. Communication cables/conductors shall have surge protection installed at each point where it exits or enters a building.

TELEPHONE INTERFACE MODULE (Optional)

Telephone Interface Module shall provide one way all call paging access from telephone to PA system. Paging shall be accomplished by building telephone system instruments interconnected to the PA system via an interface module to allow telephone dial up access to the paging amplifier. Interface modules shall produce an alert tone in the associated speakers on activation. Telephone interface module shall as a minimum conform to the following specifications:

Impedance	:	600 ohms
Frequency response	:	100Hz to 10Khz
70V Input Impedance	:	200K ohms
Output level	:	400mV rms
Input Power Requirement	:	12-24Vdc (from power supply)
Access requirement	:	Electronic (analog) or IA2 line key (line card required) PABX loop or ground-start trunk port or dedicated single-line phone.

EXECUTION

INSTALLATION

Equipment shall be installed as indicated and specified, and in accordance with the manufacturer's recommendations except where otherwise indicated. Equipment mounted out of doors or subject to inclement conditions shall be weatherproofed. The antenna shall be supported at least 1.5 m clear above the roof by means of self supported or guyed mast.

1. Equipment Racks

   Racks shall be mounted side by side and bolted together. Items of the same function shall be grouped together, either vertically or side by side. Controls shall be symmetrically arranged at a height as shown. CD/DVD, Cassette & Tuner shall be at a height above the floor as shown.

   Audio input and interconnections shall be made with approved shielded cable and plug connectors; output connections may be screw terminal type. All connections to power supplies shall utilize standard male plug and female receptacle connectors with the female receptacle being the source side of the connection. Input, output, interconnections, test points, and relays shall be accessible at the rear of the equipment rack for maintenance and testing. Each item shall be removed from the rack without disturbing other items or connections. Empty space in equipment racks shall be covered by blank panels so that the entire front of the rack is occupied by panels.

2. Wiring

   Wiring shall be installed in rigid steel conduit, intermediate metal conduit, cable trays, or electric metallic tubing as specified in Section INTERIOR WIRING SYSTEM. Wiring for microphone, grounding, line level, and speaker and power cables shall be isolated from each other by physical isolation and metallic shielding. Shielding shall be terminated at only one end.

GROUNDING

All grounding practices shall comply with NFPA 70. The mast antenna shall be separately grounded. Equipment shall be grounded to the serving panel board the ground bus through a green grounding conductor. Metallic conduits serving the equipment shall be isolated on the equipment end with an insulating bushing to prevent noise from being transferred to the circuit. Equipment racks shall be grounded to the panel board ground bus utilizing a #8 conductor. The grounding conductor shall be terminated to the rack using a connector suitable for that purpose.

ACCEPTANCE TESTS

After installation has been completed, the Contractor shall conduct acceptance tests, utilizing the approved test procedures, to demonstrate that equipment operates in accordance with specification requirements. The Contractor shall notify the Engineer 14 days prior to the performance of tests. In no case shall notice be given until after the Contractor has received written Engineer approval of the test plans as specified. The acceptance tests shall include originating and receiving messages at specified stations, at proper volume levels, without cross talk or noise from other links or non-designated units.

TRAINING

The Contractor shall conduct a training course for members of the operating and maintenance staff as designated by the Engineer. The training course will be given at the installation during normal working hours for a total of hours and shall start after the system is functionally complete but prior to final acceptance tests. The field instructions shall cover all the items contained in the approved operating and maintenance manuals, as well as demonstrations of routine maintenance operations. The Engineer shall be notified at least 14 days prior to the start of the training course.

ITEM 22 : FIRE DETECTION AND ALARM SYSTEM

GENERAL

"Electrical General Requirements" applies to this Item with additions and modifications specified herein.

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition or the revised version of such codes and standards are current at the date twenty-eight (28) days prior to date of bid submission shall apply. During Contract execution, any changes in such codes and standards shall be applied after approval by the Owner.

1. Factory Mutual Engineering and Research Corporation (FM)
   FM P7825 (2005) Approval Guide Fire Protection

2. National Fire Protection Association (NFPA)
   NFPA 70 (2005) National Electrical Code
   NFPA 72 (2002) National Fire Alarm Code
   NFPA 90A (2002) Installation of Air Conditioning and Ventilating Systems
   NFPA 101 (2002) Life Safety Code

3. Institute of Integrated Electrical Engineers (IIEE) PEC (2000) Philippine Electrical Code

4. Underwriters Laboratories Inc. (UL)
   UL 268 (1996; rev thru Oct 2003) Smoke Detectors for Fire Alarm Signalling Systems
   UL 514A (2004) Metallic Outlet Boxes
   UL 514B (2004) Fittings for Conduit and Outlet Boxes
   UL 864 (2003; rev thru Oct 2003) Control Units and Accessories for Fire alarm Systems
   UL 464 (2003; rev thru Oct 2003) Audible Signal Appliances
   UL 1242 (2000; rev thru May 2003) Intermediate Metal Conduit
   UL 1971 (2000; rev thru May 2004) Safety Signaling Devices for the Hearing Impaired
   UL 521 (1999; rev thru Oct 2002) Heat Detectors for Fire Protective Signaling Systems

DESCRIPTION OF WORK

The work includes providing new interior fire alarm system including material, tools, equipment, installation, and testing necessary for and incidental to the provision of a complete and usable standard system conforming to the applicable requirements of PEC, NFPA 70, NFPA 72, NFPA 90A, and NFPA 101, and this specification. Materials and equipment to be furnished under this contract shall be essentially the current design products of manufacturers regularly engaged in production of such equipment and shall be listed by the Underwriters' Laboratories, Inc. in the UL FPED, or approved by Factory Mutual System and listed in FM P7825.

SUBMITTALS

Submit the following.

1. Shop Drawings

    a. System layout

    b. System wiring diagrams

    c. Conductor wire marker schedule

2. Product Data

    a. Fire Control Panel

    b. Batteries

    c. Battery charger

    d. Manual Call Point / Pull Stations

    e. Smoke detectors

    f. Alarm Bell

    g. Duct smoke detectors (Optional)

    h. Audio/Visual/Alarm horns (Optional)

    i. Graphic annunciator panel (Optional)

    j. Wiring

    k. Conduit

    l. Outlet boxes

    m. Fittings for conduit and outlet boxes

Data which describe more than one type of item shall be clearly marked to indicate which type the Contractor intends to provide.

Submit one original for each item and clear, legible, first-generation photocopies for the remainder of the specified copies. Incomplete or illegible photocopies will not be accepted. Partial submittals will not be accepted.

3. Test Reports

4. Preliminary testing

5. Final acceptance testing

Submit for all inspections and tests specified under paragraph entitled "Field Quality Control."

6. Certificates

a. Qualifications of installer

b. Qualifications of system technician

7. Operation and Maintenance Data

a. Fire alarm system

8. Closeout Submittals

a. System as-built drawings

QUALITY ASSURANCE

1. Qualifications of Installer

The Contractor or installer shall have satisfactorily installed fire alarm systems of the same type and design as specified herein. Prior to commencing fire alarm system work, submit data showing that the Contractor or installer has satisfactorily installed three fire alarm systems of the same type and design as specified herein within the past three years. For each system installed, submit the following:

a. A detailed summary of the type and design of the system.

b. The contract name or number, completion date of the project and total cost of the system.

c. The name and telephone number of the facility or installation for which the work was performed.

2. Manufacturer's Representative

Provide the services of a representative or technician from the manufacturer of the system, experienced in the installation and operation of the type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of the system and to provide instruction to Owner representative.

3. Qualifications of System Technician

Installation drawings, shop drawings and as-built drawings shall be prepared by, or under the supervision of, a qualified technician. A qualified technician shall be an individual who is experienced with the types of work specified herein. The contractor must submit data showing the name and certification of the technician on or before submitting drawings.

4. Drawing Requirements

a. System Layout

Submit shop drawings of the system layout showing locations of initiating devices and alarm horns. Show wire color coding, wire counts, and device wiring order.

b. System Wiring Diagrams

Submit complete wiring diagrams of the system showing points of connection and terminals used for all electrical connections in the system. Show all modules and lamps in the control panel.

c. System As-Built Drawings

Upon completion, and before final acceptance of the work, furnish to Engineer 4 complete sets of as-built drawings, including complete as-built circuit diagrams, of each the system. The as built drawings should be like contract drawings and have a block title like contract drawings.

MAINTENANCE

1. Spare Parts

Furnish the following spare parts:

a. Five (5) complete sets of system keys
b. One (1) of each type of audible and visual alarm device installed
c. Two (2) of each type of fuse required by the system
d. One (1) spare zone modules for modular type control panels in addition to those installed in the panel
e. Two (2) of each type of heat detector installed
f. Tow (2) of each type of smoke detector base and head installed

2. Manuals

Submit operation and maintenance data manuals. The manual shall include circuit drawings; wiring and control diagrams; installation instructions; maintenance instructions; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list.

MATERIAL REQUIREMENTS

SYSTEM DESIGN

1. Operation

Provide a complete, electrically supervised, zoned, annunciated, fire alarm system as described herein, and as shown on the drawings. Provide separate circuits from the control panel to each zone of initiating devices as specified herein.

a. Fire Alarm Signal Initiation

Operation shall be such that actuation of any:

1) Manual Call Station or Manual Pull Station
2) Smoke detector

Shall cause all the following actions:

a) All building evacuation alarm devices Audio/visual alarm horns to operate continuously.

b) The annunciator is a signal board or indicator, often electrically controlled, that visually and/or audibly alerts personnel to abnormal conditions or events, such as a fire or alarm.

All operations shall remain in alarm mode until the system is manually restored to normal.

a. Monitoring Integrity of Installation Conductors

All system circuits shall be electrically monitored for integrity including the following:

1) Initiating circuits.

2) Evacuation alarm circuits

3) Battery power supply low and no voltage across the standby battery terminals and open battery circuit. Provide Class A initiating device circuits, and Class A notification device circuits as defined by NFPA 72. For Class A circuits, they provide separate conduits for outgoing, and return (redundant) conductors as required by NFPA 72. A ground fault condition or single break in any other circuit shall cause operation of the system trouble signals. Loss of AC power, abnormal AC voltage, a break in the standby battery power circuit, or low battery voltage shall also cause operation of system trouble signals. The abnormal position of any switch in the control panel shall also cause operation of the system trouble signals. Audible and visual equipment for supervision of the AC power supply shall be energized from the auxiliary DC power supply and vice versa. Trouble signals shall sound continuously until manually silenced or the system has been restored to normal.

b. Walk-Test Mode

Provide system with walk-test mode to allow one person to test alarm and supervisory features of initiating devices. Walk-test mode shall be enabled from the control panel by authorized service personnel. The control panel shall display a unique visual indication when the system is in walk-test mode. If testing ceases while in walk-test mode, after a preset delay system shall automatically return to normal standby mode.

c. Alarm Verification Feature

Systems shall have a smoke detector alarm verification feature. Upon activation of any area smoke detector, the system shall institute an alarm verification process prior to enabling of the alarm functions as specified herein. Activation of any initiating device other than an area smoke detector shall cause immediate enabling of system into alarm mode. If an alarm input from a smoke detector on the initial zone in alarm is present at the end of an initial delay period not exceeding 20 seconds, all alarm functions as specified herein shall be immediately enabled. If a smoke detector alarm input is not present at the end of the initial delay period, a second-stage confirmation period of one minute shall be initiated. If a smoke detector alarm input is received during the second-stage confirmation period, all alarm functions shall be immediately enabled. During the verification process, activation of any area smoke detector on any zone other than the initial zone in alarm shall also cause the system to go into alarm mode immediately. If no smoke detector alarm input occurs within the second-stage confirmation period, the system shall be reset too normal. Any alarm input received from an area smoke detector after the second-stage confirmation period has elapsed shall cause the system to institute a new verification process.

2. Primary Power

The Primary power supply shall be 240 volts AC service, transformed through a two winding isolation type transformer and rectified to 24 volts DC for operation of all initiating devices, notification device signaling line and trouble signal. The current alarm draw of the entire fire alarm system shall not exceed 80 percent of the rated output of the system power supply modules. Obtain AC operating power as shown on contract drawings. Provide an independent enclosed circuit breaker with provisions for locking the cover and operating handle in the "POWER ON" position. Paint the enclosure red and identify with the lettered designation "FIRE ALARM SYSTEM POWER".

3. Auxiliary Power

Provide secondary DC power supply for operation of system in the event of failure of the AC source. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and shall not cause transmission of a false alarm.

a. Storage Batteries

Provide sealed lead calcium or sealed lead acid or batteries and charger. Dry cell batteries are not acceptable. House batteries in the control panel. Provide batteries of adequate ampere-hour rating to operate the system, including audible trouble signal devices, and under supervisory conditions for 60 hours, at the end of which time batteries shall be capable of operating the entire system in a full alarm condition for not less than 15 minutes. Provide calculations substantiating the battery capacity. Provide reliable separation between cells to prevent contact between terminals of adjacent cells and between battery terminals and other metal parts.

b. Battery Charger

Provide completely automatic high/low charging rate type capable of recovery of the batteries from full discharge to full charge in 24 hours or less. Provide a trouble light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high-rate switch is provided. House charger in the control panel.

COMPONENT DESIGN

1. Fire Alarm Control Panel (FACP)

The Fire Alarm Control Panel shall comply with the applicable requirements of UL 864. Provide modular type panel installed in a surface mounted steel cabinet with hinged door and cylinder lock. Mount with panel centerline 1.5 m above finished floor elevation. Switches and other controls shall not be accessible without the use of a key. The control panel shall be a neat, compact assembly containing all parts and equipment required to provide specified operating and supervisory functions of the system.

Each control panel component shall be listed as UL, or FM approved and approved by the control panel manufacturer for use in the control panel. The panel cabinet shall be finished on the inside and outside with factory-applied enamel finish. Provide a main annunciator located on the exterior of the cabinet door or visible through the cabinet door. Provide audible trouble signal. Provide permanent engraved rigid plastic or metal identification plates, or silk-screened labels attached to the rear face of the panel viewing window, for all lamps and switches. Provide panels with the following switches:

a. Trouble silencing switch which silences audible trouble signals without extinguishing trouble indicating lamps. For non-self resetting type switch, upon correction of the trouble condition, audible signals will again sound until the switch is returned to its normal position. For silencing switch of the momentary action, self resetting type, the trouble signal circuit shall be automatically restored to normal upon correction of the trouble condition.

b. Evacuation alarm silencing switch which when activated will silence all alarm notification devices without resetting the panel, and cause operation of system trouble signals. Subsequent alarms from additional zones not originally in alarms shall cause activation of the notification devices even with the alarm silencing switch in the "silenced" position.

c. Individual zone disconnects switches which when operated will disable only their respective initiating circuit and cause operation of the system and zone trouble signals.

d. Reset switch which when activated will restore the system to normal standby status after the cause of the alarm has been corrected, and all activated initiating devices reset. Operation of reset switch shall restore activated smoke detectors to normal standby status.

e. Lamp test switch.

f. Drill switch which will enable test of notification devices and restoration to normal.

1) Graphic Annunciator Panel (Optional)

Provide a panel located as shown. Mount with panel centerline 1.5 m above finished floor elevation. Panels shall be of the interior type, surface mounted. Panels shall be provided with the building floor plan, drawn to scale, with alarm lamps mounted to represent the location of each initiating device. Panel graphics should also show the locations of the control panel and should have a "you are here" arrow showing its location. Orient building floor plan on graphics to location of person viewing the graphic, i.e. the direction the viewer is facing shall be toward the top of the graphic display. Provide a North arrow. Lamps shall illuminate upon activation of the corresponding device and shall remain illuminated until the system is reset. Panels shall have a lamp test switch.

2. Manual Pull Stations

Provide noncoded single action type with mechanical reset features. Stations shall be surface semi-flush mounted and interior type as indicated. For surface mounting provide station manufacturer's approved back box. Back box finish shall match station finish. Equip each station with a terminal strip with contacts of proper number and type to perform the functions required. Stations shall be a type not subject to operation by jarring or vibration. Break-glass-front stations are not permitted; however, a pull-lever break-rod type is acceptable provided the presence of rod is not required to reset the station. Station color shall be red. Station shall provide visible indication of operation. Restoration shall require the use of a key. Keys shall be identical throughout the system for all stations and control panels. Mount stations with operating lever not more than 1.2 m above finished floor.

2.a Manual Call Point

While both manual call points and manual pull stations serve to manually initiate fire alarms, their designs and common applications differ; a manual call point typically has a push-button or breakable glass panel design, while a manual pull station requires pulling a handle.

Functions:

- Used to manually initiate an alarm signal, alerting building occupants to an emergency (fire or other).
- Often involves pressing a button or breaking a glass/plastic panel to access an internal button or switch.
- It can be used for various emergencies, not just fire, and may be integrated into larger building management and security systems.
- Typically placed along escape routes, near exit doors, or in high-risk areas.

3. Smoke Detector (SD)

Provide smoke detectors in accordance with NFPA 101, Life Safety Code. Provide detectors designed for detection of abnormal smoke densities by the photoelectric principle. Detectors shall be 4-wire type. Provide necessary control and power modules required for operation integral with the control panel. Detectors and associated modules shall be compatible with the control panel and shall be suitable for use in a supervised circuit. Malfunction of the electrical circuits to the detector or its control or power units shall result in the operation of the system trouble signals. Each detector shall contain a visible indicator lamp that shall flash when the detector is in normal standby mode and shall glow continuously when the detector is activated. Each detector shall be the plug-in type with tab-lock or twist-lock, quick disconnect head and separate base in which the detector base contains screw terminals for making all wiring connections. The detector head shall be removable from its base without disconnecting any wires. Removal of detector head from its base shall cause activation of system trouble signals. Each detector should be screened to prevent the entrance of insects into the detection chambers.

a. 4-Wire Smoke Detectors (Optional)

Detector circuits shall be of the 4-wire type whereby the detector operating power is transmitted over conductors separate from the initiating circuit. Provide a separate, fused, power circuit for each smoke detector initiating circuit (zone). Failure of the power circuit shall be indicated as a trouble condition on the corresponding initiating circuit.

b. Photoelectric Detectors (Optional)

Operate on the light scattering principle using a LED light source. Detector shall respond to both flaming and smoldering fires. Detectors shall be factory set for sensitivity and shall require no field adjustments of any kind. Detectors shall have an obscuration rating in accordance with UL 268.

c. Detector Spacing and Location

Detector spacing and location shall be in accordance with the manufacturer's recommendations and the requirements of NFPA 72, except provide at least two detectors in all rooms of 54 square meters or larger in area. In no case shall spacing exceed 9 by 9 m per detector, and 9 linear m per detector along corridors. Detectors shall not be placed closer than 0.9 m from any air discharge or return grille, nor closer than 300 mm to any part of any lighting fixture.

4. Notification Devices

Provide in accordance with NFPA 72 and as indicated. Do not exceed 80 percent of the listed rating in amperes of any notification device circuit. Additional circuits above those shown shall be provided if required to meet this requirement. Effective sound levels shall comply with NFPA 72. Provide devices in addition to those shown if required in order to meet NFPA 72 sound level requirements.

a. **Alarm Bell**

An "alarm bell" is a bell-shaped device, or metaphorically any sign or signal, that is designed to alert people about danger or a problem. It can be a literal bell used in a fire alarm system, or used in the figurative sense, where something sets off "alarm bells" to indicate that something is wrong.

b. Alarm Horns (Optional)

Surface-mounted vibrating type suitable for use in an electrically supervised circuit and shall have a sound output rating of at least 90 decibels at 3 m, when tested in accordance with UL 464 while emitting a slow whoop tone.

c. Visible Devices

Surface-mounted assembly of the stroboscopic type suitable for use in an electrically supervised circuit and powered from the notification device circuits. Devices shall provide a minimum of 75 candela measured in accordance with UL 1971, but in no case less than the effective intensity required by NFPA 72 for the device spacing and location shown. Lamps shall be protected by a thermoplastic lens and labeled "FIRE" in letters at least 12 mm high. Provide visible devices within 300 mm of each audible appliance and as indicated. Visible devices may be part of an audio-visual assembly. Where more than two devices are in the same room or corridor, provide synchronized operation.

5. Conduit

a. Intermediate Metal Conduit (IMC) UL 1242, zinc-coated steel only.

6. Outlet Boxes UL 514A, zinc-coated steel.

7. Fittings for Conduit and Outlet Boxes UL 514B, zinc-coated steel.

8. Wiring

NFPA 70, PEC and NFPA 72. Wire for 240V circuits shall be 3.5 mm^2 minimum copper conductors. Wire for low voltage DC circuits shall be 2.0 mm^2 minimum copper conductors Insulation shall be 75 degree C minimum with nylon jacket. Color codes all wiring.

EXECUTION

INSTALLATION

Installation shall be in accordance with the requirements of NFPA 70, PEC NFPA 72 and NFPA 90A. Each conductor used for the same specific function shall be distinctively color coded. Each function color code should remain consistent throughout the system. Use colors as directed by the Engineer. All wiring shall be in steel conduit. All circuit conductors shall be identified within each enclosure where a tap, splice or termination is made. Conductor identification shall be by plastic coated self-sticking printed markers. The markers shall be attached in a manner that will not permit accidental detachment. Control circuit terminations shall be properly identified. Wire devices so that

their removal will activate system trouble signals. Pigtail or "T" tap connections are prohibited. Wiring for DC circuits shall not be permitted in the same conduit or tubing as wiring for AC circuits. Paint all junction boxes cover red or provide them with permanent labels reading "FIRE ALARM CIRCUIT." Provide a written schedule of conductor markings identifying each wire marker, the purpose, the origin, and termination point of each conductor. The conductor wire marker schedule shall be turned over to the Engineer at the time of preliminary testing with as built drawings.
1. Additional Installation Requirements

Pull all conductors splice free. Make all conductor connections under screw terminals. Provide insulated barrier type terminal strips at junction points. Use of wire nuts, crimped connectors, or twisting of conductors is prohibited. All control panels shall be dressed out in a professional manner with all wires running in the vertical or horizontal plane, cut to exact length, making all turns at 90-degree angles, and tightly bundled and wire wrapped. Conduit may not enter the top of control panel cabinet.

FIELD QUALITY CONTROL

1. Preliminary Testing

Notify Engineer prior to performing preliminary testing. The contractor shall conduct the following tests during installation of wiring and system components. Any deficiency pertaining to these requirements shall be corrected by the Contractor prior to final acceptance testing of the system. Record results of testing. Submit all test results to the Engineer.

a. Operation of Entire System. Operate all initiating and indicating devices.

b. Operation of Supervisory Systems: Operate all portions to demonstrate correctness of installation.

c. Smoke Detector Test: Clean the smoke detectors in accordance with the manufacturer's recommended procedures. Test smoke detectors using magnet-activated test switches, manufacturers provided test cards, or smoke. Use of aerosol sprays to test smoke detectors is prohibited.

2. Final Acceptance Testing

The Contractor shall notify the Engineer when the system is ready for final acceptance testing. Request scheduling for final acceptance testing only after all necessary preliminary tests have been made and all deficiencies found have been corrected to the satisfaction of the equipment manufacturer's technical representative and the Engineer and written certification to this effect has been received by the Fire Protection Engineer. The system shall be in service at least 15 calendar days prior to final acceptance testing. The Contractor shall allow at least 15 calendar days between the dates final testing is requested and the date the final acceptance testing takes place. The Contractor shall furnish all equipment, instruments, devices and personnel for this test. The system shall be tested for approval in the presence of representatives of the manufacturer, the Engineer, and the Fire Protection Engineer. All necessary tests shall be made including the following, and any deficiency found shall be corrected and the system retested.

a. Entire System

Test the entire system by operating all fire alarm initiating, notification, and signaling devices. Perform tests with the system operating on primary power and repeat the test with the system operating on battery power only. Provide necessary equipment to test smoke detectors and heat detectors.

b. Supervisory Systems

All aspects of the supervisory functions of the systems should be operated. Introduce faults in each circuit at random locations as directed by the Fire Protection Engineer. Verify proper trouble annunciator at the control panel.

3. Additional Tests

When deficiencies, defects or malfunctions develop during the tests required, all further testing of the system shall be suspended until proper adjustments, corrections or revisions have been made to assure proper performance of the system. If these revisions require more than a nominal delay, the Engineer shall be notified when the additional work has been completed, to arrange a new inspection and test of the fire alarm system. All tests required shall be repeated prior to final acceptance, unless directed otherwise.

ITEM 23 : COMMUNITY ANTENNA TELEVISION SYSTEM (CATV)

GENERAL

Electrical General Requirements applies to this Item, with the additions and modifications specified herein.

DESCRIPTION OF WORK

The community antenna television (CATV) is a cable television system that receives television broadcast by antenna and relays them by cable to paying subscribers in areas where direct reception is either poor or not possible.

These cable systems use a "community antenna" to receive broadcast signals (often from communications satellites), which they then retransmit via cables to homes and establishments in the local area subscribing to the service.

CATV uses radio frequency signals transmitted through coaxial cable to deliver broadcasted programming to consumers.

MATERIALS REQUIREMENTS

a. It includes co-axial cables, fiber optic cables, amplifiers and other transmission components. This is the point where the distribution network connects to the viewer's home. Set-top box: This is the device used by the viewer to decode the television signals and display them on the TV

b. The conduit shall be polyvinyl-chloride conduit (PVC) where specified, shall be heavy wall, high impact resistant Schedule 40, with factory made bends, couplings and fittings. PVC cement for joints shall be of the same brand as for the PVC pipe.

c. All outlets of whatever kind, for all systems, there shall be provided a suitable fitting, which shall be either a box or other device especially designed to receive the type of fitting to be mounted thereon.

d. Cable TV sockets are used to provide the connection between a television or signal receiver and the cable that runs to the aerial. They are commonly referred to as aerial or co axial sockets and are typically found in most homes as well as commercial premises.

e. Junction and pull boxes, of code gauge steel, galvanized shall be provided as indicated or as required for facilitating the pulling of wires and cables. Pull boxes as finished places shall be located and installed with permission and to the satisfaction of the Engineer.

f. Cable TV splitter is a compact unit, which splits a cable TV signal from the source to accommodate more than one device in the vicinity. For instance, if there are three functional televisions in your house, one for each room, yet there is only one coax cable outlet, then you can use a splitter to cut and distribute the main cable TV signal to the three TV sets without disturbing the design of the house. A coax cable splitter can be nickel-plated, ideal for outdoor usage, or chromate/zinc-plated, which works well indoors. It can have one input and multiple outputs, ranging from two to sixteen. The more output there is, the higher the chances of signal loss at each port, resulting in altered picture quality on your TV screens or other side effects. Cable TV splitters are usually

inexpensive, and most cable companies include them alongside extra coaxial wires in their welcome kit for new users.

g. Cable splitters can be of multiple types. One of the most popular types is a transformer cable splitter, which has a higher performance, but also a higher cost. It splits the main signal equally to all the connected ports without degrading the signal quality per se. Then, we have resistor cable splitters, which are relatively cheaper but can only divide and transmit fifty percent of the signal to the output cables, facing a fifty percent signal loss at the base unit. You may also find balanced cable splitters with an even number of ports, where all the output cables receive equally reduced signal strength. On the other hand, an unbalanced cable splitter has an odd number of outgoing ports, where some ports get better signal quality than others do. HDMI cable splitters are also available in the market, working best for television sets that don't have a coaxial port.

HERE ARE SOME OF THE LISTS OF LOCAL CATV PROVIDERS:

a. Cable link
b. Destiny Cable
c. Sky Cable
d. Parasat Cable
e. CIGNAL TV
f. Global Cable
g. Home Cable, etc.,

EXECUTION

CATV INSTALLATION:

1. RG-6 is the standard for cable installation, can be used both above- and below-ground. Make sure that you purchase about 10%-20% more than you think you'll need in case of unforeseen complications.

2. Connect a coaxial cable to the distribution point located either on the "pedestal", which emerges from the ground, or on an overhead utility cable at some point near the place where cable is to be installed.

   a. Note: It is illegal to connect cables to the distribution point without getting permission from the cable company.

3. Run the cable to the point the cable is to enter the subscriber's home or other. There are two different ways you can run this cable to the home:

   a. You can bury "flooded" coaxial cable from the buried distribution point or pedestal to the point at the subscriber's home or other structure where the cable will enter. When burying cable, you may want to run it through PVC piping to help prevent it from being accidentally cut by a shovel.
   b. You can run a special aerial cable with molded suspension wire from the distribution point on the overhead utility cable to a point on the eaves of the subscriber's home. Screw a hook into the eaves to which the far end of the molded suspension wire on the aerial coaxial cable can be looped and fastened.

4. Drive a grounding spike into the earth at or near the point where the coaxial cable enters the home or other structure or locate a cold-water pipe in the area. Fasten a 12-gauge grounding wire to the grounding spike or cold-water pipe at one end and to

a coaxial cable grounding block at the other. This will form a connection to the earth that will ground the coaxial shield in the cable and serve to divert lightning strikes.

4.a Use the coaxial cable stripping tool to remove the insulation in layers from the coaxial cable and the external woven wire "shield" of the cable. Place a connector at the end of the striped cable and crimp or compress it.

- When terminating the cable, ensure that there are no loose wires poking out of the connector. This will lead to bad or no signal. Avoid using screw- or push-on connectors, as these can become loose very easily and lead to a bad connection.
- Details on terminating coaxial cables.
- Fasten the coaxial cable from the distribution point/pedestal to one tap on the coaxial cable grounding block. Make sure that it is securely fastened.
- Fasten a coaxial cable to the other tap on the coaxial cable grounding block. This will be the cable that runs into the house. Make sure that it is long enough to reach the destination with one cable.

QUALITY ASSURANCE

- Wiring Diagrams and Installation Details

These items of equipment function in the system and include an overall system schematic indicating the relationship of CATV units on one diagram. Drawings shall include wiring diagrams and installation details of equipment indicating proposed locations, layout and arrangements, and other items that must be shown to ensure coordinated installation.

WORKMANSHIP

The work throughout shall be executed in the best and most thorough manner under the direction of and to the satisfaction of the Registered Electrical Engineer or Master Electrician, who will interpret the intent meaning of the drawings and specifications and shall have the power to reject any work and materials which in his judgment, are not in full accordance therewith.

TESTING OPERATIONS

When the CATV installation is completed, the Contractor shall test the installed CATV materials and equipment in the presence of a Registered Electrical Engineer or Master Electrician. The system shall be free from any defects, shorts or grounds. The Contractor at no extra cost shall furnish all necessary instruments and personnel required for the testing.

GUARANTEE

Upon completion and before final acceptance of the work, the Contractor shall furnish the Engineer with a written guarantee stating that all works executed are free from defects on materials and workmanship. The guarantee shall be for a period of one year from the date of final acceptance. Any work that becomes defective during the said period shall be corrected / replaced by the Contractor at his own expense in a manner satisfactory to the Authority.