BIDS AND AWARDS COMMITTEE

Bid Bulletin No. 1

27 October 2020

PROCUREMENT OF DESIGN AND BUILD SCHEME FOR THE ARCHITECTURAL AND ENGINEERING (A&E) DESIGN OF FIT-OUT AND LANDSCAPE WORKS AND CONSTRUCTION OF ESSENTIAL MECHANICAL, ELECTRICAL (DATA CONDUIT), FIRE PROTECTION, SANITARY (MEFPS) AND OTHER CIVIL WORKS FOR THE TWENTY-THREE (23) STOREY PHILIPPINE STATISTICS AUTHORITY (PSA) OFFICE BUILDING WITH COVERED ROOF DECK

This Bid Bulletin No. 1 modifies respective portions of the Bidding Documents, issued on 22 October 2020.

The changes to the Bidding Documents, as indicated in the succeeding pages, are being issued in compliance with Section 22.5 of the Revised 2016 Implementing Rules and Regulations of RA 9184. Under this section, the procuring entity is directed to issue an amendment at least seven (7) days before the deadline for submission of the bid.

Except as expressly amended by this Bid Bulletin, all other terms and conditions of the Bidding Documents issued on 22 October 2020 shall remain unchanged and shall remain in full force and effect in accordance with their terms.

For guidance and information of all concerned.

(Sgd.)
MINERVA ELOISA P. ESQUIVIAS
OIC Deputy National Statistician
BAC Chairperson

PROCUREMENT OF DESIGN AND BUILD SCHEME FOR THE ARCHITECTURAL AND ENGINEERING (A&E) DESIGN OF FIT-OUT AND LANDSCAPE WORKS AND CONSTRUCTION OF ESSENTIAL MECHANICAL, ELECTRICAL (DATA CONDUIT), FIRE PROTECTION, SANITARY (MEFPS) AND OTHER CIVIL WORKS FOR THE TWENTY-THREE (23) STOREY PHILIPPINE STATISTICS AUTHORITY (PSA) OFFICE BUILDING WITH COVERED ROOF DECK

Reference	***Amendments / Revision***
Section VI – Specifications	See attached updated Specifications
Section VIII – Bill of Quantities (BOQ)	See attached updated Bill of Quantities (BOQ)

Section VI. Specifications

Notes on Specifications

A set of precise and clear specifications is a prerequisite for Bidders to respond realistically and competitively to the requirements of the Procuring Entity without qualifying or conditioning their Bids. In the context of international competitive bidding, the specifications must be drafted to permit the widest possible competition and, at the same time, present a clear statement of the required standards of workmanship, materials, and performance of the goods and services to be procured. Only if this is done will the objectives of economy, efficiency, and fairness in procurement be realized, responsiveness of Bids be ensured, and the subsequent task of bid evaluation facilitated. The specifications should require that all goods and materials to be incorporated in the Works be new, unused, of the most recent or current models, and incorporate all recent improvements in design and materials unless provided otherwise in the Contract.

Samples of specifications from previous similar projects are useful in this respect. The use of metric units is mandatory. Most specifications are normally written specially by the Procuring Entity or its representative to suit the Works at hand. There is no standard set of Specifications for universal application in all sectors in all regions, but there are established principles and practices, which are reflected in these PBDs.

There are considerable advantages in standardizing General Specifications for repetitive Works in recognized public sectors, such as highways, ports, railways, urban housing, irrigation, and water supply, in the same country or region where similar conditions prevail. The General Specifications should cover all classes of workmanship, materials, and equipment commonly involved in construction, although not necessarily to be used in a particular Works Contract. Deletions or addenda should then adapt the General Specifications to the particular Works.

Care must be taken in drafting specifications to ensure that they are not restrictive. In the specification of standards for goods, materials, and workmanship, recognized international standards should be used as much as possible. Where other particular standards are used, whether national standards or other standards, the specifications should state that goods, materials, and workmanship that meet other authoritative standards, and which ensure substantially equal or higher quality than the standards mentioned, will also be acceptable. The following clause may be inserted in the SCC.

Sample Clause: Equivalency of Standards and Codes

Wherever reference is made in the Contract to specific standards and codes to be met by the goods and materials to be furnished, and work performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise expressly stated in the Contract. Where such standards and codes are national, or relate to a particular country or region, other authoritative standards that ensure a substantially equal or higher quality than the standards and codes specified will be accepted subject to the Procuring Entity's Representative's prior review and written consent. Differences between the standards specified and the proposed alternative standards shall be fully described in writing by the Contractor and submitted to the Procuring Entity's Representative at least twenty-eight (28) days prior to the date when the Contractor desires the Procuring Entity's Representative's consent. In the event the Procuring Entity's Representative determines that such proposed deviations do not ensure substantially equal or higher quality, the Contractor shall comply with the standards specified in the documents.

These notes are intended only as information for the Procuring Entity or the person drafting the Bidding Documents. They should not be included in the final Bidding Documents.

STAGE I - ARCHITECTURAL AND ENGINEERING (A&E) DESIGN OF FIT-OUT AND LANDSCAPE WORKS:

Deliverables	Deadline/Timeline	
1. Detailed program of work, approach, work plan and schedule for the implementation of the contract works. i. The order in which it intends to carry out the work including anticipated timing for each stage of design/detailed engineering design; ii. Periods for review of specific outputs and any other submissions and approvals; iii. General description of the design methods to be adopted; iv. Number and names of personnel to be assigned for each phase of the work;	**Note:** Within fourteen (14) Calendar Days after issuance of NTP	
2. Reconnaissance, Engineering Surveys and On-Site Investigations.	**Note:** Within forty-five (45) Calendar Days from receipt of 1st Deliverables	
3. Preparation of Preliminary Plans, Elevations, Specification Outlines, Preliminary Cost Estimates, Value Engineering/ Value Analysis Study and other specific recommendations by the Consultant for the Fit-Out and Landscape Design for Architectural/ Civil (Wall/ Partition Works Design: Detailed Connections, Doors and Windows, Ceiling Works), Sanitary/ Plumbing (Plumbing System of additional toilets and integration to main system), Electro-Mechanical (AC System location design of indoor units and integration system of what is on site, Lighting and Power System including perimeter walls, guard houses, etc., Lighting Fixtures including Parking System using lights), Auxiliary Works/ Network/ Cabling/ Data System (BMS in close coordination with ITDS), Fire Detection and Alarm System (Smoke Detector and Sprinkler Location Plan), CATV System, PA/BGM System (Acoustical Design and Sound System for Press Room, Conference and Meetings Rooms), Telephone System, Security/ CCTV System integrated with BMS, Furnishings (Furniture Design, Cabinetries, Counters), Landscaping Works (Details and Planting Methodology, Drainage and Watering System, Front Perimeter Wall		

Design, Guard Houses, Front Landscape & Gate Design, Balconies plants and shrubbery) and Specialty Works (Shades and Curtains, etc.) for Approval before Final Design.		
4. Submission of Final Plans of Approved Preliminary Plan for Fit-Outs and Design for Architectural/Civil, Sanitary/Plumbing, Electro-Mechanical, Network/ Cabling/ BMS, Fire Detection and Alarm System, Furnishings, Specialty Works and Landscaping Works including Working Drawings, Technical Specifications, Detailed Cost Estimates for permit purposes, wherever required, and Bid Documents.	**Note:** Within ninety (90) Calendar Days from receipt of NTP	
5. Approval of Final Plans duly signed and sealed by respective professionals for Fit-Outs and Design for Architectural/ Civil, Sanitary/ Plumbing, Electro-Mechanical, Network/ Cabling/ BMS, Fire Detection and Alarm System, Furnishings, Specialty Works and Landscaping Works including Working Drawings, Technical Specifications, Detailed Cost Estimates for permit purposes, wherever required, and Bid Documents.	**Note:** Within one hundred ten (110) Calendar Days from receipt of NTP	

STAGE II – CONSTRUCTION OF ESSENTIAL MEFPS AND OTHER SUPPORTING CIVIL WORKS:

ELECTRICAL SPECIFICATIONS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Provide all materials and equipment and perform all the work necessary for the complete execution of all the electrical works as shown on the electrical drawings and specifications. Except as otherwise excluded, and which without excluding the generality of the foregoing, shall include but not limited to the following principal items of work:

1. Complete power service entrance including concreting works.
2. Building power and grounding systems.
3. Power distribution equipment, including normal and emergency distribution and lighting/power panelboards, and automatic transfer switches.
4. A system of lighting and power wiring including all feeders, branch circuits and connection to all devices and motors.
5. Main feeders from service transformers to distribution panelboards and from generating set to automatic transfer switches.
6. All lighting fixtures, exit light and battery operated emergency lighting units including all lamps.
7. High voltage primary feeder from utility primary metering to each unit substation.
8. Installation and connection of electrical equipment such as fuel pumps' controllers etc.
9. Securing of electrical wiring permit, certificate of final inspections, and utility connections.
10. Complete testing of all electrical systems.
11. Complete directories, signages and painting of all electrical work and equipment.
12. Grouting or fire proof sealing of openings in floors and walls after all raceways or ducts are in place and sealing of all such openings if not used.

If anything has been omitted or not enumerated in the specifications and the plans of any item of work, which is necessary and usually furnished with the materials and

standard practice in electrical installations, then such items must be are hereby included in this electrical work.

1.2 APPLICATION

A. This section applies to all sections of Division 16, "Electrical" of this project except as specified otherwise in each individual section.

1.3 ADDITIONAL ELECTRICAL WORK

A. Receive, handle, set and connect certain electrical equipment furnished by the Owner.

B. Provide excavation, backfill, concrete, structural supports, miscellaneous materials, and labor for complete installation of items specified under this division unless otherwise shown.

1.4 SUBMITTALS

A. Obtain approval before procurement, fabrication, or delivery of items to the jobsite. Partial submittals will not be acceptable and will be returned without review. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout, dimensions, capacity, project specification and paragraph reference.

1. Shop Drawings: In addition to the requirements of the Contract Clauses, shop drawings shall meet the following requirements. Drawings shall be a minimum of 20 inches by 30 inches in size, except as specified otherwise. Drawings shall include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, 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, revise drawings to show acceptable equipment and resubmit.

2. Manufacturer's Data: Submittals for each manufactured items shall be current manufacturer's descriptive literature of catalogued products, equipment drawings, diagrams, performance and characteristics curves, and catalog cuts.

3. Publication Compliance: Where equipment or materials are specified to conform to industry and technical society publications of organizations such as Philippine National Standards (PNS), Japanese Industrial Standards (JIS), International Electrotechnical Commission (IEC), British Standards (BS), American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), and Underwriters Laboratories Inc. (UL), submit

proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Engineer. In lieu of the label or listing, submit a certificate from an approved independent testing organization, adequately equipped and competent to perform such services, stating that the item has been tested in accordance with the specified organization's test methods and that the item conform to the specified organization's publication.

Certificates of Compliance: Submit manufacturer's certifications as required on products, materials, finish, and equipment indicated in the technical sections. Certifications shall be documents prepared specifically for this contract. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified materials." Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance.

B. Contractor's failure to submit proper shop drawings and obtain approval of the equipment, material or devices prior to manufacturing, delivery on the jobsite and installation shall not be reason to initiate change order or allow for additional compensation to the contractor, when changes are necessary to comply with requirements of the specifications or drawings.

1.5 CONNECTION TO OTHER EQUIPMENT

A. Complete manufacturer's detailed shop drawings wiring and connection diagrams of equipment requiring electrical connection will be provided as specified elsewhere. Contractor shall obtain drawings at the time they are needed.

B. Work that must be altered because of contractor's failure to obtain shop drawings shall be corrected, without additions to the contract price.

1.6 COORDINATION DRAWINGS

A. Drawing are diagrammatic and show general location of conduit and equipment, exact location of conduit and equipment not located by dimensions on drawing shall be determined when equipment and mechanical drawings are available. Contractor shall use these drawings to coordinate installation of electrical equipment. Contractor shall submit coordination drawings to Owner's Representative before installation of equipment with consideration given to interference and appearance.

1.7 OPERATION AND MAINTENANCE MANUAL

A. Submit as required for systems and equipment indicated in the technical sections. Furnish three copies, bound in hardback binders or an approved equivalent. Furnish one complete manual prior to performance of systems or equipment tests, and furnish the remaining manuals prior to contract completion. Inscribe the following identification on the cover: the words "OPERATION AND MAINTENANCE MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment. Include a table of contents and assemble the manual to conform to the table of contents, with the table 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:

1. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the system or equipment.

2. A control sequence describing startup, operation, and shutdown.

3. Description of the function of each principal items of equipment.

4. Installation and maintenance instructions.

5. Safety precautions.

6. Diagrams and illustrations.

7. Testing methods.

8. Performance data.

9. Lubrication schedule including type, grade, temperature range, and frequency.

10. Parts List: The list shall indicate sources of supply, recommended spare parts, price, shipping weight and name of servicing organization.

11. Appendix: List qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

1.8 POSTED OPERATING INSTRUCTIONS

A. Furnish approve operating instructions for systems and equipment indicated in the technical sections for use by operation and maintenance personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions as directed. Attach or post operating instructions adjacent to each principal system and equipment including start-up, property adjustment, operating, lubrication, shutdown, safety

precautions, procedure in the event of equipment failure, and other items of instructions as recommended by the manufacturer of each system or equipment. Provide weather-resistant materials or weatherproof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.9 INSTRUCTION TO OWNER PERSONNEL

A. Where indicated in the technical sections, furnish the services of competent instructors to give full instruction to owner personnel in the adjustment, operation, and maintenance of systems and equipment, including pertinent safety requirements as required. Each instructor shall be thoroughly familiar with all 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 of 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 each individual sections. Instructions to owner personnel shall be at no cost to the Owner.

1.10 DELIVERY AND STORAGE

A. Handle, store, and protect equipment and materials in accordance with the manufacturer's recommendations and with the requirements of Philippine Electrical Code. Replace damaged or defective items with new items.

1.11 CATALOGE PRODUCTS/SERVICE AVAILABILITY

A. Materials and equipment shall be current products by manufacturers regularly engaged in the production of such products. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The 2-year period shall be satisfactorily completed by a product for sale on the commercial market through advertisements or manufacturer's catalogs. Product having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusively of the manufacturers' factory or laboratory tests, is furnished. The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment or a regular and emergency basis during the warranty period of the contract.

1.12 MANUFACTURER'S RECOMMENDATIONS

A. Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

1.13 RECORD DRAWINGS

A. Contractor shall keep in field, and open for inspection by the Owner's Representative, an accurate current, progressive record of actual installation of electrical system. On completion of work, contractor shall deliver to Owner's Representative, marked prints showing actual routing of conduits and ducts, location and elevation of outlets, circuit numbers of lighting and power circuits, installation details of lighting fixtures, power panels, etc.

B. Contractor will be permitted to make changes to meet field conditions or material delivery conditions which may arise. However, in each instance, proposed change must be submitted in form of drawings or sketches for approval and acceptance by Owner's Representative.

1.14 CODES, PERMITS, INSPECTIONS, AND OWNER REQUIREMENTS

A. Work shall comply with the latest requirements of Philippine Electrical Code, Building Rules and Regulations, Local Ordinances, and such other statutory provisions that pertain to this class of work. Such code, rules, regulations and local ordinances are to be considered part of these Contract Documents.

B. Contractor shall, at his own expense, obtain necessary permit for construction and performance of work specified.

C. Contractor shall, at his own expense, secure Certificate of Final Inspection and approval from Electrician's Office of the City or Municipality prior to final approval of the work.

1.15 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be as-shown primary, three-phase, 4 wire, 60 hertz, 400 volts secondary, three-phase, line to line and 230 volts, single phase, line to neutral or as indicated on the drawings. Final connections to the power distribution system at utility power lines shall be made by the Contractor as directed by Electric Utility Company.

1.16 ELECTRICAL REQUIREMENTS

A. Furnish motors, controllers, contactors and disconnects with their respective pieces of equipment not covered under the mechanical contract and or as shown on the drawings. Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Control voltage for controllers and contactors shall not exceed 120 volts nominal. Provide control wiring and conduit under the section specifying the associated equipment. Control wiring and conduit shall conform to the requirements of the section specifying the associated equipment.

PART 2 EXECUTION

2.1 PAINTING OF EQUIPMENT

A. Factory Applied: Electrical equipment shall have factory-applied painting systems which shall, as a minimum meet the requirements of NEMA ICS 6 corrosion-resistance test or approved equal.

B. Field Applied: Paint electrical equipment as required to match finish or to meet safety criteria.

BASIC MATERIALS AND METHODS FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 DESCRIPTION OF THE WORK

A. This section of the specifications covers the basic materials, wiring and construction methods to be provided for the electrical work under sections of these specifications.

1.2 CONCRETE AND EARTHWORK

A. Concrete work shall conform to Section "Cast-in-Place Concrete" and earthwork shall conform to Section "Earthwork". The Contractor shall be responsible for the correct location of foundation and anchor bolts for electrical equipment.

PART 2 PRODUCTS

2.1 MATERIALS

A. The Contractor shall provide material necessary for the proper execution of the work. The materials shall be new and the best of their respective kinds for the use intended. The Contractor shall furnish a complete list of materials and equipment he proposes to use, including delivery dates, subject to the approval of the Owner's Representative, in writing, before ordering the same.

B. Materials shall be listed and labeled by the Philippine Standards (PS) and internationally recognized laboratories where listing service is provided for the type of material specified material shall also meet the applicable standards of NEMA and Local Regulations. Installation shall be strictly in accordance with the requirements of the Philippine Electrical Code.

2.2 ELECTRICAL TAPE (600 VOLT WIRING)

A. Tape shall be polyvinyl chloride, minimum 0.18 mm thickness.
B. Tape shall be PS rated at 80°C and shall maintain flexibility and adhesion from -18°C to +38°C.

2.3 TERMINAL LUGS AND CONNECTORS

A. Terminal and wire connections shall be made using solderless, bolt type lugs. Connectors shall be tin plated copper construction.

2.4 ELECTRICAL SUPPORT DEVICES

A. Junction boxes, cabinets, switches and other electrical equipment shall be rigidly supported by attachment to the building structure prior to the installation of conduit.

B. Rigid steel conduits shall be supported with one hole malleable iron clamps at intervals not greater than 3 meters and within 0.6 meter of a bend or outlet box.

C. Groups of exposed parallel conduits shall be supported by trapeze hangers or metal framing.

2.5 METAL FRAMING

A. Metal framing for support of electrical equipment and conduit runs shall normally be of steel strip cold formed. Aluminum framing shall be furnished only when so noted. One side shall have a continuous slot with unturned clamping ridges on each side. Attachments shall be made to the framing member by means of hardened, toothed, slotted nuts held in place within the member by an attached spring.

1. Framing and attachment fittings shall be made from hot rolled, pickled and oiled steel plates or strip.

2. Nuts shall be made from steel bar stock, case hardened after machining. Nut shall be rectangular and shaped to permit a quarter turn after insertion into channel slot and prevent any further turning of the nut.

3. Channel and parts shall be carefully cleaned and bonderized, then dip painted with a corrosion resistant primer and oven baked. Where so noted, the finish shall be hot-dipped galvanized after manufacturing operations are completed zinc weight shall be 56 grams per 0.09 sm. of surface.

4. Parts, screws and nuts shall be coated with zinc electrolytically.

2.6 HANGER RODS

A. Hanger rods shall be galvanized steel or cadmium plated, 6 mm minimum diameter.

1. Hardware rods shall be fastened to structural steel members with suitable beam clamps or to concrete inserts set flush to the surface.

2.7 HARDWARE FINISH

A. Hardware finish for concrete inserts, pipe straps, nuts, bolts, washers, screws, etc. shall be galvanized or cadmium plated.

2.8 MISCELLANEOUS

A. The Contractor shall furnish and install necessary locknuts, bushings, pipe clamps, ground clamps, supports, pull boxes, mounting bolts, inserts, lugs and such other materials, as may be necessary and proper in the execution of this work.

PART 3 EXECUTION

3.1 LABOR AND SUPERVISION

A. Workmanship shall be in accordance with best practices of trade. Electrical work shall be installed under direct supervision of an electrical engineer.

3.2 LAYOUT AND COORDINATION

A. Contractor shall be responsible for laying out work on site in conformance with contract documents and shall be responsible for damage caused by reason of inaccuracy on his part. Contractor shall take field measurements necessary for his work and shall be responsible for their accuracy.

B. Contractor shall coordinate location of equipment, conduit, outlets, etc. in proper relationship to work specified elsewhere. When other work interferes with this locations, Contractor shall bring matter to attention of Owner's Representative whose decision will be final as to which shall take precedence. Where this is not done, Owner's Representative reserves right to make such changes in work as are necessary to avoid interference, and such changes shall not be considered as extra work.

C. Contractor shall carefully refer to room dimensions, door swings and locations of other equipment for location of outlets. In the event of discrepancy with electrical drawings, Owner requirement shall govern. Provide electrical service and connections to items so requiring in other divisions. Contractor shall check such drawings and specifications, other than electrical, to so determine.

D. Ceiling lighting fixture outlets shall be located for symmetrical installation of lighting fixtures between beams, walls, breaks in ceilings, etc. unless specifically shown or dimensioned on the drawings.

E. Contractor shall keep himself fully informed of progress of general construction, and shall install his work that is concealed and built into building, in place, insufficient time to ensure proper location, without delays to work of other trades. Properly attend electrical work during progress of building-in to prevent misalignment of and damages to electrical work.

3.3 CUTTING AND PATCHING

A. Do cutting, fitting or patching of work that may be required to make its several parts come together properly, and fit it to receive, or be received by work of others, shown upon or reasonably implied by the drawings and specifications.

B. Avoid cutting into work of others by using sleeves, inserts, chases, etc. The Contractor, in whose work it shall be necessary to use these methods, shall build same into his work, but this Contractor shall be responsible for the correct size and location of same, and shall furnish sleeves and inserts.

C. If necessary to cut into the work of another Contractor it shall be done by that Contractor, at this Contractor's expense or by this Contractor with the consent of the other Contractor. Patching made necessary by such cutting shall be executed in the same manner.

D. Cutting shall be done with such tools and methods as will prevent damage to surrounding building areas or equipment, and shall be performed in a neat and orderly manner.

E. Building structural members shall not be drilled, punched, cut, burned, or welded without approval of Owner's Representative. This Contractor will be responsible for damage he inflicts on the building structure.

3.4 DAMAGE TO OTHER WORK

A. This Contractor shall be held responsible for damage to other work caused by this work, or through the neglect of this workmen. Patching and repairing of damaged work shall be done by workmen of the proper trade, but the cost of same shall be paid for this Contractor.

3.5 PAINTING

A. Patched wall surfaces, boxes, or other equipment installed will be finish painted under other sections of these specifications.

B. Factory finished equipment shall be handled with care, to avoid marring the finish. Finishes damaged during installation shall be repaired to the satisfaction of the Architect/Engineer to Owner's Representative by this Contractor. Also, prime coats shall be made and kept intact by this Contractor.

B. Operate each wall switch with circuit energized and verify proper operation.

C. Verify that each receptacle device is energized.

D. Test each receptacle device for proper polarity.

E. Test each GFCI receptacle device for proper operation.

3.5 ADJUSTMENT & CLEANING

Clean installed work.

Clean exposed surfaces to remove splatters and restore finish.

Adjust devices and wall plates to be flush and level. Where outlet boxes are not within 4mm of the finish wall surface, install an extension ring or reinstall outlet box to bring it to within 4mm of the surface in order to provide secure support for the device.

Protect all devices and plates from paint and construction material. All devices and plates shall be clean, undamaged and unscratched.

LIGHTING FIXTURES

PART 1 – GENERAL

DESCRIPTION

The work required under this section consists of the supply, installation, testing and commissioning of the lighting fixtures and associated equipment and materials.

QUALITY ASSURANCE

A. Industry Referenced Standards: The following specifications and standards are incorporated into and become part of this specification by reference. Except where a specific date is given, the issue in effect (including amendments, addenda, revisions, supplements and errata) on the date of invitation for bids, shall apply. In text, such specifications and standards are referenced to be basic designation only.

International Electrotechnical Commission (IEC)

The National Fire Protection Association:
National Electrical Code
Underwriter's Laboratories, Inc.

A. Polyvinyl Chloride (PVC) Conduit shall be schedule 40 heavy wall rated for 90 C conductors and UL listed for aboveground and underground uses in accordance with PEC article 5.6.3. Conduit shall conform to NEMA TC-2 and UL -651 standards.

B. Fittings such as couplings, elbows, offsets, conduit adapters, etc. shall be fabricated from same material as conduit.

PART 3 EXECUTION

3.1 APPLICATION

A. Unless otherwise indicated all types of conduit shall be Intermediate metal conduit to be installed for exposed interior wiring, in concrete slabs, in exterior walls, for exposed exterior wiring, and as shown on drawings except as may be specifically accepted elsewhere in the specifications.

B. Rigid PVC conduit shall be used for underground work only as indicated in the drawings. The conduit shall be concrete encased under paved areas and other location as noted on the drawings. PVC conduit shall also be used in corrosive areas as defined on the drawings, and concealed in floors and walls whenever possible.

C. All 20 mm and 25 mm diameter conduit sizes if embedded in concrete shall be Rigid PVC conduit and remaining type and sizes of conduit shall be rigid steel conduit or unless otherwise indicated in the drawing.

D. Flexible liquidtight PVC jacketed steel conduit shall be used for connections to motors and equipment subject to vibration and in wet or damp locations.

E. Pendant mounted lighting fixtures shall be supported using rigid steel conduit without exception.

F. Minimum size conduit shall be 15 mm unless otherwise noted.

3.2 INSTALLATION

A. Exposed conduit shall be run parallel or perpendicular to building walls and shall be kept as inconspicuous as possible.

B. Conduits shall be concealed in walls and floors, wherever possible. In areas where there are dropped ceilings, conduits shall be installed above ceiling.

C. Conduits and cable trays may be exposed in mechanical equipment rooms.

D. Concealed conduit shall be run in straight lines with long sweep bends and offsets.

E. Conduit entries through building walls below grade shall be made watertight by means of manufactured fittings. Fittings shall provide sleeve through wall having neoprene

ring gasket which can be compressed for positive seal between entering conduit and fitting body.

F. Underground conduits entering areas below grade shall be arranged to drain water that may enter conduit system. Where possible conduits shall pitch away from building to exterior manholes. Junction boxes at conduit entries within building shall be provided with drain holes.

G. Where conduits penetrate fire walls or partitions, pack openings with mineral fiber or approved insulation to maintain integrity of fire barriers.

H. Conduit connections to pull boxes, safety switches, etc. shall be made by use of double steel locknuts. The conduit system, including pullboxes, shall form a continuously conductive grounding system.

I. Conduits shall be protected immediately after installation by means of installing flat, noncorrosive, metallic discs and steel bushings at each end. Discs shall not be removed until necessary for pulling cable. Prior to pulling of cables, steel bushings and metallic discs shall be removed and phenolic insulating bushings shall be installed on end of each conduit of 25 mm size and over.

J. No horizontal runs of conduits may be installed in masonry walls, except by specific permission of the Owner's representative.

K. Conduit shall be substantially supported by pipe straps, or suitable clamps or hangers. Attached to structure of building to provide substantial and rigid installation. Joint use of hangers with heating and plumbing lines will not be permitted.

L. Expansion joints shall be provided in conduit systems that cross building expansion joints or for raceways exceeding 30 meters. Bonding straps shall be used to provide continuous ground around expansion joint.

M. For 20 mm and 25 mm diameter size Rigid PVC conduit embedded in concrete, provide special fitting such as adapter for joining or connecting between PVC and rigid steel conduit. Adapter fitting shall be embedded in concrete and there will be no exposed part of PVC conduit.

3.3 CONDUIT IN SLABS

A. Conduits in structural slabs shall be placed between upper and lower layers of reinforcing steel and shall be spaced at least 200 mm apart. 20 mm conduits may be used in 110 mm and thicker slabs. 25 mm conduits may be used in 130 mm and thicker slabs. Maximum conduit size shall be 40 mm in structural concrete slabs. Conduits running parallel to slab supports such as columns, beams and walls shall not be installed less than 300 mm from such elements. Conduits shall have a minimum of 40 mm of concrete all around.

WIRES AND CABLES FOR 0-600 V CIRCUITS and POWER CABLES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide building wires, power cables, control cables, flexible cords, splices, taps, and termination's as required for electrical work covered by the Contract Documents.

PART 2 PRODUCTS

2.1 BUILDING WIRES FOR 600 VOLTS AND LESS

A. General

1. Conductors shall be new and shall show the name and trademark of the manufacturer and shall be tagged showing acceptance by Underwriter's Laboratories. Conductors shall be identified in accordance with Philippine Electrical Code color coding. Conductors shall be 600 volt insulated and shall be 3.5 mm^2 or larger unless otherwise noted. Sizes larger than 3.5 mm^2 are noted on the drawings.

5. Conductors shall be stranded copper.

6. Conductors used in fluorescent fixture channels shall be rated 90°C.

7. Conductors for power circuits shall be type THHN/THWN.

8. Equipment grounding conductors shall be green or have the ends taped with green tape and shall be type TW.

6. Conductors for wiring in high ambient areas shall be stranded flexible tinned copper. Silicone rubber insulated with heat and moisture resistant glass braid jacket, rated 200°C intermittent operating temperature, 180°C continuous.

B. Insulation Types shall be as follows:

1. Type THHN conductor insulation shall be polyvinyl chloride plastic. Rating shall be **90**°C in wet or dry locations.

C. Approved Product Manufacturers or approved equal.

1. Insulated copper, annealed conductors:

2.2 FLEXIBLE CORDS

A. Flexible cords shall be furnished for pendent connections to lighting fixtures and connections to portable equipment.

2.3 CONTROL CABLE

A. Multiple conductor control cables shall be rated 600 Volts, shall have outer jacket as specified, and be suitable for installation in open, air, ducts, conduit, or direct burial.

B. Conductors: Stranded soft copper or number shown.

C. Insulation: As specified below with stranded IPCEA Color Coding.

2.4 POWER CABLE

A. Power cables shall be rated as specified, 133% shall have outer jacket as specified, and be suitable for installation in open or direct burial.

B. Conductors: Copper

C. Insulation: XLPE Insulation,Extruded Semi-Conductive Conductor

D. Temperature:90 degrees C up to 250 degrees C short circuit condition

PART 3 EXECUTION

3.1 CONDUCTOR INSTALLATION

A. Interiors of conduit shall be clean and dry before pulling wire. If dirt or moisture has entered conduits contractor shall swab them clean.

B. Care shall be exercised while installing wire in conduits so as not to injure conductor insulation. Use only UL listed wire pulling lubricants for pulling-in conductors.

C. Free ends and loops of wire at boxes and enclosures shall be pushed back in box and protected by blank covers or other means until the interior painting or decorating work is completed.

3.2 CONDUCTOR IDENTIFICATION

A. The conductors of branch circuits for power and lighting shall be color coded for identification purposes in accordance with Article 5.3 of the Philippine Electrical Code. Refer to Section 16055 of these specifications.

B. Power feeders for 600 volts and below shall be color coded by using permanent-colored, non - aging insulating tape.

C. Branch circuits shall be connected as numbered on drawings. Test and permanently tag by circuit number each circuit wire, except neutrals, in panel gutter before connecting to panels, using numbered tapes.

D. Terminal strips shall be lettered or numbered, and numbered or lettered tapes shall be attached to conductors connected through terminal strips.

3.3 SPLICES, TAPS AND TERMINATIONS

A. Splices and taps of conductors 5.5 mm² and smaller shall be made using electrical spring connectors with vinyl insulating caps.

B. Splices and taps of conductors larger than 5.5 mm² shall all be made by split-bolt type connectors. Finished splice or tap shall be insulated with one layer of vinyl backed mastic followed by two half-lapped layers of electrical tape or premolded caps or heat shrinkable tubing.

C. Feeder conductors shall be terminated with pressure bolt type lugs.

D. Conductors for other than feeders shall be terminated using pressure bolt type terminals. Where connections are to be made under screw heads only, install insulated crimp type spade lugs on stranded wire ends before connections are made.

E. Connectors shall contain only one wire unless listed for multiple conductors.

F. Feeder cables shall be continuous without splices.

3.4 TESTING

A. Continuity shall be checked by means of a DC test device using a bell or buzzer. Circuit and phase identification tags shall comply with 3.2 above.

B. Lighting circuit shall be identified and shall pass operational tests to see that the circuits perform functions for which they are designed.

C. Cable connections must pass a visual inspection for workmanship and conformance with standard practice.

D. Conductors and leads shall be tested for continuity. Feeder and branch circuits shall be given a megger test using 1000 volt motor driven megger.

1. Megger tests shall be made between one conductor and ground with the other conductors grounded. Each conductor shall be tested in the same manner. Megger readings for cables connected at both ends shall be recorded.

2. Each feeder conductor shall be meggered with the cable connected to the open breaker at the equipment. Connections at the other end of each of these cables shall be as follows:

WIRING DEVICES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Wall switches.
B. Receptacles.
C. Device plates and decorative box covers.
D. Access floor box.

1.2 RELATED SECTIONS

A. Section 16130 - Boxes.

1.3 REFERENCES

A. Philippine Electrical Code
B. NECA - Standard of Installation.
C. NEMA WD 1 - General Requirements for Wiring Devices.
D. NEMA WD 6 - Wiring Device -- Dimensional Requirements.
E. NFPA 70 - National Electrical Code.
F. PEC - Philippine Electrical Code

1.4 SUBMITTALS

A. Product Data: Submit three (3) manufacturer's sample or catalog information showing each dimensions, colors, configuration and etc. Final selection shall be made by the Architect.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70 or PEC.

B. Provide Products listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 WALL SWITCHES

A. Description: NEMA WD 1, Heavy-Duty, AC only general-use snap switch.

B. Body and Handle: Ivory plastic with toggle handle.

C. Ratings:

1. Voltage: 300 volts, AC.
2. Current: 15 amperes.

D. Ratings: Match branch circuit and load characteristics.

2.2 RECEPTACLES

A. Description: NEMA WD 1, Heavy-duty general use receptacle.

B. Device Body: Ivory plastic.

C. Configuration: NEMA WD 6, type as specified and indicated.

D. Convenience Receptacle: Type as indicated.

E. General purpose receptacle are 20 ampere 250 volt 3 pin grounding type.

F. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.3 WALL PLATES

A. Decorative Cover Plate: Ivory, smooth plastic, modern plate.

B. Jumbo Cover Plate: Ivory, smooth plastic, modern plate.

C. Weatherproof Cover Plate: Gasketed cast metal with gasketed device cover. Weatherproof accessories are to be of non-corroding metal or polycarbonate enclosure with a IP56 rating.

DIGITAL KILOWATT-HOUR METER

A. Manufacturers or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions prior to beginning work.

B. Verify that wall openings are neatly cut and will be completely covered by wall plates.

C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 INSTALLATION

Install in accordance with NECA "Standard of Installation."

B. Install switches with OFF position down.

C. Install receptacles with grounding pole .

D. Install decorative plates on switch and receptacle in finished areas.

E. Connect wiring devices by wrapping conductor around screw terminal.
Use jumbo size plates for outlets installed in masonry walls.

Connect the grounding terminal of each device to the equipment grounding conductor of the circuit and connect to the metallic outlet box grounding lug with a pig-tail conductor. The connection shall be made with a conductor pig-tail such that removal of the device will not interrupt the ground continuity of the downstream devices.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Install wall switch 1.2 m above finished floor.

B. Install convenience receptacle 300 mm above finished floor.

C. Install convenience receptacle 150 mm above counter or backsplash of counter.

3.4 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Operate each wall switch with circuit energized and verify proper operation.

C. Verify that each receptacle device is energized.

D. Test each receptacle device for proper polarity.

E. Test each GFCI receptacle device for proper operation.

3.5 ADJUSTMENT & CLEANING

Clean installed work.

Clean exposed surfaces to remove splatters and restore finish.

Adjust devices and wall plates to be flush and level. Where outlet boxes are not within 4mm of the finish wall surface, install an extension ring or reinstall outlet box to bring it to within 4mm of the surface in order to provide secure support for the device.

Protect all devices and plates from paint and construction material. All devices and plates shall be clean, undamaged and unscratched.

LIGHTING FIXTURES

PART 1 – GENERAL

DESCRIPTION

The work required under this section consists of the supply, installation, testing and commissioning of the lighting fixtures and associated equipment and materials.

QUALITY ASSURANCE

A. Industry Referenced Standards: The following specifications and standards are incorporated into and become part of this specification by reference. Except where a specific date is given, the issue in effect (including amendments, addenda, revisions, supplements and errata) on the date of invitation for bids, shall apply. In text, such specifications and standards are referenced to be basic designation only.

International Electrotechnical Commission (IEC)

The National Fire Protection Association:
National Electrical Code
Underwriter's Laboratories, Inc.

Electric Lighting Fixtures
American National Standards Institute (ANSI)
C82.1, .2, .3: Ballasts
The Philippine Electrical Code

International Electrical Commission

IEC 347 Lamp Control Gear
IEC 662 High Pressure Sodium Lamps
IEC 598 Luminaires General
IEC 921 Ballasts for Fluorescent Lamps
IEC 922 Ballasts for Discharge Lamps – General

SUBSTITUTIONS

Lighting fixtures are described in the fixture schedule. A request to utilize fixtures other than those listed in the fixture schedule must be submitted for approval in accordance with these specifications. Process critical and architecturally significant fittings require substantial submittal material to be considered for substitution.

PART 2 – PRODUCTS

GENERAL

Furnish all materials specified herein or indicated on the drawings.

All lighting fixtures, ballasts and lighting controls shall be UL listed and bear a UL label or IEC equivalent.

Fixtures shall be selected from the fixture schedule from the description of the fixture with consideration to mounting, number and types of lamps, and reference notes contained in the fixture schedule and in accordance with these specifications. The fixture catalogue number is provided for easy reference only.

Ballasts and transformers shall be suitably rated for operation on electrical system voltage to which they are to be connected.

1.) **Exit Signs**

Emergency Exit luminaries shall:

Be of the 2x10 watt (minimum) fluorescent lamp type, with one lamp for battery operated emergency operation and the other lamp for 220V operation. Under mains failure the battery will operate the luminaries for 3 hours.
Incorporate "EXIT" lettering directional arrows as detailed in the Schedule or as determined on site.
Contains a main failure relay.
Be adequate ventilated.
Contained sealed nickel cadmium cells with the following features:
Securely fastened in position with purpose made clamps separately housed in a battery pack.
Located clear in any source.

Positioned to permit removal and replacement without removing other components, and the luminaries mounted in position.
Minimum installation life of five (5) years and a guaranteed life of 3 years when operated in accordance with the manufacturer's directions in the proposed exit luminaries.

Have reversed battery polarity protection.
Have lamp removal protection.
LED indication of charging mode.

2.) **Emergency Luminaires**

All emergency luminaries shall:

Contain visual indicator lights
Include local light switches
Contain inverter protection against damage in the event of lamp failure removal.
Contain battery packs to operate the luminaries for a period of 3 hours.
Standard luminaries specified with battery back up shall be delivered to site complete with all inverters, change over system and battery.

3.) **FLUORESCENT LIGHTING FIXTURES ACCESSORIES**

a. **Housing**
Gauge 24 cold rolled steel in white powder coated glossy paint finish with 60-80 microns thickness.

b. **Reflector**
0.4mm thick anodized aluminum in mirror finish with 86% total reflectance and 14% diffuse reflectance.

c. **Louver**
Multi-lined 0.7mm thick anodized aluminum in matt finish.

d. **Ballast**
230V/60Hz., program warm start high frequency electronic ballast, permissible voltage 198-264V, overvoltage protection 350V/2h, power factor >0.95, operating temperature -20 to +55 °C and with Philippine Standard quality and safety certification mark. ENEC conformance.

e. **Fluorescent Lamp**
T8 energy saving and tri-phosphor 36 watts w/ 3350 lumen output and 18 watts w/ 1350 lumen output color 80's TL'D energy saving lamp.

f. **Lampholder**
White Polycarbonate casing, 130 °C Temperature
G13 push-through rotary type lampholder for T8 and T12 lamp.

PART 3 – EXECUTION

FIXTURE SUPPORTS AND MOUNTING

Lighting fixtures will be installed in accordance with the manufacturer's recommended mounting methods. Provide complete details regarding the required mounting methods for each of the fittings in the location they are to be installed. All lightings shall be supported from the building structure.

Surface mounted fixtures mounted on concrete structure, sheet rock or plaster ceiling or low density acoustical tile ceilings shall be mounted with two 6mm x 40mm x 100mm metal spaces between the fixture and the ceiling, if required. HID fittings shall be provided complete with "quick mount" base for ease of maintenance.

Propose complete dimensioned, fixing details for all fittings recessed in the walk-on ceiling to enable the ceiling to be prepared for their mounting.

INSTALLATION

Verify focusing, orientation and mounting details of all fittings prior to installing.

Labels shall be positioned on fixtures so that they will not be visible under normal operating conditions of the fixtures.

Install all recessed or semi-recessed luminaries in a means enabling adequate cooling.

Install lamps in all lighting fixtures.

Do not install luminaries or transformers in thermal insulation.

Allow for repositioning of all production area fittings to ensure full coordination with process or building services pieces of equipment.

Luminaires are not be suspended off sprinkler, water, or mechanical services. Use steel pipe suspension rods or electroplated welded link chain as appropriate.

Provide unswitched active supply to each emergency luminaries, exit signs.

All lighting fixtures shall be free of light leaks, wraps, dents, and other irregularities.

CLEANING AND ADJUSTMENT

Provide replacement lamps and control gear for all fixtures in which lamps have burned out, are inoperative or for fixtures in which lamps are not providing 100% output.

Replace all metal halide lamps which have a discernable color shift after 100 hours of operation.

EMERGENCY LIGHTING

A. Mains Supply

Before commissioning, ensure mains supply has been continuously connected for at least 24 hours.

B. Single-Point Systems

Disconnect the mains supply to each general lighting final sub-circuit and verify the correct operation of luminaries and exit signs for a continuous period of 2 hours. Then restore normal supply and verify the operation of the indicator lights on each luminaries.

C. Record test results for all circuits and luminaries and provide format to record future maintenance testing.

GROUNDING

PART 1 GENERAL

1.1 **DESCRIPTION OF WORK**

Grounding systems shall be installed in accordance with requirements of Philippine Electrical Code.

Switchgear, transformers, panelboards, system neutrals, conduit system, telecom, grounding bus and electrical equipment shall be grounded.

The building electrical system is 3 phase, 3 wire plus protective ground supplemented with an equipment grounding system. The equipment grounding system shall be established with equipment grounding conductors. The use of metallic raceways for equipment grounding is not acceptable.

Driven electrodes, earth pits, connection to building structured elements, copper, strapping etc. as appropriate to be included.

Building grounding shall be provided as shown.

PART 2 PRODUCTS

2.1 **GROUND RODS**

Copper clad steel, 20 mm X 3 M

2.2 **BARE COPPER WIRE**

Soft Drawn

2.3 **BRASS CONNECTORS**

Bolt type or exothermic weld.

PART 3 EXECUTION

3.1 Ground conductors for electrical equipment shall be sized in accordance with Meralco and Philippine Electrical Code Article 4.2 when not indicated on drawings. Double locknuts shall be used at box connections on feeder and motor circuits.

3.2 Grounding bus bars as shown in the plans shall be provided. These grounding bus shall have riser connected to the ground loop.

3.3 Connections, cable to cable, between cable and ground rods, or cable and steel shall be made by bolt type connectors or exothermic weld connection. Buried connections shall be covered with cold pitch and wrapped with tape.

3.4 Ground rods shall be installed at locations shown on drawings.

3.5 Bonding: Metallic conduits entering switchboards, MCC's substations, and other equipment fed from substations shall be bonded by means of bonding bushings with copper cable jumpers to ground bus.

3.6 Flexible connections to motors shall be jumpered with flexible copper equipment grounding conductor.

3.7 Receptacle Grounding: Green pigtail shall be installed from grounding screw of grounding outlets to outlet box in each instance where receptacle attachment bar is not approved as self grounding type.

3.8 Ground all non current carrying parts of the electrical system, i.e., wireways, equipment enclosures and frames, junction and outlet boxes, machine frames and other conductive items in close proximity with electrical circuits, to provide a low impedance path for potential grounded faults.

3.9 Lighting fixtures shall be grounded with a green insulated ground wire secured to the fixture with a bond lug, screw, or clip specifically made for such use.

3.10 Equipment bonding jumpers shall be installed inside raceways.

3.11 Grounding conductor for branch circuits are not shown on the drawings, however, grounding conductors shall be installed with all branch circuit raceways and cables. Grounding conductor shall be as noted otherwise on the plan.

3.12 Grounding conductors for feeders will be installed. Where the grounding conductor size is not indicated in the drawings, the conductor shall be sized in accordance with the equipment grounding conductor table of the Philippine Electrical Code.

3.13 A grounding conductor will be installed in all flexible conduit installations. For branch circuits the grounding conductor shall be sized to match branch circuit conductors.

3.14 The equipment grounding conductor shall be attached to equipment with a bolt or sheet metal screw used for no other purpose. Where the grounding conductor is stranded, attachment shall be made utilizing a lug attached to the grounding conductor with a crimping tool

3.14 Ground all motors by drilling and tapping the bottom of the motor junction box and attaching the equipment grounding conductor to the box with a round head bolt used for no other purpose. Conductor attachment shall be through the use of a lug attached to the conductor with crimping tool.

3.15 Equipment grounding conductors shall terminate on the panelboard or switchboard ground bus only. Do not terminate on the neutral bus. Provide a separate termination lug for each conductor. Conductors shall terminate in the same section as the phase conductors originate. Do not terminate neutral conductors on the ground bus.

3.16 Effectively earth all metal work in the vicinity of switchboards. Do not earth equipment via a neutral bus or the earth connection.

3.17 Ground Resistance: This Contractor shall furnish instruments for and measure ground resistance of entire main grounding system and each rod. Measured resistance of entire system for building and substations shall not exceed 5 Ohms.

3.18 Resistance test of each ground rod and of entire system, where specified, shall be determined by "fall-of-potential" method using either a ground Ohmer or megger ground tester. Owner's Representative shall be notified in writing 24 hours in advance of test and test shall be performed in the presence of the Owner's Representative. Where minimum resistance as specified cannot be obtained with number of ground rods shown on drawings, additional rods shall be driven until desired resistance is obtained. Additional rods shall be located at least 3 meters from other rods.

3.19 Inspect wiring system junction point locations for proper grounding. Verify connections of grounds either mechanical, hydraulic or exothermic. Verify proper connections to all components of the grounding system. Note all system components which are interconnected and the type of connection.

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide nameplates on the following types of equipment:

1. Panelboards
2. Safety Switches or Circuit Breakers
3. Control Panels
4. Control Devices
5. Cabinets and Pull Boxes
6. Receptacles
7. Automatic Transfer Switch
8. Transformer and related Electrical Equipment
9. Switchgear/ Switchboard, Panelboard and related equipment directories.

B. Provide color coding of branch circuit and feeder conductors for phase and voltage identification.

C. Provide wire markers for:

1. Branch Circuit Identification

2. Control Wire Identification

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Equipment nameplates shall be engraved laminated phenolic, with white surface and black core. Use 3 mm thick material for plates up to 50 x 100 mm. Larger size, use 4 mm thick material.

B. Edges of nameplates shall be chamfered 1 mm x 45 approximately. Lettering shall be gothic or normal block style. Space between lines shall be equal to width of the letters. Use 6mm minimum height letters which occupy four per 25 mm. Increase size to 20mm on largest plates. Lettering shall include name of equipment specific unit number and references to 'on-off' or other instructions applicable lettering on receptacles shall indicate branch circuit number and panel identification.

2.2 **WIRE MARKERS**

Shall be oil-resistant, adhesive backed vinyl film with legends etched into surface.

PART 3 EXECUTION

3.1 **CONDUCTOR COLOR CODE**

A. Branch circuit and feeder conductors shall be color coded by furnishing conductors with colored insulation or by wrapping insulation with colored tape where exposed in junction boxes, pull boxes and cabinets. Color coding shall be as follows:

B. 400 Volts, 3 Phase, 3 Wire

1.	Phase Conductors	-	Red (A), Yellow (B), Blue (C)
2.	Neutral	-	White
3.	Grounding	-	Green

C. 230 Volts, 1 Phase, 2 Wire

1.	Phase Conductors	-	Black, Red
2.	Grounding	-	Green

D. Branch circuit wiring shall maintain same wire coloring throughout circuit.

3.2 **CONDUCTOR LABELING**

A. Each branch circuit conductor shall be labeled with wire markers to identify circuit number.

3.3 **NAMEPLATE ATTACHMENT**

A. Except where adhesive is specified, other nameplates shall be securely attached using corrosion resistant metal screws.

3.4 **WIRING COLOR CODING FOR AUXILLARY SYSTEMS**

Color coding or wire markers of control wiring for equipment furnished by Owner or other trades shall be the same as the equipment marking or color coding.

2.1 **AUTOMATIC SWITCH EQUIPMENT**

Switches shall be UL listed for use in emergency system describe in NFPA No. 70 and shall be manufactured and tested in compliance with applicable requirements of UL 1008, NEMA KS1 and 2 and IEEE No. 472 or approved equal.

Complete factory assembled transfer equipment with electronic control designed for surge voltage isolation, voltage sensors on all phases of both sources, linear operator, permanently attached manual handles, positive mechanical and electrical interlocking, and mechanically held contacts. Equipment rated 1000 amps and less shall include quick-make, quick-break contact mechanisms for manual transfer under load.

A. Project Drawings:

Refer to the project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, number of poles, voltage and ampere ratings, enclosures, and accessories.

All transfer switches and accessories shall be UL listed and labeled, tested per UL Standard 1008, and CSA Approved.

B. Ratings:

Transfer switches shall be rated to carry 100 percent of rated current continuously in the enclosure. Circuit breaker type transfer switches do not meet this specification shall not be accepted.

Transfer switches shall be continuously rated in ambient temperatures of -40 to +50 degrees C, relative humidity up to 95% (non-condensing), altitudes up to 10,000 feet and seismic zone 4.

Transfer switch equipment shall have a withstand and closing rating (WCR) in RMS symmetrical amperes greater than the available fault currents of 200,000 amperes, RMS symmetrical, at a power factor between 0.0 and approximately 0.20 at a maximum voltage of 480 a.c.

C. Construction:

Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in both positions. Transfer switches rated through 1000 amperes shall be equipped with permanently attached manual operating handles and quick-break, quick-make over-center contact mechanisms suitable for safe manual operation under load. Transfer switches over 1000 amperes shall be equipped with manual operators for service use only under de-energized conditions.

Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishment. Arc chutes shall have insulating covers to prevent interphase flashover.

Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.

Enclosures shall be UL listed. The enclosure shall provide NEC wire bend space. The cabinet door shall be key-locking. Controls on cabinet door shall be key-operated. Provide switch position indicator lamps and power available lamps for both sources (four total) on the outside cabinet door.

Transfer switches shall be mounted in enclosures as designated on the drawings. Separate enclosures shall be the NEMA type specified. The cabinet shall provide required wire bend space at point of entry as shown on the drawings. Manual operating handles and all control switches (other than key-operated switches) shall be accessible to authorized personnel only by opening the key-locking cabinet door.

Transfer switches with manual operating handles and/or non key-operated control switches located on outside of cabinet do not meet this specification and are not acceptable.

D. Automatic Controls:

Control shall be solid-state and designed for a high level of immunity to power line surges and transients, demonstrated by test to IEEE Standard 587-1980. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs.

Solid-state undervoltage sensors shall simultaneously monitor all phases of both sources. Pick-up and drop-out settings shall be adjustable. Voltage sensors shall allow for adjustment to sense partial loss of voltage on any phase. Voltage sensors shall have field calibration of actual supply voltage to nominal system voltage.

Controls shall be provided with solid-state overvoltage sensors, adjustable from 100-130% of nominal, to monitor all phases of the normal and emergency sources. Provide adjustable time delay of 0.5 to 2.2 sec.

Controls shall be provided with a solid-state over and under frequency sensor to monitor the normal and emergency sources. Pickup bandwidth shall be adjustable from a minimum of ± 4% to a maximum of ± 20% of nominal frequency. Dropout shall be ± 5% of nominal wider than pickup frequency bandwidth. Adjustable time delay shall be from 0.1 to 15 sec.

Automatic controls shall signal the engine-generator set to start upon signal from normal source sensors. Solid-state time delay start, adjustable from 0 to 5 seconds (factory set at 2 seconds) shall avoid nuisance start-ups. Battery voltage starting contacts shall be gold, dry type contacts factory wired to a field wiring terminal block.

The switch shall transfer when the emergency source reaches the set point voltage and frequency. Provide a solid-state time delay on transfer, adjustable from 0 to 120 seconds.

The switch shall retransfer the load to the normal source after a time delay retransfer, adjustable from 0 to 30 minutes. Retransfer time delay shall be immediately bypassed if the emergency power source fails.

Controls shall signal the engine-generator set to stop after a time delay, adjustable from 0 to 10 minutes, beginning on return to the normal source.

Power for transfer operation shall be from the source to which the load is being transferred.

The control shall include latching diagnostic indicators to pinpoint the last successful step in the sequence of control functions, and to indicate the present status of the control functions in real time, as follows:

Source 1 OK
Start Gen Set
Source 2 OK
Transfer Timing
Transfer Complete
Retransfer Timing
Retransfer Complete
Timing for Stop

The control shall include provisions for remote transfer inhibit and area protection.

Transfer switches as designated on the drawings, shall be equipped with a field adjustable time delay during switching in both directions, during which time the load is isolated from both power sources, to allow load residual voltage to decay before closure to the opposite source. The delay feature shall have an adjustable range of 0 to 7.5 seconds. Phase angle monitor is not acceptable.

E. Front Panel Devices:

Provide devices mounted on cabinet front consisting of:

A key-operated selector switch to provide the following positions and functions:

Test - Simulates normal power loss to control for testing of generator set. Controls shall provide for a test with or without load transfer.

Normal - Normal operating position.

Retransfer - Momentary position to override retransfer time delay and cause immediate return to normal source, if available.

Non-automatic Controls transfer switches designated on the drawings, shall be provided with a non-automatic control. The control shall operate the transfer switch position either by a remote contact opening or closing, or by a front panel mounted selector switch. The selector switch shall be a three-position switch. In the center Auto position the transfer switch shall transfer and retransfer in response to input signals as shown. The key shall be removable with the selector switch in the Auto position only. Turning the selector switch to the Emergency position shall transfer load to an energized emergency power source. Turning the selector switch to the Normal position shall transfer load to an energized normal power source.

F. Accessory Items:

Transfer switches as shown on the drawings shall be equipped with accessories as follows:

1. Meters: Provide an AC Voltmeter, an Ammeter, and a Frequency meter; 2.5 inch, analog, 2% accuracy. Provide a phase selector switch to read L-L voltage and current of both power sources.

2. Exerciser Clock: Provide solid state exerciser clock to set the day, time, and duration of generator set exercise/test period. Provide a with/without load selector switch for the exercise period.

3. Battery Charger: Provide a float charge battery charger rated 10 amps. DC output voltage shall be as required for the starting batteries. An ammeter shall display charging current. The battery charger shall have fused AC input and fused DC output. Include fault indications and Form C contact for AC Fail, High Battery Voltage, and Low Battery Voltage.

4. Battery Charger: Provide a float charger battery charger rated 2 amps. DC output voltage shall be as required for the starting batteries. An ammeter shall display charging current. The battery charger shall have fused AC input and DC outputs.

5. Manual Selector Switch: Provide a manual/automatic retransfer selector switch to provide either automatic retransfer after the retransfer time delay, or a manual retransfer when selected by an operator.

6. Load Shed: Provide a load shed relay, to move the transfer switch from the emergency position to a neutral position, on receipt of a signal from a remote device.

7. Signal Module: Provide signal module, to delay the transfer and retransfer of the switch for up to 50 seconds to provide a pretransfer warning signal contact. Provide signals for the following conditions:

   - source 1 available
   - source 2 available
   - test/exercise
   - backup source available

   Contacts for these functions are to be form C type, rated for 120 VAC or 30 VDC at amps.

8. Phase Sequence Monitor/Balance Module: Provide Phase Sequence Monitor and Balance module to protect against inadvertent phase rotation hookup and monitor for voltage phase imbalance between phases.

9. Enclosure: The switch and accessories shall be in free-standing, floor-mounted and ventilated NEMA ICS 6 or equal, smooth sheet metal enclosure constructed in accordance with UL 1008 or equal. Gage of the metal shall be not less than 14. Doors shall have suitable hinges, locking handle latch, and gasketed jambs. The enclosure shall be equipped with one approved size and type of grounding lugs grounding the enclosure using 100 sq. mm copper conductors. The Contractor's field wiring terminating within the enclosure shall comply with NFPA No. 70 or Philippine Electrical Code equivalent. If wiring is not color coded, wires shall be permanently tagged near the terminal

at each end with the wire number shown on approved shop drawings. Terminal blocks shall conform to NEMA ICS 4 or equivalent. Terminal facilities shall be suitably arranged for entrance of external conductors from the top of the enclosure. Main switch terminals, shall be of the pressure type and suitable for the termination of copper conductors.

a. Construction: The enclosure shall be constructed for convenient removal and replacement of contacts, coils, springs and control devices from the front without the removal of main power conductors or removal of major components.

b. Cleaning and Painting: Ferrous surfaces shall be cleaned and painted. Surfaces to be painted shall be free of all oil, grease, welding slag and spatter, mill scale, deleterious corrosion, dirt and other foreign substances. Painting shall include at least one coat of rust-inhibiting primer and one coat of finish enamel. The rust-inhibiting primer shall be applied to a clean, dry surface as soon as practicable after cleaning. Painting shall be manufacturer's standard material and process except that the total dry film thickness shall not be less than 2.5 mils. Color of the finish coat may be the manufacturer's standard color. The finish shall be free from runs, sags, peeling or other defects.

PART 3 EXECUTION

3.1 Contractor shall install and connect switchboard at the location as shown on the approved drawings. Provide necessary supports, framework, etc. as required for proper rigid installation.

PANELBOARDS

PART 1 - GENERAL

1.1 **SECTION INCLUDES**

A. Distribution panelboards.

B. Branch circuit panelboards.

1.2 **RELATED SECTIONS**

A. Section 16170 - Grounding and Bonding.

B. Section 16195 - Electrical Identification.

1.3 **REFERENCES**

A. NECA Standard of Installation (published by the National Electrical Contractors Association).

B. NEMA AB1 - Molded Case Circuit Breakers.

C. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies.

D. NEMA KS1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

E. NEMA PB 1 - Panelboards.

F. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

G. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).

H. NFPA 70 - National Electrical Code.

PEC - Philippine Electrical Code.

1.4 SUBMITTALS FOR REVIEW

A. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

1.5 SUBMITTALS FOR INFORMATION

A. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 SUBMITTALS FOR CLOSEOUT

A. Record actual locations of panelboards and record actual circuiting arrangements in project record documents.

B. Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

1.8 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70 or PEC.

B. Products: Listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.9 MAINTENANCE MATERIALS

A. Furnish two (2) of each panelboard key.

PART 2 PRODUCTS

2.1 DISTRIBUTION PANELBOARDS

Description: NEMA PB 1, circuit breaker type.

A. Service Conditions :

1. Temperature :
2. Altitude :

Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.

Minimum integrated short circuit rating: As indicated.

Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower, with bimetal overload relay. Coil operating voltage: 120 volts, 60 Hertz. Size as shown on Drawings. Provide unit mounted control power transformer and HAND-OFF-AUTO selector switch or STOP-START pushbutton station and RED, GREEN indicating light in front cover.

Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.

Enclosure: As indicated, sizes as required.

Cabinet Front: Surface type, fastened with concealed trim clamps or screws, concealed hinged door with flush lock with key, metal directory frame, finished in manufacturer's standard gray powder coating enamel.

2.2 BRANCH CIRCUIT PANELBOARDS

A. Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

B. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard; provide insulated ground bus where scheduled.

C. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 240 volt panelboards or as indicated in the plans.

D. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.

E. Enclosure: NEMA PB 1, Type 1/ Type 3R.

F. Cabinet Box: As required.

G. Cabinet Front: Flush / Surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray powder coating or enamel.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1 and the NECA "Standard of Installation."

B. Install panelboards plumb. Install recessed panelboards flush with wall finishes.

C. Height: 6 feet (1800 mm) to top of panelboard; install panelboards taller than 6 feet (1800 mm) with bottom no more than 4 inches (100 mm) above floor.

D. Provide filler plates for unused spaces in panelboards.

E. Provide typed or neatly handwritten circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

F. Provide engraved plastic nameplates under the provisions of Section 16195.

G. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling/ below floor. Minimum spare conduits: As indicated. Identify each as SPARE.

H. Ground and bond panelboard enclosure according to Section 16170.

3.2 FIELD QUALITY CONTROL

A. Field inspection, testing, and adjusting shall be performed.
B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.4 for switches, Section 7.5 for circuit breakers.

3.3 **ADJUSTING**

A. Adjust installed work.

Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

ENCLOSED CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 **SECTION INCLUDES**

A. Molded case enclosed circuit breakers.

1.2 **RELATED SECTIONS**

A. Section 16195 - Electrical Identification: Engraved nameplates.

1.3 **REFERENCES**

NEMA AB 1 - Molded Case Circuit Breakers.

NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).

NFPA 70 - National Electrical Code.

PEC - Philippine Electrical Code.

1.4 **SUBMITTALS FOR REVIEW**

A. Product Data: Provide catalog sheets showing ratings, trip units, time current curves, dimensions, and enclosure details.

1.5 **SUBMITTALS FOR INFORMATION**

Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include

instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience, and with service facilities within 100 miles of Project.

1.7 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70 or PEC.

B. Products: Listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 EXTRA PRODUCTS

A. Furnish three (3) of each size and type of current limiter.

PART 2 PRODUCTS

2.1 MOLDED CASE CIRCUIT BREAKER

A. Circuit Breaker: NEMA AB 1.

2.2 PRODUCT OPTIONS AND FEATURES

A. Accessories: As scheduled. Conform to NEMA AB 1.
B. Shunt Trip Device: 120 volts, AC.
C. Undervoltage Trip Device: 120 volts, AC.
D. Auxiliary Switch: 120 volts, AC.
E. Alarm Switch: 120 volts, AC.
F. Electrical Operator: 120 volts, AC.
G. Handle Lock: Provisions for sealing.
H. Insulated Grounding Lug: In each enclosure.
I. Products suitable for use as service entrance equipment where so applied.

2.3 ENCLOSURE

A. Enclosure: NEMA AB 1, Type as required.
B. Fabricate enclosure from steel.
C. Finish using manufacturer's standard enamel finish gray color.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with NECA "Standard of Installation."
B. Install enclosed circuit breakers plumb. Provide supports in accordance with Section 16190.
C. Height: 5 ft (1500 mm) to operating handle.
D. Locate and install engraved plastic nameplates under the provisions of Section 16195.

3.2 **FIELD QUALITY CONTROL**

A. Inspect and test in accordance with NETA ATS, except Section 4.
B. Perform inspections and tests listed in NETA ATS, Section 7.6.1.1.

3.3 **ADJUSTING**

Adjust installed work.
Adjust trip settings so that circuit breakers coordinate with other overcurrent protective devices in circuit.

C. Adjust trip settings to provide adequate protection from overcurrent and fault currents.

FIRE BARRIER

1.0 GENERAL

1.1 The penetration seal (also referred to as "Fire Stop", Fire Barrier" or " Through Penetration Fire Stop") must provide the same fire resistance as the wall or floor in which the penetration opening is located.

The fire resistance of the penetration seal must be certified by either one of the following institutions:

Fire Insurer's Research Corp. U.K. (FIRTO)
Underwriters Laboratories U.S.A. (UL)
Factory Mutual Eng. Corp. (FM)
The German Institute for Construction Technology
The institute TNO Netherlands (TNO)

The penetration seal must be rated for wall and floor penetration. A test report or approval listing for a wall penetration only is not acceptable for floor penetrations. On the other hand, test reports and approval s for floor penetrations are acceptable for both wall and floor installation.

The supplier must furnish proof that the tests are conducted with single cables, cables in multiple layers and cable bundles.

The manufacturer must furnish proof that the penetration seal was tested with at least 3 cable trays penetrating with trays being at least 40% by volume filled with cables.

Where aluminum cable trays are penetrating the opening, the penetration seal must have been tested with an aluminum tray.

2.0 REQUIREMENTS

The penetration seal must be unaffected by direct water exposure, moisture or prolonged exposure to humidity

Where a wet coating material, a putty or mastic are being used for the installation of the penetration seal, said materials must not contain components or substances which are hazardous to human health, i.e. toxic, carcinogenic or skin irritating.

The penetration seal must be unaffected and not lose its fire protective effectiveness by aging.
The ease of retrofitting, such as the addition of cables or other utilities is a mandatory requirement. Wherever retrofitting is expected to be frequent, a "fire pillow" type is preferable.

Where a pillow type of fire seal is required or specified, the fire pillows must be meet the following requirements:

A fire pillow type seal must meet the same fire protection requirements as listed above under "Requirements for Penetration Seals" as per PEC, NEC, NFPA requirements.

A fire pillow type seal must have been tested in an opening no less than 800 x 800mm, unsupported by cable trays or other utilities, withstanding the horse stream test as per UL 1479 or ASTM E-814.

A single fire pillow, when held over an open flame (Bunsen burner) for 5 minutes with the tip of the flame impinging on the bottom of the pillow, must not allow the filling material to run out.

Since it is expected that fire pillows, over prolonged periods of time and possibly aided by vibration, will "settle", i.e. compact, whereby in wall penetrations openings on the top side could develop, the fire pillows should counteract this by expanding during heat exposure.

Where required, the pillow – type penetration seal should be protected against theft or damaged by a metal screen with a wire gauge of no less than 4mm.

PAD MOUNTED TRANSFORMER, COMPARTAMENTAL TYPE.

1.0 General

Description and ratings. The transformer(s) shall be compartmental type. Indoor installation, loop feed, dead front. Manufactured in accordance to ANSI, IEEE and NEMA standard.

Coolant and insulating fluid shall be Envirotemp FR3 transformer fluid.

2.0 Rating

The transformers shall be 2x1500kVA and 1x1000kVA. Primary voltage 34.5kV delta. Secondary voltage 240V wye, 4 wire, 60 Hz with two 2 ½% full capacity below normal taps. Impedance shall be 5.75%

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3.0 Construction

3.1 General

3.1.1 Tank

The transformers shall be sealed-tank construction of sufficient strength to withstand a pressure of 25% greater than maximum operating pressure. Carbon steel plate is reinforced with external side wall braces as required. Tank seams are continuously welded using an automatic seam welded.

Each cooler assembly is individual is individually welded and receives a pressurized check for leaks prior to assembly on the tank. After the coolers are attached to the tank, the completed tank assembly is leak tested before it is painted. After the

transformer has been assembled and tested, preparations are made to weld the cover to the top tank flange.

3.1.2 Coils

Coils shall be wound with copper conductors.

3.1.3 Core

Cores shall be fabricated of high grade, grain oriented silicon steel laminations, carefully annealed after fabrication to restore high magnetic permeability. Magnetic flux is to be kept well below the saturation point.

3.2 Finish

Tank, radiators and terminal chambers, if provided, shall be treated to remove oil and scale by either shotblast or phosphatizing treatment to ensure proper paint adhesion. All exterior surfaces shall be primed, using a high quality catalyzed epoxy enamel. Minimum dry film thickness shall be 2mils. A modified alkyd top coat with a minimum dry film thickness of 1mil shall be applied to all primed surfaces. The color of the finish coat shall be coordinated with the switchgear manufacturer in order to match the color of the switchgear.

4.0 Standard Feature

2.1 The weather cover over the cabinet is provided with additional hold down hardware to secure it more firmly to the cabinet

2.2 Four lifting hooks

2.3 Boltedon terminal compartment with removable front sill

2.4 Hinged,lift-off cabinet doors.

2.5 Interlocked penta –head bolt/padlock handle operates a cam assembly which is part of the 3-point door latching mechanism.

2.6 For live front construction, externally clamped high voltage porcelain bushings with a single eyebolt for 4/0 cable.

2.7 For dead front construction, externally clamped high voltage bushing wells for loadbreak or non-loadbreakinserts.

2.8 Lightning arrester mounting pads (live front only).

2.9 Tank ground pads (1 in HV, 1 in LV)

2.10 Steel high/low voltage compartment barrier.

2.11 Two ½ "penta-head bolts must be removed from the flange formed on the steel high/low barrier before the H.V. door can be opened (1/2" hex-head bolts available as an option).

2.12 Externally clamped low voltage bushings with threaded copper stud for full load current below 2100 amps. Externally clamped integral low voltage bushings for current above 2100 amps. NEMA spades provided per ANSI hole requirements.

2.13 Nameplate.

2.14 Fill plug and self-actuating pressure releif device.

2.15 Drain valve with sampler.

2.16 Removable neutral ground strap.

1. Five-legged core/coil assembly (inside tank)
2. Handhole cover bolted onto tank top (protected by weathercover)

3. Panel-type coolers

4.17 Tap changer designed for de energized operation only.

4.18 Primary Termination

- Externally-clamped bushing wells with loadbreak or non-Loadbreak inserts.

4. Integral loadbreak bushings.

4.19 Secondary Termination

5. Externally-clamped bushings with threaded copper studs to meet REA specification.

4.20 Primary Switching

6. LBOR oil switch, loop or radical feed
7. Externally operated series-multiple (dual voltage) switch.
8. EFD air switch, radial feed, with current limiting fuse

4.21 Overcurrent Protection

9. Internal primary protective links
10. Bayonet-type fuses
11. Drawout, loadbreak current limiting fuses, with or without interlocking transformer switch
12. Secondary oil circuit breaker
13. Internal, partial-range current limiting fuse.

4.22 Overvoltage Protection

14. Distribution class, metal oxide arresters, 3 thru 36 kV ratings available.
15. Under oil arresters.

4.23 Construction

16. 24" and 30" deep terminal cabinet.
17. Low profile design with hinged weather cover over the cabinet that can be raised for removal of Bayonet-type fuses.
18. Drain valve and sampling device
19. Mounting plate for CT's or PT's.
20. Interphase barriers
21. Molded case external secondary breakers.
22. Accessories – Oil gauge, thermometer, drain valve and sampler, pressure-vacuum gauge provision.

5.0 Standard test

Ratio
Polarity
Phase Rotation
No-Load Loss
Exitation Current
Impedance Voltage
Load Loss
Applied Potential
Induced Potential

MECHANICAL SPECIFICATIONS

1.00 : SPECIFIC PROVISIONS

1.01 Scope of the Contractor

The work covered by this part of the specifications consist in performing all operations in connection with the supply and installation of the air conditions and ventilating system complete in strict accordance with this part of the specifications and applicable drawings and subject to terms and conditions of the contract.

1.02 General Condition

The contract drawings indicate the extent and general arrangement of the air conditioning and ventilating systems. If departures from the drawings are deemed necessary by the contractor, details of such departures and the reasons therefore shall be submitted to the Architect for approval. No such departure shall be made without the prior written of approval of the Architect or his authorized representative.

102.1 Applicable Drawings:

All materials, machineries, and equipment to be furnished shall be of the required quality used in good commercial and trade practice and shall be essentially the standard products of reputable manufacturers. The acceptability of these items including their workmanship and method of installation shall be established by the following:

a. The Philippine Mechanical Engineering Code
b. The Philippine Electrical Code
c. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
d. Fire Code of the Philippines
e. American Society of Mechanical Engineers (ASME)
f. National Fire Protection Associations (NFPA)
g. American Society of Testing Materials (ASTM)
h. Air Moving and Conditioning Associations (AMCA)
i. American National Standard Institute (ANSI)
j. National Electrical Manufacturing Association (NEMA)
k. Underwriter's Laboratory (UL)
l. Safe Organization of the Phils., Inc.

102.3 Equipment Schedule:

As soon as practicable, after date of the award of the contract, a complete schedule of equipment proposed for installation shall be submitted for the approval of the Architect/Engineer showing dimensions and

arrangement of the equipment and necessary clearances. The schedule shall include catalogs, brochures diagrams, and drawings. In the event any items or equipment contained in the schedule fails to comply with the specifications, such item may be rejected.

102.4 Shop Drawings:

As soon as practicable, after award of the contract and prior to installation, complete shop drawings, showing the sizes and the type of equipment, together with complete piping layout and electrical connections, shall be submitted to the Architect/Engineer for approval. This holds true also for the air distribution ductwork and actual diffuser locations.

102.5 As-Built Plans:

Within a reasonable period but not ninety (90) days from date of completion and acceptance of the installation "As-Built" drawings shall be furnished the building Owner thru the Architect. The As-Built plans shall be include all contract drawings with the necessary revisions and modifications resulting in change from the original drawings, supplemented by such schematic, isometric, or other types of drawings as may be necessary to provide a clear understanding of installed systems As-Built.

102.6 Government Permits and Certificate of Inspection:

Prior to start of installation, the contractor shall secure a permit to install from the authorized agency having jurisdiction over the place of installation and before final acceptance by the Owner a final certificate of inspection and a permit to operate the system shall be secured from the same government agency. Fees and other expenses due on these permits shall be borne by the contractors.

102.7 Local Laws and Ordinances:

Aside from herein specified the equipment and materials to be furnished and the installation of the system shall conform to local laws, codes and other ordinances that are in force.

102.8 If there are discrepancies between these specifications and the drawings the Architect/Engineer should be consulted.

1.03 Coordination of Works done by others

103.1 It shall be the responsibility of the contractor to closely coordinate his work with the works of the Building contractor, Electrical Contractor, Sanitary Contractor, and other to avoid conflicts and to insure the smooth and proper installation of the project.

103.2 This contractor shall carefully check space requirements to make sure that his equipment, air ducts, piping, dampers, motor controllers, etc. can be installed in the space allotted for the same.

1.04 Description of System

In general, the work shall include but not limited to the following items of works as follows:

104.1 Supply and installation of air conditioning and ventilating and exhaust units.

104.2 Supply and installation of air conditioning and ventilating ductworks.

104.3 Supply and installation of electrical materials such as circuit breakers, conduits, wires, starters, etc., for the air conditioning and ventilating units.

104.4 Testing and balancing.

104.5 Warranty of the air conditioning and ventilating system.

104.6 Securing and payment of all necessary government permits.

1.05 Work not included

In general, the following items of work are not included but shall be provided by others and has to be coordinated by this contractor.

105.1 All necessary main electrical power feeder terminating to about 5 m away from the motor concerned. Individual circuit breaker shall be provided by this contractor.

105.2 Floor drain provisions for condensate disposal shall be coordinated with the Plumbing Contractor.

2.00 : BASIC MATERIALS & METHODS

2.01 TECHNICAL SPECIFICATIONS

201.1 Air- cooled multi split inverter air conditioning system
Unit shall be air cooled, split type multi-system air conditioner consisting of one outdoor unit and multiple indoor units, each having capability to cool each room independently. Up to three indoor units shall be connected to one outdoor unit and controlled individually. Compressor shall be equipped with inverter controller, and capable of changing the rotating speed to follow variation in cooling load Outdoor unit shall be suitable for mix-match connection of Wall mounted type indoor units. Refrigerant shall be R410a which is non CFC and shall have zero ozone depletion factor (HFC) and low global warning potential

201.2 Air-cooled outdoor condensing unit

The capacity of the outdoor unit shall match the summation of the cooling capacity of indoor units, no diversity factor shall be allowed. The air-cooled condensing unit shall be factory assembled unit housed in a sturdy weather-proof casing constructed from rust-proof mild steel panels coated with a bakes enamel finish. Exterior surfaces shall be factory applied with epoxy weather-resistant coating. Condensing unit shall be equipped with inverter controller which enables it to reduce minimum load down to 10% of the total. The system shall be able to reduce its minimum load without having to utilize any hot bypass system. The unit shall be reinforced to prevent drumming and shall be stabilized against any resonance occurring during normal operation. Noise level shall not be more than 48 dBA measured horizontally 1 m away and 1.5 m above ground. The condensing unit shall be designed to operate safely when connected to the Fan Coil Units and shall have the following components:

a. Compressor Assembly

The compressor Assembly shall consist of a high efficient swing Compressor and equipped with Inverter Control capable changing the speed linearly in accordance to the room load requirement. The Compressor should have high Energy ER value and should be mounted on springs within the compressor casing to minimize vibration. In addition the whole compressor assembly should also be mounted with sound proofing materials so that complete vibration is not transferred outside. The compressor assembly shall have low operation noise level and shall be equipped with safety devices such as overload relay and over current relay to protect the compressor in case of malfunction.

b. Condenser Assembly

The Air Cooled Condenser Coil shall be constructed with cross fin copper tubes, mechanically bonded to aluminium waffle louvre fins. The condenser coil shall have large face area to minimize noise and gives a high EER transfer. The fins shall come standard with an anti-corrosion treatment (P.E. Coated) to ensure greater resistance against salt air & atmospheric damage. The thickness of the coating shall be between 2.0 to 3.0 microns.

c. Condenser Fan and Motor Assembly

The condenser fan shall be direct drive propeller type running at low speed low noise and made from pressed out aluminium or die cast polypropylene. The condenser fan shall be dynamically and statically balanced for minimum noise and vibration. The condenser fan shall be directly coupled to an outdoor induction type motor having low power consumption and shall be of 2 speeds type and shall automatically run on low speed if the ambient temperature is low. The discharge grille of the condensing unit shall be adjustable to divert the hot air in the desired position. Motor shall be protected by built-in automatic reset

device for protecting against overloading and overheating. The motor shall be suitable for either 400v, 3 phase, 50Hz or 230V, single phase, 50Hz electrical supply, as specified. Contactors and start relays shall be provided. For units that are 14kW cooling capacity and below, single phase motors may be used. For larger units, exceeding 14kW cooling capacity, three phase motors shall be used.

d. Accumulator

The cylindrical accumulator shall be constructed from mild plates pressed into shape. The accumulator shall have sufficient capacity to prevent any liquid refrigerant from flowing back into the compressor suction plate.

e. Refrigerant Flow Control

The refrigerant flow control shall be of electronic expansion valves. It shall modulate the refrigerant volume continuously in respond to load variations of the room.

f. Soft Starters

All Condensing Units shall be of soft-start to ensure low starting current.

201.3 **Indoor Fan Coil Unit**

Each indoor fan coil unit shall be of the wall mounted type housed in a stylist flat panel cabinet constructed from strong engineered plastics, or ceiling mounted duct connected type, or wall built-in type with a wooden grille (optional) or ceiling cassette and shall consist of the following component.

a. Cross fin evaporator

The cross fin evaporator shall be constructed from strong clean copper tubes mechanically bonded to the waffle louver aluminium fins. The face velocity of the coil shall be exceptionally low to ensure quiet operation.

b. Evaporator fan and Motor

The evaporator fan shall be of the multi-blade centrifugal type with active discharge flaps. It shall be of standard blade of the zigzag skew-angle random pitch fan to ensure good airflow and low noise. The fan shall be pressed out of aluminium or strong mild steel plates and should be statically and dynamically balanced to ensure low noise and vibration free operations. It shall be equipped with direct driven induction motor suitable for multi speeds operation.

c. Air louver

The auto swing louver shall be able to circulate air to the right and left, up and down and create wider air distribution.

d. Fan speed

The Fan Speed shall have at least 5 steps, and with an automatic fan speed feature to automatically control the fan speed according to the room load requirement.

e. Filters

Two layered air purifying filter consisting of an electrostatic filter to catch even tobacco smoke of 0.01 micron, and an activated charcoal filter to remove unpleasant odours effectively purifies the air in the room.

201.4 Electrical Control System

Controls shall be factory installed and wired, and located in separate enclosure, Contactors shall be provided for compressors, fans, compressor motor running and start relays. Remote thermostat with temperature range of 18 deg C to 30 deg C shall be provided. The remote controller shall be from same manufacturer as the fan coil unit. The thermostat shall be of wireless micro-computer controller for regulating the room temperature. It shall be equipped with "Mis-wiring" Checking Function which automatically corrects the mistakes of control wiring during commissioning.

Interlock for condenser and evaporator unit with the compressor circuit shall be provided. Safety devices shall consist of high and low pressure stats and compressor overload devices. Unit wiring shall incorporate a timer to prevent short cycling from restarting for a 5 minute period. The unit shall include a 230V control circuit. Discharge line thermostat, oil pressure switches, pressure relief valves and circuit breakers shall be incorporated.

The control of the air-cooled split units shall be from its wireless remote controller. The following minimum functions shall be provided.

- On/Off control
- Timer control
- Room temperature setting
- Fan speed selection

2.02 Cabinet-Type Centrifugal Blower

202.1 Furnish and install cabinet type centrifugal blowers complete with 50 mm thick washable filters installed in accessible section, motor, belt sheaves, vibration isolators and belt guards.

202.2 Centrifugal blower shall be statically and dynamically balanced and tested by the manufacturer. Blower wheels shall be steel with backwardly inclined blades designed for low noise level. Wheel construction shall consist of die formed blades welded between a heavy back plate and retaining ring. All wheels shall be mounted on a single shaft designed to operate without undue vibration and shall be driven with V-belts selected for 150 percent of the motor horsepower. They shall be encased in a heavy gage steel housing that is sufficiently reinforced as to be rigid and flutter free.

The shafts shall be turned, ground and polished and shall be selected for operation well below the first critical speed and shall have rust preventive coating. Shafts shall be supported by self-aligning bearings with grease seal and lubrication fittings. All components shall be thoroughly cleaned and given a coat of primer paint and baked enamel finished. Fan motors and drives shall be mounted out of the air stream. Motor bases shall be adjustable. All fanse shall be provided with 19mm drain pipe coupling welded to the lowest point of the fan housing.

2.03 Refrigerant Piping

203.1 Refrigerant piping shall be type L and hard drawn seamless copper, suitable for a working pressure of 2413 kpa. Fittings shall be wrought copper of brass designed for use with high temperature solder and suitable for a working pressure of not less than 2413 kpa. Joints from soldered to threaded joints shall be made with standard adapter fittings using high temperature solder. Pipes or tubing shall be cut accurately to measurements established at the building lines. All piping shall be laid straight and no pipe shall be laid against other metal without insulation. After cutting, the tubing shall be reamed, all burrs removed and the internal surface thoroughly cleaned. While soldering pipes and fittings together, a continuos flow of inert nitrogen gas must be applied to sweep the internal surface of the tubing to avoid the formation of oxide inside.

203.2 Condensate drain piping shall be of PVC pipe and sized to liberally dispose of the condensate to the nearest floor drain. A P-trap with a clean out plug shall be provided at the outlet for each drain pan and shall be insulated with flexible Elastomeric Pipe insulation contact adhesive.

203.3 Pipe supports, and hangers shall be provided and fabricated in workmanship manner out of steel angles, rods and flat bars. Metal to metal contact between pipes and hangers must be avoided by providing 3 mm thick rubber in between. Supports on horizontal lines shall be spaced at not more than 1.80 meters on center. All piping must be properly anchored so that no stress is placed on equipment connection by expansion.

203.4 Pipe sleeves shall be of standard steel pipes with sufficient diameter to provide a minimum clearance of 6 mm around the pipe and in case of insulated pipe approximately 6 mm around the insulation. Pipe sleeves shall be installed whenever a permitted to pass thru bearing wall, beam bar columns unless permitted by the Architect.

203.5 Piping insulation shall be properly size applied on all refrigerant suction lines and condensate drain lines. Insulation material shall be flexible elastomeric pipe insulation contact adhesive. For pipes installed outdoors a weather resistant Aluminum metal cladding protective finish is to be applied.

2.04 Controls

204.1 Operation of the air conditioning system shall be fully automatic. They shall be capable of maintaining at full or partial loads inside conditions of 24.4 C. D. B. (plus or minus 1.11 C) and 50% relative humidity (plus or minus 5% RH). The controls shall be wired in such a way that whenever a condensing unit is in operation the fan coil unit is also in operation.

204.2 The compressor crankcase heater must be of such capacity to provide sufficient heat to the oil in the crankcase during in operative periods so that serious oil foaming and slagging shall be prevented. The heater must be automatically energized whenever compressor operation stops and de-energized when the compressor starts.

2.05 Valves, Dehydration and sight glasses

205.1 Refrigerant valves shall be installed in the suction and discharge line adjacent to the compressor or unless built-in valves are furnished and the liquid line on the discharge side of the condenser. The valves shall be wrought copper or brass for use with R-22 and suitable for working pressure of 2413 kpa.

205.2 Thermostatic expansion valves of the proper capacity shall be installed in the refrigerant supply line to the evaporator. They shall be of diaphragm type externally equalized and must be one of such optimum size as to maintain a full active evaporator under all load conditions and yet reduce the possibility of flooding the refrigerant to the compressors during light loads.

205.3 Solenoid valves shall be installed where required and shall be designed for the operating pressure of the system. Valves capacities shall be based on the pressure drop across them not exceeding 3 psi.

205.4 Dehydrators in combination with strainers shall be installed in the refrigerant line of the inlet side of the thermostatic expansion and solenoid valves. They shall have brass or copper bodies designed for a working pressure of 2413 kpa.

205.5 Sight glasses shall be a combination of liquid and moisture indicators and shall be installed in the refrigerant lines to indicate whether or not the systems are properly charged whether or not refrigerant in the system is dry.

207.2 Fire dampers shall be fabricated from heavy gage black iron sheets and equipped with fusible link set to melt at 73 °C.

207.3 In general, access doors at hand dampers shall be large enough and so placed that damper blade position may be observed. Access door at five dampers shall be large enough and replaced that damper blades may be repositioned with fusible link replaced.

209.1 Supply and exhaust grilles shall be deflection horizontal and vertical face bars. They shall be fabricated from gauge 20 B. I. Sheets bonerized after fabrication and finished with baked enamel paint. Exhaust and fresh air louver shall be fabricated or the same material as the grilles and shall have curved and hemmed edges to give appearance as well as rigidity and

strength.

209.2 Supply air diffuser for business office area shall be 4-way ceiling diffusers.

210.1 Air conditioning ducts shall be insulated with 25mm thick fiberglass 2 pounds density with integral aluminum foil reinforced barrier or one side. Refer to mechanical plans for installation details.

2.13 Electric Motor

213.1 Motor shall be of sizes as specified or as schedule herein or on the drawings as required for driving compressor, fan and blower, all motor shall operate at speed and electrical characteristics specified on the drawings. They shall be guaranteed to operate at rated output with plus or minus ten (10) percent voltage variation at their terminals.

213.2 Motors above 560 watts shall be 3-phase squirrel cage induction type, constant speed. Motor 560 watts and below shall be single phase capacitor start induction run, or split type or shaded pole type as approved for the service.

213.3 Motor driving indoor equipment shall be open drip-proof construction. Motor driving outdoor equipment shall be of the totally enclosed fan-cooled construction. Motor driving equipment thru pulleys and belt shall be provided with belt guards. The belt guards shall be made of heavy wire mesh or expanded metal set in a suitable frames, covering the motor pulleys, belt and driving sheaves with access plates for tachometer.

2.14 Motor Controller

214.1 All motor starters shall be magnetic type complete with overload and relays manufactured in accordance with NEMA Standard. Starter installed outdoor shall have rain tight enclosures.

214.2 Starter for motor 5.60 kW and below shall be across the line type. Starters for motor above 5.60 kW shall be reduced voltage type.

214.3 Unless otherwise indicated in the drawings circuit breakers shall operate in the thermal magnetic principle. Aside from serving as disconnecting means they shall afford protection for motors against phasing circuit faults. They shall be provided with enclosure suitable for the application.

2.15 Wiring

All electric power and control wiring necessary to be provided by the contractor shall be accomplished in accordance with the requirement of the electrical plans and specifications and shall conform to National Electric Code.

Wiring system including materials shall also comply with the specifications under the electrical division of the project.

2.16 Testing and Balancing

216.1 Upon completion of installation and when the system is ready for operation capacity and general tests shall be conducted by a competent and experienced accredited balancing engineer to be furnished by the contractor. These test shall demonstrate the specified capacities of the equipment.

216.2 All instruments to be used shall be of the industrial grade recently calibrated and the proper type to suit the type of system being tested and balanced.

216.3 During this test the contractor shall demonstrate to the satisfaction of the owner, or his representative that all parts are installed correctly and operating properly. The contractor shall be responsible for the satisfactory operation of all temperature and humidity controls and safety controls.

216.5 Technical Publications:

a. Maintenance and operational manual. Three (3) copies shall be furnished to the owner at completion. The manual shall be bound between hard covers and shall contain but not limited to installation and operating instructions. Maintenance procedures, illustration and drawings, detailed description, tests, adjustments and safety precautions.

b. Part List - giving part numbers and prices for the equipment furnished shall be submitted to owner

2.17 Guarantee and Service

The air conditioning and ventilating systems and equipments and accessories furnished and installed under this part of the specifications shall be guaranteed to a period of one (1) year from date of acceptance thereof, and materials and equipment furnished shall be free from any defect in the materials, workmanship and design. At any time within one year after acceptance and upon proper notice the contractor shall rectify any and all deficiencies including replacement of part or the entire units without additional cost to the owners, if such deficiencies have been caused directly or indirectly by inferior materials, faulty workmanship and/or defective design or parts. Expendable items such as oil, refrigerant, belts, filters, etc., are included in this one year guarantee. During the guarantee period the contractor shall perform free monthly inspection and service and make adjustment if necessary for proper efficient operation of the system.

FIRE PROTECTION SPECIFICATIONS

FIRE PROTECTION SYSTEM

SECTION 1-FIRE PROTECTION

FPS 100 - GENERAL CONDITIONS

A. The General Conditions form a part of these specifications and contract.
B. The Sub-contractor for the Fire Protection Works is designated as the Contractor in this Division.

FPS 200 - SCOPE OF WORKS

A. Furnishing of all materials, labor, tools, equipment and accessories for the complete installation, testing and adjustment, ready for use of the proposed automatic fire sprinkler system.

The work essentially shall include, but shall not necessarily be limited to the following items:

a. Sprinkler system for the floors as shown on the plans.

b. Fire Department Connections, fire hose valves, roof manifolds and dry stand pipes system.

c. Materials and accessories:

1. Automatic fire sprinkler system, risers, piping, hangers, supervisory flow switches, sway braces including installation of sprinkler system and accessories.

2. Supply and installation of the wet standpipe system consisting of interior fire hose cabinet.

3. Supply and installation of dry standpipe system consisting of Fire Department inlets, fire hose valves and testing hose valve headers.

4. Miscellaneous metal works, hangers, braces, signs, supports & misc. materials.

5. Supply and installation of alarm check valve assembly with retarding chambers, motor gong, bell complete with trims and accessories including connection to the building central fire alarm system.

controllers and accessories to include foundation, vibration and accessories .

e Installation and supply of floor control valves and water flow switches including connection of electrical wiring up to the fire alarm box or fire

4. Fire alarm bells and fire station for the alarm system.

5. Construction of the reinforced concrete water and fire storage reservoir including elevated water tanks.

d. mechanical grooved coupling and flexible connectors.
e. fire department connections (inlet & outlet), hose valves, hose headers and hose cabinets.
f. sprinkler heads
g. riser supports and sleeves

3. List of miscellaneous materials proposed, including pipe, ftgs, valves, etc. and manhole accessories, identifying manufacturer and type.

4. Filed test reports

5. Such other similar information the Engineer may require.

FPS 600 : ACCEPTANCE TESTS

A. Acceptance of work shall be conditioned on successful tests of the entire system.

B. Test requirement laid out in the standards for the installation of sprinkler system NFPA-13 shall be performed prior to the approval of the work.

C. Isolated leak tests or partial tests of areas may be performed prior to installation of ceiling materials in the area to preclude any damage there at during total system final tests.

D. The Contractor shall furnish the owner a written statement to the effect the work covered by the Contract has been completed and tested, before requesting for final approval of the installation by the Fire Department Authority.

FPA 700 : WORKMANSHIP AND COORDINATION OF WORK WITH OTHERS

A. The Contractor shall be held fully responsible for the work of any manufacturer or subcontractor supplying materials to or performing work for as it is intended that the entire Fire Protection System shall be ready in every respect for satisfactory and efficient operation when finally delivered to the Owners

B. The Contractor shall assume full responsibility and shall provide the services of the of a qualified Engineer to supervise the complete installation of equipment and to conduct the final acceptance tests.

C. The work throughout shall be executed in the most thorough and satisfactory manner in accordance with the best practices of the trade.

FPS 800 : SPRINKLER HEADS

A. Type :

Automatic standard 15mm Ø orifice, solder fillet type, upright, pendent or sidewall heads. Pendent heads shall be provided with aluminum escutcheon or approved equivalent to fit into ceiling boards or ceiling runners, flush or concealed type pendent units shall be accepted as substitute. Heads shall be UL Inc. approved, of one brand all throughout and shall be standard product of a reputable manufacturer.

B. Head rating & type :

Genset Room	175 to 225 ° F Chrome plated
Public Areas, Lobby	135°F (for use in max.
	Chrome plated
Offices, hostels, corridors,	ceiling temperature of
Hallways, Bedroom & Toilet	100°F)
Storage, other	- do - Brass, wax coated
areas	

C. Pipe Thread & Valve Seat - 15mm Ø nominal

D. Spare Sprinkler Heads :	(165°F)	(212°F)
1. Upright Type	20 pcs	4 pcs
2. Recessed (Pendent) type	10 pcs	2 pcs
3. Sidewall Type	5 pcs	2 pcs

E. Sprinkler Tongs 3 pcs. required

F. Sprinkler Wrench 3 pcs. required

G. Furnished spare heads as required in the code and maintenance services part list for a period of at least one (1) year reckoned from the date after termination of warranty.

FPS 900 : FIRE HOSE CABINETS

A. Hose and valve assembly as manufactured by ELKHART Brass Mfg. Co. of approved equal.

Hose - 40mm Ø, 30m Single Jacketed, Rubber lined for basement to 5th floor.

Nozzle - combination fog and solid stream, 40mm Ø, chrome plated, model No. L-205

Rack - Semi-Automatic, chrome plated model No. S-41

Angle Type Combination Type Pressure Restricting Valve - 40mm Ø, chrome plated polished trim, for exceeding 100 psi water pressure, provide with nipple and union patent, set at 70 psi water pressure.

Hose nipple- for components, shall be chrome plated. Provide two (2) universal spanner wrenches, Model46-5.

B. Cabinet- full flush mounting door with anodized cal-colored aluminum for all glass plate, frame and box shall be No. 14 gauge steel with white interior and red exterior baked enamel finishes over primer. Cabinet size shall contain the above components.

FPS 1000 : FIRE DEPARTMENT CONNECTION (INLET)

Two way sidewalk inlet connection shall be similar or equal to ELKHART model No. 735 vertical cast brass with plug spring check snouts, complete with plugs and chain and cat brass escutcheon lettered "Dry Standpipe" threads to suit integrated Metropolitan Fire Department specifications.

FPS 1100: WALL HYDRANTS (FIRE HOSE VALVES)

A. Threads and type of connection to match Integrated Metropolitan Fire Department requirements.

B. Type: Single outlet as shown on the plan, wall mounted.

C. Finish: Polish brass

D. Outlet shall have chain connected caps or plugs.

FPA 1200: ROOF MANIFOLDS (OUTLET)

A. Type : Twin angle valve outlet connections, with chain secured or plugs, size, 65 mm x 65mm x 150 mm.

B. Threads and type of connection to match Integrated Metropolitan Fire Department requirements.

C. Finish: polished brass

D. Outlet shall have chain connected caps or plugs.

FPS 1300: PORTABLE FIRE EXTINGUISHERS

Furnish and install as indicted: on the drawings portable fire extinguisher, 10lbs, dry chemical type capable for type ABC fire. Units shall be approved by the Fire Department
having jurisdiction and UL listed. Mounting shall be inside fire hose cabinets and as shown on drawings.

FPS 1400: PIPINGS - GENERAL

A. Where American Standards are specified, other approved national or local standards may be acceptable, provided copies of these standard Specifications are forwarded to the Engineer for his written approval.

B. Black iron, schedule 40 pipes, ASTM A 53 for risers only (wet and dry)

C. Black iron, schedule 40 pipes, ASTM A-120 for inside building installations (feed mains, cross mains and branch lines.

D. All inside piping shall be installed by means of screwed or flanged fittings. Flanged joint shall be used at all sprinkler risers and provided with 1.6 mm thick long fiber asbestos, cross laminated gasket "cranite".

E. Torch cutting shall not be permitted as means of modifying or repairing sprinkler system.

F. All welding shall be "shop welding" only and shall be done by electric are welding process.

FPS 1500: FITTINGS GENERAL

A. Sprinkler system fitting shall be extra heavy pattern. Whenever a change in pipe size is made, one piece of reducing fitting shall be used. Provide mechanical grooved couplings at each main feed line of every floor just after the riser and along the ceiling line.

B. All fittings shall be of malleable iron fittings.

C. Steel pipe flanges matting with steel equipment flanges shall have the same facing as mating flange.

D. Screwed union shall not be used on pipes larger than 50 mm (2"). Couplings and unions of pipes other than screwed type shall be of types approved specifically for sprinkler used.

FPS 1600: VALVES-GENERAL

A. All valves shall be of the same manufacture for each class of piping and as much as possible, for the entire project. Valves shall permanently bear affixed stamp or tag indicating manufacturer, catalog number, pressure and temperature ratings of gate valve, angel valves, check valves, pressure relief with all cast iron body with bronze trim.

B. Furnish all valves and accessories material necessary for piping not shown on drawings as follows:

1. Vents and drains for equipment to which piping connections are made.

2. Connections to metering instruments and controls including pressure gauges, thermometer, controllers, traps and appurtenances requires for proper functioning on instrument in controls.

3. Temporary valves and accessories required for placing equipment into initial service.

4. Piping 50 mm (2") and smaller required for proper operation of piping system and equipment, including drain valves required to drain all low points in piping.

C. Valve seats shall be renewable except for forged steel and high pressure cast steel valves where manufacturer's standard is integral seats.

D. All valves shall be approved by Factory Manual and Underwriters Laboratories, Inc. (UL listed).

E. Where required and not noted, provided chain-wheel operators, extending chain for chain operated valves to which 1.2 meters of nearest floor or operating platform of valves.

F. Provide floor stand with flanged faces for bolting to floor or platforms and other special devices where specified or noted on drawings.

G. Provide extension stem, universal joints stem guide bearings and other accessories required to locate floor stands in convenient location with interference with other equipment, piping or building parts.

H. Floor control valves within the building shall be approved indicating wedge gate with electrical contact and which will open when valve is partially or totally put in close position.

FPS 1700: SWAY BRACES, HANGER AND SUPPORTS

A. Sway Bracing: Steel flat bars, structural grade 7 mm minimum thickness, with corrosion protection; shape/type as shown on plans.

B. Pipe Hangers: Steel flat bars, structural grade 7 mm minimum thickness, with corrosion protection, shape as shown on plans and 13 mm dia. bars with corrosion protection as shown on plans.

C. Sway Bracings Installation

1. Adequate sway bracing shall be provided to oppose longitudinal or transverse pipe movements.

2. Lateral bracing shall withstand a force equal to 50% of the weight of the water contained in piping, valves and fittings.

3. When pipes 100 mm dia. and larger are supported in the vertical position, the supports shall be at a minimum spacing of 3.0 meters (10') on center. Holes in concrete for expansion shield shall be made of the proper size and depth, as specified for the type of shield used, to provide a uniform contact with the shield over its entire length and circumference.

4. Maximum distance between hangers shall be 3.65 meters (12') for size mm (1'). Provide at least one hanger for each length of branch line, one between each two cross main branches, one hanger for each 4.75 meters (15') length of feed mains. the distance between the hanger and the center line of upright sprinkler shall be not less than 76 mm(3").

E. Support on Risers

Risers shall be adequately supported either by attachments directly to the riser or by hangers located on the horizontal connections close to the risers. Supports shall be provided at the ground level and at each third level and at the top most level of the riser.

A. MATERIALS:

1. Through fottings - cast iron

2. Below Grade - cast iron or standard weight iron pipe.

3. Above Grade - steel pipe.

B. INSTALLATION

1. Minimum clearance between the pipe and sleeve shall not be less than 25 mm (1") for pipes. 25 mm (1") to 89 mm (3-1/2") and 50 mm (2") clearance for pipes 100 mm (4") and larger. The clearance between pipes and sleeves shall be filled with non-combustible flexible materials such as asbestos rope and furnished with semi- hardening mastic flush.

2. Floor sleeves shall extend at least 76mm (3") above the top of the wearing surface.

3. Drains, fire department connections, test manifolds and other auxiliary pipings connected to risers shall not be cemented into walls or floors.

FPS 1900: PIPE PAINTING

A. Sprinkler heads, valve stems and the like shall not be painted.

B. After installation and test and before the installation of ceiling fixtures or boards, all pipings shall be prime painted and coated with two coats of gloss re quick drying enamel.

FPS 2000: ALARM CHECK VALVES

A. The alarm assemblies shall be so constructed and installed, that any flow of water from the sprinkler system equal to or greater than from a single automatic sprinkler head, will result in an audible and visual alarm bells whether water or electrically actuated shall be capable of being actuated both automatically and annually.

B. The water actuated alarm check valve assembly shall be complete with all the necessary attachments required to give an alarm and ease in maintenance.

The gong shall be installed as indicated in the plans. The alarm check valve shall consist of but not limited to the following:

1. Retard chamber
2. Water motor

3. Weatherproof gong, 300 mm dia.
4. Strainer
5. Pressure gages
6. Drain and attachments
7. Electrically supervised control valves
8. Pressure switches

FPS 2100 : FLOOR CONTROL VALVES & WATER FLOW SWITCHES OR DETECTORS.

A. Flow alarm valves with sizes indicated on the plans shall be provided with two (2) N.O. electrical contracts that will close instantaneously with steady flow of water in the pipe and shall be complete with tamperproof terminal chamber with minimum of 1/2" Ø conduit knock-out. False alarm shall be prevented by an adjustable pneumatic device to retard the flow switch operation due to water surges. The switch shall be actuated only by an unidirectional flow of water. Conduits connections, conduit box, riser, etc. shall be under Electrical Contractor scope of works.

B. The alarm apparatus shall be substantially supported, located and installed so that all parts shall be readily accessible for inspection, removal and repair.

C. An actual water flow, through the use of the test connection, shall be employed to tests the operation of the sprinkler alarm units in each floor or as a whole.

FPS 2200 SPRINKLER FIRE ALARM AND SUPERVISORY SYSTEM

The supervisory and sprinkler fire alarm system shall be integrated with the building Fire Alarm System at the control room (security office) at the ground floor. The Sprinkler Fire Alarm System annunciator shall indicate the supervisory switches of the system.

FPS 2300 MARKERS, INSTRUCTION & IDENTIFICATION SIGNBOARD

These signboards shall be made of gauge No. 14 black iron sheet with baked enamel finish and letter of instruction as shown in the plans. Additional signboards shall be mounted on the unobstructed for easy identification reading. Paints shall be basically gloss fire red and white.

FPS 2400 : PUMPS

A. GENERAL :

1. Manufacturer's installation drawings shall be submitted together with the proposal. After installation is completed as "as-installed" drawings showing all the field revisions and exact locations/dimensions on reproducible form plus two (2) white print copies shall be submitted to the Owners at the Contractor's Expense.

2. Pump performances curves shall be submitted together with the proposal. The Pump efficiencies at the various work loads shall be indicated thereon and properly marked.

3. Test run shall be performed by the supplier after the installation is completed, to demonstrate conformity to the manufacturer's specifications. A successful test shall be a condition to the Owner's acceptance of the installed equipment and to final payment.

4. A direct statement on the availability of spare parts and maintenance service from pump supplier, for a period of at least three (3) years reckoned from the date of acceptance test shall be submitted.

B. FIRE PUMPS

1. There shall be One (1) unit of Fire Pump for the system. The pumps, electric motor drive, all control and necessary attachments specified herein shall be UL listed. and Fm Approved and shall be furnished under this contract. The pump shall be capable of delivering not less than 150 percent of rated capacity at not less than 65 percent of total head. The shut-off head shall not exceed 120 percent of the rated heads. The fire pump shall be Vertical In Line. Vertically mounted electric motor drive. . Fire Pump to be supplied with accessories to include controllers, circuit breakers, starters and contactors. Fire pump volumetric capacity shall be 750 GPM vs 250 PSIG , approx. 150 HP.

Pump unit major Accessories :

a. Circulating relief valve
b. Hose valve manifold 105Ø, hose valve
c. Flow Measuring Device
d. Relief valve and discharge cone
e. Suction Strainer
f. Primary Connection
g. Capacity plate
h. Automatic Air released valve fittings
I. Water level testing device and piping
j. Pressure gauge, 80mm Ø
k. Pressure switches

2. Electric Motor Drive :

HP	- 150 HP or as per manufacturer's recommendations
Voltage	- 380 V
Phase	- 3
Frequency	- 60 hz
Temperature rise	- 40 degree C
Service Factor	- 1.15 min.

3. Motor Controller :

a. Type - Combination circuit breaker and starter; UL listed and FM approved:

1. Circuit Breaker - magnetic trip, 3 phase, 230 V (min.) 300 times motor FLA continuos rating. Interrupting rating not less than 40,000 rms. amps. symmetrical at 230 VAC with external operating handle.

2. Starter - magnetic, wye delta reduced voltage type, close transition with 3-0.L relays and necessary auxiliary contacts.

3. Enclosure - watertight type, NEMA 4 floor mounted.

4. Flow Measuring Device

Fire pump shall be acquired also with "Flow Measuring Device" consisting of flow meter and flow indicator.

Flow pump flowmeter shall be orifice type 1/8" thk 304 Stainless steel " Meriam: series 951B30 or approved equal; flange meriam Series 952 or approved equal; Flowmeter Manometer " Meriam" Model 30EB25 for wall mounting, with single indicating tube, rated 250 PSIG. maximum operating pressure, scale for direct GPM reading and complete with mercury fluid, return well, valve and piping manifold; Flowmeter bellows or D/P Dial Option differential pressure indicator, berylium copper with forged brass housing, 500PSIG. maximum pressure rating, GPM scale reading and complete with pulsation dampener, valve and manifold.

5. Installation Drawings:

Manufacturer's installation drawings shall be submitted as part of Shop drawings, section 500 of the Specifications.

6. Performance Curves:

Performance curves shall be submitted together with the requirements of section 500. The pump efficiencies at various work loads shall be indicated thereon and properly marked.

7. Installation :

The Contractor shall assume unit responsibility and shall provide the services of a qualified Engineer to supervise the complete installation of equipment who shall be available conducting the final acceptance test as stated under Section 600 of the Specifications.

C. Jockey Pump

1. There shall be One (1) unit of Jockey Pump for the system. Pump rating shall be 25 GPM vs 250 PSIG . Vertical in line, complete with pump bowl assembly and riser pipes drive with controllers and accessories to be installed inside Fire Storage Tank and shall be setting for a maximum of 10 ft. depth. Jockey pump to be supplied with accessories to include controllers. circuit breakers, starters and contactors. The drive shall be Vertical mounted electric motor, 1800 rpm complete with controls and accessories, 380 Volts, 3-phase 60Hz, approx. 10 HP.

2. Jockey Pump Control Panels : furnish ready for wiring jockey pump, General Electric CRI 35 type "F" with "H-O-A" switch and timer run relay, with three overload relays, Clark Controller, Cutter Hammer, Inc. " Firetrol of as approved.

D. PUMP SEQUENCE OF OPERATION

Adjust pressure switches to control the fire pump operation in the following sequence :

Pump	Pump on	Pump off
a. 25 gpm Jockey Pump	250 PSIG	160 PSIG
b. 750 gpm Fire Pump	250 PSIG	Manual

E. SYSTEM REQUIREMENTS :

(Minimum Requirement)

F. SPARE PARTS:

Furnish spare parts and maintenance service part lists for a period of at least one (1) year reckoned from the date after termination of warranty as indicated in Section 2700 of this Specifications.

MOTORS :

1. General Requirements:

a. Motor type required for project: Refer to other parts of specifications.

b. Motor shall be furnished with driven equipment to assure proper coordination of motor and control characteristics with requirements of driven equipment. Contractor is responsible for proper correlation of horsepower, starting torque, other characteristics of electrical equipment, with requirements of driven equipment.

c. Horsepower nameplate rating shall be at least as great as the brake horsepower required to drive the equipment under the maximum specified conditions without consideration of service factor.

d. Conform to NEMA Standard No. MGI entitled "Motor and Generator", except where specifically noted otherwise.

e. Conform to ANSI Standard No. C50, 2-1955 " Alternating - Current Induction Motors, Induction Machine is in General and Universal Motors.

f. Torque and speed characteristics, suited to requirements of driven equipment, including gear reducers if specified.

g. Maximum speed : 1750 rpm unless specified otherwise.

h. Horsepower :

1). Motor HP rating specified shall be nameplate rating without consideration of motor service factor.

2). Nameplate HP not less than HP required by driven equipment operated at maximum conditions specified.

i. Duty : continuous

j. Service factor: as specified herein, unless specifically stipulated otherwise in detailed equipment specifications.

k. Bearings: ball, unless otherwise specified; provide for in-service lubrication of enclosed motors, unless specifically noted otherwise.

l. Base :

1). Provide cast iron or steel motor base with provision for motor alignment on direct coupled drives.

2) Provide sliding or hinge motor base with screw type, automatic gravity type, or other manufacturer's standard means of adjustment for belt or chain drives.

m. Accessories: lifting lugs as required.

n. Motor specified as 460-volts, three phase or 230-volts single-phase, may be designed for single or dual voltage in accordance with manufacturer's standard for horsepower and speed required.

o. Frequency: 60 Hz.

2. Enclosure and Insulation :

a. Suitable for 40 degree C ambient duty, with standard service factor, unless otherwise specified.

b. Drip-proof encapsulated : encapsulated moisture sealed insulation system, with weather resistant conduit box: bearing shielded against entrance of moisture and dirt; and anti corrosion treatment of exposed metal parts, 40 degree C ambient, continuous duty, with 1.15 (min.) service factor.

c. Totally enclosed non-ventilated of fan-cooled; 40 degree C ambient, continuous duty, with 1.15 (min.) service factor.

d. If other types of insulation are proposed, operating temperature must be guaranteed satisfactory for proposed installation.

3. Types:

Single-phase induction; method of starting suited to driven load requirement; constant or multi-speed, and method of starting as specified.

FPS 2500 : ACCEPTANCE TESTS

A. The Contractor shall conduct test in the presence of inspector or authority having jurisdiction (The Philippine Fire Protection Association of Fire Protection Associates).

B. To remove foreign materials which may have entered the piping during installation of same, flushing or underground connection is required before sprinkler piping is connected.

C. Hydrostatic Tests :

1. Test pressure not less than 200 psi for two hours.

2. No visible leakage for inside sprinkler piping will be allowed. For underground mains and lead-ins, exceeding the permissible leakage or joints necessary repair shall be made.

3. All control valve water pressure to insure proper operating tests. Use clean, non-corrosive water.

4. Fire connection shall be tested.

D. Testing of drainage facilities shall be made by opening the main drain valve while the control valve is wide open.

E. Test certificate shall be filled out and signed by the Owner's and Contractor's representative.

F. System operations and maintenance chart shall be submitted to the Owner's upon completion of the Contract. This shall include, among others, the locations of the control valves and care of the new equipment.

FPS 2600 MINOR MODIFICATIONS AND TIME COMPLETION

A. The plans as drawn should conditions as accurately as it is possible to indicate them in scale. The Plans are diagrammatical and do not necessarily show all fittings, etc. necessary to fit the building conditions. The location of valves, fittings and the fixture shown on the plans are approximately. The contractor shall be responsible for the proper location in order to make them fit with architectural details and instructions.

B. The Contractor shall complete the work herein described in accordance with the specific schedules set by the Owners in accordance with General Contractor's Schedule of Work.

FPS 2700: GUARANTEE

The Contractor shall guarantee that the installed sprinkler system complies with the requirements of the authorities and free from all defective workmanship and materials and will remain so, for a period of one (1) year from the date to final inspection and acceptance of the work. Any defect appearing within one year shall be corrected by the Contractor at no additional cost to the Owner.

FPS 2800: CONTRACTOR'S RESPONSIBILITY

A. The Contractor shall provide temporary fire protection system during the construction period. This shall be of sufficient capacity to put any fire that may break out at any floors due to construction operations. This is in addition to temporary fire extinguisher required.

b. The Contractor shall identify and save the Owner, the Architect and the Consulting Engineer harmless from and against all liabilities for damage to property occasioned by any or omission of this Contractor on any of this Sub-contractors, including any and all expenses, legal or otherwise which may be insured by the Owner, the Architect or the Consulting Engineer, in the defense of any claims, action or suits.

13.03 PRESSURE TEST FOR WATER LINES:

a. After the pipe have been installed, the joints completed and with joins exposed for

examination, all newly installed pipe or any valve section therefore, shall be subjected to hydrostatic pressure 1 1/2 the designed working pressure of the system or as specified by the Architect.

b. The duration of each pressure test shall be at least 10 minutes unless otherwise specified by the Architect.

c. Each section of pipeline shall be slowly filled with water and the specified test pressure,

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

13.04 DEFECTIVE WORK

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

b. All repairs to piping shall be made with new materials at the expense of the contractor.

c. No caulking of screwed joints of holes will be accepted

13.05 DISINFECTION OF WATER DISTRIBUTION SYSTEM & WATER TANKS (as per AWWA C-601)

a. The entire water system shall be thoroughly flushed and disinfected with chlorine before it is place on operation. Water tanks shall be washed and swabbed.

b. Chlorination materials shall be liquid chlorine or hypochlorite, as specified and shall be introduced into water lines in a manner approved by the Engineer. Tank shall be thoroughly cleaned of all debris, dirt or dust before swabbing.

ELECTRONICS SPECIFICATIONS

GROUNDING AND BONDING

Part 1 – GENERAL

1.1 DESCRIPTION

A. Provide grounding system in accordance with the Contract Documents

1.2 QUALITY ASSURANCE

A. Utility company approval of service installation

1.3 STANDARDS

A. American National Standards Institute (ANSI):
ANSI/IEEE 81 – Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Ground System Part 1: Nominal Measurements

B. National Fire Protection Association (NFPA)

C. Philippine Electrical Code (PEC): PEC (PART 1 and 2: 2019)

D. Underwriter ‘s Laboratories, Inc. (UL):
UL 44 – Thermoset Insulated Wires and Cables
UL 83 – Thermoplastic Insulated Wires and Cables
UL 467 – Grounding and Bonding Equipment

E. Utility Company Requirements

1.4 SUBMITTALS

A. Shop Drawings:
1. Showing the location of system grounding electrode connections and the routing of grounding electrode conductor.

B. Test Reports:
1. Certified test reports of ground resistance.

C. Certifications: Two weeks prior to final inspection, deliver to the Resident Engineer four copies of the certification that the material and installation is in accordance with the drawings and specifications and has been properly installed.

1.5 FIELD TESTING

A. Resistance testing of grounding rod system indicating maximum 2 ohms resistance to ground (except that it shall be 1 ohm maximum for telecommunications grounding system).

1.6 IDENTIFICATION

A. Provide an identification nameplate for each ground bus cabinet.

PART 2 – PROUDUCTS

2.1 General

A. Grounding connections shall be brazed molded exothermic welded, bolted, clamp terminal or pressure connector type.

2.2 GROUNDING WIRES

A. General Purpose: UL and PEC approved types, copper, with TW, THW, XHHW or dual rated THHN-THWN insulation color identified green.
B. Isolated Power System: Type XHHW insulation with dielectric constant of 3.5 or less.
C. Size wire not less than what is shown and not less than required by the PEC.

2.3 GROUNDING ELECTRODE SYSTEM

A. Provide the following grounding electrodes, bonded together to form the grounding electrode system:

1. Metal underground water pipe in direct contact with the ground for 3 meter or more and electrically continuous to the points of connection of the grounding electrode conductor and bonding conductors.
2. Concrete encased electrode consisting of the minimum of 6000 mm bare copper wire not smaller than 22 mm^2 or zinc galvanized steel or electrically conductive coated steel reinforcing bars encased by a minimum of 50 mm concrete, located within and near the bottom of a concrete foundation or footing that is in direct contact with the ground. Provide one user ground for High Voltage and Low Voltage Switchgears, extend 20 mm conduit (minimum) with 80 mm^2 (minimum) copper conductor from the lower most level of the building to each main grounding bus cabinet.
3. Grounding rod of copper clad steel, minimum 20 mm diameter, minimum 3 meters long, driven full length into the ground. If the maximum resistance to ground cannot be obtained with a single ground, provide additional ground rod, provide additional ground rod installed not closer than 2 meters apart until the required maximum resistance to ground is obtained.
4. Other grounding electrodes as shown on the Drawings.

2.4 GROUNDING BUS CABINETS

A. Provide a grounding bus cabinet in the Main Electrical Transformer and Genset Room. Provide grounding bus cabinet in other locations shown on the Drawings
B. Grounding bus cabinets shall be NEMA 1 enclosure with drilled copper bus on standoff insulator.

2.5 TELECOMMUNICATIONS GROUNDING SYSTEM

A. Provide a continuous bare copper grounding conductor to each telecom terminal cabinet. Bond the telecommunications grounding system to the grounding electrode system.

PART 3 - EXECUTION

3.1 GENERAL

A. Ground in accordance with the PEC9 and PEC3, as shown on drawings, and as hereinafter specified.
B. System Grounding:
    1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and the related transformers.
    2. Separately derived system (transformers downstream from the service entrance): Ground the secondary neutral.
    3. Isolation transformers and isolated power system shall not be system grounded.
C. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosure, raceways, junction boxes, outlet boxes, cabinets, machine frame, and other conductive items in close proximity with electrical circuits shall be bonded.
    1. Metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames and other conductive items in close proximity with electrical circuits

shall be bonded to grounding system for personnel safety and to provide a low impedance path for possible ground fault currents. Non-conductive paint, enamel, or similar coating shall be removed at threads and contact surfaces to preserve grounding continuity or fitting shall be provided to make sure removal unnecessary.

3.2 PRIMARY EQUIPMENT AND CIRCUITS

A. Switchgear: Provide a bare grounding electrode conductor from the switchgear ground bus to the grounding electrode system, metal underground water pipe or driven ground rods for the grounding electrode.

B. Duct Banks and Manholes:

1. Provide a bare equipment grounding conductor in each duct containing medium or high voltages cables. Connect the ground conductors to the switchgear ground bus, to all manhole hardware, to the cable shielding of medium or high voltage cable splices and terminations, and equipment enclosures.
2. Provide a grounding conductor having at least 50 percent capacity of the largest phase conductor in the duct bank.
3. Connect the equipment grounding conductor to the ground rod.

C. Power Transformers:

1. Provide a driven ground rod and connect with a grounding electrode conductor to the grounding facilities at the transformer.
2. Ground the secondary neutral.
3. Connect lightning arrester grounds to the pad ground per PEC.

D. Lightning Arrester: Connect lightning arresters grounds to the equipment ground bus or ground rods as applicable.

E. Outdoor Fences: Connect outdoor fences around electrical equipment to the grounding electrode system.

F. Metallic Conduit: Metallic conduits which terminate without mechanical connection to housing of electrical equipment by means of locknut and bushings or adapters, provided with grounding bushings. Connect bushing with a bare grounding conductor to the equipment ground bus.

3.3 SECONDARY EQUIPMENT AND CIRCUITS

A. Main Bonding Jumper: Connect the secondary service neutral to the ground bus in the service equipment.

B. Water Pipe and Supplemental Electrode:

1. Provide a ground conductor connection between the service equipment ground bus and the metallic water pipe system. Jumper insulating joints in the water pipe.
2. Provide a supplemental ground electrode and bond to the water pipe ground, or connect to the service equipment ground bus.

C. Service Disconnect (Separate Individual Enclosure): Provide a ground bar bolted to the enclosure with lugs for connecting the various grounding conductors.

D. Conduit System:

1. Ground all metallic conduit system.
2. Non-metallic conduit systems shall contain a grounding conductor.
3. Conduit provide for mechanical protection containing only a grounding conductor, bond to that conductor at the entrance and exit from the conduit.

E. Boxes, Cabinets, Enclosures and Panelboards:

1. Bond the grounding wires to each pull box, junction box, outlet box, cabinets, and other enclosure through which the ground wires pass.
2. Provide lugs in each box and enclosure for ground wire termination.

3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs for terminating the ground wires.

F. Receptacles that are not approved for grounding through their mounting screws. Ground with a ground wire from green ground terminal on the receptacle to the outlet box ground screw,

G. Fixed electrical appliances and equipment shall have ground lug installed for termination of the green ground conductor.

3.4 CONDUCTIVE PIPING

A. Bond all conductive piping systems in the building to the electrical system ground. Bonding connections shall be made as close as practical to the water pipe ground or service equipment ground bus.

3.5 GROUNDING RESISTANCE

A. Grounding system ground resistance must not exceed to 2 ohms (1 ohm for telecommunication system). Final test shall assure this requirement is met

B. Services at power company interface points shall comply with the power company ground resistance requirements.

C. Make necessary modifications to the ground electrodes for compliance that are needed without additional cost to the Owner, including the provisions of a multi rod system.

3.6 GROUND ROD INSTALLATION

A. Drive each rod vertically in the earth for not less than 3 meters in depth. (If applicable)

B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.

C. When making exothermic welds, wire brush or file the point of contact to a bare metal surface. Use cartridges and molds in accordance with the manufacturer's recommendations. After welds have been made and cooled, brush slag from the weld area and thoroughly clean the joint.

D. For compression connectors, use homogenous copper, anticorrosion, surface treatment compound at connectors in accordance with connector manufacturer's recommendations. Use connector manufacturer's compression tool. Notify Engineer prior to back filling any ground connections.

E. Grounding electrodes in horizontal trenches to achieve the specified resistance.

END OF SECTION

HANGERS AND SUPPORTS FOR ELECTRONICS SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes

1. Hangers and supports for electrical equipment and systems
2. Construction requirements for concrete bases.

1.2 PERFOMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combines operating weight of supported equipment and connected system and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five (5) times the applied force.

1.3 SUBMITTALS

A. Product Data: For steel slotted support systems.

B. Retain first paragraph and subparagraphs below if supporting systems are required to withstand specific design loads and Architect either has delegated design responsibility to Contractor or wants to review structural data as another way to verify supporting system's compliance with performance requirements.

C. Shop Drawings: (Signed and sealed by a qualified professional engineer.) Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components
3. Equipment support.

D. Welding certificates.

1.4 QUAILTY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code – Steel".

B. Comply with NFPA 10.

PART 2 – GENERAL

2.1 SUPPORT, ANCHORAGE AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include.
2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4
5. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and cable supports: as described in NECA 1 and NECA 101.

C. Conduit and cable support devices: steel and malleable-iron, hangers, clamp, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for conductors in vertical conduit: factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cable in riser conduits. Plug shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural steel for fabricated supports and restraints: ASTM A 36/A 36M, steel plates, shapes and bar; black and galvanized.

F. Mounting, anchoring and attachment components: item for fastening electrical items or their supports to building surfaces includes the following:
   1. Powder actuated fastener: threaded-steel stud, for use in hardened Portland cement concrete, steel or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   2. Mechanical expansion anchors: Insert wedge type, zinc coated stainless steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building material in which used.
   3. Concrete Inserts: Steel or malleable-iron slotted support system units similar to MSS type 18; complying with MFMA-4 or MSS SP-58
   4. Clamps for attachment to steel structural elements: MSS SP-58, type suitable for attached structural element.
   5. Through Bolts: structural type, hex head, and high strength. Comply with ASTM A 325.
   6. Toggle Bolts: All steel spring head type.
   7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLES

A. Description: welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 – EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and system except if requirements in this Section are stricter.
B. In first paragraph below, support spacing in NECA 1, Table 1, are more detailed and specific and generally stricter than those permitted by NFPA 70 for IMC. Revise to suit Project, and consider retaining reference to NECA table for critical projects.
C. Maximum Support Spacing and Minimum Hanger Rod Size for raceway; Space supports for IMC shall be 1200 mm interval minimum. Minimum rod size shall be ¼ inch (6mm) in diameter.
D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with two-bolt conduit clamps.
E. Spring steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inch (38mm) and smaller raceways serving branch circuits and communications systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
B. Retain first paragraph below to permit raceways running perpendicular to bar joist and trusses to be supported by letting them rest within the joist or truss openings. NECA 1 does not mention this method. If seismic design requirements apply, consult structural engineer or authorities having jurisdiction before permitting this support method and specify seismic requirements.
C. Raceway support method: in addition to methods described in NECA 1, IMC may be supported by openings through structure members, as permitted in NFPA 70.
D. Strength of support Assemblies: where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200lb (90kg).

E. Mounting and anchorage of surface mounted equipment and components: anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To wood: fasten with lag screws or through bolts.
   2. To new concrete: bolt to concrete inserts.
   3. To masonry: approved toggle type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To existing concrete: expansion anchor fasteners.
   5. Instead of expansion anchor, powder actuated driven threaded studs provided with lock washer and nuts may be used in existing standard weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
   6. To steel: welded threaded studs complying with AWS D1.1/D1.1M, with lock washer and nuts, beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP – 69, spring tension clamps.
   7. To light steel: sheet metal screws.
   8. Item mounted on hollow walls and nonstructural building surfaces: mount cabinets panel boards, disconnect switches, control enclosures, pull and junction boxes, transformer, and other devices on slotted channel racks attached to substrate by means that meet seismic restraint strength and anchorage requirements.

F. Drill holes for expansion anchors in concrete at locations and depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 COCRETE BASES:

A. Construct concrete bases of dimension indicated but not less than 4 inches (100 mm) larger in bothdirection than supported unit and so anchors will be a minimum of 10 bolts diameter from edge of the base
B. Use 3000-psi (20.7MPa) 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirement are specified in division 3 section Cast-in-place Concrete

C. Anchor to Concrete
   1. Place and anchorage devices. Use supported equipment manufacturer's setting drawings, Templates, diagrams, instruction, and direction furnished with items to be embedded.
   2. Install anchor bolts to be elevations required for proper attachment to supported equipment.
   3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

END OF SECTION

STRUCTURED CABLING SYSTEM

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. The work to be done under this section of the specification shall consist of the furnishing and installation of Telecommunication Backbone Cabling System.

B. The materials to be used shall be new, tested, labeled and approved by the appropriate industry standards.

C. The complete Structured Cabling System shall consist of the following:

1. Administration/Equipment Room Subsystem [Main Distribution Frame (MDF) / Intermediate Distribution Frame (IDF)/
2. Riser Backbone Subsystem
3. Entrance Facilities
4. Cabling Containment System

D. The Administration Subsystem are the Main Cross-connect (MC)/MDF within the MDF Room. The Intermediate Cross-connect (IC)/IDF and the Horizontal Cross-connects (HC's) Telecom Rooms distributed on different floors links the Horizontal and Backbone Subsystem. It consists of wiring blocks and distribution wire panels for termination of copper cables, labeling hardware for providing circuit identification and patch cords or jumper wire used for creating circuit connections and Cable Management System.

E. The main routes within the building is the Riser Backbone. They link all the Telecom Rooms of the buildings to the Main Cross-connect/Data Center. It consists of the backbone cable between these locations and the associated connecting hardware terminating this media.

F. The Cabling Containment System supports and protects horizontal and backbone cabling.
It consists of raceways, fittings, and boxes.

G. All the passive components of this structured cabling system shall be in compliance with the existing industry standards on the latest performance parameters.

H. Review shop drawings, systems schematics and network diagrams submitted under this and other Sections, as well as other Divisions, to ensure coordination between works required among different trades. Coordinate the installation sequence with other Contractors to avoid conflicts and to provide the fastest overall installation schedule. Coordinate installation with Architectural and Structural features, and equipment installed under other Sections of the Specifications.

I. The following work shall be carried out by others:

1. Other building auxiliary systems

J. Movement of devices and equipment +3-5m away from location in the plan should not incur additional cost or variation orders.

1.2 QUALITY ASSURANCE

A. Comply with relevant portions of the PECE and PEC as applicable to communications systems.

B. Comply with EIA/TIA-568-B, BICSI, or ISO/IEC 11801 standards pertaining to structured cabling installations.

C. Engineer in-charge supervising the work shall be a duly Registered Electronics Engineer supervised by a Professional Electronics Engineer as required by R.A. 9292 and revised National Building Code.

1.3 STANDARDS

A. ANSI/TIA/EIA -568B - Commercial Building Telecommunications Cabling

B. ISO/IEC 11801 - Generic Cabling for Customer Premises

C. UL

D. Philippine Electronics Code (Vol. 1 and 2)

E. Philippine Electrical Code

1.4 SUBMITTALS

A. Submit manufacturer's data of all proposed equipment and materials.

B. Shop drawings shall include, but not be limited to, the following:

1. System Diagram
2. Floor plan layouts, sectional view and installation details
3. Telecom Room details

C. Submit samples of rack, cabinet, patch panel/punch block, terminal block, faceplate, outlet/jack, cables and other applicable connectors.

D. Submit As-Built Drawings to include the following information:

1. Floor plan showing location of all Telecom Rooms locations, major run paths, backbone and risers.
2. List of major components and their place in the system.
3. Synopsis of the numbering scheme and cross connect log.

E. Submit Operation and Maintenance Manuals, including test results with link characteristics for each cable run.

F. Sourcing of skilled workers shall be from an authorized and certified systems integrator, with minimum or 10 years of experience.

PART 2 – PRODUCTS

2.1 ADMINISTRATION SUBSYSTEM

A. Copper Termination Block (Voice Riser and Cross-connection) and Fiber Optics Termination Block (Data Riser & Cross Connection).

B. The termination block shall support the appropriate Category applications and facilitate cross-connection and inert-connection using either cross-connection wire or patch cords.

C. The termination block shall be 110-type or equivalent and shall comply with the following:

1. Be made of flame-retardant thermoplastic, with the base consisting of horizontal index strips for terminating 100-pairs of conductors.
2. Contain access openings for rear to front cable routing to the point of termination.
3. Have termination strips on the base to be notched and divided into 5-pair increments.
4. Have clear label holders with the appropriate colored inserts available for the wiring blocks. The insert labels provided with the product shall contain vertical lines spaced on 5-pair circuit size and shall not interfere with running, tracing or removing patch cords. Label holders must be capable of mounting between each row of connecting blocks.
5. Have bases available in 19-inch panels and high-density frame configurations for rack or wall mounting with cable management/troughs hardware.
6. Have connecting blocks used for either the termination of cross-connect (jumper) wire or patch cords. The connecting blocks shall be in 5-pair size. All connecting blocks shall have color-coded tips of Blue, Orange, Green, Brown and Slate and be of single piece construction.
7. Have connecting blocks with a minimum of 200 terminations without signal degradation below standard compliance limit.
8. Support wire sizes: Solid 22-26 AWG
9. Be made by an ISO 9001 and 14001 Certified Manufacturer.
10. UL LISTED

3.1 GENERAL INSTALLATION

A. Install the system in accordance with the Plans and Specifications, all Local and National Applicable Codes, PECE and PEC Wiring Criteria, ANSI/EIA/TIA-568-B.series Commercial Building Wiring Standards and the Manufacturer's recommendations.

B. The Contractor shall provide any necessary screws, anchors, clamps, tie wraps, distribution rings, wire raceways, miscellaneous grounding and support hardware, etc. necessary to facilitate the installation of the system.

C. It shall be the responsibility of the Contractor to furnish any special installation equipment or tools necessary to properly complete the system. This may include, but is not limited to, tools for terminating cables and testing equipment for copper cables, communication devices, jack stands for cable reels.

D. The Contractor shall not place any distribution cabling alongside or near power lines, or share the same conduit, channels or sleeve with electrical apparatus.

E. The Contractor shall be responsible for providing approved grounding at all newly installed Telecom/Equipment Rooms. The Contractor shall also be responsible for ensuring ground continuity by properly bonding all appropriate cabling, closures, cabinets, service boxes and framework.

All grounds shall consist of N°6 AWG copper wire and shall be supplied from an approved building ground and bonded to the main electrical ground.

3.2 GROUNDING

A. All grounding/earthing and bonding shall be done in accordance with applicable codes and regulations.

3.3 WORKMANSHIP

A. All work shall be done in workman like fashion of the highest standards in the telecommunications industry. All equipment and materials are to be installed in a neat and secure manner, while cables are to be properly dressed. Workers must clean the worksite from any debris or trash at the close of each workday.

3.4 ADMINISTRATION DOCUMENTATION

A. Labeling

1. Racks, Panels, Blocks

A unique identifier shall be marked on each piece of connecting hardware to identify it as connecting hardware.

Each port on the connecting hardware shall be labeled with its identifier.

B. Drawings

As-built drawing shall be supplied by the Contractor showing the locations of and identifiers for all:

Backbone cable routing and terminations

C. Records

All records shall be created by the installation Contractor and turned over at the completion of work. The format shall be computer based and both soft copies and hard copies shall be part of the As-built package. The minimum requirements include:

1. Connecting hardware and connecting hardware position records must contain the identifier, type, damaged position numbers, and references to the cable identifier attached to it.

3.5 WARRANTY

Either a basic link or channel model configuration may be applied to the horizontal and/or backbone sub-systems of the structured cabling system. Applications assurance is only applied to a channel model configuration.

A. System Warranty

A twenty (20) year warranty available for category 6 structured cabling system shall be provided for an end-to-end channel model installation which covers applications assurance, cable, connecting hardware and the labor cost for the repair or replacement thereof.

B. Product Warranty

The manufacturer of passive telecommunications equipment used in a manner not associated with the Systems Warranty must have a minimum twenty (20) year Component Warranty on all its product. The Products Warranty covers the components against defects in material under normal and proper use.

- Applications Supported

Existing and future applications supported for a channel model warranty include those approved by the Institute of Electronic and Electrical Engineer (IEEE), the Asynchronous Transfer Mode (ATM) Forum, the American National Standards (ISO) that specify compatibility with the cable referenced herein. Additional applications that are covered by this warranty include those under development for use on Gigabit Ethernet (IEEE 802.3z, 802.3ab, 802.3ae) and 622 Mb/s ATM.

***END OF SECTION ***

FIRE DETECTION AND ALARM SYSTEM (FDAS)

PART 1 – GENERAL

1.1 DESCRIPTION

A. Provide fire detection and alarm system in accordance with the Contract Documents.

B. The fire detection and alarm system shall be a stand-alone system operating independently of other control systems. It shall have an automatic dial-up feature to Local Fire Station.

C. Related work specified in other divisions of these specifications:

1. Sprinkler water flow and tamper switches.
2. Magnetic door holders and electric door locking hardware.
3. Installation of fire alarm speaker and firefighter's phone jack in elevator cabs.
4. Public Address Emergency Announcement

D. Movement of devices and equipment +3-5m away from location in the plan should not incur additional cost or variation orders.

1.2 QUALITY ASSURANCE

A. Fire Department approval of fire detection and alarm system.

B. Manufacturer and equipment supplier shall have a minimum of ten years experience as Contractor of fire detection and alarm system and shall have at least five completed or on going FDAS installation in the Philippines.

C. Equipment supplier shall have 24 hour parts and labor service available with a maximum 4 hour response time.

D. Prior to making required submittals, system supplier shall meet with the Fire Department and make an informal presentation of the fire alarm and detection system. Meeting minutes shall be issued and comments incorporated into the required submittals.

E. Engineer in-charge supervising the work shall be a duly Registered Professional Electronics Engineer as required by R.A. 9292 and revised National Building Code.

1.3 STANDARDS

A. Bureau of Fire Department Requirements

B. National Building Code of the Philippines (Latest)

C. National Fire Protection Association (NFPA 72, 101, 5000)

D. United Laboratories, Inc. (UL):

- UL 268 - Smoke Detectors for Fire Alarm System
- UL 268A - Smoke Detectors for Duct Application
- UL 521 - Heat Detectors for Fire protective Signaling Systems

1.4 ABBREVIATIONS

A. FACP Fire Alarm Control Panel

1.5 SUBMITTALS

A. Minutes of system supplier's meeting with the Bureau of Fire Department.

B. Manufacturer's product data sheets for equipment including Fire Marshal listing numbers.

C. Floor plans (minimum 1:100 scale) showing device locations and interconnecting conduit and wire. Floor plan (minimum 1:25 scale) of the Fire Command Center (FCC) indicating fire management system equipment, equipment

furnished by others, tables, plan racks, and required clearances. Elevations (minimum 1:25 scale) of each wall of the FCC.

D. Riser diagram showing devices, equipment, and interconnecting conduit and wire. Indicate points of connection to other equipment such as motor control centers, damper actuators, fire pump controllers, dry pipe sprinkler systems, electric door locking hardware, and magnetic door holders.

E. Scaled detail drawings of FACP

F. Wiring diagram for each device.

1.6 FIELD TESTING

A. Wiring shall be inspected and tested for continuity and short circuits. The minimum allowable insulation resistance between any two conductors or between conductors and ground is ten mega-ohms measured with a 500 volt megger.

B. Field Test Reports:

1. Certification that equipment has been properly installed and is in satisfactory operating condition.
2. Sensitivity settings for smoke detectors.
3. Detailed operational test report in matrix form indicating each initiating device, each signaling device, each communication device, and each control and indicating light on each piece of equipment. Report shall certify the following:

a. Successful operation of each alarm and supervisory initiating device.
b. Successful operation of each signaling device.
c. Successful operation of automatic smoke control sequences.
d. Successful operation of FACP
e. Successful operation of line supervision devices.
f. Successful operation of offsite alarm monitoring system connection (optional).
g. Successful operation of unlocking electronically locked doors.

1.7 IDENTIFICATION

A. Provide an identification nameplate for each equipment cabinet.

1.8 SEQUENCE OF OPERATION

A. A computerized intelligent addressable, non-coded, two stage evacuation system complete with integrated emergency voice evacuation and two way communication system will be provided. The system will be designed using National Building Code of the Philippines (latest) and other related standards such as NFPA as reference.

B. The main design principle of the proposed system is to provide localized microprocessor based intelligent Fire Alarm Control Panel, FACP with Emergency Voice Evacuation System. Detectors and system device are able to identify maintenance points, malfunctioning and line discontinuity.

C. The primary means of detection/suppression will be a system of smoke detectors integrated with the automatic sprinkler system. Smoke detectors will be provided in all areas of the building to comply with local codes, and will be supplemented by the following types of early warning detection.

D. All detectors and zone control and monitor modules will be connected on an addressable loop and will each possess a unique address to allow specific identification in the case of alarm or malfunction and environmental

E. Upon activation of any alarm, initiating devices the system will sends signal to:

1. Transmit an evacuation broadcast to the fire floor, floor above and floor below.
2. Transmit an alert broadcast to the remainder of the tower and the below grade floors.
3. Automatically stop all building floors recirculating air handling systems.
4. Automatically start all smoke removal and pressurization fan systems as well as open/close appropriate dampers.
5. Activate all fire shutters to 1st stage position (if there's presence).
6. Release all secure door magnetic locks or electronically locked doors.
7. Annunciate all functions at the Fire Alarm Control Panel located in the FCC Room.
8. Should the initial alarm not be acknowledge within five minutes, an evacuation broadcast will be transmitted to the entire building complex.
9. Transmit signal to the local fire department.
10. A hard copy printout to be initiated at the printer.

F. A selective paging system will be integrated with the signaling system to allow authorized announcements.

G. An integrated UL listed dedicated two way fire fighter's telephone system will be provided at each exit stair entry to allow direct communication between the fire fighters and the Fire Command Center.

H. The main control panel will consist of a central processing unit, printer and colour LCD unit annunciator with a complete graphics package identifying all fire zone status.

I. The printer shall be as an event and status printer, it shall be laserjet type with a minimum speed of 200 characters per second at 10 characters per inch.

1.9 SYSTEM ZONING (TO BE FURTHER COORDINATED WITH THE FIRE AND LIFE SAFETY CONSULTANT)

A. Firefighter's Telephone System:

1. Plug in jacks: Each stairwell shall be a separate, individual zone.
2. Emergency telephones: Each stairwell shall be a separate, individual zone.
3. Each bank of elevator cabs shall be a separate, individual zone.
4. Each elevator lobby bank riser shall be a separate, individual zone.

B. Damper Override Control and Status Indication:

1. Separate zone for each damper actuator.

Damper switches each with open close and auto functions as well as positive indication shall be provided at each floor and are to be provided at the main control panel.

1.10 TRAINING

A. The Contractor shall provide appropriate training for the operation and maintenance of the fire detection and alarm system,

PART 2 – PRODUCT

A. Contractor must have at least 10 years of experience and existence.

2.2 LINE SUPERVISION

A. All system equipment and wiring shall be supervised.

B. Style 7 wiring shall be arranged so that the system shall not be affected by a single open, short, or ground condition. Report trouble condition and automatically switch over to alternate wiring path.

C. Style Y wiring shall utilize end of line resistors.

D. Addressable Channel Wiring: Style 6.

E. Multiplex Channel Wiring: Style 7.

F. Non Addressable Initiating Device Wiring: Style Y.

2.3 STANDBY BATTERIES

A. Provide sufficient battery (NiCd) capacity to operate the entire system upon loss of power under maximum normal load for a minimum period of 24 hours with a minimum of 5 minutes of alarm operation at the end of this period.

B. The system shall automatically transfer to the standby batteries upon power failure. Battery charging and recharging shall be automatic.

2.4 FIRE ALARM CONTROL PANEL (FACP)

A. Solid state, microprocessor based, modular design, fully supervised and intelligent addressable. Steel enclosure in standard finish, with hinged, locking door. Integral power supply, standby batteries, and battery charger.

B. Provide power on LED, power failure LED, system trouble LED, system reset switch, alarm silence switch, trouble silence switch, manual evacuation switch, alarm acknowledge switch, trouble acknowledge switch, supervisory service acknowledge switch, lamp test button, tone alert, battery supervision LED, auxiliary relays, and other system indicators and controls necessary for processing alarm and signaling functions. Indicating lamps shall be LED type.

C. Provide appropriate permanent identification labeling of control and indicating functions.

D. Annunciation:

Serial annunciator with back lit, alphanumeric, 80 character liquid crystal display indicating clear language information as to the type of alarm (device type), point status (alarm or trouble), number of alarms on the system, and a custom location label. Ability to scroll back through prior system actions.

E. System shall utilize analog type smoke detection with alarm verification, self test feature, individual sensor automatic timed sensitivity adjustment, individual smoke sensor field adjustable sensitivity set from FACP, and automatic maintenance alarm feature.

F. With Lon Bus or Lon Works interface.

2.5 FIRE ALARM INITIATING DEVICES

A. General:

1. Intelligent Addressable type.
2. Provide auxiliary relays where required to satisfy system operational requirements.
3. Smoke detectors shall be intelligent analog type.

B. Manual Pull Stations:

1. Furnish and install where indicated on plan.
2. All manual pull station shall be single action non-coded break glass type.
3. Manual station shall be constructed of Red Lexan or Die Cast Metal with clearly visible operating instruction.
4. Station shall be suitable for surface mounting on matching back box.
5. Pulling the alarm handle shall activate the toggle switch which shall cause the station n alarm position.
6. Push button type manual station shall not be acceptable.

C. Smoke and Heat Detectors:

1. Photoelectric smoke detector:

a. LED light source, silicon photodiode receiving element. Line filter and time delay circuitry to prevent transient false alarms.
b. 360° smoke entry, locking tamper screw, pulsating on power LED indicator, UL 268.
c. Adjustable obscuration/smoke detection levels.
d. Provides maintenance identification alarm.
e. Provides two LED function/working indication.

2. Heat detector:

a. 135° Combination fixed temperature and rate of rise heat detector
b. Locking tamper screw, UL 521.
c. Provides maintenance identification alarm.
d. Provides two LED function/working indication.

D. Device Monitoring Module

1. The device monitoring module shall permit the use of conventional detecting devices including sprinkler flow switches and supervisory switches on the addressable system. The module can be mounted together in the fire alarm cabinet or be in the standard outlet boxes located near the device being monitored.

E. Control Module

1. Interfaces a controlled device to the addressable system. This enables the fire alarm panel to direct an instruction only to the intended device by addressing to its control module.

F. Sounder (Horn) - Strobes

1. Fire lights shall be a xenon-strobe type or equivalent. It shall be low-voltage (24 VDC).

- The maximum pulse duration shall be 2/10ths of one second (0.2 second with a maximum duty cycle of 40%). A pulse duration is defined as the time interval between initial and final points of 10% of maximum signal.
- The intensity shall be minimum of 75 candela.
- The flash rate shall be minimum of 1 Hz and a maximum of 3 Hz.

2. The color shall be clear or nominal white (i.e. unfiltered or clear filtered white light).
3. Electric, utilizing solid state electronic technology operating on a nominal 24 VDC, with a nominal rating of 82 dBA at 3m.

G. Annunciator Panel-Back Lit Graphic Type

1. Graphic annunciator showing the site plan, and access way shall be provided and installed at the security room unless noted otherwise.
2. Indicating Lamps

Provide supervised light emitting diodes (LED's) for indication.

2.6 EMERGENCY VOICE EVACUATION PANEL (EVAC) PANEL

A. A fully automatic combination voice communication and fire fighters intercom system which provides automatic and alarm signaling per the NFPA 72.

E. One or two-way communications system for relocation/evacuation of building personnel and assisting fire-fighting efforts in controlling smoke and fire.

F. "ALL-CALL" tone and Voice Signaling.

G. Selective Tone and Voice Signaling with Redundant tone generators.

H. Module removal supervision

I. Service Diagnostic Center.

J. "ALARM/RESOUND/RESTORE" Feature

K. Short Circuit Speaker Disconnect

L. "On/Normal/Off" Auxiliary controls

M. Local annunciation with Time-out of selective alarm signal to general alarm "ALL-CALL"

N. Fully integratable with any Public Address system

2.7 OPERATOR WORKSTATION

The network reporting terminal shall be a high performance desktop computer with printer located in the Propertt Management office.

The high performance desktop computer shall consist of the following as a minimum requirements:

A. Intel Dual Core i7 3GHz Processor
4 GB DD2 memory 256MB Video RAM
2TB HDD
Keyboard; mouse and CD Rom Drive

Latest Windows Operating System and Fire Alarm System Software.
21' Color LCD Monitor

B. Provide Laserjet Color Printer

2.8 BATTERY AND CHARGER

A. Battery:

Nickel cadmium or maintenance-free sealed lead acid type, 24 volt nominal with sufficient capacity to power the fire alarm system for not less than twenty four (24) hours upon a normal AC power failure.

B. Charger:

Automatic with constant potential charger maintaining the battery fully charged under all service conditions. Charger will operate at 230 volt, 60 Hz source.

2.9 PRINTER

Printer shall be of the automatic type with code, time date, location, category and condition. System printer shall be of high a reliability digital input device, UL approved, for fire alarm applications. The printer will operate at a minimum speed of 30 characters per second.

2.10 SYSTEM SOFTWARE

A. Automatic detector addressing and status indication.

B. Secure signal transmission on unshielded cables.

C. Intelligence distributed across the detectors and the fire control panel.

D. Drag & drop graphics and GUI interface.

E. Graphic screens are created with a built-in drawing utility of the protected area and are linked to fire alarm devices.

F. Should a device got to alarm, the appropriate graphic floor plan is displayed along with operator instructions.

G. History manager which tracks and stores events.

PART 3 – EXECUTION

3.1 GENERAL

A. All equipment shall be installed and connected in accordance with the manufacturer's recommendations. Following the required specifications indicated here.

B. Wiring shall be color coded, and in accordance with the manufacturer's recommendations and Fire Department requirements. Install wiring in an independent, dedicated metallic raceway system.

C. Connections to devices installed in accessible tile ceilings shall be in flexible conduit. Device back boxes shall be securely attached to framing members.

D. Provide wireways above and/or below equipment cabinets to accommodate large concentrations of wiring. Conductors within equipment cabinets shall be carefully formed and harnessed.

E. Connect equipment to emergency power system.

F. Provide power supply wiring to electric damper actuators used for smoke control that are not controlled by the temperature control system.

G. Furnish a fire alarm speaker and a firefighter's plug in jack for each elevator. Coordinate installation with elevator equipment supplier.

H. Provide a 25 mm empty conduit from the FACP to the nearest telecom terminal backboard.

I. Speaker circuits on individual floor are to be wired in alternate pattern e.g. 'a'-'b'-'a'-'b'-'a'.

J. The supplier/contractor must provide a complete layout plan for a class "A" wiring reflecting the location/position of the control panel, smoke detectors, pull stations and alarm horn.

K. The supplier/contractor must provide quarterly preventive maintenance during the defects liability and warranty periods.

L. A provision of a preventive service maintenance contract after the one year of warranty period.

3.2 TESTING AND COMMISSIONING

A. Provide the service of a competent factory-trained engineer or technical authorized by the manufacturer of the fire detection and alarm system equipment to technically supervise and participate during all of the adjustments and tests for the system. Make all adjustments and tests in the presence of the Project Manager.

B. When the system has been completed, and prior to the final inspection, furnish testing equipment and perform the following tests in the presence of the Engineer and the Local authority having jurisdiction.

1. Check installation, supervision and operation to ascertain that they will function as specified.
2. When any defects are detected, make repairs or install replacement components, and repeat the test.

C. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall perform the required test. In addition, the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence o the Owner's Representative, Project Manager, Consultant and the local authority having jurisdiction.

***END OF SECTION ***

INTEGRATED SECURITY MANAGEMENT SYSTEM

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Furnish all labor, materials, supplies, equipment, devices, appliances and perform all operations necessary for the installation of the complete Security System.

B. Any equipment not specifically mentioned in the Specifications or not shown on the Contract Drawings, but deemed necessary for the satisfactory operation of the system, shall be provided. All cost of such equipment shall be included in the bid price.

C. The specialty Contractor shall be responsible for coordination having properly assessed the fire alarm and other specified interfacing requirements and the conduit and wiring requirements relevant to their full compliance with this Specifications.

D. The system shall provide Security Management capable of allowing the on-duty guards to monitor and keep under surveillance, the specific doors, rooms and areas of the building with a minimum effort but with maximum efficiency.

E. The system shall be microprocessor based capable of providing the Security System Administrator advanced database entry, controllers' configurations, systems graphics, reports, events/alarms management facilities.

F. The system shall be capable to provide complete integration of doors access, alarm monitoring, photo badging, card printing and CCTV control.

G. A Guard Tour Facility shall be provided whereby the Security Administrator shall have complete flexibility in programming guards tours, utilizing any local combination of Tour Stations.

H. A card access control sub-system shall be provided with a high level of flexibility and comprehensive system management and database reporting facilities.

I. Intrusion alarm shall comprise of intruder alarm door switches with sirens and strobe lights on some doors/areas.

J. A closed circuit television (CCTV) shall be installed and fully integrated with the Security System allowing real time control and feedback from a CCTV camera directly from the Security System Administrator workstation.

K. All circuit wiring shall be continuously supervised from open or short circuit and connection to earth and the system shall be able to detect tampering.

L. During bid stage, the Contractor shall adequately and accurately describe the proposed system at the time of bidding.

M. Movement of devices and equipment +3-5m away from location in the plan should not incur additional cost or variation orders.

1.2 QUALITY ASSURANCE

A. The entire security system installation shall be carried out in accordance with the PECE and PEC. The Fire Code of the Philippines & Regulations, NFPA, latest National Building Code and applicable local ordinances.

B. The Contractor shall have 10 years minimum experience and with 24 hours service department.

C. Engineer in-charge supervising the work shall be a duly Registered Professional Electronics Engineer as required by R.A. 9292 and revised National Building Code.

1.4 SUBMITTALS

A. The Contractor shall supply a full set of drawings, specifications and catalogue sheets describing the various components belonging to the offered system.

1.5 TRAINING

A. The Contractor shall provide appropriate training for the operation and maintenance of the security system, in accordance with the requirements of Section 16001.

C. Engineer in-charge supervising the work shall be a duly Registered Professional Electronics Engineer as required by R.A. 9292 and revised National Building Code.

1.4 SUBMITTALS

A. Make submittals for the security system in accordance with the requirements of Section 16001.

B. The Contractor shall supply a full set of drawings, specifications and catalogue sheets describing the various components belonging to the offered system.

1.5 TRAINING

A. The Contractor shall provide appropriate training for the operation and maintenance of the security system, in accordance with the requirements of Section 16001.

PART 2 – PRODUCTS

PART 3 – EXECUTION

3.1 INSTALLATION

A. All wiring shall be in a complete conduit system separate from other building wiring. Wiring color code shall be maintained throughout the scope of the work.

B. All security system lines shall be provided with separate runs from power distribution lines. Separation distance from any power lines shall be maintained to at least 30 cm in parallel and 10 cm in perpendicular.

C. Raceways shall be provided at the control room for cable runs and equipment interconnection.

D. Conduit runs from the ground floor shall be provided with stub out at the second floor. Runs shall be of sufficient sizes to accommodate installation and replacement of security cables.

E. Pull boxes for security system runs shall be provided with removable lock and cover.

F. Installation equipment and services that pertain to other work in the Contract shall be closely coordinated with the appropriate Contractors.

G. Coordinate with Builder to ensure that:

1. All required building penetrations are provided, otherwise provide details (eg: drawings).
2. Trimming shall be provided for all ceilings and walls where security detection devices and cables are required provide details.
3. Interfaces between motorized doors and the Security System are fully compatible, fully commissioned and tested, and provide all the control, monitoring signals and information required by the Security System.

H. Coordinate with the Electrical Contractor to ensure that:

1. No conflict occurs between cable conduit or cable tray routes for the two services.
2. Sufficient essential supply is supplied and installed to meet the requirements of the Security System Contractor.
3. The cabling is terminated in an agreed fashion and documented to a level satisfactory to both Contractors.
4. All cabling are done in an orderly and neat fashion and which allows clear identification and segregation of the cabling looms.
5. The systems are tested and commissioned successfully.
6. All interfaces are fully documented to the satisfaction of the Security System and Electrical Contractors.

I. Coordinate with the Fire Alarm Contractor to ensure that:

1. Interfacing compatibility between the Security and Fire System is achieved.
2. The Security and Fire Systems are fully operational and have been tested and commissioned fully and meets the requirements of this Specification.
3. Inter-system cabling is terminated in an agreed fashion and documented to a level satisfactory to both Contractors.

4. Junction boxes, properly labeled termination strips, conduits, cables are suitably located for the Security-Fire system interface.

5. Location of intercom within the Security Control Room (on console) and associated installation is in accordance with the Security Control Room design.

6. All Fire-Security interfaces are fully documented to the satisfaction of the Security System and Fire Contractors.

J. The manufacturer's authorized representative shall provide all on-site software modifications and supervision of installation of the complete Security System installation, perform a complete functional test of the system, and submit a written report to the Project Manager attesting to the proper operation of the complete system.

K. Unless specified otherwise, the manufacturer's recommendations shall be followed with regard to workmanship and associated materials, equipment, components and devices, whether or not the particular manufacturer has been specified.

L. Where equipment and materials enters in environmental condition e. g. temperature, humidity, rain, fog, steam, etc., all said materials, equipment, components and devices which could be affected by such shall be selected and installed to ensure satisfactory operation.

M. Variations of positions shall be affected without cost variation if the change is advised before the equipment is cabled and it is not more than ten (10) meters distant.

N. Equipment supplied and installed shall be such that interference from outside sources (magnetic, electrical or EMI noise distortion, etc.) shall not be accepted as reasons for non-operational equipment or systems.

3.2 TESTING AND COMMISSIONING

A. Provide the service of a competent factory-trained engineer or technical authorized by the manufacturer of the security system equipment to technically supervise and participate during all of the adjustments and tests for the system. Make all adjustments and tests in the presence of the Project Manager.

B. When the system has been completed, and prior to the final inspection, furnish testing equipment and perform the following tests in the presence of the Engineer and the Local authority having jurisdiction.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity and insulation.
2. Test the insulation on all installed cable and wiring by standard methods as recommended by the equipment manufacturer.
3. Test all security system devices circuits for open and ground and verify response of trouble signals.
4. Check installation, supervision and operation to ascertain that they will function as specified.
5. When any defects are detected, make repairs or install replacement components, and repeat the test.

C. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall perform the required test. In addition, the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of the Owner's Representative, Project Manager, Consultant and the local authority having jurisdiction.

***END OF SECTION ***

SECTION 17726

BACKGROUND MUSIC (BGM) AND PUBLIC ADDRESS (PA) SYSTEM

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Furnish and install a complete and functional Background Music (BGM) and Public Address (PA) System integrated to the Fire Alarm System.

1.2 RELATED WORK

A. All work specified in this Section is subject to the provisions of Section 16001 - General Provisions.

B. Refer to the following Sections for related work in connection with the Background Music and Paging System.

Section 16490 – Fire Barrier
Section 16112 - Raceways
Section 16170 - Grounding
Section 17720 - Fire Detection and Alarm System

1.3 SYSTEM DESCRIPTION

A. The work covered in this Section of the Specification includes the furnishing of all labor, equipment, materials and performance of all operations associated with the installation of the background music and paging system as shown on the drawings and as herein specified.

B. The Contractor shall be capable of providing comprehensive sound distribution via computer-operated matrix zone set-up and control.

C. All works shall be in accordance with governing Codes and Standards, Drawings, Specifications and all related Bid Documents. If a discrepancy is noted between the documents, this shall be notified to the Project Manager in writing and further clarification shall be given.

D. Any equipment/components not specifically mentioned in the specifications or not shown on the Contract Drawings but deemed necessary for the satisfactory operation of the system shall be provided. All cost for such shall be included in the bid price.

E. All major equipment and materials used for the installation shall be of the same make and type to ensure uniformly of standard and composition. All equipment and components shall be new and the manufacturer's current model.

F. All materials, appliances, equipment, and devices shall be tested, used, and listed by Underwriters Laboratory (UL).

G. All equipment shall be mounted on standard equipment racks.

H. The system shall be provided to perform the following functions:

1. Distribute paging system or announcement that is selectable per zone from the paging microphones. Each floor is treated as a single zone.
2. Provide paging to car park area.
3. Distribute background music to any combination or individual speaker, either in a single or multiple channels that could be selected locally.
4. Override distributed background music to some areas with the public address & emergency announcement and automatically return to the background music after the announcement.
5. Distribute program material from a radio tuner as part of the multiple channel distribution to selected areas only.
6. Permit distribution of an emergency announcement to select all zones regardless of the volume controller, program selector or source selector settings.
7. Sound pressure level of music shall be 6dB above background noise level and paging system shall be 10dB above background noise level.

I. The Contractor shall submit a detailed schematic wiring diagram showing all component units with type references, gain or loss, designed to operate to give the system performance as specified.

J. The Contractor shall submit a fully technical and mechanical description of every piece of equipment and cables used, including manufacturer's technical literature.

K. The work specified herein shall be coordinated with other trades involved in the construction. All work shall be carefully laid out in advance, coordinating system feature with Electrical, Mechanical, Architectural and Structural features of construction.

L. Movement of devices and equipment +3-5m away from location in the plan should not incur additional cost or variation orders.

1.4 QUALITY ASSURANCE

A. Electronic Components: Comply with latest applicable standards of EIA; PEC; standard industry grade; types and ratings commonly available in local distributor without prior written approval from the Project Manager.

B. Entire system, including mounting, installing, connecting, aligning, testing, and adjusting, to be the responsibility of one Contractor.

C. Engineer in-charge supervising the work shall be a duly Registered Professional Electronics Engineer as required by R.A. 9292 and revised National Building Code.

D. Installer: company specializing in sound system installation with 10 years documented experience.

1.6 SUBMITTALS

A. Make submittals for the background music and public address system in accordance with the requirements of Section 16001.

B. The Contractor shall submit a fully technical and mechanical description of every piece of equipment and cables to be used, including manufacturer's technical literature.

C. The Contractor shall provide a description of the methods proposed to show that the actual performance will be in accordance with the specifications for technical performance, including necessary test methods, procedures, and equipment that will be used.

D. Submit shop drawings to include the following:

1. System diagram
2. Floor plan layouts, sectional view and installation details.

E. Submit samples of cables and other components as required.

F. Submit as-built drawings to include the following

1. Floor plan layouts, sectional view and installation details.
2. List of major components and their place in the system.

3. Synopsis of the numbering scheme and cross connect log.

G. Submit O&M manuals, including test results.

1.7 TRAINING

The Contractor shall provide appropriate training for the operation and maintenance of the background music and paging system in accordance with the requirements of Section 16001.

1.8 PRODUCT DELIVERY AND STORAGE

A. Deliver and store background music & public address system equipment in undamaged factory packaging according to the requirements of Section 16001.

B. Store background music & public address system equipment on elevated platforms in a clean, dry location. Protect from dirt, water, construction debris, and traffic.

PART 2 – PRODUCTS

2.1 RADIO TUNER

A. Radio tuners shall have digitally synthesized tuning system and can receive both AM and FM signals. The tuner shall meet or exceed the following characteristics:

Frequency Range	:	520-1610 Khz (AM) 88-108 MHz (FM)
Useable Sensitivity	:	10.8 dBf (mono)
Signal strength required 50 dB quieting	:	15.9 dBf (mono) 37.3 dBf (stereo)
Capture Ratio	:	1.0 dB AM Suppression 65 dB
Alternate Channel Selectivity		: 80 dB
Stereo Separation		60 dB at 1 KHz
Total Harmonic Distortion	:	0.05 % (mono) 0.08 % (stereo) At 1 KHz

Signal to Noise Ratio : 85 dB (mono)
81 dB (stereo)

2.2 COMPACT DISC PLAYER

A. The Compact Disc Player at least 10 units shall have magazine, or separate tray to hold at least 5 disc at a time.

B. It shall at least have 18-bit, 8 x over sampling rate D/A converter and 3-beam laser pick-up.

C. The disc player shall include, but not limited to the following features:

1. Disc play mode (single disc play/5-disc play) switch
2. Shuffle play (shuffle with 1 disc, shuffle with next random selected disc, etc).
3. 32-Random music selection (from 1-5 discs)
4. 5-way repeat mode (all disc/one disc/one selection/RMS/shuffle)
5. 6 mode time

D. The compact disc player shall meet or exceed the following electrical characteristics:

Frequency Response (Hz) : 20-20,000 (± 0.5 dB) Signal-to-noise ratio (dB) : 100 min.

Harmonic Distortion (% at 1 KHz)	:	0.05 max.
Dynamic Range (dB)	:	88 min.
Channel Separation (dB at 1 KHz)	:	90 min.
Output Level	:	2 Vrms at 50K ohm

2.3 MICROPHONES

A. Microphone shall be of the unidirectional dynamic type with assembly consisting of momentary DPDT spring return switch with self-wiping silver plated contact.

B. It shall be sensitive and rugged with a frequency response of 100 to 10,000 Hz and an output level of 58 dB.

C. The base shall be fitted with a locking type receptacle to accept a locking type microphone cable connector.

2.4 REMOTE PAGING MICROPHONES

A. Remote Paging Microphone shall be a free-standing unit with a high quality phantom powered electric/condenser microphone.

Nominal input level : 84dB SPL
Maximum input level : 124dB SPL
Nominal output level with 3mV SPL in & Maximum gain setting 1Veff (0 dBV) ±3dB
: Vo=0.1dBV

Signal-to-noise ratio at nom.
Output level typical : >62dB
: 64dB (signal 0dBV, noise A-weighted)

B. There shall be numeric keypad for the selection of loudspeaker zones and press-to-talk key.

C. Busy and Wait/Talk LED's shall be available to advise the user as to whether a call may be activated, the status of the call and whether any other calls are active.

2.5 PRE-AMP MODULES

A. The pre-amp shall be fully solid state of modular detail with volume and separate bass/treble control and accepts input from microphone, tuner or CD player and chime inputs.

B. Electronic switching for line remote control to be incorporated. Built-in priority circuit for microphone circuits shall be provided.

C. A test tone generator module shall be incorporated to provide test zone to power amplifier for calibration purpose.

2.6 POWER AMPLIFIER

A. Amplifiers shall be solid-state high-power amplifiers and operate on 220V power supply.

B. The power amplifiers shall each have a minimum rated power output rating in RMS as required.

C. They shall be capable of producing their rated power output at less than 1% distortion over the frequency range of 40 Hz to 16,000 Hz and capable of producing full rated sine wave power output on a continuous basis with no undue heating of any component.

D. They shall have a frequency response of within ± 2 dB from 40 Hz to 16,000 Hz and a noise level at least 80 dB below rated output.

E. The output of the amplifier shall be suitable to feed a "constant voltage" distribution line system of 100V.

F. The amplifier shall be provided with separate volume controls for the input channels, separate high and low tone controls, supply on/off switch and pilot light and other necessary switches and controls.

G. The amplifier shall be complete with a power supply unit comprising of all necessary transformer, rectifier, filter etc. suitable for rated electricity supply.

H. The complete amplifier shall be housed in a sheet metal cabinet for rack mounting and all controls and switches shall be fixed in the front panel of the cabinet.

I. The Contractor shall provide the amplifier with all flexible cords, sockets, plugs, including electricity supply for the system.

J. The amplifier shall also include an automatic and self-restoring protective circuit to protect against damage from prolonged or extreme overloads such as a shorted output line. This circuit shall be of the electrically controlled type, which is not subject to instantaneous overloads. It shall automatically remove power from the amplifier when damage is threatened and automatically restore the amplifier to operation when danger is past.

2.7 LIMITER AMPLIFIER

A. Technical Specification shall be as follows:

1.	Frequency response	:	20 Hz to 20 KHz
2.	Threshold	:	+ 4 dBm to + 12 dBm by 2 dB steps
3.	Attack	:	Auto-nominal 5 m-sec at 12 dB of control
4.	Release	:	0.1, 0.2, 0.5, 1, 2 sec and auto
5.	Noise	:	85 dBm
6.	Output	:	Adjustable up to + 20 dBm into 600 ohm

2.8 MATRIX CONTROLLER

A. The Matrix Controller shall be microprocessor controlled and incorporating interface circuitry for the comprehensive range of system input and output modules.

B. It shall be modular in design to provide a wide range of system configurations and capacity.

C. The Matrix Controller shall be field programmable via the units graphic LCD and function key, and 320 x 240 dot LCD Display.

D. The unit shall have minimum expansion capacity of 64 inputs/128 output.

E. The required configuration as to the number of sound input sources and loudspeaker zones shall be as shown on the single line diagram drawing.

F. All data entered shall be retained in the event of a power failure and when switching off.

G. Capable of handling other multimedia/auxiliary services such as IPOD, MP3's, etc.

H. Standalone but software driven.

2.9 TERMINAL BLOCKS

A. Cable terminal blocks shall be arranged in accordance with the group of speakers, areas and function. These shall be capable of terminating 1.5mm copper wires and shall be conveniently located in the upper or lower portion of the rack.

2.10 POWER SUPPLY

A. The main power supply provided to the Equipment Rack for use of the Public Address and Background Music System shall be as follows:

Voltage : 220V ± 6% single phase 2 wire
Power Supply : 4 N° 13A switched socket outlets Frequency Characteristics : 20 – 20,000Hz

B. The Contractor shall make due allowance by providing all necessary power supply units, voltage regulators, spike eliminators, step down transformers, rectifiers, relays, radio suppresser, converters, etc. to ensure that all his equipment will perform completely and satisfactorily.

C. All necessary power supply required for the operation of amplifiers, speaker, sound equipment, devices, controls etc. after the main power supply point, shall be supplied and installed by the Contractor.

2.11 EQUIPMENT RACK

A. All equipment such as power amplifiers, tape deck, tuner, etc. shall be mounted onto a standard equipment rack.

B. All inputs shall be of an interchangeable modular type such that the individual modules can be mounted in mixer frames, or in mixed power amplifiers.

C. All system and peripheral units shall be properly matched with the equipment rack and provided compact neat installation.

D. Forced ventilation fans shall be incorporated for the equipment rack.

E. All wiring within the rack shall be fixed securely without strain. For the purpose of certification, all wires shall be numbered and/or color-coded.

The wiring shall be formed in a neat and systematic manner, with cable supported clear of panels and without crossovers.

F. All incoming and outgoing signal sources from the equipment racks to the microphone station and speaker zone shall be inter-connected via approved type of plugs and sockets.

2.12 CEILING MOUNTED LOUDSPEAKERS

A. All ceiling mounted loudspeakers shall be suitable for both voice and music broadcasting and shall be recess mounted in the false ceiling. Where there is no false ceiling, surface type shall be provided.

B. The loudspeakers shall be 150mm diameter in public areas having viscous-damped cone and ceramic magnet.

C. They shall have at least a frequency range of 100 Hz to 16,000 Hz at rated output.

D. Flux density shall be at least 10,000 gauss.

E. The loudspeakers shall have an output impedance of 8 ohms and power output tappings of 1.5, 3 and 6 watts (max.)

F. The sound pressure level shall be at least 90 dB at 1w, 1m.

G. Each loudspeaker shall be equipped with a line matching transformer. Transformer shall be provided for each speaker with power tap settings for 100V lines. Insertion loss of the transformers shall not exceed 1 dB.

H. Circular and recessed baffle grilles with torsion spring mounted shall be provided for each loudspeaker in public areas. Construction shall be a minimum of 2mm steel with a white finish trim, matt black baffle grilles and acoustic enclosure. A sample shall be submitted to the Project Manager for the approval of the Consultant.

2.13 WALL MOUNTED BOX SPEAKER

A. The wall mounted box speaker shall come complete with matching transformer, connector and necessary mounting brackets. All metal parts shall be protected against rust and corrosion.

B. The finishing color of the box speaker shall be able to match with the wall and shall be approved by the Owner, Architect and Engineer.

C. The technical performance of the speaker shall meet the following:

91 dB Sound Pressure Level	:	1 Watt, 1 Meter
Coverage Angle	:	180o
Frequency Response	:	100 Hz - 10,000 Hz
Power Output (max.)	:	10W
Output Voltage	:	100V

2.14 AUTOMATIC MESSAGE ANNOUNCER

The system shall be a fully automatic unit which repeats recorded messages at predetermined interval during background music broadcast and emergency. The unit shall accept CD and shall be front loading. All controls shall be front accessible including power ON/OFF, CD loading, track selection and, message selection buttons and indication etc. The unit shall have automatic gain control (AGC) circuit, message skipping, built in timer, announcement priority and live announcement features. Interval timer shall be switched selectable including OFF.

2.15 CHIME/TONE SIGNAL GENERATOR

A. The unit shall be modular type and suitable for rack mounting.

B. Two chime modules and two alarms signal modules shall be provided.

B. Signals shall be programmed to precede an announcement from a call station or either used as an independently alarm for hazardous events.

C. Adjustable output level and sounding time features shall be provided for the chime and alarm signal modules.

2.16 CALL STATION

A. Call station shall be provided in the control room.

B. The call station shall be constructed of hairline stainless steel panels and built into custom made console complete with the following:

1. Condenser microphone on a gooseneck stem of high quality with a built-in bass roll-off filter giving a clear voice reproduction, even in difficult acoustic environments.
2. 100 pre-select loudspeaker zone illuminated push buttons.
3. 10 different call tones, chimes and alarm signals selection illuminated push buttons.
4. Press-to-talk and all-call illuminated buttons.
5. 4 levels of priority/talk selections.
6. 10 illuminated user function keys for selections of pre-recorded messages, routing of a low priority call preceded by an attention tone to pre-programmed selection of zones, routing of an alarm tone followed by a pre-recorded evacuation message to all loudspeaker zones, toggling a control relay on and off which switches a warning lamp, etc., selecting a music source, turning the music volume up/down, muting the music and resetting the system.
7. Busy LED to advise the operator whether a call may be activated. Red busy LED flashing means that another call is in progress. Red busy LED lights up continuously indicates that the call has been blocked by another call with a higher priority.
8. Wait/Talk LED to advise the operator whether a call is accepted. Green wait LED flashing indicates that the call is accepted and the attention tone or prerecorded message is being transmitted. Green talk LED lights up continuously when the attention tone or message finishes and the microphone is switched on to enable speech broadcast.
9. LED intensity preset to compensate for various local lighting conditions. The illumination intensity of the LED shall be adjustable.
10. Built-in compressor to keep the signal output level of the call stations constant even in situations where the operator's speech volume level changes radically. The degree of compression shall be preset over a range of 30 dB from 84 to 114 dB (SPL).
11. Balanced line level output allowing call stations to be located up to 1000 m from the control centre using only standard 2-core screened cables.

12. Loudspeaker zone template onto which the name of the loudspeaker zones can be written.
13. Built-in monitor loudspeaker complete with volume control.
14. Key switch protection to prevent unauthorised access.

2.17 VOLUME CONTROL

A. Volume control shall be provided with appropriate wall plates, flush mounting over standard utility box and appropriate size of junction box.

B. Irrespective of the control position, it shall be capable to make the impedance of the circuit constant.

C. Where common line transformer shall be required, the volume control capacity shall be suitable for each speaker or group of speakers for adjustment of the volume from zero to full load as required for the room or area in question.

2.18 WIRING

A. Wiring shall be in accordance with PEC and as recommended by the manufacturer of the system. All wires and cables shall comply with the requirements of the Underwriters Laboratories, the ASTM and ICEA or local agencies responsible. The size of conductor shall not be less 1.25 mm^2 as indicated on the plans.

B. Wiring and terminals cabinets shall be permanently tagged and identified with metal phenolic tags attached by nylon ties.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General

1. An authorized representative of the manufacturer of the system shall install and be responsible for the satisfactory operation and certification of the complete system.
2. Properly coordinate services of the various trades, carefully co-ordinate levels, work sequence, accessibility of various services.

3. All works shall be conducted under the supervision of company trained personnel, and shall be responsible for supervising the installation to the endorsement of the Project Manager.

4. All wirings inside panels and trunkings are to be properly grouped, strapped and fixed in location by endorsed type cable strap.

5. All wiring to be labeled with numbering markers on both ends which correspond to the numbering scheme of the shop drawings. All edges of the panel, support, frame etc. to be properly rounded off to prevent damage to the insulation. All wiring shall be terminated.

6. Proper segregation shall be maintained throughout for cable wiring carrying different voltage range. All signal and power cables shall be furnished with cable markers for distinguishing from other cables.

B. Electrical Power

1. Fabricate and install 3-wire isolated ground AC power strips in all floor mounted equipment racks, each with an adequate number of receptacles for all equipment served plus two additional utility receptacles. Provide separate 20A circuits for signal processing equipment and power amplifiers, distributing power amplifier loads such that no circuit draws more than 12A maximum under full power conditions.

2. Provide isolated ground receptacles for all power strips. Isolate AC power grounds from the power strip ducting and equipment racks, gather all grounds to a common $8mm^2$ bus, and terminate the ground bus to the equipment rack unipoint ground busbar with an $8mm^2$ minimum insulated cable.

C. Cabling:

1. Provide identical conductor color coding for all cables furnishing identical functions throughout the systems, isolate all audio and video lines from the conduit systems. Insulate shield drain wires with insulating heat-sink tubing.

2. All cables shall be run in conduits. The space factor for cables installed in conduit shall not exceed 40%.

D. Labeling:

1. Labels in general shall be made from white "Traffolite" laminated white/black/white and suitably engraved with black lettering in English.
2. Labels shall be fixed by screws.
3. Each of the sound rack, wall plate and interfacing termination cabinet shall be labeled on the front cover indicating the field equipment controlled by the unit.
4. Cables shall be labeled at appropriate locations for identification.
5. All equipment items, device plates, equipment rack panels, devices, controls, receptacles, and cables shall be labeled as to the function performed and the area served. Exact dimension of the lettering shall suit particular item of the equipment and shall be submitted to the Project Manager for approval.

E. Equipment Racks

1. Arrange equipment to prevent temperatures form rising above 37.7°C with ambient room temperature of 21°C. Mount perforated ventilation panels above, below and between each power amplifier and at top and bottom of each equipment rack.
2. Locate equipment having operator employed controls and indicators centered at 150mm above the floor. Locate patch panels at least 75cm above the floor.
3. Install equipment to provide free access to all equipment terminations. Installation requiring the de-mounting or de-energizing of equipment for access to terminations is not acceptable.
4. Install hinges on any chassis over which mounts wired components for Contractor fabricated equipment items. Dress and secure associated wiring.
5. Ventilation slots covered by vermin proof mesh shall be provided between each equipment for adequate ventilation.
6. Allow sufficient space for cooling of power amplifier heat sink.

3.2 TESTING AND COMMISSIONING

A. Perform loop continuity test and megger test on all single core and multicore cable with electronic components and equipment removed.

B. Test all equipment and system according to manufacturer's recommended procedure.

C. Check proper connection and labeling of all system wiring.

D. For main background music equipment rack, adjust the system to proper condition and output levels. Check operation of all equipment. Check and adjust output levels of all pre-amp and amplifiers so that they are not operated in saturation conditions.

E. Check that all connectors and plugs are compatible and the complete microphone cassette player, amplifier and speaker can operate in harmony without mismatch.

F. Check zoning operation of speaker system under emergency override conditions.

G. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall repeat all the above tests. In addition, the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of the Project Manager.

*** END OF SECTION ***

SECTION 17751

TELEPHONE AND PABX SYSTEM

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. The Works to be executed under this Contract comprise, without limitation:

1. The design, procurement, manufacture, supply, delivery, installation, testing, commissioning and defects liability maintenance of the Telephone and PABX System.
2. Obtaining all Relevant Authorities' approvals and consents in respect of the Works.

B. The complete Telephone and PABX System shall include the following:

1. Private Automatic Branch Exchange (PABX) complete with distribution frame located in the Building MDF Room at Ground floor.
2. Operator's desk consoles
3. Operator's headsets
4. Cross connections, jumpers, cabling and connectors
5. Diagnostic facilities, development and commissioning of software
6. Grounding and necessary work and materials associated with efficient operation of the telephone system
7. Uninterrupted Power Supply (UPS) System
8. Surge Protection Device (SPD) provision for the protection against current fluctuation.

1.2 RELATED WORK

A. Section 16001 - General Provisions

B. Section 16490 – Fire Barrier

C. Section 16112 - Raceways

D. Section 16170 - Grounding

Contractors with minimum of 10 years experience.

2.2 DESIGN CRITERIA

A. The design criteria for PABX System is as follows:

1. The Main Incoming Telephone Lines shall be the distributed into many different users groups. They shall be generally classified as follows and shall be used as reference only:

a. Administration, Facilities and Back-of-the House

b. Office Areas.
c. Meeting/ Seminar Conference Room.
d. Branch head office and security head office shall have dedicated set of direct lines from the MDF.

B. PABX Design Criteria:

1. GENERAL

a. Private Automatic Branch Exchange equipment shall be fully digital communication system and be able to provide ultimate flexibility of the telephone communication networks.
b. The PABX equipment shall be expandable by adding standard modules and cubicles in future without the necessity of changing or replacing any installed components and interruption of operation. The type of system offered shall have capacity for up to 20% expansion to the present required capacity.

2. OPERATING CONDITIONS

a. The PABX equipment shall be suitable for continuous operation at 240V, 60Hz AC electrical supply, ambient temperature at 15°C to 40°C and relative humidity of up to 100%.

3. SYSTEM CAPACITY

a. The PABX equipment shall be capable of handling minimum 16 trunk lines, 8 fully digital phone/ extensions and 32 analog handsets (VOIP capable).
b. The PABX system provided shall be able to interface to the public automatic telephone network of Philippines and shall function satisfactorily with telephone instruments for the extensions provided by Public Telephone Network Provider (PTNP).
c. The PABX system provided shall allow integrated Service Digital Network (ISDN) access from a Dual Tone Multiple Frequency (DTMF) Terminal.
d. All the equipment cabinets shall be of the latest design and completely sealed against entry of dust, moisture and

vermin. The design shall allow easy access for maintenance purposes.

e. The PABX shall be designed based on the modular concept. This will afford a cost effective and systematic means for future expansion.

f. All equipment and circuit interfaces shall be compatible with PTNP public exchange network and shall conform to CCITT recommendations. The PABX equipment shall be able to accept "Line Tone Reversal" signal from PTNP without additional hardware.

g. UPS Battery backup shall be rated for 4 hours at busy hour load.

h. There shall be 2 kinds of instruments connected to the extensions, digital type (20%) and analogue type (80%).

i. All frames shall be sized to the number of lines and extensions needed for the covered area and have 25% of spare capacity for future expansion.

j. All termination for external extension lines shall be equipped with gas discharge protectors for surge protection.

C. Operations and Maintenance Design Criteria

1. All cable plant or telecom room shall be designed to permit simple and economic operation and maintenance.

2. All cable plant or telecom room shall be designed to include self-diagnostic functions to facilitate rapid location of faulty components or replaceable modules. Replacement of failed components or modules shall be easily undertaken with minimum reference to the Operation and Maintenance Manuals.

2.2 SYSTEM DESCRIPTION

A. The system shall be distributed throughout Offices and Conference Room from one (1) MDF room located at ground floor.

B. Provision at the MDF will be made for up to two Public Telephone Network Providers (PTNP) to interface with.

C. There will be two entrance facilities and equipment rooms provided for use by the two PTNP's. Equipment rooms will be located adjacent to the MC or MDF Room at ground floor.

D. In the normal daily operation, incoming calls shall be answered by either the user (depending on the class of service and location) or by an operator who will then forward the call to the appropriate person or function.

E. For direct lines to the pay phones and card phones concessionaires, telephone systems, and residential units shall also originated form the common MDF and all the equipment, using the Structured Wiring System, to connect their end unit devices.

F. There shall be direct lines dedicated to the In-house security office and Fire Command Center room for use by firemen, security, and aviation communications hotline systems.

G. The Telephone system shall have call accounting hardware, systems software, and application software that will allow reconciliation and billing of telephone usage, equipment, and features.

H. The telephone system shall have the following minimum features:

1. Class of Service Distinction
2. Automatic Call Distribution
3. Flexible Numbering System
4. System Park
5. Trunk Barring Service Classes
6. Add On Conference
7. Automatic Call Forwarding
8. Automatic Ring Back
9. Data Transmission
10. Call Forward
11. Hunting On Free
12. Call Waiting (Camp-on)
13. Call Pick-up
14. Call Transfer
15. Line Lockout
16. International Dialing
17. Access To Operator
18. Extension Hunting

19. Music on Hold/Camp-on
20. Call Back
21. Caller ID Capability

2.3 WORK BY OTHERS AND INTERFACES

A. Interface with Public Telephone Network Providers

B. Interface with Trunked Radio System

C. Power supply requirements

2.4 TECHNICAL SPECIFICATION

A. Telephone System

1. The PABX equipment shall be solid state, stored program controlled, and time division-switching system complete with on-line automatic, self-diagnostic maintenance features.
2. The signaling techniques used by the PABX equipment shall conform to the requirements of public carrier and otherwise with other requirements dictated by signaling techniques.
3. The PABX equipment shall be based on a modular and interactive design in order to facilitate simple installation, expansion and maintenance.
4. Standalone PABX equipment cabinets shall be of the expandable type with interchangeable plug-in control cards, telephone line cards, external line cards and assemblies. The central processing equipment shall be designed with nonvolatile memory and for DC operation.
5. The PABX, including any cabinets, shall be capable of future expansion with respect to the number of trunk lines, extensions and internal connecting links without causing interruption to normal operations being provided to existing users.
6. To permit maximum flexibility of operation, all extension telephone features between extensions shall be made through the PABX by software assignment. Hardware assignment of features shall not be acceptable.
7. Hardware equipment and software utilities shall be provided for the re-starting of the PABX. Upon resumption of power supply

following a long term power failure, re-starting of the PABX shall be initiated automatically without manual intervention.

8. All PABX control and switching circuits shall utilize solid state, processor based technology and shall be stored-program controlled and shall be designed for 24 hours per day continuous operation and with a design life of at least 10 years.

9. All Printed Circuit Board's shall be modular in construction and be arranged such that interconnection between different units can be achieved by means of prefabricated connectors.

10. The system memory shall have sufficient expansion capability not only to allow for the ultimate design capacity of the system but also to allow for new options and customized software utilities besides the standard packages required in this ER Specification.

11. Semiconductor memories used for controlling vital system functions, which are necessary for the system to operate, and set ups shall retain their stored data, resident in the semiconductor memory, for a period of at least 8 hours when the power supply has been cut off.

12. Secondary memory storage shall be provided for administration, maintenance and statistical purposes in the form of either high-speed tape or disk. The storage capacity shall be capable of storing all software programs and 6 months operational and accounting data for administration, maintenance and statistics during normal operation.

B. Standard Extensions – Analogue

1. Extension circuits (ports) to support standard analogue telephone operation with DTMF signaling. Operation shall be over Unshielded Twisted Pair (UTP) category 6 cable.

2. The number of units for analog telephone sets shall be determined as per plan.

C. Standard Extensions – Digital

1. Extension circuits (ports) to support system integral handsets capable of multi-line / multifunction operation.

2. Protocol shall support the ISDN Basic Rate interface operation.

3. The circuits shall be capable of handling handset operation using the Unshielded Twisted Pair (UTP) category 6 cable.

4. Attendant Answering Position. It shall have 32 programmable keys with display which features enhanced operability, direct station selection, station speed dial, call message indicator lamp.

5. Executive/ Service Area. The Multi line digital phone set, with 8 LED buttons, 8 line keys with LCD display, which can be assigned to any outside line, other station lines, or as feature buttons, 10 dedicated feature keys, hands-free feature, dedicated microphone, speaker, transfer, conference, hold and answer button, data communication compatible (option), visual ringing message waiting lamp, boss-secretary feature.

D. Links to Other Telephone System

1. Links shall be required to other telephone systems. The telephone system shall be capable of connection to these other telephone systems providing a level of facilities transparency utilizing a recognized protocol.

E. Loop-Dial Both-way Tie Lines

1. The loop-dial both-way tie lines shall be required to interconnect the telephone system to the trunked mobile radio system and potentially other telephone systems.

2. The tie lines shall operate in accordance with the technical Requirements for Connection of CPE with base-band or DC Continuity Operation to Private Circuits with DTMF operation.

F. Four-Wire E&M Tie Lines

1. The four-wire E&M tie lines shall be required to interconnect the telephone system to other telephone systems.

G. Power Fail Extensions

1. In the event of a loss of DC power or if a PABX has a major failure (e.g. central processors), the telephone system shall 'switch' to analogue outgoing exchange lines, nominated analogue extension telephones. The switching shall take place automatically in the event of loss of DC power; otherwise it shall be capable of being initialized manually.

H. Operator Console Facilities

1. The consoles shall as a minimum include a digital keypad with DTMF facilities to signal numerical codes for initiating calls to extensions, exchange lines and tie lines as well as for other miscellaneous functions.
2. Access shall be available to the common store of the abbreviated dialing facility.
3. The console shall also include other single-function or multiple-function keys or buttons, visual display and audible alarms as are detailed below and necessary to facilitate the speedy handling of calls.

I. Public Exchange Connections

1. Integrated Service Digital Network (ISDN) Primary Rate Links

a. The predominant connection to Philippine Public Network service or equivalent shall be via an ISDN based service.
b. The telephone system shall be capable of full operation with the public network service providers and the derived circuits shall be capable of being configured flexibly or used flexibly as incoming (with inward dialing) or outgoing circuits.
c. In particular, for outgoing calls, the telephone system shall be capable of detecting the called party answer to enable, accurate timing and therefore costing of chargeable calls.

J. Alternate Routing

1. The telephone system shall be programmable such that alternate routing can be provided automatically for public network access, or tie lines.

K. Least Cost or Most Efficient Routing

1. The telephone system shall be programmable to analyze dialed codes and automatically select the least cost or most efficient route.

L. System Traffic Handling Capacity

1. The telephone system must be equipped with sufficient internal traffic dependent and handling devices to satisfy a grade of service (GOS) of 0.001 bases on:

a. the extension and exchange line levels and operation as per the wired for capacities given in the appended facilities schedule; and

b. an average traffic level of 0.1E (Erlang) per extension with average call hold time of 3 minutes (average of 2 calls/extension/hour);

M. Battery System

The battery system shall include batteries, cables, do battery charges and control equipment and associated cables, supports and enclosures. They shall be located in the PABX cubicle.

The dc power system shall be as required by the system. The maximum voltage of dc supply at the point of connection to dc submains shall be 116% of nominal volts under all conditions of battery operation or charge.

The minimum end voltage of the dc supply at the point of connection to dc submains shall be 85% minimum of nominal volts or higher as required by the PABX equipment after supplying the full rated load for a period of twenty minutes without any power available from any source other than the batteries.

Provide a battery cut off circuit to disconnect the load from the battery after the 20 minutes discharge period to prevent total discharge of the battery. Provide a set of voltage battery disconnect has occurred:

- Batteries shall be with a nominal lift of 10 years.
- The battery system shall be capable of the performance specified without sustaining damage.
- Batteries shall be of the translucent case type to permit easy identification of electrolyte levels.
- Filing, siphoning and testing equipment shall be supplied.
- Battery links shall be copper busbars.
- All joints shall be treated with a corrosion inhibiting compound.

Batteries shall be mounted on treated wooden or reinforced fiberglass stands with removable reinforced fiberglass drip trays under each rack of cells.

The battery charger shall be mounted in a separate, fully enclosed, well ventilated metal cubicle.

The charger shall be designed to float charge the batteries continuously and boost charge automatically from a fully discharged conditions to a fully charged condition within 15 hours whilst maintaining any standing loads. In addition, the battery charger shall be sized to maintain the full dc load where ac supply is available to the charger. Under such conditions the batteries shall not be discharging.
All necessary regulator shall be built into the control cubicle.

The voltage regulator shall be current rated at not less than the maximum charger output and system output and shall be capable of maintaining the dc supply voltage within the tolerances specified irrespective of the voltage required for boost or float charging the battery.

PART 3 – EXECUTION

3.1 INSTALLATION

A. System Installation

1. After award of contract, and within the time period specified in the contract, the Contractor shall deliver the total system in a manner that fully complies with the requirements of this specification. The Contractor shall make no substitutions or changes in the system without written approval from the Owner or engineer.
2. The Contractor shall install all equipment and systems in a manner that complies with accepted industry standards of good practice, the requirements of this specification, and in a manner which does not constitute a safety hazard. The Contractor shall insure that all installation personnel understands and complies with all the requirements of this specification.
3. The Contractor shall install suitable filters, traps, directional couplers, splitters, telephone/data outlets, and pads for minimizing interference and for balancing the amplifiers and distribution

system(s). Items used for balancing and minimizing interference shall be able to pass telephone and data channels in the frequency bands selected, in the directions specified, with low loss, and high isolation and with MIN delay of specified frequencies and signals.

4. All passive equipment shall be connected according to the OEM's specifications to insure correct termination, isolation, impedance match and signal level balance at each telephone/data outlet.

5. Where telephone/data outlets are installed adjacent to each other, install one outlet for each instrument.

6. All lines shall be terminated in a suitable manner to facilitate future expansion of the system.

7. All vertical and horizontal copper and fiber optic lines shall be terminated so shall require modifications of the system PABX or signal closet equipment only.

8. Terminating resistors or devices shall be used to terminate all unused branches, outlets, equipment ports of the system, and shall be devices designed for the purpose of terminating fiber optic or twisted pair cables carrying telephone and data.

9. Equipment installed outdoors shall be weatherproof or installed in weatherproof enclosures with hinged doors and locks with two keys.

10. Equipment installed indoors shall be installed in metal cabinets with hinged doors and locks with two keys.

B. Equipment Assembly

1. Consoles and Cabinets

a. Each console or cabinet (here-in-after referred to as **"enclosure"**) shall have OEM produced top, bottom and side panels; except, enclosures mounted sided by side, where only two outside panels shall be included. Each enclosure shall be: Floor or wall mounted with standard knockout holes for conduit connection or cable entrance; provide for ventilation of the equipment; have front and rear locking doors (except, wall mounted cabinets that require only a front locking door is required - but, the entire enclosure shall be hinged at the wall anchor point to allow access to its inside); power outlet strip(s), bulkhead connector and patch panel(s).

b. Rack mounted equipment shall be installed on the enclosure's equipment adjustable mounting racks with equipment normally requiring adjustment or observation mounted so operational adjustment(s) can be conveniently made. Heavy equipment shall be mounted with rack slides or rails allowing servicing from the front of the enclosure. Heavy equipment shall not depend only upon front panel mounting screws for support. Equipment shall be provided with sufficient cable slack to permit servicing by removal of the installed equipment from the front of the enclosure. A color matched blank panel (spacer) of 1.75 inches high, shall be installed between each piece of equipment (active or passive) to insure adequate air circulation. The enclosure shall be designed for efficient equipment cooling and air ventilation. Each console or cabinet shall be equipped with a quiet fan and non-disposable air filter.

c. Enclosures and stand-alone radio relay racks shall be installed plumb and square. Each shall be permanently attached to the building structure and held firmly in place. Fifteen inches of front vertical space opening shall be provided for additional equipment with appropriate color matched blank panels installed to cover unused enclosure openings.

d. Signal connector, patch, and bulkhead panels (I.e.: audio, data, control, RF, TV, etc.) shall be connected so that output for from each source, device or system component shall enter the panel at the top row of jacks, beginning left to right as viewed from the front, which will be called "input". Each connection to a load, device or system component shall exit the panel at the bottom row of jacks, beginning left to right as viewed from the front, which will be called "output".

(1) Equipment installed indoors shall be installed in metal racks or enclosures with hinged doors so as to be accessible for maintenance without interference to other nearby equipment.

(2) Cables shall enter the equipment racks or enclosures in such a manner that all doors or access panels shall open and close without disturbing or damaging the cables.

(3) All distribution hardware shall be securely mounted in a manner that shall provide access to the

connections for testing and allow sufficient cable room for the doors or access panels to open and close without disturbing the cables.

2. Installation of the PABX

a. General

(1) The PABX installation shall comply with all laws and codes applying to interconnected telephone installations in effect.

(2) In the absence of specifications regarding details implies that best general industry practices shall prevail and that first quality material and workmanship shall be provided.

(3) All material, provided by the Contractor, shall be new and thoroughly tested. All installation shall be carried out in a professional manner.

(4) The Contractor shall provide a triplex outlet with modular jacks with cover plate for each telephone outlet as shown on the drawings. The Contractor shall provide the appropriate modular jack (single or triplex) with appropriate cover plate for each 'OUTLET' location identified and verified on the drawings.

(5) The Contractor shall install all patient and wall telephone instruments on a single modular jack designed for wall telephone instruments and patient wall or PBPU installations.

(6) All permanent telephone cables and wires shall be installed in conduit or an enclosed duct system or be of the type approved for installation, as determined by Owner requirements, without conduit or enclosed duct system.

(7) Where cable and wire penetrate through fire/smoke partitions, firewalls, or floors, the Contractor shall provide fire/smoke stopping around the outside of any installed conduit/cable tray. The Contractor shall provide and install fire stopping material, type approved by the Architect or engineer, inside the provided conduit/cable tray after installation is complete.

b. The Contractor shall

(1) Install the equipment in accordance with the specifications for the PABX as specified and recommended by the OEM.

(2) Provide a full time on-site Project Manager effective with issuance of the notice to proceed. The Project Manager shall be responsible to fully coordinate and supervise all contractor/sub-contractor personnel in all phases of the installation, training, inspection, cutover, and final acceptance of the system. The Project Manager shall be provided a complete copy of these specifications to include all amendments prior to start of installation of the telephone system.

(3) Coordinate and conduct the PABX data base survey with a member of the RE. The Contractor is responsible for identifying all programming of features, classes of service, and equipment to be installed by types and physical locations as specified in this document and all attachments thereto. After the survey is completed, a complete list of equipment shall be provided to the Owner and engineer **for approval prior to start of installation**.

(4) Be responsible for the removal and replacement of damaged ceiling tiles during installation and maintenance service of the cable and wire distribution system. The Contractor shall be responsible for restoring immediate areas (that is approximately three foot in diameter) that were damaged during the system installation and maintenance service.

(5) Run all cross connects to established circuits during installation and maintenance service for the contract life.

(6) Remove, on a daily basis, all debris and scrap generated in the conduct of work.

(7) Provide Contractor personnel (switch technicians, installers, trainers, and the project manager, etc.) on premise for seven consecutive days after cutover to clear any malfunctions which may develop,

to assign/reassign any software features/COS, and conduct any additional training as required.

(8) Insure that the Project Manager and sufficient skilled personnel remain on premise until all items on the punch list, developed during inspection, cut-over, and acceptance testing of the system are completed, inspected, and accepted by the engineer.

(9) Be responsible for any and all coordination with the local Telephone Company relative to interface with the commercial telephone system. The Contractor shall also be responsible for the removal of all voice and/or data equipment and cabling abandoned by the local Telephone Company, or other organizations and not retained for exclusive use by Owner as a result of this installation

(10) Connect all telephone equipment located in the equipment room to a common provided ground buss. The common system ground shall be in all telephone closets and the PABX switch room.

(11) Provide PABX ground between PABX and all interfaced systems such as dictation equipment chassis, radio page equipment chassis, etc.

(12) Ensure that other dedicated telecommunications systems applications within the Facility (i.e., pay stations, electro-writing equipment, facsimile etc.) that require space within switch room/telephone closets, conduits, and cable pair are accommodated. Coordination between applicable parties will be necessary to ensure accommodation of these systems. It shall be the responsibility of the bidders to determine the requirements and include them in his proposal.

(13) All portions of the system installation shall conform to local building and fire codes.

(14) The Contractor shall not use gasoline, benzene, alcohol, naphtha, carbon tetrachloride, or turpentine for cleaning any part of the equipment. Flammable materials shall be kept in suitable places outside the building. OSHA safety standards and local Facility safety standards shall prevail.

C. Conduit, Cables and Wiring, Cable Tray, Raceways, Signal Ducts, etc.

1. General

a. The Contractor shall employ the latest installation practices and materials.

b. All cables shall be installed in conduit and/or signal ducts.

D. A provision of hybrid – internet protocol (IP) based PABX system with a maximum requirement of eight (8) trunkline, 16-port analog extension lines and 8-port digital extension lines with adequate grounding system including:

1. Brochures and software licenses.
2. Extra telephone sets at least two (2) each for analog and digital extensions.
3. CAT 6 4-pair cable and dual telephone outlets.

3.2 PROOF OF PERFORMANCE TESTS

A. Acceptance Testing

1. The system shall be tested to verify that the system meets all the requirements of this document under operating conditions, and complies with all system performance standards listed herein. The Contractor shall give at least 20 working days advance notice, in writing to the Owner and engineer, stating the tentative date(s) for conducting testing that will certify proof of performance of the system.

2. Test Procedure:

The test shall be performed on a "go-no-go" basis. Only those operator adjustments required to show proof of performance shall be allowed. The test shall demonstrate and verify that the installed system complies with the operational and technical requirements of this specification under operating conditions.

a. Documentation Review:

All system manuals, as-installed drawings, pretest form(s), computerized signal surveys, cabinet pictorial(s), outlets, distribution system details, etc., shall be reviewed at this time.

b. Mechanical and Physical Inspection:

Tour all areas the system is provided to insure that all systems and subsystems are installed in place. An inventory may be taken at this time.

c. Subsystem Functional Test:

After the above inspection, functional and operational testing shall commence in the following manner:

(1) First: The Contractor shall perform an operational test of each subsystem to verify that all equipment is properly connected, interfaced and is functionally operational to meet the requirements of this document. If any subsystem is not functionally ready, that subsystem shall be declared unacceptable and all testing shall be terminated. At this point, the Contractor shall be permitted one hour to correct the deficiencies.

(2) Second: It may be mutually agreed upon, at this time, to wait one hour or to commence testing of the next subsystem.

(3) Third: Repeated failures of subsystem testing or total system testing, which results in a cumulative time of four hours to effect repairs, shall be grounds for declaring the entire system unacceptable and all testing to be terminated.

d. Subsystem Performance Test:

After the functional test, each subsystem shall be checked to verify that all performance requirements and standards are met. The performance requirements shall be verified using the necessary test equipment. A spectrum analyzer, signal level meter and BERT shall be used to verify there are no visible signal distortions, such as intermodulation, beats, etc. appearing on any received or generated telephone or data channel.

e. Total System Test:

The testing shall proceed until the system and subsystems are functionally tested and accepted. The total system tests shall verify that the requirements have been met for all system signals as described herein.

(1) LEC Point of Debarkation:

The system output(s) shall be checked to verify that all performance requirements are met

(2) PABX:

This test shall be conducted within 30 days following successful pretesting of the PABX. In addition to compliance with the technical characteristics and quantities of equipment specified herein, the Final Acceptance Test shall contain the provision that 30 continuous days uninterrupted telephone service, must be completed prior to the Contractor being deemed to be in compliance with the contract.

4. Test Conclusion:

a. At the conclusion of the Acceptance Test, the Project Manager and the Contractor shall jointly agree to the results of the test, and reschedule testing on deficiencies and shortages, if any, with the Owner and engineer. Any retests that are needed to reach agreement on the results of these tests or to later establish compliance with these specifications will be done at the Contractor's expense.

b. If the system is declared unacceptable without conditions, all rescheduled retest expenses will be borne by the Contractor as described herein.

(1) END USERS SHOULD NOT BE PERMITTED TO USE THE FACILITY WHERE PROJECT MANAGER HAS NOT ACCEPTED THE TELEPHONE PABX SYSTEM.

3.3 SYSTEM GUARANTY

A. Contractor's Responsibility

The Contractor shall guarantee that all installed material and equipment will be free from defects, workmanship, and will remain so for a period of one year from date of final acceptance of the system by Project Manager. The Contractor shall provide OEM's equipment warranty documents, to the Owner and engineer, certifying that all equipment installed under this document conforms to its published specifications.

B. The Contractor shall provide a written commitment from the system equipment OEM to the supply of parts and on-site engineering support services for the one year guaranty service (materials and labor) in the event of default or unsatisfactory service by the Contractor.

1. The OEM certification shall describe, in the event of default or unsatisfactory service by the Contractor, the OEM or an authorized distributor shall fully support the contract (initial installation, guaranty service for the one year warranty period of the contract).
2. The system equipment OEM's signatory of the certified written commitment must be of an individual who has the full authority to obligate the OEM to this commitment. Names, corporate addresses, and telephone numbers of the individuals who have this authority shall be provided as a part of the commitment.

C. The Contractor's maintenance personnel shall have the ability to contact the Contractor and OEM's central emergency assistance maintenance center and request remote diagnostic testing and assistance in resolving technical problems at any time, 365 days a year. The Contractor via a business telephone line at no additional cost shall provide this contact capability to Owner. Each Contractor maintenance and supervisor individual shall be fully qualified by the OEM and provide the RE with copies of current and qualified OEM training certificates.

D. Additionally, defining the warranty outlines concerning this system, the Contractor shall accomplish the following minimum requirements during the one year warranty period:

1. Response time during the one year warranty period

a. The Contractor shall respond on-site, during the standard work week, to a routine trouble call within 24 hours of its report. A routine trouble is considered a trouble that causes a subsystem to be inoperable.
b. The Contractor shall respond on-site to an emergency trouble call within eight hours of its report. An emergency trouble is considered a trouble that causes a system to be inoperable at any time.

(1) An emergency trouble call shall be deemed appropriate when a failure involves more than 20 voice and/or data circuits.
(2) In addition, the failure of a common control unit, power supply, signal generating device or attendant console shall also be deemed as an emergency maintenance call.

c. The Contractor shall respond on-site to a catastrophic trouble call within four hours of its report. A catastrophic trouble call is considered a PABX failure.

(1) If a PABX failure cannot be corrected within six hours, the Contractor shall be responsible for providing an alternate CSU equipped for a minimum of 100 main station lines, l0 CO trunks, l0 FTS access lines and two operator's console.
(2) This alternate system shall be operational within 12 hours (to commence at the end of the six-hour trouble shooting period) and shall provide emergency service to critical areas as determined by the Director.
(3) The alternate system shall be a programmable system and a pre-written program tape shall be provided to the Engineer prior to cut-over of the main telephone system.

d. Failures affecting operation of critical emergency health care facilities (i.e., cardiac arrest teams, intensive care units, etc.) shall also be deemed as a catastrophic trouble call if so determined by the Facility Director. The Project Manager shall notify the Contractor of this type of trouble call at the direction of the Facility Director.

e. The Contractor shall respond on-site to installation of station or equipment requests or service within:

(1) Eight hours for emergency installations designated by the Project Manager, and
(2) Three working days for routine installations designated by the Project Manager.

f. A standard workweek is considered Monday through Friday exclusive of Holidays. If any trouble cannot be

corrected within one working day, the Contractor shall furnish and install compatible substitute equipment returning the system or subsystem to full operational capability, as described herein, until repairs are complete.

g. The Engineer and/or Project Manager are the Contractor's reporting and contact officials for system trouble calls, during the guaranty period.

2. Required on-site visits during the one year warranty period

a. The Contractor shall visit, on-site, for a minimum of eight hours, once every two weeks, during the guaranty period, to perform system preventive maintenance, equipment cleaning and operational adjustments to maintain the system according the descriptions identified in this SPECS.

(1) The Contractor shall arrange all Facility visits with the Project Manager prior to performing the required maintenance visits.
(2) The Contractor in accordance with the OEM's recommended practice and service intervals shall perform preventive maintenance during non-busy time agreed to by the Project Manager and Contractor.
(3) The preventive maintenance schedule shall be provided to and approved by the Engineer and Project Manager.
(4) Provide on-site a stock of replacement spare parts and equipment, plus test equipment, as specified herein, ensuring they meet the OEM's minimum recommended spare parts stock sizing requirements for this specific system.

b. The Contractor shall provide the Project Manager a type written report itemizing each deficiency found and the corrective action performed during each required visit or official reported trouble call. The Project Manager shall provide Owner, copies of these reports for evaluation.

(1) The Project Manager shall ensure copies of these reports are entered into the system's official acquisition documents.

(2) The Project Manager shall ensure copies of these reports are entered into the system's official technical as-installed documents.

***END OF SECTION ***

SECTION 16781

CABLE TELEVISION SYSTEM

PART 1 GENERAL

1.1 SCOPE

A. This document describes the products and execution requirements relating to furnishing and installing Cable Television System.

B. All cables and related terminations, support and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by the Contractor as detailed in this document.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. If the bid documents are in conflict, this specification shall take precedence. The successful vendor shall meet or exceed all requirements for the Cable TV system described in this document.

1.2 REGULATORY REFERENCES:

A. All work and materials shall conform in every detail to the rules and requirements of the Philippine Electrical Code, the Fire Code of the Philippines and present manufacturing and installation standards and practices.

B. All materials shall be UL Listed and shall be marked as such. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label; the entire system shall be so labeled.

C. EIA Compliance: Comply with all Electronics Industries Association Standards that apply including but not limited to:

a. ANSI/TIA/EIA - 568-B.1, Commercial Building Telecommunications Cabling Standard Part 1: General Requirements

b. ANSI/TIA/EIA – 569-A, Commercial Building Standard for Telecommunications Pathways and Spaces

c. ANSI/TIA/EIA – 607A, Commercial Building Grounding and Bonding Requirements for Telecommunications, October 2002.

If this document and any of the documents listed above are in conflict, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.

This document does not replace any code, either partially or wholly. The contractor must be aware of local codes that may impact this project.

1.3 APPROVED CONTRACTOR

A. Contractors Qualifications:

1. Firms regularly engaged in installation of components and accessories, of types, capacities and characteristics required by this project.

2. Firms whose products and workmanship have been satisfactory in similar projects.

3. Firms with a record of providing such services for not less than 5 years.

4. Contractor must be knowledgeable in local, provincial and national codes, standards and regulations. All work shall comply with the latest revision of the codes, standards or regulations. When conflict exists between local or national codes, standards or regulations, the most stringent codes, standards or regulations shall be followed.

1.4 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, and supplies and performing all operations necessary to complete the installation of cable television system in compliance with all

standards, specifications and drawings. The contractor will provide and install all of the required material to form a complete system whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:

1. Furnish and install a complete cable television system cabling and wiring infrastructure.

2. Furnish and install cable TV outlets as indicated in the plans.

3. Furnish and install all required cabinets, pull boxes, equipment and accessories required and necessary for the connection of video sets.

4. Coordinate with the Cable TV Operator for the connection and satisfactory performance of the system.

5. Provide owner test results and documentation. Tests results shall be provided on a floppy or CD as well as a paper copy. Drawings shall be provided in AutoCAD on a CD along with a paper copy. (Testing documentation and As-built drawings)

6. Provide owner with software to read and print test results submitted on a floppy or CD.

1.5 SUBMITTALS

A. Under the provisions of a request for proposal, prior to the start of work the contractor shall:

1. Submit copies of the certification of the company and names of staff that will be performing the installation and termination of the installation to provide proof of compliance of this spec and standards.

2. Submit system diagram and descriptive information of the proposed equipment.

3. Work shall not proceed without the Owner's approval of the submitted items.

4. No equipment and materials shall be installed unless with recommendation or approval by the Cable TV operator.

1.6 QUALITY ASSURANCE

1. The Contractor must have successful experience in designing, installing, commissioning, training and servicing cable television systems for commercial and/or residential applications

2. Installers shall have completed factory training and be certified as qualified to install, operate and maintain products specified.

1.7 DELIVERY, STORAGE AND HANDLING

Delivery and receipt of products shall be at the site. Equipment shall be stored according to manufacturer's recommendations as a minimum. In addition, equipment and cables must be stored in a location protected from vandalism and weather. If necessary, cable shall be stored off site at the contractor's expense.

1.8 DRAWINGS

It shall be understood that the electrical details and drawings provided with the specification package are diagrammatic. They are included to show the intent of the specifications and to aid the contractor in bidding the job. The contractor shall make allowance in the bid proposal to cover whatever work is required to comply with the intent of the plans, standards and specifications.

The contractor shall verify all dimensions at the site and be responsible for their accuracy.

Prior to submitting the bid, the contractor shall call the attention of the Engineer to any materials or apparatus the telecommunications contractor believes to be inadequate and to any necessary items of work omitted.

PART 2 PRODUCTS

2.1 TV ANTENNA WALL OUTLETS

TV Wall Outlet shall be flush mounted, 75 ohm TV outlet. Input and output connection is through 75 ohm clamp type suitable for RG-6 or RG-59, solid or foam core cable. Output connection is 300 ohm no-strip screw type. AC isolated

2.2 CABLE SPLITTERS

Cable splitter shall be of high quality zinc die cast case with anticorrosive chromate finish It should be multiple capacitor design for improved cable splitter response

2.3 DISTRIBUTION AMPLIFIERS

A. The distribution amplifier shall be :

B.

1. Dual push-pull hybrid modules for high output with low distortion
2. Built-in variable gain and slope controls input and output test ports allow signal testing without interruption of service
3. Passive (with optional or integrated return filters) and active two-way capability
4. Attenuator and cable equalization options available
5. Exceptional temperature stability
6. Line transient protection
7. Aluminum chassis provides excellent heat dissipation

2.4 CABLES

A. Coaxial cables shall be as RG-6 or RG- 11. It shall be of high quality and acceptable to the Cable TV operator.

PART 3 EXECUTIONS

3.1 INSTALLATION

A. Install the system in accordance with Philippine Electrical Code and other applicable codes.

B. Install equipment in accordance with manufactures written instructions.

C. All equipment shall be firmly secured in place unless requirements of portability dictate otherwise. Fastenings and supports shall be adequate to support their loads with a safety factor of at least three times the weight of the equipment installed. Install all boxes, equipment, hardware, and other materials plumb, level, and square.

D. Install all electronic equipment and supporting components in a neat and cosmetically dressed-out manner. All saw cuts, holes, recesses, and woodwork shall be straight and consistent. This shall include the use of

moldings, grommets, bushings, etc., as required to properly dress out the installation of the equipment. Do not use sticky-back tape for fasteners.

3.2 CABLE, WIRE, AND CONNECTORS

A. All cable and wire shall be new and unspliced. Splicing of cables and conductors is expressly prohibited in any location other than the equipment cabinet. Splicing of video cables will not be allowed in any location.

B. Sufficient cable length shall be provided at all connector locations so as to permit wiring maintenance and connector replacement in the future.

C. All cables that pass through cover plates of junction boxes and raceways, through slab-to-slab walls, and through conduit lines shall be properly sealed and protected with appropriate gaskets.

D. Separation between system cables and all other services shall be maximized to prevent and/or minimize the potential for electro-magnetic interference. Particular care shall be taken to ensure at least a 12" separation from electrical lines whenever feasible.

At points where separation is unavoidable, system cables shall cross other services at right angles.

E. Cables shall be installed in a manner that ensures no signal cables are placed on top or any lighting fixtures, HVAC controls or sensing devices, fire safety and sprinkler system equipment or detection devices, or any other electrical or mechanical equipment.

F. No cables shall be laid directly on top of false ceiling tiles.

G. System cables shall be installed in a manner that will not block access to other equipment or services, across removable service panels and/or in any other manner that would prohibit or hinder routine maintenance of systems such as but not limited to the following:

1. HVAC systems
2. Fire & safety equipment
3. Building mechanical and control systems
4. Telecom or Data systems
5. Security systems

H. Do not place any wires or cables for this system in any conduit, raceway, wireway or cable tray that is used for the mechanical systems of the building.

I. All inter-rack cables shall be grouped according to the signals being carried to reduce signal contamination. As a general practice all power cables shall be run on the left side of equipment racks as viewed from the rear. All other cables shall be run on the right side of the rack as viewed from the rear.

J. All solder connections shall be made with rosin-core solder. Temperature controlled soldering irons shall be used for all soldering work. No soldering guns, gas or butane, or temperature unregulated irons shall be used.

3.3 IDENTIFICATION AND LABELING

A. All cables, regardless of length, shall be marked with wrap-around number or letter cable markers at both ends. These labels shall be self-laminating to ensure durability.

B. There shall be no unmarked cables in the system.

C. Marking codes used on cables shall correspond to codes provided with system documentation, and/or the written "as-built" documentation.

3.4 TESTING AND ACCEPTANCE

The service of a competent, factory-trained engineer or technician shall be provided to technically supervise and participate during all of the adjustments and tests for the system.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

2. Check installation, supervision, and operation of all devices

3.5 AS-BUILT DRAWINGS

A. The drawings are to include cable routes and TV outlets locations. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The Owner will provide floor plans in paper and electronic (DWG, AutoCAD) formats on which as-built construction information can be added. These documents will be modified accordingly by the contractor to denote as-built information as defined above and returned to the Owner.

B. The Contractors shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (Auto CAD form).

PART 4 WARRANTY AND SERVICES

4.1 WARRANTY

Provide original equipment manufacturer's warranty documentation for the acceptance of the Owner

Warranty period shall be one year commencing with the date of substantial completion.

4.2 FINAL ACCEPTANCE & SYSTEM CERTIFICATION

Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation, and successful performance of the system for a two week period will constitute acceptance of the system.

*** END OF SECTION ***

SECTION 17990

TESTING AND COMMISSIONING OF ELECTRONICS SERVICES

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. Provide any materials, equipment and labor required, and make such tests as specified in the various Electrical/Electronic Systems and Communication Systems as specified herein, and as otherwise deemed necessary to show proper execution of the work in the presence of the Architect/Engineer.

B. Any defect or deficiencies discovered as result of such tests shall be corrected without additional cost to the Owner.

C. After the installation is completed and properly adjusted, operating tests shall be conducted. The various equipment and systems shall be demonstrated to operate in accordance with the requirements of the Contract Documents. Tests shall be performed in the presence of the Architect/Engineer. Provide electric power, instruments and personnel necessary for performing the various tests.

D. Procedures and tests outlined below are to be considered as in addition to normal visual and mechanical inspections which must be carried out prior to balancing equipment in service.

E. Procedures and test outline below are to be considered as in addition to tests called for under other sections of the electrical specifications.

F. Perform the following tests in the presence of the Architect/Engineer:

1. Voltage test shall be made at the last outlet on each circuit. If drop in potential is excessive, correct the condition and re-test the relevant circuit.
2. All cables, after being pulled in place and before being connected, shall be tested by Megger test to determine that conductor insulation resistance is not less than that recommended by cable manufacturer. Four copies of all test shall be furnished to the Architect. All cable failing insulation test shall be removed, replaced and re-tested.
3. All equipment shall pass similar tests and entire system tested after all final connections have been made.
4. All motors shall be tested under load with ammeter readings taken in each phase, and the RPM of motors recorded at the time. All motors shall be tested for correct direction of rotation.

1.2 TESTING, SPECIAL REQUIREMENTS

A. The contractor shall take every precaution possible to assure the proper functioning of equipment or systems, and shall adhere to the following procedures.

1. Electrical equipment delivered to job-site during construction shall be protected in such a way that will prevent dirt, dust, water or any other foreign materials from entering or contaminating the working parts. This protection shall also be provided after installation as long as construction operations continue.

2. Before any equipment or system is energized, the following procedures and tests should be followed and/or performed.

a. Clean all dirt, dust and moisture from equipment.

b. Check for loose bus and cable connections.

c. Check for missing insulation in equipment and on conductors.

d. Check for any modifications, alternations, or the use of unapproved parts in the assembly of the equipment against the approved submittals.

e. Ascertain that all circuit breaker short interrupting ratings are adequate.

f. The equipment room or area should be free of moisture accumulations.

g. Check conductors run in multiple to ensure that they are properly phased.

h. Conduct a "megger" test of all equipment and wiring (the use of battery operated test lights and bells is not acceptable for this test).

B. Ascertain that all equipment is rated for the available fault current.

1.3 SUBMITTALS

A. The study result shall be submitted for review in the following form:

1. For the short circuit study, five (5) bound copies of the computer printout together with five (5) prints of the device location diagrams.

2. For the device coordination study, five (5) bound copies of the time current curves, together with a tabulation of relay identification, location and recommended settings. A commentary covering the basis for selection of settings, and suggestions for improvement of coordination and protection shall be included where applicable.

B. A short circuit study and protective device coordination study shall be performed as described herein.

C. A short circuit study shall determine the maximum duty that the system protective devices, transformers, and interconnections will be subjected to in event of three phase and/or line-to-ground fault conditions.

The fault study shall also provide the basic information required for determining protective relay settings.

D. The results of the study shall be presented graphically on time-current coordination curves. These curves to illustrate the selected trip characteristics of the protective devices in series to the fault location, and show the degree of protection attained from transformers, motor, etc. as selective tripping obtained from the backup protective devices.

E. The results of the study shall also be presented as data tabulations under the following heading where applicable:

1. Short Circuit Data:

Current values for maximum and minimum fault conditions for close-in and line end fault locations for each protective device.

A Comparative tabulation of the calculated short circuit duties versus the ratings of the applied circuit breakers and fuses. If the study reveals problem areas or inadequacies of protective device, the report shall include recommendations for corrective steps to be taken.

2. Devices Identification and Settings:

A Listing of relay types and available taps, current transformer ratios, breaker types, fuse ratings, and the location of each device in the system.

The recommended tap and time dial setting, and the instantaneous pickup setting is to be given for each over current relay and setting for each breaker.

A critique of the applied devices shall be included with comments pertaining to the suitability of the selected types, ranges and CT ratios, etc.

3. Device Operation Check:

For faults at each bus location, the operation time in second shall be listed for each relay at the fault bus one and two buses away from the fault bus.

F. The contractor shall obtain the following data where applicable from the switchgear manufacturer, utility company and/or other Sub-Contractor to enable him to proceed with the

short circuit and coordination study. (Data to be obtained unless otherwise noted from contract document send/or manufacturer furnished equipment for the project).

1. Single line interconnection diagram.
2. Short circuit contribution from power company source and X/R ratio of this contribution.
3. Impedance, voltage ratio, MVA rating and method of neutral grounding of power transformers.
4. The ohmic reactance value of current limiting reactors.
5. The ratings of all induction motors. Rating of motors should include full load amperes, voltage, speed and sub-transient reactance.
6. Type voltage rating, size and number of conductors, type of conduits, shielding, and lengths of all interconnecting cable.
7. Identification of circuit breakers and power fuses to include manufacturer and type, voltage rating, interrupting and momentary short circuit ratings, and rated interrupting time.
8. Indication of which tie breakers or switches are normally closed or cannot be closed for certain reasons.
9. The ratio of the instrument transformers energizing each relay.
10. The type designation, range of adjustments, style or catalogue number and the manufacturer of each protection relay. The existing settings on each relay should be included if applicable.

1.4 SAFETY AND PRECAUTIONS

A. Safety practices shall include but are not limited to the following requirements:

1. Local Authority and Insurance Company's Standards/Requirements.
2. Applicable National and Local Safety operating procedures.
3. Owner's safety practices.

B. All tests shall be performed with apparatus de-energized except where otherwise specifically required herein.

C. Power circuits shall have conductors shortened to earth by a hot line grounding device approved for the purpose.

D. In all cases, work shall not proceed until it has been determined that it is safe to do so.

E. The Contractor shall have available, sufficient protective barriers and warning signs to conduct specified tests safety.

PART 2 – PRODUCTS

(Not Applicable)

PART 3 – EXECUTION

3.1 TESTING, ADJUSTING AND VERIFICATION

A. Provide necessary material, labor and miscellaneous services for temporary feeders, provision of jumpers and connections, and handling equipment during the testing, adjusting and verification procedure.

B. Confirm that all protective device schemes function properly. Conduct circuit breaker trip test. Apply correct voltage and current to protective device.

C. Provide cross wattmeter readings equivalent or any differential and or directional relay schemes. Verify metering schemes.

D. During the testing and verification procedure, conduct spot checks on selected protective devices with representative of the Owner and/or Engineer to adjust and to retest prospective devices to that final settings will result in performance in accordance with approved issue of respective coordination curve.

E. Witness tests shall occur in locations to be determined once manufacturers have been agreed with the successful electrical sub-contract tenderer.

F. Provide factory witness testing to suit delivery schedule of manufacturers. Provide hourly rates etc. to re-witness equipment if initial tests fails.

G. Provide all submission and final report as previously specified.

H. The final report and study shall include assurance for the following items:

1. That the protective devices on the main low voltage equipment is coordinate with the Utility Company protective devices.
2. That the protective devices within the parameters of the study conform to the results of the study.
3. That the equipment has been tested and performs as per the settings of approved coordination curves.
4. That the "as left" condition of the protective device correspond to the record documents.

Complete studies and reports shall be submitted simultaneously to the Engineer as well as part of the requirement of the Project Record Document.

3.2 BUILDING DISTRIBUTION SYSTEM

A. Before energizing any portion of the electrical systems perform megger tests on all feeders. Result to conform to the applicable Codes and Standards to the satisfaction of the authorized inspection authority and to the Electrical Engineer.

B. Upon completion of the building and immediately prior to final inspection and takeover check the load balance on all feeders at distribution centres, motor control and panelboards. Tests to be carried out by turning on all possible loads in the building and checking load current balance. If load ambulance exceeds 10 percent, reconnect circuit to balance load.

C. Make voltage checks throughout building after building is in operation for sixty (60) days and at this time. If directed by the Electrical Engineer, adjust transformer tap settings. Readings taken at this time to be logged, tabulated and any adjustments made to be suitably logged and incorporated in the Operating and Maintenance Manuals.

D. All protective devices to be tested and calibrated on site prior to energizing, to ensure proper operation as calculated on coordination studies provided by equipment suppliers. Testing and calibration to consist of verification of published curves and setting of devices at specified settings. Complete report to be submitted to the Electrical Engineer within seven (7) days of completion of testing.

3.3 SYSTEM

The following systems and equipment are to be tested, inspected and certified.

A. Wire and Cable (600 Volts and Below):

1. Inspect all splices and terminations and make mechanically and electrically tight transformer tap settings. Readings taken at this time to be logged, tabulated and any adjustments made to be suitable logged and incorporated in the Operating and Maintenance Manuals.
2. Perform standard 500 volt insulation test with "megger" tester for all conductors. Test shall show insulation resistance in excess of minimum values required by Codes. Submit certification to the Architect/Engineer.

B. Motor Controllers:

1. Submit with certification in tabular form a complete listing of all motors on the project for which motor controllers have been provided. Include on this listing, the nameplate full load amperes of each motor and the size overload heaters installation each motor controller.

C. Motors:

1. Test all motors under load and confirm that motor rotation is correct.

D. Engine Generator and Automatic Transfer Switches.

1. Factory Testing:

a. Prior to shipment of each engine-generator set from the factory, a certified load test shall be performed and the results submitted to the Architect/Engineer for approval before shipment of the unit. The test shall conform the proper operation of all alarms and shut down circuits.
b. The test shall also demonstrate compliance with the set performance criteria as specified herein.
c. Testing shall be performed as follows:

1. In a period of five (5) hours with a loading of 25, 50, 75, 100 and 110 percent of rated load. Step loading procedures shall be utilized (i.e. 25 percent first hour, 50% second hour, etc).
2. Shock load of 100% of rated output, step loading is unacceptable. Maintain 100 load for 1 hour.

2. Field Testing:

a. After completion of the installation, the Contractor shall arrange with the engineer for a load test of each control switchgear and related automatic transfer switches. The generator shall be required to startup and accept full load within 10 seconds. The unit shall continue to operate for not less than four (4) hours at 100 percent rated load. The test shall also include demonstrating that all alarms, signals, shut down devices, lift recall, etc., are functioning properly. The Contractor shall be responsible for securing all temporary loadbanks, etc. required for the tests.

b. The Contractor shall supply all fuel for the testing. Upon acceptance by the Architect/Engineer the day tank and main fuel oil tank shall be filled to capacity after testing.

E. HV Switchgear, Substation, Low Voltage Switchboards.

1. At the completion of the work equipment shall be field tested in the presence of the Engineer in accordance with applicable standards. Tests shall be conducted under the close supervision of the service organization of the manufacturer.

2. Tests shall include the following:

a. Operation of each disconnecting means under load.
b. Operation of all metering equipment.
c. Operation of all alarm devices.
d. Operation of forced air cooling system.
e. Operation of all key interlocks.

3. The manufacturer shall observe all cable bracing both incoming and outgoing and certify that same in provided in accordance with the manufacturer's recommendations.

4. The earth leakage systems shall be set at the level specified by the switchboard supplier.

5. As work shall be retorqued in accordance with manufacturer's recommendations. Submit certification of same.

F. Lighting Protection System

1. Provide testing for the system as per applicable codes and standards attach a certified label at the origin of the electrical installation as required by this standard.

G. Grounding

1. Upon completion of the electrical grounding system for the contractor shall test the grounding system for stray currents, earths, shorts, etc. These tests shall be performed with approved instruments.

H. Auxiliary Systems

1. Refer to the auxiliary system sections the details of Testing.

3.4 COMMISSIONING

A. The Contractor shall be responsible for the coordination of all the previously described elements which comprise the whole installation.

B. In addition, the Contractor shall carry out final settings and adjustments and commissioning of the whole installation up to including the incoming circuit breakers of the main low voltage switchboards in accordance with the manufacturer's recommendations and recognized practice.

C. Details of proposed commissioning procedures shall accompany the Contractor's proposal Submission.

*** END OF SECTION ***

SANITARY/PLUMBING SPECIFICATIONS

PART 1:GENERAL

1.01 SUMMARY

The General Conditions apply to all work under this section of the Specifications.

1.02 SCOPE OFWORK

Unless otherwise specified, the Contractor or his sub-contractor shall furnish all materials, tools, equipment, apparatus, appliances, accessories, transportation, labor and supervision required for the complete installation and testing of the Plumbing system ready for use in accordance with the best practiceofthePlumbingTradeaslistedhereinbutnotlimited tothefollowing:

a. The Plumbing Contractor is required to refer to all architectural, structural, mechanical and electrical plans and investigate all possible interference and conditions affecting hiswork.

b. All work shall comply with the pertinent provisions of the Plumbing Code of the concerned city, the code on Sanitation of the Phil., and/or the National Plumbing Code of thePhilippines.

c. Watersupplyanddistributionsystemforthebuildingandground, including supply and installation of pumpingsystem.

d. All building sanitary drains, waste and venting systems including floor drains.

e. Sewage collection and disposal system including cleanout, sewer junction boxes, sewer manholes up to SepticTank.

f. Building storm drainage system including deck and roof drains, canopy drains, trench drains up to disposalpoint.

g. Supply and installation of all plumbing fixtures, fittings, trims and accessories.

h. Supply and installation and test run, Transfer Pump, Sump Pump, Elevator Pit Pump and other equipment under Plumbingworks.

i. Testing for leakage of all storm drainage, waste, sewer and venting system plus pressure testing and dis-infection for the water supply and distributionsystem.

j. Testingforleakageanddis-infectionforthewatertanks.

k. Securing of all permits and licenses as required to include water connection system

l. Excavation and backfilling in connection with the work shall be included.

m. Preparationandsubmittaloftwo(2)setsofas-builtplans.

n. Furnishingofwrittenone(1)yearwarrantyontheplumbingsystem.

1.03 WORK NOTINCLUDED

a.Construction of the R. C. Water Tank shall be by CivilWorks.

b.All electrical power airings, except that furnished as an integral part of factory assembled equipment except as otherwise specifiedherein.

c. PaintingexceptasrequiredbythePlumbingcodeandasspecifiedherein.

1.04 NOTES ONDRAWINGS

a. The Drawings show the general arrangement of all piping. However, where local and/or actual conditions at the jobsite necessitate a deviation or rearrangement, the Contractor shall prepare and submit the new arrangement for the Architect'sapproval.

b. Small scale Drawings do not possibly indicate all offsets, fittings and other parts of the system required. The Contractor shall arrange such work accordingly, furnishing such fittings, traps valves and accessories as may be required to meet such conditions.

1.05 APPLICABLESPECIFICATION,CODES,ORDINANCES,PERMITS&FEES

a. The work covered in this contract is to be installed according to the specs codes, ordinances and requirements of the following:

1. NationalPlumbingcodeofthePhilip

2. TheCodeonSanitationofthePhilippines

3. Ordinancesofconcernedcityormunicipality

4. All construction permits and fees required for the work shall be obtained by and At the expense of the contractor. The contract shall furnish the Owner final Certificate of inspection after the completion of the work.

1.06 WORKMANSHIP&COORDINATIONWITHOTHERTRADES

a. All work shall be performed in first class and neat workmanship by mechanics skilled in their trades and such mechanics and their work shall be satisfactory to the Engineer.

b. The Plumbing Contractor is required to refer to the General Conditionsand to all architectural, structural, electrical and fire protection plans and specifications and shall investigate all possible interferences and conditions affecting hiswork

PART 2:PRODUCT

2.01 GENERAL

a. Except as specified, the Contractor shall submit for the Engineers approval, four (4) copies of a complete list of manufacturer's names of all equipment and materials he proposes to use, within thirty (30) days after award of contract.

b. The Contractor shall assume the cost of and the entire responsibility for any change in the work as shown on contract drawings, which may be occasioned by approval of materials other than those,specified.

2.02 PIPES AND FITTINGS SCHEDULE

a. Cold Water Lines - shall be Poly Propylene Random, (PPR) pipe. Use screwed connection from 15 mm dia. to 65 mm dia. and flanged connection from 75 mm dia. andlarger.

b. Sewer Line - shall be PVC series1000

c. Vent/Waste Lines - shall be PVC series1000

d. Downspouts - shall be PVC series1000

e. StormDrainageLines-shallbePVCseries1000

For outside building, concrete drain pipe (CDP), tongue and groove, mortar joints, reinforced for 300 mm B and larger use 3000psi.

f. Perforated Pipe - shall be shall be polyvinyl chloride (PVC) pipe, series 1000

2.03 VALVES

a. Gate Valve - 75 mm & larger, shall be rising stem, iron body with bronze trim, flanged connection, min. of 150 psig working pressure, 50 mm & smaller, shall be rising stem all bronze, female threaded, min. of 15 psig workingpressure.

b. CheckValve—Non-slamtype,150psigworkingpressure

c. FloatValve—150psigworkingpressure

2.04 OTHERMATERIALS

a. Drains-"cast-ironpermanufacturesstandard.

1. RoofStrainer
2. FloorDrain
3. ShowerDrain
4. Deck
5. Canopy

b. WaterMeter

c. Hose Bibs - 20 mm standard hose connection, male tapered threads, polished chromium plated.

d. Drainage Junction Boxes - 140 kg/sq.c m. reinforced concrete with pre-cast reinforced concretecover.

1.Thrust Block - 140 kg/sq.c.m. plainconcrete

2. Area-Drain/Catch Basin -14 kg/sq., reinforced concrete with Cast iron or steel grating cover.

3. Cistern-210 kg/sq.cm. reinforcedconcrete

2.05 JOINTING

a. Flanged JointGasket

b. ScrewedJoints-U.S.FederalSpecificationsGG-P-251.

c. PVC Pipes and Fittings - PVC cement or as per the Manufacturer's recommendations.

d. DissimilarPipes-Adapterfittingsshallbeused.

e. ConcreteDrainPipe-Cementmortar.

PART 3: IDENTIFICATIONANDAPPROVALOFMATERIALS

a. Each length of pipe, fittings, traps, fixtures, and device used in the Plumbing System shall have cast, tamped or marked on it, the manufacturer's trademark or name, the weight, type and classes of product when so required by theStandard.

b. Within thirty (30) days after award of the Contract, the Contractor shall submit for the Architect's approval, the names of suppliers and materials proposed including trade names and/or samples of the materials if deemed necessary

c. Brand names mentioned in this Specification are only for the purposes of indicating the desired quality anddesign.

PART 4: SUBSTITUTION & TESTING OFMATERIALS

a. Materials intend to be substituted for those originally specified shall be accepted only after a formal request for substitution, accompaniedby:

1. Reasons forsubstitutions;

2.Certificateoftestindicatingquality,comparedtothoseoriginallyspecified;

3. Cost comparisons with materials originally specified. Request shall be submitted to the Architect for evaluation at least 15 working days before installation of subject material is due, or at least 7 days before opening of bids.

b. Cost of testing materials, whether on originally specified items or on substitution, shall be the account of the Contractor.

c. Results oftestsshallbesubmittedtotheArchitectforevaluationatleast15 daysbeforethematerial isduefor installationonthejob

PART 5: SOIL, WASTE, DRAIN AND VENTPIPES

5.01 GENERAL

a. Underground waste water pipes, and water pipes and fittings shall be cast iron, unless specifically noted, Soil & waste pipes above ground shall be polyvinyl chloride (PVC) pipes.
Vent pipes shall be polyvinyl chloride (PVC) pipe. Fittings for piping above ground shall be drainage pattern. Fitting on all dry vents shall be polyvinyl chloride (PVC)pipe.

5.02 SUPPORTS

a. Horizontal line shall be supported by well secured length heavy duty strap hangers or floor chairs as required. Vertical lines shall be secured strongly by hooks to the building frame and a suitable bracket or chairs shall be provided at the floors from which theystart.

b. In soft ground liable to settlement, a gravel base 300 mm. deep and twice the width of the pipe shall be rolled or tamped. Backfilling shall becarefully placed and tamped for the purpose, in such a manner that the pipe lines or connections are notdisturb.

5.03 TRAPS

a. Every fixture shall be separately trapped by vented water sealed traps as close he fixtures outlets as the conditions allow, but in no case ata distance greater than 600 mm. In case of the upper or the only fixture on a soil pipe extended full size through the roof, a vent shall not be required when said fixture has its center stack. Traps shall be of the same diameter as the waste pipes from the fixtures which they shall serve, all traps shall have a water seal of at least 32 millimeters with a brass thumb screw cleanout at the bottom of thesea.

5.04 VENT

Vent shall be taken from the crown of the fixtures, except for water closet traps,inwhichcase, thebranchlineshallbeventedbelowandtrapandabove all small waste inlets, so connected as to prevent obstructions. Each vent pipe shall be run separately above the fixtures into the adjacent soil pipes, a distance not more than 1.50 meters. If more than this distance, the vent shall run independently through theroof.

a. A vent line shall be wherever practicable, direct extension or a soil or wasteline.

b. Main vent risers at 4.5 meters along or more shall be connected at theroof with the main water or soil pipes below the lowest vent outlet with a forty-five-degree (45°)connection.

c. All vertical soil or vent pipes shall be carried up to least 600 mm above the roof of the building and the open side ends are to be entirely and securely covered with GA. 16 mesh coppercloth.

d. Vent pipes in roof spaces shall be run as close as possible to the underside of roof with horizontal piping pitched down to stacks without forming traps. Where an end or circuit vent pipe from fixtures it shall be connected into the main vent or ventstack.

5.05 ROUGHING-IN

a. Rough-in for pipes and fixtures shall be carried along with the building construction. Correctly located openings of proper sizes shall be provided where required in the walls and floors for the passage of pipes. All items to be embedded in concrete shall be thoroughly clean and free from all rust, scale andpaint.

5.06 FITTINGS

a. All changesinpipessizesonsoil,wasteanddrainlinesshallbemadewith reducing fittings or reducers. All changes in direction shall be made by the appropriated use of forty-five degrees (45°) wyes, or long sweep bends, except that sanitary tees may be used on vertical stacks. Short quarter bends or elbows may be used in solid and waste lines where the change in direction is from the horizontal to the vertical and on discharge from the water closet.

5.07 JOINTS ANDCONNECTIONS

a. Alljointsshallbeairandwatertight.Forjoiningpipes, thefollowingshall beused:

1. Galvanizedwroughtironorsteelpipe,screwedorthreadedjoints,use sealant.

2. Concretepipes:belland spigot or tongue and groove.

3. Polyvinyl chloride (PVC) pipes, socket type with PVCcement.

PART 6: WATER DISTRIBUTIONSYSTEM

6.01 METER

a. WatermetersMAINshallbefurnishedbytheContractorandinstalledwith theproperand completepipingarrangementforthesystem.

6.02 INSTALLATION

a. Thepipingshallbeextendedtoallfixtures,outletsandequipmentfromthe gate valves installed in the branch near theriser.

b. Unions shall be provided where required fordisconnection.

c. Allpipesshallbecutaccuratelytomeasurementsandshallbeworkedinto placewithoutspringing orfacing.Careshallbetakensoasnottoweaken the structural portions of the building.

d. Allservicepipesvalvesandfittingsshallbekeptatsufficientdistancefrom work to permit finished covering not less than 15 mm from such work or from finished covering on the differentservice.

e. Changesinpipesshallbemadewithreducingfittings.

f. Accessible contraction - Expansion joints shall be made wherein necessary.Horizontalrunsor pipeover15m.inlengthshallbeanchored to wall or the supporting structure about midway on the run to force expansion and contraction equally towards theends.

PART7:EXCAVATING,PIPELAYINGANDBACKFILLING

7.01 TRENCHES

Trenches for all underground pipelines shall be excavated to the required depthsandgrades.Bell holesshallbeprovidedsothatpipewillrestonwell- tamped solid ground for its entire length. Where rock is encountered, excavationshallextendtoadepth150mmbelowthepipebottomandother approved fillingmaterials.

7.02 CONCRETEPROTECTION

Allpipesexceptconcretepipesandcast-ironpipesthatwillrununderground shallbeprotectedwith ClassBconcretecasing,aminimumof100mmaround the pipe perimeter and 250 mm below the finishgrade.

7.03 MATERIALS

Materials for backfilling shall be free of debris or big rocks. Backfill shall be placedinhorizontal layers,properlymoistenedandcompactedtoanoptimum density that will prevent excessive settlement andshrinkage.

PART 8:MISCELANEOUS

8.01 CLEANOUTS

Cleanout shall be of the same size as the pipe, the location of which is extended to an easily accessibleplace.

8.02 TRAPS

a. Everyplumbing fixturesor equipment requiring connections to the drainagesystemshallbe equippedwithatrap.

b. Eachtrapshallbeplacedasnearaspossibletothefixture.Nofixture shall bedouble-trapped.

8.03 VALVES AND HOSEBIBBS

a. Valvesshallbeprovidedonallwatersuppliestofixturesasspecified.

b. Hose bibs shall be made of brass with 15 mm make male inlet threads hexagon shoulders and 20 mm connections.

8.04 PIPE HANGERS INSERTS ANDSUPPORTS

a. Horizontal runs of pipe shall be hung with adjustable wrought iron or malleableironpipehangers spacednotover3mapart,excepthuband spigot soil pipes which shall have hangers spaced not over 1.52 m. apart and located near thehub.

b. Hangers shall have short turnbuckle or other approved means of adjustment.

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

d. Verticalrunsofpipeshallbesupportedbywroughtironclampsorcollars spaced not more than 9 m.apart.

e. WaterandVentPipes-65mmandlarger;bandtype6.4mmx25mmflat midsteelorblackiron with15mmroundrodwithplatesandnuts;50mm andsmallersplitringtypewith10mmironrodswith insertsplates;toggle bolts, clamps or expansionshield.

8.05 PIPESLEEVES

a.Pipesleevesshallbeinstalledandproperlysecuredinplaceatallpoints where pipes pass through masonry orconcrete.

b. Pipesleevesshallbeofsufficient diametertoprovideapproximately6.4 mm clearance around the pipe ofinsulation.

c. Pipe sleeves in walls and partitions shall be of cast iron, wrought ironor steel pipe. Pipe sleeves in concrete beams or concrete slabs shall be wrought iron or steelpipe.

d. Pipe sleeves on footings shall be cast iron or steel and shall be not less than100mmlargerin diameterthanthepipetobeinstalled.

e. Wherepipespassthroughwaterproofingmembrane,thesleevesshallbe provided with an integral flange or clamping device to which a flashing shield can besoldered.

f. The space between the pipes and sleeves shall be made watertight by inserting a packed oakum gasket and filling the remaining space with poured lead caulkingthoroughly.

PART 9: FIXTURES, FITTINGS, ANDACCESSORIES

A. REFER TO ARCHITECTURALSPECIFICATIONS

PART10:PUMPS

10.01 GENERAL

a. All equipment's shall be supplied from reputable firms engaged in the manufactureofeach particularitem.Theentireassemblyasinstalledshall be given a start-up and test run to prove that all the specifications have beenmetbeforeacceptancebytheOwner.Thetestdurationshallbe 24 hours. Submittal of the Certificate of Test to the Owners shall be a condition of finalpayment.

b. TheSpecificationshereinstatedarebasicguideonly.Otheritemsnotso indicated but which are obviously necessary for the proper operation of system as intended shall be supplied in accordance with accepted engineeringstandards.

c. Theequipmentshallbeguaranteedforaperiodofatleastone(1)yearof trouble free operation. The supplier of equipment shall certify to the availability of spare parts locally and service in case of system breakdowns within a period of at least three (3) years. Manuals of operation and maintenance and list of spare parts shall be supplied togetherwiththe equipment.SubmittalofWarrantyCertificateshallbeon condition to the finalpayment.

d. The supplier shall submit at least two (2) copies of pumps performance curves showing among other, the pump rating and pump efficiency, properly markedthereon.

e. Accessoriestobesuppliedforeachgroupshallincludeonenon-slamtype check valve, and two (2) gate valves, of size equal to the size of pump discharge and suction and rated 150 psi. Also, one pressure gauge for eachsetofpumpsandpipefittingnecessaryforcompleteinstallationshall beprovided.Thepressuregaugeshallbe100mmfacediameterandshall bereadingfrom0psi(or kg/cm)to100psi(or7kg/cm).

f. Pricequotedshallincludecostdeliveryofallquoteditemstothejobsite. Pump and mother installation dimension drawings shall be submitted together with thequotation.

g. The brands, names and place of manufacture of pump, motor, valves, controls and all accessories where applicable shall be indicated in the quotation. Also, a description of pump impellers being offered shall be included.

h. Ametalnameplateindicatinginindeliblelettersthecorrectspecifications of the pump and motor shall be properly attached to the assembly at a locationsuchthattheinformationwritten thereoncanbeconvenientlyread by all concerned.

i. Aseparatepriceshallbequotedforinstallationworkandpreparation submittalofasinstalled drawings.

10.02 TRANSFERPUMP

a. NumberofUnits—TP1/TP2

b. Capacity of each Unit: 350 GPM vs. 370 Ft. TDH. Approximately 37.5 KW each.

c. Type: Centrifugal End Suction duplex pump, closed-coupled to electric motor, bronze fitted with electric motor drive on a common base, suitable for pumping domestic water supply by negative suction from water tank with control andaccessories.

d. Electric Motor Drive: 380 volts, 3-Phase, 60 cycles, 37.5KW.

e. MotorControls:

f. Accessories: Vibration insulating hose connection at suction and discharge line.

10.03 BOOSTERPUMP

a. NumberofUnits—BP1/BP2

b. CapacityofeachUnit:100GPMVS.90Ft.TDH.Approximately5.0HP each

c. Type: Vertical in line duplex pump with simultaneous operation, closed- coupled to electric motor, bronze fitted with electric motor drive on a common base, suitable for pumping domestic water supply by negative suction from water tank with control andaccessories.

d. ElectricMotorDrive:230volts,3-Phase,60cycles,5.0Hp.

e. MotorControls:

f. Accessories: Vibration insulating hose connection at suction and discharge line.

10.04 ELEVATORPUMP

a. NumberofUnits—2unts-EP1

b. Capacity of each Unit: 42 GPM vs. 20 Ft. TDH. Approximately1.0 HP each.

c. Type: Submersible Pump, coupled to electric motor, bronze fitted with electric motor drive on a common base with control and accessories

d. ElectricMotorDrive: 230volts,1-Phase,60cycles, 0.50HP.

e. MotorControls:

f. Accessories: Vibration insulating hose connection at suction anddischarge line.

10.05 SEWAGE EJECTORPUMP

a. NumberofUnits—SE1/SE2

b. Capacity of each Unit: 50 GPM vs. 20 Ft. TDH. Approximately 0.5 HP each.

c. Type:SewageEjectorPump,coupledtoelectricmotor,bronzefittedwith electricmotordriveona commonbasewithcontrolandaccessories.

d. ElectricMotorDrive:230volts,1-Phase,60cycles, 5.0.HP.

e. MotorControls:

f.Accessories: Vibration insulating hose connection at suction and discharge line.

10.06 SUMPPUMP

a. NumberofUnits—SP1/SP2

b. Capacity of each Unit: 130 GPM vs. 60 Ft. TDH. Approximately 5.0 HP each.

c. Type: Submersible Pump, coupled to electric motor, bronze fitted with electric motor drive on a common base with control andaccessories.

d. ElectricMotorDrive:230volts,1-Phase,60cycles,5.0HP.

e. MotorControls:

f. Accessories: Vibration insulating hose connection at suction and discharge line.

PART11:WATERRESERVOIR:

11.01 GROUND TANK - Reinforcedconcrete
Capacity: 33,632 gallons for potablewater
Capacity: 30,000 gallons for fire water

ELEVATED WATERTANK
Capacity: 2-5,000gallons

11.02 PIPING, FITTINGS AND MISCELLANEOUS METALWORKS

a. Furnish and install all pipe fittings, valves, specials, pipe supports, miscellaneous metalwork andallrequiredappurtenancesasshownonthe plans and as required to make the entire piping systemoperable.

b. Allmaterialsfurnishedandinstalledshallbenewandguaranteedfreefrom defect in design, materials andworkmanship.

c. Adequate protective measures shall be provided to protect pipes, fittings, valves and all other materials from damage or injury during storage and installation.

11.03 FLANGES, GASKETS, ANDBOLTS:

a. FlangesshallconformindimensionsanddrillingtoASAB-161Class125.

b. Gaskets shall bering-type.

c.Bolts shall be standard square head machine bolts with heavy, hot, pressed hexagon nuts. Threads shall conform to ASA-B-1.1, coarse thread series, Class 2fit.

11.04 MANHOLE ANDCOVER:

a. All castings for manhole frames shall be tough, gray iron free from warps, cracks, holes, swells and cold shuts, and approximately 3 *mm*thick.

b. All casting shall conform to the requirements of ASTM Standard A-48 for gray fromcastings.

11.05 LADDERRUNGS

a. LadderRungsshallbeof20mmdiameterroundstainless-steelbar places in the wall as shown fromcastings.

11.06 INSTALLATION

a. All pipes shall be carefully placed and supported at the proper lines and grade where possible shall be sloped to permit completedraining.

b. Piping runs shown on Drawings shall be followed as closely as possible, except for minor adjustments to avoid adverse effect on architectural and/or structural features. If major relocations are required, they shall be subjected to the approval of theArchitect.

c. Carefully inspect all pipe and fittings before installation. Inspection of pipe shall include light tapping with a hammer to detect cracks of defects. No pipe fittings or valve which are cracked or shown defects shall beused.

d. Piping shall be properly supported by suitable anchors, brackets, or hangers. Vertical pipes shall be anchored by suitable galvanized steel straps. Pipe supports shall be provided as shown on the Plans and whenever else necessary to prevent stain on joints or to facilitate taking down pipe.

e. Piping through the Walls - Where the pipe pass through walls, care shall be exercised to ensure these joints arewatertight.

11.07 TEST FORWATER:

a. Tightness of completed Tank - The completed reinforced concrete ground and structural steel tanks shall be tested for water-tightness by filling it up with clean water after cleaning out all dirt and debris inside the tank. The watershallbeallowedtostandforaminimumperiodof24hours reckoned from the time the free-board line was reached during filling up. After the 24 hours period there shall be no drop-in water level in the tank more than 40 mm, otherwise, the leaks shall be located and plugged properly and the test for water-tightness berepeated.

11.08 DEFECTIVEWORK:

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

b.All repairs to piping shall be made with new material at the expense of the Contractor.

c. No caulking of screwed joints of holes will beaccepted.

11.09 TESTCERTIFICATE

a. Test Certificate shall be filled out and signed by the Owner's representative

PART 12: SITE PLUMBINGUTILITIES

12. 01 GENERAL

a. The entire site plumbing utilities system shall be laid out and installed consistent throughout with the given slopes in the plans. Pipe joints and connections to area drains, catch basin, and

junction boxes shall possess such leak-proof and seepage-proof integrity achievable with the works called for under this particular section of theSpecifications.

b. Junction Boxes for storm & sanitary (sewer) drainage lines outside the building shall be cast-in-place reinforced concrete sections and pre-cast concretecover.

c. Trench excavation and backfilling shall be as specified in excavation, trenching and backfilling for utilitysystem.

d. Concrete DrainagePipe:

1. Material, Pipe shall be reinforced concrete pipe (300 mm IZI & larger) non-reinforced Concrete pipe 250 mm CI & smaller conforming to ASTMC14-75.

2.Installation

a. Bedding surfaces shall provide a firm foundation, carefully shaped true to line andgrade.

b. Concrete pipe shall be laid carefully with hubs upgrade and ends fully and closely joints. Joints shall be cement mortar. Cement mortar shall consist of one-part Portland Cement and 1-1/2 parts clean sharp sand with only enough water for workability. A gasket of closely twisted hemp or Oakum shall be placed around the pipe. The gasket shall be in the (1) piece of suitable diameter (not less than 19 mm and shall be lapped at the top. The gasket shall be saturated. With that cement before being placed and rammed. The joint shall be completely filled with cement mortar and rammed thoroughly with a wooden caulking tool.
The joint shall then be overfilled and finished to a smooth leveloutside.

12.02 EXCAVATION FOR STORM AND SANITARY (SEWER DRAINAGESYSTEM)

a. General. The Contractor shall do all excavation of whatever substances encountered below depth shown on drawings. Excavated materials not required for fill or backfill shall be removed from site as directed by the Engineer and disposed of by the Contractor. Excavation for accessories to have mm minimum and 60 mm maximum clearance in allside.
Excavation shall not carry below the required depth. Excess excavation below required level shall be backfilled at the Contractor's expense with earth, sand, gravel, or concrete, as directed by Engineer, and thoroughly tamped unstable soil shall be removed and replaced with gravel or crushed stone, which shall be thoroughlytamped.
The Engineer shall determine the depth of removal of unstable soil. Ground adjacent to all excavation shall be graded to prevent water running. The Contractor shall remove by pumping or other means approved by the Engineer any water accumulated in excavation and keep trench un-watered unit! the bedding incomplete.

b. Trench Excavation. Banks of trenches shall be vertical. Soft materials shall be reported to the Engineer. In rock, excavation shall be carried 200 mm below bottom of pipe. Loose earth or gravel shall be used for backfill, and tamped thoroughly and rounded to received pipe as above.

c. RockExcavation.Rockexcavationshallincluderemovalofboulderslarger than $1/2m^3$ in volume and ledge rock concrete or masonry structures that required drilling,melting.

d. Bracing and Shoring. The Contractor shall do all bracing sheathing and shoringnecessaryto performandprotectallexcavationasindicatedon the plans, as required for safety, as directed by the Architect, or to conform to governinglaws.

12.03 TESTING

a. Test: Test for workmanship on utility lines shall be conducted in accordance with the

applicable utility specification beforebackfilling.

13.04BACKFILLING

a. Backfilling: After pipes have been tested and approved, backfilling shall be done with approved material free for large clods orstones.

1. Trenches. Backfill material shall be placed evenly and carefully around and over pipe in 150 mm maximum layers. Each layer shall be thoroughly and carefully rammed until 300 mm of cover exists over pipe. The remainder of backfill material shall be placed, moistenedand compacted. Water settling will not be permitted in clay soils. It may be required at the option of the Engineer in sandysoils.

2. Trench under areas to be paved. Material shall be placed in 200 mm maximum layers after filling 300 mm above pipe as previously escribed. Each layer shall be compacted to density equal to that of adjacent original material so that pavement can be placedimmediately.

3. Structures:Allforms,trash,anddebrisshallberemovedandcleared away.Approvedbackfill materialmaybefromexcavationorborrow,it shall be free from rock, lumber of debris. Backfill material shall be placed symmetrically on all side in eight-inch maximum layers.Each layer shall be moistened and compacted with mechanical or hand tampers.Inareatobepaved, eachlayershallbecompactedtodensity equal to that of adjacent materials so that pavement can be placed immediately.

a. Maintenance. The Contractor shall refill for settlement all backfilledareas.

b.Clean-uptheContractorshallcleanupanddisposeofallexcessmaterials, trash, wood forms and otherdebris.

PART 13: TEST ANDDISINFECTION

13.01 DRAINAGE SYSTEMTEST

a.Theentiredrainageandventingsystemshallhaveallnecessaryopenings whichcanbeplugged topermittheentiresystemtobefilledwithwaterto thelevelofthehigheststackvent/orventstack abovetheroof.

b. Thesystemshallholdthiswaterforafullthirty(30)minutesduringwhich time there shall be no drop more than 100mm.

c. Each section of pipeline shall be slowly filled water and the specified test pressure, measured at the point of lowest elevation shall be applied by meansofsatisfactorytotheArchitect.Duringthe fillingofthepipeinand before applying the test pressure, all air shall be expelled from the pipe line. To accomplish this tap shall be made, if necessary, at point of highestelevation,andafter completionofthetestthetapsshallbetightly plugged unless otherwisespecified.

d. Duringthetest,allexposepipes,fittings,valvesjointsandcouplings will be carefully examined. If found to be cracked or defective, they shall be removedandreplacedbythecontractorwith soundmaterialsathisown expense. The test shall be repeated until satisfactory result has been obtained.

13.02 PRESSURE TESTS FOR WATERLINES

a. After the pipe have been installed, the joints completed and with joints exposed for examination, all newly installed pipe or any valve section shall be subjected to hydrostatic

pressure 1 1/2 thedesigned pressureofthesystemorasspecifiedbytheArchitect.

b. The duration of each pressure test shall be at least 10 minutes unless otherwise specified by the Architect.

c. Eachsectionofpipelineshallbeslowlyfilledwaterandthespecifiedtest pressure, measured at the point of lowest elevation, shall be applied by means of satisfactory to the Architects. During the filling of the pipe and before applying the test pressure, all air shall be expelled from the pipeline.Toaccomplish,thistapshallbemade,ifnecessary,atpointof highestelevation,and aftercompletionofthetestthetapsshallbetightly plugged unless otherwisespecified.
Duringthetest,allexposedpipes,fittings,valves,jointsandcouplingswill be carefully examined. If found to be cracked or defective, they shall be removed and replaced by the Contractor with sound materials at his expenses. The test shall then be repeated until satisfactory result has been obtained.

13.03 PRESSURE TEST FOR WATERLINES:

a. After the pipe have been installed, the joints completed and with joins exposed for examination, all newly installed pipe or any valve section, therefore, shall be subjected to hydrostatic pressure 1 1/2 the designed workingpressureofthesystemorasspecifiedbythe Architect.

b. The duration of each pressure test shall be at least 10 minutes unless otherwise specified by theArchitect.

c. Eachsectionofpipelineshallbeslowlyfilledwithwaterandthespecified testpressure, measuredatthepointoflowestelevation,shallbeapplied bymeansofapumplowestelevation, shallappliedbymeansofapump connectedtothepipeinamannersatisfactorytotheArchitect. Duringthe filling of the pipe and before applying the test pressure, all air shall be expelled from the pipeline. To accomplish this type shall be made, if necessary, at point of highest elevation, and after completion of the test thetapsshallbetightlypluggedunlessotherwisespecified. Duringthetest,allexposedpipes,fittings,valves,jointsandcouplingswill be carefully examined. If found to be cracked or defective, they shall be removed and replaced by the Contractor with sound materials at his expenses. The test shall then be repeated until satisfactory results are obtained.

13.04 DEFECTIVEWORK

a. If the inspection or test shows any defect, such defective work or material shallbereplaced andthetestshallberepeatedunlessuntilsatisfactoryto the Architect.

b. All repairs to piping shall be made with new materials at the expense of the contractor.

c. No caulking of screwed joints of holes will be accepted

13.05 DISINFECTION OF WATER DISTRIBUTION SYSTEM & WATER TANKS (as per AWWA C-601)

a. The entire water system shall be thoroughly flushed and disinfected with chlorine before it is place on operation. Water tanks shall be washed and swabbed.

b. Chlorination materials shall be liquid chlorine or hypochlorite, as specified and shall be introduced into water lines in a manner approved by the Engineer. Tank shall be thoroughly cleaned of all debris, dirt or dust before swabbing.

CIVIL WORKS SPECIFICATIONS

SECTION 01010
SUMMARY OF WORK

1.0 GENERAL

1.1 The works to be undertaken in this Contract includes the furnishing of all materials, labor, supervision, tools, equipment, all required permits, licenses, and other services necessary to complete the items of works in accordance with the plans, specifications and all related contract documents.

1.2 All applicable provisions of the different divisions of the Specifications shall apply to all items cited in this summary of work.

1.3 Omissions from the drawings or specifications or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications or which are customarily performed shall not relieve the Contractor from performing such omitted or misdescribed details of the work but shall be performed as if fully and correctly set forth and described in the Drawings and Specifications.

1.4 The Contractor shall be responsible for coordinating his work with the other Bid Package Contractors necessary to avoid conflicts and to ensure the satisfactory completion of the Project.

1.5 All works shall conform to the requirements of the applicable codes and standards specified in these specifications.

1.6 All works and materials shall conform to all local codes and regulations covering this installation.

1.7 The contractor shall be responsible for filing all documents, paying for all fees, and securing all permits, inspections and approvals necessary for conducting this work.

1.8 Preparation and submission of reproducible as-built drawings (hard copy & electronic file).

2.0 SPECIFICS

The different features of the work of this project are divided into different packages. They are as follows:

2.1 MOBILIZATION AND DEMOBILIZATION

The Contractor shall mobilize equipment and manpower in accordance or ahead of the approved equipment and manpower deployment schedule.

The Contractor shall not demobilize equipment without the approval of the Construction Manager.

Mobilization and demobilization cost shall be included in the bid cost.

2.2 TEMPORARY FACILITIES

The Contractor shall provide its temporary facilities complete with utilities at its own expense. This shall include but not limited to office, conference room, fabrication area, warehouse and office for the Owner's Representative. The Owner's Representative office shall be not less

than 20 sq. meters in floor area provided with four sets of tables and chairs, 3-drawer filing cabinet, air conditioning unit and plan rack.

The Contractor shall maintain the Temporary Facilities.

Upon completion of the project, the Contractor shall remove the temporary facilities and clean the area. Removal shall only start upon the approval of the Construction Manager.

2.3 All Other Infrastructures

Among the specific scope of work intended for a General Contractor are:

PART 1 - Roadways

This will consists of Portland Cement Concrete Pavement (PCCP), curb and gutters and sidewalks.

b.) Site Grading

c.) Drainage System

The Storm drainage system shall include drainage pipes, manholes, curb-inlets, drainage junction boxes, trenches, connection to existing lines/manholes, relocation of existing lines (where applicable) and all necessary appurtenances.

d.) Water Line Distribution System

e.) Slope protection

2.4 Other relevant miscellaneous works.

***** End of Section *****

SECTION 01100
SUBMITTALS

1.0 GENERAL

Wherever submittals are required hereunder, all such Contractor submittals shall be submitted to the Owner or any of his authorized representatives at the construction site for recording.

2.0 SHOP AND AS-BUILT DRAWINGS

Whenever called for in these specifications or on the drawing, or where required by the Owner, the Contractor shall furnish shop drawings for review and approval.

The Contractor shall prepare as-built drawings and submit same to the Owner within one (1) month after the completion of the work. As-built drawings shall show the actual revisions as installed at Site, incorporating all modifications carried out during the progress of the works.

3.0 SUBMITTAL OF PROPOSED EQUIVALENT PRODUCTS

All materials, processes, or equipment which are to be offered by the Contractor as equivalent to those indicated or specified in the Contract Documents shall be submitted within 30 calendar days after date of execution of the Contract to the Engineer for approval.

4.0 SAMPLES

Unless otherwise specified, whenever in the Specifications samples are required, the Contractor shall submit not less than two (2) samples of each such item or material to the Owner for approval at no additional cost to the Owner.

Samples, as required herein, shall be submitted for approval a minimum of seven (7) working days prior to ordering such material for delivery to the jobsite, and shall be submitted in an orderly sequence so that dependent materials or equipment can be assembled and reviewed without causing delays in the work.

All samples shall be individually and indelibly labeled or tagged, indicating thereon all specified physical characteristics and manufacturer's names for identification and submit to the Engineer for approval. Upon receiving approval, one (1) set of the samples will be stamped and dated by the Engineer and returned to the Contractor until completion of the work.

Unless otherwise specified, all colors and textures of specified items will be selected by the Engineer from the manufacturer's standard colors and standard product lines.

***** End of Section *****

SECTION 01200
VARIATIONS

PART 1 - GENERAL

Variations from contract requirements require Owner approval and will be considered where advantageous to the Owner. When proposing a variation, submit a written request to the Engineer with documentation of the nature and features of the variation and why the variation is desirable and beneficial to the Owner. If lower cost is a benefit, also include an estimate of the cost saving. Identify the proposed variation separately and include the documentation for the proposed variation along with the required submittal for the item. When submitting a variation for approval, the Contractor warrants the following:

1.1 Variation is Compatible

The Variation has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of the work.

1.1 Contractor is Responsible

The Contractor shall take actions and bear the additional costs, including review costs by the Owner, necessary due to the proposed variation.

PART 2 - REVIEW PERIOD IS MODIFIED

In addition to the normal submittal review period, a period of 15 working days will be allowed for consideration by the Owner of variations or submittals with variations.

***** End of Section *****

SECTION 01300
WARRANTIES

PART 3 - GENERAL

1.1 Related Documents

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 Summary

A. This Section includes administrative and procedural requirements for warranties required by the Contract Documents, including manufacturers standard warranties on products and special warranties. Refer to the General Conditions for terms of the Contractor's period for correction of the Work.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Submittals" specifies procedures for submitting warranties.
2. Division 1 through 16 Sections for specific requirements for warranties on products and installations specified to be warranted.
3. Certification and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

C. Disclaimer and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products. Manufacturer's disclaimers and limitations on product warranties do not relive suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

1.3 Definitions

A. Standard product warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

B. Special warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.4 Warranty Requirements

A. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.

B. Reinstatement of Warranty: When work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that work covered by a warranty has failed, replace or rebuild the work to an acceptable condition complying with requirements of the Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether the Owner has benefited from use of the work through a portion of its anticipated useful service life.

D. Owner's Recourse: Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, or remedies.

1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

E. Where the Contract Documents require a special warranty, or similar commitment on the work or part of the work, the Owner reserves the right to refuse to accept Work, until the contractor presents evidence that entities required to countersign such commitments are willing to do so.

1.5 Submittals

A. Submit written warranties to the Consultants prior to the date certified for Substantial Completion. If the Consultant's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Consultant.

1. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Consultant within 15days of completion of that designated portion of the Work.

B. When the Contract Documents require the Contractor, or the Contractor and a subcontractor, supplier or manufacturer to execute a special warranty, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner, through the Consultants, for approval prior to final execution.

C. Form of Submittal: A Final Completion compile 2 copies of each required warranty properly executed by the Contractor, of by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

D. Bind warranties and bonds in heavy-duty, commercial-quality, durable 3-ring, vinyl-covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by11-inch (115-by-280-mm) paper.

1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address, and telephone number of the Installer.
2. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project title or name, and name of the Contractor.
3. When warranted construction requires operation and maintenance manuals, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

***** End of Section *****

SECTION 02100
DEMOLITION AND REMOVAL

1.0 GENERAL

1.1 Scope

This section includes demolition and removal of existing work in the way of new construction.

1.2 References

a. The National Building Code of the Philippines

b. Department of Environmental and Natural Resources

1.3 General Requirements

Do not begin demolition until authorization is received from the Owner or Engineer. Remove rubbish and debris from the project site. Store materials that cannot be removed daily in areas specified by the Engineer.

1.4 Submittals

1.4.1 Demolition plan

Submit proposed demolition and removal procedures to the Engineer for approval before work is started. Include procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services, and a detailed description of methods and equipment to be used for each operation and of the sequence of operations.

1.5 Regulatory and Safety Requirements

Comply with local hauling and disposal regulations.

1.6 Dust and Debris Control

Prevent the spread of dust and debris and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, flooding, or pollution.

1.7 Protection

1.7.1 Traffic Control Signs

Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Anchor barricades in a manner to prevent displacement. Notify the Engineer prior to beginning such work.

1.7.2 Existing Work

Protect existing work which is to remain in place, be reused, or remain the property of the Owner. Repair items which are to remain and which are damaged during performance of the work to their original condition, or replace with new ones. Provide new supports and reinforcement for existing construction weakened by demolition or removal work. Repairs, reinforcement, or structural replacement must have Engineer's approval.

1.7.3 Weather Protection

For portions of a building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas so as to ensure effectiveness and to prevent displacement.

1.7.4 Trees

Comply with Department of Environment and Natural Resources (DENR) regulations for protection of natural resources.

1.7.5 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.

1.8 Burning

Burning will not be permitted. Where burning is permitted, adherence to local regulations shall be required.

1.9 Relocations

Perform the removal and reinstallation of relocated items as indicated. Repair items to be relocated which are damaged or replace damaged items with new undamaged items as approved by the Engineer.

2.0 MATERIAL REQUIREMENTS (Not Applicable)

3.0 CONSTRUCTION REQUIRMENTS

3.1 Existing Facilities To Be Removed

3.1.1 Structures

Remove indicated existing structures to grade to new finished grade.

3.1.2 Utilities and Related Equipment

Remove existing utilities as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Engineer. Remove meters and related equipment and deliver to a location in accordance with instructions of the Engineer. If utility lines are encountered that are not shown on drawings, contact the Engineer for further instructions.

3.1.3 Paving and Slabs

Remove concrete and asphaltic concrete paving and slabs as indicated. Provide neat sawcuts at limits of pavement removal as indicated.

3.2 Disposition of Material

3.2.1 Title to Materials

Except where specified in other sections, all materials and equipment removed, and not reused, shall become the property of the Contractor and shall be removed from Owner's property. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by the Engineer of the Contractor's demolition and removal procedures, and authorization by the Engineer to begin demolition.
The Owner will not be responsible for the condition or loss of, or damage to, such property after notice to proceed. Materials and equipment shall not be viewed by prospective purchasers or sold on the site.

3.2.2 Reuse of Materials and Equipment

Remove and store materials and equipment listed and indicated to be reused or relocated to prevent damage, and reinstall as the work progresses.

3.2.3 Salvaged Materials and Equipment

Remove materials and equipment that are indicated and specified to be removed by the Contractor and that are to remain the property of the Owner, and deliver to a storage site selected by the Engineer.

3.3 Cleanup

3.3.1 Debris and Rubbish

Remove and transport debris and rubbish in a manner that will prevent spillage on pavements, streets or adjacent areas. Clean up spillage from pavements, streets and adjacent areas.

***** End of Section *****

SECTION 02200
SITE PREPARATION

1.0 DESCRIPTION

This section shall consist of clearing, grubbing, removing and disposing of all vegetation and debris within the limits of the project site, including the borrow site, as designated in the Contract except those objects that are designated to remain in place or are to be removed in consonance with other provisions of this specification. The work shall also include the preservations from injury or defacement of all objects designated to remain.

2.0 CONSTRUCTION REQUIREMENTS

2.1 General

The Engineer will establish the limits of work and designate all trees, shrubs, plants and other things to remain if there are any.

2.2 Protection of Existing Utilities

Contact the Engineer 72 hours prior to construction for the location of all existing underground utilities. Movement of construction machinery and equipment over pipes and utilities during grading shall be at the Contractor's risk. For exposing a utility or other buried obstruction, use hand or light equipment for excavation. Start hand or light equipment stripping on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work as affected by the contract grading until approval for filling is granted by the Engineer. Report damage to utility lines or subsurface construction immediately to the Engineer. It will be the responsibility and expense of the Contractor to repair and restore the damage to its original state or even better.

2.3 Clearing and Grubbing

All surface objects and all trees, stumps, roots and other protruding obstructions, not designated to remain, shall be cleared and/or grubbed, including mowing as required, except as provided below:

a. Removal of undisturbed stumps and roots and non-perishable solid objects with a minimum of 900mm (36 inches) below natural ground surface.

b. Grubbing of pits, channel changes and ditches will be required only to the depth necessitated by the proposed excavation within such areas.

c. In areas outside of the grading limits of cut and embankment areas, stumps and non-perishable solid objects shall be cut off not more than 150mm (6 inches) above the ground line or low water level. However, trees in these areas shall not be cut or removed.

Except in areas to be excavated, stump holes and other holes from which obstructions are removed shall be backfilled with suitable material and compacted to the required density.

If perishable material is burned, it shall be burned under the constant care of competent watchman at such times and in such a manner that the surrounding vegetation, and other adjacent property or anything designated to remain within the limits of the property will not be jeopardized. If permitted, burning shall be done in accordance with applicable laws, ordinances and regulations.

Materials and debris which cannot be burned and perishable material may be disposed of by methods and at locations approved by the Engineer on or off the project site. If the disposal location is outside the project area, the Contractor shall make all necessary arrangements with the property owner or owners in writing for obtaining suitable disposal locations. The cost involved shall be included in the unit bid price. A copy of such agreement shall be furnished to Owner or Engineer.

2.4 Method of Measurement

The work to be paid shall be the number of square meters and fractions thereof acceptably cleared and grubbed within the limits indicated on the plans.

***** End of Section *****

SECTION 02300
SHORING/SHEETING/EXCAVATION SUPPORT SYSTEMS

1.0 GENERAL

This section shall include the use of shoring, sheeting, bracing and all the other excavation support system required during trench excavations for structures and pipes as specified and directed herein.

2.0 TECHNICAL REQUIREMENTS

2.1 General

The Contractor shall furnish, install and maintain such sheeting, shoring, bracing and other support system as may be required to support the sides of trench or structural excavations, to prevent any earth movement which could diminish the excavation width to below that necessary for construction, and to protect adjacent structures from damage. The Engineer may direct that additional trench supports be installed by the Contractor, at the Contractor's expense, should the existing supports be deemed insufficient. Provision of additional supports (or acceptance of existing supports) shall not relieve the Contractor of his sole responsibility for the provision of adequate support of excavations, especially for the protection of workmen.

2.2 Placement and Removal

Sheeting, shoring and bracing shall be placed to avoid the formation of voids outside of the excavation, but if voids are formed, they shall be immediately filled with compacted sand. The Contractor shall leave sheeting, shoring and bracing, in place to be embedded in the backfill if directed to do so by the Engineer. The Engineer may direct that sheeting and bracing be cut off at any specified elevation and left in place. The Contractor will be paid for sheeting left in place in accordance with the specifications. All sheeting not left in place shall be removed cautiously in the presence of the Engineer to prevent damage to the construction or nearby structures. Any voids formed by removal of sheeting shall be filled with structural fill or as directed by the Engineer. Wood sheeting shall not be withdrawn if driven below the spring line of a pipe, and any wood sheeting shall be cut off no lower than one foot above the top of any pipe.

2.3 Responsibility

Failure by the Engineer to direct that sheeting, shoring or bracing shall be left in place, will not relieve the Contractor of his responsibility for any damage caused by removal of sheeting, whether due to his negligence or not. The Contractor is fully responsible for providing a safe working condition for his and other employees working on the site.

***** End of Section *****

SECTION 02400
EARTHWORKS

1.0 GENERAL

1.1 Scope of Work

The Contractor shall perform all earthwork required for the proposed construction and ancillary facilities as specified and shown on the Contract Documents or as directed by the Engineer to result in a complete and functional facility.

Work in this section includes all surface and trench excavation for all structures and site utilities, bedding and backfilling of structures, roadways, and pipelines, construction of embankments, slope protection and stabilization and final site grading. Also included are the ancillary earthwork operations required for successful completion of the work, such as structural fill construction, protection of excavated surfaces during construction, runoff erosion control, construction dewatering, dust control, etc. Excavation of rock ripping, drilling or blasting is also part of the project earthwork requirements where necessary.

1.2 Earthwork Classifications

Earthwork is specified and shall be measured and paid for under the following classifications:

(a) Topsoil Stripping and Stockpiling
(b) Excavation - Common
(c) Excavation - Rock
(d) Trench Excavation - Common
(e) Trench Excavation - Rock
(f) Additional Excavation

(g) Embankment Construction
(h) Structural Fill
(i) Pipe Bedding and Trench Backfill
(j) Common Fill and Site Grading
(k) Sub-surface Drainage
(l) Slope and Bank Protection

1.3 Description of Work

Work in this section shall consist of all surface and trench excavation for lagoons, dams, structures, pipelines, and roads including topsoil removal, common excavation, rock excavation and slope preparation. Work specified herein also includes all common fill, structural fill, backfill, embankment construction, pipe bedding, trench backfill, and final grading, and rock excavation by ripping or blasting. This section includes provisions covering slope protection, slope drainage, foundation drainage and temporary protection of excavated surfaces during construction.

The work specified in this section shall include all labor, equipment, fuel, materials, borrow areas, stockpiling areas and spoil disposal areas required to meet the project requirements as delineated in the Contract Documents and as directed by the Engineer.

Materials excavated from the site may, under certain circumstances, be reused for backfill on the project. All materials proposed by the Contractor for reuse shall be approved by the Engineer based upon tests performed by acceptable testing agencies as specified herein and as dictated by standard practice.

The Contractor shall prepare and submit a program for stockpiling of both on-site and imported materials on the site or at other locations. The program shall identify those on-site areas required for stockpiling of materials and the Engineer will endeavor to make such locations available to the Contractor at no additional cost, except that the Contractor shall bear the cost of constructing all necessary temporary facilities such as access roads, drainage ditches, etc.

The Owner assumes no liability whatsoever if adequate on-site locations are not available, and must review and accept the Contractor's stockpiling program.

1.4 Submittals

The Contractor shall prepare the following submittals whenever applicable which for ease of understanding are listed below:

1.4.1 Submittals with Bid

The Contractor shall present with his bid a general program or schedule for civil works construction. The Contractor's bid shall be considered unresponsive without this program. The program shall address the scheduling of the various earthworks work elements and related equipment and manpower needs. The schedule submitted shall indicate the Contractor's ability to meet the project deadlines.

1.4.2 Submittals Prior to Construction

The Contractor shall submit to the Engineer the following information no less than thirty (30) days before earthwork operations begin:

(1) Detailed plans and schedules for all proposed excavation methods and sequences, including necessary site drainage and safety provisions.

(2) The sources, equipment and procedures proposed to obtain all necessary borrow material of the required quality, size and grading as specified herein for each class of backfill.

(3) Detailed plans and schedules for construction of each of the major structural fills and embankments to the lines, grades and tolerances required for the project and as shown on the Drawings.

(4) The Contractor shall also submit, together with excavation plans, detailed plans of proposed spoil areas and temporary stockpile areas to be approved by the Engineer. Volumes, material types, heights, grades and temporary and permanent drainage works shall be included in this submittal.

1.4.3 Submittals During Construction

(1) The Contractor shall notify the Owner in writing at least five (5) days in advance of any significant excavation, to enable him to verify all necessary elevations and cross-sections of the original ground surface. The Contractor shall clear any and all vegetation that may interfere with the quantity survey, in advance, and at his own expense.

(2) The Contractor shall submit to the Owner the results of all materials and compaction tests performed by or for him within a period of five (5) days, whether such tests are required by the specifications or not.

(3) The contractor shall submit monthly progress reports on project earthworks, to include estimated volumes (monthly and cumulative) of all classes of excavation and fill, together with accurate drawings of said work completed to date. Monthly reports shall be submitted ten (10) days after the end of the month reported on.

1.4.4 Approvals

The review and acceptance by the Owner through his Engineer of the Contractor's submittals on earthwork procedures, equipment and sequences shall not be interpreted as approval of said procedures, equipment and sequences, and shall not relieve him of full responsibility for the complete, proper and safe execution of the work.

1.5 Standard Specification References

ASTM D422	Standard Method for Particle-Size Analysis of Soils
ASTM D423	Standard Test Method for Liquid Limit of Soils
ASTM D424	Standard Test Method for Plastic Limit and Plasticity Index of Soils
ASTM D1140	Standard Test Method for Amount of Material in Soils Finer than the No. 200 (70mm) Sieve
ASTM D1556	Standard Test method for Density of Soil in Place by the Sand-Cone Method

ASTM D1557	Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop
ASTM D 698	Standard Test Method for Moisture-Density Relations of Soil and Soil Aggregate Mixtures Using 5.5-lb (2.49 kg) Rammer and 12-in. (305 mm) Drop
ASTM D1883	Standard Test Method for Bearing Ratio of Laboratory-Compacted Soils
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soil and Fine Aggregate
ASTM D2922	Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D3017	Standard Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D2487	Standard Test Method for Classification of Soils for Engineering Purposes
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM D1682	Standard Test Methods for Breaking Load and Elongation of Textile Fabrics
ASTM D1777	Standard Method for Measuring Thickness of Textile Materials

1.6 Definitions

1.6.1 Area Excavation

The most general class of excavation including earthmoving with dozers and grades, resulting in the general shaping of the site to meet design grades and the preparation of structural foundation sub-bases.

1.6.2 Trench Excavation

The excavation of trenches primarily for the installation of pipelines or ducts, in which the depth to width ratio of the excavation exceeds 1.0. Typically, trench excavation requires sheeting and bracing for safety and structural integrity.

1.6.3 Common Excavation

The removal of all soil materials not specifically defined as rock, by digging or ripping. The physical difference between rock and material removable by ripping is given elsewhere in this section.

1.6.4 Additional Excavation

Any excavation of any class not originally planned for, but performed at the specific direction of the Engineer. Additional excavation will be paid for at the respective Unit Prices listed in the Bid Form, and is different from over-excavation performed by the Contractor for his own reasons and at his own expense.

1.6.5 Structural Fill

The placement of selected, approved fill material in compacted lifts to support structural foundations by transmitting the applied load to undisturbed natural soils of suitable bearing capacity. The zone of influence of a structure is defined as starting at a distance of 1 meter outside a footing end, and sloping outward and downward at a 1:1 to undisturbed material.

1.6.6 Embankments

The placement of imported or approved on site fill material in lifts to form stable slopes as shown in the Drawings. Embankment construction includes slopes and subsurface drainage, also as shown in the Drawings.

1.6.7 Common Fill

All site fills not classified as structural, or trench fills, and generally employing approved on-site material.

1.6.8 Drainrock

A layer of graded, compacted crushed gravel to be placed under all large hydraulic structures for support and transmittal of water away from the structures to drains or outlets.

1.6.9 Pipe Bedding

A layer of sand or sandy soil placed and compacted to form a support surface into which pipe is laid.

1.6.10 Pipe Zone Backfill

The pipe zone starts at the top of the bedding layer or trench base if no bedding is used, and ends 300mm above the top of the pipe. All pipe zone backfill must be compacted structural fill material.

1.6.11 Trench Backfill

Trench backfill includes all materials placed above the pipe zone up to the top of trench. This material must be structural fill material below structures or roads, but may be common fill in other areas.

1.6.12 Subsurface Drainage

Includes piping, drain rock and related material designed to control and remove groundwater flow from the vicinity of foundations, embankments and other key facilities.

1.6.13 Topsoil

The top one (1) meter of undisturbed earth. Topsoil is the organic residual soil that must be removed in areas where structure, pipelines, roadways or fills are to be placed.

1.6.14 Impervious Material

A layer of compacted material used primarily to prevent water from percolating and saturating the embankment.

1.7 Compaction Tests

1.7.1 Test Reference

Where backfill is required to be compacted to a specified density, tests for compliance may be made by the Contractor using the test procedure specified in "Methods of Test for Moisture-Density Relations of Soils, using a 10-lb. Rammer and 18 in. Drop" (ASTM D1557) or using a 5.5 lb. Rammer and 12 in. Drop (ASTM D698). Field density tests shall be performed in accordance with the test procedure specified in "Method for Test for Density of Soil in Place by the Sand-Cone Method" (ASTM D1556), however, up to 50 percent of the in-place density readings may be made using a properly calibrated nuclear density meter as specified in "Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)" (ASTM 2922-81).

1.7.2 Test Locations and Frequencies

The location and frequency of field compaction tests shall be at the discretion of Engineer. The Contractor shall give the Engineer advance notice of the need to perform compaction tests on a compacted lift, and allow sufficient time to perform the necessary tests before attempting to place any new fill material. Should the Contractor place fill over an untested layer, that layer shall be considered as sub-standard and subject to the provisions given below for sub-standard compaction.

1.7.3 Test Failure

Any layer or portion thereof that does not meet minimum density requirements, as determined by the Engineer, shall be reworked and recompacted until it meets the specified density requirements. The costs of performing the additional density tests necessitated thereby shall be borne by the Contractor. In the event that adequate compaction of a lift cannot be obtained after a reasonable amount of time, even after recompaction and retesting, the lift shall be removed and replaced with suitable material.

1.7.4 Adverse Weather Condition

If weather conditions beyond the Contractor's control create a need to retest a lift already in place and accepted, then such testing will be at the expense of the Owner. This shall not apply in cases where the Contractor has been pre-warned by the Engineer to protect a fill against anticipated adverse conditions and he has failed to properly institute adequate protective measures.

1.8 Lines and Grades

1.8.1 Requirements

All excavations and engineered fills shall be constructed to the lines, grades and dimensions shown on the drawings or as directed by the Engineer.

1.8.2 Modifications

The Engineer may modify lines, grades or dimensions at any time prior to or during construction and the Contractor shall not be entitled to any adjustment in his Unit Prices or to any costs as a result of such changes other than those cost changes derived from modified quantities.

1.10.4 Adverse Conditions

The Engineer reserves the right to suspend or limit earthwork operations during periods of extended adverse weather conditions, and the Contractor shall have no basis for claiming such as reason for delays or extra payments. It is expressly understood that the job site is located in an area subject to yearly periods of heavy tropical rainfall. the Contractor shall schedule his earthwork taking into account of this wet season.

1.11 General Measurement and Provisions

Measurement of payment of any class of earthwork specified herein shall be based on the in-situ volume in cubic meter as measured from a survey made prior to any excavation or fill work and the lines and grades shown on the drawings or established on the site as directed by the Engineer.

Payment shall be made at the Unit Prices entered in the Schedule of Prices, which shall include the following whichever are applicable:

a. The cost of all labor, equipment and materials involved in excavation, including drilling, blasting, ripping or excavating by other means and in construction of fills and slope protection.

b. Obtaining all necessary permits and licenses for the use of explosives or any other materials and equipment.

c. Trimming of excavated surfaces by machine or by hand.

d. Any sheeting and bracing necessary to support sides of excavations.

e. Transporting materials to stockpile, spoil, or point of incorporation into permanent works.

f. Rehandling of materials.

g. Clearing, preparation and formation of stockpiles of materials suitable for use in embankment construction or as backfill.

h. All necessary drainage works to keep excavation free of standing water.

i. Clearing, preparation and formation of spoil areas for unsuitable or surplus materials, including trimming and leveling to lines and grades, and surface drainage.

j. The costs of obtaining off-site spoil disposal areas and the costs of transporting excess materials thereto.

k. The cost of material tests or retests above those provided by the Engineer.

2.0 EXECUTION

2.1 Topsoil Stripping and Stockpiling

2.1.1 Definition

This work consists of stripping of topsoil to a depth 0.30 meters below the existing ground areas, hauling said topsoil to a designated local stock fill site, and protecting topsoil prior to its reuse under landscaping and final grading.

2.1.2 Technical Requirements

The Contractor shall employ sufficient care and supervision and shall use proper equipment to insure that top-soil stripped does not go below the required depth unless otherwise necessary and directed by the Engineer. Topsoil shall be stockpiled in a separate area from other soil material, and shall be protected by heavy plastic if left in place during wet weather. Topsoil may be reused for landscaping and final grading purposes but first be approved by the Owner. Under no circumstances shall topsoil be reused below structures, piping or roadways. Any topsoil remaining after all work is complete is the property of the Owner and shall be disposed of by the Contractor as directed.

2.2 Area Excavation - Common

2.2.1 Description

a. The work described herein consists of all common excavation; hauling and stockpiling required preparing the site for construction of structures, roads, embankments, excepting rock excavation and trench excavation.

b. Excavation work includes all construction drainage, dewatering, sheeting and bracing and sediment control work required to complete the work as shown on the drawings, as specified herein, and as directed by the Engineer and all other area excavation by whatever means shall be classified as common. Common excavation includes excavation by ripping.

c. The work includes all incidental excavation related to temporary site facilities such as site access roads, office buildings, camp sites, construction plants, etc. which are not part of the permanent work. Disposal of excess or rejected unsatisfactory soils from the excavation is included in the work.

2.2.2 Technical Requirements

a. This category of excavation includes, but is not restricted to, earth, gravel, hard and compact material such as cemented gravel, and soft or disintegrated rock of such hardness and texture that it can be removed without blasting, by using a bulldozer developing 425 bhp of continuous power, with or without ripping. This criterion shall also apply (except for trench excavation) irrespective of the type or capacity of plant actually used for the excavation, or whether use of a 425 bhp bulldozer is practical or convenient. Trimming of slopes shall be included. If necessary, excavations shall be sheeted and braced.

b. The Contractor shall at all times during construction maintain a proper ditching, pumping and dewatering and shall keep all excavations as dry as possible.

c. Excavation for structures shall progress in uniform horizontal layers, with extreme caution exercised as the face of the excavation approaches the line and grade of the foundation base shown in the drawing. The Contractor shall notify the Engineer promptly of any rock encountered or when the excavation is within 500mm of the final cut surface or foundation elevation. Excavation equipment shall be of a size and type suitable for carrying out the work as specified. During final excavation to subgrade level, the Contractor shall take whatever precautions are necessary to prevent disturbance and remolding of the subgrade. In load bearing soil (i.e., soil

under structures, pipelines and roadways), final excavation to subgrade shall be by hand or by using light weight machines with smooth edge buckets. Load bearing soil which has been softened and disturbed by mixture with water due to the Contractor's actions shall be removed to solid ground and replaced with structural or lean concrete at his expense.

d. Should the subgrade be properly reached on the final stage of excavation and found to be unsatisfactory for the support of the structures, then such material shall be over-excavated and properly replaced with structural fill. The Contractor shall be paid for such excavation and fill in accordance with the Unit Prices for those items as discussed.

e. After the required excavation under buildings has been completed, the exposed surface shall be scarified to a depth of 150mm, brought to optimum moisture content, and rolled to achieve a compaction of 95 percent of maximum density as measured by the Modified Proctor Test (ASTM D1557).

f. Excavations for all hydraulic structures shall proceed to the base of the drain-rock layer, after which the top 150mm of soil shall be scarified and brought to optimum moisture content, following which it shall be compacted to 95 percent of maximum density as measured by the Modified Proctor Test (ASTM D1557).

g. Excavations in roadways or in areas to be paved with concrete shall be extended to the bottom of the aggregate base, if such base is called for; otherwise it shall extend to the bottom of the pavement. After the required excavation has been completed, the exposed surface shall be scarified to a depth of 150mm, brought to optimum moisture content, and rolled with heavy compaction equipment to 95 percent of maximum density as measured by the Modified Proctor Test (ASTM D1557).

2.3 Area Excavation - Rock (Only Where Applicable)

2.3.1 Scope of Work

The work described herein consists of rock excavation by blasting including all solid rock in place which cannot be removed until loosened by blasting, barring or wedging and all boulders or detached pieces of solid rock which cannot be removed. Solid rock under this definition, as distinguished from soft or disintegrated rock as defined earlier which the Contractor chooses to blast before removal, is defined as sound rock of such hardness and texture that it cannot be loosened or ripped by a bulldozer capable of developing 425 bhp of continuous power equipped with a single shank ripper. Determination of the delineation line between rock excavation and common excavation shall be made by the Engineer.

2.3.2 Technical Requirements

(a) Material which in the opinion of the Contractor can be removed only by blasting, shall be exposed. No blasting shall be carried out without the approval in writing of the Engineer.

(b) Before blasting proceeds, the top surface of the rock shall be surveyed by the Contractor, and the survey results to be agreed to by the Engineer. Lines shown on the Geotechnical Drawings in the Information for Bidders Volume of the Specifications delineating sound rock and weathered rock are approximate only and shall not be used for measurement purposes.

2.4 Trench Excavation - Common

2.4.1 General

The work described herein consists of excavation of any material, except rock material as defined in this section, within small or restricted areas where the width of excavation is less than or equal to the pipe diameter plus 0.6 meters, and the depth to width ratio is equal to or greater than 1.0. Where a pipe is to be installed in a location that is to be subject to area excavation or fills, trench excavation is to be measured from the finished ground surface (for areas in cuts) or from 500mm above the top of the pipe (for areas in fills). The work includes loading, hauling, disposal of excess material, sheeting and bracing not left in place and dewatering of the trench. Where more than one pipe is to be laid in a trench, the trench width shall be calculated providing 250mm clearances between the outside wall of the outer pipes and the walls of the trench.

2.4.2 Execution

a. This category of excavation includes, but is not restricted to earth, gravel, hard and compact materials such as cemented gravel, and soft or disintegrated rock of such hardness and texture that could be removed without blasting, by using a backhoe developing 150 bhp of continuous power without ripping. This criterion shall apply irrespective of the type or capacity of backhoe actually used for the excavation.

b. All excavations shall be sheeted and braced to meet the requirements of the specification where necessary.

c. The Contractor shall at all times during construction maintain proper ditching, pumping and dewatering to meet the requirements of the specifications and shall keep all excavations as dry as possible.

d. Trench excavation for pipes and ducts shall proceed to the lines and grades shown on the drawings. The bottom 200mm measured up from the pipe invert elevation shall be excavated by hand rather than by machine, and shall be carefully brought to the proper slopes. The base of the trench shall be carefully worked to remove any rocks or stones that might contact the pipe.

e. The Contractor shall over-excavate by hand beneath the pipe to a depth of 150mm and replace the excavated material with gravel bedding material as specified. The gravel bedding material shall be compacted to 95 percent of maximum density at optimum moisture content as measured by the Standard Proctor Test (ASTM D 698). Such over-excavation and replacement with gravel bedding may be omitted if directed and approved by the Engineer.

f. Where pipes or ducts are to be laid in fills, the fill shall be constructed to a depth of at least 500mm above the top of the pipe or duct before the pipe trench is excavated into the fill. Payment shall be based on this depth of trench.

g. The trench bottom shall receive a final smoothing using a string line or laser instrument, such that each pipe when first laid will be in continuous contact with the ground along the extreme bottom of the pipe. Rounding out of the trench bottom is not required. Bell holes may be hand excavated at the Contractor's expense.

h. When directed by the Engineer, pipe and duct trenches may be over-excavated beyond a depth of 150mm. Such over-excavation shall be to the depth ordered. The trench shall be refilled to the grade of the bottom of the pipe with gravel material and compacted to 95 percent of maximum density at optimum moisture content as measured by the Standard Proctor Test (ASTM D 698). Such over-excavation and replacement with pipe trench, bedding material shall be paid for under the appropriate Unit Price bid items.

1.8.3 Construction Surveys

The Contractor shall be responsible for properly setting out all the structures and slopes, in accordance with these specifications. All extra work and over-excavation caused by the Contractor's negligence in setting out shall be at his expense, and shall be corrected immediately.

1.8.4 Over-Excavation

The Contractor shall use care, and the most appropriate methods of excavation, to avoid carrying excavation beyond the lines and grades shown on the drawings, or of loosening of material or the breaking of rock outside of the excavation limits. If for any reason, excavation or disturbance is carried beyond the lines and grades shown in the drawings, the Contractor shall, at his own expense, remove the excess material and take the necessary measure to restore the required lines and grades with approved fill material or concrete. Should the Contractor wish to excavate beyond the limits given in the drawings, he may only do so after obtaining prior permission from the Engineer. Such excavation and any backfilling with approved materials shall be at the Contractor's expense.

1.9 Disposal of Excess Material

The Contractor shall remove from the site and dispose all excess excavated material at his own expense. The location of the spoil disposal areas shall meet all legal requirements at no extra costs.

1.10 Construction Dewatering

1.10.1 General

The Contractor shall maintain at all times during construction proper equipment, manpower and facilities to prevent water from entering excavations and to remove any water from excavations, and shall keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the fills, structures or pipes to be built thereon have been completed.

1.10.2 Objective

Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the sub-grade soils at the proposed bottom of excavation. The Contractor shall prevent floatation of structures or pipelines by maintaining a positive and continuous removal of water. The Contractor shall also take any other precautions necessary to prevent uplift during construction.

1.10.3 Responsibility

The Contractor is responsible for developing the plans and provisions for control of water at the construction site. The Contractor to the Engineer for review shall submit a proposed drainage control program ten (10) days in advance of associated construction activities. The Contractor shall be solely responsible for the adequacy and implementation of the said program. The Contractor shall be fully responsible and liable for all damages, which may result from failure to adequately keep excavations dewatered. Such damages may include over excavation and structural backfilling or placement of lean concrete should the bearing capacity of the undisturbed foundation surfaces be reduced by the action of uncontrolled water. The nature of such corrective measures shall be determined by the Engineer and shall be at the expense of the Contractor. The Engineer shall determine if damages to the bearing capacity of foundation level soils are due to the actions of the Contractor, but may require the use of lean concrete as backfill material irrespective of responsibility. If the use of structural fill or lean concrete is not due to the Contractor's actions, then such materials shall be paid for under the Unit Prices of those items.

2.5 Trench Excavation - Rock (Only Where Applicable)

2.5.1 Scope of Work

The work described herein consists of rock excavation by controlled blasting, or other approved methods in trenches, including removal of large boulders which cannot be removed as specified in Section 02200 paragraph 2.4. Solid rock under this definition is distinguished from soft or disintegrated rock which the Contractor chooses to blast before removal for his own convenience. Determination of the delineation line between rock excavation and trench excavation shall be made by the Engineer.

2.5.2 Technical Requirements

a. Rock excavation by blasting or other approved methods shall meet all of the technical specifications outlines in paragraph 2.3 of this section. Trench support and drainage, and all other requirements for trench excavation specified shall be conformed to.

b. The Engineer shall be notified immediately when rock is encountered in a trench excavation. No blasting shall be allowed until the Engineer issues a written approval on the basis of a blasting plan submitted by the Contractor. The volume of rock shall be determined by survey after the rock surface has been exposed.

c. In all cases where rock is excavated from a pipe trench, the trench shall be over-excavated by a minimum of 200mm, and backfilled with gravel material conforming to Section 02200, paragraph 2.10. In no case shall a pipe barrel or bell be permitted to rest directly on rock.

2.6 Additional Excavation

2.6.1 Scope of Work

The work described herein is any excavation ordered by the Engineer during the course of the work subsequent to completion of specified construction work in a particular area, or in addition to planned excavation work. Such excavation is defined as additional excavation.

2.6.2 Technical Requirements

Additional excavation may consist of excavation described in the different Sub-section 2.2, 2.3, 2.4, 2.5. the differentiation between common and rock excavation shall be made by the Engineer.

2.7 Embankment

2.7.1 Description

This item shall consist of the construction of embankment in accordance with this specification and in conformity with the lines, grades, and dimensions shown on the Plans or established by the Engineer.

1.1.1 Material Requirements

Embankment shall be constructed of suitable materials, in consonance with the following definitions:

PART 2 - Suitable Material – Material which is acceptable in accordance with the contract and which can be compacted in the manner specified in this item. It can be common material, unless under

structural fill shall be used..

Selected Borrow, for topping – soil of such gradation that all particles will pass a sieve with 75 mm. (3 inches) square openings and not more than 15 mass percent will pass the 0.075 mm (No. 200) sieve, as determined by AASHTO T 11. The material shall have a plasticity index of not more than 6 as determined by AASHTO T 90 and a liquid limit of not more than 30 as determined by AASHTO T 89.

PART 3 - Unsuitable Material – Material other than suitable material such as:

PART 4 - Materials containing detrimental quantities of organic material, such as grass, roots and sewage.
PART 5 - Highly organic soils such as peat and muck.
PART 6 - Soils with liquid limit exceeding 80 and/or plasticity index exceeding 55.
PART 7 - Soils with a natural water content exceeding 100%.
PART 8 - Soils with very low natural density, 800 kg/m^3 or lower.
PART 9 - Soils that cannot be properly compacted as determined by the Engineer.

1.1.2 Construction Requirement

1.1.2.1 General

Prior to construction of embankment, all necessary clearing and grubbing in that area shall have been performed in conformity with Section 02100 Subsection 2.3, Clearing and Grubbing.

Embankment construction shall consist of constructing roadway embankments, including preparation of the areas upon which they are to be placed; the construction of dikes within or adjacent to the roadway; the placing and compacting of approve material within roadway areas where unsuitable material has been removed; and the placing and compacting of embankment material in holes, pits, and other depressions within the roadway area.

Embankments and backfills shall contain no muck, peat, sod, roots or other deleterious matter. Rocks, broken concrete or other solid, bulky materials shall not be placed in embankment areas where piling is to be placed or driven.

Where shown on the plans or directed by the Engineer, the surface of the existing ground shall be compacted to a depth of 150 mm (6 inches) and to the specified requirements of this item.

Where provided on the plans and Bill of Quantities the top portions of the roadbed in both cuts and embankments, as indicated, shall consist of selected borrow for topping from excavations.

1.1.2.2 Methods of Construction

When there is evidence of discrepancies on the actual elevations and that shown on the Plans, a preconstruction survey referred to the datum plane used in the approved plan shall be undertaken by the contractor under the control of the Engineer to serve as basis for the computation of the actual volume of the embankment materials.

When embankment is to be placed and compacted on hillsides, or when new embankment is to be constructed against existing embankments, or when embankment is built one-half width at a time, the existing slopes that are steeper than 3:1 when measured at right angles to the roadway shall be continuously benched over those areas as the work is brought up in layers. Benching will be subject to

Dumping and rolling areas shall be kept separate, and no lift shall be covered by another until compaction complies with the requirements of Subsection 2.7.3.3.

Hauling and leveling equipment shall be so routed and distributed over each layer of the fill in such a manner as to make use of compaction effort afforded thereby and to minimize rutting and uneven compaction.

1.1.2.3 Compaction

Compaction Trials.

Before commencing the formation of embankments, the Contractor shall submit in writing to the Engineer for approval his proposal for the compaction of each type of fill material to be used in the Works. The proposal shall include the relationship between the types of compaction equipment, and the number of passes required and the method of adjusting moisture content. The Contractor shall carry out full of compaction trials on areas not less than 10 m wide and 50 m long as required by the Engineer and using his proposed procedures or such amendments thereto as may be found necessary to satisfy the Engineer that all the specified requirements regarding compaction can be consistently achieved. Compaction trials with the main types of fill material to be sued in the Works shall be completed before work with the corresponding materials will be allowed to commence.
Throughout the periods when compaction of earthwork is in progress, the Contractor shall adhere to the compaction procedures found form compaction trials for each type of material being compacted, each type of compaction equipment employed and each degree of compaction specified.

Earth

The Contractor shall compact the material placed in all embankment layers and the material scarified to the designated depth below subgrade in cut section, until a uniform density of not less than 95 mass percent of the maximum using Standard Proctor Test (ASTM D 698 or AASHTO T 99) Method C, is attained, at a moisture content determined by the Engineer to be suitable for such density.

The Engineer shall during progress of the Work, make density tests of compacted material in accordance with AASHTO T 191, T 205, or other approved field density tests, including the sue of properly calibrated nuclear testing devices. A correction for coarse particles may be made in accordance with AASHTO T 224. If, by such tests, the Engineer determines that the specified density and moisture conditions have not been attained, the Contractor shall perform additional work as may be necessary to attain the specified conditions.

At least one group of three in-situ density tests shall be carried out for each 500 m^2 of each layer of compacted fill.

Rock

Density requirements will not apply to portions of embankments constructed of materials which cannot be tested in accordance with approved methods.

Embankment materials classified as rock shall be deposited, spread and leveled the full width of the fill with sufficient earth or other fine material so deposited to fill the interstices to produce a dense compact embankment. In addition, one of the rollers, vibrators, or compactors approved by the Engineer, shall compact the embankment full width.

1.1.2.4 Protection of Roadbed During Construction

During the construction of the roadway, the roadbed shall be maintained in such condition that it will be well drained at all times. Side ditches or gutters emptying from cuts to embankments or otherwise shall be so constructed as to avoid damage to embankments by erosion.

1.1.2.5 Protection of Structures

If embankment can be deposited on one side only of abutments, wing walls, piers or culvert headwalls, care shall be taken that the area immediately adjacent to the structure is not compacted to the extent that it will cause overturning of, or excessive pressure against the structure. When noted on the Plans, the fill adjacent to the end bent until the superstructure is in place. When embankment is to be placed on both sides of a concrete wall or box type structure, operations shall be so conducted that the embankment is always at approximately the same elevation on both sides of the structure.

1.1.2.6 Rounding and Warping Slopes

Rounding – Except in solid rock, the tops and bottoms of all slopes, including the lopes of drainage ditches, shall be rounded as indicated on the Plans. A layer of earth overlaying rock shall be rounded above the rock as done in earth slopes.

Warping - Adjustments in slopes shall be made to avoid injury in standing trees or marring of weathered rock, or to harmonize with existing landscape features, and the transition to such adjusted slopes shall be gradual. At intersections of cuts and fills, slopes shall be adjusted and warped to flow into each other or into the natural ground surfaces without noticeable break.

1.1.2.7 Finishing Roadbed and Slopes

After the roadbed has been substantially completed, the full width shall be conditioned by removing any soft or other unsuitable material that will not compact properly or serve the intended purpose. The resulting areas and all other low sections, holes or depression shall be brought to grade with suitable selected material. Scarifying, blading, dragging, rolling or other methods of work shall be performed or used as necessary to provide a thoroughly compacted roadbed shaped to the grades and cross-sections shown on the plans or as staked by the Engineer.

All earth slopes shall be left with roughened surfaces but shall be reasonably uniform, without any noticeable break, and in reasonably close conformity with the Plans or other surfaces indicated on the Plans, or as staked by the Engineer, with no variations therefrom readily discernible as viewed form the road.

1.1.2.8 Serrated Slopes

Cut slopes in reparable material (soft rock) having slope ratios between 0.75:1 and 2:1 shall be constructed so that the final slope line shall consist of a series of small horizontal steps. The step rise and tread dimensions shall be shown on the plans. No scaling shall be performed on the stepped slopes except for removal of large rocks which will obviously be a safety hazard if they fall into the ditchline or roadway.

1.1.2.9 Earth Berms

When called for in the Contract, permanent earth berms shall be constructed of well graded materials with no rocks having a diameter greater than 0.25 the height of the berm. When local material is not acceptable, acceptable material shall be imported, as directed by the Engineer.

Compacted Berms

Compacted berm construction shall consist of moistening or drying and placing material as necessary in locations shown on the drawings or as established by the engineer. Material shall contain no frozen material, roots, sod, or other deleterious materials. Contractor shall take precautions to prevent material for escaping over the embankment slope. Shoulder surface beneath berm will be roughened to provide a bond between the berm and shoulder when completed. The Contractor shall compact the material placed until at least 90 mass percent of the maximum density is obtained as determined by AASHTO T 99, Method C. The cross-section of the finished compacted berm shall reasonably conform to the typical cross-section as shown on the Plans.

Uncompacted Berms

Uncompacted berm construction shall consist of drying, if necessary, and placing material in locations shown on the Plans or as established by the Engineer. Material shall contain no frozen material, roots, sod or other deleterious materials. Contractor shall take precautions to prevent material form escaping over the embankment slope.

2.8 Structural Fill

2.8.1 Scope of Work

Structural fills shall include but not be limited to all fills designed to support buildings, hydraulic structures, and channels. In addition, structural fills may be required to support pipelines in certain areas as shown on the drawings, or as directed by the Engineer. Structural fills shall be furnished as specified where existing materials encountered at bearing elevations are found to be unsuitable then the Contractor is directed to replace them, or where the drawings show foundation elevations set above the grade of soils with satisfactory bearing capacity, or as directed by the Engineer. Structural fill shall be used below structures having underdrains where shown on the Drawings.

2.8.2 Technical Requirements

a. Structural fills shall be carried down to undisturbed earth having adequate bearing capacity as determined by the Engineer. Compacted structural fill shall be constructed beneath foundations laterally outward to the limits defined by a 1:1 sloped outward and downward from a point located at least one (1.0) meter to the exterior of the bottom edge of all foundations and carried downward at that slope to suitable undisturbed earth.

b. Structural fill shall be well graded and non-plastic materials. Before any structural fill is paved over the existing ground surface, the ground shall be cleared and grubbed and the topsoil shall be stripped in accordance with these specifications. Structural fill particles shall be sound and not more than five percent (5%) shall pass the No. 200 sieve, nor more than fifty percent (50%) the No. 40 sieve. The material shall be free from organic matter, clay lumps, or other deleterious materials. The maximum particle size shall not exceed seventy-five percent (75%) of the lift thickness.

c. A sieve analysis of the proposed structural fill material shall be submitted for review and approval by the Engineer at least 30 days before the first use of the material. In addition, samples of structural fill shall be submitted to the Engineer for sieve analysis for each 2,500 cubic meter of structural fill placed, or whenever the source or quality of fill material is varied. The Engineer shall have the right to reject structural fill material at any time.

d. As specified in the paragraph for Area Excavation-Common, the bearing surface in areas of structural excavations shall be scarified to a depth of 150mm below the drainrock base, and recompacted to at least ninety-five percent (95%) of Modified Proctor maximum density, after the soil is brought to near the optimum moisture content. If in-place densities are not adequate, the Engineer will require additional rolling and/or modification of soil moisture content until satisfactory results are obtained. Rolling shall be by pneumatic tire rollers or smooth drum vibratory rollers of capacities per instructions from the Engineer.

e. Structural fill layers shall be placed in lifts of 200mm in depth after compaction. Fill material shall be approved by the Engineer and hauled to the fill and tipped directly on the fill lift being placed. No material shall be dozed from any bench or layer to a lower bench or layer. Material shall be spread on each layer by graders or dozers.

f. Each lift shall be brought to near optimum moisture-content prior to compaction. No compaction of completely dry material shall be permitted. Each lift shall be compacted to ninety-five percent (95%) of Modified Proctor optimum density using pneumatic tire rollers or smooth drum vibratory rollers of capacities approved in advance by the Engineer. Should any test reveal inadequate compaction of a structural fill layer, then the entire layer shall receive at least one additional complete pass of the roller. A complete pass shall include a single coverage of the entire layer including twenty percent (20%) overlap of drum width. If after a reasonable amount of recompaction is completed, and satisfactory results have not been obtained, then the Contractor shall remove the lift and replace it with satisfactory material. Care shall be taken to avoid contamination of structural fill with other materials.

The Contractor shall be required to replace any such contaminated structural fill layers at his own expense.

g. The minimum number of passes per lift is two, after which the Engineer may conduct whatever test work it deems necessary to determine the degree of compaction obtained. Additional passes of the roller shall be required until adequate results are obtained. Retesting of compaction shall be at the Contractor's expense.

h. In areas inaccessible to large rollers, hand-held tampers may be used to obtain adequate compaction, but use of hand-held equipment must be approved in advance by the Engineer.

i. Structural fill shall be brought up to the required grade in lifts of equal compacted depth. Each lift shall meet the requirements of this Section.

2.9 Pipe Bedding and Trench Backfill

2.9.1 Scope of Work

As specified, buried pipe may be laid directly on the prepared trench bottom as shown on the drawings. Alternatively, the Engineer at its option may require that the trench be over-excavated by 150mm and replaced with gravel bedding material. Payment shall be made for over-excavation and replacement bedding when such over-excavation and replacement bedding is directed by the Engineer and carried out to the depths and lengths as required.

2.9.2 Technical Requirements

a. Bedding material shall consist of sand or selected sandy soil, and shall be free of loam, clay, and deleterious materials.

b. Bedding shall be brought to optimum moisture content and shall be compacted using hand-held tampers to ninety-five percent (95%) of Standard Proctor density.

c. Trench backfill to a depth of 300mm over the top of the pipe shall use clean sand/sandy gravel as specified for structural fill. Trench backfill shall be subject to material and compaction testing and acceptance or rejection by the Engineer.

d. Trench backfill shall be placed in 100mm layers uniformly on each side of the pipe, and then compacted by hand-held tampers to ninety-five percent (95%) of Standard Proctor maximum density. Extreme care shall be used to avoid damaging the pipe during compaction. Such layered compaction shall continue to a depth of 300mm over the top of the pipe. This is defined as the pipe zone. If the pipe is located under or within the zone of influence of a structure or under roadways, then the backfill above the pipe zone shall be the same material used in the pipe zone and shall be compacted to ninety-five percent (95%) of Modified Proctor maximum density in 200mm lifts until the backfill reaches the foundation, roadway base or leaves the zone of influence of the structure. The zone of influence is defined as starting at a horizontal distance of 1.0 meter outside of the foundation's bottom outside edge, and extending outward laterally in a downward direction at a 1:1 slope.

e. In areas away from structures and/or roadways or their zone of influence as defined in this section, backfill above the pipe zone shall be common fill compacted to ninety-five percent (95%) of Standard Proctor maximum density in 200mm lifts.

f. Water settling by flooding and jetting of pipe trench backfill material shall not be permitted, unless otherwise approved by the Engineer.

g. In no case shall backfill material be end-tipped directly from a truck into a pipe trench. All backfill material shall be tipped at the trench edge and then transferred to the trench by hand or with small capacity frontment loaders. All due care shall be taken to insure that displacement of the pipe or damage thereto does not occur. If damaged or displaced, repair shall be made promptly as directed by the Engineer and at the Contractor's expense.

h. Backfilling of pipes shall begin as soon as practical after the pipe has been laid, jointed and inspected, except that backfilling must be coordinated with testing as specified.

i. Clean sand shall be used for bedding and backfill in the pipe zone for any pipe not concrete encased and having a coal-tar enamel coating for corrosion protection.

j. Concrete encased pipe shall be covered with moist earth for curing within 24 hours after concrete placement, but only after the concrete has developed sufficient strength to resist any deformation. The curing time for the concrete encasement shall be a minimum of 28 days. No earth load shall be placed on the encasement until the 28 day period has elapsed.

k. Where specifically shown on the Drawings or as directed by the Engineer, the pipe shall be backfilled with sand cement in the pipe zone as defined in this section. Sand cement for pipe backfill shall consist of a mixture of graded fine aggregate and Portland Cement, Type I or II as specified in Division 03, Concrete. The minimum cement content shall be 100 kg/cu.m. The sand cement and water shall be proportioned so as to yield a minimum compressive strength of 7 MPa after seven (7) days as determined on two comparison cylinders taken twice during each shift. Material poured into test cylinders shall not be tamped or vibrated. Forty-eight hours after being made, cylinders shall be totally immersed in water, and shall be removed from water twenty-four (24) hours before testing and allowed to drain and air dry. The average diameter of

the cylinders used for calculating the cross-sectional area shall be determined before the cylinders are immersed in water. Cylinders shall otherwise be tested in accordance with ASTM C39. Sand cement shall be thoroughly mixed using the minimum quantity of water required to yield a fluid, readily pumpable, mixture. Sand cement shall be placed in uniform lifts not exceeding a depth of 150mm on each side of the pipe in such a manner that any movement of floating of the pipe is precluded and no voids are formed. The presence of dirt clumps, or other extraneous matter will not be allowed. Light poling or vibration will be permitted. Within one hour of placement, sand cement shall be covered with a 150mm layer of damp earth, but trench backfill may not be completed until 24 hours after placement of the sand cement grout.

2.10 Common Fill and Site Grading

2.10.1 Scope of Work

Common fill shall include all other fill not classified as structural fill, trench backfill or landscaping loam. Common fill shall be used for rough grading site, backfill on some portions of structures, and other miscellaneous applications.

2.10.2 Technical Requirements

a. Common fill may be obtained from on-site excavated material if tested and approved or from off-site sources, which shall also be tested and approved by the Engineer. Common fill shall consist of mineral soil, substantially free of clay lumps, organic materials, loam, wood, trash, and other objectionable material that may be compressible or which cannot be compacted adequately. Common fill shall not contain stones larger than 100mm in any dimension, nor stones larger than 60mm in the top half meter of fill. Common fill shall not contain broken concrete, masonry, rubble, pavement, or other debris. It shall be easily spread and compacted, and the percent passing a No. 200 sieve shall not exceed twenty percent (20%). the liquid limit of the portion passing the No. 40 sieve shall not exceed fifty percent (50%).

b. The Contractor shall provide temporary surface drainage facilities as required to intercept or divert runoff water that otherwise might interfere with grading work in progress or damage grading work already in place. Permanent storm drainage facilities may be used for a portion of the temporary drainage requirement, but shall be flushed and cleaned before final acceptance of the work. All slopes shall be protected from damage resulting from surface water flow during construction prior to implementing final slope protection requirements.

c. Common fill shall be placed in layers having a maximum thickness of 250mm after compaction, unless the Contractor can demonstrate to the Engineer that thicker layers can be adequately compacted. Common fill shall be compacted to at least ninety-five percent (95%) of Standard Proctor maximum density. Moisture content of the material shall be at or near optimum when compaction begins. All common fill shall receive a minimum of two (2) passes of the compaction roller. The Engineer shall review and approve the compaction equipment used, including type of unit, weight and loading transmitted to the fill fifteen (15) days before final placement begins.

d. Backfill shall not be dropped directly upon any structure or pipe. Material placed within 600mm of any structure or pipe shall be free of rocks, or consolidated masses of soil materials having maximum dimensions greater than 60mm. Backfill shall not be placed on or around any structure until the concrete has cured for a minimum period of twenty-eight (28) days.

e. Backfill around water-retaining structures shall not be placed until the structures have been

tested for water-tightness, and the structures shall be full of water while backfill is being placed. Backfill around structure shall be placed in uniform depth son all sides of the structure. Backfill within two (2) meter of structures shall be compacted using hand-held tampers. Construction equipment, trucks or other vehicles weighing in excess of 4,500 kg shall not be permitted closer to the walls than a horizontal distance equal to the depth of the fill at that time.

f. Placement of common fill shall include all material and labor associated with rough site grading preparatory to final landscape grading. Grading in preparation for placing of loam and topsoil in planting areas, and construction of finishing facilities such as sidewalks, parking areas, roads, signs, etc. shall be performed at all locations indicated, to the lines, grades and elevations shown in the drawings. Such work shall be performed at all times in such a manner that the technical requirements for final slopes, lines and grades can be met. The Contractor shall notify the Engineer immediately of any incongruities encountered in final grading, including contouring problems, slope stability difficulties or aesthetic considerations.

g. All conflicting or excess materials encountered within the site grading limits shown, of whatever nature, shall be removed from the site and disposed of as directed. The intent of this section is that the Contractor shall perform all work necessary to render the site ready for final landscaping.

h. The Contractor shall provide at his own expense any temporary stockpiling, processing and rehandling of fill materials required for grading the site in a logical construction sequence, and to meet the requirements of this section or the direction of the Engineer.

i. The Engineer shall have the right to make minor adjustments or revisions to lines or grades, during the course of construction, to meet the project objectives, and the Contractor shall only be reimbursed for such modifications on the basis of changes in quantities. No changes in Unit Prices shall be permitted.

j. Stones or rock fragments larger than 60mm in their greatest dimension will not be permitted within the top 150mm of the finished subgrade of all fills and embankments.

k. In cut slopes, all loose or protruding rocks or consolidated soil masses shall be barred loose or otherwise removed to line or finished grade. All cut and fill slopes shall be uniformly trimmed to the slope, cross section, and alignment shown on the drawings. All cut slopes shall be trimmed to a stable grade and cross section.

2.11 Subsurface Drainage (Only Where Applicable)

2.11.1 Scope of Work

Subsurface drainage includes provisions for foundation drains, slope and embankment drains, roadway subdrains and related facilities as shown on the drawings or as directed by the Engineer.

2.11.2 Technical Requirements

a. All subsurface drainage pipes shall be either Schedule 40 PVC pipe, or non-reinforced concrete drain pipe of the types and classes required. All pipes in drainage trenches shall be perforated and surrounded by drainrocks to the dimensions shown on the drawings. In addition, where shown on the drawings, the free draining backfill shall be wrapped in non-woven polypropylene drainage fabric. Upon leaving the drainage trench location, the pipe shall be non-perforated and

shall discharge as shown on the drawings, or as directed by the Engineer. The pipe dimensions shall be as shown on the drawings.

b. Perforated pipe holes shall be located on the bottom of the pipe 13mmØ @ 150mm o. c. staggered.

c. The minimum allowable slope shall be 0.005 while the minimum pipe diameter shall be 100mm. where the drainrock in the trench or bed is enclosed within drainage fabric, the drainrock shall be open-graded material as shown on the drawings.

d. All drainrock shall be graded crush rock or granular material, free of organic material, loam, wood, trash, and other objectionable material. Rock shall be sound, durable material, angular or sub-angular in shape, of suitable quality to insure permanence in its intended use. Round stones, flat thin stones, or soft material such as sandstones shall not be permitted. Drainrock shall be lightly compacted with hand tampers after placement.

e. Filter cloth shall be used where shown on the drawings to provide a positive separation between drainrock and soil layers being drained. Filter fabric shall be made of polypropylene, melted and extruded into continuous filaments, formed into non-woven layered sheets and then needle-punched to form an inseparably bonded fabric. All filter fabric used shall have a minimum thickness of 2.28mm as measured by ASTM D1777. The minimum grab strength shall be 100 kg, while the maximum elongation shall be 140 percent; both as measured by ASTM D1682. Trapezoidal tear strength shall be a minimum of 25 kg as determined per ASTM D2263 procedures. Burst strength shall be 2.4 MPa as measured in accordance with ASTM D751. The water permeability of the fabric shall have an equivalent sieve size of 0.200mm to 0.149mm. the fabric shall be no-biodegradable, and resistant to a full range of pH values from 1 to 13. Material specifications and samples shall be submitted for review by the Engineer prior to first use.

2.12 Slope and Bank Protection (Only Where Applicable)

2.12.1 Scope of Work

Slope and bank protection shall consist of furnishing and placing two classes of material:

- riprap (grouted in place or loose)
- vegetative cover

Slope and bank protection include all material and labor necessary to apply protective covers or vegetation to embankments, channels, streambanks, etc. to protect these works from erosion due to rainfall, stormwater runoff or streamflow.

2.12.2 Technical Requirements

a. Riprap (Handplaced, Grouted or Loose)

aa. Unless otherwise authorized by the Owner, the Contractor shall promptly place riprap or other bank protection measures in conjunction with the construction of the slopes or embankments being constructed, with time delays allowed only for proper completion of the affected embankments, or to prevent admixture of riprap and bank material. Riprap shall be either loose or grouted as directed on the drawings or by the Engineer and shall be placed by hand at the locations and in close conformity with the lines and grades shown on the drawings.

bb. Riprap shall be placed on foundation slopes of compacted gravel excavated below anticipated scour to the elevations shown on the drawings. A trench shall be excavated at the base of the slope to start the placement of riprap. The gravel drainage blanket shall be graded to a depth of 150mm to yield a continuous, uninterrupted bed of the required thickness. It shall be compacted at a minimum by one pass of a crawler-type tractor of total gross weight equal to 14,000 kgs. Additional grading shall be done, or additional gravel furnished and placed, to repair any damage done to the gravel bed by water action prior to placement of riprap.

cc. Riprap shall be hand-placed on the prepared gravel bed, starting at the trench excavated at the slope base which shall receive a course of the largest stones meeting the specifications. Riprap shall be placed in progressive courses upwards from this base, with each stone placed in contact with surrounding stones, but with its weight carried by the underlying material and not by the adjacent stones. Stones shall be laid so that the minimum dimension is perpendicular to the prepared bed.

Spaces between stones shall be filled with spalls of suitable size to construct a solid, stable slope free from large voids and defects. The exposed face of the hand-placed riprap shall be made as smooth as the shape and size of the stones will permit, but shall not vary more than 200mm from a plane surface on the required slope. Where shown on the drawings, hand-placed riprap shall then be grouted or mortared in place.

dd. The riprap shall be sound, durable rock which is roughly rectangular in shape and of sufficient quality to insure permanence in the conditions under which it is to be used. Rounded stones, boulders, sandstones, or similar soft stone or flat rocks shall not be used. The material supplied shall ba free of fines, overburden, spoil, shale, and organic materials, and shall be subject to approval by the Engineer.

ee. For grouted riprap, at least fifty percent (50%) of the stones shall weigh in excess of seventy (70) kgs each. The smallest dimension of each stone shall not be less than 300mm.

***** End of Section *****

SECTION 02600
STORM DRAINAGE SYSTEM

1.0 GENERAL

1.1 References

Material requirements, methods, procedures, testing requirements and other related items called for in this Section shall conform to the applicable standards of the American Association of State Highway and Transportation Officials (AASHTO), American Concrete Pipe Association (ACPA), American National Standards Institute, (ANSI) and American Society for Testing and Materials (ASTM).

1.2 Submittals

Submit the following in accordance with Section 01100, Submittals. Submit within 90 days after the contract award date and prior to commencing work on the system.

1.2.1 Manufacturer's Catalog Data

a. Pipes and Fittings

b. Joints and couplings

1.2.2 Shop Drawings

a. Precast concrete manholes

b. Metal work

1.2.3 Certificates of Compliance

a. Pipe and fittings, including factory-applied linings

b. Pipe joint materials

c. Cast-iron frames, covers, and gratings

d. Precast concrete manhole sections

Submit certificates attesting that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and that production control tests have been performed at the frequency or intervals specified in the publication. Other tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

1.3 Delivery, Storage, and Handling

1.3.1 Delivery and Storage

1.3.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.3.1.2 Metal Items

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.3.1.3 Cement, Aggregates, and Reinforcement

Store as specified in Section 03300, Cast-In-Place Concrete.

1.4 Handling

Handle pipe, fittings, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Carry, do not drag pipe to trench.

2.0 MATERIAL REQUIREMENTS

2.1 Pipeline and Culvert Materials

2.1.1 Concrete Piping

2.1.1.1 Concrete Pipe and Fittings

Storm drainage pipe and culvert pipe sizes 300 mm diameter and larger shall be reinforced concrete pipe conforming to ASTM C76, Class II Wall B. Circular pipe with elliptical reinforcement shall have a readily visible line no less than 300mm (12 inches) long painted or otherwise applied on the inside and outside of the pipe at each end so that when the pipe is laid in the proper position, the line will be at the center of the top of the pipe. Fittings and specials shall conform to the applicable requirements specified for the pipe and shall be of the same strength as the pipe. Cement used in manufacturing pipe and fittings shall be Type V conforming to ASTM C150.

2.1.1.2 Joints

Jointing shall be mortar composed of one part cement and two parts sand.

2.2 Concrete Materials

Provide as specified in Section 03300, Cast-In-Place Concrete.

2.3 Miscellaneous Materials

2.3.1 Precast Concrete and Associated Materials

2.3.1.1 Precast Concrete Manhole Sections

Precast concrete manhole risers, base sections, and tops shall conform to ASTM C478. Base and first riser shall be monolithic.

2.3.1.2 Gaskets and Connectors

Gaskets for joints between manhole sections shall conform to ASTM C443. Resilient connectors for making joints between manhole and pipes entering manhole shall conform to ASTM C923.

2.3.2 Metal Items

2.3.2.1 Frames, Covers, and Gratings

Unless otherwise indicated, frames and covers shall be cast iron, traffic type. Figure numbers as indicated. Steel gratings shall be of commercial grade steel and be of welded construction.

2.3.2.2 Drainage Structure Steps

Structural Steps shall be Zinc-coated steed indicated on plan conforming to ANSI A14.3. As an option, plastic or rubber coating pressure-molded to the steel may be used. Plastic coating shall conform to ASTM D4101, copolymer polypropylene. Rubber shall conform to ASTM C443, except shore a durometer hardness shall be 70 plus or minus 5. For curb inlets, steel sump ladder rungs as indicated may be used in lieu of cast-iron steps; rungs shall be zinc-coated after fabrication. Aluminum steps or rungs will not be permitted. Steps are not required in manholes, curb inlets, or catch basins less than 1220mm deep.

3.0 CONSTRUCTION REQUIREMENTS

3.1 Installation of Pipelines and Appurtenant Construction

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to pipeline installation except where specific exception is made under paragraph entitled "Special Requirements."

3.1.1.1 Location

The work covered by this section shall terminate at a point shown on the Drawings.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 02200, Earthworks.

3.1.1.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; remove those found defective from site and replace with new. Provide proper facilities for lowering sections of pipe into trenches. Lay pipe with the bell or groove ends in the upgrade direction. Adjust tongues in grooves to produce a uniform space. Blocking or wedging between tongues and grooves will not be permitted. Replace by one of the proper dimensions any pipe or fitting that does not allow sufficient space for proper caulking or installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batter boards not more than 25 feet apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batter boards for the same purpose.

3.1.1.4 Connections to Existing Lines

Notify Engineer in writing at least 10 days prior to date that connections are to be made. Obtain approval of the Engineer before interrupting service. Conduct work so that there is minimum interruption of service on existing line.

3.1.2 Special Requirements

3.1.2.1 Installation of Concrete Piping to the Correct Grade and Alignment

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the provisions for rubber gasket jointing and jointing procedures of ACPA 01-103 or of ACPA 01-102, Chapter 9. Make joints with the gaskets previously specified for joints with this piping. Clean and dry surfaces receiving lubricants, cements, or adhesives. Affix gaskets to pipe not more than 24 hours prior to the installation of the pipe. Protect gaskets from sun, blowing dust, and other deleterious agents at all times. Before installation of the pipe, inspect gaskets and remove and replace loose or improperly affixed gaskets. Align each pipe section with the previously installed pipe section, and pull the joint together. If, while pulling the joint, the gasket becomes loose and can be seen through the exterior joint recess when the pipe is pulled up to within one inch of closure, remove the pipe and remake the joint.

3.1.3 Concrete Work

Perform cast-in-place concrete work in accordance with Section 03300, Cast-In-Place Concrete.

A. Concrete Encasement: As shown in the Drawings

3.1.5 Manhole, Curb Inlet, and Catch Basin Construction

Construct base slab of cast-in-place concrete or use precast concrete base sections. After verifying the correct invert elevation, make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent drainage sections. For changes in direction of drains and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab. For precast concrete construction, make joints between sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete piping. Give a smooth finish to inside joints of precast concrete manholes, curb inlets, and catch basins. Parging will not be required for precast concrete manholes. Cast-in-place concrete work shall be in accordance with the paragraph entitled, "Concrete Work." Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer. Where a new manhole is constructed on an existing line, remove existing pipe as required to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding beyond into the manhole. Use resilient connectors as specified for pipe connectors to concrete manholes.

3.1.5 Metal Work

3.1.6.1 Workmanship and Finish

Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron and steel to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide rabbets, lugs, and brackets wherever necessary for fitting and support. Apply zinc coating to steel gratings after fabrication in accordance with ASTM A525. Clean surfaces of steel frames and covers to bare metal by a blasting process. Where surfaces cannot be cleaned satisfactorily by blasting, clean to bare metal by wire brushing or other mechanical means. For surfaces contaminated with rust, dirt, oil, grease, or other contaminants, wash with solvents until thoroughly clean. Immediately after cleaning, coat surfaces with a coat of primer pretreatment coating, applied to a dry film thickness of 0.3 to 0.5 mil; or apply a crystalline phosphate coating. As soon as practicable after the pretreatment coating has dried, prime treated surfaces with a coat of zinc chromate primer, alkalyd type paint applied to a minimum dry film thickness of 1.0 mils. If primed surfaces are damaged before removal from the shop, retouch with primer.

3.1.6.2 Field Painting

After installation, clean cast-iron frames, covers, gratings, and steps not buried in masonry or concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

3.2 Field Quality Control

3.2.1 Field Tests and Inspections

The Engineer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests and provide labor, equipment, and incidentals required for testing. Be able to produce evidence, when required, that each item of work have been constructed properly in accordance with the drawings and specifications.

3.2.2 Pipeline Testing

Check each straight run of pipeline for gross deficiencies by holding a flashlight beam in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line.

3.2.3 Field Tests for Concrete

Field testing requirements are covered in Section 03300, Cast-in-Place Concrete.

***** End of Section *****

SECTION 03100
CONCRETE FORMWORKS

1.0 GENERAL

1.1 Scope

The Contractor shall provide forms to confine the concrete and shape it to the required lines. Plastering, in general, shall not be allowed. The Contractor shall assume full responsibility for the adequate design of all forms. However, forms which in the opinion of the Engineer are unsafe or inadequate in any respect, may at any time be condemned by the Engineer; and the Contractor shall promptly remove the condemned forms from the work and replace them at his own expense. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. Whenever, in the opinion of the Engineer, additional forms are necessary to maintain the progress schedule, such additional forms shall be provided by the Contractor at his own expense. The design and inspection of concrete forms, false work, and shoring shall comply with the applicable safety regulations and as may be specified in these Specifications.

1.2 Submittals

Shop drawings for Formwork: Include design calculations indicating arrangement of forms, sizes and grades of supports (lumber), panels, and related components. Indicate placement schedule, construction and location and method of forming control joints. Include locations of inserts, pipework, conduit, sleeves, and other embedded items. Furnish drawings and description of shoring and reshoring methods proposed for floor and roof slabs, spandrel beams, and other horizontal concrete members. Furnish schedule of form removal of structures (including two-way slabs) not included in paragraph entitled "Removal of Forms".

2.0 MATERIAL REQUIREMENTS

Except as otherwise expressly approved by the Engineer, all lumber brought at the job site for use as forms, shoring, or bracing shall be new material. All forms shall be smooth surface forms and shall be of the following materials:

Wall	-	steel or plywood panels
Columns	-	steel, plywood or surfaced lumber

Roof	-	plywood
All other work (including roads)	-	steel panels, plywood or surfaced lumber

Plywood shall be manufactured especially for concrete formwork and shall be oiled with an approved form oil and edge sealed.

3.0 CONSTRUCTION REQUIREMENTS

3.1 Design

a. All forms shall be true in every respect to the required shape and size, shall conform with the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, or offsets, or similar surface defects in the finished concrete. Plywood, 16.0 mm (5/8 in.) and greater in thickness, may be fastened directly to studding if the studs are close enough to prevent visible deflection marks in concrete. The forms shall be tight so as to prevent the loss of water, cement, and fines during placing and vibrating of the concrete. Adequate clean-out holes shall be provided at the bottom of each lift of forms. The size, number and location of such cleanouts shall be subject to the approval of the Engineer.

b. Concrete construction joints will not be permitted on locations other than those shown or specified, except as may be approved by the Engineer. When a second lift is placed on hardened concrete, special precaution shall be taken in the way of the number, location and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the form where required.

c. Unless otherwise shown, exterior corners in concrete members shall be provided with 19.0, (3/4 in.) chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise shown.

d. Reservoir forms and falsework supporting the roof slab shall be designed for a minimum additional live load or 0.96 KPa (20 psf).

e. Column forms shall be checked for plumbness before concrete is deposited. Hand holes shall be provided in column forms at lowest points of pour lifts to render this space accessible for cleaning.

f. All girder, beam, and slab centerlines shall be crowned at least 6.3 mm in all direction for every 4.57 m (15 ft.) span. However, cambers from all cantilevers shall be as indicated on the plans or obtained from the Engineer by the Contractor.

g. The following are the tolerance limits for formwork:

aa. Variation from plumb:

In lines and surfaces of columns, piers, walls and risers:

In	3.05 m (10 ft.)	6.3 mm (1/4 in.)

6.10 m (20 ft.) max	9.5 mm (3/8 in.)
12.20 m (40 ft.), or more	19.0 mm (3/4 in.)

For exposed corner columns and/or piers control joint grooves and other conspicuous lines:

In any bay 6.10 m (20 ft.) max.	6.3 mm (1/4 in.)
In 12.20 m (40 ft.), or more	13.0 mm (1/2 in.)

bb. Variation in cross-sectional dimensions of columns and piers, beams, and thickness of walls and slabs:

Minus	6.3 mm (1/4 in.)
Plus	13.0 mm (1/2 in.)

cc. Footings:

Variations in dimensions on drawings (applied to concrete only and not reinforcing bars or dowels):

Minus	13.0 mm (1/2 in.)
Plus	50.0 mm (2 in.)

Misplacement of eccentricity, two percent (2%) of the footings width in the direction of misplacement but not to exceed 50.0 mm (2 in.).

Reduction in thickness: Five percent (5%) at specified thickness.

3.2 Form Ties

Form ties with integral waterstops shall be provided with cork or other suitable means for forming a conical hole to insure that the form tie may be broken off back the face of the concrete. The maximum diameter or removable cones for rod ties, or of other removable form tie fasteners having a circular cross-section, shall not exceed 38 mm (1-1/2 in.) and all such fasteners shall be such as to leave holes of regular shape for reaming. Holes left by the removal of fasteners from the ends of snap-ties or form-ties shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough before being filled with dry packed mortar. Wire ties for holding forms will not be permitted. No form tying device or part thereof, other than metal, shall be left embedded in the concrete, nor shall any tie be removed in such manner as to leave a hole extending through the interior of the concrete member. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 25 mm (1 in.) back from the formed face or faces of the concrete. Form ties or metal roads left embedded in concrete of water retaining tanks shall be equipped with an integral metal waterstop of not less than 38 mm (1-1/2 in.) in diameter.

3.3 Vertical Surfaces

All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is called for on the Drawings or explicitly authorized by the Engineer. Not less than 25 mm (1 in.) of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for

members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

3.4 Maintenance of Forms

Forms shall be maintained at all times in good condition, particularly as to size, shape, strength, rigidity, tightness, and smoothness of surface. Forms when in place, shall conform to the established alignment and grades. Before concrete is placed, the forms shall be thoroughly cleaned. The form's surfaces shall be treated with a non-staining mineral oil or other lubricant approved by the Engineer. Any excess lubricant shall be satisfactorily removed before placing the concrete. In addition, all forms shall be given a preliminary oil treatment by the manufacturer or shall be oiled by the Contractor at least two (2) weeks in advance of their use. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embodied in concrete. Forms may be reused if in good condition and if approved by the Engineer. Light sanding between uses will be required wherever necessary in the opinion of the Engineer to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view. In the case of forms for the inside wall surfaces of hydraulic structures, unused tie rod holes shall be covered with metal caps or shall be filled by other methods approved by the Engineer.

3.5 Removal of Forms

Direction of the Engineer concerning the removal of forms shall be strictly followed, and this work shall be done with care so as to avoid injury to the concrete. No heavy loading on lean concrete will be permitted. In the case of roof slabs and above-ground floor slabs, forms shall remain in place until test cylinders for the roof concrete attain a minimum comprehensive strength of 15.52 MPa (2,250 psi) provided that no forms shall be disturbed or removed under an individual panel or unit before the concrete in the adjacent panel or unit has attained a strength of 15.52 MPa (2,250 psi) and has been in place for a minimum of seven (7) days. The time required to establish said strength will be determined by the Engineer who will make several test cylinders for this purpose from concrete used in the first group of roof panels placed. If the time so determined is more than seven-day minimum, then it shall be used as the minimum length of time. Forms for all vertical walls and columns shall
remain in place at least three (3) days after the concrete has been placed. Forms for all parts of the work not specifically mentioned herein shall remain in place for periods of time as ordered by the Engineer.

3.6 Formworks for Concrete Pavement

3.6.1 Forms

Forms shall be of steel or of wood, of an approved section, and of a depth-equal to the thickness of the pavement at the edge. The base of the forms shall be of sufficient width to provided necessary stability in all directions. The flange braces must extend outward on the base to not less than 2/3 the height of the form.

All forms shall be rigidly supported on a bed of thoroughly compacted material during the entire operation of placing and finishing the concrete. Forms shall be provided with adequate devices for secure setting so that when in place, they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing or paving equipment.

3.6.2 Preparation of Grade (Side Form Construction)

After the sub grade or base has been placed and compacted to the required density, the areas which will support the paving machine and the grade on which the pavement is to be constructed shall be trimmed

to the proper elevation by means of a properly designed machine extending the work at least 60 cm beyond each edge of the proposed concrete pavement. If loss of density results from the trimming operation, it shall be restored by additional compaction before concrete is placed. If any traffic is allowed to use the prepared sub grade or base, the surface shall be checked and corrected immediately before the placing of concrete. The sub grade or base shall be uniformly moist when the concrete is placed.

3.6.3 Setting Forms

a. Base Support

The foundation under the forms shall be hard and true to grade so that the form when set will be firmly in contact for its length and at the specified grade. Any roadbed, which at the form line is found below established grade, shall be filled with approved granular materials to grade in lifts of three (3) cm. or less, thoroughly rerolled or tampered. Imperfections or variations above grade shall be corrected by tamping or by cutting as necessary.

b. Form Setting

Forms shall be set at least 150 m in advance of the point where concrete is being placed. After the forms have been set to correct grade, the base shall be thoroughly tamped, mechanically or by hand, at both the inside and outside edges of the base of the forms. The forms shall not deviate from true line by more than one (1) cm at any point.

c. Grade Alignment

The alignment and grade elevations of the forms shall be checked and corrections shall be made by the Contractor immediately before placing the concrete. Testing as to crown and elevation, prior to placing of concrete can be made by means of holding an approved Template in a vertical position and moved backward and forward on the forms.

When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

***** End of Section *****

SECTION 03200
CONCRETE REINFORCEMENT

1.0 GENERAL

1.1 Scope

This item shall consist of furnishing, bending, fabricating and placing of steel reinforcement of the type, size, shape, and grade required in accordance with this specifications and in conformity with the requirements shown on the Plans or as directed by the Engineer.

1.2 Submittals

Contractor shall submit for the approval of the Engineer detailed reinforcement drawings. These drawings will include bar-placing , bar bending, bar list, and any other reinforcement drawings as may be required to facilitate placement and checking of reinforcing bars. The reinforcement drawings submitted shall show the name of the structure location by stationing where the reinforcement drawing is intended and all the

necessary information required by the Engineer. It shall likewise bear the tamp or seal of Contractor as evidence that the drawings have been checked by the Contractor.

2.0 MATERIAL REQUIREMENTS

All reinforcing steel bars to be furnished shall be Grade 40 for 20 mm and smaller and Grade 60 for 25 mm and larger or PNS 49, deformed type and conforming to the requirements of ASTM A-615. The nominal dimensions and unit weights of bar designation shall be in accordance with the following table:

Bar Diameter	Designation Weight Number kg/m	Nominal Cross Section Area (sq. mm)	Dimensions Perimeter (mm)
6 mm	0.222	28.30	18.85
8 mm	0.395	50.27	25.13
10 mm	0.616	78.54	31.42
12 mm	0.888	113.10	37.70
16 mm	1.579	201.10	50.27
20 mm	2.466	314.16	62.83
25 mm	3.854	490.90	78.54
28 mm	4.833	615.75	87.96
32 mm	6.313	804.25	100.53
36 mm	7.991	1,017.90	113.10

Bar numbers are based on the number of weights of an inch included in the nominal diameter of bars. The nominal diameter of a deformed bar is equivalent to the diameter of a plain bar having the same weight per foot of the deformed bar.

3.0 CONSTRUCTION REQUIREMENTS

Workmanship shall be at the highest grade and shall be in accordance with the latest standard practice of the industry.

3.1 Cutting and Bending

Cutting and bending of reinforcing bars may be done in shop or at the job site. All bending works shall be in accordance with the latest standard practice and by approved machine methods. Radii for bends and hooks will be specified on the approved detailed reinforcement drawings in accordance with sound design procedure. Unless otherwise specified, hooks and bends shall not be required for concrete with thickness less than 150mm.

3.2 Placing

Reinforcement shall be laid, anchored and embedded in the concrete as shown on the drawings or as directed by the Engineer. Unless otherwise directed, the spacing of reinforcement bars shall be measured along the center line of the bars. Reinforcement shall be inspected for compliance with

This item covers all the materials as cement, aggregates, water, admixtures, reinforcement, and the proportioning, mixing, transporting, placing, finishing, curing and protecting of concrete, including supplies, equipment, tools and all other incidentals necessary for concrete works.

1.2 Reference Standards

Concrete materials, methods and procedures shall conform to the applicable standards of the American Society for Testing and Materials (ASTM), the Philippine National Standards (PNS), and the American Concrete Institute (ACI).

1.3 Submittals

1.3.1 Concrete Mix Design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Furnish a complete list of materials including type, brand, source and amount of cement, and admixtures; applicable reference specifications; and copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Obtain approval before concrete placement. Submit additional data regarding concrete aggregates if the source of aggregate changes.

1.3.2 Certificates of Compliance

a. Aggregates
b. Admixtures
c. Cement

2.0 MATERIALS REQUIREMENTS

2.1 Cement

2.1.1 General

The cement shall conform to the requirements of the standard specification of Portland Cement, ASTM C-150 Type 1 or PNS 07. Special cement may be used subject to the approval of the Engineer provided it meets the requirements of Portland Cement with regards to strength, soundness and setting time.

2.1.2 Storage

Contractor shall, immediately upon delivery of cement to the jobsite, store the same in a dry, weathertight and properly ventilated structure with adequate provisions for the prevention of absorption of moisture. All storage facilities shall be subject to the approval of the Engineer and shall be such as to permit easy access for the inspection and identification. In order that cement may not become unduly aged after delivery, the Contractor shall use any cement of the same type, which has been stored at the site for 60 days or more before using cement of lesser storage age. Any cement stored at the project site over four months shall not be used unless retest proves it to be satisfactory. Sacked cement shall not be stocked higher than 14 sacks for storage for a period of no longer than 30 days and not higher than seven sacks for longer period.

2.2 Fine Aggregates

2.2.1 General

The term "Fine Aggregates" is used to designate aggregates in which the maximum size of particles is 5 millimeters. Fine aggregates for concrete, mortar and grout shall be provided by the Contractor and shall consist of natural sand, manufactured sand, or a combination of both. The different components shall be batched separately, subject to the written approval of the Engineer, or blended prior to the delivery to the batching plant.

As a means of providing moisture control, the Contractor may be required to stockpile fine aggregates over porous drain to remove excessive water and to stabilize the moisture content.

2.2.2 Quality

Fine aggregates shall conform to the requirements of ASTM C33 or PNS 18 and shall consist of hard, tough durable, uncoated rock particles. The Contractor shall exercise every possible precaution in transporting, washing and screening operations to prevent contamination of sand particles. Fine aggregates shall conform to the following requirements:

a. Grading

It is assumed that the sand available in natural deposits will require processing to provide a suitable gradation. Regardless of the source, the fine aggregates shall be well graded from fine to coarse and the gradation as delivered to the mixers shall conform to the following requirements unless otherwise approved:

Sieve Designation US Standard Square Mesh	Percent by Weight Passing Individual Sizes
3/8"(9.50mm)	100
No. 4 (4.75mm)	95 - 100
No. 8 (2.36mm)	85 - 95
No. 16 (1.18mm)	60 - 85
No. 30 (0.600mm)	25 - 60
No. 50 (0.300mm)	10 - 30
No. 100 (0.150mm)	2 - 10

In addition to the grading limits shown above, the fine aggregates as delivered to the mixer shall have the fineness modulus of not less than 2.30 or more than 3.00. The grading of the fine aggregates also shall be controlled so that the fineness modulus of at least 9 to 10 samples of the fine aggregates as delivered to the mixer shall not vary more than 0.10 from the average fineness modulus of all samples previously taken. The fineness modulus shall be determined by dividing by 100, the sum of the cumulative percentages retained on the US standard sieve No. 4, 8, 16, 30, 50 and 100. At the option of the Contractor, fine aggregates may be separated into more sizes or classifications, but the resulting sand when combined before entering the concrete mixer shall be of uniform grading within the limits specified above.

b. Particle Shape

The shape of the particles shall be generally spherical or cubical and reasonably free from flat or elongated particles. A flat or elongated particle is defined as a particle having a maximum dimension in

excess of five times the minimum dimension. Rocks which break down into such shape, regardless of the type of processing equipment used, will not be approved for use in the production of fine aggregates.

c. Deleterious Substances

The maximum percentages of deleterious substances in the fine aggregates as delivered to the mixer shall not exceed the following values:

	Percent by Weight
Materials passing No. 200	3
Screen Designation 16	1
Shale (Designation 17)	1
Clay (Designation 13)	1
Total of other deleterious substances (such as alkali, mica, soft, flaky particles and loam)	2

The designation in parenthesis refers to methods of testing described in the seventh (7th) edition of the US Bureau of Reclamation Concrete Manual and ASTM.

The sum of the percentages of all deleterious substances shall not exceed 5% by weight. Fine aggregates producing a color darker than the standard in the colorimatic test for organic impurity (USBR Designation 14 or ASTM C-40) may be rejected. Fine aggregate having specific gravity (USBR Designation 9 or ASTM C-128, saturated surface dry basis) of less than 2.60 may be rejected. The fine aggregate may be rejected if the portion retained on No. 50 (0.300mm) screen, when subjected to five cycles of sodium sulphate test for soundness (USBR Designation 19 or ASTM C-88) shows an average loss of more than 10% by weight. fine aggregates delivered to the batching plant may be rejected if it contains more than 0.15% soluble sulphate for any one sample or more than 0.10% for an average of at least 9 out of 10 consecutive test samples of finished sand, when samples are taken hourly. The percent soluble sulphate in fine aggregates shall be determined in accordance with the method of test prescribed in subparagraph (d) below. The use of beach sand is prohibited without the written consent of the Owner.

d. Sampling

Sampling of fine and coarse aggregates shall be done in accordance with the appropriate requirements of Section 12 of ASTM C-33. The source from which fine and coarse aggregates is to be obtained shall be selected well in advance of the time when the materials will be required in the work. Unless otherwise specified, all test samples should be taken under the supervision of the Engineer in sufficient time as approved to permit adequate testing and examination of the results sufficiently in advance of the time for use in concrete. Routine control test and analysis of the fine and coarse aggregate s at various stages in the processing operation shall be made. The approval of a source shall not be construed as containing approval of all materials from the source, and the Contractor will be held responsible for the specified quality of all such materials used in the work.

2.2.3 Storage

Fine aggregates shall be stored in such a manner as to avoid the inclusion of any foreign materials in the concrete. The storage of stockpile shall be constructed so as to prevent segregation. Depositing of

materials in storage and its removal there from shall be done in such a manner as to result in increasing the uniformity of the grading insofar as this is practicable. All fine aggregates shall remain in free drainage storage for at least seventy-two (72) hours prior to use. Sufficient live storage shall be maintained at all times to permit continuous placement of concrete.

2.3 Coarse Aggregates

2.3.1 General

The term "Coarse Aggregate" is used to designate aggregates of such sizes as to fall within the range of 0.5 cm, to 7.5 cm or any size or range of sizes within such limits. The coarse aggregates shall be reasonably well graded within the nominal size ranges hereinafter specified. Coarse aggregate for concrete shall be furnished by the Contractor and shall consists of crushed rock of mixture of natural gravel and crushed rock. Coarse aggregate, as delivered to the batching plant shall have a uniform and stable moisture content. Any rewashing found necessary to provide clean aggregates shall be done prior to finish screening. Rewashing shall not be performed in finish screen.

2.3.2 Quality

Coarse aggregates shall conform to the requirement of ASTM C-33 or PNS 78 and shall consist of hard, dense, uncoated durable rock fragments.

a. Grading

The coarse aggregates shall be well graded from fine to coarse. It shall be separated into the following specific size groups. The grading of the aggregates within the separated size groups as delivered to the mixer shall be as follows:

Coarse aggregates shall contain not more than 1.5 percent of materials passing the No. 200 sieve meshing, nor more than 5% of soft fragments.

It shall have an abrasion loss of not more than 40 percent at 500 revolutions. Sodium sulphate soundness shall not be more than 12% loss.

Unless otherwise directed, the maximum sizes of aggregates to be used in concrete for the various parts of the work shall be in accordance with the following:

General Use	Max Aggregate Dia
Lean Concrete to control water Intrusion and other miscellaneous uses	37.5 mm
Concrete for Footings, Walls	37.5 mm
Slabs Beams, 0.22 to 0.75 meter thick	
Concrete for thin walls, slabs beams less than 0.22 meters thick	19 mm
Concrete for reinforced concrete pipes	12.5 mm

In all cases, the diameter of the aggregate shall not exceed 1/2 the distance between the reinforcing steel bars of the members being placed.

b. Particle Shape

The particle shape of the crushed coarse aggregate shall be generally spherical or cubical and reasonably free from flat or elongated particles. A flat or elongated particle is defined as a particle having a maximum dimension in excess of five times the minimum dimensions. Rocks which breaks down into such shape will not be approved for the production of aggregate.

c. Deleterious Substances

The deleterious substances in any size of coarse aggregate, as delivered to the mixer, shall not exceed the following values:

	Percent by Weight
Material Passing No. 200 (Screen Designation 16)*	1/2
Shale (Designation 18)	1
Clay Lumps (Designation 13)	1/2
Other Deleterious Substances	1

The designations in parenthesis refers to methods of Testing described in the seventh edition of the U.S. Bureau of Reclamation Concrete Manual and ASTM.

The sum of the percentages of all deleterious substances in any size, as delivered to the mixer, shall not exceed 3% by weight. Coarse aggregate may be rejected if it fails to meet the following requirements:

1. Petrographic Examination

If more than 10% of poor aggregate particles can be identified in physical quality test and in case 20% of the particles would be classified with respect to the chemical quality (USBR Desig. 7 or ASTM C-295).

2. Sodium-Sulfate Test for Soundness (USBR Desig. 9 or ASTM C-88)

If the weighted average loss, after cycles is more than 12% by weight.

3. Specific Gravity (USBR Desig. 10 or ASTM C-127)

If the specific gravity (saturated surface-dry basis) is less than 2.60.

4. Sampling

All sampling of coarse aggregates shall be in accordance with Subsection 2.2.2(d), Section 03300.

2.3.3 Storage

Coarse aggregate storage or stockpiles shall be built in such a manner as to avoid the inclusion of any foreign materials in the concrete and to prevent segregation and excessive breakage. Water sprayers shall be installed to keep that portion of the coarse aggregate stockpiles saturated which is intended for immediate use in concrete. Sufficient live storage shall be maintained at all times to permit continuous placement of concrete.

2.4 Aggregates Sampling and Testing

Sampling of aggregate materials approved for use in the work, shall be done in accordance with ASTM Sampling Method at 10 days in advance of the time when the placing of concrete is expected to begin.

The samples of aggregates shall be obtained and tested in accordance with the following ASTM standard methods:

Sampling Aggregate	C 75
Sieve Analysis	C 136
Amount of material finer than 200 sieve	C 117
Organic impurities	C 40
Mortar Strength	C 87
Soundness	C 88
Soft particles	C 235
Abrasion Loss	C 131
Clay lumps	C 142

No aggregate shall be used until official advice had been received that it has satisfactorily passed all tests. Material from source which has been previously tested and shown satisfactory compliance with all the requirements given herein may be used without further testing. Test reports for previous tests must be available before approval can be given.

During construction, aggregate will be sampled or delivered to the mixer to determine compliance with Specification provision. Test shall be made in accordance with applicable ASTM standards.

2.5 Admixtures

In order to reduce the cement content and/or the amount of mixing water, and to improve the concrete workability, the Contractor may be allowed to use Admixtures and as such he shall submit to the Engineer for approval such Admixture he proposes to use. However, no additional payment will be made to the Contractor in view of this as the cost thereof is considered included in the contract unit price for the different classes of concrete.

The following types of admixtures will be given consideration provided that they conform to the provisions of this paragraph:

a. Air entraining agent
b. Water reducing admixtures
c. Water reducing and retarding admixtures
d. Water reducing and accelerating admixtures

Admixtures shall be furnished in a powder or liquid form. If furnished in a solution it shall contain at 50% solids and a mold inhibitor. The admixtures effect on the properties of Portland Cement concrete mixtures shall meet the requirements of ASTM C 494.

Admixtures will be accepted on manufacturers certification of conformance with the specifications but permission to clip on certification shall be in no way relieve the Contractor of responsibility for furnishing an admixture not meeting specification requirements. Where the Engineer has reason to believe that

testing is necessary to prove compliance with the requirements of these specifications, it may order these admixtures to be sampled and tested anytime. The Contractor shall provide facilities satisfactory to the Engineer for readily procuring samples for test.

Air Entraining Agent - concrete produced with water reducing agents shall contain four to six percent of entrained air by volume. The air entraining agent shall conform to the requirements of ASTM C 260, and shall be tested in accordance with ASTM C 233. The total calculated air content of the concrete is discharged from the mixer shall be as follows:

Coarse Aggregate Maximum Size	Total Air - Percent by Volume of Concrete
2 cm	5 ± 1
3.8 cm	4 ± 1

The agent in solution shall be maintained at uniform strength and shall be added to the batch in a portion of the mixing water. This solution shall be batched by means of a mechanical batcher capable of accurate measurement. When a retarder dispersing agent is used in the concrete, the portion of the mixing water containing the air-entraining agent shall be introduced separately into the mixer.

Water Reducing Agent or Water Reducing and Set Retarding Agent - the Contractor may be allowed to use an approved water reducing agent, or water-reducing and set retarding agent in concrete. The ASTM designations for these admixtures are Type A and Type D, respectively. The agent used shall be either suitable calcium, sodium or ammonium salts of lignosulfonic acids or of the nonlignin, hydroxylated carboxylic and acid groups. The agent shall be of uniform consistency and quality within each container and from shipment to shipment.

The amount of water reducing, or water reducing and set retarding agent to be used in each concrete mix shall in general be within the following limits:

Lignosulfonic Acid Type 0.27 to 0.37 percent of solid crystalline lignin, by weight, of cement.

Hydroxylated Carboxylic

Acid Type 0.25 to 0.50 percent of liquid, by weight.
Water Reducing and Accelerating Admixture - the ASTM designation for this admixture is Type E. Water reducing and accelerating admixture may be used by the Contractor for speeding up precasting and post-tensioning operations for precast and prestressed beams, girders, slabs and bearing pads, if approved.

2.6 Water

The water used in concrete, mortar and grout shall be free from objectionable quantities of silt, organic matter, alkali, salts and other impurities. The recommendation of the seventh edition of the U.S. Bureau of Reclamation Concrete Manual for mixing water shall be followed,

3.0 CONSTRUCTION REQUIREMENTS

3.1 Classification and Proportioning of Concrete Mixtures

a. Classification and Design Mixtures

The mixture for all classes of concrete shall be designed by the Contractor to obtain the compressive strength at the age of 28 days as specified below.

Size of Compressive Class of Aggregates	Minimum Comp. Strength	Designated Maximum Dia. Aggregate
Y 12.5 mm	3,000 psi	12.5 mm to 4.75 mm
AA 19 mm	3,000 psi	19.0 mm to 4.75 mm
A 37.5 mm	3,000 psi	37.5 mm to 4.75 mm
B 50 mm	2,500 psi	50.0 mm to 4.75 mm
C 75 mm	2,500 psi	75.0 mm to 4.75 mm
Z 75 mm	(1,500-2,000 psi)	5.0 mm to 4.75 mm

Unless otherwise specified, the Contractor shall prepare a design mix for concrete pavement that will produce a compressive strength of 3,500 psi when tested at fourteen (14) days.

b. Aggregate Content

Concrete mixtures shall be designed to use the largest size and the maximum amount of coarse aggregate as practicable for the intended use of the concrete.

c. Consistency

The amount of water to be used in the concrete shall be regulated as required to secure concrete of the proper consistency and to adjust for any variation in the moisture content or grading of the aggregates as they enter the mixer.

It shall be such consistency that it will flow around reinforcing steel bar but individual particles if the coarse aggregate when isolated shall have coating of mortar containing its proportionate amount of sand. The consistency shall be gauged by the ability of the equipment to properly place it and not by the difficulty in mixing or transporting. Addition of water to compensate for stiffening of the concrete before placing will not be permitted. Uniformity in concrete consistency from batch will be required.

The slump of the concrete at the time of placing shall not exceed 5 centimeters in heavy concrete sections and at top of walls, piers and parapets, 10 centimeters for pumped or air placed concrete, 7.5 centimeters for concrete elsewhere.

The Engineer reserves the right to require a lesser slump whenever concrete of lesser slump can be consolidated readily into place by means of the vibration specified in Subsection 3.8(e), Section 03300.

Notwithstanding the approval of the design mixtures and the above specified minimum cement content for different classes or gradation of aggregates, the Contractor shall be responsible that all concrete meet the desired strength.

3.2 Mixing Concrete

a. General

Concrete shall be machine-mixed. Hand mixing shall be allowed only in cases of emergency when there is machine breakdown or malfunction, and in the construction of small structures where the total volume of

concrete is less than two cubic meters. A written consent of the Engineer must be secured by the Contractor in both cases.

No concrete shall be mixed, placed or finished when natural light is insufficient, unless an adequate and approved artificial lighting system is operated.

b. Mixing at Site

Concrete shall be thoroughly mixed in a batch mixer of an approved capacity and type which ensure a uniform and homogenous mixing of the concrete materials. The minimum mixing time for each batch, after all materials and water are introduced into the mixer, shall be as follows:

Capacity of Mixer	Mixing Time
0.40 cu.m. or smaller	1-1/2 minutes
0.60 to 1.20 cu.m.	1-1/2 minutes
1.50 to 2.30 cu.m.	2 minutes
3 cu.m.	2-1/2 minutes

Overmixing, requiring the introduction of additional water to preserve the required consistency, will not be permitted. Overmixed concrete shall be wasted.

c. Truck Mixing

Truck mixing shall be of the revolving drum type, water-tight, and so constructed that the concrete can be mixed to insure a uniform distribution of materials throughout the mass. All solid materials for the concrete shall be accurately measured at the proportioning plant before being charged into the drum. Except as subsequently provided, the truck mixer shall be equipped with the tank for carrying mixing water. Only the prescribed amount of water shall be placed in the tank unless the tank is equipped with a device by which the quantity of water added can readily be verified. The mixing water maybe added directly to the batch in which case a tank shall not be required. Truck mixer must be provided with a device by which the mixing time can be readily verified by the Engineer.

When cement is fed into the mixer drum containing water or on surface with wet aggregates and when the temperature is above 32□C, or when high early strength Portland Cement is used, the mixing limit shall be reduced to 1.5 minutes. The limitation in time between the introduction of the cement to the aggregates and the beginning of the mixing may be waived, when the aggregates are sufficiently free from moisture, since in this case there is no harmful effect on the cement.

3.3 Re-Tempering

Concrete, mortar and grout mixers which have developed initial set shall not be used. Concrete, mortar and grout which have partially hardened shall not be retempered or remixed.

3.4 Sampling and Testing of Concrete

The Contractor shall provide required samples of concrete. Sampling will, in all cases be performed by or under the direct supervision of the Engineer and Contractor shall provide without cost to the Owner all available tools and labor as may be required. Concrete sampling shall be carried on during concrete operations at the rate of one standard sample for each 75 cubic meters of concrete or fraction thereof placed during each continuous placing operations but in no case shall there be less than one (1) sample

for each class of concrete for each day concreting. Each standard sample shall consist of three standard cylinders (6 inches diameter by 12 inches high). Testing of the cylinders shall be one (1) sample at 7 days and two (2) samples at 28 days.

Sampling shall conform to ASTM Designations C-172, preparations, storage and curing to ASTM Designation C-31 and testing to ASTM Designation C-39. The sample shall be tested by an approved testing laboratory at the expense of the Contractor.

3.5 Time of Hauling and Placing Mixed Concrete

Concrete shall be placed in its final position in the forms within 45 minutes after the introduction of the mixing water to the cement and aggregates, or the cement to the aggregates.

3.6 Delivery

The rate of the delivery of the concrete during concreting operation shall be such as to provide for the proper handling and placing of the concrete. The rate shall be such that the interval between batches shall not exceed 40 minutes. The method of delivering and handling the concrete shall be such as to facilitate proper placing with the minimum of rehandling and without damage to the concrete structure.

3.7 Conveying and Placing Concrete

a. General

Approval of the Engineer shall be obtained before starting any concrete pour. Concrete placement will not be permitted when,in the opinion of the Engineer, conditions prevent proper placement and consolidation. Before concrete is placed, all saw dust, chips, and other construction debris and extraneous matters will be removed from the interior of forms, struts, stays, and braces, serving temporarily to hold the forms in correct shape and alignments, pending the placing of concrete at their location, shall be removed when the concrete placing has reached an elevation rendering their services unnecessary as may be. These temporary members shall be entirely removed from the forms and not be buried in concrete. Surfaces of existing concrete left after the partial demolition against which new concrete is to be placed, shall be cleared thoroughly of all loose concrete coatings or concrete dust by brushing or other effective means followed by thorough washing or jetting. Such surfaces shall be kept moist at least 24 hours before pouring the new concrete.

Concrete shall be placed only in the presence of the Engineer or his duly authorized representatives.

Any and all concrete placed in the absence of the Engineer or his duly authorized representative will not be considered for measurement and payment, and shall be removed at the direction of the Engineer with the Contractor assuming all losses.

Concrete shall be conveyed from the mixer to forms, as rapidly as practicable, by methods which will prevent segregation, or loss of ingredients. There shall be no vertical drop greater than 1.5 meters except where specifically authorized by the Engineer. Belt conveyors, clutes similar continuously exposed flow, will not be permitted.

b. Concrete on Earth Foundation

All concrete shall be placed upon clean and damp surfaces free from standing or running water. Prior to placing concrete, the earth foundation shall be satisfactorily compacted in accordance with these specifications.

c. Concrete on Rock and Other Concrete

Rock surfaces or hardened concrete upon or against which concrete is to be placed shall be clean, free from oil, standing or running water, mud, drummy rock objectionable coatings, debris, loose and semi detached or unsound fragments. Fault, fissures and seams in rock shall be cleaned to satisfactory depth and to firm rock on the sides. Immediately before concrete is placed, all surfaces shall be cleaned thoroughly by the use of high velocity, air water jets, wet sand blasting or other satisfactory means. When required by the Engineer, roughing by grooving with pneumatic tool, of existing concrete surfaces against which concrete is to be placed may be required. All surfaces against shall be wetted before placing concrete and approximately horizontal surface shall be covered immediately before the concrete is placed, with a layer of mortar not to exceed 15mm in thickness and of the same cement-sand ratio as used in the concrete.

d. Lift on Concrete

The permissible depth of concrete placed in one lift will be as shown in the detailed Drawings or as directed for each structure by the Engineer. Unless otherwise authorized or shown, lifts or mass concrete shall not exceed 1.5 meters in height, and a minimum of 72 hours shall elapse between the placing of each successive lifts. Lifts of three meters will be permitted in piers and walls. Height of lift specified herein will not apply where the use of slip form has been approved. All concrete, when placed and vibrated shall be approximately horizontal layers not to exceed 500mm in thickness unless otherwise specifically authorized. The placement of concrete surfaces shall not have reached their initial set before additional concrete is placed thereon. Slabs shall generally be placed in one lift unless the depth is so great that this procedure will proclude objectionable results.

e. Consolidation of Concrete

Consolidation of concrete shall be by the use of mechanical vibration equipment. The vibrating equipment shall be on the internal type and shall at all times be adequate in number of units and power of each units shall be capable to properly consolidate all concrete. The frequency of vibration shall not be less than 6,000 revolutions per minute. Form or surface vibrators shall not be used, unless otherwise specified in other Section of this Technical Specification. The duration of vibration shall be limited to that necessary to produce satisfactory consolidation without causing objectionable segregation. In consolidating each layer of concrete the vibrating head shall be allowed to penetrate under the action of its own weight and revibrate the concrete in the upper portion of the underlying layer.

At least one (1) standby unit of vibrating equipment in good running condition shall be at the pouring site at any one time.

f Finishing of Concrete Lift Surface

The manipulation of the concrete adjacent to the surface of the lift in connection with completing lift placement shall be the minimum necessary to produce not only the degree of consolidation desired in the surface layer of concrete but also a surface with the desired degree of roughness for bond with the next lift. Surface vibration or excessive surface working will not be permitted. All unfinished top surface not covered by forms and which are not to be covered by additional concrete or backfill, shall be carried slightly above grade, as directed, and struck off by board finish.

g. Placing Concrete Through Reinforcement

In placing concrete through reinforcement, care shall be taken so that no segregation of the coarse aggregate occurs. On the bottom of beams and slabs, where the congestion of steel near the forms makes placing difficult, a layer of mortar of the same cement-sand ratio is used in the concrete shall be first deposited to cover the surface.

h. Depositing Concrete in Water

When specifically authorized, concrete may be deposited in water. The methods and equipment used shall be subject to approval of the Engineer.

3.8 Repair of Concrete

No repair of work or plaster finish on formed concrete structures will be permitted, unless otherwise provided in these Specifications or directed by the Engineer. All defective concrete shall be removed and replaced with the Contractor assuming all expenses and losses. If directed, the Contractor shall notify the Engineer of the start of the repair work at least 24 hours in advance thereof and shall repair concrete only in the presence of the Engineer or its authorized representative, unless inspection of such repair work is waived.

Workmanship methods, preparation of concrete for repair, materials and curing shall be as directed. Only workmen skilled in the repair of concrete shall perform such work. Repairs of defective concrete shall be within 48 hours after the removal of forms.

Surfaces to which concrete is to be bonded shall be clean and dry when coated with epoxy.

Surfaces of concrete to be repaired with sealing compound method shall be cured by the water curing method for one day before application of the sealing compound. All repair shall be sound and free from shrinkage, cracks and drummy areas after they have been cured and have dried 30 days.

Surfaces of repairs which will be exposed to view shall blend inconspicuously with surrounding concrete surfaces.

3.9 Construction Joints

Construction or contraction joints shall be provided where shown or specified in the Drawings.

The Waterstop: The waterstop shall conform to ASTM D412 and shall have a minimum tensile strength of 9.65 MPa (1400 psi) and ultimate elongation of 280%.

Expansion Joint Filler: The expansion joint filler shall be pre-formed, non-extruding type of filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture conforming to ASTM D 1752, Type I.

Sealant for joints shall be polyurethane polymer designed for bonding to concrete.

***** End of Section *****

SECTION 04100

UNIT MASONRY

1.0 GENERAL

1.1 Scope of Work

The work includes furnishing labour, equipment and materials, and performing all operations required to complete concrete masonry work as shown and specified on the drawings and specifications.

1.2 Applicable Documents

The following specifications and standards shall form part of this specification to the extent required by the references thereto.

ASTM	American Society for Testing and Materials
C144-87	Standard Specification for Aggregate for Masonry Mortar
PSA	Product Standards Agency Pub. (Phil.)
PNS 16-84	Concrete Hollow Blocks, Specs for

1.3 Requirements

Concrete masonry work of the type indicated shall be provided and shall be properly coordinated with the work of other trades.

2.0 MATERIALS

2.1 Concrete Hollow Blocks

Concrete hollow block shall be a standard product of a recognized manufacturer conforming to PNS 16, as indicated on the drawings.

2.2 Cement, Reinforcing Steel, and Water

Cement, reinforcing steel and water shall be as specified in Division 3.0, Concrete.

2.3 Lime

Lime may be either finely pulverized quick lime, slake or hydrated lime (92% hydrated) and shall be a standard product of a recognized manufacturer.

2.4 Delivery, Storage and Protection of Materials

Delivery, storage and protection of materials shall be as specified in Division 3.0, Concrete, and as specified herein.

a. Lime shall be delivered in original sealed containers plainly marked with name and brand of manufacturer, and kept dry until used. Defective lime or lime showing partial set or caking shall not be used.

b. Concrete masonry units shall immediately upon delivery to the job site be stacked under covered area or otherwise protected from exposure to the weather and contact with soil. Care shall be exercised in handling the blocks to avoid breakage.

3.0 WORKMANSHIP

Masonry walls shall be placed level and plumb all around. One section of the walls shall not be placed in advance of the others, unless specifically approved. Unfinished work shall be stepped back for joining with new work; toothing shall not be permitted. Heights of masonry shall be checked with an instrument at sills and heads of openings to maintain the level of the walls. Door and window frames, louvered openings, anchors, pipes, and conduits shall be installed in carefully and neatly as the masonry work progresses. Spaces around metal door frames shall be filled solidly with mortar. Drilling, cutting, fitting and patching, to accommodate the work of others, shall be performed by skilled workers. Bolts, anchors, inserts, plugs, ties, and miscellaneous metal work specified elsewhere shall be placed in position as the work progresses. Chases of approved dimensions for pipes and other purposes shall be provided, where indicated necessary. Tops of exposed walls and waterproof membrane, well secured in place. Walls and partitions shall be structurally bonded or anchored to each other and to concrete walls, beams, and columns.

3.1 Mortar Mixing

Mortar materials shall be measured in approved containers, which shall insure that the specified proportions of materials can be controlled and accurately maintained during the progress of the work. Unless specified otherwise, mortar shall be mixed in proportions by volume. The aggregates shall be introduced and mixed in such a manner that materials will be distributed uniformly throughout the mass. A sufficient amount of water shall be added gradually and the mass further mixed, not less than 3 minutes, until a mortar of the plasticity necessary for the purpose intended shall be obtained. The mortar shall be mixed in a manner such that the quantity of water can be controlled accurately and uniformly. Mortar boxes, pans, or mixer drums shall be kept clean and free of debris or dried mortar. The mortar shall be used before the initial setting of the cement has taken place. Retempering of mortar in which cement has started to set shall not be permitted.

3.2 Proportion

Mortar shall be mixed in the volumetric proportions of one part Portland cement, 1/4 part hydrated lime and 3 parts sand.

3.3 Mortar Joints

Mortar joint shall be uniform in thickness, and the average thickness of any three consecutive joints shall be 9.50 mm. "Gage rods" shall be made and approved prior to starting the work and shall be used throughout the work. Changes in coursing or bonding after the work has started shall not be permitted. Joints in masonry which will not be exposed shall be struck flush. Joints shall be brushed to remove all loose and excess mortar.

3.4 Concrete Masonry Unit Work

The first course of concrete masonry unit shall be laid in full bed of mortar, for the full width of the unit; the succeeding courses shall be laid with broken joints. Concrete masonry units with the cells vertical shall have bed-joints formed by applying the mortar to the entire tops surfaces of the inner and outer face shells, and the head joints formed by applying the mortar for a width of about 25mm to the ends of the adjoining units laid previously. The mortar for joints shall be smooth, not furrowed, and shall be of such thickness that it will be forced out of joints as the units are being placed in position. Where anchors, bolts, ties and reinforcing bars occur within the cells of the units, such cells shall be solidly filled with mortar or grout as the work progresses. Horizontal tie reinforcement shall be provided where indicated. Reinforcement shall be continuous and provided in the longest available lengths. Reinforcement above and below opening shall extend and be embedded into the columns, unless otherwise shown on the drawings. Splices shall overlap not less than 150 mm. Reinforcement shall be embedded in the mortar joints in such manner that all parts shall be protected by mortar. The two top courses of filler block walls shall have their cores filled with grout when placed in position.

Unless otherwise shown on the drawings, the blocks compressive strength, the size and spacing of vertical bars shall be as follows:

For 150 mm (6") CBH	- 12mm (1/2") dia. at 600 mm (24") on centres' - Minimum compressive strength of 350 psi for non-load bearing. - Minimum compressive strength of 1,400 psi for load bearing.
For 100 mm (4") CHB	- 10mm (3/8") dia. at 600 mm (24") on centers - Minimum compressive strength of 1,400 psi for load bearing. - Minimum compressive strength of 350 psi for non-load bearing.
For horizontal bars:	- 12mm (1/2") dia. at 600 mm (24") on centers (every third course) for 150 mm (6") and 100 mm (4") CBHs.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Samples of Materials

Samples of cement, sand, lime, reinforcing bars and concrete hollow blocks shall be submitted for inspection and approval before delivery of these materials to the site.

4.2 Tests and Test Reports

The testing requirements stated herein or incorporated in referenced contract documents may be waived provided certified copies of report of tests from approved laboratories performed on previously manufactured materials are submitted and approved. Test reports shall be accompanied by notarized copies from the manufacturer certifying that the previously tested material is of the same type, quality, manufacture, and make as those proposed for this project.

ACCELELOGRAPH SPECIFICATIONS

EARTHQUAKE RECORDING INSTRUMENTATION FOR BUILDINGS

I. INTRODUCTION

Technology on building instrumentation for seismic monitoring has improved tremendously in the past decade. The purpose of the Guidelines and Implementing Rules on Earthquake Recording Instrumentation for Buildings is to provide information on the specifications and uses of earthquake recording instruments for buildings as provided in Section 105.2 of the National Structural Code of the Philippines 2010 Volume 1, 6th Edition (NSCP 2010).

Further, the Guidelines and Implementing Rules on Earthquake Recording Instrumentation for Buildings provide earthquake instrumentation schemes for certain buildings to record building response during major seismic events for subsequent analysis and provide immediate alarm annunciation to ensure that the building occupants can be moved to safety as per the Building Emergency Evacuation Plan (BEEP) of the National Disaster Risk Reduction Management Council (NDRRMC), which is the basis for the guidelines of earthquake drills in the Philippines.

Installation of earthquake recording instruments was first required in the National Structural Code of the Philippines 1992, 4th Edition, wherein structural engineers were only interested in the strength design capacity on the buildings based on seismic parameters provided in the Uniform Building Code (UBC) of the United States, referral code of the NSCP. Structural code developers started to recognize the importance of not only strength but serviceability and performance as well. The experiences from the 1994 Northridge Earthquake in the US and the 1995 Kobe Earthquake in Japan gave credence to these considerations. DPWH therefore deemed it necessary to improve our understanding of the building response based on real seismic event from local earthquake generators by enforcing placement of earthquake recording instrumentation for buildings as the NSCP provision was reiterated in 2001, 5th Edition, as well as in the latest 2010, 6th Edition.

The NSCP 2010 states that *"Unless waived by the building official, everybuilding in Seismic Zone 4 over fifty (50) meters in height shall be provided with not less than three (3) approved recording accelerographs. The accelerographs shall be interconnected for common start and common timing."*

The Philippines needs to have its own earthquake baseline data for validating the seismic design parameters used during and future structural design of buildings, in order to support earthquake disaster mitigation efforts. Hence, the waiver stated in the NSCP 2010 is temporarily suspended until such time that considerable sets of adequate earthquake records have been obtained for various specified types of buildings and relevant provisions in the NSCP have been amended. However, for the purposes of the Earthquake Recording Instrumentation for Buildings, the Department of Public Works and Highways has identified buildings in Table 1 to be necessarily installed by the said seismic monitoring system.

II. **OBJECTIVES**

Section 102 of the National Building Code of the Philippines, otherwise known as PD 1096, states that: "It is hereby declared to be the policy of the State to safeguard life, health, property, and public welfare, consistent with the principles of sound environmental management and control; and to this end, make it the purpose of this

Code to provide for all buildings and structures, a framework of minimum standards and requirements to regulate and control their location, site, design, quality of materials, construction, use, occupancy, and maintenance".

In conformance with the said Section 102 and as provided in the NSCP 2010, these Guidelines and Implementing Rules on Earthquake Recording Instrumentation for Buildings were developed to primarily safeguard lives, and for clear understanding of the actual dynamic behavior of buildings/structures under earthquake loading and confirm the structural design parameters used or to be adopted in compliance to the specific provisions of the NSCP. The recorded data will be used to improve the safety provisions of local structural code there by reducing loss of lives and limbs as well as properties during future damaging earthquakes, and to improve our understanding of the behavior and potential damage of building under the dynamic load of earthquakes. This will be achieved through the development of an integrated network that measures the earthquake source, transmitted ground motions structural response. These measurements will be correlated with observations of structural response to evaluate the current design and construction practices in order to minimize damage to buildings during future earthquakes. The response data from several buildings in a particular area or several areas will also be used as the basis for the government's earthquake disaster mitigation/remedial and rehabilitation strategies including its emergency response and relief operations programs.

The seismic recording and instrumentation machine must be used to set off alarms at specified intensity levels triggering real-time alarm information and may also trigger automatic switch off for utilities such as gas lines, electric power lines and elevators as may be prudent in case of such high intensity earthquake. The recorded

data are also important parameters for buildings' safety re-evaluation and resumption of occupancy including post-earthquake evaluation of buildings. These safety alarm systems have been proven worldwide that they have mitigated secondary consequences of earthquake disasters and have saved countless of lives, or at least minimize the loss of lives.

III. **DEFINITION OF TEMS AND ACRONYMS**

ACCELERATION. The rate at which the velocity of a particle with time as recordedby seismic accelerograph (expressed in Gal or cm/sec squared).

*ACCELEROMETER.*A sensing equipment that measures seismic acceleration and pass the information to the accelerograph for further processing and conversion to the intensity, velocity and displacement.

*ACTIONS (GROUND MOTION).*A general term including all aspects of ground motion, namely acceleration velocity and displacement from an earthquake or other energy source.

BANDWIDTH. The frequencyrange that the accelerometer operates,measured inHertz (Hz).

*CERTIFIED CIVIL/STRUCTURAL ENGINEER.*A civil engineer with special qualifications to practice structural engineering with appropriate training in seismic instrumentation to be conducted by ASEP in coordination with DPWH.

*CHANNEL.*A path along which information (as data or voice) in the form of electrical signal, passes; a band of frequencies of sufficient width for a single radio or television communication.

CLUSTERED BUILDINGS. A group of buildings (enumeratedin Table 1) built closetogether having similar design, construction, occupancy and function on a sizable tract of land. Each building should be treated separately.

*DAMPING.*The energy dissipation properties of a material or system under cyclic stress.

DISPLACEMENT. The measured distance traveled by a particlefrom an initialposition.

ENVIRONMENT. The aggregate of surrounding things,conditions,or influences thatmay affect the operability of an instrumentation device such as accelerograph, velocitimeter, etc.

ERI. EarthquakeRecording Instrumentations

FTP. FileTransferProtocol

GB. Giga Byte

GALS. A unit of groundacceleration with conversion asfollows: 1 gal= 1 cm/squares, 981.5 gals = 1g where 1 g = 9.815 m/square s (NSCP Sec. 208.2)

g. Acceleration due to gravity equals to 9.81 m/sec^2 or 32.2 ft/sec^2.

INTENSITY. A descriptive scale(such as Philippine IntensityScale,Modified MercalliIntensity Scale and Shindo Scale) that indicates the local effects and potential damage produced by an earthquake on the Earth's surface as it affects humans, animals, structures and natural objects such as bodies of water.

*IP 67.*The Ingress Protection rating system is a classification system showing the degrees of protection of the instrumentation device from solid objects and liquids. The first number refers to the solid objects, normally dust. If the first number is 0, there is no protection provided. A number 5 refers to limited protection against dust. The number 6 is for total protection against dust. The second number of the IP rating system refers to protection against immersion between 15 cm to 1m for 30 minutes.

IP. InternetProtocol

MICROTREMORS. A low amplitudeambient vibration ofthe ground caused by man-made or atmospheric disturbances.

NATURAL FREQUENCY. Thenumberofwavecyclesper second which asystemtend to oscillate in the absence of any driving or damping force.

NTP. NetworkTime Protocol.

PEAK GROUND ACCELERATION (PGA). The maximumground acceleration at aspecific location for time interval.

PERIOD. The time intervalrequired for one full cycle of wave.

*REFUGE AREA.*An area inside a building, where people evacuate or assemble during a disaster or emergency i. e, fire, which is appropriate for other events but not for earthquake.

RESPONSE SPECTRUM. A plot of the peak or amplitude of steady-state response(displacement, velocity and acceleration) of a series of oscillators of varying natural frequency that are forced into motion by the same base vibration or shock.

RMS. Root Mean Square

SEISMIC ACCELEROGRAPH. Accelerograph that records the acceleration of particleson the surface of the earth as a function of time, which is called an accelerogram. The accelerograph generally records three (3) mutually perpendicular components of motion in the vertical and two (2) orthogonal horizontal directions.

SEISMOGRAPH. A generic term used to describe a recording device that detectsground motion due to earthquake. Typically, this will comprise a recorder and a seismometer, which is a sensor that detects the velocity of the ground. Usually very sensitive than accelerograph and will easily detect a blast at a range of 100 km.

SFTP. Secure FileTransfer Protocol

SIR. Seismic Instrumentation Room

*STRONG M0TION.*Ground motion of sufficient amplitude to be of interest in evaluating the damage caused by earthquakes or nuclear explosions.

TCP. Transmission Control Protocol

TIME HISTORY. The sequence of values of any time-varying quantity (such as aground motion measurement) at a set of equal time intervals.

TRI-AXIAL. The characteristics ofan accelerometer to provide ground shakingsensing in three (3) dimensions commonly known as x, y, z (i.e., transverse, longitudinal, and vertical).

VELOCITIMETER. An instrument used to measure velocity of a particle.

*VELOCITY.*A measure of the rate of motion of a particle expressed as the rate of change of its position in a particular direction with time.

IV. EARTHQUAKE RECORDING INSTRUMENTATION REQUIREMENTS

1. Application

The requirements of Earthquake Recording Instrumentation (ERI) shall apply to all existing buildings listed in Table 1, located in Seismic Zone 4 (entire Philippines except, Palawan and Tawi-Tawi located in Zone 2), prior to issuance of Certificate of Occupancy. Building Permits shall only be issued on buildings required for seismic instrumentation when site or location of Seismic Instrumentation Room (SIR) has been indicated or incorporated in the plan.

Table 1 shows the types of buildings required to be installed with earthquake recording instrumentation located in cities and municipalities within 200-km radius from a Type A faults as specified in the NSCP 2010 and as indicated from the active fault maps issued by the Philippine Institute of Volcanology and Seismology (PHIVOLCS). For buildings located in cities and municipalities outside of the 200-km radius, only the installation of a single accelerograph may be placed at the ground floor/lowest-basement level.

For clustered buildings with completely similar design and construction, it should follow the same requirement for a single building.

2. Instrumentation of Selected Building

All owners of existing buildings listed in Table 1 shall provide accessible seismic instrumentation room for the installation of appropriate earthquake recording

instruments. Location of said instruments shall be determined by a Civil/Structural Engineer.

For proposed buildings, the Civil/Structural Engineer shall include the layout, installation requirements, and location of the instrument in the structural plan submitted for building permit purposes.

The actual installation of the instruments shall be under the supervision of the Certified Civil/Structural Engineer verified and confirmed by the Building Official.

For existing buildings, the installation and operation of these instruments shall form part of the requirements of the Annual Certificate of Inspection issued by the Building Official.

Owners of existing buildings with already installed Earthquake Recording Instrumentation (ERI) shall be notified by the Building Official to comply with these guidelines accordingly, in case the specifications of the ERI installed do not conform as prescribed in these guidelines. However, the jurisdiction of the annual inspection shall be limited only on reporting the existence of the seismic instruments in a building, detailed installation number, latest certification of the local building official and a narrative physical condition as it was found by the Building Official.

For newly constructed buildings, the installation of these instruments shall form part of the requirements for Certificate of Occupancy issued by the Building Official, indicating there on Earthquake Instrument Notification Procedures in Compliance to these guidelines and rules.

TABLE 1. SEISMIC INSTRUMENTATION REQUIREMENTS

TYPE/HEIGHT OF BUILDING	LOCATION	REQUIREMENTS
GOVERNMENT BUILDINGS A. Hospitals, schools andother buildings above fifty (50) meters in height	At least 3 accelerographs located at: 1. Ground Floor/lowest Basement; 2. Middle Floor, and 3. Floor below Roof	ERI in compliance with this IRR
B. Hospitals with fifty (50)-bed capacity or more and schools with twenty(20) classrooms or more but not than three(3) storeys	One Accelerograph installed at Ground Floor/Lowest Basement	ERI in compliance with this IRR
C. Provincial/City/Municipal Halls and Buildings	One Accelerograph installed at Ground Floor/Lowest Basement	ERI in compliance with this IRR

TYPE/HEIGHT OF BUILDING	LOCATION	REQUIREMENTS
PRIVATE BUILDINGS A. Buildings above fifty (50) meters in height	At least 3 accelerographs located at: 1. Ground Floor / Lowest Basement 2. Middle Floor, and 3. Floor Below Roof	ERI in compliance with this IRR
B. Hospitals with fifty (50)-bed capacity or more and schools with twenty (20) classrooms or more but not less than 3 storeys	One accelerographs installed at the Ground Floor / Lowest Basement	ERI in compliance with this IRR
C. Commercial buildings with occupancy of at least 1,000 persons or gross floor area of at least 10,000 square meters.	One accelerographs installed at the Ground Floor / Lowest Basement	ERI in compliance with this IRR
D. Industrial buildings with occupancy of at least 1,000 persons and gross floor area of at least 10,000 square meters	One accelerographs installed at the Ground Floor / Lowest Basement	ERI in compliance with this IRR

Blueprint of the as-built plans of the buildings;

3. Additional Requisite Information of Buildings to be Instrumented

It is necessary to establish a baseline data to make effective use of the records to be collected from the accelerograph installed in the building. The following information are required:

a. Blueprint of the as-built plans of the buildings;

b. Structural design calculations/computations;

c. Dynamic analysis (mode shapes and frequencies), as used in the design

calculations, if available, forced vibration test results, and ambient vibration test results; and,

d. Comprehensive sub-surface soil exploration and investigation report.

V. STANDARD SPECIFICATIONS

1. The following are the minimum specifications for Earthquake Recording Instruments (ERI) to be used for buildings listed in Table 1:

a. Accelerogaph

- Seismic qualified as tested by recognized international testing laboratory
- Stores seismic activity information as gathered by the attached accelerometer
- Equipped with fault detection
- Provides real-time alarm information (either audio, visual or both) duringan earthquake event.
- Equipped with internal battery back-up power to ensure continuous operation during a power fluctuation.
- Where applicable, it may include:
- Minimum design life: 10 years and should be demonstrated and certifiedto have a 40,000-hour(minimum)mean timebetween failures
- Minimum of three components (vertical, longitudinal andtransverse)
- Natural Frequency: Above 50 Hz
- Damping: Approximately 60-70 percent critical
- Sensitivity: 2g
- Bandwidth: DC to 100 Hz
- Environment: IP 67

b. Recording

- Sampling Frequency: Minimum of 100 samples per second
- Time: From at least 20 seconds before the ground shaking begins until 30 seconds after the last triggering level motion
- RMS Noise: System noise shall be less than 40 µg measured over 0-30 Hz.
- Media: Memory Card
- Continuous Recording: capable of continuous recording
- AD Converter: 16

bits c. Timing

- Interval: Half a second or less
- Accuracy:Plus or minus 0.2 second per 100 seconds
- Type: GPS or NTP Server

d. Triggering (As applicable)

- Method: Pendulum or other device using earthquake motion as an exciting force
- Level: Accelerograph: 0.5 to 100 gals nominal velocitimeter: 5 µm/s to 1 mm/s
- Time: Full operation of accelerograph/velocity in not over 0.1 second after activitation.

e. Power

- Battery maintained by charger

f. Communication

- Ethernet: 10 base –T or 100 base-TX
- Protocol: TCP/IP FTP/SFTP

2. Records. To maintain continuous recording of data, a media for recording must be used at all times.

3. Battery Inspection. The accelerograph shall be tested with any charge device disconnected from an electric power source.

VI. LOCATION AND INSTALLATION OF THE INSTRUMENTS

1. General

The instrument shall be located so that access by qualified technical personnel is maintained at all times and is unobstructed by room contents. A sign stating "MAINTAIN CLEAR ACCESS TO THIS INSTRUMENT" shall be posted in a conspicuous location. *No instrumentshallbe located in refuge area.*

The preferred locations of the instruments are in small, seldom used rooms or closets near a column (in a vertically aligned stack), with adequate space to securely mount the instrument and an approved protective enclosure attached securely to the floor. The location shall be marked on the submitted structural and architectural floor plans and properly approved.

2. Buildings with Three (3) or More Accelerographs

For buildings with 3 or more accelerographs, the instruments shall be located in the ground floor/lowest basement, middle floor, and floor below the roof. The locations of the instruments are selected to provide the maximum information of the building response from a major earthquake. Such information would form part of the valuable data in understanding the building's behavior during major seismic event.

3. Orientation of Instruments

All instruments shall be installed with the same orientation relative to the building, with the orientation chosen such that the reference or long dimension of the instrument is aligned with a major axis of the building. The orientation of the instruments shall be clearly marked on the submitted structural and architectural plans. The owner/supplier shall certify that the instruments are oriented as per plan and confirmed by the concerned Building Official.

VII. DATA RETRIEVAL AND INTERPRETATION

Immediately after the occurrence of magnitude 6 earthquake or greater, the Building Official shall require the owner to retrieve the data and to have the data interpreted by a Certified Civil/Structural Engineer. The data and interpretation shall be submitted by the Owner to DPWH for storage, post-earthquake safety evaluation of the buildings and emergency response demands through the concerned Building Official.

VIII. DATA STORAGE AND ARCHIVING

Data storage and archiving shall be at DPWH Central Office or other data centers designated by the DPWH. The ASEP, upon written request to the DPWH, shall be provided by the said data.

IX. CERTIFICATE OF INSTALLATION OF EARTHQUAKE RECORDING INSTRUMENTATION

Upon compliance of the building owners to these guidelines and implementing rules on earthquake recording instrumentation, the Building Official shall issue a Certificate of Installation of Earthquake Recording Instrumentation. The Certificate must be posted in a conspicuous place, properly protected/secured in the ground floor lobby of the building as well as at the site of each instrument.

X. PROHIBITION

The mixing/combination of the seismic equipment's peripherals and parts with other brands or maker must not be done because these systems and parts are not inter-operable(or if they are, it diminishes its accuracy) and will definitely contribute to the dysfunctionality of the machine in time.

XI. TESTING, INSPECTION AND COMMISSIONING

Each component of seismic monitoring system shall be tested individually and as a complete system for proper functioning of all operational features. Only test equipment from company with international testing certification shall be allowed to make the testing. Only calibrated results shall be subjected to commissioning and acceptance, and shall qualify towards the issuance of the necessary permits by the Office of the Building Official. Test results must be signed by the respective suppliers and shall be submitted to

the Building Official, as a requirement for the certification of the Building Official who will commission the instrument.

The owner of the building shall be responsible for the protection and maintenance of the site of the ERI as prescribed in this IRR.

Building Owner, Building Official, and Supplier shall inspect, test, and commission the seismic monitoring system together to ensure that the systems are in proper operational condition and comply with the requirements of these guidelines.

XII. SUPPORT AND MAINTENANCE

The seismic monitoring system shall have a maintenance clearance as per the requirement of the National Structural Code of the Philippines under Section 105.2. "Maintenance and service shall be provided by the owner of the building."

The supplier shall provide guarantee that the system shall have a maintenance period for at least 10 years.

For the service period, the maximum service interval is one year. The three Recording accelerographs shall be integrated together to function in unison that a failure in one unit shall not hinder the progress of the entire building seismic monitoring system. The accelerograph shall be equipped with fault detection and alarm that in the event of a fault, the building owners shall call the supplier, and report the fault to Building Official. Calibration testing shall be made in a per year basis to ensure that the integrated systems are in its proper operational efficiency.

The equipment obsolescence shall not hinder the proper continuous operation of the equipment throughout the 10yearsduration. When the equipment's supplier finds that the instrument must be removed from the building for repair, there must be a service unit as a temporary replacement to continue the collection of data, if and when there is an occurrence of an earthquake during the duration of the repair.

XIII. SEPARABILITY CLAUSE

If any provision of these Guidelines and Implementing Rules on Earthquake Recording Instrumentation for Buildings or the application thereof to any person or circumstance is declared unconstitutional or invalid by any competent court, the other sections and

provisions hereof which are not affected thereby shall continue to be in full force and effect.

XIV. REPEALING AND AMENDING CLAUSE

All Department Orders, Rules and Regulations, Memoranda, Circulars and other issuances in consistent here with or contrary to the provisions of these Guidelines and Implementing Rules on Earthquake Recording Instrumentation for Buildings are hereby superseded or modified accordingly.

XV. EFFECTIVITY

These Guidelines and Implementing Rules on Earthquake Recording Instrumentation for Buildings shall take effect fifteen days after its publication once a week for three (3) consecutive weeks in a newspaper of general circulation.

XVI. REFERENCES

1. D. Skoinik et. Al. A Quantitative Basis for Building Instrumentation Specifications, NSF CMMI Researchand Innovation Conference 2009 (Hawaii)
2. M. Celebi. Seismic Instrumentation of Buildings: Special GSA/USGS Project (2002).
3. Guideline for ANSS Seismic Monitoring of Engineered Civil Systems- Version 1.0
4. National Building Code of the Philippines (PD 1096)
5. National Structural Code of the Philippines (NSCP) 2010 5th Edition
6. Industry Code and Standards
    a. National Fire Protection Association

Section VIII. Bill of Quantities

Notes on the Bill of Quantities

Objectives

The objectives of the Bill of Quantities are:

to provide sufficient information on the quantities of Works to be performed to enable Bids to be prepared efficiently and accurately; and

when a Contract has been entered into, to provide a priced Bill of Quantities for use in the periodic valuation of Works executed.

In order to attain these objectives, Works should be itemized in the Bill of Quantities in sufficient detail to distinguish between the different classes of Works, or between Works of the same nature carried out in different locations or in other circumstances which may give rise to different considerations of cost. Consistent with these requirements, the layout and content of the Bill of Quantities should be as simple and brief as possible.

Daywork Schedule

A Daywork Schedule should be included only if the probability of unforeseen work, outside the items included in the Bill of Quantities, is high. To facilitate checking by the Entity of the realism of rates quoted by the Bidders, the Daywork Schedule should normally comprise the following:

A list of the various classes of labor, materials, and Constructional Plant for which basic daywork rates or prices are to be inserted by the Bidder, together with a statement of the conditions under which the Contractor will be paid for work executed on a daywork basis.

Nominal quantities for each item of Daywork, to be priced by each Bidder at Daywork rates as Bid. The rate to be entered by the Bidder against each basic Daywork item should include the Contractor's profit, overheads, supervision, and other charges.

Provisional Sums

A general provision for physical contingencies (quantity overruns) may be made by including a provisional sum in the Summary Bill of Quantities. Similarly, a contingency allowance for possible price increases should be provided as a provisional sum in the Summary Bill of Quantities. The inclusion of such provisional sums often facilitates budgetary approval by avoiding the need to request periodic supplementary approvals as the future need arises. Where such provisional sums or contingency allowances are used, the SCC should state the manner in which they will be used, and under whose authority (usually the Procuring Entity's Representative's).

The estimated cost of specialized work to be carried out, or of special goods to be supplied, by other contractors should be indicated in the relevant part of the Bill of Quantities as a particular provisional sum with an appropriate brief description. A separate procurement procedure is normally carried out by the Procuring Entity to select such specialized contractors. To provide an element of competition among the Bidders in respect of any facilities, amenities, attendance, etc., to be provided by the successful Bidder as prime Contractor for the use and convenience of the specialist contractors, each related provisional sum should be followed by an item in the Bill of Quantities inviting the Bidder to quote a sum for such amenities, facilities, attendance, etc.

Signature Box

A signature box shall be added at the bottom of each page of the Bill of Quantities where the authorized representative of the Bidder shall affix his signature. Failure of the authorized representative to sign each and every page of the Bill of Quantities shall be a cause for rejection of his bid.

These Notes for Preparing a Bill of Quantities are intended only as information for the Procuring Entity or the person drafting the Bidding Documents. They should not be included in the final documents.

REPUBLIC OF THE PHILIPPINES
PHILIPPINE STATISTICS AUTHORITY
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COMPANY LOGO

COMPANY NAME AND ADDRESS

PROCUREMENT OF DESIGN AND BUILD SERVICES FOR THE A&E DESIGN OF FIT-OUT AND LANDSCAPE WORKS AND CONSTRUCTION OF ESSENTIAL MEFPS AND OTHER SUPPORTING CIVIL WORKS.

PROJECT: 23 STOREY COVERED WITH ROOFDECK PSA BUILDING
LOCATION:EAST AVENUE DILIMAN QUEZON CITY

BILL OF QUANTITIES SUMMARY (STAGE II)

Item	Description	Total Amount
I	**GENERAL REQUIREMENTS**	
II	**ELECTRICAL WORKS**	
III	**MECHANICAL WORKS**	
	II.1. Air-Conditioning and Ventillation System	
	II.2. Fire Protection System	
	II.3. Fuel Oil System	
IV	**ELECTRONICS/ AUXILIARY WORKS**	
V	**PLUMBING WORKS**	
VI	**CIVIL WORKS**	
	TOTAL AMOUNT	

Submitted by:

_____

Name
Position
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COMP ANY LOGO

COMPANY NAME AND ADDRESS

PROCUREMENT OF DESIGN AND BUILD SERVICES FOR THE A&E DESIGN OF FIT-OUT AND LANDSCAPE WORKS AND CONSTRUCTION OF ESSENTIAL MEFPS AND OTHER SUPPORTING CIVIL WORKS. (STAGE II)

Location: PSA Complex, East Avenue, Quezon City

BILL OF QUANTITIES (BOQ)

I. GENERAL REQUIREMENTS

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST
					OCM	PROFIT	%	VALUE				
1	2	3	4		6	7	8	9 5X8	10 (_%)[5+9]	11 9+10	12 5+11	13 12x3
I	**GENERAL REQUIREMENTS**											
I.1	**GENERAL REQUIREMENTS/ PRELIMINARIES**											
	I.1 **Mobilization**	1.00	lot									
	I.2 **Permits and Licenses**	1.00	lot									
	I.3 **Temporary Facilities**	11.00	month/s									
	I.3.1 **Temporary Offices**											
	I.3.2 **Barracks for Staff**											
	I.3.3 **Barracks for Workers**											
	I.4 **Temporary Utilities (Water, Electricity , Internet and Communication)**	11.00	month/s									
	I.5 **Site Supervision /Site Management and Office Expenses**	11.00	month/s									
	I.6 **Safety and Security**	11.00	month/s									
	I.7 **Bonds and Insurances**											
	I.7.1 Premium on Bid Security	4.00	month/s									
	I.7.2 Premium on Performance Security	24.00	month/s									
	I.7.3 Premium on Warranty Security	15.00	month/s									
	I.7.4 Premium on Surety for Advance Payment	11.00	month/s									
	I.7.5 Premium on Contractors All Risk Insurance	11.00	month/s									
	I.7.6 Premium on Contractor Employees Accident Insurance and CGL	11.00	month/s									
	I.8 **As-Built Drawings and Shop Drawings**	11.00	lot									
	I.9 **Quality Control/ Testing and Commisioning**	1.00	lot									
	I.10 **Site Clearing and Demobilization**	11.00	month/s									
	I.11 **Lifting Machine (Equipments)**	11.00	month/s									
	I.12 **Additional Construction Safety & Health (Covid Response)**	1.00	lot									
											TOTAL	

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II. ELECTRICAL WORKS

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
II.	**ELECTRICAL WORKS (see attached plans)**												
II.1	**SERVICE ENTRANCE**												
	II.1.1 **Wires and Cables including connectors, tapes, etc.**												
	II.1.1.1 **XLPE CABLE (34.5 KV) ,- copper, -XLPE insulation, Extruded Semi-Conductive Conductor, - 90 degrees C up to 250 degrees C short circuit condition**	262.00	lm/s										Location: Ground. AS PER DESIGNERS RECOMMENDATION
	II.1.1.2 **Cable Terminating Kit**	7.00	set										
II.2	**MAIN AND SUB-MAIN DISTRIBUTION**												
	II.2.1 **Pipes**												
	II.2.1.1 **15mm ø IMC Pipe**	2,853.00	lgt										Location: Where needed. AS PER DESIGNERS RECOMMENDATION
	II.2.1.2 **25mm ø IMC Pipe**	1,423.00	lgt										
	II.2.1.3 **32mm ø IMC Pipe**	579.00	lgt										
	II.2.1.4 **40mm ø IMC Pipe**	338.00	lgt										
	II.2.1.5 **50mm ø IMC Pipe**	152.00	lgt										
	II.2.1.6 **80mm ø IMC Pipe**	448.00	lgt										
	II.2.1.7 **90mm ø IMC Pipe**	243.00	lgt										
	II.2.1.8 **100mm ø IMC Pipe**	1,565.00	lgt										
	II.2.1.9 **20mm ø PVC Pipe**	350.00	lgt										
	II.2.2 **Wires and Cables (Including Fittings, Supports and Hangers and Consumables)** stranded copper wire												
	II.2.2.1 **3.5mm sq. THHN**	43,088.00	lm/s										Location: Where needed. AS PER DESIGNERS RECOMMENDATION
	II.2.2.2 **5.5mm sq. THHN**	11,259.00	lm/s										
	II.2.2.3 **8.0mm sq. THHN**	23,618.00	lm/s										
	II.2.2.4 **14mm sq. THHN**	5,928.00	lm/s										
	II.2.2.5 **22mm sq. THHN**	3,846.00	lm/s										
	II.2.2.6 **30mm sq. THHN**	4,626.00	lm/s										
	II.2.2.7 **38mm sq. THHN**	5,535.00	lm/s										
	II.2.2.8 **50mm sq. THHN**	197.60	lm/s										
	II.2.2.9 **60mm sq. THHN**	2,252.00	lm/s										
	II.2.2.10 **100mm sq. THHN**	932.00	lm/s										

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II. ELECTRICAL WORKS

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	II.2.2.11 **125mm sq. THHN**	1,178.00	lm/s										Location: Where needed. AS PER DESIGNERS RECOMMENDATION
	II.2.2.12 **150mm sq. THHN**	105.00	lm/s										
	II.2.2.13 **175mm sq. THHN**	85.00	lm/s										
	II.2.2.14 **200mm sq. THHN**	4,106.00	lm/s										
	II.2.2.15 **250mm sq. THHN**	10,441.00	lm/s										ocation: Where needed. AS PER DESIGNERS RECOMMENDATION
	II.2.2.16 **250mm sq. Fire Rated Cable**	1,437.00	lm/s										
	II.2.2.17 **80mm sq. THHN**	88.00	lm/s										
	II.2.3 **GROUNDING**												
	II.2.3.1 **3.5mm sq. TW**	15,080.80	lm/s										Location: Where needed. AS PER DESIGNERS RECOMMENDATION
	II.2.3.2 **5.5mm sq. TW**	3,906.00	lm/s										
	II.2.3.3 **8.0mm sq. TW**	833.70	lm/s										
	II.2.3.4 **14mm sq. TW**	531.30	lm/s										
	II.1.2.3.5 **22mm sq. TW**	1,804.95	lm/s										
	II.2.3.6 **30mm sq. TW**	1,801.80	lm/s										
	I.2.3.7 **50mm sq. TW**	52.50	lm/s										
II.3	**LIGHTING FIXTURES**												
	II.3.1 **Including necessary Supports , boxes and dropped flexible metal conduits (FOR COMMON TOILETS FROM 7TH-24TH Flr)**												AS PER DESIGNERS RECOMMENDATION
	I.3.1.1 **Cove Light**	78.00	pcs										
II.4	**PANEL BOARDS, HV/LV SWITCH GEAR (MAIN & SUB-MAIN)**												
	II.4.1 **Panel Boards (According to plans and specifications, complete with accessories and others to make the equipment fucntionable)**												
	II.4.1.1 **LBS W/POWER FUSE (Private Pole included)**	1.00	lot										Location: Ground Floor. AS PER DESIGNERS RECOMMENDATION
	II.4.1.2 **T1 (1500KVA , 34.5KV /400V, 3Ø,60HZ) Compartmental type**	1.00	assy										
	II.4.1.3 **T2 (1500KVA , 34.5KV /400V, 3Ø,60HZ) Compartmental type**	1.00	assy										
	II.4.1.4 **T3 (1000KVA , 34.5KV /400V, 3Ø,60HZ) Compartmental type**	1.00	assy										
	II.4.1.5 **PP10 with ground and neutral bus terminal** **MAIN: 1-MCCB,ABN53c, 50A,3P, 14KA @ 415V** **BRS:** **30-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 700mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION

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II. ELECTRICAL WORKS

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	II.4.1.6 **LP10 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN63c, 60A, 3P. 14KA @ 415V** **BRS:** **25-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **1- SPCAE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 700mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.7 **DP10 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 100A, 3P, 37KA @ 415V** **BRS:** **1-MCCB, ABS103c, 60A, 3P, 37KA @ 415V** **1-MCCB, ABS103c, 50A, 3P, 37KA @ 415V** **2-SPACE, 100AF, 3P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 700mm X 550mmX 150mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.8 **PP11C with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 75A, 3P, 18KA @ 415V** **BRS:** **42-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 800mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.9 **PP11 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN63c, 40A, 3P. 14KA @ 415V** **BRS:** **20-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **2- SPCAE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 700mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.10 **LP11 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 100A, 3P. 18KA @ 415V** **BRS:** **24-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 650mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.11 **DP11 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS203c, 175A, 3P. 37KA @ 415V** **BRS:** **1-MCCB, ABS103c, 100A, 3P, 37KA @ 415V** **1-MCCB, ABS103c, 75A, 3P, 37KA @ 415V** **1-MCCB, ABS103c, 40A, 3P, 37KA @ 415V** **1-SPACE, 100AF, 3P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 750mm X 600mmX 150mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION

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II. ELECTRICAL WORKS

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	II.4.1.12 **PP12C with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 75A, 3P, 18KA @ 415V** **BRS:** **40-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 800mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.13 **PP12 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN53c, 40A, 3P. 14KA @ 415V** **BRS:** **20-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **2- SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 650mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.14 **LP12 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 100A, 3P. 18KA @ 415V** **BRS:** **25-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **2- SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 650mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.15 **DP12 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS203c, 200A, 3P. 37KA @ 415V** **BRS:** **1-MCCB, ABS103c, 100A, 3P, 37KA @ 415V** **1-MCCB, ABS103c, 75A, 3P, 37KA @ 415V** **1-MCCB, ABS103c, 40A, 3P, 37KA @ 415V** **1-SPACE, 100AF, 3P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 750mm X 600mmX 150mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.16 **PP14C with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 75A, 3P, 18KA @ 415V** **BRS:** **40-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 800mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.17 **PP14 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN53c, 40A, 3P. 14KA @ 415V** **BRS:** **20-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **2- SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 650mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNESR RECOMMENDATION

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II. ELECTRICAL WORKS

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	II.4.1.18 **LP14 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 100A, 3P. 18KA @ 415V** **BRS:** **30-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **2- SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 650mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.19 **DP14 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS203c, 200A, 3P. 37KA @ 415V** **BRS:** **1-MCCB, ABS103c, 100A, 3P, 37KA @ 415V** **1-MCCB, ABS103c, 75A, 3P, 37KA @ 415V** **1-MCCB, ABS103c, 40A, 3P, 37KA @ 415V** **1-SPACE, 100AF, 3P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 750mm X 600mmX 150mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.20 **PP15C with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 75A, 3P, 18KA @ 415V** **BRS:** **36-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 750mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.21 **PP15 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 75A, 3P. 18KA @ 415V** **BRS:** **36-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 650mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.22 **LP15 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN53c, 50A, 3P. 14KA @ 415V** **BRS:** **23-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **1- SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 650mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.23 **DP15 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS203c, 175A, 3P. 37KA @ 415V** **BRS:** **1-MCCB, ABS103c, 100A, 3P, 37KA @ 415V** **1-MCCB, ABS103c, 75A, 3P, 37KA @ 415V** **1-MCCB, ABS103c, 50A, 3P, 37KA @ 415V** **1-SPACE, 100AF, 3P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 750mm X 600mmX 150mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION

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II. ELECTRICAL WORKS

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	II.4.1.24 **PP16C with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN63c, 60A, 3P, 18KA @ 415V** **BRS:** **30-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 700mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.25 **PP16 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN53c, 50A, 3P. 14KA @ 415V** **BRS:** **29-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **1-SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 700mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.26 **LP16 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN63c, 60A, 3P. 14KA @ 415V** **BRS:** **24-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 650mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.27 **DP16 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS203c, 175A, 3P. 37KA @ 415V** **BRS:** **1-MCCB, ABS103c, 60A, 3P, 37KA @ 415V** **1-MCCB, ABS103c, 50A, 3P, 37KA @ 415V** **1-SPACE, 100AF, 3P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 750mm X 600mmX 150mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.28 **PP17C with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN53c, 40A, 3P, 14KA @ 415V** **BRS:** **18-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 600mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.29 **PP17 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 75A, 3P. 18KA @ 415V** **BRS:** **40-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 800mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION

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ITEM NO.	DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	II.4.1.30 **LP17 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN63c, 60A, 3P. 14KA @ 415V** **BRS:** **26-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 650mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.31 **DP17 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS203c, 175A, 3P. 37KA @ 415V** **BRS:** **1-MCCB, ABS103c, 75A, 3P, 37KA @ 415V** **1-MCCB, ABS103c, 60A, 3P, 37KA @ 415V** **1-MCCB, ABS103c, 40A, 3P, 37KA @ 415V** **1-SPACE, 100AF, 3P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 750mm X 600mmX 150mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.32 **PP18 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN53c, 50A, 3P. 14KA @ 415V** **BRS:** **25-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **1-SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 700mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.33 **LP18 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN63c, 60A, 3P. 14KA @ 415V** **BRS:** **24-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 650mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.34 **DP18 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 100A, 3P. 37KA @ 415V** **BRS:** **1-MCCB, ABS103c, 60A, 3P, 37KA @ 415V** **1-MCCB, ABS103c, 50A, 3P, 37KA @ 415V** **2-SPACE, 100AF, 3P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 650mm X 600mmX 150mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.35 **PP19C with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN63c, 60A, 3P, 14KA @ 415V** **BRS:** **30-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 700mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION

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					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	II.4.1.36 **PP19 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN63c, 60A, 3P. 14KA @ 415V** **BRS:** **31-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **1-SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 750mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.37 **LP19 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN63c, 60A, 3P. 14KA @ 415V** **BRS:** **25-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **1-SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 750mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.38 **DP19 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS203c, 175A, 3P. 37KA @ 415V** **BRS:** **3-MCCB, ABS103c, 60A, 3P, 37KA @ 415V** **1-SPACE, 100AF, 3P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 750mm X 600mmX 150mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.39 **PP20C with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 75A, 3P, 14KA @ 415V** **BRS:** **36-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 750mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.40 **PP20 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN53c, 50A, 3P. 14KA @ 415V** **BRS:** **23-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **2-SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 700mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.41 **LP20 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 75A, 3P. 18KA @ 415V** **BRS:** **29-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **1-SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 700mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION

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					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	II.4.1.42 **DP20 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS203c, 175A, 3P. 37KA @ 415V** **BRS:** **2-MCCB, ABS103c, 75A, 3P, 37KA @ 415V** **1-MCCB, ABS103c, 40A, 3P, 37KA @ 415V** **1-SPACE, 100AF, 3P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 750mm X 600mmX 150mm**	1.00	assy									AS PER DESIGNERS RECOMMENDATION
	II.4.1.43 **PP21C with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 75A, 3P, 14KA @ 415V** **BRS:** **39-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **1-SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 800mm X 400mmX 130mm**	1.00	assy									AS PER DESIGNERS RECOMMENDATION
	II.4.1.44 **PP21 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN53c, 50A, 3P. 14KA @ 415V** **BRS:** **23-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **1-SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 650mm X 400mmX 130mm**	1.00	assy									AS PER DESIGNERS RECOMMENDATION
	II.4.1.45 **LP21 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 75A, 3P. 18KA @ 415V** **BRS:** **25-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **1-SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 750mm X 400mmX 130mm**	1.00	assy									AS PER DESIGNERS RECOMMENDATION
	II.4.1.46 **DP21 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS203c, 175A, 3P. 37KA @ 415V** **BRS:** **2-MCCB, ABS103c, 75A, 3P, 37KA @ 415V** **1-MCCB, ABS103c, 40A, 3P, 37KA @ 415V** **1-SPACE, 100AF, 3P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 750mm X 600mmX 150mm**	1.00	assy									AS PER DESIGNERS RECOMMENDATION
	II.4.1.47 **PP22C with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 75A, 3P, 14KA @ 415V** **BRS:** **39-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **1-SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 800mm X 400mmX 130mm**	1.00	assy									AS PER DESIGNERS RECOMMENDATION

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					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	II.4.1.48 **PP22 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN53c, 50A, 3P. 14KA @ 415V** **BRS:** **23-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **1-SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 650mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.49 **LP22 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 75A, 3P. 18KA @ 415V** **BRS:** **25-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **1-SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 700mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.50 **DP22 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS203c, 175A, 3P. 37KA @ 415V** **BRS:** **2-MCCB, ABS103c, 75A, 3P, 37KA @ 415V** **1-MCCB, ABS103c, 40A, 3P, 37KA @ 415V** **1-SPACE, 100AF, 3P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 750mm X 600mmX 150mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.51 **PP23C with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN53c, 50A, 3P, 14KA @ 415V** **BRS:** **21-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **1-SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 650mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.52 **PP23 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 75A, 3P. 18KA @ 400V** **BRS:** **35-MCB, BKN-b, 20A, 1P, 10KA @ 400V** **1-SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 900mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.53 **LP23 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 60A, 3P. 18KA @ 400V** **BRS:** **24-MCB, BKN-b, 20A, 1P, 10KA @ 400V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 750mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION

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					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	II.4.1.54 **DP23 with ground and neutral bus terminal** **MAIN: 1-60AT, 250AF, 3P, 400V, MCCB 37KA** **BRS:** **1-70AT, 100AF, 3P, MCCB 37KA** **1-60AT, 100AF, 3P, MCCB 37KA** **1-40AT, 100AF, 3P, MCCB 37KA** **1-SPACE, 100AF, 3P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 750mm X 600mmX 150mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.55 **PP24 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN53c, 40A, 3P. 14KA @ 415V** **BRS:** **24-MCB, BKN-b, 20A, 1P, 10KA @ 230V** **1-SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 750mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.56 **LP24 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 75A, 3P, 18KA @ 400V** **BRS:** **28-MCB, BKN-b, 20A, 1P, 10KA @ 400V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 750mm X 400mmX 130mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.57 **DP24 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 100A, 3P. 37KA @ 415V** **BRS:** **1-MCCB, ABS103c, 70A, 3P, 37KA @ 415V** **1-MCCB, ABS103c, 40A, 3P, 37KA @ 415V** **2-SPACE, 100AF, 3P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 700mm X 600mmX 150mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION

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					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	II.4.1.58 **DPPSRTI 17 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS803c, 500A, 3P. 65KA @ 400V** **BRS:** **1-MCCB, ABS403c, 350A, 3P, 50KA @ 400V** **1-MCCB, ABS203c, 160A, 3P, 37KA @ 415V** **2-SPACE, 100AF, 3P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 1250mm X 750mmX 350mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.59 **SUB-METER CENTER (SMC-8) with ground and neutral bus terminal** **ECB: 1-MCCB, ABS203c, 125A, 3P, 37KA @ 415V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 400mm X 550mmX 85mm** **BUSBAR GUTTER** **125A, 3PHASE, 400V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 1600mm X 350mmX 250mm** **CIRCUIT BREAKER GUTTER** **BRS:13-MCCB, ABN101c, 60A, 1P, 25KA @ 240V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 1600mm X 350mmX 250mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.60 **PP17FCU with ground and neutral bus terminal**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.61 **PP17 ACCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN403c, 350A, 3P, 50KA @ 400V** **BRS:** **1-MCCB ABH203c, 160A, 3P, 50KA @ 400V** **2-MCCB ABH203c, 125A, 3P, 50KA @ 400V** **1-MCCB ABH203c, 75A, 3P, 50KA @ 400V** **1-MCCB ABH203c, 60A, 3P, 50KA @ 400V** **1-MCCB ABH203c, 50A, 3P, 50KA @ 400V** **1-MCCB ABH203c, 40A, 3P, 50KA @ 400V** **3-100AF, 3P, SPACE** **NEMA-1, FREE STANDING, GI SHEET G#14, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 1800mm X 7000mmX 450mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION

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					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	II.4.1.62 **DPPSRTI 18 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS403c, 400A, 3P. 50KA @ 400V** **BRS:** **1-MCCB, ABS403c, 300A, 3P, 50KA @ 400V** **1-MCCB, ABS103c, 100A, 3P, 37KA @ 415V** **2-SPACE, 100AF, 3P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 1250mm X 750mmX 350mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.63 **PP18 FCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 40A, 3P, 37KA @ 400V** **BRS:** **12-MCCB, ABN101c, 20A, 1P, 25KA @ 240V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 600mm X 550mmX 150mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.64 **PP18 ACCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN403c, 350A, 3P, 50KA @ 400V** **BRS:** **1-MCCB ABH203c, 160A, 3P, 50KA @ 400V** **2-MCCB ABH203c, 125A, 3P, 50KA @ 400V** **1-MCCB ABH203c, 75A, 3P, 50KA @ 400V** **1-MCCB ABH203c, 60A, 3P, 50KA @ 400V** **1-MCCB ABH203c, 50A, 3P, 50KA @ 400V** **1-MCCB ABH203c, 40A, 3P, 50KA @ 400V** **4-100AF, 3P, SPACE** **NEMA-1, FREE STANDING, GI SHEET G#14, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 1800mm X 700mmX 450mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.65 **DPACCU1 with ground and neutral bus terminal** **MAIN: 1-ACB, AS-20ES-20H, 2000A, 3P 85KA @ 400V, FT.EO** **BRS:** **2-MCCB ABS403c, 350A, 3P, 50KA @ 400V** **6-MCCB ABS403c, 300A, 3P, 50KA @ 400V** **4- SPACE, 3P** **NEMA-1, FREE STANDING, 2-VERTICAL SECTIONS, GI SHEET G#14, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 2200mm X 1600mmX 1000mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.66 **PP7FCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 30A, 3P, 37KA @ 400V** **BRS:** **12-MCCB, ABN101c, 20A, 1P, 25KA @ 240V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 550mm X 550mmX 150mm**	1.00	assy										AS PER DESIGNER RECOMMENDATION

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ITEM NO.	DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	II.4.1.67 **PP7ACCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 350A, 3P, 50KA @ 400V** **BRS:** **1-MCCB ABS103c, 160A, 3P, 37KA @ 400V** **2-MCCB ABS103c, 125A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 100A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 60A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 50A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 30A, 3P, 37KA @ 400V** **3-100AF, 3P, SPACE** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 1350mm X 700mmX 250mm**	1.00	assy									AS PER DESIGNER RECOMMENDATION
	II.4.1.68 **NPP8FCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 30A, 3P, 37KA @ 400V** **BRS:** **12-MCCB, ABN101c, 20A, 1P, 25KA @ 240V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 550mm X 550mmX 150mm**	1.00	assy									AS PER DESIGNERS RECOMMENDATION
	II.4.1.69 **PP8ACCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 300A, 3P, 50KA @ 400V** **BRS:** **2-MCCB ABS103c, 125A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 80A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 60A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 50A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 30A, 3P, 37KA @ 400V** **4-100AF, 3P, SPACE** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 1350mm X 700mmX 250mm**	1.00	assy									AS PER DESIGNERS RECOMMENDATION
	II.4.1.70 **PP9FCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 30A, 3P, 37KA @ 400V** **BRS:** **12-MCCB, ABN101c, 20A, 1P, 25KA @ 240V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 600mm X 550mmX 150mm**	1.00	assy									AS PER DESIGNERS RECOMMENDATION
	II.4.1.71 **PP9ACCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 350A, 3P, 50KA @ 400V** **BRS:** **1-MCCB ABS103c, 175A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 160A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 100A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 80A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 30A, 3P, 37KA @ 400V** **5-100AF, 3P, SPACE** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 1350mm X 700mmX 250mm**	1.00	assy									AS PER DESIGNERS RECOMMENDATION

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II. ELECTRICAL WORKS

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	II.4.1.72 **PP10FCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABN103c, 30A, 3P, 37KA @ 400V** **BRS:** **12-MCCB, ABN101c, 20A, 1P, 25KA @ 240V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 600mm X 550mmX 150mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.73 **PP10ACCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 300A, 3P, 50KA @ 400V** **BRS:** **2-MCCB ABS103c, 125A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 80A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 70A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 50A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 30A, 3P, 37KA @ 400V** **3-100AF, 3P, SPACE** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 1350mm X 700mmX 250mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.74 **PP11FCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 30A, 3P, 37KA @ 400V** **BRS:** **12-MCCB, ABN101c, 20A, 1P, 25KA @ 240V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 600mm X 550mmX 150mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.75 **PP11ACCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 300A, 3P, 50KA @ 400V** **BRS:** **1-MCCB ABS103c, 125A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 80A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 70A, 3P, 37KA @ 400V** **1-MCCB ABS1203c, 50A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 30A, 3P, 37KA @ 400V** **3-100AF, 3P, SPACE** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 1350mm X 700mmX 250mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.76 **PP12FCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 30A, 3P, 37KA @ 400V** **BRS:** **12-MCCB, ABN101c, 20A, 1P, 25KA @ 240V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 600mm X 550mmX 150mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION

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II. ELECTRICAL WORKS

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					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	II.4.1.77 **PP12ACCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 300A, 3P, 50KA @ 400V** **BRS:** **1-MCCB ABS103c, 125A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 100A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 60A, 3P, 37KA @ 400V** **1-MCCB ABS1203c, 50A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 30A, 3P, 37KA @ 400V** **3-100AF, 3P, SPACE** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 1450mm X 700mmX 250mm**	1.00	assy									AS PER DESIGNERS RECOMMENDATION
	II.4.1.78 **PP14FCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 30A, 3P, 37KA @ 400V** **BRS:** **12-MCCB, ABN101c, 20A, 1P, 25KA @ 240V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 600mm X 550mmX 150mm**	1.00	assy									AS PER DESIGNERS RECOMMENDATION
	II.4.1.79 **PP14ACCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 300A, 3P, 50KA @ 400V** **BRS:** **1-MCCB ABS103c, 125A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 100A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 80A, 3P, 37KA @ 400V** **1-MCCB ABS1203c, 40A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 30A, 3P, 37KA @ 400V** **4-100AF, 3P, SPACE** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 1450mm X 700mmX 250mm**	1.00	assy									AS PER DESIGNERS RECOMMENDATION
	II.4.1.80 **PP15FCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 30A, 3P, 37KA @ 400V** **BRS:** **12-MCCB, ABN101c, 20A, 1P, 25KA @ 240V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 600mm X 550mmX 150mm**	1.00	assy									AS PER DESIGNERS RECOMMENDATION
	II.4.1.81 **PP15ACCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 300A, 3P, 50KA @ 400V** **BRS:** **2-MCCB ABS103c, 125A, 3P, 37KA @ 400V** **2-MCCB ABS103c, 100A, 3P, 37KA @ 400V** **2-MCCB ABS103c, 50A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 30A, 3P, 37KA @ 400V** **3-100AF, 3P, SPACE** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 1350mm X 700mmX 250mm**	1.00	assy									AS PER DESIGNERS RECOMMENDATION
	II.4.1.82 **PPSF with ground and neutral bus terminal**	1.00	assy									AS PER DESIGNERS RECOMMENDATION

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II. ELECTRICAL WORKS

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					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	I.4.1.83 **PP16FCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 30A, 3P, 37KA @ 400V** **BRS:** **12-MCCB, ABN101c, 20A, 1P, 25KA @ 240V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 600mm X 550mmX 150mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.84 **PP16ACCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS403c, 300A, 3P, 50KA @ 400V** **BRS:** **2-MCCB ABS203c, 125A, 3P, 37KA @ 400V** **2-MCCB ABS103c, 100A, 3P, 37KA @ 400V** **3-MCCB ABS103c, 50A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 30A, 3P, 37KA @ 400V** **2-100AF, 3P, SPACE** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 1350mm X 700mmX 250mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.85 **PP19FCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 30A, 3P, 37KA @ 400V** **BRS:** **12-MCCB, ABN101c, 20A, 1P, 25KA @ 240V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 650mm X 550mmX 150mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.86 **PP19ACCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS403c, 350A, 3P, 50KA @ 400V** **BRS:** **1-MCCB ABS203c, 160A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 125A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 100A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 80A, 3P, 37KA @ 400V** **2-MCCB ABS103c, 50A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 30A, 3P, 37KA @ 400V** **3-100AF, 3P, SPACE** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 1350mm X 700mmX 250mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.87 **PP20FCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 30A, 3P, 37KA @ 400V** **BRS:** **12-MCCB, ABN101c, 20A, 1P, 25KA @ 240V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 600mm X 550mmX 150mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION

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					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	II.4.1.88 **PP20ACCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS403c, 350A, 3P, 50KA @ 400V** **BRS:** **1-MCCB ABS203c, 160A, 3P, 37KA @ 400V** **3-MCCB ABS103c, 100A, 3P, 37KA @ 400V** **2-MCCB ABS103c, 50A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 30A, 3P, 37KA @ 400V** **3-100AF, 3P, SPACE** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 1450mm X 700mmX 250mm**	1.00	assy									AS PER DESIGNERS RECOMMENDATION
	II.4.1.89 **PP21FCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 30A, 3P, 37KA @ 400V** **BRS:** **12-MCCB, ABN101c, 20A, 1P, 25KA @ 240V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 600mm X 550mmX 150mm**	1.00	assy									AS PER DESIGNERS RECOMMENDATION
	II.4.1.90 **PP21ACCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS403c, 350A, 3P, 50KA @ 400V** **BRS:** **1-MCCB ABS203c, 160A, 3P, 37KA @ 400V** **2-MCCB ABS103c, 125A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 100A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 80A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 50A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 30A, 3P, 37KA @ 400V** **3-100AF, 3P, SPACE** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 1450mm X 700mmX 250mm**	1.00	assy									AS PER DESIGNERS RECOMMENDATION
	II.4.1.91 **PP22FCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 30A, 3P, 37KA @ 400V** **BRS:** **12-MCCB, ABN101c, 20A, 1P, 25KA @ 240V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 600mm X 550mmX 150mm**	1.00	assy									AS PER DESIGNERS RECOMMENDATION
	II.4.1.92 **PP22ACCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS403c, 300A, 3P, 50KA @ 400V** **BRS:** **1-MCCB ABS103c, 125A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 100A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 80A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 60A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 50A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 30A, 3P, 37KA @ 400V** **4-100AF, 3P, SPACE** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 1350mm X 700mmX 250mm**	1.00	assy									AS PER DESIGNERS RECOMMENDATION

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					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	II.4.1.93 **PP23FCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 40A, 3P, 37KA @ 400V** **BRS:** **12-MCCB, ABN101c, 20A, 1P, 25KA @ 240V** **2-SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 700mm X 550mmX 150mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.94 **PP23ACCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS403c, 350A, 3P, 50KA @ 400V** **BRS:** **4-MCCB ABS103c, 125A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 80A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 40A, 3P, 37KA @ 400V** **4-100AF, 3P, SPACE** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 1350mm X 700mmX 250mm**	1.00	assy										7th to 24th Floor. AS PER DESIGNERS RECOMMENDATION
	II.4.1.95 **PP24FCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 30A, 3P, 37KA @ 400V** **BRS:** **12-MCCB, ABN101c, 20A, 1P, 25KA @ 240V** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 600mm X 550mmX 150mm**	1.00	assy										7th to 24th Floor. AS PER DESIGNERS RECOMMENDATION
	II.4.1.96 **PP24ACCU with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS403c, 350A, 3P, 50KA @ 400V** **BRS:** **1-MCCB ABS103c, 125A, 3P, 37KA @ 400V** **3-MCCB ABS103c, 100A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 50A, 3P, 37KA @ 400V** **1-MCCB ABS103c, 30A, 3P, 37KA @ 400V** **4-100AF, 3P, SPACE** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 1350mm X 700mmX 250mm**	1.00	assy										AS PER DESIGNERS RECOMMENDATION
	II.4.1.97 **PPEF9 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 40A, 3P, 37KA @ 400V** **BRS:** **8-MCCB, ABS103c, 20A, 3P, 37KA @ 400V** **2- SPACE, 100AF, 3P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 950mm X 650mmX 150mm**	1.00	set										AS PER DESIGNERS RECOMMENDATION
	II.4.1.97 **PPEF18 with ground and neutral bus terminal** **MAIN: 1-MCCB, ABS103c, 40A, 3P, 37KA @ 400V** **BRS:** **8-MCCB, ABS103c, 20A, 3P, 37KA @ 400V** **2- SPACE, 100AF, 3P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 950mm X 650mmX 150mm**	1.00	set										AS PER DESIGNERS RECOMMENDATION

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					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	II.4.1.98 **MDPSERVA with ground and neutral bus terminal**	1.00	assy										Location: 7th to 24th Floor. AS PER DESIGNERS RECOMMENDATION
	II.4.1.99 **DPSERV AI with ground and neutral bus terminal**	1.00	assy										
	II.4.1.100 **DPSERV A2 with ground and neutral bus terminal**	1.00	assy										
	II.4.1.101 **PP SERV 7A with ground and neutral bus terminal**	1.00	assy										
	II.4.1.102 **PP SERV 8A with ground and neutral bus terminal**	1.00	assy										
	II.4.1.103 **PP SERV 9A with ground and neutral bus terminal**	1.00	assy										
	II.4.1.104 **PP SERV 10A with ground and neutral bus terminal**	1.00	assy										
	II.4.1.105 **PP SERV 11A with ground and neutral bus terminal**	1.00	assy										
	II.4.1.106 **PP SERV 12A with ground and neutral bus terminal**	1.00	assy										
	II.4.1.107 **PP SERV 13A with ground and neutral bus terminal**	1.00	assy										
	II.4.1.108 **PP SERV 14A with ground and neutral bus terminal**	1.00	assy										
	II.4.1.109 **PP SERV 15A with ground and neutral bus terminal**	1.00	assy										
	II.4.1.110 **PP SERV 16A with ground and neutral bus terminal**	1.00	assy										
	II.4.1.111 **PP SERV 17A with ground and neutral bus terminal**	1.00	assy										
	II.4.1.112 **PP SERV 18A with ground and neutral bus terminal**	1.00	assy										
	II.4.1.113 **PP SERV 19A with ground and neutral bus terminal**	1.00	assy										
	II.4.1.114 **PP SERV 20A with ground and neutral bus terminal**	1.00	assy										
	II.4.1.115 **PP SERV 21A with ground and neutral bus terminal**	1.00	assy										
	II.4.1.116 **PP SERV 22A with ground and neutral bus terminal**	1.00	assy										
	II.4.1.117 **PP SERV 23A with ground and neutral bus terminal**	1.00	assy										
	II.4.1.118 **PP SERV 24A with ground and neutral bus terminal**	1.00	assy										
	II.4.1.119 **MDPSERVB with ground and neutral bus terminal**	1.00	assy										
	II.4.1.120 **DPSERVB1 with ground and neutral bus terminal**	1.00	assy										
	II.4.1.121 **DPSERVB2 with ground and neutral bus terminal**	1.00	assy										
	II.4.1.122 **PPSERV 7B with ground and neutral bus terminal**	1.00	assy										
	II.4.1.123 **PPSERV 8B with ground and neutral bus terminal**	1.00	assy										
	II.4.1.124 **PPSERV 9B with ground and neutral bus terminal**	1.00	assy										
	II.4.1.125 **PPSERV 10B with ground and neutral bus terminal**	1.00	assy										
	II.4.1.126 **PPSERV 11B with ground and neutral bus terminal**	1.00	assy										

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II. ELECTRICAL WORKS

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	II.4.1.127 **PPSERV 12B with ground and neutral bus terminal**	1.00	assy										Location: 7th to 24th Floor. AS PER DESIGNERS RECOMMENDATION
	II.4.1.128 **PPSERV 13B with ground and neutral bus terminal**	1.00	assy										
	II.4.1.129 **PPSERV 14B with ground and neutral bus terminal**	1.00	assy										
	II.4.1.130 **PPSERV 15B with ground and neutral bus terminal**	1.00	assy										
	II.4.1.131 **PPSERV 16B with ground and neutral bus terminal**	1.00	assy										
	II.4.1.132 **PPSERV 17B with ground and neutral bus terminal**	1.00	assy										
	II.4.1.133 **PPSERV 18B with ground and neutral bus terminal**	1.00	assy										
	II.4.1.134 **PPSERV 19B with ground and neutral bus terminal**	1.00	assy										
	II.4.1.135 **PPSERV 20B with ground and neutral bus terminal**	1.00	assy										
	II.4.1.136 **PPSERV 21B with ground and neutral bus terminal**	1.00	assy										
	II.4.1.137 **PPSERV 22B with ground and neutral bus terminal**	1.00	assy										
	II.4.1.138 **PPSERV 23B with ground and neutral bus terminal**	1.00	assy										
	II.4.1.139 **PPSERV 24B with ground and neutral bus terminal**	1.00	assy										
	II.4.1.140 **LPU 1-LPU13 (TYPICAL) with ground and neutral bus termina**	13.00	assy										
	LIGHTING AND POWER SYSTEM												Location: Where needed. AS PER DESIGNERS RECOMMENDATION
	II.4.2 **Boxes and Pull Boxes (including fittings and accessories)**												
	II.4.2.1 **Utility Box**	5,261.00	pcs										
	II.4.2.2 **Square Box**	5,322.00	pcs										
	II.4.2.3 **Pull Box (500mm x 400mm x 100mm) w/ cover**	17.00	set										
	II.4.3 **Wires and Cables**												Location: Where needed. AS PER DESIGNERS RECOMMENDATION
	II.4.3.1 **3.5mm2 THHN**	224,192.00	lm/s										
	II.4.3.2 **3.5mm sq. TW**	112,096.00	lm/s										
II.5	**WIRING DEVICES**												Location: Where needed. AS PER DESIGNERS RECOMMENDATION
	II.5.1 **Three Way Switch, -NEMA WD 1, heavy-duty, AC only general-use snap switch, -300v, AC / 15 amperes, -Manufacturers or approve equal**	32.00	pcs										
	II.5.2 **GFCI Duplex Convenience Outlet, -NEMA WD 1, heavy-duty general use receptacle, - manufacturers or approved equal**	5.00	pcs										
II.6	**PP1** **Sump pump for Machine Room Less Elevator (Including Fittings, Supports and Hangers and Consumables) for basement elevator pit of Basement - 6/F**												Location: Basement. AS PER DESIGNERS RECOMMENDATION
	II.6.1 **1SET 2-3.5mm sq. THHN, STRANDED COPPER WIRE**	147.00	lm/s										

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II. ELECTRICAL WORKS

ITEM NO.		DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
						OCM	PROFIT	%	VALUE					
1		2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
		II.6.2 **1SET 1-3.5mm sq. TW, STRANDED COPPER WIRE**	73.50	lm/s										Location: Basement. AS PER DESIGNERS RECOMMENDATION
		II.6.3 **15mm ø IMC Pipe**	73.50	lgt										
		II.6.4 **20 AT 1phase, 1 pole, MCCB, ABN101C, 20A, 1P, 25KA @ 230V**	1.00	pcs										
		II.6.5 **GFCI Duplex Convenience Outlet, -NEMA WD 1, heavy-duty general use receptacle, - manufacturers or approved equal**	1.00	pcs										
II.7	**MDPB TO**	**Exhaust Fan (PPERFD) (Including Fittings, Supports and Hangers and Consumables) for additional exhaust/ fresh air fan (ACCU) by mechanical at roofdeck**												
		II.7.1 **1set (4-200mm sq. THHN) STRANDED COPPER WIRE**	974.40	lm/s										Location: Ground Floor. AS PER DESIGNERS RECOMMENDATION
		II.7.2 **1set (1-22mm sq. TW) STRANDED COPPER WIRE**	243.60	lm/s										
		II.7.3 **1set (80mm IMC pipe)**	243.60	lgt										
		II.7.4 **250ATCB 3phase, 3P, MCCB, ABS203C, 250A, 3P, 37KA @ 400V**	1.00	pc										
II.8	**PP23ACCU =**	**PPEFRD PanelAT ROOFDECK (Including Fittings, Supports and Hangers and Consumables) Main: 1-MCCB, ABS403c, 250A, 3P, 50kA @ 400V Brs: 1- MCCB, ABS203C, 60A, 3P, 37KA @400V (AHU/FRESH AIRROOFDECK @ 22KW) 3-MCCB, ABS103C, 40A, 3P, 37KA @400V (ACCU/FRESH AIR @ 20HP) 2-MCCB, ABS103C, 40A, 3P, 37KA @400V (ACCU/SERVER ROOM @ 20HP) 5- MCCB,ABS103S, 20A, 3P, 37KA @400V (1- CR EXHAUSTFAN, 2-SMOKE EVACUATION, 2- EXHAUST FAN) ROOF DECK 1- SPACE, 100AF, 3P NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS DIMENSION: 2200mm X 1600mmX 1000mm**	1.00	assy										
	60A	II.8.1 **1set (4-14mm sq. THHN) STRANDED COPPER WIRE**	168.00	lm/s										Location: Roof Deck. AS PER DESIGNERS RECOMMENDATION
		II.8.2 **1set (1-5.5mm sq. TW) STRANDED COPPER WIRE**	42.00	lm/s										
		II.8.3 **1set (25mm ø IMC Pipe)**	42.00	lgt										
	5-20A	II.8.4 **1set (4-3.5mm sq. THHN) STRANDED COPPER WIRE**	3,360.00	lm/s										
		II.8.5 **1set (1-3.5mm sq. TW) STRANDED COPPER WIRE**	210.00	lm/s										
		II.8.6 **1set (15mm ø IMC Pipe)**	210.00	lgt										
	3-40A	II.8.7 **1SET (4-8.0mm sq. THHN) STRANDED COPPER WIRE**	2,016.00	lm/s										
		II.8.8 **1SET (1-5.5 mm sq. TW) STRANDED COPPER WIRE**	126.00	lm/s										
		II.8.9 **1SET (25mm ø IMC pipe)**	126.00	lgt										
	2-40A	II.8.10 **1SET (4-8.0mm sq. THHN) STRANDED COPPER WIRE**	2,016.00	lm/s										
		II.8.11 **1SET (1-5.5 mm sq. TW) STRANDED COPPER WIRE**	126.00	lm/s										
		II.8.12 **1SET (25mm ø IMC pipe)**	126.00	lgt										

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II. ELECTRICAL WORKS

ITEM NO.	DESCRIPTION		QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
						OCM	PROFIT	%	VALUE					
1	2		3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
II.9	**PP11C =**	**ACUSERVBUP with ground and neutral bus terminal (Including Fittings, Supports and Hangers and Consumables) unit should be included to FCU spare/space panel for server room aircon**	1.00	assy										
		II.9.1 **17-20 AT 1phase, 1 pole, MCCB,ABN101C,20A,1P,25KA @ 230V**	17.00	pc										Location: 7th-24th Floor. AS PER DESIGNERS RECOMMENDATION
		II.9.2 **1SET (4-8.0mm sq. THHN) STRANDED COPPER WIRE**	714.00	lm/s										
		II.9.3 **1SET (1-5.5 mm sq. TW) STRANDED COPPER WIRE**	178.50	lm/s										
		II.9.4 **1SET (25mm ø IMC pipe)**	178.50	lgt										
II.10	at **PPBP** connection	**Panel PPBP (Including Fittings, Supports and Hangers and Consumables) additional pump for back-up at potable and non-potable at roofdeck**												
		additional 2 booster pump from panel PPBP base on exixting specs on panel												
		#1. booster pump 1, 5HP, 2PHASE, 2POLE, 230V												
		II.10.1 **80ATCB, 1P, MCCB, ABN101C, 80A, 1P, 25KA @ 240V**	1.00	pc										
		II.10.2 **1set (2-22mm sq. THHN)**	105.00	lm/s										Location: Roof Deck. AS PER DESIGNERS RECOMMENDATION
		II.10.3 **1set (1-8.0mm sq. TW)**	52.50	lm/s										
		II.10.4 **1set (32mm ø RSC pipe)**	52.50	lgt										
		#2. booster pump, 5HP, 2PHASE, 2POLE, 230V												
		80ATCB, 1P (WITH SPARE), MCCB, ABN101C, 80A, 1P, 25KA @ 240V												
		II.10.5 **1set (2-22mm sq. THHN), STRANDED COPPER WIRE**	105.00	lm/s										
		II.10.6 **1set (1-8.0mm sq. TW), STRANDED COPPER WIRE**	52.50	lm/s										
		II.10.7 **1set (32mm ø RSC pipe)**	52.50	lgt										
II.11	**LPELEV =**	**Panel PPJT (Including Fittings, Supports and Hangers and Consumables)** **MAIN: 1-MCCB, ABN53C, 40A, 3P, 14KA @ 415V** **BRS:** **10-MCCB,ABN101C,20A,1P,25KA @ 230V** **2- SPACE, 60AF, 1P** **NEMA-1, SURFACE MOUNTED, GI SHEET G#16, POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 600mm X 550mmX 150mm**	1.00	assy										Location: Basement. AS PER DESIGNERS RECOMMENDATION
		40 ATCB, 3P, 3ø, MCCB, ABN53C, 40A, 3P, 14KA @ 415V												
		II.11.1 **1SET (4-8.0mm sq. THHN), STRANDED COPPER WIRE**	105.00	lm/s										
		II.11.2 **1SET (1-5.5 mm sq. TW), STRANDED COPPER WIRE**	26.25	lm/s										
		II.11.3 **1SET (25mm ø IMC pipe)**	26.25	lgt										

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II. ELECTRICAL WORKS

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
II.12	**LP2=** **Panel LPB (Including Fittings, Supports and Hangers and Consumables)** **MAIN: 1-MCCB,ABS103C,30A,3P,37KA@415V** **BRS:** **14-MCB,BKN-B,20A,1P,10KA@230** **2-SPARE** **NEMA-1, SURFACEMOUNTED, GI SHEET G#16,** **POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 600mm X 400mm X 130mm**	1.00	assy										Location: Basement. AS PER DESIGNERS RECOMMENDATION
	30 ATCB, 3P, 3ø												
	II.12.1 **1SET (4-5.5mm sq. THHN)**	105.00	lm/s										
	II.12.2 **1SET (1-5.5 mm sq. TW)**	26.25	lm/s										
	II.12.3 **1SET (20mm ø IMC pipe)**	26.25	lgt										
II.13	**PP8 =** **PPB (Including Fittings, Supports and Hangers and Consumables)** **MAIN: 1- MCCB, ABN53C, 40A, 3P, 14KA @ 415V** **BRS:** **14-MCB,BKN-B,20A,1P,10KA @ 230V** **2-SPARE** **NEMA-1, SURFACE MOUNTED, DI SHEET G#16,** **POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 600mm X 400mm X 130mm**	1.00	assy										Location: Basement. AS PER DESIGNERS RECOMMENDATION
	40 ATCB, 3P, 3ø												
	II.13.1 **1SET (4-8.0mm sq. THHN)**	105.00	lm/s										
	II.13.2 **1SET (1-5.5 mm sq. TW)**	26.25	lm/s										
	II.13.3 **1SET (25mm ø IMC pipe)**	26.25	lgt										
II.14	**DP2=** **DPB (Including Fittings, Supports and Hangers and Consumables)** **MAIN: 1- MCCB, ABN103C, 100A, 3P, 18KA @ 415V** **BRS:** **1-MCCB,ABS103C,30A,3P,37KA@415V** **1- MCCB, ABN53C, 40A, 3P, 14KA @ 415V** **1- MCCB, ABS203C, 60A, 3P, 37KA @400V** **1-SPARE** **NEMA-1, SURFACE MOUNTED GI SHEET G#16,** **POWDER COATED FINISH WITH NEUTRAL, GROUNDING & TERMINAL LUGS** **DIMENSION: 700mm X 550mm X 150mm**	1.00	assy										Location: Basement. AS PER DESIGNERS RECOMMENDATION
	100 ATCB, 3P, 3ø	1.00											
	II.14.1 **1SET (4-30mm sq. THHN)**	235.20	lm/s										
	II.14.2 **1SET (1-8.0 mm sq. TW)**	58.80	lm/s										
	II.14.3 **1SET (32mm ø IMC pipe)**	58.80	lgt										
	II.14.4 **1set (4-14mm sq. THHN)**	123.48	lm/s										
	II.14.5 **1set (1-5.5mm sq. TW)**	123.48	lm/s										
	II.14.6 **1set (25mm ø IMC Pipe)**	123.48	lgt										
	II.14.7 **Square Box**	21.00	pcs										

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						OCM	PROFIT	%	VALUE					
1	2		3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
II.15	CR Office **WATER HEATER**	**WATER HEATER FOR OFFICE CR (Including Fittings, Supports and Hangers and Consumables) CR for 11/f, 15/f, 17/f, 18/f, 19/f, 20/f, 21/f, 22/f, 23/f**												
		II.15.1 **GFCI Duplex Convenience Outlet, -NEMA WD 1, heavy-duty general use receptacle, - manufacturers or approved equal**	20.00	pcs										
		II.15.2 **20- 20ATCB, 1P**	20.00	pcs										AS PER DESIGNERS RECOMMENDATION
		II.15.3 **1SET (2-3.5mm sq. THHN)**	5,460.00	lm/s										
		II.15.4 **1SET (1-3.5 mm sq. TW)**	2,730.00	lm/s										
		II.15.5 **1SET (20mm ø PVC pipe)**	2,730.00	lgt										
		II.15.6 **Utility Box**	20.00	pcs										
		II.15.7 **Square Box**	520.00	pcs										
II.16	**Electric Vehicle Charger**	**Hiconics Ce Certificated 43kw/22kw AC Type 2 Charge Point, Charging Pile for Electric Vehicles**	12.00	units										
		II.16.1 **1-MCCB, ABS103c, 100A, 3P, 37KA @ 415V**	12.00	units										
		II.16.2 **1SET (4-30mm sq. THHN)**	6,552.00	lm/s										Location: Basement, 2/F - 6/F parking
		II.16.3 **1SET (1-8.0 mm sq. TW)**	819.00	lm/s										AS PER DESIGNERS RECOMMENDATION
		II.16.4 **1SET (32mm ø PVC pipe)**	819.00	lgt										
		II.16.5 **Square Box**	120.00	pcs										
		II.16.6 **ECB 100AT,3P NEMA 3R**	12.00	units										
II.17	**FUEL PUMP**	II.17.1 **2-20AMCB, 1P**	2.00	units										
		II.17.2 **1SET (2-3.5mm sq. THHN)**	260.00	lm/s										Location: Ground Floor.
		II.17.4 **1SET (1-3.5 mm sq. TW)**	130.00	lm/s										AS PER DESIGNERS RECOMMENDATION
		II.17.5 **1SET (20mm ø IMC pipe)**	130.00	lm/s										

TOTAL	

Note: *Wires, Cables and Pipes will be based on existing as well as specs of the designer/contractor.*

General Notes:
Works should be undergo commissioning and testing after installation of equipments, materials and supply before take-over
Works should have documentation for reference before take-over
Works completion should be inspected by contractor and owner representative based on approved variation order.
Specifications of New Essential Works unless stated should follow specifications of existing works.

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III. MECHANICAL WORKS

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
III.	**MECHANICAL WORKS (see attached plans)**												
III.1	**AIR-CONDITIONING AND VENTILLATION SYSTEM**												
	III.1.1 EQUIPMENT (ROOF DECK)												
	III.1.1.1 **TEF- Roof deck (SWSI Centrifugal type, 16000CFM, 250PA, Belt Drive, 4.17KW,380/3P/60Hz, Complete with Accessories as per specs)**	1.00	Unit										As per designers recommendation. (for approval)
	III.1.1.2 **AHU-VRV- Roof deck (SWSI Centrifugal type, 24000CFM,Internal Static Pressure 304.28 pa, External Static Pressure 500 pa, Belt Drive, 22KW,380/3P/60Hz/1775rpm, Complete with Accessories as per specs), Including Out unit and Accessories**	1.00	Unit										Same as installed equipment on site to ensure proper connectivity.
	III.1.1.3 **Smoke Evacuation Fan(2),1Pressurization Fan(1)- Roof deck (SWSI Centrifugal type, 16000CFM, 250PA, Belt Drive, 4.17KW,380/3P/60Hz, Complete with Accessories as per specs)**	3.00	Unit										As per designers recommendation. (for approval)
	III.1.1.4 **EF- Roof deck (SWSI Centrifugal type, 12000CFM, 250PA, Belt Drive, 4.17KW,380/3P/60Hz, Complete with Accessories as per specs)**	2.00	Unit										As per designers recommendation. (for approval)
	III.1.2 Breaker (NEMA 3R) (STAND ALONE FOR EQPTS)												
	III.1.2.1 **Breaker (NEMA 3R) -60 AMP,380V/3PHASE/60HZ**	7.00	pcs										
	III.1.2.2 **Breaker (NEMA 3R) -40 AMP,380V/3PHASE/60HZ**	4.00	pcs										As per designers recommendation. (for approval)
	III.1.2.2.1 **14mm2 THHN**	283.50	lm										
	III.1.2.2.2 **40mmØ Liquid Tight Flexible Conduit**	189.00	lm										
	III.1.2.2.3 **5.5mm2 THHN (Grounding)**	189.00	lm										
	III.1.3 AIR-CONDITIONING SYSTEM												
	III.1.3.1 Copper Pipes, and Insulations												Same as installed equipment on site to ensure proper connectivity.
	III.1.4.1.1 **12.7 mm dia.**	2,494.80	lm										Server Room (AC Back-up) & Riser Pipes. Type L, Hard Drawn
	III.1.4.1.2 **28.58 mm dia.**	2,494.80	lm										
	III.1.4.1.3 **15.80 mm dia. (Include Server Room Back UP)**	909.30	lm										
	III.1.4.1.4 **34.5 mm dia**	827.40	lm										
	III.1.4.1.5 **44.45 mm dia. (Server Room A/C Back Up)**	81.90	lm										
	III.1.3.2 Refnet Fittings												
	III.1.4.2.1 **44.45 mm dia**	17.00	pcs										
	III.1.4.2.2 **15.80 mm dia**	69.00	pcs										Server Room (AC Back-up) & Riser Pipes. Hard Drawn
	III.1.4.2.3 **34.5 mm dia**	52.00	pcs										
	III.1.4.2.4 **28.58 mm dia**	36.00	pcs										
	III.1.4.2.5 **12.7 mm dia**	36.00	pcs										
	III.1.4.3 Valve												Server Room (AC Back-up) & Riser Pipes. Class 125 (at 300 psi maximum capacity)
	III.1.4.3.1 **12.7 mm dia.**	36.00	pcs										
	III.1.4.3.2 **28.58 mm dia.**	36.00	pcs										

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III. MECHANICAL WORKS

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	III.1.4.3.3 **15.80 mm dia. (Include Server A/C Back Up)**	52.00	pcs										Server Room (AC Back-up) & Riser Pipes. Class 125 (at 300 psi maximum capacity)
	III.1.4.3.4 **34.5 mm dia.**	52.00	pcs										
	III.1.4.3.5 **44.45 mm dia.**	17.00	pcs										
	III.1.4.5 Fittings												
	III.1.4.5.1 **12.7 male Copper Adopter**	36.00	pcs										Server Room (AC Back-up) & Riser Pipes. Hard Drawn
	III.1.4.5.2 **28.58 male Copper adopter**	36.00	pcs										
	III.1.4.5.3 **15.80 male Copper adopter (Include Server A/C Back Up)**	52.00	pcs										
	III.1.4.5.4 **34.5 male Copper adopter**	52.00	pcs										
	III.1.4.5.5 **44.45 male Copper Adopter**	17.00	pcs										
	III.1.5 ELECTROMECHNICAL WORKS												
	III.1.5.1 **Electrical Components**												
	III.1.5.1.1 **FCU Circuit Breaker**	17.00	pcs										
	III.1.5.1.2 **ACCU Circuit Breaker (NEMA 3R)**	2.00	set										Server Room (AC Back-up). Same as installed equipment on site to ensure proper connectivity.
	III.1.5.1.3 **100mm2 THHN**	18.90	lm										
	III.1.5.1.4 **65mmØ Liquid Tight Flexible Conduit**	6.30	lm										
	III.1.5.1.5 **22mm2 THHN (Grounding)**	6.30	lm										
	III.1.5.1.6 **100mm2 THHN (Neutral)**	6.30	lm										
	III.1.6 VENTILLATION SYSTEM												
	III.1.4.1 **Fresh Air Duct 1200 mm x 600 mm (As per site condition)**												Riser (All Floors) GI Sheet (per engineering standards)
	III.1.4.1.1 **Gauge 20**	129.05	sheet										
	III.1.4.2 **Duct Insulation**												Riser (All Floors) Polyolefin (per engineering standards)
	III.1.4.2.1 **Polyolefin foam with factory applied aluminum foil vapor barrier**	383.26	m2										
	III.1.4.3 **Exhaust Air Duct (2 Duct Chase) 800 mm x 900 mm (As per site condition)**												Riser (All Floors) GI Sheet (per engineering standards)
	III.1.4.3.1 **Gauge 20**	247.52	sheet										
	III.1.4.4 **Wall Demolition (2 Duct Chase)**												
	III.1.4.4.1 **3000mm x 4000mm**	1,209.60	m2										
	III.1.7 VENT CAP												8th Floor Aluminum As per original plan.
	III.1.5.1 **100mm ø**	10.00	pcs										
	III.1.8 Smoke Evacuation Duct (2 Duct Chase) 800 mm x 900 mm												Riser (All Floors) GI Sheet As per designers recommendation. (for approval)
	III.1.6.1 **Gauge 20**	247.52	sheet										
	III.1.9 Volume Damper												Aluminum/GI Sheet (provide samples for approval) (per engineering standards)
	III.1.7.1 **Relief Motorized Damper 400 mm x 350 mm (Smoke Evacuation)**	46.00	pcs										
	III.1.7.2 **Manual Volume Damper**												

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III. MECHANICAL WORKS

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	III.1.7.2.1 **600mm x 600mm (Fresh Air)**	23.00	pcs										Aluminum/GI Sheet (provide samples for approval) (per engineering standards)
	III.1.7.3 **Manual Volume Damper**												
	III.1.7.3.1 **600mm x 300mm (Exhaust Air)**	46.00	pcs										
	III.1.10 Air Louver												
	III.1.8.1 **600 mm x 300 mm (Smoke Evacuation)**	46.00	pcs										
III.2	**FIRE PROTECTION**												
	III.2.1 FIRE PROTECTION												
	III.2.1.1 **Straight Pipe Sch. 40 Including Fitting**												
	III.2.1.1.1 **25 mm dia.**	892.50	L										Schedule 40 BI Pipe
	III.2.1.1.2 **32 mm dia**	214.20	L										
`	III.2.1.2 **Sprinkler Heads**												Brass/Copper (provide samples for approval) (per original specifications)
	III.2.1.2.1 **Heads**	2,822.00	pcs										
III.3	**FUEL OIL SYSTEM**												
	III.3.1 FUEL OIL STORAGE TANK AND ACCESSORIES												
	III.3.1.1 **Fuel Oil Tank (72 hrs)**												Horizontal Above Ground. Gauge 1/4" thk Metal Steel (per original plans)
	Size Up to 72 hrs Storage Capacity												
	III.3.1.1.1 **2500mm (dia) x 5000 mm (length)**	2.00	unit										
	III.3.1.2 **Fuel Day Tank (8hrs)**												
	III.3.1.2.1 **1000mm (dia) x 1116 mm (length)**	2.00	unit										
	III.3.1.3 **Fuel Oil Pump**												Power Rating: 2HP, 220, Single Phase (per original plans)
	III.3.1.3.1 **220v/1phase/60hz**	2.00	unit										
	III.3.1.4 **Breaker (NEMA 3R) - 20 AMP,230V/1PHASE**	2.00	pcs										As per designers recommendation on original plan.
	III.3.1.4 **Fuel Dispenser**	2.00	unit										
	III.3.1.5 **Fuel Separator**	2.00	unit										
	III.3.1.6 **Ball Valve (Class 125)**												Class 125 (at 300 psi maximum capacity) (per engineering standards)
	III.3.1.6.1 **80 mm dia**	4.00	pcs										
	III.3.1.6.2 **50mm dia**	2.00	pcs										
	III.3.1.6.3 **32 mm dia**	2.00	pcs										
	III.3.1.7 **Check Valve (Class 125)**												
	III.3.1.7.1 **80 mm dia**	2.00	pcs										
	III.3.1.8 **Automatic Float Valve (Class 125)**												
	III.3.1.8.1 **220v/1phase/60hz**	2.00	pcs										
	III.3.1.8.2 **80 mm dia**												
	III.3.1.9 **Strainer (Class 125)**												
	III.3.1.9.1 **80 mm dia**	2.00	pcs										

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III. MECHANICAL WORKS

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	III.3.1.10 **Flexible Connector (Class 125)**												Class 125 (at 300 psi maximum capacity) (per engineering standards)
	III.3.1.10.1 **80 mm dia**	2.00	pcs										
	III.3.1.11 **Pressure Sensor**												
	III.3.1.11.1 **1/4 NPT**	2.00	pcs										
	III.3.1.12 **2-Way Diverging Gate Valve (Class 125)**												
	III.3.1.12.1 **80 mm dia**	2.00	pcs										
	III.3.1.13 **3-Way Diverging Gate Valve (Class 125)**												
	III.3.1.13.1 **80 mm dia**	2.00	pcs										
	III.3.1.14 **Gate Valve (Class 125)**												
	III.3.1.14.1 **50mm dia**	2.00	pcs										
	III.3.1.15 **Equalizer Balancing Valve (Class 125)**												
	III.3.1.15.1 **80 mm dia**	1.00	pcs										
	III.3.1.16 **Fuel Lever Arm**	2.00	pcs										As per designers recommendation of original plan. (per engineering standards)
	III.3.1.17 **High Sensor**	1.00	pcs										
	III.3.1.18 **Low Sensor**	1.00	pcs										
	III.3.1.19 **Straight Pipe (Sch. 40) Including Fitting**												BI Pipe (Sch.40). Per original specifications. Per engineering standards.
	III.3.1.19.1 **100mm dia**	95.09	lm										
	III.3.1.19.2 **80mm dia**	104.38	lm										
	III.3.1.19.3 **65 mm dia**	386.04	lm										
	III.3.1.19.4 **50 mm dia**	68.62	lm										
	III.3.1.19.5 **40 mm dia**	15.75	lm										
	III.3.1.19.6 **32 mm dia**	15.75	lm										

TOTAL

Note: *Wires, Cables and Pipes will be based on existing as well as specs of the designer/contractor.*

General Notes:

Works should be undergo commissioning and testing after installation of equipments, materials and supply before take-over
Works should have documentation for reference before take-over.

Works completion should be inspected by contractor and owner representative based on approved variation order.

Specifications of New Essential Works unless stated should follow specifications of existing works.

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IV. ELECTRONICS / AUXILIARY WORKS

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
IV.	**ELECTRONICS/ AUXILIARY WORKS (see attached plans)**												
IV.1	**AUXILLARY WORKS (DATA SYSTEM)**												Location : Riser (per engineering standards)
	IV.1.1 **Roughing-ins (including fittings and accessories, in place)**												
	IV.1.1.1 **63mm ø PVC Conduit**	200.00	lgt										
IV.2	**FIRE ALARM AND DETECTION SYSTEM**												Location : Riser (per engineering standards)
	IV.2.1 **Roughing-ins (including fittings and accessories, in place)**												
	IV.2.1.1 **15mm ø RSC Pipe Conduit**	1,635.00	lgt										
	IV.2.1.2 **32mm ø RSC Pipe Conduit**	500.00	lgt										
	IV.2.2 **Wires and Cables**												Riser, Basement to 6th floor (per designers recommendation for approval)
	IV.2.2.1 **1.25 mm^2 TF Wire**	29,162.00	lm										
	IV.4.2.2 **Pull Box**	24.00	assy										Riser, Auxiliary Room, Basement to 24th floor
	IV.2.3 **Devices and Equipments (Including Consumables)**												**Specifications:** Solid state, microprocessor based, modular design, fully supervised and intelligent addressable. Steel enclosure in standard finish, with hinged, locking door. Integral power supply, stand by batteries and battery charger. Provide power on LED, power failure LED, system trouble LED, system reset switch, alarm silence switch, trouble silence switch, manual evacuation switch, alarm acknowledge switch, trouble acknowledge switch, supervisory service acknowledge switch, lamp test button, tone alert, battery supervision LED, auxiliary relays and other system indicators and controls necessary for processing alarm and signalling functions. Provide appropriate permanent identification labelling of control and indicating function. Indicating lamps shall be LED type. (per designers recommendation for approval) **Location:** Ground Floor, Security Office
	IV.2.3.1 **Fire Alarm Control Panel (Addressable)**	1.00	assy										

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IV. ELECTRONICS / AUXILIARY WORKS

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					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	IV.2.3.2 **Monitoring Module**	24.00	set/s										**Specifications:** Shall permit the use of conventional detecting devices including sprinkler flow switches and supervisory switches on the addressable system. Can be mounted together in the fire alarm cabinet or be in the standard outlet boxes located near the device being monitored **Location:** Basement to 24th flr
	IV.2.3.3 **IDC (Initiating Device Circuit)**	16.00	set/s										**Specifications** : Addressable, provide auxiliary relays where required to satisfy the system operational requirements **Location :** Basement to 24th flr
	V.2.3.4 **Smoke Detector (Addressable)**	41.00	set/s										**Specification :** Photoelectric smoke detector, 360O smoke entry, adjustable obscuration/smoke detection levels, provides maintenance identification alarm, provides two LED function/working indicators. **Location :** Basement to 6th floor
	IV.2.3.5 **Heat Detector (Addressable)**	10.00	set/s										**Specification :** 135^{O} combination fixed temperature and rate of rise heat detector, provides maintenance identification alarm, provides two LED function/working indicators. **Location :** Basement to 6th floor
	IV.2.3.6 **Manual Pull Station (Addressable)**	12.00	set/s										**Specification :** single action non-coded break glass type, shall be constructed on red lexan or die cast metal with clearly visible operating instruction, station shall be suitable for surface mounting on matching back box, pulling the alarm handle shall activate the toggle switch shall cause the station alarm position, push button type manual station shall not be acceptable. **Location :** Basement to 6th floor
	IV.2.3.7 **Fire Alarm Annunciator (Addressable)**	7.00	set/s										**Specification :** Graphic annunciator showing the site plan, and access way shall be provided and installed at the security room unless noted otherwise, with indicating lamps. **Location :** Basement to 6th floor
	IV.2.3.8 **Speaker Horn**	12.00	set/s										**Specification :** Speaker Horn with strobe fire light shall be a xenon-

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IV. ELECTRONICS / AUXILIARY WORKS

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					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	IV.2.3.9 **Firemans Tel Jack**	7.00	set/s										**Specification :** Plug in jacks, each stairwell shall be a separate, individual zone, heavy-duty. **Location :** Basement to 6th floor
IV.3	**CATV SYSTEM**												
	IV.3.1 **Roughing-ins (including fittings and accessories, in place)**												
	IV.3.1.1 **50mm ø PVC Conduit**	50.00	lgt										As designers recommendation. (for approval) **Location :** riser and auxiliary room
	IV.3.1.2 **110mm ø PVC Conduit**	110.00	lgt										
	IV.3.2 **Boxes and Pull Boxes**												
	IV.3.2.1 **Utility Box**	22.00	pcs										**Specification :** metal 2" x 4" **Location :** auxiliary room
	IV.3.2.2 **Pull Box**	14.00	assy										**Specification :** metal powder coated 8" x 8" x 4"
	IV.3.3 **Cabinets with Slide Gutters, Backboards, Briddle Rings, and Terminal Block, etc.**												**Specifications** : cabinet type 24 ports
	IV.3.3.1 **MCTC (cabinet type 24 ports)**	1.00	assy										**Location :** ground floor, MDF Room
	IV.3.3.2 **CTC (cabinet type 12 ports)**	17.00	assy										**Specifications** : cabinet type 12 ports
	IV.3.4 **Wires and Cables (Including Consumables and supports)**												As per designers recommendation (for Approval) **Location :** Riser
	IV.3.4.1 **RG-59 Coaxial Cable**	2,952.00	lm/s										
	IV.3.4.2 **8.0. mm² TW**	20.00	lm/s										As per designers recommendation (for Approval) **Location :** Ground floor, MDF Room
	IV.3.4.3 **20mmØ x 3000mm Copper Clad Steel Ground Rod**	3.00	pcs										As per designers recommendation (for Approval). **Location :** Ground floor, MDF Room
IV.4	**PA/BGM SYSTEM**												As per designers recommendation (for Approval). **Location :** Riser
	IV.4.1 **Roughing-ins(including fittings and accessories, in place)**												
	IV.4.1.1 **50mm ø RSC Pipe**	50.00	lgt										
	IV.4.2 **Boxes and Pull Boxes**												As per designers recommendation (for Approval). **Location :** Auxiliary Room
	IV.4.2.1 **PABGM Pull Box**	22.00	assy										

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IV. ELECTRONICS / AUXILIARY WORKS

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					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
IV.5	**TELEPHONE SYSTEM**												
	IV.5.1 **Roughing-ins(including fittings, accessories and supports, in place)**												As per designers recommendation (for Approval). **Location** : Riser
	IV.5.1.1 **110mmø PVC (for Basement to 24th floor)**	1.00	lot										
	IV.5.1.2 **50mmø PVC (for Basement to 24th floor)**	1.00	lot										
	IV.5.2 **Cabinets & Accessories**												**Specifications** : T3 box cabinet, Type 3R, Length/Height – 1.2 meters, Depth -0.22 meters (as per designers recommendation for approval). **Location :** Ground Floor, Telco Room
	IV.5.2.1 **MTTC -1**	1.00	set/s										
	IV.5.2.2 **MTTC -2**	1.00	set/s										**Specifications** : T3 box cabinet, Type 3R, Length/Height – 1.2 meters, Depth -0.22 meters (as per designers recommendation for approval). **Location :** Ground Floor, Telco
	IV.5.2.3 **MDF**	1.00	set/s										**Specifications** : will be made for two public telephone network (as per designers recommendation for approval). **Location :** Ground Floor, Telco Room
	IV.5.2.4 **PABX**	1.00	set/s										**Specifications :** Capacity for up to 20% expansion to the present required capacity, capable of handling minimum of 16 trunk lines, 8 fully digital phone/extensions and 32 analog handsets (VOIP capable), UPS battery shall be rated for 4
	IV.5.2.5 **TTC (25 units)**	25.00	set/s										**Specifications :** T3 box cabinet, Type 3R, Length/Height – 0.3
	IV.5.3 **Wiring Devices & Boxes**												**Specifications:** metal powder coated 8" x 8" x 4" **Location :** Ground Floor, 7th Floor to 24th Floor, Server Room
	IV.5.3.1 **Pull Box (for Basement to 24th floor)**	1.00	lot										
	IV.5.4 **Grounding System (Complete with Accessories)**												As per designers recommendation (for Approval). **Location** : Ground Floor, Telco Room
	IV.5.4.1 **20mm dia. 3000mm Copper Clad Steel Ground Rod**	2.00	pcs										

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IV. ELECTRONICS / AUXILIARY WORKS

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	IV.5.4.2 **8.0 sq. mm TW**	20.00	lm										As per designers recommendation (for Approval)
IV.6	**CCTV SYSTEM**												
	IV.6.1 **Roughing-ins(including fittings, accessories and supports, in place)**												As per designers recommendation (for Approval) **Location:** Riser and Auxiliary Room
	IV.6.1.1 **20mmø PVC Conduit**	4,032.00	lgt										
	IV.6.2 **Equipments, Cabinets & Accessories**												**Specifications :** Retention of 30 days with rate of 6 FPS with resolution 320 x 240, compression type - H.264, Real-time Viewing resolution - 640 x 48 compression type - H.264, 22" Flat LCD Monitor
	IV.6.2.1 **CCTV Console**	1.00	set/s										
	IV.6.2.2 **CCTV Terminal Cabinet**	8.00	set/s										**Specification** : modular, with cooling (as per designers recommendation for approval). **Location :** 2nd Floor, 4th Floor, 8th Floor, 11th floor, 14 floor, 18th floor, 20th floor and 24th floor, Auxiliary Room
	IV.6.2.3 **CCTV Camera Ceiling Mounted**	4.00	set/s										**Specifications** : Vandal-resistant Network IR Fixed Dome Camera, 4K resolution, IP67 weatherproof, can operate for 24 hrs (as per designers recommendation for approval). **Location :** Basement to 6th floor
	IV.6.2.4 **Camera Wall Mounted**	40.00	set/s										**Specifications :** 4K resolution, IP67 weatherproof, can operate for 24
	IV.6.3 **Wiring Devices & Boxes**												**Specifications :** metal powder coated 8" x 8" x 4" **Location :** Basement to 24th floor, Auxiliary Room
	IV.6.3.1 **Pull Box**	17.00	set/s										
	IV.6.4 **Grounding System (Complete with Accessories)**												Per designers recommendation for approval. **Location** : Ground Floor, Security Room
	IV.6.4.1 **20mm dia. 3000mm Copper Clad Steel Ground Rod**	1.00	pcs										
	IV.6.4.2 **8.0 sq. mm TW**	10.00	lm										
	IV.6.5 **Wires and Cables**												Per designers recommendation for approval. **Location** : Basement to 6th floor
	IV.6.5.1 **Cat 5e UTP Cable 4-Pairs**	12,096.00	lm										
	IV.6.5.2 **3.5mm2 THHN Wire**	12,096.00	lm										

TOTAL	

Note: *Wires, Cables and Pipes will be based on existing as well as specs of the designer/contractor.*

General Notes:

Works should be undergo commissioning and testing after installation of equipments, materials and supply before take-over
Works should have documentation for reference before take-over.
Works completion should be inspected by contractor and owner representative based on approved variation order.

Specifications of New Essential Works unless stated should follow specifications of existing works.

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V. SANITARY/ PLUMBING WORKS

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9	10	11	12	13	
V.	**SANITARY/ PLUMBING WORKS (see attached plans)**												
V.1	V.1.1 **PVC Pipe Series 1000 including Fittings**												
	V.1.1.1 **100mm Ø**	229.95	lm										Per engineering standards (for approval). **Location:** 7th and 8th Floor
	V.1.1.2 **50mm Ø**	110.25	lm										
	V.1.2 **PVC Clean-Out Series 1000**												
	V.1.2.1 **100mm Ø**	12.00	pcs										
	V.1.3 **PVC P-TRAP Series 1000**	97.00	pcs										
V.2	**DRAINS AND CLEAN OUT**												
	V.2.1 **Floor Drain (Cast Iron)**												
	V.2.1.1 **100mm Ø**	44.00	pcs										
	V.2.2 **Floor Clean-out (Brass Counter Sunk)**												
	V.2.2.1 **100mm Ø**	15.00	pcs										Per engineering standards (for approval). **Location:** Ground to Roof Deck
	V.2.3 **Deck Drain (Cast Iron)**												
	V.2.3.1 **75mm Ø**	22.00	pcs										
	V.2.4 **Balcony Drain (Cast Iron)**												
	V.2.4.1 **50mm Ø**	85.00	pcs										
	V.2.5 **Area Drain (14kg/sq. reinforced concrete w/ Cast Iron or Steel grating cover)**												
	V.2.5.1 **600mm x 600mm**	28.00	pcs										
V.3	**WATER LINE WORKS**												
	V.3.1 **PPR Pipes & Fittings (PN20)**												
	V.3.1.1 **32mm Ø**	183.75	lm										Per engineering standards (for approval). **Location**: 7th and 8th Floor
	V.3.2 **Gate Valve (Iron w/ Bronze trim flanged connection (150 psig working pressure)**												
	V.3.2.1 **32mm Ø**	42.00	pcs										
	V.3.3 **Hose Bib (Polished Chromium Plated)**	5.00	pcs										Per engineering standards
	V.3.4 **Clevis Hanger including anchoring and consumables**												
	V.3.4.1 **100mm Ø**	194.00	pcs										Per engineering standards (for approval). **Location**: 7th and 8th Floor
	V.3.4.2 **65mm Ø**	94.00	pcs										
	V.3.5 **Loop Hanger including anchoring and consumables**												
	V.3.5.1 **32mm Ø**	171.00	pcs										
V.4	**PLUMBING FIXTURES**												
	V.4.1 **Water Closet**	14.00	sets										
	V.4.2 **Counter Top Lavatory**	17.00	sets										Per engineering standards (for approval). **Location**: 7th and 8th Floor
	V.4.2.1 **Lavatory Faucet**	17.00	sets										
	V.4.3 **Kitchen Sink (Stainless)**	7.00	sets										
	V.4.3.1 **Sink Faucet**	7.00	sets										
	V.4.4 **Hot and Cold**												
	V.4.4.1 **Shower Valves PP Single with rain shower head**	17.00	sets										

TOTAL	

Note: *Pipes will be based on existing as well as specs of the designer/contractor for connectivity.*

General Notes:
Works should be undergo testing after installation of fixtures and materials before take-over
Works should have documentation for reference before take-over.
Works completion should be inspected by contractor and owner representative based on approved variation order.
Specifications of New Essential Works unless stated should follow specifications of existing works.

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VI. CIVIL WORKS

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
VI.	**CIVIL WORKS (see attached plans)**												
VI.1	**ARCHITECTURAL WORKS**												Per engineering standard practice for installation.
	VI.1.1 **PARTITIONS (8th Floor)(see plans attached)**												
	VI.1.1.1 **150mm THK CHB**	1,283.69	sqm										
	VI.1.2 **PARTITIONS (9th Floor)((see plans attached)**												
	VI.1.2.1 **150mm THK CHB**	245.13	sqm										
	VI.1.3 **PARTITIONS (10th Floor)(see plans attached)**												
	VI.1.3.1 **150mm THK CHB**	260.77	sqm										
	VI.1.4 **WATERPROOFING HOSTEL TOILETS (8th Floor)(see plans attached)**												
	VI.1.4.1 **Liquid-Applied Waterproofing (based on designers recommendation)**	80.37	sqm										
VI.2	**STRUCTURAL WORKS (Based on designers recommendation)**												Per engineering standard practice for installation.
	VI.2.1 **FOR FUEL PUMP @ BASEMENT**												
	CONCRETE PAD (150mmX1500mmX1500mm)												
	VI.2.1.1 **Rebars (Grade 60)**	77.68	kgs										
	VI.2.1.2 **Concrete (6000 psi)**	0.36	cum										
	VI.2.1.3 **Formworks (3/4" thk Phenolic Board supported with Aluma)**	0.95	sqm										
	VI.2.2 **FOR FRESH AIR @ ROOF DECK**												
	CONCRETE PAD (150mmX3400mmX4300mm)												
	VI.2.2.1 **Rebars (Grade 60)**	1,553.66	kgs										
	VI.2.2.2 **Concrete (6000 psi)**	6.91	cum										
	VI.2.2.3 **Formworks (3/4" thk Phenolic Board supported with Aluma)**	7.28	sqm										
	VI.2.3 **FOR FRESH AIR @ ROOF DECK**												
	CONCRETE PAD (150mmX1500mmX1500mm)												
	VI.2.3.1 **Rebars (Grade 60)**	233.05	kgs										
	VI.2.3.2 **Concrete (6000 psi)**	1.06	cum										
	VI.2.3.3 **Formworks (3/4" thk Phenolic Board supported with Aluma)**	2.84	sqm										
	VI.2.4 **FOR ACCU @ ROOF DECK**												
	CONCRETE PAD (150mmX1500mmX1500mm)												
	VI.2.4.1 **Rebars (Grade 60)**	155.37	kgs										
	VI.2.4.2 **Concrete (6000 psi)**	0.71	cum										
	VI.2.4.3 **Formworks (3/4" thk Phenolic Board supported with Aluma)**	1.89	sqm										
	VI.2.5 **FOR SMOKE DETECTION @ ROOF DECK**												
	CONCRETE PAD (150mmX1500mmX1500mm)												
	VI.2.5.1 **Rebars (Grade 60)**	155.37	kgs										
	VI.2.5.2 **Concrete (6000 psi)**	0.71	cum										
	VI.2.5.3 **Formworks (3/4" thk Phenolic Board supported with Aluma)**	1.89	sqm										

Submitted by:

Name
Position
Company Name
Address & Contact Number

VI. CIVIL WORKS

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		VAT	TOTAL INDIRECT COST	UNIT COST	TOTAL COST	REMARKS/ LOCATION/ SPECIFICATIONS
					OCM	PROFIT	%	VALUE					
1	2	3	4	5	6	7	8	9 5X8	10 5%[5+9]	11 9+10	12 5+11	13 12x3	
	VI.2.6 **FOR EXHAUST @ ROOF DECK**												Per engineering standard practice for installation.
	CONCRETE PAD (150mmX1500mmX1500mm)												
	VI.2.6.1 **Rebars (Grade 60)**	155.37	kgs										
	VI.2.6.2 **Concrete (6000 psi)**	0.71	cum										
	VI.2.6.3 **Formworks (3/4" thk Phenolic Board supported with Aluma)**	1.89	sqm										
	VI.2.7 **RAINWATER TANK (7500mmWx7500mmLx3000mmH)(site based on designers recommendation)**												
	TANK STRUCTURAL COMPONENTS												
	VI.2.7.1 **Rebars (Grade 60)**	7,848.04	kgs										
	VI.2.7.2 **Concrete (6000 psi)(with integral waterproofing)**	57.36	cum										
	VI.2.7.3 **Formworks (3/4" thk Phenolic Board supported with Aluma)**	189.00	sqm										
	VI.2.7.4 **Lean Concrete (3,000 psi)**	11.81	cum										
	VI.2.7.5 **Gravel Bedding (150mm thk)**	8.86	cum										
	VI.2.7.6 **Vapor Barrier (2-3mm thk with 300mm overlapping)**	59.06	sqm										
	VI.2.8 **SITE WORKS (Based on Designers recommendations)**												
	VI.2.8.1 **SITE SURVEY (location of rainwater tank)**	64.00	sqm.										
	EARTHWORKS												
	VI.2.8.2 **Excavation**	256.00	cum										
	VI.2.8.3 **Trimming**	120.00	sqm										
	VI.2.8.4 **Hauling and Disposal**	153.73	cum										
	VI.2.8.5 **Backfilling and Compaction**	35.00	sqm										
	VI.2.8.6 **Soil Treatment**	139.00	sq.m										
	VI.2.8.7 **Perimeter Fencing during excavation for security.**	50.00	lm										
VI.3	**EARTHQUAKE RECORDING INSTRUMENTATION**												Per engineering standards (for approval).
	VI.3.1 ACCELELOGRAPH												
	VI.3.1.1 **Supply, Delivery and Installation of Seismic Accelelograph**	3.00	unit										

TOTAL	

Note: *Verify all works based on existing as well as specs of the designer/contractor.*

General Notes:

Works should be undergo commissioning and testing after installation of equipments, materials and supply before take-over
Works should have documentation for reference before take-over.

Works completion should be inspected by contractor and owner representative based on approved variation order.

Specifications of New Essential Works unless stated should follow specifications of existing works.

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