depths of more than 20mm in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support the conduit by ceiling support system. Spring-steel fasteners may be used for lighting branch circuit conduits supports in suspended ceilings in dry locations.

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

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

5. Conduit Installed in Concrete Floor Slabs

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

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

7. Flexible Connection:

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

**c. Boxes, Outlets, and Supports**

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

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

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

2. Pull Boxes:

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

**d. Mounting Heights**

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

**e. Conductor Identification**

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

**f. Splices**

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

**g. Covers and Device Plates**

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

**h. Electrical Penetrations**

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

**i. Grounding and Bonding**

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

1. Grounding Conductor

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

2. Resistance

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

**FIELD QUALITY CONTROL**

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

a. Devices Subject to Manual Operation

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

b. Test on 600-volt wiring

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

c. Grounding System Test

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

## INTERIOR LIGHTING

### SUBMITTALS

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

a. Manufacturer's Data

1. LED Panel Light recessed mounted type with frosted glass cover (600 x 600 mm) daylight, 42 watts. 4500K (Color Temperature)

2. LED Downlight 20W, recessed type, 230 V, Aluminum Housing, Frosted

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

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

### RECESS AND FLUSH MOUNTED FIXTURES

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

## EXECUTION

## INSTALLATION

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

## GROUNDING

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

## FIELD TESTS

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

a. Operating Test

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

b Insulation Resistance Test

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

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

## ITEM 26 : DISTRIBUTION TRANSFORMER

### SCOPE OF WORK

The work to be done shall consist of supply, delivery and installation of the distribution transformer completed in accordance with all the materials submitted by Misamis Oriental II Electric Cooperative (MORESCO II), including labor, tools and equipment and all incidental work as found necessary.

### GENERAL REQUIREMENTS

a) All work shall be done in accordance with the requirements of the publications and agencies having jurisdiction, as well as the requirements of the approved standards.

1. American National Standard Institute - (ANSI)
2. Institute of Electrical and Electronics Engineers - (IEEE)
3. National Electrical Manufacturer Association - (NEMA)
4. Philippine Electrical Code - (PEC)
   Philippine National Standard - (PNS)

b) Materials Requirements

- 3 sets of Distribution Transformer,
- Conventional
- Pole Type
- Oil Immersed
- Self – Cooled
- Single Phase, 1Ø, 60hz
- 65 °C Temperature rise

| | | |
|---|---|---|
| Capacity | : | Coordinate with local electric cooperative (Transformer- KVA) |
| Primary Voltage | : | 7.62 / 13.2 Y kV<br>2-2.5% taps FCAN and<br>2-2.5% taps FCBN<br>Available on tap changer for de-energized operation |
| Primary BIL Rating | : | 95kV |
| Secondary Voltage | : | 120 /240V |
| Secondary BIL Rating | : | 30kV |
| Percent Impedance | : | ANSI Standard |
| HV/LV Conductor | : | Copper / Aluminum |
| Insulating Fluid | : | Mineral Oil |
| Core | : | Silicon Core |
| NLL | : | 190W |
| LL | : | 650W |

c) Standard Test Reports:

1. Routine Tests:

- Turn Ratio Test
- Voltage Ratio Test
- No Load Loss & Load Loss Test

- o Impedance Voltage Test
- o Applied Potential Test
- o Induced Potential Test

2. Type of Test:

- o Impulse test
- o Temperature Rise Test

**PRODUCTS (DISTRIBUTION TRANSFORMER)**

External Features:

- o High Voltage Bushing
- o Low Voltage Bushing
- o Tank and Cover
- o Pressure Relief Valve
- o Tank and Low Voltage Grounding Provision
- o Externally Operated No-Load Tap Changer
- o Radiators

Internal Features:

- o Core Coil Assembly
- o Winding Material
- o Insulating Di-Electric Fluid
- o Coil Support

**PRODUCTS (GENERAL DESCRIPTION)**

1. **High Voltage Bushing**, the cover mounted and tank - wall high voltage bushing is made of wet processed porcelain suitable for both copper and aluminum conductors.

2. **Low Voltage Bushing**, single or double eyebolt or spade terminal made of wet process porcelain.

3. **Tank and Cover**, manufactured from hot-rolled steel sheets and pressure tested to ensure a leak free enclosure. Grit blasted or chemically treated to remove every trace of scale, rust, or oil, for better paint adhesion. Outer and inner surfaces are primed with epoxy primer for rust prevention, and the outer surface is coated with polyurethane.

4. **Pressure Relief Valve** gradually releases excess pressure and is designed for outdoor condition.

5. **Tank and Low Voltage Grounding Provisions**, provided to help prevent damage to the transformer during electrical surges.

6. **Externally Operated No-Load Tap Changer**, provides up to five (5) primary voltage for convenient changing of high voltage tap connection at no –load.
7. **Radiators**, made of hot-rolled steel sheets, are provided for higher KVA units for added cooling surface.

8. **Core Coil Assembly** uses a superior transformer insulation system and is permanently centered in the tank using a close fitted steel frame. Materials used for our coils are either silicon-iron for our blue and silver series or Amorphous metal for our gold line.

9. **Winding Material**, distribution transformer uses a combination of standard copper-aluminum or copper-copper winding materials.

10. **Insulating –Di- Electric Fluid**, used are either mineral oil or an environment friendly high fire point fluid.

11. **Coil Support** used compatible materials to hold the coil in place and restraint it during short circuit-circuit conditions. Core clamps and clamp angles are also used to ensure that the core and windings are effectively secured even during mechanical stresses.

## EXECUTION

### INSTALLATION

The installation of the concrete pad transformer is in accordance with the rules and regulations of the requirements of the Misamis oriental II electric cooperative.

### GROUNDING

Ground all exposed non-current-carrying metallic parts of electrical equipment.

### WORKMANSHIP

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

### TESTING OPERATIONS

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

### GUARANTEE

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

## ITEM 27 : GROUNDING SYSTEM AND LIGHTNING PROTECTION

### GENERAL

REFERENCES

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

1. American National Standards Institute (ANSI)

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

2. Institute of Electrical and Electronics Engineers (IEEE)

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

3. National Fire Protection Association (NFPA)

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

4. Underwriters Laboratories (UL)

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

5. Institute of Integrated Electrical Engineer (IIEE)

   PEC (2002) Philippine Electrical Code

6. Philippine National Standard (PNS)

   BS (2002) Bureau of Standard

RELATED REQUIREMENTS

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

System Requirements

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

SUBMITTALS

1. Shop Drawings

Overall lightning protection system for each major component

2. Test Reports

Grounding system test
Lightning protection system inspection

3. Certificates

UL listing or label

QUALITY ASSURANCE

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

1. Installation Drawings

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

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

2. UL Listing or Label

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

SITE CONDITIONS

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

**MATERIAL REQUIREMENTS**

MATERIALS

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

1. Main and Bonding Conductors

   NFPA 780 and UL 96

2. Copper

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

COMPONENTS

1. Air Terminals

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

2. Ground Rods

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

3. Connections and Terminations

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

4. Connector Fittings

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

5. Lightning Protection Components

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

**EXECUTION**

INTEGRAL SYSTEM

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

1. Air Terminals

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

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

2. Down Conductors

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

a. Ground Connections

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

b. Grounding Electrodes

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

FIELD QUALITY CONTROL

1. Grounding System Test

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

2. Lightning Protection System Inspection

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

## ITEM 28 : BACKGROUND MUSIC / PUBLIC ADDRESS SYSTEM

### GENERAL

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

REFERENCES

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

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

3. National Fire Protection Association (NFPA)

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

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

SUBMITTALS

The following shall be submitted.

1. Shop Drawings

   a. Detail Drawings

Detail drawings as specified.

2. Product Data

   a. Spare Parts

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

3. Test Reports

   a. Approved Test Procedures

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

b. Acceptance Tests

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

4. Certificates

a. Components

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

5. Operation and Maintenance Data

a. Public Address System

SYSTEM DESCRIPTION

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

1. Multi-Channel System with Paging

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

2. Single-Channel System

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

3. System Performance

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

4. Detail Drawings

The Contractor shall submit detailed drawings consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, performance charts and

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

5. Spare Parts

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

DELIVERY AND STORAGE

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

VERIFICATION OF DIMENSIONS

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

**MATERIAL REQUIREMENTS**

STANDARD PRODUCTS

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

1. Identical Items

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

2. Nameplates

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

MIXER-PREAMPLIFIER (Optional)

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

| | | |
|---|---|---|
| Rated Output | : | 18 dB |
| Frequency Response | : | Plus, or Minus 1 dB, 20 - 20,000 Hz |
| Distortion | : | Less than 0.5 percent, 20 - 20,000 Hz |

| | | |
|---|---|---|
| Signal to noise | : | Microphone - 60 dB |
| Auxiliary | : | 70 dB |
| Inputs | : | 5-independent balanced low–impedance transformer-isolated |
| Input Sensitivity | : | Microphone - 0.003 volts, Auxiliary 0.125 volts,<br>Magnetic Cartridge - 0.0005 volts |
| Input Channel Isolation | : | 80 dB minimum |
| Tone Controls | : | Plus, or Minus 10 dB range at 50 and 15,000 Hz |
| Power Requirement | : | 220-240 VAC, 60 Hz |

**POWER AMPLIFIERS**

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

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

MIXER AMPLIFIER (Optional)

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

| | | |
|---|---|---|
| Rated Power Output (RPO) | : | 35, 60, 125 watts RMS |
| Frequency Response | : | Plus, or Minus 3 dB, 20-20,000 Hz |
| Distortion | : | Less than 1% at RPO, 60 - 13,000 Hz |
| Inputs | : | 2 microphones (high impedance or low impedance unbalanced<br>2 Aux. (high impedance) |
| Output Impedance | : | Balanced 4 and 8 ohms |
| Output Voltage | : | 25 and 70.7 volts |
| Power Requirement | : | 220-240 VAC, 60 Hz |

MICROPHONE INPUT MODULES

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

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

**MICROPHONES**

1. Desk Microphone

Microphones shall as a minimum conform to the following specifications:

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

2. Gooseneck Microphone

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

3. Microphone Jack

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

**LOUDSPEAKERS**

1. Cone Speaker (Optional)

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

| | | |
|---|---|---|
| Application | : | Wall baffle, Ceiling |
| Frequency range | : | 60 to 12,000 Hz |

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

2. Horn Speaker (Optional)

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

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

3. Dual Horn Speaker (Optional)

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

4. High Output Speaker Enclosures (Optional)

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

5. Wall Baffle Speaker Enclosures (Optional)

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

**6. Ceiling Mounted Speaker**

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

SPEAKER SWITCHING PANEL

1. Selector Switches

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

2. System Power supply

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

AM/FM EQUIPMENT (Optional)

1. AM/FM Tuner

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

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

2. AM/FM Antenna

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

COMPACT DISC/DVD PLAYER (Optional)

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

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

CASSETTE TAPE EQUIPMENT (Optional)

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

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

PRIORITY RELAYS AND CONTROLS

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

SWITCHES AND CONTROLS

1. Radio System Control Switch

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

2. Remote Loudspeaker ON/OFF Switches

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

3. Remote Loudspeaker Volume Controls

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

**EQUIPMENT RACKS**

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

**CABLES**

1. Speaker Cable

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

2. Microphone Cable

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

3. Antenna Cable

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

TERMINALS

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

SURGE PROTECTION

1. Power Line Surge Protection

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

2. Signal Surge Protection

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

TELEPHONE INTERFACE MODULE (Optional)

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

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

**EXECUTION**

INSTALLATION

Equipment shall be installed as indicated and specified, and in accordance with the manufacturer's recommendations except where otherwise indicated. Equipment mounted out of doors or subject to

inclement conditions shall be weatherproofed. The antenna shall be supported at least 1.5 m clear above the roof by means of self supported or guyed mast.

1. Equipment Racks

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

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

2. Wiring

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

GROUNDING

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

ACCEPTANCE TESTS

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

TRAINING

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

# ITEM 29 : FIRE DETECTION AND ALARM SYSTEM

## GENERAL

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

REFERENCES

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

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

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

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

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

## DESCRIPTION OF WORK

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

SUBMITTALS

Submit the following.

1. Shop Drawings

   a. System layout

   b. System wiring diagrams.

c. Conductor wire marker schedule

2. Product Data

a. Fire Control Panel

b. Batteries

c. Battery charger

d. Manual Call Point / Pull Stations

e. Smoke detectors

f. Alarm Bell

g. Duct smoke detectors (Optional)

h. Audio/Visual/Alarm horns (Optional)

i. Graphic annunciator panel (Optional)

j. Wiring

k. Conduit

l. Outlet boxes

m. Fittings for conduit and outlet boxes

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

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

3. Test Reports

4. Preliminary testing

5. Final acceptance testing

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

6. Certificates

a. Qualifications of installer

b. Qualifications of system technician

7. Operation and Maintenance Data

a. Fire alarm system

8. Closeout Submittals

a. System as-built drawings

QUALITY ASSURANCE

1. Qualifications of Installer

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

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

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

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

2. Manufacturer's Representative

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

3. Qualifications of System Technician

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

4. Drawing Requirements

a. System Layout

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

b. System Wiring Diagrams

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

c. System As-Built Drawings

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

MAINTENANCE

1. Spare Parts

Furnish the following spare parts:

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

2. Manuals

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

**MATERIAL REQUIREMENTS**

SYSTEM DESIGN

1. Operation

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

**a. Fire Alarm Signal Initiation**

Operation shall be such that actuation of any:

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

Shall cause all the following actions:

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

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

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

a. Monitoring Integrity of Installation Conductors

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

1) Initiating circuits.

2) Evacuation alarm circuits

3) Battery power supply low and no voltage across the standby battery terminals and open battery circuit. Provide Class A initiating device circuits, and Class A notification device

circuits as defined by NFPA 72. For Class A circuits, they provide separate conduits for outgoing, and return (redundant) conductors as required by NFPA 72. A ground fault condition or single break in any other circuit shall cause operation of the system trouble signals. Loss of AC power, abnormal AC voltage, a break in the standby battery power circuit, or low battery voltage shall also cause operation of system trouble signals. The abnormal position of any switch in the control panel shall also cause operation of the system trouble signals. Audible and visual equipment for supervision of the AC power supply shall be energized from the auxiliary DC power supply and vice versa. Trouble signals shall sound continuously until manually silenced or the system has been restored to normal.

b. Walk-Test Mode

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

c. Alarm Verification Feature

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

2. Primary Power

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

3. Auxiliary Power

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

a. Storage Batteries

Provide sealed lead calcium or sealed lead acid or batteries and charger. Dry cell batteries are not acceptable. House batteries in the control panel. Provide batteries of adequate

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

b. Battery Charger

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

COMPONENT DESIGN

**1. Fire Alarm Control Panel (FACP)**

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

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

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

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

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

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

e. Lamp test switch.

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

1) Graphic Annunciator Panel (Optional)

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

2. **Manual Pull Stations**

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

2.a **Manual Call Point**

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

Functions:

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

3. **Smoke Detector (SD)**

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

a. 4-Wire Smoke Detectors (Optional)

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

b. Photoelectric Detectors (Optional)

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

c. Detector Spacing and Location

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

4. Notification Devices

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

a. **Alarm Bell**

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

b. Alarm Horns (Optional)

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

c. Visible Devices

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

5. Conduit

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

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

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

8. Wiring

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

**EXECUTION**

INSTALLATION

Installation shall be in accordance with the requirements of NFPA 70, PEC NFPA 72 and NFPA 90A. Each conductor used for the same specific function shall be distinctively color coded. Each function color code should remain consistent throughout the system. Use colors as directed by the Engineer. All wiring shall be in steel conduit. All circuit conductors shall be identified within each enclosure where a tap, splice or termination is made. Conductor identification shall be by plastic coated self-sticking printed markers. The markers shall be attached in a manner that will not permit accidental detachment. Control circuit terminations shall be properly identified. Wire devices so that their removal will activate system trouble signals. Pigtail or "T" tap connections are prohibited. Wiring for DC circuits shall not be permitted in the same conduit or tubing as wiring for AC circuits. Paint all junction boxes cover red or provide them with permanent labels reading "FIRE ALARM CIRCUIT." Provide a written schedule of conductor markings identifying each wire marker, the purpose, the origin, and termination point of each conductor. The conductor wire marker schedule shall be turned over to the Engineer at the time of preliminary testing with as built drawings.
1. Additional Installation Requirements

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

FIELD QUALITY CONTROL

1. Preliminary Testing

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

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

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

c. Smoke Detector Test: Clean the smoke detectors in accordance with the manufacturer's recommended procedures. Test smoke detectors using magnet-activated test switches,

manufacturers provided test cards, or smoke. Use of aerosol sprays to test smoke detectors is prohibited.

2. Final Acceptance Testing

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

a. Entire System

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

b. Supervisory Systems

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

3. Additional Tests

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

## ITEM 30 : WIRE COMMUNICATION AND SIGNAL SYSTEM

### TELEPHONE SYSTEM

### GENERAL

Electrical General Requirements apply 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 with the local telephone company as the provider. Any deviation of the plans and specifications shall be brought to the attention of the Engineer for resolution.

PRODUCTS

CONDUIT AND FITTINGS

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

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

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

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

OUTLETS, BOXES AND FITTINGS

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

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

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

JUNCTION AND PULL BOXES

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

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

LOCAL TELEPHONE COMPANY PROVIDER / INTERCONNECTION OF PABX SYSTEM

a. All components and 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 in the plans.

c. Intermediate Distribution Frame (IDF)

The Intermediate Distribution Frame (IDF) is a free-standing or wall-mounted rack for managing and interconnecting a telecommunication between end-user devices and the main distribution frame (MDF).

The IDF might be located on each floor or a multi-floor story building, which arranges cables along the walls in the MDF on the first floor. The MDF would contain wires connecting the telephone company with the service provider to one or another building.

The IDF can contain circuit termination equipment from various auxiliary components in central part of the office environments. In both LAN and WAN conditions. Additionally, IDF can handle different types of devices, including backup systems, hard disk drives, independent disk, coaxial cable, category-6, fiber optic cables, and networking devices, including hubs, switches and routers.

**EXECUTION**

INSTALLATION

The telephone installation shall be installed as shown in the approved 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 on the wall near the floor in the ticket 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 the ceiling floor), and it will need to be close enough to the cable output that you can connect 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 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 cables 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 layout system in accordance with the latest Local Telephone Company.

## ITEM 31 : 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 split type and ceiling cassette 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 a

# ITEM 32 : UNITARY AIR-CONDITIONING SYSTEMS

## GENERAL

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

## GENERAL REQUIREMENTS

1. Unitary Air-Conditioning System

Air conditioning units in retail stores shall be supplied and installed by the tenant. Capacity of equipment shall not be less than that indicated. In the NFPA standards and SMACNA manuals referred herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. Reference to the "authority having jurisdiction" shall be interpreted to mean the Engineer.

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.

**MATERIAL REQUIREMENTS**

Unitary Air –Conditioning System – Split Type Inverter

1. General

The air-conditioning systems shall be designed, constructed, and rating tested in accordance with ARI Standard 210 for unitary air-conditioning equipment of capacities below 135,000 Btu's per hour and ARI Standard 300 for unitary equipment with capacities of 135,000 Btu's per hour and greater. Units shall be ARI certified. Units with capacities below 135,000 Btu's per hour shall be listed in the ARI Directory of Certified Unitary Air-Conditioners.

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

Provide hermetic, semi-hermetic rotary, or screw type provided with all the minimum standard equipment and accessories listed therein. Compressor speed for compressors above 20 tons shall not exceed 1750 rpm. Provide compressors with automatic capacity reduction of at least 50 percent for units over 10 tons. Compressors shall start unloaded. Provide each compressor with devices to protect the compressor from short-cycling when shut-down by safety controls. Provide a pump-down cycle of the non-recycling start type for each compressor 20 tons and over. Provide compressors with vibration isolators. Compressor motor shall be suitable for electric power characteristics as indicated. Motor shall conform to NEMA NG-1. Motor starters shall conform to NEMA ICS. Motors shall be constant speed, squirrel-cage induction, open type or hermetically sealed, low starting current, high-torque type, and shall be furnished with reduced voltage or and magnetic across-the-line type motor starter with weather-resistant enclosures

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.

COOLING COILS

1. Direct-Expansion Coils

Direct-expansion coils shall be fin-and-tube type constructed of seamless copper or aluminum tubes and copper or aluminum fins mechanically bonded or soldered or helically wound to tubes. Casing and tube support sheets shall be not lighter than 16-gauge (0.0635-inch nominal thickness) galvanized steel, formed to provide structural strength. Suction header shall be seamless copper tubing or seamless or resistance welded steel tube with copper connection. Supply header shall consist of a distributor to distribute the refrigerant liquid through seamless copper tubing, equally to all the circuit in the coil. Tubes shall be circuited to insure minimum pressure drop and maximum heat transfer. Circulating shall permit refrigerant flew from liquid inlet to suction outlet without causing oil staging or restricting refrigerant flow in coil. Rack coil shall be tested at the factory under water at not less than 300 psi air pressure and shall be suitable for 200 psi working pressure. Each coil shall be completely dehydrated and scaled at the factory upon completion of pressure tests. Coil shall be mounted for counter flow service.

2. Filters

Filter shall be of the sectional or panel cleanable type and be capable of filtering the entire air supply.

3. Manometers

Provide inclined-type manometers for filter stations of 2,000 cfm capacity or larger including filters furnished as integral parts of air handling units and filters installed separately. Manometers shall be of sufficient length to read at least one inch of water column, shall be graduated in 1/10 inches, and equipped with spirit level. Equip each manometer with over-pressure safety traps to prevent loss of oil, and two three-way vent valves for checking zero setting.

CLEANING, PAINTING AND IDENTIFICATION

Cleaning, painting and identification of piping shall be as specified under, "Painting" of "Building Works".

IDENTIFICATION TAGS AND PLATES

Provide equipment, thermometers, valves, and controllers with tags numbered and stamped for their use. Plates and tags shall be of brass or suitable non-ferrous material, securely mounted or attached. Minimum letter and numeral size shall be 1/8 inch.

**EXECUTION**

INSTALLATION

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

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. Unitary 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, Air-conditioners, Unitary, Split 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.

## ITEM 33 : GRID-TIED SOLAR PV SYSTEM

### SCOPE OF WORK

The scope of work includes Supply, Installation, Testing and Commissioning of Grid-Tied Solar PV Module mounted on a roof-deck. All necessary, feasibility study, Civil work, Mounting of Module Structures, PV Module Installation, Inverter Installation, DC/AC Cabling and interconnections, Installation of Lightning Arrester and Earthing System according to standards, Net Metering, and repairs of all necessary inspections from Misamis Oriental II Electric Cooperative (MORESCO II), as part of Pre-Commissioning, if any, and Commissioning of PV Solar Panel shall be subject to supplier scope including labor, tools and equipment and all incidental work if required.

### GENERAL REQUIREMENTS

a) All work shall be done in accordance with the requirements of the publications and agencies having jurisdiction, as well as the requirements of the approved standards.

| | | | |
|---|---|---|---|
| 1. | Philippine Energy Regulatory Commission | - | (PERC) |
| 2. | Department of Energy | - | (DOE) |
| 3. | Renewable Energy Law (RA No. 9513) | - | (REL) |
| 4. | Philippine Electrical Code<br>Philippine National Standard | -<br>- | (PEC)<br>(PNS) |
| 5. | Confederation of Solar Developers of the Philippines | - | (CSDP) |
| 6. | Philippines Solar Power Alliance | - | (PSPA) |

b) Materials Requirements of Solar Panel PV

1. Solar PV modules and array
2. Module mounting structure.
3. Junction Boxes
4. Power Conditioning Unit
5. DC & AC Switches
6. Cables and installation accessories
7. Earthing and lightning protection
8. Solar Meter and Net Meter

**Solar PV Modules and Array:**

Solar modules shall be Crystalline (Mono/Poly) (or) Thin Film (or) Concentrator PV modules type. The peak power output of the PV Module shall be min 620Wp under STC. Module Voc shall be minimum 48.50V. The power output of the PV module must be reported under standard test conditions (STC).

The mechanical structure shall withstand gusts of wind / cyclonic wind up to 185 km/hr from the back side of the panel.

Module Junction box (weatherproof), where the module terminals shall be interconnected and output taken, shall be designed for long life outdoor operation in harsh environments as

per the relevant specifications and protected against surges. It should have a provision for "Opening" for replacing the cable, if required.

The modules must be installed according to the supplier's work oriented.

PV modules used in solar power must be warranted for output wattage, which should not be less than 90% at the end of 10 years and 80% at the end of 25 years.

**Module Mounting Structure:**

The PV modules will be mounted on roof deck which can withstand loads of modules and high wind velocities up to 185 km per hour. The support structure used in the solar power will be hot dip Galvanized Iron (G.I).

**The "Mounting Structure" should have the following features:**

• The modules support structure shall be Mild Steel /hot dipped Galvanized Iron for holding the PV modules. The size of angle iron is prescribed by the supplier.

• Each panel frame structure shall be so fabricated as to be filled on the roof deck on its legs. The legs of the structure shall be fixed in the roof deck. The foundation shall support SPV modules at a given orientation, absorb and transfer the mechanical loads to the ground properly and shall withstand a maximum wind speed of 185 km/hr.

• All nuts and bolts should be made of good quality Stainless Steel.

• The structure should be designed to allow easy replacement of any module.

• The array structure should be so designed that it will occupy minimum space without sacrificing the output from the SPV panels.

• The minimum clearance of the lowest part of the module structure and the developed ground level shall not be less than 500 mm.

**Junction Boxes:**

The junction boxes must be dust proof, vermin proof, and waterproof, and they must be manufactured of FRP / Thermoplastic. The terminals must be linked to a copper bus bar configuration of appropriate size. The junction boxes must have sufficient cable entry ports with proper cable glands for both incoming and outgoing cables. For simple identification, suitable markings must be supplied on the bus bar, and cable ferrules must be installed at the cable termination positions. Each main junction box must include an adequate rated blocking diode. The junction boxes must be of high quality.

**Power Conditioning Unit (PCU):**

As SPV array produces direct current electricity, it is necessary to convert this direct current into alternating current and adjust the voltage levels to match the grid voltage. Conversion shall be achieved using an electronic Inverter and the associated control and protection devices. All these components of the system are termed the "Power Conditioning Unit (PCU)". In addition, the PCU also houses MPPT (Maximum Power Point Tracker), an interface between Solar PV array & the Inverter,

**DC & AC Switches**

**DC SIDE:**

- MCB of suitable rating shall be provided for connection and disconnection of array & PCU for maintenance purposes.
- Switches and Circuit Breakers on the DC side shall be DC rated or they shall be sufficiently de-rated, if AC rated switches are used.

**AC SIDE:**

MCB of suitable rating shall be provided for connection and disconnection of PCU & load.

**Cables and accessories:**

All the cables shall be supplied conforming to IEC 60227/IS 694 & IEC 60502/IS 1554 shall be of kV grade as per requirement. Only PVC copper cables shall be used.

The size of the cables between array interconnections, array to junction boxes, junction box to PCU, PCU to AC Distribution Box etc. shall be selected to keep the voltage drop and losses to the minimum. Permissible Wire Drop on DC side shall be <= 1%

**Earthing and Lightning Protection:**

**Earthing:** The array structure of the PV shall be grounded properly using an adequate number of earthing kits. All metal casing or shielding of solar power shall be thoroughly grounded to ensure safety of solar power.

**Lightning:** The SPV solar power

The SPV solar power shall be provided with lightning & over voltage protection. The main aim in this protection shall be to reduce the over voltage to a tolerable value before it reaches the PV or other sub system components. The source of over voltage can be lightning, atmosphere disturbances etc.

**Solar Meter and Net Meter:**

A separate Energy Meter called Solar Meter shall be provided at the output of PCU to record energy generation from the Solar power System. (This energy meter should not be integrated with PCU). Solar energy meter means a unidirectional meter to be installed at the delivery point of the solar power energy system to measure the solar power generated electricity. This Energy Meter should be tested along with the Net Meter.

Net meter: As per (Renewable Energy and Net Metering) Regulations 2020, net metering system is to be provided to the solar power consumer. Net meter means the bidirectional energy meter to be installed at the interconnection point of the consumer with the network of distribution licensee. Energy meters should be installed and maintained in accordance with the provisions of the local electric cooperative. The Contractor /supplier shall maintain the Metering System as per coordination with local electric cooperative. The defective meter shall be immediately tested and rectified/ replaced. A solar meter and bidirectional energy meter suitable for the installed solar power shall be supplied and installed by the contractor after testing and sealing from respective suppliers. Energy Meters must be provided with the necessary data cables if required. The solar energy meter and net energy meter shall be of accuracy as given and CT and PT shall be utilized according to metering regulations 2006 and their amendment.

**Mechanical and Design Specification or Equivalent**
**Mono-Crystalline PV Modules (620W)**

| | |
|---|---|
| Cell Type | n-type Double Glass Bifacial Module, Mono |
| No. of cells | 132 (6*22) |
| Glass | 2.0mm/2.0mm, tempered |
| Junction box | IP 68 rated, 3^diodes |
| Frame | 35mm anodized Aluminum Alloy |
| Cable cross section size | 4 mm^2 (IEC), 12AWG (UL) |
| Cable length (including Connector) | Portrait: 300mm(+)/400mm(-)<br>Landscape: 1500mm(+)/1500mm(-) |
| Connectors | QC 4.10-351/MC4-EVO2A |
| Dimension | 2,382mm±2mm * 1134mm±2mm * 30mm±1mm |
| Weight | 33.1kg |
| Hail resistance | Max Ø25mm at 23 m/s |
| Wind load | 2400 Pa / 244 kg/m$^2$ |

Temperature Ratings

| | |
|---|---|
| Temp. coefficient of $P_{max}$ (% / ( °C) ) | -0.29 |
| Temp. coefficient of $V_{oc}$ (% / ( °C) | -0.260 |
| Temp. coefficient of $I_{sc}$ (% / ( °C) | +0.046 |
| Non. operating temp. NOCT ( °C ) | 43 to 45± 2 |

Electrical Specifications (STC)

| | |
|---|---|
| Normal Max. Power $P_{max}$ (Wp) | 620W |
| Maximum operating voltage $V_{MPP}$ (V) | 40.21 |
| Maximum operating current $I_{MPP}$ (A) | 15.42 |
| Open circuit voltage $V_{oc}$ (V) | 48.50 |
| Short circuit current $I_{sc}$ (A) | 16.13 |
| Module efficiency n (%) | 23.00 |

*STC Standard test condition (Irradiance 1000 W/m$^2$, Cell temperature 25 °C and air mass of AM 1.5 and with speed of 1m/s)

Operating Conditions

| | |
|---|---|
| Maximum System Voltage | 1500V DC |
| Operating Temperature ( °C ) | - 40 to+ 85 |
| Maximum Series Fuse Rating | 35A |
| Maximum Static Load, Front* | 5400Pa (112 lb/ft^2) |
| Maximum Static Load, Back* | 2400Pa (50 lb/ft^2) |
| NOCT | 45±2°C |
| Bifaciality** | 80% ± 10% |
| Fire Perfomance | UL Type 29 |

Package Information

| | |
|---|---|
| Packaging Configuration | 31 pcs / pallet |
| Loading Capacity | 558 pcs to 620 pcs / 40 HQ Container |
| Size / Pallet | 2396mm x 1120mm x 1250mm |
| Weight | 1,191.60 kg |

## EXECUTION

### INSTALLATION

The installation of solar power PV modules on the roof deck must be installed as supplied, delivered, and installed according to the supplier.

### WORKMANSHIP

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

### TESTING OPERATIONS

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

### GUARANTEE

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

## ITEM 34 : COMMUNITY ANTENNA TELEVISION SYSTEM (CATV)

### GENERAL

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

### DESCRIPTION OF WORK

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

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

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

### MATERIALS REQUIREMENTS

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

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

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

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

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

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

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

**HERE ARE SOME OF THE LISTS OF LOCAL CATV PROVIDERS:**

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

**EXECUTION**

CATV INSTALLATION:

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

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

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

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

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

4. Drive a grounding spike into the earth at or near the point where the coaxial cable enters the home or other structure or locate a cold-water pipe in the area. Fasten a 12-gauge grounding wire to the grounding spike or cold-water pipe at one end and to a coaxial cable grounding block at the other. This will form a connection to the earth that will ground the coaxial shield in the cable and serve to divert lightning strikes.

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

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

QUALITY ASSURANCE

- Wiring Diagrams and Installation Details

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

**WORKMANSHIP**

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

**TESTING OPERATIONS**

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

**GUARANTEE**

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

# ITEM 35 : EXHAUST EQUIPMENT

## GENERAL

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

SCOPE OF WORK

1. Furnish materials that are new, of first-class quality.
2. Install all materials in strict accordance with the manufacturer's instructions and specifications.

## PRODUCTS

MATERIAL REQUIREMENTS

1. Bathroom Ceiling Mounted Exhaust Fan

The exhaust fans shall be of the built-in ceiling type, ceiling mounted, suitable for operation. Sizes and capacities are based on models or approved equal. Brand and models indicated herein is for the purpose of establishing product quality, capacities and dimensions. Other brands satisfying the same shall likewise be accepted, subject to the approval of the owner and Engineer In-Charge. The capacities of the units shall be as shown on the Drawings.

2. Wall Mounted Propeller Exhaust Fan (Optional)

The wall-mounted propeller exhaust fan shall be direct-drive three blade type with a steel mounting plate. Capacity of the fan shall be as shown on the drawings. Fan blades shall be constructed of steel or aluminum. The fan hub shall be of heavy construction and shall be of steel or semi-steel, and the blades shall be riveted to the hub. Fan blade shall be quiet in operation and shall be statically and dynamically balanced at the factory. Motor and Drive shall be of the condenser motor type, tightly sealed and dust proof with non-lubricating ball bearings. The fan shall be provided with automatic shutters to prevent air from re-entering the fan when fan is off. The fan control switch shall be located as near as possible to the fan.

## EXECUTION

1. Install the fan securely to the ceiling.
2. Install back-draft dampers and check to make sure they are free to open and close.
3. Connect power and check rotation of fan.

# ITEM 36 : PROJECT BILLBOARD

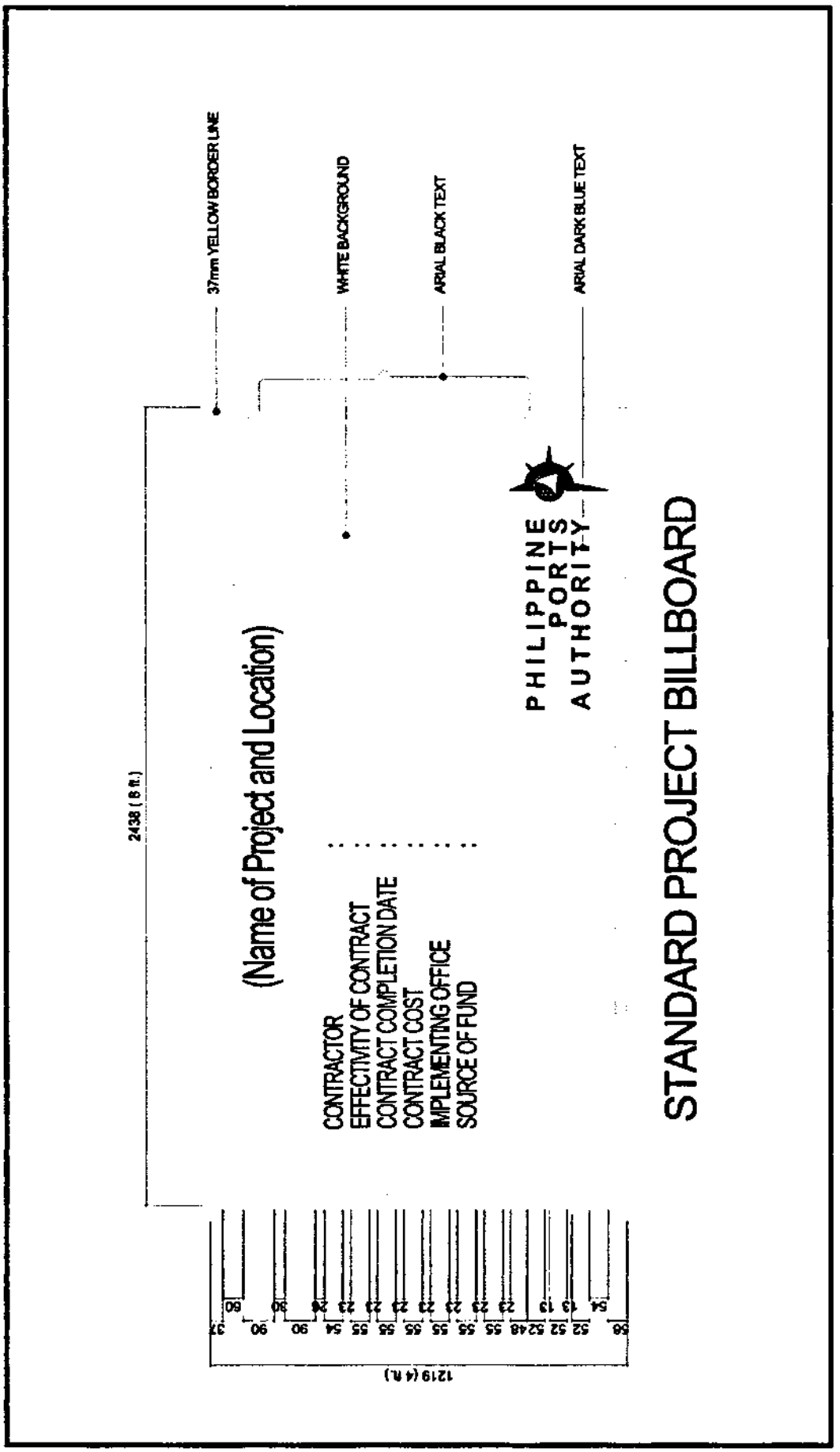
## SPECIFICATION

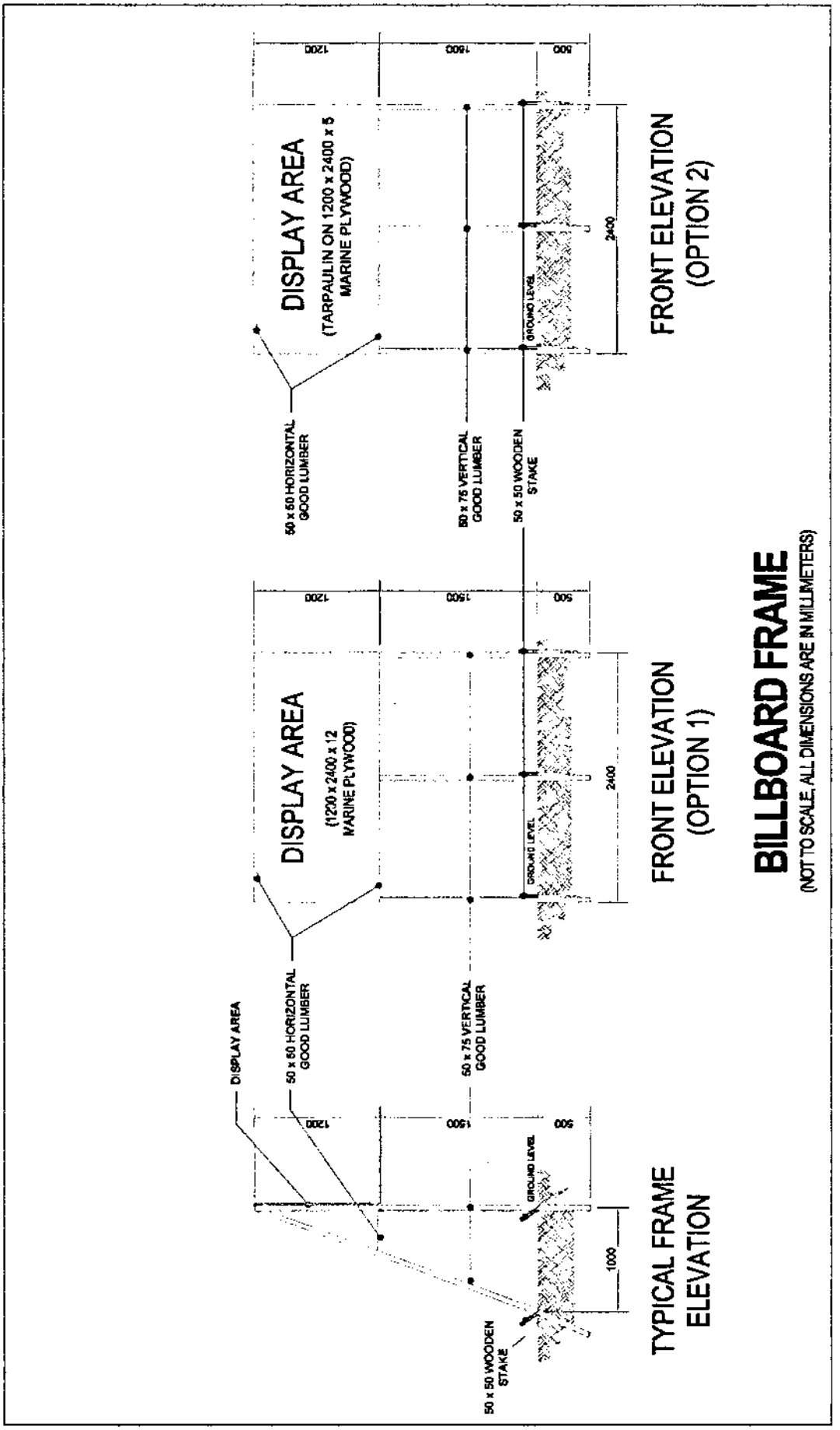
The Project Billboard shall be installed at location(s) designated by the Engineer.

The size and specifications of materials for the standard billboard shall be 4ft. x 8ft. (1,200mm x 2,400mm) using ½ inch (12mm) marine plywood or tarpaulin poster on 3/16 inch (5mm) marine plywood.

Project billboards shall not contain Name(s) and/or picture(s) of any personages.

See attached drawings for further details of the standard billboard.


37mm YELLOW BORDER LINE
WHITE BACKGROUND
ARIAL BLACK TEXT
ARIAL DARK BLUE TEXT
2438 ( 8 ft.)
(Name of Project and Location)
CONTRACTOR
EFFECTIVITY OF CONTRACT
CONTRACT COMPLETION DATE
CONTRACT COST
IMPLEMENTING OFFICE
SOURCE OF FUND
PHILIPPINE PORTS AUTHORITY
STANDARD PROJECT BILLBOARD
1219 ( 4 ft.)


BILLBOARD FRAME
(NOT TO SCALE, ALL DIMENSIONS ARE IN MILLIMETERS)
FRONT ELEVATION
(OPTION 2)
DISPLAY AREA
(TARPAULIN ON 1200 x 2400 x 5
MARINE PLYWOOD)
50 x 50 HORIZONTAL
GOOD LUMBER
50 x 75 VERTICAL
GOOD LUMBER
50 x 50 WOODEN
STAKE
GROUND LEVEL
2400
1200
1500
500
FRONT ELEVATION
(OPTION 1)
DISPLAY AREA
(1220 x 2400 x 12
MARINE PLYWOOD)
TYPICAL FRAME
ELEVATION
1000

## ITEM 37 : SAFETY SIGNAGES AND BARRICADES

### DESCRIPTION

This work includes the furnishing and installing of safety signages and barricades in accordance with the specifications and to the details shown below in the drawings, or as directed by the Engineer.

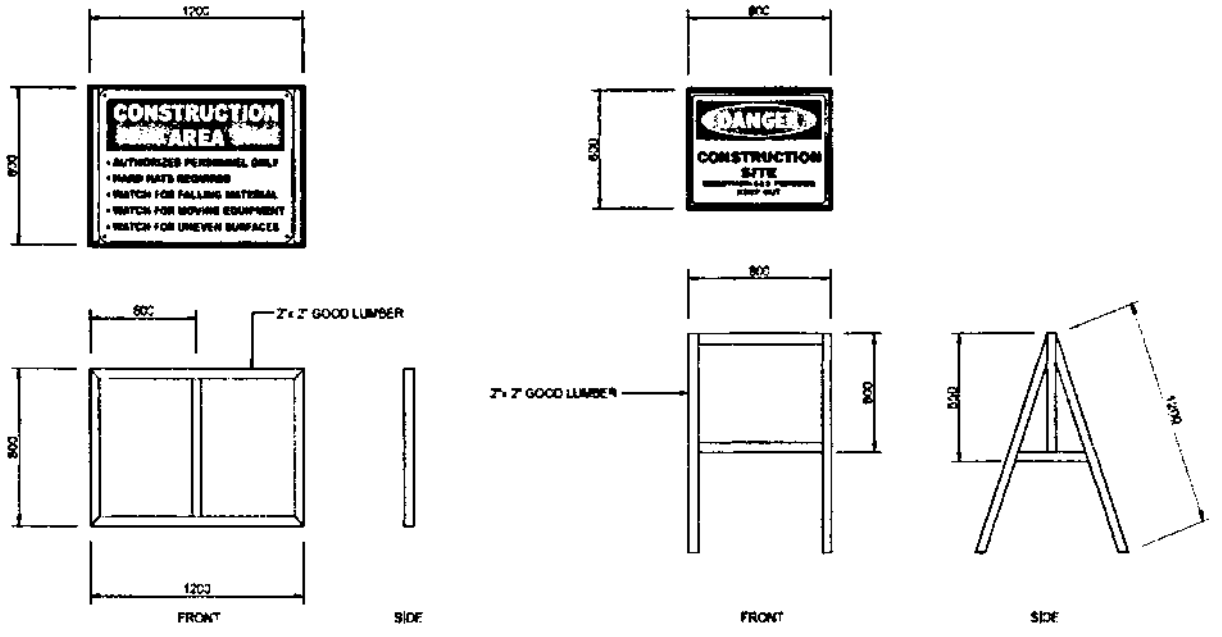
### SPECIFICATION

The Signage's and Barricades shall be installed at location(s) designated by the Engineer.

The sizes of the standard signages shall be 2-2/3ft x 4ft (800mm X 1,200mm) for fixed type and 2ft x 2–2/3ft (600mm x 800mm) for mobile type. For barricade standard 2ft x 2–2/3ft (600mm x 800mm) shall be provided.

The materials to be used for signages and barricades are ½ inch (12mm) marine plywood or tarpaulin poster on 2" x 2" (50mm x 50mm) good lumber frame (see drawing below).

The printing or painting shall be the discretion of the Engineer.




STANDARD PLAN FOR SIGNAGES AND BARRICADES

# *SECTION VII*

# *DRAWINGS*
# *(APPROVED PLANS)*

# DRAWINGS AND APPROVED PLANS
## (SEE ISSUED APPROVED PLANS)

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| PS - 03 of 40 | • GENERAL PLAN |
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| | | |
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| GC - 05 OF 15 | • FLOOR PLAN<br>• ROOF DECK PLAN<br>• REFLECTED CEILING PLAN | • WALL PARTITION LAYOUT<br>• FRONT ELEVATION<br>• REAR ELEVATION |
| GC - 06 OF 15 | • RIGHT SIDE ELEVATION<br>• LEFT SIDE ELEVATION<br>• CROSS SECTION | • LONGITUDINAL SECTION<br>• SCHEDULE OF GATES |
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|---|---|
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# *SECTION VIII*

# *BILL OF QUANTITIES and ATTACHMENTS*

# SECTION VIII – BILL OF QUANTITIES

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# BID SUMMARY
## JASAAN PORT EXPANSION PROJECT
**Port of Jasaan, Misamis Oriental**

| NO. | DESCRIPTION OF WORK | AMOUNT (Pesos) |
|---|---|---|
| BILL NO. 1 | GENERAL EXPENSES | |
| BILL NO. 2 | REMOVAL AND DEMOLITION WORKS | |
| BILL NO. 3 | ACCESS ROAD (173.58m X 9.00m) | |
| BILL NO. 4 | PORT OPERATIONAL AREA | |
| BILL NO. 5 | RC WHARF (SEGMENT 1) | |
| BILL NO. 6 | RC WHARF WITH RORO RAMP (SEGMENT 2) | |
| BILL NO. 7 | RECONSTRUCTION OF EXISTING RORO RAMP TO RC PLATFORM | |
| BILL NO. 8 | PASSENGER TERMINAL BUILDING | |
| BILL NO. 9 | CONSTRUCTION OF COVERED WALKWAY | |
| BILL NO. 10 | CONSTRUCTION OF GATE COMPLEX 1 AND 2, AND GUARD HOUSE | |
| **BID PRICE** | | |

Name of Firm

Name of Bidder/Authorized Representative
(Signatory's Legal Capacity)

Date

# BILL OF QUANTITIES
## JASAAN PORT EXPANSION PROJECT
**Port of Jasaan, Misamis Oriental**

| NO. (1) | DESCRIPTION OF WORK (2) | UNIT (3) | QTY. (4) | UNIT PRICE (Pesos) (5) | AMOUNT (Pesos) (4) x (5) |
|---|---|---|---|---|---|
| BILL NO. | 1 GENERAL EXPENSES | | | | |
| 1.01 | Mobilization, demobilization and cleaning | lot | 1 | | |
| 1.02 | Rental of temporary site office and residence for the Engineer and staff | mo. | 22 | | |
| 1.03 | Maintain temporary site office and residence for the Engineer and staff | mo. | 22 | | |
| 1.04 | Provide Construction Safety and Health Program in the execution of the project | mo. | 22 | | |
| | **TOTAL FOR BILL NO. 1** | | | | - |

Name of Bidder/ Authorized Representative
(Signatory's Legal Capacity)

# BILL OF QUANTITIES
## JASAAN PORT EXPANSION PROJECT
**Port of Jasaan, Misamis Oriental**

| NO. (1) | DESCRIPTION OF WORK (2) | UNIT (3) | QTY. (4) | UNIT PRICE (Pesos) (5) | AMOUNT (Pesos) (4) x (5) |
|---|---|---|---|---|---|
| **BILL NO.** | **2 REMOVAL AND DEMOLITION WORKS** | | | | |
| 2.01 | Demolish and dispose existing building structure | sq.m. | 39 | | |
| 2.02 | Demolish and dispose existing PCCP | sq.m. | 621 | | |
| 2.03 | Demolish and expose existing riprap | cu.m. | 279 | | |
| 2.04 | Chip existing RC curb, flushed to deck level and smoothened with mortar | l.m. | 107 | | |
| 2.05 | Remove existing 35T mooring bollard and mooring bitts and turn over to the authority as directed by the Engineer | no. | 9 | | |
| 2.06 | Remove existing V-type fenders and truck tire fenders and turn over to the authority as directed by the Engineer | no. | 13 | | |
| 2.07 | Demolish and dispose existing temporary steel fence | l.m. | 30 | | |
| 2.08 | Demolish and dispose existing CHB fence | lm. | 27 | | |
| 2.09 | Remove existing gate and turn over to the authority as directed by the Engineer | lm. | 4 | | |
| 2.10 | Remove existing solar lamp posts and turn over to the authority as directed by the Engineer | no. | 14 | | |
| 2.11 | Remove existing twin floodlight lamp posts and turn over to the authority as directed by the Engineer | no. | 2 | | |
| 2.12 | Extract portion of existing bulkhead | cu.m. | 12 | | |

Name of Bidder/ Authorized Representative
(Signatory's Legal Capacity)

# BILL OF QUANTITIES
## JASAAN PORT EXPANSION PROJECT
**Port of Jasaan, Misamis Oriental**

| NO. (1) | DESCRIPTION OF WORK (2) | UNIT (3) | QTY. (4) | UNIT PRICE (Pesos) (5) | AMOUNT (Pesos) (4) x (5) |
|---|---|---|---|---|---|
| 2.13 | Excavation of existing seabed | cu.m. | 411 | | |
| 2.14 | Excavation of existing fill materials | cu.m. | 827 | | |
| | **TOTAL FOR BILL NO. 2** | | | | - |

Name of Bidder/ Authorized Representative
(Signatory's Legal Capacity)

# BILL OF QUANTITIES
## JASAAN PORT EXPANSION PROJECT
**Port of Jasaan, Misamis Oriental**

| NO. (1) | DESCRIPTION OF WORK (2) | UNIT (3) | QTY. (4) | UNIT PRICE (Pesos) (5) | AMOUNT (Pesos) (4) x (5) |
|---|---|---|---|---|---|
| BILL NO. | 3 ACCESS ROAD (173.58m X 9.00m) | | | | |
| 3.01 | Supply and place 3,500 psi. concrete for R.C. curb, retaining wall, culvert, stairlanding, outfall, lamp post foundation and floodlight foundation | cu.m. | 270 | | |
| 3.02 | Supply and install steel reinforcements for R.C. curb, retaining wall, culvert, stairs, outfall, lamp post foundation and floodlight foundation | kg. | 25,885 | | |
| 3.03 | Supply and place gravel bedding | cu.m. | 37 | | |
| 3.04 | Supply and place 50-100 kg./pc. core rocks | cu.m. | 222 | | |
| 3.05 | Supply and place 1000 kg./pc. armour rocks | cu.m. | 1,021 | | |
| 3.06 | Supply and install geotextile fabric | sq.m. | 937 | | |
| 3.07 | Supply and place sand and gravel fill | cu.m. | 148 | | |
| 3.08 | Supply, spread and compact aggregate sub-base course | cu.m. | 454 | | |
| 3.09 | Supply, spread and compact aggregate base course | cu.m. | 376 | | |
| 3.10 | Construct portland cement concrete pavement (300mm thk) including dowel bars and construction joint | sq.m. | 1,882 | | |
| 3.11 | Construct catch drain manhole | set | 1 | | |
| 3.12 | Supply and install High Density Polyethylene Pipe, 600mm dia. | l.m. | 13 | | |

Name of Bidder/ Authorized Representative
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# BILL OF QUANTITIES
## JASAAN PORT EXPANSION PROJECT
**Port of Jasaan, Misamis Oriental**

| NO. (1) | DESCRIPTION OF WORK (2) | UNIT (3) | QTY. (4) | UNIT PRICE (Pesos) (5) | AMOUNT (Pesos) (4) x (5) |
|---|---|---|---|---|---|
| 3.13 | Supply and install High Density Polyethylene Pipe, 900mm dia. | l.m. | 38 | | |
| 3.14 | Supply and deliver to site mooring cleat (15 Tons) including accessories | set | 10 | | |
| 3.15 | Install mooring cleats and accessories | set | 10 | | |
| 3.16 | Construct security fence including painting and accessories | l.m. | 21 | | |
| 3.17 | Reinstallation of existing lamp posts including provision of necessary stainless steel anchor bolts, nuts and other incidentals | set | 12 | | |
| | **TOTAL FOR BILL NO. 3** | | | | - |

Name of Bidder/ Authorized Representative
(Signatory's Legal Capacity)

# BILL OF QUANTITIES
## JASAAN PORT EXPANSION PROJECT
**Port of Jasaan, Misamis Oriental**

| NO. (1) | DESCRIPTION OF WORK (2) | UNIT (3) | QTY. (4) | UNIT PRICE (Pesos) (5) | AMOUNT (Pesos) (4) x (5) |
|---|---|---|---|---|---|
| **BILL NO.** | **4 PORT OPERATIONAL AREA** | | | | |
| 4.01 | Supply and deliver to site Z-Type steel sheet piles including steel corner piles/ connectors | m.t. | 133 | | |
| 4.02 | Supply and apply high-build epoxy protective coating for steel sheet piles (Abrasion Resistant Modified Epoxy With ≥85% Volume Solid, Min. Dry Film Thickness = 800 Microns) | sq.m. | 859 | | |
| 4.03 | Supply and install dowel bars for steel sheet piles | kg. | 1,457 | | |
| 4.04 | Handle, pitch and drive Z-type sheet piles and corner piles | l.m. | 1,148 | | |
| 4.05 | Supply and install steel waling and splice plate for the steel sheet piles | kg. | 5,355 | | |
| 4.06 | Supply and install tie-rod including accessories<br>a) 44mm Ø x 16.00m | set | 39 | | |
| 4.07 | Supply and place 3,500 psi. concrete for R.C. curb, retaining wall, curtain wall and anchor wall | cu.m. | 303 | | |
| 4.08 | Supply and install steel reinforcements for R.C. curb, retaining wall, curtain wall and anchor wall | kg. | 27,439 | | |
| 4.09 | Supply and place 50-100 kg./pc. core rocks | cu.m. | 755 | | |
| 4.10 | Supply and place 1000 kg./pc. armour rocks (2-layers) | cu.m. | 178 | | |
| 4.11 | Supply and install geotextile fabric | sq.m. | 1,133 | | |

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# BILL OF QUANTITIES
## JASAAN PORT EXPANSION PROJECT
**Port of Jasaan, Misamis Oriental**

| NO. (1) | DESCRIPTION OF WORK (2) | UNIT (3) | QTY. (4) | UNIT PRICE (Pesos) (5) | AMOUNT (Pesos) (4) x (5) |
|---|---|---|---|---|---|
| 4.12 | Supply and place sand and gravel fill | cu.m. | 4,584 | | |
| 4.13 | Supply, spread and compact aggregate sub-base course | cu.m. | 853 | | |
| 4.14 | Supply, spread and compact aggregate base course | cu.m. | 269 | | |
| 4.15 | Supply and place gravel bedding | cu.m. | 23 | | |
| 4.16 | Construct portland cement concrete pavement (300mm thk) including dowel bars and construction joint | sq.m. | 1,347 | | |
| 4.17 | Construct security fence including accessories | l.m. | 77 | | |
| 4.18 | Supply and install hot-dipped galvanized angle bar, 100mm x 100mm x 10mm for constrution joints including dowel bars | l.m. | 51 | | |
| 4.19 | Construct port lighting system including supply, delivery and installation of 10m Floodlights and High Must Tower and other incidentals | lot | 1 | | |
| 4.20 | Supply and deliver to site 450mm x 450mm vertical PSC piles for High Must Tower foundati | l.m. | 15 | | |
| 4.21 | Handle, pitch and drive 450m x 450mm Vertical PSC piles for High Must Tower foundation | l.m. | 15 | | |
| 4.22 | Cut/chip and dispose newly driven PSC pile up to required elevation | no. | 1 | | |
| | **TOTAL FOR BILL NO. 4** | | | | - |

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# BILL OF QUANTITIES
## JASAAN PORT EXPANSION PROJECT
**Port of Jasaan, Misamis Oriental**

| NO. (1) | DESCRIPTION OF WORK (2) | UNIT (3) | QTY. (4) | UNIT PRICE (Pesos) (5) | AMOUNT (Pesos) (4) x (5) |
|---|---|---|---|---|---|
| BILL NO. | 5 RC WHARF (SEGMENT 1) | | | | |
| 5.01 | Supply, deliver and drive Test Pile, Ø 550mm x 39m steel pipe piles (13mm thick, A252 Grade 2) including splicing thereof | no. | 1 | | |
| 5.02 | Supply and deliver to site Ø 550mm steel pipe piles (13mm thick, A252 Grade 2) | m.t | 636 | | |
| 5.03 | Handle, pitch and drive Ø 550mm vertical steel pipe piles | l.m. | 1,900 | | |
| 5.04 | Handle, pitch and drive Ø 550mm batter steel pipe piles | l.m. | 1,794 | | |
| 5.05 | Supply and install reinforcing cylindrical band plate at the tip of steel pipe piles | kg. | 2,446 | | |
| 5.06 | Splice Ø 550mm steel pipe piles | no. | 96 | | |
| 5.07 | Extraction of clogged materials inside the steel pipe piles | cu.m. | 73 | | |
| 5.08 | Supply and place 3,500 psi concrete filler for steel pipe piles | cu.m. | 382 | | |
| 5.09 | Supply and install steel cage bar for steel pipe piles | kg. | 88,358 | | |
| 5.10 | Application of polyurethane-base external coating for steel pipe piles (Polyurethane @ 1,500 microns dry film thickness or equivalent) | sq.m. | 2,728 | | |
| 5.11 | Cutting of driven steel piles to required elevation and turn-over of excess materials to authority | no. | 97 | | |
| 5.12 | Supply and place 3,500 psi. concrete for RC deck, beam, pile cap, mooring and fender block, curtain wall, and curb | cu.m. | 427 | | |

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# BILL OF QUANTITIES
## JASAAN PORT EXPANSION PROJECT
### Port of Jasaan, Misamis Oriental

| NO. (1) | DESCRIPTION OF WORK (2) | UNIT (3) | QTY. (4) | UNIT PRICE (Pesos) (5) | AMOUNT (Pesos) (4) x (5) |
|---|---|---|---|---|---|
| 5.13 | Supply and install steel reinforcement for RC deck, beam, pile cap, mooring and fender block, curtain wall, and curb | kg. | 74,462 | | |
| 5.14 | Supply and install hot-dipped galvanized angle bar, 100mm x 100mm x 10mm for constrution joints including dowel bars | l.m. | 68 | | |
| 5.15 | Supply and deliver to site rubber dock fender (V-type, 500H x 1500L) including accessories | set | 6 | | |
| 5.16 | Install rubber dock fender including accessories | set | 6 | | |
| 5.17 | Supply and deliver to site mooring bollard, 35-Ton, Tee-head including accessories | set | 3 | | |
| 5.18 | Install mooring bollard including accessories | set | 3 | | |
| | **TOTAL FOR BILL NO. 5** | | | | - |

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# BILL OF QUANTITIES
## JASAAN PORT EXPANSION PROJECT
**Port of Jasaan, Misamis Oriental**

| NO. (1) | DESCRIPTION OF WORK (2) | UNIT (3) | QTY. (4) | UNIT PRICE (Pesos) (5) | AMOUNT (Pesos) (4) x (5) |
|---|---|---|---|---|---|
| BILL NO. | 6 RC WHARF WITH RORO RAMP (SEGMENT 2) | | | | |
| 6.01 | Supply, deliver and drive Test Pile, Ø 550mm x 39m steel pipe piles (13mm thick, A252 Grade 2) including splicing thereof | no. | 2 | | |
| 6.02 | Supply and deliver to site Ø 550mm steel pipe piles (13mm thick, A252 Grade 2) | m.t | 603 | | |
| 6.03 | Handle, pitch and drive Ø 550mm vertical steel pipe piles | l.m. | 1,672 | | |
| 6.04 | Handle, pitch and drive Ø 550mm batter steel pipe piles | l.m. | 1,833 | | |
| 6.05 | Supply and install reinforcing cylindrical band plate at the tip of steel pipe piles | kg. | 2,345 | | |
| 6.06 | Splice Ø 550mm steel pipe piles | no. | 91 | | |
| 6.07 | Extraction of clogged materials inside the steel pipe piles | cu.m. | 70 | | |
| 6.08 | Supply and place 3,500 psi concrete filler for steel pipe piles | cu.m. | 367 | | |
| 6.09 | Supply and install steel cage bar for steel pipe piles | kg. | 84,840 | | |
| 6.10 | Application of polyurethane-base external coating for steel pipe piles (Polyurethane @ 1,500 microns dry film thickness or equivalent) | sq.m. | 2,620 | | |
| 6.11 | Cutting of driven steel piles to required elevation and turn-over of excess materials to authority | no. | 93 | | |
| 6.12 | Supply and place 3,500 psi. concrete for RC deck, beam, pile cap, mooring and fender block, curtain wall, and curb | cu.m. | 442 | | |

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# BILL OF QUANTITIES
## JASAAN PORT EXPANSION PROJECT
**Port of Jasaan, Misamis Oriental**

| NO. (1) | DESCRIPTION OF WORK (2) | UNIT (3) | QTY. (4) | UNIT PRICE (Pesos) (5) | AMOUNT (Pesos) (4) x (5) |
|---|---|---|---|---|---|
| 6.13 | Supply and install steel reinforcement for RC deck, beam, pile cap, mooring and fender block, curtain wall, and curb | kg. | 80,414 | | |
| 6.14 | Supply and install hot-dipped galvanized angle bar, 100mm x 100mm x 10mm for constrution joints including dowel bars | l.m. | 69 | | |
| 6.15 | Supply and deliver to site rubber dock fender (V-type, 500H x 1500L) including accessories | set | 8 | | |
| 6.16 | Install rubber dock fender including accessories | set | 8 | | |
| 6.17 | Supply and deliver to site mooring bollard, 35-Ton, Tee-head including accessories | set | 3 | | |
| 6.18 | Install mooring bollard including accessories | set | 3 | | |
| 6.19 | Supply and install machine bended 20mm thick steel ramp protection with welded end cover and 100mm Ø pouring holes at 50mm interval | set | 5 | | |
| | **TOTAL FOR BILL NO. 6** | | | | - |

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# BILL OF QUANTITIES
## JASAAN PORT EXPANSION PROJECT
**Port of Jasaan, Misamis Oriental**

| NO. (1) | DESCRIPTION OF WORK (2) | UNIT (3) | QTY. (4) | UNIT PRICE (Pesos) (5) | AMOUNT (Pesos) (4) x (5) |
|---|---|---|---|---|---|
| BILL NO. | 7 RECONSTRUCTION OF EXISTING RORO RAMP TO RC PLATFORM | | | | |
| 7.01 | Supply and place 3,500 psi. concrete for deck, beam, pile cap, RC curb and curtain wall | cu.m. | 48 | | |
| 7.02 | Supply and install steel reinforcement for deck, beam, pile cap, RC curb and curtain wall | kg. | 10,901 | | |
| 7.03 | Supply and install hot-dipped galvanized 100mm x 100mm x 10mm angle bar for construction joints, including dowel bars | l.m. | 31 | | |
| | TOTAL FOR BILL NO. 7 | | | | - |

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# BILL OF QUANTITIES
## JASAAN PORT EXPANSION PROJECT
**Port of Jasaan, Misamis Oriental**

| NO. (1) | DESCRIPTION OF WORK (2) | UNIT (3) | QTY. (4) | UNIT PRICE (Pesos) (5) | AMOUNT (Pesos) (4) x (5) |
|---|---|---|---|---|---|
| **BILL NO.** | **8 PASSENGER TERMINAL BUILDING** | | | | |
| 8.01 | Demolition of existing concrete pavement for construction of Gate Complex 1 & 2, Guard Outpost, covered walkway and Pumphouse | sq.m. | 181 | | |
| 8.02 | Excavation and backfilling works for building foundations, electrical system and plumbing system | cu.m. | 244 | | |
| 8.03 | Scraping of existing fill | cu.m. | 36 | | |
| 8.04 | Supply and deliver to site 450mm x 450mm vertical PSC piles | l.m. | 527 | | |
| 8.05 | Handle, pitch and drive 450m x 450mm Vertical PSC piles | l.m. | 527 | | |
| 8.06 | Cut/chip and dispose newly driven PSC pile up to required elevation | no. | 17 | | |
| 8.07 | Splicing of PSC piles | no. | 17 | | |
| 8.08 | Subgrade preparation | sq.m. | 277 | | |
| 8.09 | Supply and apply soil treatment | sq.m. | 277 | | |
| 8.10 | Supply, place and compact gravel bedding | cu.m. | 37 | | |
| 8.11 | Supply and place 50mm thick lean concrete for concrete piles | cu.m. | 2 | | |
| 8.12 | Supply, spread and compact aggregate sub-base course | cu.m. | 120 | | |

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**Port of Jasaan, Misamis Oriental**

| NO. (1) | DESCRIPTION OF WORK (2) | UNIT (3) | QTY. (4) | UNIT PRICE (Pesos) (5) | AMOUNT (Pesos) (4) x (5) |
|---|---|---|---|---|---|
| 8.13 | Supply and place 4,000 psi concrete for building structure | cu.m. | 253 | | |
| 8.14 | Supply and install steel reinforcement for building structure | | | | |
| | a. Grade 40 | kg. | 25,258 | | |
| | b. Grade 60 | kg. | 25,559 | | |
| 8.15 | Construct 4,000 psi concrete slab on grade, stairs and ramps on-fill including reinforcements | sq.m. | 267 | | |
| 8.16 | Supply, fabricate and install structural steel materials | kg. | 5,946 | | |
| 8.17 | Supply and apply anti corrosive epoxy paint with zinc phosphate (2 coats) | sq.m. | 107 | | |
| 8.18 | Construct 150 mm thick CHB wall including steel reinforcements | sq.m. | 536 | | |
| 8.19 | Construct 100 mm thick CHB wall including steel reinforcements | sq.m. | 261 | | |
| 8.20 | Construct septic vault including fittings and accessories | no. | 1 | | |
| 8.21 | Construct catch basin including accessories | no. | 6 | | |
| 8.22 | Construct Pumphouse including other appurtenances | lot | 1 | | |
| 8.23 | Supply and place 13mm thk. cement plaster | sq.m. | 1,223 | | |
| 8.24 | Supply and apply elastomeric paint (2 coats) | sq.m. | 1,140 | | |
| 8.25 | Supply and apply flat latex paint (2 coats) | sq.m. | 217 | | |

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# BILL OF QUANTITIES
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**Port of Jasaan, Misamis Oriental**

| NO. (1) | DESCRIPTION OF WORK (2) | UNIT (3) | QTY. (4) | UNIT PRICE (Pesos) (5) | AMOUNT (Pesos) (4) x (5) |
|---|---|---|---|---|---|
| 8.26 | Supply and apply quick-drying enamel (2 coats) | sq.m. | 82 | | |
| 8.27 | Supply and apply waterproofing | sq.m. | 407 | | |
| 8.28 | Supply and install 4mm thk. Aluminum composite panels | sq.m. | 575 | | |
| 8.29 | Supply and install 600mm x 600mm unglazed ceramic tiles | sq.m. | 389 | | |
| 8.30 | Supply and install Non-slip Ceramic Tiles | sq.m. | 72 | | |
| 8.31 | Supply and install glazed ceramic wall tiles | sq.m. | 203 | | |
| 8.32 | Supply and install 300mm x 300mm tactile blocks | sq.m. | 3 | | |
| 8.33 | Supply and install 12mm thk. Synthetic granite | sq.m. | 8 | | |
| 8.34 | Supply and install 50mm thk. Rigid-type stair nosing | l.m. | 11 | | |
| 8.35 | Supply and install C1: Aluminum Clip-in Perforated Panels, Bone white, or equivalent (600mm x 1200mm x 0.70mm) | sq.m. | 241 | | |
| 8.36 | Supply and install C2: 12mm thk. Gypsum board painted on 0.40mm thk. Galvanized Steel Ceiling Suspension System @ 0.40m O.C. (Furring), 0.60m O.C. (Carrying Channel), and 1.20m O.C. B.W. (suspension rod) | sq.m. | 183 | | |

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