ITEM 09 B: 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.

WOOD LAMINATES AND WOOD PLASTIC COMPOSITE PANELS

INTRODUCTION

a. Wood Laminate

A wood laminate is a thin sheet of material used to cover the core of a wood project in order to change the appearance of the material. Laminates may be any material, but typically they are made of veneers, which are thin sheets of wood.

High-pressure decorative laminates are characterized by their qualities, durability, and functional performance. High-pressure laminate sheets are available in a wide variety of colors, patterns, and surface finishes. They are resistant to wear, scratching, impact, moisture, heat, and staining; and possess good hygienic and anti-static properties, being easy to clean and maintain.

b. Wood-plastic composite

Wood-plastic composite architectural products are a sustainable timber alternative with added benefits such as durability and strength.

SCOPE OF WORK

This item shall consist of furnishing all wood laminates and wood composite panel materials, labor, tools and equipment required in undertaking the proper installation as shown on the Plans and in accordance with these specifications.

SPECIFICATIONS

a. Wood Laminates: 0.8mm thick Wood Grain Laminates for Interior Cladding or any approved equivalent by the designing Architect.

b. Wood Composite Panels:

Supply and Installation of Wood-Plastic Composite Fluted panels in sizes: 224mm X 26mm X 2900mm or any approved equivalent by the designing Architect.

Supply and Installation of Wood-Plastic Composite Ceiling Baffles in sizes: 50mm X 90mm including angle bracket support or any approved equivalent by the designing Architect.

SUBMITTALS

a. Product Data

Manufacturer's printed product literature, specifications, and data sheets

b. Shop Drawings

Indicate project layout; dimensions and thickness of panels; connections; details and locations of joints and sealant; methods of anchorage; number of anchors; supports; reinforcement; flashings; accessories; materials; and finishes.

c. Samples

1. Sample materials for selection and verification of finishes, colors, and textures.

2. Sample of panel assembly.

QUALITY ASSURANCE

a. Fabricator/installer to be accepted by the manufacturer.

b. Fabricator/installer to have work similar in scope and size to this project.

c. Take field measurements prior to completion of shop manufacture or fabrication. Coordinate fabrication schedule with construction progress to avoid delay of work. Field fabrication should be allowed to ensure proper fit and keep it to a minimum with the majority of fabrication being done under controlled shop conditions.

PREPARATION

Ensure surfaces to receive wood laminates and wood-plastic composite panels are structurally leveled, even, smooth, clean, dry, and free from defects detrimental to work. Notify consultant thru writing of conditions unfavorable to proper and timely completion of work. Do not proceed with erection until unsatisfactory conditions have been corrected.

ACCESSORIES

Screws, nuts, washers, bolts, rivets, angle bars and other miscellaneous fastening devices shall be made of non-corrosive materials such as aluminum and stainless steel.

ITEM 09 C: ROOFING AND TINSMITHRY

SCOPE OF WORK

The work shall include but not limited to all labor, materials, tools, equipment and incidentals necessary to furnish and install the roofing sheets including fittings, flashing caps, ridge rolls, gutters and construction of concrete eaves and canopy excluding waterproofing, to provide completely sound water tight roof for the buildings as shown on the Drawings and specified herein.

MATERIAL REQUIREMENTS

ROOFING SHEETS

Ultra Panel
Roof, Long span, pre-painted, pre-insulated roof panel system, composed of an exterior metal skin cladding using "snap on side overlap" fastening system and an interior liner cladding of eitheretal skin or aluminum kraft vapor barrier sandwiched between is, PIR "Polyisocyanurate" foam to provide a high level thermal insulation.

Base Metal thickness	:	0.37mm, 0.47mm, 0.57mm
Total Coated thickness	:	0.40mm, 0.50mm, 0.60mm
Anti-rust Coating	:	Alloy coating of aluminum and zinc. Alloy is comprised of 55% aluminum, 43.4% zinc and 1.6% silicon
Coating Standards	:	AZ 150 (150 gm/m^2) ASTMA A - 792 ASTM A - 792
Back Coat	:	5 – 8 microns bottom coat
Length	:	up to transportable length (long span), minimum chance of leaks
Color	:	White
Material Finish	:	Pre-painted galvalume of 0.50mm thk. of metal with 25mm thk. Polyisocyanurate foam "PIR" insulated with aluminum kraft paper backing
Insulation Thickness	:	50mm thk. PIR / 75mm thk. polyisocyanurate foam PIR)
Insulation Materials	:	composed of MDI (polymetric methyl diphenyl isocyanurate) with certain types of polyol

EXECUTION

ROOFING SHEETS

1. Roof, Long span

   Spacing of purlins safe at 1.0m to 1.2m.

   At least 28 days before laying of roofing sheet start, the Contractor shall submit for

approval of the Engineer, shop drawings indicating materials and method of installation. No roofing sheets laying work shall commence without the Engineer's approval of the shop drawings and work method.

Laying shall start from the end opposite the side from where the prevailing monsoon is coming from. The first sheet shall be laid and installed with the turned-down edge towards the outside of the area to be covered. The next sheet shall be overlapped to the previous sheet in such a manner that the exposed edge is turned down and the covered edge is turned up. The overlapped edge in the side shall be with the rib having the anti-capillary groove. End and side laps including flashing shall be as approved by the Engineer.

The straps shall be fixed and fastened with the fastener and washer as shown on the Drawings.

STEEL CANOPY

Construction of the steel canopy shall be in accordance with the Technical Drawings and as directed by the Engineer.

Roofing shall be a 6mm thick Solid Sheet Polycarbonate.

HANDLING AND STORAGE

The sheet shall be lifted directly and shall not be dragged over the other sheets or rough surfaces.

When working on a roof, the workers shall wear flat rubber-soled shoes.

The tool shall be handled carefully to prevent them from sliding over the coated surface.

When installation work is completed, all metal off-cuts, used nails and other metallic scrap shall be removed from the roof area.

When using drills, hacksaws, or files in the roof area, care shall be taken that metal particles and fillings are swept off the roof immediately.

If not required for immediate use, sheets or bundles shall be staked and clear off the ground. If left in the open, sheets shall be protected by loose tarpaulin or similar covers.

Bundles shall not be left expose to the weather.

C CHANNEL

Aluminum C-channel is often referred to as architectural angle and channel. Aluminum C-channel has uses in many industries and is often an ideal choice due to its non-corrosive properties and structural strength. Aluminum C-channel is considerably less expensive than wood, is lighter in weight, insect resistant, and resists warping and cracking from water damage.

C-sections
Height: 100, 120, 150, 200, 250, 300 mm
Thickness: 1.0–3.0 mm
Minimum length 1600 mm
Maximum length 18000 mm

ITEM 09 D: ALUMINUM COMPOSITE PANEL

I.INTRODUCTION

A. MATERIAL COMPOSITION

Aluminum Composite Panel (ACP) is a lightweight durable panel made of laminated aluminum and polyethylene core compound, coated with an advanced fluorocarbon paint Polyvinylidine Flouride (PVDF) to ensure the excellent durability of the surface finish. It is an excellent material for exterior and

Interior cladding of new building construction as well as retro fit applications. It also has a high degree of levelness top reserve the fine architectural design and can be roller bended to suit various design shapes. The laminated structure of ACP ensures exceptional strength of the panel.

THICKNESSES:
3mm (Polyester) 4 to 6mmPVDF/+Nano

B. CHARACTERISTICS

1. Flatness–as the composite material is rigid, the flat surface can be preserved. This is considered a major advantage of ACP.

2. Fire Resistance–ACP are laminated at
Temperatures from 200° to 250° to bond aluminum sheets to the polyethylene core. The non-flammable aluminum cover sheets protect the plastic core.

3. Light Weight–as the weight is less than ½ to ⅓
Of the weight of porcelain enamel, iron, copper, stainless and other metal panels, consequently it can reduce the weight of the building.

4. Durability–ACP is highly resistant to chemical corrosion due to the PVDF coating. The composite material is rigid, resistant to blows, breakage, and pressure and has high bending and breaking strength.

SPECIFICATION

I. Aluminum Composite Panel (ACP) must be composed of density polyethylene core sandwiched between two sheets of aluminum,

II. It must be strong, lightweight approximately 5.5kg/sqm. But must be exceptionally flat.

III. The ACP composition

- Two sheets of aluminum
- Front side aluminum roll coated with polyvinylidine fluoride PVDF according to AAMA605.2 requirements.

IV. PVDF coating finish adhere to the following standards.

Testing Item	Standard	Result
Finished coat thickness	ISO 2360 (CNS 8406)	27.6m
Gloss	ASTM D532-89	20 ~ 45 %
Pencil hardness	ASTM D3363-00	2H
Toughness	ASTM D4145-83	2T no rift
Adhesive force	ASTM 3359-97	4B
Impact resistance	ASTM D2794-93	>100 kg. cm.
Abrasion resistance	ASTM D968-93	64.6 L/mil
Mortar resistance	ASTM 605.2-90	24 Hrs. pat test exceed
Himidity resistance	ASTM D714-97	3000 hr no blister
	ASTM D2247-02	
Boiling- water resistance	ASTM D3359-B	Passed
Salt-spray resistance	ASTM D117-03	3000 hr no blister
Acid resistance	ASTM D1308-87	No effect
	AAMA 605.2-91, TEST #7, 7.31	
Alkali resistance	ASTM D1308-87	Passed
Solvent resistance	ASTM D2248-73	Passed
	ECCAT T5 & NCCA No. 11-18	
Color retention	ASTM D2244-93	ΔE = 0.34
Chalk resistance	ASTM D4214-98	No chalking
Gloss retantion	ASTM D2244-93	84.2 %

V. Total thickness must be 4.0mm minimum (standard)

VI. Framing must also be made of aluminum to prevent corrosion of the panels.

VII. Aluminum Composite panel supplier must be the same company that will install the framing and will fabricate and install all panels. This is to insure optimum workmanship. All labor and installation must have a warranty of not less than one year.

Methodology

II. SUBMITTALS

A. PRODUCT DATA

Manufacturer's printed product literature, specifications, and data sheets

B. SHOP DRAWINGS

1.Indicate project layout and elevations; dimensions and thickness of panels; connections; details and locations of joints and sealant; methods of anchorage; number of anchors; supports; reinforcement; flashings; accessories; materials; and finishes.

2. Indicate proposed joints details providing watertight and structurally sound panel system that allows no uncontrolled water penetration on inside face of panel system as determined by ASTME331.

C. SAMPLES

1. Sample of panel system materials for selection
and verification of finishes, colors, and sealant colors.

2. Sample of panel assembly.

D. TEST REPORTS (as requested)

Certified test reports for ACP from approved independent testing laboratories indicating compliance with specifications for specified performance, characteristics, and physical properties.

III. QUALITY ASSURANCE

a. Fabricator / installer to be accepted by the manufacturer.

b. Fabricator / installer to have work similar in scope and size to this project.

c. Take field measurements prior to completion of shop fabrication. Coordinate fabrication schedule with construction progress to avoid delay of work. Field fabrication should be allowed to ensure proper fit and keep it to minimum with majority of fabrication being done under controlled shop conditions.

d. Maximum deviation from vertical and horizontal alignment of erected panels should be made.

e. Assume responsibility for components of exterior panel system including, but not limited to, attachment to sub-construction, panel-to-panel joinery, panel-to-dissimilar-material joinery, and joint seal associated with panel system.

IV. DELIVERY, STORAGE, and HANDLING

a. Cover exposed surfaces with pressure-sensitive heavy protection paper or apply strippable plastic coating, before shipping to the job site.

b. Leave protective covering in place until final cleaning of building.

c. Deliver materials in (manufacturer's) original sealed packaging.

d. Store panels and accessories in a dry, secure location and protect from weather.

e. Protect finish and edges of panel.

V. LOADING AND UNLOADING

a. Panels must be handled carefully to prevent damage

b. Panels may buckle if they are not properly supported.

c. A forklift may be used for panels up to 10 feet (3 meters) long. However, some means of supporting the panel load over a longer distance from the forks may be used.

VI. PREPARATION

Ensure surfaces to receive panels are structurally sound, even, smooth, clean, dry, and free from defects detrimental to work. Notify consultant thru writing of conditions unfavorable to proper and timely completion of work. Do not proceed with erection until unsatisfactory conditions have been corrected.

VII. ACCESSORIES

a. Extrusions, formed members, sheet, and plate are in accordance with ASTMB209 and recommendations of the Manufacturer's

b. Panel stiffeners are structurally fastened or restrained at ends and secured to rear face of ACP with double-sided tape of sufficient size and strength to maintain panel flatness.

c. Sealant within the panel system to conform with the Manufacturer's standards to meet performance requirements.

d. Fasteners are not exposed except where unavoidable.

Aluminum Composite Panel Color / Thickness/ Location

Parapet Wall -	4mm thick ACP (As Selected by the Architect)
Exposed Beams - under Steel Canopy	4mm thick ACP (As Selected by the Architect)

Details are shown in the plans.

ITEM 09 E: HANDRAILS, RAILINGS AND GUARDRAILS

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 the installation of handrails, railings and guardrails as indicated on the drawings and as specified herein.

SUBMITTAL

1. Manufacturer's technical data for products and processed used in handrails, railing, guardrails system, including finishes and grout.

2. Shop Drawings showing details of fabrication and installation for each type and of handrail, railing, and guardrails required including plans, elevations, sections, profiles of rails, fittings, connections, and anchors.

3. Prepare samples of each type of metal handrails & railings stainless steel hairline finish. Where finish involves normal color and texture variations, include sample sets composed of two or more units showing limits of such variations expected in completed works.

- Include 6" long samples of each distinctly different railing member including guardrails, handrails, top rails, posts, and balusters. Include samples of fittings and brackets if requested by Architect.

- Include sample of typical welded connection.

QUALITY ASSURANCE

Single Source Responsibility

Obtain handrails, guardrail and railing systems of each type and material from a single manufacturer.

STORAGE

Store handrails, guardrail and railing systems in clean, dry location, away from uncured concrete and masonry, protected against damage of any kind. Cover with waterproof paper, tarpaulin, or polyethylene sheeting; allow for air circulation inside the covering.

FABRICATION

General

Fabricate handrails and railing systems to design, dimensions and details shown. Provide handrail and railing members in sizes and profiles indicated, with supporting posts and brackets or size and spacing shown, but not less than required to comply with
requirements indicated for structural performance.

Shop Assembly

Pre-assembled items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

Welded Connections

Fabricate handrails, guardrail and railing systems of materials for interconnections of members of welding. Use welding method, which is appropriate for metal and finish, indicated and develops strength required to comply with structural performance criteria. Finish exposed welds and surfaces smooth, flush, and blended to match adjoining surfaces.

Form changes in direction of railing members by bending members by metering, or as indicated on the drawing, as approved by the Architect.

Furnish inserts and other anchorage devices for connecting handrails, guardrail and railing systems to concrete or masonry work. Fabricate anchorage devices, which are capable of withstanding loading imposed by handrails, guardrails and railing systems.

Coordinate anchorage devices with supporting structure.

a. For railing, and guardrail posts set in concrete provide pre-chiseled openings and insert posts as indicated on drawings. Fill opening with non-shrink, non-metallic grout.

MATERIALS

General

Comply with standards indicated for forms and types of metals indicated or required for handrail and railing system components.

a. Ramp Railings:

   As indicated on plans.

b. Guardrail

   As indicated on plans.

Refer to plans for the required dimension of various types of stainless steel railings and location.

Fastenings: commercial types, except where special types are shown or required.

Fastenings for all exterior work shall be non-ferrous, unless otherwise shown. Fastenings for steel and aluminum and for all other interior work, where exposed, shall match the fastened metal.

Miscellaneous materials or accessories not listed above shall be provided
as specified hereinafter the various items of work and/or indicated on the drawings, or in accordance with manufacturer's specifications.

Execution

PREPARATION

Ensure surfaces to receive panels are structurally sound, even, smooth, clean, dry, and free from defects detrimental to work.

INSTALLATION

a. Safety precaution and procedure shall be observed in determining the sizes and in providing the required clearances by measuring the actual opening to receive the glass.

b. Secure glass with stainless steel brackets.

METAL FINISHES

Comply with NAAMM "Metal Finishes Manual" for recommendations and designations of finishes, except as otherwise indicated.

EXECUTION

PREPARATION

a. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as sleeves, concrete inserts, anchor bolts, and miscellaneous items having integral anchors, which are to be embedded in concrete and masonry construction. Coordinate delivery of such items to project site.

b. Field Measurements
Take field measurements prior to fabrication.

INSTALLATION

GENERAL

a. Fit exposed connections accurately together to form tight, hairline joints.

b. Perform cutting, drilling, and fitting required for installation of handrails, guardrail and railing systems. Set work accurately in location, alignment, and elevation, plumb, level, true, and free of rack, measured from established lines and levels.

c. Field Welding

Comply with applicable AWS specification for procedures of manual shielded metal-arc welding, for appearance and quality of welds made, and for methods used in correcting welding work. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed welded joints smooth and restore finish to match finish of adjacent rail surfaces.

d. Prior to anchoring, adjust handrails and railing systems to ensure matching alignment at abutting joints. Space posts at interval indicated but not less than that required by design loading.

ANCHORING POSTS

a. Concrete-Anchored Posts: Provide chiseled opening on concrete base as indicated on the drawings to receive railing posts and required anchoring system, holes of all loose material, insert posts, and fill annular space between post and concrete with non-shrink, non-metallic epoxy grout, mixed and placed to comply with grout manufacturer's directions.

RAILING CONNECTIONS

a. Welded Connections: Use fully welded joints for permanently connecting railing components by welding. Cope or butt components to provide 100 percent contact or use manufacturer's standard fittings designed for this purpose.

ANCHORING RAILING ENDS

a. Anchor railing ends to metal surfaces with manufacturer's standard fittings using concealed fasteners, unless otherwise indicated.

b. Anchor Railing Ends to Concrete or Masonry, use drilled-in expansion shields and concealed hanger bolts, unless otherwise indicated.

PROTECTION

a. Protect finishes of railing, handrails and guardrails system from damage during construction period by use of temporary protective coverings approved by railing manufacturer. Remove protective covering at time of Substantial Completion.

b. Restore finishes damaged during installation and construction period so that no evidence remains of correction work. Return items which cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units as required.

ITEM 09 F: MODULARS, TABLES AND CHAIRS OF VARIOUS TYPE INCLUDING ACCESSORIES

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 gang chairs and other accessories for the buildings as indicated on the drawings and as specified herein.

MODULARS

Modular System	*Unit*	*Quantity*
Office Table (1500mm x 750mm)	no.	4.00
Side Table		

CHAIRS

Chairs	*Unit*	*Quantity*
One-Seater Sofa	no.	4.00
Sofa Set	no.	1.00
Visitor Chair	no.	7.00
Mid-back Office Chair	no.	20.00
Bar Stool	no.	2.00
3-Seater Gang Chair	no.	64.00
4-Seater Gang Chair	no.	68.00

OTHERS

Hospital Bed	no.	2.00
Stanchion Post w/ Retractable Belt	no.	18.00
File / Storage Cabinet	no.	7.00
Turnstile Gate Access Control System Integrated to QR Code Ticketing System	no.	7.00
98" Information Screen (LED TV)	no.	5.00

SUBMITTAL

1. Shop drawings for all gang chair and other accessories for the building 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 supply shall submit to the Engineer for approval representative samples of finishing materials. No placing of orders for material for finishing works shall be made without his approval.

EXECUTION

All materials will be delivered and installed (if needed to be installed) on site.

ITEM 09 G: CONCRETE WATERPROOFING

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 shall cover the waterproofing requirements for the building as shown on the drawings.

The work shall consist of furnishing all labor, materials, equipment, and other incidentals necessary for the integral waterproofing works where required as shown on the drawings and in accordance with the requirements of these specifications as directed by the Project-In-Charged.

SUBMITTAL

1. Material description and physical properties, application details, and recommendations regarding shelf life, application procedures, and precautions on flammability and toxicity.

2. Samples for each waterproofing type.

DELIVERY AND STORAGE

Deliver manufactured waterproofing materials in manufacturer's original, unopened containers, with labels intact and legible. Containers of materials covered by referenced specification number shall bear the specification number, type, and class of the contents. Store and protect materials in accordance with the manufacturer's instructions, and use within their indicated shelf life. Promptly remove from the site materials or incomplete work adversely affected by exposure to moisture. Use pallets and canvas tarpaulins to cover stored materials top to bottom.

PRODUCTS

I. DEEP PENETRATING SEALER

Deep Penetrating Sealer (DPS) is an environmentally friendly; non-toxic, odorless, clear, water-soluble liquid compound, which is safe and easy to use.

Deep Penetrating Sealer (DPS) penetrates below the surface and chemically reacts with the alkali and lime found in concrete. This reaction creates a silica gel membrane within the pores and capillaries of the concrete, permanently sealing it against the ingress of moisture yet allowing the concrete to breathe. Over a period of time, the silica gel membrane hydrates and solidifies into a crystalline structure, increasing the hardness and strength of both new and old concrete while reducing moisture vapor emissions and permanently stopping the penetration and flow of water and water-borne contaminants such as chlorides and acids, both on the positive or negative side forging a waterproofed and preserved concrete structure.
EXECUTION

- All existing dirt and other surface contaminants adhering on the surface must be thoroughly removed. Apply Concrete Neutralizer using sufficient coats to completely neutralize the surface. Do not wash off. When sufficiently dry, dust lightly to remove crystalline deposits.

- Mix thoroughly the product mixture as per manufacturer's instruction. Any change from the recommended proportion will affect its quality. Scrape the bottoms, sides and corners of the container to ensure complete and full blending. Prepare only enough quantities that can be used within the pot-life period. Do not delay application. Apply DPS by brush or roller or by using an airless spray.

- Allow to cure overnight prior to application of topcoat.

II. FLEXIBLE MODIFIED CEMENTITIOUS

Flexible Modified Cementitious (FMC) is a two-component latex modified cementitious coating. It can be simply achieved by mixing the pre-packed dry-mixing powder with the formulated flexible latex admixture, and subsequent brushing the slurry on various substrates. It protects a wide range of buildings and structural concrete components with excellent resistance to water, aggressive chemicals, long-term weathering, and scratching. It is applicable for those structures subjected to long-term water immersion.

1. Free surfaces from dirt or foreign materials. For the waterproofing to work best, manufacturers recommend the surfaces be sand blasted, bush-hammered or acid-etched.

2. Apply 2 coats of the cementitious waterproofing. The first coat could include the manufacturer's materials only. The second coating will include a cement-sand mixture and also have chemical and metallic elements too. If supplementary waterproofing is required, then a third coat may be required. This typically includes sand and cement for that extra protection.

Methods of Application

Trowel

Application of the coating is done using the handheld trowel, by simply applying and spreading the coating using the trowel.

Spray

This method uses spraying equipment like the ones used in painting vehicles.
It is preferred due to its precise finish and efficiency. It is also faster to use the spray than the trowel method.

Brush

Use a typical brush similar to roll brushes that are used in painting houses. It also has a uniform finish and is faster to use compared to the trowel.

It is good to note that different surfaces will dictate the method of application.

ITEM 09 H: PAINTING

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

This Section covers the surface preparation, coating materials and application of coatings systems required for the Works.

The work shall consist of furnishing of all labor, materials, equipment and other incidentals necessary for the supply of painting materials and the complete painting of surfaces as shown on the drawings in accordance with this Specification and as directed by the Engineer.

The term paint as hereinafter used includes emulsion paints, varnishes, oils, pigments, thinner and dryers.

All exposed metal surfaces, except metal surfaces embedded in concrete, shall be painted unless otherwise specified.

STANDARD

The following publications listed below, but referred to thereafter by basic designation only, forms a part of these Specifications to the extent indicated by the reference thereto:

Steel Structures Painting Council (SSPC) U.S. Specification JIS K 5628 Red-lead Zinc Chromate Anti-Corrosive Paint.

SUBMITTAL

1. The Contractor shall submit work method statements with lists of materials to the Engineer for approval twenty eight days before the starting of works. This statement shall include following items:

    a. Type of paint and manufacturer
    b. Manufacturer's specifications
    c. Storage and delivery of materials
    d. Surface preparation
    e. Finish painting and drying
    f. Touch-up painting, if any
    g. Equipment

2. The Contractor, before placing order for the painting materials, shall submit to the Engineer for approval samples of materials. No placing of orders for material shall be made without his approval.

STORAGE AND DELIVERY

1. The Contractor shall deliver all material to the site in the original labeled sealed cans and containers, with labels intact and seal unbroken.

    a. Seals shall remain unbroken until after inspection and acceptance of material by the Engineer.

b. The Contractor shall deliver materials in ample quantities sufficiently in advance of the need to avoid any delay or interruptions in the works.

2. Paint in thinner shall be stored in accordance with the approved manufacturer's instructions.

a. All regulations required for storage of paint shall be observed and all necessary safety signs required by governing codes shall be posted.

b. Any damage caused by failure to exercise proper precautions in paint storage shall be repaired.

MATERIAL REQUIREMENTS

PAINT

Paints for the protective coating system shall be the product of a manufacturer approved by the Engineer.

Paints for exterior finish must be with tile like durability and elegance, fast drying, solvent based acrylic, highly suitable for coastal or polluted areas with excellent anti-fungus properties and alkali resistance.

100% Acrylic, water based, quick-drying, easy to clean-up and environmentally friendly, resist dirt, stains, alkali, water, humidity, algae, mold and mildew growth and highly durable paint for interior finish.

An all-purpose synthetic quick dry paint for all types of wood and metal surfaces. It has high gloss, good color retention and outstanding durability.

For pipes, valves and equipment, galvanized and ungalvanized ferrous metal, use a 100% acrylic gloss paint, has excellent resistance to ultraviolet rays and resists chalking, cracking and color fading, dries fast and environmentally friendly.

SCHEDULE OF PAINTING

Architectural Items	
a. Exterior Finishes	
1. On Concrete Walls	
Three Coats, Concrete Masonry Paint	Elastomeric Paint or approved equal
2. Unprimed Ferrous Metal	
First Coat	Red Oxide Primer, #310 or approved equal
Second & Third Coat	Quick Dry Enamel or approved equal
3. On Concrete Block Wall	
Masonry Neutralizer	Masonry Neutralizer #44 or approved equal
Three Coats	Elastomeric Paint

Concrete Masonry Paint	or approved equal
4. On Wood	
First Coat Exterior Wood Primer	Flatwall Enamel or approved equal
Second & Third Coat Exterior enamel	Quick Drying Enamel or approved equal
b. Interior Finishes Location of the various finishes are listed in the Finish Schedule on the drawings or else will be confirmed by PPA	
1. On primer and coated metal two coats of interior semi-gloss enamel or as indicated in the Schedule finish	Red Oxide Primer #310, Quick Dry Enamel or approved equal
2. On Plaster	
First Coat	Masonry Neutralizer #44 or approved equal
Three Coats	Elastomeric Paint or approved equal
3. On Wood	
First Coat Enamel undercoater	Flatwall Enamel or approved equal
Second & Third Coat Exterior enamel	Quick Drying Enamel or approved equal
4. Wood Stain Finish	
First Coat Second & Third Coats Fourth & Fifth Coats	Oil Wood Stain , Lacquer Sanding Seale r#1254 Clear Gloss Lacquer #1250 or approved equal
c. Non – Architectural Items (Piping, valves, equipment, etc.)	
1. Piping, valves, equipment etc. in rooms are to be painted	
2. Galvanized pipes and ducts	
Primer – one coat Finish – one coat	Red Oxide Primer, #310 or approved equal Quick Dry Enamel or approved equal
3. Black steel pipes	
Primer – one coat Finish – one coat	Red Oxide Primer, #310 or approved equal Quick Dry Enamel or approved equal
4. Mechanical Items	
a. Ungalvanized ferrous metal Primer – one coat Finish – one coat	 Red Oxide Primer, #310 or approved equal Quick Dry Enamel or approved equal or approved equal

b. Galvanized ferrous metal Primer – one coat Finish – one coat	 Red Oxide Primer, #310 or approved equal Quick Dry Enamel or approved equal or approved equal
c. Submerged galvanized ferrous metal Primer – one coat	Red Oxide Primer, #310 or approved equal
d. Buried miscellaneous ferrous surface valves, & flanged joints (excl. pipe) Primer – one coat	Red Oxide Primer, #310 or approved equal

EXECUTION

SURFACE PREPARATION OF STEEL

1. Steel surfaces shall be cleaned as follows:

   a. All round welds, burrs and sharp surface projections shall be ground smooth and all weld splatter shall be removed prior to blast cleaning.

   b. Sand abrasives, if used, shall be clean, and free from salt and extraneous matter. The sand shall pass through a 2.0mm test sieve, and be substantially retained on a 0.18mm test sieve, with at least 25 percent retained on a 0.355mm test sieve.

   c. Metallic abrasive, if used, shall be sharp, hard and free from dust, and shall pass through a 1.8 mm test sieve.

   d. Blast cleaning operations shall not be conducted on surfaces that will be wet after blasting and before coating, or when the surfaces are less than 10°C above degree points, or when the relative humidity of the air is greater than 95 percent.

   e. Any oil, grease, soil, dust or other foreign matter deposited on the cleaned surfaces shall be removed prior to painting. In the event that rusting occurs after completion of the surface preparation, the surfaces shall be cleaned again in accordance with the specified method.

   f. Particular care shall be taken to prevent the contamination of other corrosive chemicals before the application of the paint. Such contamination shall be removed from the cleaned surface by flash blasting and the paint applied immediately.

   g. Care shall be taken to prevent contamination of cleaned and painted surfaces by cleaning operations in an adjacent area.

   h. Surfaces not to be painted shall be suitably protected from the effects of cleaning and painting operations.

SURFACE PREPARATION OF WOOD

1. Wood surfaces shall be sanded to a fresh surface. Surface mould where present, shall be removed by washing, rubbing down and burning off as necessary. Resinous exudation and large knots shall be removed and replaced with filler or other materials approved by the Engineer.

2. Parts of timber to be enclosed in walls shall always be primed unless already impregnated. Priming shall be brushed on and a minimum of two coats applied to end grain. When the priming paint is hard, all cracks, holds, open joints, etc. shall be made good with hard stopping and rubbed down with fine abrasive paper. Priming of joinery shall be applied only on site after the Engineer has approved such joinery and before it is fixed. For internal surfaces primer coats shall be carefully flatted.

SURFACE PREPARATION OF CONCRETE AND PLASTER

Concrete and cement plaster surfaces to be painted shall be prepared by removing efflorescence, dust, dirt, grease, oil, asphalt, tar, excessive mortar and mortar dropping and by roughening to remove glaze. A zinc sulfate solution shall be applied before prime cost.

SURFACE PREPARATION FOR FIBER CEMENT SURFACES

Shall be dry and clean prior to application of the specified first-coat material. Oil, grease, or rust stains shall be carefully removed by the use of suitable solvent. Wire brushing will not be permitted. After the first coat has become dry and prior to application of finish coats, touch-up coats shall be applied to suction spots.

ALUMINUM FRAMES FOR DOORS AND WINDOWS

All metal surfaces shall undergo pre-treatment process which includes: desmutting, water-rinsing, degreasing/etching, water rinsing, zinc phosphating, water rinsing and acid rinsing.

Powder coating application, shall be factory applied and shall be done in one operation using an electro-static powder gun. The materials to be coated should be well connected to earth. Coating thickness should be kept to a minimum of 60 microns for exposed areas. On details which are to be treated mechanically after coating (drilling, sawing, etc.), the coating film must not exceed 100 microns.

The powder coating shall be oven cured in the range of 20 minutes at 220° C (metal temperature measured on the area with greatest metal thickness). The temperature variation in the oven should not exceed +/- 10° C.

Handling

Coated items should be cooled to no less than 40° Centigrade before handling. Precautions should be taken to avoid damages on the finished coating during stacking, storing and transportation.

Storage and Delivery

Inspect materials delivered to the site for damage. Unload and store with minimum handling. Provide storage space in dry location with adequate ventilation, free from dust or water and easily accessible for inspection and handling. Store materials neatly on the floor, properly stacked on non-absorptive strips or wood platforms. Protect finished surfaces during shipping and handling using manufacturer's standard method.

WOOD REPAIR

Badly decayed areas shall be removed and repaired. Areas and pieces decayed beyond repair shall be replaced with new pieces that match originals in all respects. Moderately decayed areas, weathered, or gouged wood shall be patched with approved patching compounds, and shall be sanded smooth. The source or cause of wood decay shall be identified and corrected prior to application of patching materials. Wet wood shall be completely dried to a moisture content not exceeding 12 percent, as measured by a moisture meter, to its full depth before patching,

unless otherwise authorized. Wood that is to be patched shall be clean of dust, grease, and loose paint.

1. Epoxy Wood Repair

   Epoxy wood repair materials shall be applied in accordance with manufacturer's written instructions. Health and safety instructions shall be followed in accordance with the manufacturer's instructions. Clean mixing equipment shall be used to avoid contamination. Mix and proportions shall be as directed by the manufacturer. Batches shall be only large enough to complete the specific job intended. Patching materials shall be completely cured before painting or reinstallation of patched pieces.

2. Epoxy Consolidant and Epoxy Paste

   Epoxy liquid wood consolidant shall be used:

   1. To penetrate and impregnate deteriorated wood sections in order to reinforce wood fibers that have become softened or absorbent.

   2. As a primer for areas that are to receive epoxy paste filler. Epoxy paste shall be used to fill areas where portions of wood are missing such as holes, cracks, gaps, gouges, and other voids.

MIXING AND THINNING

Mixing and thinning of paint shall be done in accordance with the approved manufacturer's printed instructions. The pot life of each paint as stated by the manufacturer shall not be exceeded.

WEATHER CONDITION

The paint shall not be applied when the relative humidity is above 85 percent. The paint shall not be applied in rain, wind, fog, dust or mist.

APPLICATION

Workmanship shall be first class in every respect. All work shall be done in a workmanship manner so that the finished surfaces shall be free from runs, chop, ridges, waves, laps and unnecessary brush marks. All coats shall be applied in such manner as to produce an even film of uniform thickness. Edges, corners, crevices, welds and rivets shall receive special attention to ensure that they receive an adequate thickness of paint.

All painting shall be done by thoroughly experienced workmen.

Safety regulations shall be adhered to at all times, including the wearing of respirators by persons engaged on assisting in spray painting. Adjacent areas and installation shall be protected by the use of cloths or other approved precautionary measures.

Plain enamel and varnish shall be applied carefully with good clean brushes or approved spraying equipment, except that the initial coat on any surface shall be applied with brush. Sufficient time shall be allowed between coats to assure thorough drying and each coat shall be in proper condition before receiving the next coat.

Sanding and dusting as required shall be performed between coats in varnishing work. Finish coat shall be smooth and free from runs, sags, and other defects. Exterior paint shall not be applied during rainy days.

All paint when applied shall provide a satisfactory film and smooth, even surface. Paint shall be

thoroughly stirred and kept at a uniform consistency during application. Powdered metallic pigments added at the time of use shall be mixed by adding the powder in small increments to about one-third of the base paint or vehicle, with thorough mixing to obtain a smooth paste. The remainder of the base paint shall then be thoroughly stirred in.

Different brands of emulsion paints shall not be mixed prior to application of the materials.

Where necessary to suit conditions of surface temperature, weather and method of application, the package paint may be thinned immediately prior to application in accordance with the approved manufacturer's directions, but not in excess of 125 cc of suitable thinner per liter (one pint per gallon). Before using, the paint shall be mixed to a uniform consistency and shall be stirred frequently during application.

Paints other than water-thinned paints shall be applied only to surfaces which are completely free of moisture as determined by sight or touch and only such combinations of humidity to be painted as will cause evaporation rather than condensation.

Surfaces which have been cleaned, pretreated and/or otherwise been prepared for painting shall be primed or painted with one coat of finish paint as soon as practicable after such preparation has been completed, but in any event prior to any deterioration of the prepared surfaces.

The first coat of paint on all exterior surfaces shall be applied by brush. Interior prime coats and all other subsequent coats on either exterior or interior surfaces may be applied by brush or spray. Whenever spraying is permitted all areas inaccessible to spray painting shall be coated by brushing or other suitable means. Brushes to be used for application of water-emulsions shall be soaked in water for a period of 2 hours prior to use.

All cloths and cotton waste which might constitute a fire hazard shall be placed in closed metal containers or destroyed at the end of each day.

Upon completion of the work, all staging, scaffolding, and containers shall be removed from the site or destroyed in a manner approved by the Engineer. Paint spots, or stains upon adjacent surfaces shall be removed and the entire job left clean and acceptable to the Engineer.

No smoking shall be permitted in the vicinity where painting is going on.

TOUCH-UP PAINTING

Touch-up painting shall be done with the same paint as used for the original coat. The resulting minimum dry film shall be the same as for the original coat.

Touch-up painting shall include cleaning and painting of field connections, welds and all damaged or defective paint and rusted areas.

During touch-up painting, only loose, cracked, brittle or non-adherent paint shall be removed during cleaning. All exposed edges shall be feathered. Touch-up painting shall be performed in a manner which will minimize damage to sound paint. Rust spots shall be thoroughly cleaned and edges of the existing paint shall be scraped back to sound material.

DRYING

1. No primer or paint shall be forced to be dried under conditions which will cause cracking, wrinkling, blistering, formation of pores which would detrimentally affect the condition of the paint.

2. No drier shall be added to the paint unless specified in the approved manufacturer's instructions.

3. Painted surfaces shall be protected from dust, dirt, and the elements of the weather until dry to the fullest extent practicable.

4. After drying, any areas of paint damaged from any cause shall be removed, the surface again prepared and then touched-up with the same paint and to the same thickness as the undamaged areas as specified in sub-section 4.14.3.7 above.

HANDLING

1. Precautions shall be taken to minimize damage to paint films resulting from stacking for drying.

2. Paint which is damaged in handling shall be scraped off and touched-up with the same paint and in the same thickness as was previously applied to the damaged area at Contractor's expense.

INSPECTION

1. All works and materials supplied under this Specification shall be subject to inspection by the Project-In-Charge.

2. The Contractor shall correct such works or replace such materials found defective under these Specifications at his own expense.

ITEM 09 I: FACILITIES AND DEVICE FOR PERSONS WITH DISABILITY

SCOPE OF WORK

The work shall consist of furnishing materials, tools, labor and incidentals necessary for the construction/installation of facilities and device for disabled persons as shown on the Drawings and in accordance with the Implementing Rules and Regulations of Batas Pambansa Bilang 344 and this Specification.

MATERIAL REQUIREMENTS

GRAPHIC SIGNS

Graphic signs like the International Symbol of Access shall be fabricated from plastic materials, white color with either dark blue background. Letters and symbols shall be laminated and raised from the background.

HANDRAILS

Handrail for ramp shall be 38mmØ tubular stainless steel buff finished. It shall be provided with a small hole as of a Braille system.

GRABRAIL

Grabrail shall be manufactured from gauge 18 tubular stainless steel 38mmØ and provided with safety grip finish.

CONCRETE MATERIALS FOR RAMPS

1. Portland cement shall conform with the requirement of "Reinforced Concrete".
2. Aggregates shall conform with the requirements of "Reinforced Concrete".
3. Temperature bars shall have diameter of 10mm conforming with the requirements of "Concrete Works".

EXECUTION

GRAPHIC SIGNS

1. Directional and information signs, indicating the location of the ramp for physically handicapped persons, shall be installed / placed at the front of the main entrance of the Building. The signed board size and dimensions shall be based on DOTr approved Standard Design, schedule 40, sign post and the text and arrow shall be in accordance with the International Symbol of Access "B". Manual (See attached drawings and tabulation).
2. Signs shall be placed at the entrance and exits of the ramps and toilets, installed at conspicuous locations. The signboards shall be based on DOTr approved Standard Design Manual (See attached drawings and tabulation).

RAMP

The ramp shall be constructed as shown on the drawings and with a nonskid surface and tactile strips.

ITEM 09 J: TERMITE PROOFING, BUKBOK PROOFING

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 Contractor shall hire the services of an approved or accredited pesticide company to furnish all labor, materials, equipment, tools, plant, and services to complete the termite and "bukbok" proofing work hereinafter described.

EXAMINATION OF SITE

Inspect the site of work and examine the premises to fully understand existing conditions with respect to the work involved. Prior to soil stripping, excavation or filling all termite mounds within the area should be demolished, removed and treated.

MATERIAL REQUIREMENTS

CHEMICALS AND EQUIPMENT

For termite proofing, use Termiticide Concentrate acceptable to the PPA and should have license from Fertilizer and Pesticide Authority.

For "bukbok" proofing of kiln dried wood and for untreated wood, use chemical name accredited name/or acceptable to the PPA and should have valid license from Fertilizer and Pesticide Authority (FPA).

The pest control Contractor shall submit the specified chemicals in their original manufacturer sealed containers to the Project Inspector of inspection, sampling and safekeeping. Containers with broken seal shall not be accepted.

Dilution ratings (for Termicide Concentrate):

1 part Termicide Concentrate TC to 50 parts water

Pesticides - 1 : 100 concentration

Dilutions shall be done only at the jobsite in the presence of the Project Inspector. The strength of the mixture or solutions shall be made uniform by thorough stirring. All solutions prepared for termite proofing shall be used within 24 hours.

EXECUTION

CONTRACTOR LICENSE AND CERTIFICATION REQUIREMENT

The pesticide company should have a valid license from Fertilizer and Pesticide Authority of the Department of Agriculture.

All pesticide shall be applied by or under the direct supervision of a certified pesticide applicator.

ENVIRONMENTAL AND SAFETY CONDITIONS

Formulation, treatment, storage and disposal of pesticide shall be in accordance with label directions. Water for formulation shall be drawn only form site(s) designated by the Project Inspector, and the filling hose shall be fitted with a backflow preventor meeting local plumbing codes/standards. The filling operation shall be under the direct and continuous observation of the Project Inspector to prevent overflow.

APPLICATION

1. Termite Control

Application of solution shall be done by means of power sprayers fitted with flow meters for accurate monitoring of actual quantity used. At the time of soil treatment application, the soil shall be preferably in a friable condition with low moisture content to allow uniform distribution of the treatment solution throughout the soil. Do not apply pesticide during or immediately following heavy rains, or when conditions will cause runoff and create an environmental hazard. Cover treated area with waterproof sheeting if concrete is not poured on the same day as the soil treatment. Take precautions to prevent disturbance of the pesticide barrier. Before the placement of structural components, re-treatment where soil or fill is disturbed after treatment. Apply pesticide prior to placement of gravel base, vapor barrier or waterproof membrane.

a. Slab on Grade Construction

Establish a horizontal pesticide barrier over areas intended for covering by floors, porches, attached entryways, garages, carports and terraces. Apply treatment solution with a low pressure coarse spray at the rate of four (4) liters solution per square meter. Apply at the rate of seven (7) liters solution per square meter if the fill is washed gravel or other course material. Establish a continuous chemical barrier in the voids of hollow block foundation or voids of masonry. Apply treatment at the rate of seven (7) liters per 3 linear meter. Make pesticide band at least 15 cm wide the pesticide evenly distributed throughout. Treat buildings constructed with basement slabs in the same manner.

b. Crawl Space Construction

Establish a vertical pesticide barrier inside of foundation walls, both sides of interior partition walls, around piers, plumbing, and rodding and utility conduits. Apply treatment solution by rodding or rodding and trenching the fill at the rate of 15 liters solution per 3 linear meter, and 30 cm deep from grade to bottom of foundation. Treat both sides of foundation and around all piers and pipes. Make treated barrier of fill at least 15 cm wide with the pesticide evenly distributed throughout.

c. Dry Pipes and Conduits

Establish pesticide barrier on various dry pipes and conduits such as electrical service entrance, raceways, pipe chase, vents. Use powder type termiticide by injecting it inside the pipe.

d. Termite Mounds

Demolish and treat all termite mounds within the property found after the construction.

2. "Bukbok" Proofing

Kiln-dried wood, plywood, tanguile, apitong, cabinets, dividers, and paneling shall be brushed generously with Pesticides before painting or varnishing.

3. Sun-Dried Wood Treatment

Sun-dried lumber to be used for ceiling joint runners, nailer, etc. shall be brushed with Pesticides before installation of plywood or ceiling panels.

ENGINEERS

The Contractor shall submit to the Engineer for approval, a copy of the pest control company's proposal and chemical application, method/procedure including the description of the equipment to be used before start of work.

INSPECTION AND TEST

Sampling shall be done only in the presence of the Project Inspector.

Amount of sample to be taken: 50 cc each.

CONTRACTOR'S GUARANTEE

Upon completion of work, and on a condition for final acceptance, the Contractor shall submit to PPA a written guarantee from the pesticide company which shall provide that:

1. The soil poisoning treatment shall prevent subterranean termites from attacking the building on its contents for a period of not less than five (5) years.

2. The Contractor shall thereby warrant all works in pest control that all materials and workmanship applied under the contract are of good quality in every respect and will remain as such for not less that five (5) years.

   Should there be termite and "Bukbok" infestation within the one (1) year period the Contractor thereby agrees to do all necessary repairs on the damaged portions of the buildings caused by termite infestation to the satisfaction of PPA, at the Contractor's expense. Retreatment shall also be done by the Contractor after completion of the repairs and at his expense. Such repairs and corrective works shall be done within five days after a written notice from the Owner has been received by the Contractor.

   Should there be infestation after the one (1) year period up until the five (5) year guarantee, the pesticide company agrees to do all the necessary repairs at their expense. The pesticide company shall conduct annual inspection of the building and surrounding to check any infestation during the guarantee period. Notice shall be given by the pesticide company to PPA in case there is presence of termites in the surroundings.

ITEM 09 K: 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 09 L: 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 09 M: 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. PAHIYAS PATTERN
    - 3mm thk. aluminum sheet Pahiyas accent, built-up into 25mm, screwed @ the back
3. DIRECTIONAL AND IDENTIFICATION SIGNAGES
    - Aluminum composite material with metal frame and with cut-out vinyl sitcker
4. 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 10 : 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 on 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 this specifications but not limited to the following items of works.

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

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

c. Termination of all electrical system 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 in 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 of 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 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 assure 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 shall have 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 test and is approved by the Engineer. The certificate shall state that the item has been tested in accordance with 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 shall 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 conduit 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 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 places, the name plate of the distributing agent will not be acceptable.

MANUFACTURER'S 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. Installation of the items shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for 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 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 a 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 shall be grouted in. The Contractor shall do all patching requirements necessary and these shall be done so as 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 Port of Lucena, Quezon, and MERALCO Electric Company.

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 Certificate of 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. 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

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 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 whatever kind, for all system, 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 shall be at least 100mm 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 the 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 and for 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 gasket. Device plates for telephone and intercommunication outlets shall have a 3/8 inch bushed opening in center.

WALL SWITCHES AND PLATES

Wall switches in general shall 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 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 weather proof 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 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 has to 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 where 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 shall 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, 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 bus 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 where 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 conduit only. Do not weld conduits or pipe straps to steel structures. 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 depth of more than 40mm in reinforced concrete beams or to depth 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 conduit by

ceiling support system. Spring-steel fasteners may be used for lighting branch circuit conduit 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 middle one-third of concrete slab. Do not stack conduits. Space conduit 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 wall of metal enclosures. Install bushings on 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 not separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach 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 box, 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 are 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 per 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 insulated, equipment grounding conductor in feeder and branch circuits, including lighting circuits. Grounding conductor shall be separate from electrical system neutral conductor. 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. 1200 mm x 600 mm, LED Panel Light, 4500k recessed mounted type
2. Vertical Downlight recess mounted type with glass cover, E27, 230V, 11 watt LED bulb, daylight
3. Square Vertical Downlight, recessed mounted type, daylight 18 watt LED
4. LED Pendant Light, 36 watt, black hanging linear light
5. LED Striplight daylight, 10w/m
6. Vertical Downlight surface mounted type with glass cover, E27, 230V, 11 watt LED bulb, daylight

PRODUCT

LED PANEL LIGHT

a. 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). And, contain no harmful gasses 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, balcony, 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.

VERTICAL DOWNLIGHT RECESSED MOUNTED TYPE

b. Vertical downlight recess mounted type

This fixture with glass cover looks very simple but provides protection to led bulbs. Metal sheet housing gives durability, while mirrored reflection brings additional lighting effect.
Vertical downlight equipped with a glass cover that provides a smart overhead illumination solution, very modern and contemporary for decoration.

LED PANEL SQUARE LIGHT

c. LED Panel Light Square Daylight 18W LED, are 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). And, contain no harmful gasses 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, that 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, balcony, and many more. They designed specifically so that can easily transition to LEDs without necessarily revamping the current lighting setup. 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.

LED PENDANT LIGHT

d. LED Pendant Light is a modern design lighting that brings special illumination for your rooms and offices. Relaxing ambiance provided by this LED Pendant Light giving an unwind feeling for commercial facilities. This LED Pendant Light is a stylish alternative to downlight lightings application. These Pendant Lights fits very well in residential, offices, restaurants, stores, and industrial decorative lightings.

LED STRIP LIGHT

e. LED Strip Light often used or connected to an existing landscape lighting system. Great accent lighting for stairs, railings, and overhangs etc.,
The most versatile LED product in the market, ranging from accent lighting, cove lighting, mood lighting, back-lit signage, and other customized lighting requirements.
Applications include classy under cabinet lighting for your kitchen, car undercarriage or motorcycle chassis lights.
Different types and different colors, indoor or outdoor LED strip lights; and you can be sure these products will fit your fancy with the reliability and brightness you can expect from LED-based lighting.

VERTICAL DOWNLIGHT SURFACE MOUNTED TYPE

f. Surface Downlight – the housing or frame of this fixture is made of steel plate and with powder coating under high temperature. It is resistant to abrasion as well as pressure, not easy to be tarnished. As you will notice, it is specialized with light reflector that is made by high quality pure aluminum. Endurable lamp holder for extremely high temperature guarantees the safety and durability of the LED light bulbs. The other parts like springs, elastic slices and other tightening fittings make the down light firmly recessed and easy to install.

RECESS AND FLUSH MOUNTED FIXTURES

The Contractor shall install the type of materials as shown on the 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 operate 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 11 : 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.

1. 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. Lightning protection system shall conform to PEC, NFPA 70, NFPA 780, UL 96 and UL 96A.

SUBMITTALS

1. Shop Drawings

   Overall lightning protection system 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" has 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, relationship to 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

Contractor 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 forms an electrolytic couple of such nature that corrosion is accelerated in 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.

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.

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, grounding 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, is present, mount air terminal to the side. In addition, where spires project more than 3050mm above the building, continue conductor 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 area is wet with waste water that contains chemical substances, especially those corrosive 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 in excess of 10 ohms. Test the ground rod for resistance to 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 12 : 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 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 replace 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 detail 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 detail 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 appurtenances, 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 at least 2 years. All components used in the system shall be commercial designs that comply with the requirements specified. Equipment shall 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 provide 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 transformer - 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 microphone shall meet the minimum requirements of the desk microphone. Microphone shall have push to 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

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 Mounted Speaker

Wall mounted speakers are generally installed on the wall, as their name indicates. However, some may choose to place it on parapets, tables, or any other surface. It will depend on your needs and where you place the wall-mounted speakers. These speakers will occupy only a little space. Hence, it will be suitable for areas where there are space constraints. You can undertake space management effectively with wall mount speakers.

Installation of wall-mounted speakers at the right height would offer a realistic listening experience. This would be ideal for use in industrial units and commercial centers.

6. Ceiling Speaker Enclosures

Ceiling 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 complete with a transformer, insulators, crossover insulator, cable of proper length, lightning arresters, coupling transformer and divider network at the radio tuners.

COMPACT DISC/DVD PLAYER (Optional)

Player shall have three beam laser pickup, dual Digital-to-Analog converters, random access and random mode programmable playback. [Player shall have capability to play a minimum of 5, 6 discs automatically. Player shall as a minimum conform to the following:

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] [HX PRO]

Play Head: Hard Parmalloy

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 channel selected.

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 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 shall be 0.5 mm minimum.

2. Microphone Cable

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 shall be 0.5 mm minimum.

3. Antenna Cable

Antenna coaxial cable shall have 75 ohm plus or minus 2 ohm. 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 let thru 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 the building telephone system instruments interconnected to the PA system via an interface module to allow telephone dial up access to the paging amplifier. Interface module 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. Inputs, outputs, interconnections, test points, and relays shall be accessible at the rear of the equipment rack for maintenance and testing. Each item shall be removable 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 antenna mast shall be separately grounded. Equipment shall be grounded to the serving panel board 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. Grounding conductor shall be terminated to the rack using 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 of 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 13 : 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 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. Control panel and modules

b. Batteries

c. Battery charger

d. Manual call point / pull stations

e. Smoke detectors

f. Duct smoke detectors (Optional)

g. Audio/Visual/Alarm horns (Optional)

h. Graphic annunciator panel (Optional)

i. Wiring

j. Conduit

k. Outlet boxes

l. 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. Qualified technician shall be an individual who is experienced with the types of work specified herein. Contractor shall submit data showing the name and certification of the technician at or prior to submittal of 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 the Engineer 4 complete sets of as-built drawings, including complete as-built circuit diagrams, of each the system. The as built drawings shall be as the contract drawings and with title block similar to 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 station / Call Point
2) Smoke detector
3) Alarm Bell

Shall cause all of the following actions:

a) All building evacuation alarm devices Audio/visual alarm horns to operate continuously;
b) The annunciators to properly register;

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

b. 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, 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.

c. 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. Control panel shall display a unique visual indication when 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.

d. Alarm Verification Feature

System shall have a smoke detector alarm verification feature. Upon activation of any area smoke detector, 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 system to go into alarm mode immediately. If no smoke detector alarm input occurs within the second-stage confirmation period, system shall reset to normal. Any alarm input received from an area smoke detector after the second-stage confirmation period has elapsed shall cause system to institute a new verification process.

2. Primary Power

Primary power source 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 device, notification device signaling line and trouble signal. The alarm current 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 it by 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. Control Panel

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 UL listed or FM approved and approved by the control panel manufacturer for use in the control panel. Panel cabinet shall be finished on the inside and outside with factory-applied enamel finish. Provide 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 panel 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 alarm shall cause activation of the notification devices even with the alarm silencing switch in the "silenced" position.

c. Individual zone disconnect 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 panel located as shown. Mount with panel centerline 1.5 m above finished floor elevation. Panel shall be of the interior type, surface-mounted. Panel shall be provided with the building floor plan, drawn to scale, with alarm lamps mounted to represent the location of each initiating device. Panel graphic shall also show the locations of the control panel, and shall have a "you are here" arrow showing its location. Orient building floor plan on graphic 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 corresponding device and shall remain illuminated until the system is reset. Panel 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 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 presence of rod is not required to reset station. Station color shall be red. Station shall provide visible indication of operation. Restoration shall require use of a key. Keys shall be identical throughout the system for all stations and control panel. Mount stations with operating lever not more than 1.2 m above finished floor.

3. Smoke Detectors

Provide smoke detector 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 the 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. 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 shall 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 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.

b. 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 located 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 shall 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 box covers 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. 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 switch, manufacturer provided test card, 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 signalling 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 shall be operated. Introduce faults in each circuit at random locations as directed by the Fire Protection Engineer. Verify proper trouble annunciation 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 14 : WIRE COMMUNICATION AND SIGNAL SYSTEM

TELEPHONE SYSTEM

GENERAL

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

DESCRIPTION OF WORK

The telephone/data system shall consist of an interior system of conduits, outlet, boxes, and junction boxes. While, Local Telephone Company as provider for PABX interconnection for data /voice, router / Hub switch/ WI-FI modem with necessary Cat-6 cables.

These details as indicated in the plans should be coordinated to local telephone company as the provider. Any deviation of the plans and specification shall be brought to the attention of the Engineer for resolution.

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 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. At all outlets whatever kind, for all system, 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 own expense. In general outlet boxes shall be at least 100mm 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 the 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.

LOCAL TELEPHONE COMPANY PROVIDER / INTERCONNECTION OF PABX SYSTEM

a. All components, connections of Telephone Company shall conform to EIA/TIA standards.

b. Cable terminals shall be the type acceptable to the Telephone Company. Terminals shall be Cat- 6 as required on the plans.

EXECUTION

INSTALLATION

The telephone installation shall be mounted and as indicated on the plans.

MODEM /Wi-Fi network:

- Connect the cables. Once you've acquired a wireless router, you'll need to connect it to your existing Internet modem.
- Configure your router. Next, you'll need to use your computer to configure your router's default settings.
- Some modems encounter issues when paired with a specific Internet company (e.g., Comcast). Double-check your modem's compatibility with your current Internet subscription before buying (if possible). Calling your ISP is usually the best bet to figure this out.
- If you find that your modem won't work with your current subscription, try to exchange the modem for a different one that will work.
- The cable output resembles a metal cylinder with a small hole in the middle and screw threads all around the sides. You'll usually find cable outputs in the wall near the floor in the ticketing booth and in some place in indoor area.
- In some cases, there will already be a cable connected to the cable outlet.
- The modem should be relatively high up (e.g., on top of ceiling floor), and it will need to be close enough to the cable output that you can connect it without stretching or bending the cable. You'll also need to have a power outlet nearby.
- A modem generally requires a coaxial cable to connect to the cable output, as well as a power cable to connect to an electrical outlet. Both of these cables should come with your modem, but if you bought it used, you may need to find replacement cables.
- If you plan on attaching the modem to a router, you will also need an Ethernet cable.
- Consider buying a longer coaxial cable if the one that you have is too short to allow you to mount your modem properly.
- Each modem is unique, and you may require additional setup outside of this capacity. Reading your modem's manual will help make you aware of any additional steps that you have to take to install the modem.
- In most cases, it's important to contact your ISP and inform them that you have a new modem. The support professional will ask you for some information regarding the modem to walk you through the first steps.

CONNECT YOUR PABX TO LOCAL NETWORK AND CONNECT LOCAL TELEPHONE LINES TO PABX.

- Connect your PABX to the network.

  Connect one end of an Ethernet cable to the LAN port of your PABX, and the other end to any port of your company's LAN switch/router.

- Power on your PABX.

  Plug the provided power cord or power adapter into the power inlet of the PABX, and the other end to a standard electrical wall socket.
  Wait for the system to boot up till the SYSTEM LED starts to blink.

- Connect your PABX to the telephony lines

HORIZONTAL CABLE

All horizontal cabling shall be Category 6 network cables.

TELEPHONE / DATA OUTLETS

All modular jacks shall be data grade Cat- 6.

SHOP DRAWINGS

Prepare and submit complete shop drawings for the telephone system in accordance with the latest Local Telephone Company.

ITEM 15 : MECHANICAL GENERAL REQUIREMENT

GENERAL

This section applies to all Item of "MECHANICAL WORKS" except where specified in each individual section.

WORK DESCRIPTION

The work shall include the furnishing of equipment, materials, tools, labor, supervision, and other services required to install, complete, test and make operational the whole system as described on the Drawings and the Technical Specifications.

Specifically the work shall involve the following:

a. To supply, deliver, install, wires/cables, conduit, circuit breaker and make operational the variable refrigerant flow type inverter air conditioning units including bathroom exhaust fans for toilets as shown on the Drawings.

b. To supply and install the refrigerant piping system and condensate drain lines including necessary insulation and hangers.

c. To supply and install the electrical wiring connections from the AC supply provided by the Electrical Contractor which is located close to the point of installation. This shall include power and control wirings and interlocks with the thermostat control.

SUBMITTALS

Submit shop drawings, manufacturer's data and certificates for equipment, materials, and finish, and pertinent details for each system where specified in each individual section, and obtain approval before procurement, fabrication, or delivery of the items to the job site. Partial submittals are not acceptable and will be returned without review. Submittals shall include the manufacturer's name, trade name, catalogue model, or number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable industry, and technical society publication references, years of satisfactory service, and other information necessary to establish contract compliance of each item the Contractor proposes to furnish. Photographs of existing installations and data submitted in lieu of catalogue data are not acceptable and will be returned without approval. Submittals shall be a minimum of 5 print copies. Submittals of the contractor shall be reviewed and returned within a minimum of 21 days, each stamped with appropriate action.

1. Shop Drawings

Drawings shall be a minimum of 350mm x 500mm in size, with a minimum scale of 1:100 except as specified otherwise. Drawings shall include floor plans, sectional views, wiring diagrams, and installation details of equipment; and equipment spaces identifying and indicating proposed location, layout and arrangement of items of equipment, control panels, accessories, piping, ductwork, and other items that must be shown to assure a coordinated installation. Wiring diagrams shall identify circuit terminals, and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. If equipment is disapproved, drawings shall be revised to show acceptable equipment and be resubmitted.

2. Manufacturer's Data

Submittals for each manufactured item shall be manufacturer's brochure products, equipment drawings, diagrams, performance and characteristic curves, and catalogue cuts.

3. Standard Compliance

When materials or equipment must conform to the standards of organizations such as the American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), American Society of Mechanical Engineers (ASME), Air Movement and Control Association, Inc. (AMCA), American Refrigeration Institute (ARI), and Underwriters' Laboratories (UL), proof of such conformance shall be submitted to the Engineers 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 testing and is approved by the Owner or his authorized representative. 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 reference standards listed. The edition or the revised version of such codes and standards 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.

4. Codes, Inspection, Permits and Fees

a. The work under this contract shall conform to the latest requirements of:

1) Philippine National Building Code

2) Regulations of the Local Municipality

b. Nothing contained in these specifications or shown on the drawings shall be construed as to conflict with the National and local ordinances or laws. All such laws and ordinances are made a part of these Specifications.

c. All construction permits and fees for this work shall be obtained at the expense of the Contractor. The Contractor shall furnish the Owners and Engineers the final certificates of inspection and approval from the appropriate government authorities.

OPERATION AND MAINTENANCE MANUAL

Furnish an operation and maintenance manual for each item of equipment. Furnish three (3) copies of the manual bound in hardback binders or an approved equivalent. Furnish one complete manual prior to the time that the equipment are performed and furnish the remaining manuals before the contract is completed. Inscribe the following identification on the cover: the words OPERATION AND MAINTENANCE MANUAL, the name and location of equipment or the building, the name of the Contractor, and the contract number. The manual shall include the names, addresses, and the telephone numbers of each subcontractor installing the equipment, and of the local representatives for each item of equipment. The manual shall have a table of contents and be assembled to conform to the table of contents with the tab sheets placed before instructions covering the subject.

The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include: wiring and control diagrams with data to explain detailed operation and control of each item of equipment; a control sequence describing start-up, operation and shutdown; description of the function of each principal item of equipment; the procedure for starting; the procedure for operating; shutdown instructions; installation instructions; maintenance instructions; lubrication schedule including type, grade, temperature range, and frequency, safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list. The parts list for equipment shall indicate the sources of supply, recommended spare parts, and the service organizations which is reasonably convenient to the project site. The manual shall be complete in all respect for equipment, controls, accessories, and associated appurtenances provided.

POSTED OPERATING INSTRUCTIONS

Furnish approved operating instructions for each system and principal item of equipment for the use of the operation and maintenance personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal item of equipment. Operating instructions shall be printed or engraved and shall be framed under glass or in an approved laminated plastic and posted where directed by the Owner. Operating instructions shall be attached to or posted adjacent to each principal item of equipment and include directions for start up, proper adjustment, operating, lubrication, shut down, safety precautions, procedure in the event of equipment failure, and other areas as recommended by the manufacturer of each item of equipment. Operating instructions exposed to the weather shall be made of weatherproof materials or shall be suitably enclosed to be weather protected. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

SAFETY

1. Rotating Equipment Safety

    Couplings, motor shafts, gears and other exposed rotating or rapidly moving parts shall be fully guarded. The guards shall be cast iron or expanded metal. Guard parts shall be rigid and suitably secured and shall be readily removable without disassembling the guarded unit.

INSTRUCTION TO OWNER'S PERSONNEL

When specified in other sections, the Contractor shall furnish the services of competent instructors who will give full instruction to the designated personnel in the adjustment, operation, and maintenance, including pertinent safety requirements of the equipment or system specified. Each instructor shall be thoroughly familiar with all the parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Owner for regular operation. The number of man-days (8 hours) of instruction furnished shall be as specified in other sections. When more than 4 man-days of instruction are specified, approximately half of the time shall be used for classroom instruction. All other time shall be used for instruction with the equipment or system. When significant changes or modifications in the equipment or system are made under the terms of contract, additional instruction shall be provided to acquaint the operating personnel with the changes or modifications.

DELIVERY AND STORAGE

Equipment and materials shall be handled, stored, and protected to prevent damage before, during, and after installation, in accordance with the manufacturer's recommendations and as approved. Damaged or defective items shall be replaced without cost to the Owner.

STANDARD PRODUCTS/SERVICE AVAILABILITY

1. Materials and Equipment

Materials and equipment shall be standard products of manufacturer regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for seven years prior to bid opening. The seven year use shall include applications of equipment and materials under similar circumstances and of similar size as specified for the Project. The equipment shall be soled exclusively by a single, stable distributor with after sales capability.

2. Experience Required

The five (5) years experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogues, or brochures.

3. Alternative Service Record

Products having less than a five-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests can be shown.

4. Service Record

The equipment items shall be supported by service organizations. The Contractor shall submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall reasonably be convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

5. Manufacturer's Nameplate
Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

SAFETY REQUIREMENTS

Belts, pulleys, chains, gears, couplings, projecting set screws, keys, and other rotating parts located so that any person can come in close proximity thereto shall be fully enclosed or properly guarded in accordance with OSHA 29 CFR 1910.219. High temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation of a type as specified herein. Items such as catwalks, ladders, and guardrails shall be provided where required for safe operation and maintenance of the equipment.

MANUFACTURER'S RECOMMENDATIONS

Where installation procedures or any part are required to be in accordance with the manufacturer's recommendations of the material being installed, printed copies of these recommendations shall be furnished to the Owners and Engineers prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

ELECTRICAL REQUIREMENTS

Electrical components of mechanical equipment and systems such as motors, starters, and controls shall be provided under this Item and shall be as specified herein and as necessary for complete and operable system. Extended voltage range motors will not be permitted. Interconnecting wiring for components of packaged equipment shall be provided as an integral part of the equipment.

ELECTRICAL MOTORS

1. All electrical motors of sizes and types as specified for driving air conditioning and ventilating equipment shall be furnished and erected under this section. All motors shall be of proper power and speed to suit the specified makes of equipment. If other makes of equipment are accepted in any case, the proper adjustment of motor speed and power including affected changes in electrical system circuit breakers and wiring must be included without additional cost to the Owner. Technical data shall be submitted for approval before the equipment is purchased.

2. All motor ratings shall be as specified on the drawings.

3. Generally, all motors shall be constant speed, squirrel-cage type motors and energy efficient except as otherwise listed on plans. Single phase motors shall be capacitor start induction-run or split phase type as approved for the service.

4. All belt-connected motors shall have adjustable bases and set screws to maintain proper belt tension, and shall be provided with proper belt guards.

5. All motors and accessories shall comply in all respect with NEMA Standards. Types shall be as required by Local Code.

6. All motors shall be furnished with type "B" insulation and tropical fungus proofing according to NEMA standards.

CHANGES IN WORK DUE TO APPROVAL OF ALTERNATE MATERIALS

Assure the cost of, and the entire responsibility for any changes in the work shown on the Contract Documents which may be occasioned by approval of materials proposed by the Contractor other than those specified.

GUARANTEE

Furnish the Owner a written guarantee covering the satisfactory operation of the mechanical installation in all its parts for a period of one (1) year after date of final acceptance of work. During this period, repair or replace any defective work, materials or equipment furnished and installed without any cost to the Owner. Include with this guarantee certificate of every material supplier engaged by this trade of the project.

AS-BUILT DRAWINGS

1. The Contractor shall, during the progress of work, keep record of all deviations of the actual installation from that shown on the Contract Drawings.

2. Upon completion of work, the Contractor shall submit two (2) copies of the as-built drawings, signed by the Contractor's Registered Professional Mechanical Engineer and Owner Project Inspector, indicating the work as actually and finally installed, including new information not originally shown in Contract Drawings.

3. Approval of as-built drawings by the Engineer shall be a requirement for final acceptance of the completed works and of final payment.

QUALITY ASSURANCE

1. Surveys and Measurements:

   a. The Contractor shall base measurements, both horizontal and vertical, from established benchmarks. All work shall agree with these established lines and levels. Verify all measurements at site and check the correctness of same as related to the work.

   b. Should the Contractor discover any discrepancy between actual measurements and those indicated, which prevents following good practice or intent of the drawings and specifications, he shall notify the Owner's representative and shall not proceed with his work until he has received instructions from the Owner's representative upon referring the matter to the Engineer.

2. Drawings and Minor Modification:

   a. Drawings are diagrammatic and indicate the general arrangement of the system and work included in the contract. Drawings are not to be scaled. The drawing and details shall be examined for exact location of fixtures and equipment by verifying actual site conditions.

   b. The Contractor shall follow drawings in laying out work and check drawing of other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions at all points. Where headroom or space conditions appear inadequate, Owner's representative shall be notified before proceeding with installation, if directed by the Owner's representative, the Contractor shall, without extra charge, make reasonable modifications and the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

   c. Materials and Workmanship

   All materials and apparatus required for the work, except as specified otherwise, shall be new of first class quality, and shall be furnished, delivered, erected, connected and finished in every detail, and shall be so selected and arranged as to fit properly into the building spaces. Where no specific kind or quality of materials is given, first class standard articled shall be furnished.

ITEM 16 : VARIABLE REFRIGERANT FLOW AIR-CONDITIONING SYSTEM

GENERAL

"Mechanical General Requirements" applies to this Item with additions and modification specified herein.

INTRODUCTION

Variable refrigerant flow (VRF) systems vary the flow of refrigerant to indoor units based on demand. This ability to control the amount of refrigerant that is provided to fan coil units located throughout a building makes the VRF technology ideal for applications with varying loads or where zoning is required. VRF systems are available either as heat pump systems or as heat recovery systems for those applications where simultaneous heating and cooling is required. In addition to providing superior comfort, VRF systems offer design flexibility, energy savings, and cost effective installation

VRF TECHNOLOGY

In a VRF system, multiple indoor fan coil units may be connected to one outdoor unit. The outdoor unit has one or more compressors that are inverter driven, so their speed can be varied by changing the frequency of the power supply to the compressor. As the compressor speed changes, so does the amount of refrigerant delivered by the compressor. Each indoor fan coil unit has its own metering device that is controlled by the indoor unit itself, or by the outdoor unit. As each indoor unit sends a demand to the outdoor unit, the outdoor unit delivers the amount of refrigerant needed to meet the individual requirements of each indoor unit .

ADVANTAGES OF A VRF SYSTEM

Control Means Comfort The key to providing comfort is to supply heating or cooling when and where it is required without swings in room temperature. In conventional systems, the compressor is either on or off, so even spaces that have individual controls experience fluctuations in room temperature as the compressor stops and then starts again to maintain the thermostat setting.

In a VRF system, since the speed of the compressor can be varied, the compressor does not cycle on and off, but operates continuously for longer periods. The required refrigerant flow is supplied to the indoor fan coil and once the set point is reached, the refrigerant flow is adjusted to maintain the room temperature smoothly without fluctuation. In addition to having distinct set points, the indoor unit fan speeds and louver positions can be changed to provide additional comfort in the space.

Design Flexibility

One of the major advantages of a VRF system is the flexibility provided by the diversity of multiple types and sizes of fan coils are available to fit for any application. The zoning layout for a VRF system, combining outdoor units, 4-way cassette type fan coils, and hi-wall type fan coils to create comfortable conditions for varying uses of 15 different spaces within the same building. When selecting a VRF system, keep in mind that not all systems have the same piping capabilities. Systems that offer expanded piping capabilities will maximize the application flexibility provided by the VRF technology. Important considerations when reviewing piping capabilities are: 1) the maximum elevation difference allowed between the highest and lowest indoor units on a single system and 2) the distance allowed from the outdoor unit to the farthest fan coil on the system.

Cost Effective

Installation depending on the application, the installation of a VRF system can be a cost effective alternative to traditional systems that require ductwork or large pipe sizes, and pumps and boilers in the case of chilled water systems.
Outdoor units are light in weight and have a small footprint. This means that they will fit in a service elevator, so no crane is required for lifting to a rooftop installation. In some cases, savings on the total construction cost can be achieved since the lightweight unit means that additional support structure in the roof is not required.

Energy Savings

All VRF systems provide energy savings by varying compressor speed and matching the output of the system as closely as possible to the load. In addition, VRF systems do not experience the same energy losses as systems that move conditioned air through ductwork. However, differences in design in the available outdoor units will influence the efficiency level that is achieve

GENERAL REQUIREMENTS

1. Air conditioning units, fan coil units (FCU) and Air-cooled condensing units (ACCU) shall be of Variable Refrigerant flow (VRF) or variable refrigerant volume (VRV) system.

   Air-cooled condensing units (ACCU) shall be 230volts, 3-phase and 60 hertz or as indicated in the equipment schedule. ACCU shall be of high heat and corrosion resistance.

   Fan coil units (FCU) shall be 230volts, 1-phase or 3-phase and 60 hertz as indicated in the equipment schedule. FCU shall be with washable air filters and wireless thermostat remote controller. FCU shall be of low noise level or as indicated in the equipment schedule and shall be provided with adequate vibration insulators.

2. Refrigerant Piping, Fittings and Accessories

   Refrigerant piping assembly as used in this section includes pipes, flanges, bolting, gaskets, valves, relief devices, fittings, and the pressure containing parts of other piping components. It also includes hangers and supports and other equipment items necessary to prevent overstressing the pressure containing parts.

   a. Piping

   ANSI 15 and ANSI B31.5. Compatible with fluids for which they are being used and capable of withstanding the pressures and temperatures of the service that they are handling.

   b. Tubing

   Refrigerant piping shall be seamless copper tubing, hard drawn, type K, ASTM B88. Tubing used for refrigerant service shall be cleaned, sealed, capped or plugged prior to being shipped from the manufacturer's plant. Fittings for copper tubing shall be wrought copper or bronze, brazing or solder joint type ANSI B16.18 or ANSI B16.22. Copper flared type tubing may be made only in annealed copper tubing ASTM B280 and in nominal sizes smaller than one- inch only for connection to equipment and no larger than 1-3/8 inches diameter for other connections. Flanges shall be of bronze ANSI B16.24.

3. Corrosion Prevention

   Unless specified otherwise, equipment fabricated from ferrous metals that do not have a zinc coating shall be treated for prevention of rust with a factory coating or paint system that will withstand 125 hours in a salts-pray fog test except that equipment located outdoors shall be

tested for 500 hours. The salt-spray fog test shall use a 20 percent sodium chloride solution. Immediately after completion of the test, the coating shall show no signs of blistering, wrinkling or cracking, no loss of adhesion, and the specimen shall show no signs of rust creep age beyond 1/8 inch on either side of the scratch mark. The film thickness of the factory coating or paint system applied on the equipment shall be not less than film thickness used on the test specimen.

4. Safety Standards

   a. Design, Manufacture and Installation of Mechanical Refrigeration Equipment: ASHRAE Safety Code for Mechanical Refrigeration.

   b. Machinery Guards: Fully guard drive mechanisms, or other moving parts. Provide guards fabricated of steel and expanded metal, rigidly mounted, and readily removed without disassembly.

5. Fans and Centrifugal Blowers

   All fans and centrifugal blowers shall be of the type and capacity indicated and constructed in accordance with AMCA Standards. Wheels shall be dynamically and statically balanced and free from vibrations and noise. Fan wheels handling outside air shall have factory applied phenolic coating. All fans discharged up-blast or exposed to the weather shall be equipped with 11/2-inch casing drains and piped to the nearest floor drain. All fans with non-ducted inlets shall be provided with galvanized or aluminum automatic shutters. Centrifugal blower unit shall be complete with TEFC motor, grease fitting, belt guard and support as scheduled.

   Fan shaft hot rolled or forged steel machined to close tolerances for proper bearing fit and provided with keys for impeller hubs and fan pulleys.
   Fan outlet shall be removable angles and bolts for attaching canvas or other flexible connections.
   Fan housing shall be provided with access panels
   and drains

   Ceiling mounted; ducted type exhaust fans shall be 230volt, 1-phase and 60 hertz or as indicated on equipment schedule.

MATERIAL REQUIREMENTS

Variable Refrigerant Flow Air–Conditioning System

1. General

   Variable refrigerant flow (VRF) is a type of air conditioning system that uses a single refrigerant circuit to connect multiple indoor units to a single outdoor unit. VRF systems are also known as variable refrigerant volume (VRV) systems.
   VRF systems are highly efficient and can be used for both heating and cooling

   Each indoor fan coil unit has its own metering device that is controlled by the indoor unit itself, or by the outdoor unit. As each indoor unit sends a demand to the outdoor unit, the outdoor unit delivers the amount of refrigerant needed to meet the individual requirements of each indoor unit.

2. Performance Rating

   Cooling capacity of unit shall meet the sensible heat requirements and total requirements indicated. In selecting unit size, make true allowance for "sensible to total heat ratio" to satisfy required sensible cooling capacity. Submittals shall include catalogue selection data which

accounts for sensible to total heat ratio, entering air-conditions at evaporator, and condenser air-conditions.

3. Air Conditioners, Ceiling Cassette Type Inverter

The air conditioning system has a 4-way air distribution with auto sweep, it can cool an adjacent room using of the 4-way airflow outlets The fresh air intake device and additional outlet grille can condition the air in an adjoining room using one of its 4-way airflow sides..

4. Compressors

The VRF systems available on the market today differ according to the number and type of compressor.

The 3 types of units that will be compared here are:

- Single Variable Speed Compressor
- Variable Speed Compressor Plus FixedSpeed Compressor
- Multiple Variable Speed Compressors

a.) Single Variable Speed Compressor In this system with a single, large-capacity scroll compressor, the same compressor starts and runs when there is demand and no redundancy is available if the compressor fails.

b.) Variable Speed Compressor Plus Fixed-Speed Compressor In this two-compressor system, the inverter-driven compressor always starts and ramps up until it reaches its maximum capacity at which time the fixed-speed compressor starts and the inverterdriven compressor ramps down. This system provides back-up capability.

c.) Multiple Variable Speed Compressors Outdoor units with multiple inverter-driven twin rotary scroll compressors, as shown in Fig. 5, offer the most complete set of advantages achievable with a VRF system. The system with 3 inverter-driven compressors also provides greater back-up capability. If one of the compressors fails, the system will continue to operate at 67% of its original capacity, and comfort will be maintained in the conditioned space until the faulty compressor can be replaced. The starting sequence of the compressors is rotated, equalizing their operating time and thereby minimizing excess operation of an individual compressor. Multiple inverter-driven compressors allow the unit to provide better part load performance without the need to use hot gas bypass. Under low-load conditions, the system has the advantage of running only as many compressors at whatever speed is required to achieve the capacity necessary to satisfy the load and maintain comfort within the conditioned space.

5. Coils

a. Cooling coils shall conform to ARI 410 and to paragraph entitled, Cooling Coils. Coils shall be the type indicated or specified herein.

b. The air-cooled condenser coil shall be extended-surface fin-and-tube type with seamless copper or aluminum construction. Aluminum alloy conforming to ASTM B210, alloy 1100, shall be used for the tubes, and aluminum alloy conforming to chemical requirements of ASTM B209, alloy 7072, shall be used for fins and sheets. Fins shall be soldered or mechanically bonded to tubes and installed in a metal casing. Coils shall be air tested under water for leakage. After testing, dry coils for remote type units to remove free moisture, and cap to prevent entrance of foreign matter. Evacuate and seal coils at the factory.

6. Filter Boxes

Provide filter boxes with either hanged access doors or removable panels. Filter boxes shall have racks for filters arranged for angle pattern. Filters shall be of type indicated and shall conform to paragraph hereinafter entitled, "Filters".

7. Mixing Boxes

Mixing boxes shall be of physical size to match the basic unit and include equal sized flanged openings, each sized to handle full air flow. Arrangement of openings shall be as indicated. Provide openings with dampers of opposed blade type. All damper shafts shall be connected together by one continuous linkage bar. Arrange dampers for manual operation so that when one starts to close from its opened position, the other starts to open from its closed position.

8. Controls

a. Condenser Controls

Provide load pressure control to insure condensing temperature for proper system operation at all ambient temperatures down to 40°F.

b. Condenser Start-up Control Provide condenser with a start-up control package which permits start-up compressor regardless of low ambient temperatures. Package shall temporarily bypass system low pressure-start to permit start-up whenever minimum ambient temperature is below design evaporator coil suction temperature.

9. Refrigerant Circuits

Entire refrigerant circuit shall be dehydrated, purged, and charged with refrigerant and oil at factory. Factory oil charge shall be the full amount required for operation. Factory charge for refrigerant shall be the full amount required for operation.

10. Corrosion Protection

Units shall be factory corrosion protected in accordance with paragraph entitled, Corrosion Prevention.

EXECUTION

INSTALLATION

Application and installation practices for VRF air-conditioning systems shall conform to the requirements of an acceptable industry standard for installation.

1. General

Install equipment and components in a manner to insure proper and sequential operation of the equipment and its controls. Installation of equipment not covered herein or in manufacturer's instructions shall be installed as recommended by manufacturer's representative. Provide proper foundations for mounting of equipment, accessories, appurtenances, piping and controls including, but not limited to, supported vibration isolators, stands, guides, anchors, clamps, and brackets. Foundations for equipment shall conform to equipment manufacturer's recommendation, unless otherwise shown in the drawings. Set anchor bolts and sleeves accurately using properly constructed templates. Anchor bolts shall be of adequate length and provided with welded-on plates on the head end embedded in the concrete. Level equipment bases, using jacks or steel wedges, and neatly grouted-in with a non-shrinking type of grouting

mortar. Locate equipment so that working space is available for all necessary servicing such as shaft removal, disassembling compressor cylinders and pistons, replacing or adjusting drives, motors, or shaft seals, access to water heads and valves of shell and tube equipment, tube cleaning or replacement, access to automatic controls, refrigerant charging, lubrication, oil draining and working clearance under overhead lines. Provide electric isolation between dissimilar metals for the purpose of minimizing galvanic corrosion.

2. Variable Refrigerant Flow Air-Conditioning System

Install system as indicated, in accordance with the requirements of ASHRAE 15-76 and as recommended in the manufacturer's installation and operational instructions.

3. Electrical Work

Electric motor driven equipment specified herein shall be provided complete with motors, motor starters, and controls. Electrical equipment and wiring shall be in accordance with "Electrical General Requirements" . Motor starters shall be provided complete with properly sized thermal overload protection and other appurtenances necessary for the motor control wiring required for controls and devices but not indicated.

4. Piping

a. Piping Sleeves
Pipe sleeves shall be as Galvanized Iron, Schedule 20.

b. Provide refrigerant driers, sight glass liquid indicators, moisture indicators, and strainers in refrigerant piping for remote installations when not furnished by the manufacturer as part of the equipment.

c. Locate strainers close to equipment they are to protect. Provide a strainer in the common refrigerant liquid supply to two or more thermal valves in parallel when each thermal valve has a built-in strainer. Install strainers with screen down and in direction of flow as indicated on strainers body.

d. Solenoid valves shall be installed in horizontal lines with stem vertical and with flow in direction indicated on the valve. If not incorporated as internal part of the valve, provide strainers upstream of the solenoid valve. Provide service valves upstream of the solenoid valve, upstream of the strainer, and downstream of the solenoid valve. Remove the internal parts of the solenoid valve when brazing the valve.

5. Auxiliary Drain Pans, Drain Connections, and Drain Lines

Provide auxiliary drain pans under all drain pans of the units located above finished ceilings or over mechanical or electrical equipment where condensate overflow over unit drain pan may cause damage to ceilings, piping, and equipment below. Provide drain lines for all drain and auxiliary drain pans. Trap the drain from bottom pan of air-conditioning units to insure complete pan drainage. Drain lines shall be full size of opening.

6. Air Filters

Provide access panels for all concealed valves, controls, dampers, and other fittings requiring inspection and maintenance.

7. Inspection Plates and Test Holes

Inspection plates and test holes where required in casings for air balance measurements shall conform to SMACMA High Pressure Low Velocity Duct Construction Standards. Test holes shall

be a factory-fabricated, air-tight, non-corrosive test hole with screw cap and gasket. Extend cap through insulation.

8. Flashing and Pitch Pockets

Provide flashing and pitch pockets for equipment support and roof penetrations and flashing where piping or ductwork passes through exterior walls.

FIELD TESTS AND INSPECTIONS

1. Tests

All tests shall be performed and materials and equipment required for test shall be furnished by the Contractor. Tests after installation and prior to acceptance shall be performed in the presence of a representative of the Owner and subject to his approval. Equipment and material certified as having been successfully tested by the manufacturer in accordance with referenced specifications and standards will not require retesting before installation. Equipment and materials not tested at the place of manufacturer will be tested before or after installation, as applicable, where necessary to determine compliance with referenced specifications and standards.

2. Leak Testing

Upon completion of installation of the air-conditioning equipment, test all factories as well as field refrigerant piping with an electronic-type leak detector to acquire leak tight refrigerant systems. If leaks are detected at the time of installation or during the guarantee period, remove the entire refrigerant charge from the system, correct the leaks and retest the system.

3. Evacuation, Dehydration, and Charging

After system is found to be without leaks, evacuate the system using a reliable gauge and a vacuum pump capable of pulling a vacuum of at least 1 mm lig absolute. Evacuate system in strict compliance with the triple evacuation and blotter method or in strict accordance with equipment manufacturer's printed instructions. System leak testing, evacuation, dehydration, and charging with refrigerant shall comply with the requirement contained in an acceptable industry standard.

4. Start-Up and Operation Tests

The air-conditioning system and its components shall be started and initially placed under operation and checked to see that it is functioning correctly. Adjust safety and automatic control instruments as necessary to place them in proper operation and sequence. The operational test shall be not less than 8 hours.

5. Performance Tests

Upon completion of evacuation, charging, start-up, final leak testing, and proper adjustment of controls, the system shall be performance tested to demonstrate that it complies with the performance and capacity requirements of the specifications and plans. Test the system for not less than 8 hours, during which time hourly readings shall be recorded. At the end of the test period, the readings shall be averaged and the average shall be considered to be the system performance.

6. Sound Tests, VRF Air-conditioners Type

Sound pressure level measurements shall be conducted on units designated by the Owner. Calculate sound power levels by ASHRAE Systems Handbook and Product Directory. Submit test results and calculations.