immediately by the general painting of the whole surface, including the edges and bolt heads.

The application of the second field coat shall be deferred until adjoining concrete work has been placed and finished. If concreting operations have damaged the paint, the surface shall be re-cleaned and repainted.

c. General Manners

Painting shall be done in a neat and workmanlike manner. Paint may be applied with hand brushes or be spraying, except aluminum paint which preferably shall be applied by spraying. By either method the coating of paint applied shall be smoothly and uniformly spread so that no excess paint shall collect at any point. If the work done by spraying is not satisfactory to the Engineer hand brushing shall be required.

d. Brushing

When brushes are used, the paint shall be so manipulated under the brush as to produce a smooth, uniform, even coating in close contact with the metal or with previously applied paint, and shall be worked into all corners and crevices.

e. Spraying

Power spraying equipment shall be used to apply the paint in a fine spray. Without the addition of any paint, the sprayed area shall be immediately followed by brushing, when necessary, to secure uniform coverage and to eliminate wrinkling, blistering and air holes.

f. Removal of Paint

If the painting is unsatisfactory to the Engineer the paint shall be removed and the metal thoroughly cleaned and repainted.

ITEM 09 : MOORING AND FENDERING SYSTEM

SCOPE OF WORK

1. The work includes furnishing of all labor, materials and equipment to complete the installation of mooring bollards and fenders in piers/wharves.

2. The work shall include the supply, transport, handling, storage and installation of fenders systems in the newly constructed piers.

3. The Contractor shall furnish and install the necessary fittings as shown on the drawings and/or specified.

Supplementary parts necessary to complete and install each item of works shall be included whether or not shown or specified. The Contractor shall furnish to relevant trades all anchors, fastenings, inserts, fittings, fixtures or the like to be installed on or required for securing the works.

The Contractor shall submit shop drawings of all fitting works prior to placing orders and commencement of any fabrication.

MATERIAL REQUIREMENTS

MOORING SYSTEM

Designated load capacity of mooring bollards shall be as shown in the drawings and shall be referred to as the maximum load capacity. The mooring bollards shall be at rupture stage upon reaching the maximum load capacity.

Mooring bollards shall be of the dimensions, weights, capacities and designs as shown in the drawings and shall be fabricated by approved manufacturer with cast steel conforming to the requirements indicated in the plan/drawings, or approved equivalent.

The size of the bolts, nuts and washers shall be in accordance with the specifications provided in the plans/drawings. The anchor plate shall be connected to the holding down bolt as shown in the plans/drawings. All bolts, nuts, washers etc., that are exposed shall be hot dip galvanized.

Samples of the bolts, nuts, washers and anchor plates shall be submitted to the Engineer for approval before being used in the Works.

The upper part of bollards and base plates which are not embedded in concrete shall be painted. The surface of bollards shall be cleaned thoroughly by wire brush or other means prior to painting to remove rust or any other contamination which may interfere with bond of paint to metal.

The exposed surface shall be coated with rust proof paint and finishing paint, which shall be coal-tar epoxy of 120m micron thickness in accordance with JIS K5623 or the approved standard.

Base Steel:

Chemical composition and mechanical properties of base metal to be used for fabrication of mooring bollard and its accessories shall comply with ASTM A36 and other required standard stated therein.

Concrete Foundation:

Concrete foundation for mooring bollards shall conform to the requirements of the Section concerning "Reinforced Concrete".

Visual Inspection:

All mooring bollards delivered to Site shall be inspected by the Engineer for any signs of flaws or defect inimical to usage.

Mill Test Certificates:

Two (2) copies of mill test reports shall be submitted certifying that materials meet the specified standards.

Test Inspection:

Inspection of all materials and methods of fabrication shall be carried out by the Contractor. However, the Engineer reserves the right to inspect all facilities at any time during the manufacture to ensure that the materials and workmanship are in accordance with Specifications and the best of workmanship.

FENDER SYSTEM

The rubber fenders should comply with the performance requirements specified in the table provided on the plan/drawings of Rubber Dock Fenders (RDF).

PHYSICAL PROPERTIES OF MATERIALS

The rubber for the fenders shall be of high-quality natural rubber, synthetic rubber or mixed rubber blended with carbon black used in the rubber industry and shall have sufficient resilience and anti-ageing, weathering, abrasion, wear and oil resistant properties. The rubber dock fenders shall be free from bubbles, cracks and other harmful defects.

The physical properties of the rubber compound used for the fenders shall comply with the following requirements:

Physical Properties and Test Method

Test Item			Properties	Test Method	
Physical Test	Before Aging	Tensile Strength	160kg/sq.m minimum	Test piece: Dumbell No. 3	ASTM D412
		Elongation	350% minimum		ASTM D1456
		Hardness	76Hs maximum	Spring Type hardness test (Type A)	ASTM D2240
	After Aging	Tensile Strength	Not less than 80% of original value	Aging by air heating: 70±1°C x 96 hours.	ASTM D412
		Elongation			ASTM D1456
		Hardness	Not more than original value +8°		ASTM D2240
	Compression Test		30% maximum	Heat treatment: 70±1°C x 22 hours.	ASTM D395

Note: Equivalent Standards are acceptable.

FITTINGS AND ANCHORAGE

Anchor bolts and connecting hardware shall be fabricated using type of steel specified and to the required shapes and sizes shown on the approved plan/drawings.

TESTING, SAMPLING, INSPECTION, ACCEPTANCE, MARKING AND PACKAGING

Testing

All rubber dock fenders shall be tested for performance. It shall pass the required energy absorption and reaction force at a certain deflection as indicated in the plan.

The Contractor shall be required to submit test certificates showing compliance to the above requirements. The test certificates shall be certified by an independent testing institute / organization recognized by the Authority.

The standard performance testing methodology shall be Method B, to wit:

1. Fender temperature shall be stabilized at 23 degrees plus or minus 5 degrees centigrade for at least 24 hours before compression testing.

2. Break-in of fender by deflecting 3 times to rated deflection.

3. Removed load from the RDF and allow recovering for a minimum of 1 hour.

4. Deflect RDF at speed of 2-8 cm/min once to rated deflection.

The testing apparatus shall be calibrated and certified within plus or minus 1% in accordance with ISO or equivalent JIS or ASTM requirements. Calibration shall be traceable

to a national/international standard and shall be performed annually by an accredited third-party organization. The RDF performance testing center shall be subjected to accreditation by PPA and notation and /or certification by DPWH-BRS prior to acceptance.

Inspection

All fenders of each type shall be inspected for compliance to specified dimensions and all fenders shall be inspected by the Engineer for any sign of flaw or defect inimical to its use.

All anchor bolts and fittings shall be inspected. The material used for the fabrication of bolts and fittings shall be covered by the manufacturer's certified mill certificate and shall be verified by the Authority.

All RDF items/units shall be clearly numbered and marked indicated the following:

Acceptance Tolerance

The acceptance tolerance shall be based on the following:

1. Fender Dimension

Length	:	-2% to +4%
Width	:	-2% to +4%
Height	:	-2% to +4%
Thickness	:	-2% to +8%

2. Anchor Bolt Holes in Fender

Diameter of the Hole	:	+2.0mm
Pitch of the Hole	:	+4.0mm

3. Acceptance tolerance for all fenders supplied shall be as follows:

E = Energy absorption,	E ≥ Specified E but not less than 10% of the specified E
R = Reaction force,	R ≤ Specified R but not more than 10% of the specified R

Marking

All fender units shall be clearly numbered and marked. Each fender shall have the following markings.

1. Fender type and manufacturer's name or trademark
2. Production serial number
3. Date of manufacture or its abbreviation

4. Main dimensions

5. Project identification as follows:

Name of Port/Project:_____

Year supplied _____

Packaging

The fenders shall be packaged on wooden crate or wrapped individually with Polypropylene sheets except when shipped containerized. The bolts and fittings should be placed in crates and suitably treated for protection when transported by sea and stored in port areas.

EXECUTION

MOORING / FENDERING SYSTEM

All units shall be installed at the locations shown on the drawings and as directed by the Engineer.

ITEM 10 : AGGREGATE SUB-BASE COURSE

DESCRIPTION

This item shall consist of furnishing, placing and compacting an aggregate subbase course on a prepared subgrade in accordance with this Specification and the lines, grades and cross-sections shown on the Plans, or as directed by the Engineer.

MATERIAL REQUIREMENTS

Aggregate for subbase shall consist of hard, durable particles or fragments of crushed stone, crushed slag, or crushed or natural gravel and filler of natural or crushed sand or other finely divided mineral matter. The composite material shall be free from vegetable matter and lumps or balls of clay and shall be of such nature that it can be compacted readily to form a firm, stable subbase.

The subbase material shall conform to the following Grading Requirements

Grading Requirements

Sieve Designation		Mass Percent Passing
Standard, mm	Alternate US Standard	
50	2"	100
25	1"	55 – 85
9.5	3/8"	40 – 75
0.075	No. 200	0 - 12

The fraction passing the 0.075 mm (No. 200) sieve shall not be greater than 0.66 (two thirds) of the fractions passing the 0.425 mm (No. 40) sieve.

The fraction passing the 0.425 mm (No. 40) sieve shall have a liquid limit not greater than 35 and plasticity index not greater than 12 as determined by AASHTO T 89 and T 90, respectively.

The coarse portion, retained on a 2.00 mm (No. 10) sieve, shall have a mass percent of wear not exceeding 50 by the Los Angeles Abrasion Tests as determined by AASHTO T 96.

The material shall have a soaked **CBR value of not less than 25%** as determined by AASHTO T 193. The CBR value shall be obtained at the maximum dry density and determined by AASHTO T 180, Method D.

CONSTRUCTION REQUIREMENTS

PLACING

The aggregate subbase material shall be placed at a uniform mixture on a prepared subgrade in a quantity which will provide the required compacted thickness. When more than one layer is required, each layer shall be shaped and compacted before the succeeding layer is placed.

The placing of material shall begin at the point designated by the Engineer. Placing shall be from vehicles especially equipped to distribute the material in a continuous uniform layer or windrow. The layer or windrow shall be of such size that when spread and compacted the finished layer be in reasonably close conformity to the nominal thickness shown on the Plans.

When hauling is done over previously placed material, hauling equipment shall be dispersed uniformly over the entire surface of the previously constructed layer, to minimize rutting or uneven compaction.

SPREADING AND COMPACTING

When uniformly mixed, the mixture shall be spread to the plan thickness, for compaction.

Where the required thickness is 150mm or less, the material may be spread and compacted in one layer. Where the required thickness is more than 150 mm, the aggregate base shall be spread and compacted in two or more layers of approximately equal thickness, and the maximum compacted thickness of any layer shall not exceed 150 mm. All subsequent layers shall be spread and compacted in a similar manner.

The moisture content of sub-base material shall, if necessary, be adjusted prior to compaction by watering with approved sprinklers mounted on trucks or by drying out, as required in order to obtain the required compaction.

Immediately following final spreading and smoothening, each layer shall be compacted to the full width by means of approved compaction equipment. Rolling shall progress gradually from the sides to the center, parallel to the centerline of the road and shall continue until the whole surface has been rolled. Any irregularities or depressions that develop shall be corrected by loosening the material at these places and adding or removing material until the surface is smooth and uniform. Along curbs, headers, and walls, and at all places not accessible to the roller, the base material shall be compacted thoroughly with approved tampers or compactors.

If the layer of base material, or part thereof, does not conform to the required finish, the Contractor shall, at his own expense, make the necessary corrections.

Compaction of each layer shall continue until a **field density of at least 100 percent** of the maximum dry density determined in accordance with AASHTO T 180, Method D has been achieved. In-place density determination shall be made in accordance with AASHTO T 191/ASTM D 1556.

TRIAL SECTION

Before subbase construction is started, the Contractor shall spread, and compact trial sections as directed by the Engineer. The purpose of the trial sections is to check the suitability of the materials and the efficiency of the equipment and the construction method which is proposed to be used by the Contractor. Therefore, the Contractor must use the same material, equipment and procedures that he proposes to use for the main work. One trial section of about 500 m^2 shall be made for every type of material and/or construction equipment/procedure proposed for use.

After final compaction of each trial section, the Contractor shall carry out such field density tests and other tests required as directed by the Engineer.

If a trial section shows that the proposed materials, equipment or procedures in the Engineer's opinion are not suitable for subbase, the material shall be removed at the Contractor's expense, and a new trial section shall be constructed.

If the basic conditions regarding the type of material or procedure change during the execution of the work, new trial sections shall be constructed.

SURVEYS AND SETTING OUT WORKS

Before the commencement of the pavement works, the Contractor together with the Engineer shall conduct a topographic survey which will form the basis of quantity measurement.

The Contractor shall set out the works and shall be solely responsible for the accuracy of such setting-out.

Prior to placement of any material, the Contractor shall establish visible construction markers to clearly define horizontal limits of the Work.

TOLERANCES

The aggregate base course shall be laid to the designed level and transverse slopes shown on the Plans. The allowable tolerances shall be in accordance with following:

Permitted variation from design THICKNESS OF LAYER	± 20 mm
Permitted variation from design LEVEL OF SURFACE	+ 10 mm -20 mm
Permitted SURFACE IRREGULARITY Measured by 3-m straight-edge	20 mm
Permitted variation from design CROSSFALL OR CAMBER	± 0.3%
Permitted variation from design LONGITUDINAL GRADE over 25 m in length	± 0.1%

METHOD OF MEASUREMENT

Aggregate Subbase Course will be measured by the cubic meter (m3). The quantity to be paid for shall be the design volume compacted in-place as shown on the Plans, and accepted in the completed course. No allowance will be given for materials placed outside the design limits shown on the cross-sections. Trial sections shall not be measured separately but shall be included in the quantity of subbase herein measured.

ITEM 11 : AGGREGATE BASE COURSE

DESCRIPTION

This Item shall consist of furnishing, placing and compacting an aggregate base course on a prepared subgrade/subbase in accordance with this Specification and the lines, grades, thickness and typical cross-sections shown on the Plans, or as established by the Engineer.

MATERIAL REQUIREMENTS

Aggregate for base course shall consist of hard, durable particles or fragments of crushed stone, crushed slag or crushed or natural gravel and filler of natural or crushed sand or other finely divided mineral matter. The composite material shall be free from vegetable matter and lumps or balls of clay and shall be of such nature that it can be compacted readily to form a firm, stable base.

In some areas where the conventional base course materials are scarce or non-available, the use of 40% weathered limestone blended with 60% crushed stones or gravel shall be allowed, provided that the blended materials meet the requirements of this Item.

The base course material shall conform to the following Grading Requirements

Grading Requirements

Sieve Designation		Mass Percent Passing	
Standard mm	Alternate US Standard	Grading A	Grading B
50	2"	100	
37.5	1 – 1/2"	-	100
25.0	1"	60 - 85	-
19.0	3/4"	-	60 - 85
12.5	1/2"	35 - 65	-
4.75	No. 4	20 - 50	30 - 55
0.425	No. 40	5 - 20	8 - 25
0.075	No. 200	0 - 12	2 - 14

The fraction passing the 0.075 mm (No. 200) sieve shall not be greater than 0.66 (two thirds) of the fractions passing the 0.425 mm (No. 40) sieve.

The fraction passing the 0.425 mm (No. 40) sieve shall have a liquid limit not greater than 25 and plasticity index not greater than 6 as determined by AASHTO T 89 and T 90, respectively.

The coarse portion, retained on a 2.00 mm (No. 10) sieve shall have a mass percent of wear not exceeding 50 by the Los Angeles Abrasion test determined by AASHTO T 96.

The material passing the 19 mm (3/4 inch) sieve shall have a soaked **CBR value** of not less than **80%** as determined by AASHTO T 193. The CBR value shall be obtained at the maximum dry density (MDD) as determined by AASHTO T 180, Method D.

If filler, in addition to that naturally present, is necessary for meeting the grading requirements or for satisfactory bonding, it shall be uniformly blended with the base course material on the road or in a pug mill unless otherwise specified or approved. Fillers shall be taken from sources approved by the Engineer, shall be free from hard lumps and shall not contain more than 15 percent of material retained on the 4.75 mm (No. 4) sieve.

CONSTRUCTION REQUIREMENTS

PLACING

The aggregate base material shall be placed at a uniform mixture on a prepared sub-base/ subgrade in a quantity which will provide the required compacted thickness. When more than one layer is required, each layer shall be shaped and compacted before the succeeding layer is placed.

The placing of material shall begin at the point designated by the Engineer. Placing shall be from vehicles especially equipped to distribute the material in a continuous uniform layer or windrow.

The layer or windrow shall be of such size that when spread and compacted the finished layer be in reasonably close conformity to the nominal thickness shown on the Plans.

When hauling is done over previously placed material, hauling equipment shall be dispersed uniformly over the entire surface of the previously constructed layer, to minimize rutting or uneven compaction.

SPREADING AND COMPACTING

When uniformly mixed, the mixture shall be spread to the plan thickness, for compaction.

Where the required thickness is 150mm or less, the material may be spread and compacted in one layer. Where the required thickness is more than 150 mm, the aggregate base shall be spread and compacted in two or more layers of approximately equal thickness, and the maximum compacted thickness of any layer shall not exceed 150 mm. All subsequent layers shall be spread and compacted in a similar manner.

The moisture content of sub-base material shall, if necessary, be adjusted prior to compaction by watering with approved sprinklers mounted on trucks or by drying out, as required in order to obtain the required compaction.

Immediately following final spreading and smoothening, each layer shall be compacted to the full width by means of approved compaction equipment. Rolling shall progress gradually from the sides to the center, parallel to the centerline of the road and shall continue until the whole surface has been rolled. Any irregularities or depressions that develop shall be corrected by loosening the material at these places and adding or removing material until surface is smooth and uniform. Along curbs, headers, and walls, and at all places not accessible to the roller, the base material shall be compacted thoroughly with approved tampers or compactors.
If the layer of base material, or part thereof, does not conform to the required finish, the Contractor shall, at his own expense, make the necessary corrections.

Compaction of each layer shall continue until a **field density of at least 100 percent** of the maximum dry density determined in accordance with AASHTO T 180, Method D has been achieved. In-place density determination shall be made in accordance with AASHTO T 191/ASTM D 1556.

TRIAL SECTION

Before base construction is started, the Contractor shall spread, and compact trial sections as directed by the Engineer. The purpose of the trial sections is to check the suitability of the materials and the efficiency of the equipment and the construction method which is proposed to be used by the Contractor. Therefore, the Contractor must use the same material, equipment and procedures that he proposes to use for the main work. One trial section of about 500 m^2 shall be made for every type of material and/or construction equipment/procedure proposed for use.

After final compaction of each trial section, the Contractor shall carry out such field density tests and other tests required as directed by the Engineer.

If a trial section shows that the proposed materials, equipment or procedures in the Engineer's opinion are not suitable for subbase, the material shall be removed at the Contractor's expense, and a new trial section shall be constructed.

If the basic conditions regarding the type of material or procedure change during the execution of the work, new trial sections shall be constructed.

SURVEYS AND SETTING OUT WORKS

Before the commencement of the pavement works, the Contractor together with the Engineer shall conduct a topographic survey which will form the basis of quantity measurement.

The Contractor shall set out the works and shall be solely responsible for the accuracy of such setting-out.

Prior to placement of any material, the Contractor shall establish visible construction markers to clearly define horizontal limits of the Work.

TOLERANCES

The aggregate base course shall be laid to the designed level and transverse slopes shown on the Plans. The allowable tolerances shall be in accordance with following:

Permitted variation from design THICKNESS OF LAYER	± 10 mm
Permitted variation from design LEVEL OF SURFACE	+ 5 mm -10 mm
Permitted SURFACE IRREGULARITY Measured by 3-m straight-edge	5 mm
Permitted variation from design CROSSFALL OR CAMBER	± 0.2%
Permitted variation from design LONGITUDINAL GRADE over 25 m in length	± 0.1%

METHOD OF MEASUREMENT

Aggregate Base Course will be measured by the cubic meter (m3). The quantity to be paid for shall be the design volume compacted in-place as shown on the Plans, and accepted in the completed base course. No allowance shall be given for materials placed outside the design limits shown on the cross-sections. Trial sections shall not be measured separately but shall be included in the quantity of aggregate base course.

ITEM 12 : PORTLAND CEMENT CONCRETE PAVEMENT

SCOPE OF WORK

The works include the furnishing of all labor, materials and equipment required for the construction of gravel base course and concrete pavement. The works shall be in accordance with the lines and grades shown on the Drawings and in conformity with the Specifications.

MATERIAL REQUIREMENTS

Cement

Portland cement shall conform to the requirements of the Section "Reinforced Concrete".

Fine Aggregate

The fine aggregate shall be well-graded from coarse to fine and shall conform to the requirements of the Section "Reinforced Concrete".

Coarse Aggregate

Coarse aggregate shall conform to the requirements of the Section "Reinforced Concrete".

Water

Clean, fresh, potable water shall be used for the mixing of all concrete and mortar and shall be from a source approved by the Engineer. Sea water or brackish water shall not be used.

Admixture

Admixture shall only be used with the written permission of the Engineer. If air-entraining agents, water reducing agents, set retarders or strength accelerators are permitted to be used, they shall not be used in greater dosages than those recommended by the manufacturer, or as permitted by the Engineer. The cost shall be considered as already in the Contractor's unit cost bid for concrete.

TIE BARS AND SLIP BARS

Tie bars shall be deformed bars conforming to the requirements specified in AASHTO M 31 or M 42, except that rail steel shall not be used for tie bars that are to be bent and re-straightened during construction, sizes as indicated on the Drawings. The deformed bars shall be Grade 40 and shall be shipped in standard bundles, tagged and marked in accordance with the Code of Standard practice of the Concrete Reinforcement Steel Institute.

Slip bars shall be smooth round steel bars conforming to the requirements specified in AASHTO M 31 or plain M 42.

Joint Filler

Poured filler for joint shall conform to the requirements of AASHTO M173.

EXECUTION

Concrete Class

The concrete for pavement shall satisfy the following requirements:

Minimum 28-day comprehensive strength	:	24 MPa
Minimum Flexural Strength	:	3.8 MPa
Maximum Aggregate size	:	25 mm
Maximum water cement ratio	:	0.52

Proportioning, Consistency and Mixing of Concrete

The proportioning, consistency and mixing of concrete shall conform to the requirements of the Section "Reinforced Concrete".

Preparation

The base shall be watered and thoroughly moistened prior to placing of the concrete.

Formwork Construction

Formwork shall comply with the requirements of the Section "Reinforced Concrete". Forms shall be of steel, of an approved section and shall be straight and of a depth equal to thickness of the pavement at the edge. The base of the forms shall be of sufficient width to provide necessary stability in all directions. The flange braces must extend outward on the base 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. They shall be set with their faces vertical so as to produce a surface complying with the required tolerance.

Adjacent lanes may be used in lieu of forms for supporting finishing equipment provided that proper protection is afforded to the concrete of the adjacent lanes to prevent damage, and provided further that the surface of the concrete carrying the finishing equipment does not vary by more than 3mm in each meter length. Adjacent lanes in lieu of forms may not be used until the concrete is at least seven (7) days old. Flanged wheels of the finishing equipment shall not be operated on the concrete surface. The inside edge of supporting wheels of the finishing machine shall not operate closer than 100mm from the edge of the concrete lane.

Alternative to placing forms, slip-forming may be used. Slip-form paving equipment shall be equipped with the traveling side forms of sufficient dimensions, shape and strength to support the concrete laterally for a sufficient length of time during placement to produce pavement of the required cross section. No abrupt changes in longitudinal alignment of the pavement will be permitted. The horizontal deviation shall not exceed 20mm from the proper alignment established by the Engineer.

Joints

All joints, longitudinal, transverse, etc., shall be constructed as shown on the Drawings and shall be clean and free of all foreign material after completion of shoulder work prior to acceptance of the work and in accordance with the following provisions:

Longitudinal and Transverse Contact Joints:

Longitudinal contact joints are joints formed between lanes that are poured separately. Transverse contact joints are joints formed between segments of a lane that are poured separately. Transverse contact joints shall be formed perpendicular to pavement centerline at the end of each day of concrete placing, or where concreting has been stopped for 30 minutes or longer but not nearer than 1.5 meters from sawed contraction joints. All contact joints shall have faces perpendicular to the surface of the pavement. Tie bars of the size, length and spacing shown on the Drawings shall be placed across longitudinal and transverse contact joints.

Placing Concrete

The concrete shall be deposited and spread in order that segregation will not occur and place a uniform layer of concrete whose thickness is approximately 20 mm greater than that required for the finished pavement is placed. Rakes shall not be used for handling concrete.

In order to prevent the introduction into the concrete of earth and other foreign materials, the men whose duties require them to work in the concrete, shall in general, confine their movements to the area already covered with fresh concrete. Whenever it becomes necessary for these men to step out of the concrete, their footwear shall be washed or otherwise thoroughly cleaned before returning to the concrete. Repeated carelessness with regard to this detail will be deemed sufficient cause for removing and replacing such worker.

During the operation of striking off the concrete, a uniform ridge of concrete at least 70 mm in height shall be maintained ahead of the strike-off screed for its entire length. Except when making a construction joint, the finishing machine shall at no time be operated beyond that point where this surplus can be maintained in front of the strike-off screed.

After the first operation of the finishing machine, additional concrete shall be added to all low places and honeycombed spots and the concrete rescreeded. In any rescreeding, a uniform head of concrete shall be maintained ahead of the strike-off for its entire length. Honeycombed spots shall not be eliminated by tamping or grouting.

Workers on the job shall have mobile footbridges at their disposal so that they need not walk on the wet concrete.

In conjunction with the placing and spreading, the concrete shall be thoroughly spaded and vibrated along the forms, bulkhead, and joints.

The internal vibrators shall be of pneumatic, gas-driven, or electric type, and shall operate at a frequency of not less than 3,200 pulsations per minute.

Whenever the placing of the concrete is stopped or suspended for any reason, for a period of 30 minutes or longer, a suitable bulkhead shall be placed so as to produce a vertical transverse joint. If an emergency stop occurs within 2.5 meters of the contraction or an expansion joint the concrete shall be removed back to the joint. When the placing of the concrete is resumed, the bulkhead shall be removed, and a new concrete placed and

vibrated evenly and solidly against the face of previously deposited concrete. Any concrete in excess of the amount needed to complete a given section or that has been deposited outside the forms shall not be used in the work.

The Contractor shall provide suitable equipment for protecting the fresh concrete in case of rain, such as screens which will cause the rainwater to run off beyond the edges of the paving, rainproof tarpaulins or other methods approved by the Engineer. The equipment shall be sufficient to shelter from rain all areas equal to that paved in two hours of work.

Finishing Concrete

The concrete shall be compacted and finished by a mechanical, self-propelled finishing machine of approved type, having two independently operated screeds. If a machine possessing only one screed is approved, the screed will not be less than 450 mm wide and shall be equipped with compensating springs to minimize the effect of the momentum of the screed on the side forms. The number of driving wheels, the weight of the machine and the power of the motor shall be so coordinated as to prevent slippage. The top of the forms and the surface of the finishing machine wheels shall be kept free from concrete or dirt.

The machine shall at all times be in first-class mechanical condition and shall be capable of compacting and finishing the concrete are herein described. Any machine which causes displacement of the side forms from the line or grade to which they have been properly set, or causes undue delay due to mechanical difficulties, shall be removed from the work and replaced by a machine meeting the Specifications.

The finishing machine shall be operated over each section of pavement two or more times and at such intervals as will produce the desired results. Generally, two passes of the finishing machine are considered the maximum desirable.

The concrete shall be vibrated, compacted, and finished by a vibratory finishing machine. The vibratory machine shall meet the requirements for ordinary finishing, and shall be one of the following type:

1. The machine shall have two independently operated screeds; the front screed shall be equipped with vibratory units with a frequency of not less than 3,500 pulsations per minute. There shall be not less than one vibratory unit for each 2.5 meters length or portion thereof, of vibratory screed surface. The front screed shall not be less than 300mm wide and shall be equipped with a "bull nose" front edge built on a radius of not less than 50mm. This type of vibratory finishing machine shall be operated in such manner that each section of pavement will receive at least one vibratory pass, but not more than two passes, unless otherwise directed, or ;

2. The machine shall be equipped with an independently operated vibratory "pan" (or pans) and two (2) independently operated screeds, the "pan" shall be mounted in a manner that will permit it to come in contact with the forms and will permit vibration of the full width of lane simultaneously.

   There shall be not less than one vibratory unit for each 2 m. length or portion thereof, of vibrating pan surface. The vibratory units in any individual pan shall be synchronized and have a frequency of not less than 3,500 pulsations per minute. The front screed shall be capable of operating in a position that will strike off the concrete at a sufficient height above the top of the forms to allow for proper compaction with the vibrating pan. This type of vibratory finishing machine shall be operated in such

manner than each section of pavement will receive at least one vibratory pass but not more than two passes, unless otherwise directed.

After the final pass of the finishing machine and when the concrete has started to dry, the surface of the pavement shall be finished with an approved longitudinal float. The float may be operated either manually or by mechanical means. The float may be either of wood or metal shall be straight and smooth and light in weight so as not to displace or sink into the concrete surface.

To be effective, the float shall be at least 300mm wide and 3m long. When manually operated, the float shall be moved from edge to edge with a wiping motion and advance one (1) meter or more.

The succeeding trip shall overlap the previous trip. A light smoothing lute at least 3 meters long may be used provided approved by the Engineer.

The surface of the pavement shall be tested by the Contractor, before the final belting, with an approved standard straightedge 3 meter in length. Irregularities so detected shall be corrected immediately. Special attention shall be given to the concrete adjacent to transverse joints to insure that the edges thereof are not above the grade specified or the adjacent concrete below grade. All depressions or projections shall be corrected before any initial set has developed in the concrete.

After the concrete has been brought to the required grade, contour and smoothness, it shall be finished by passing over the concrete a drag of one or two burlap clothes, which give the surface the required roughness. The vehicles used to carry these cloths may be independent of the concrete-laying machine or may be incorporated with it and may be operated either by hand or mechanically.

Hand finishing will be permitted only on variable width sections of the pavement and other places where the use of the finishing machine would be impractical. Hand finishing shall be accomplished by means of the hand-operated strike-off template of either steel or steel-shod wood construction. The striking template shall be operated forward with a combined longitudinal and transverse motion and shall be so manipulated that neither end will be raised off the side forms. A similar tamper shall be used for tamping the concrete.

As soon as the concrete has attained its initial set, the edges of the pavement, the longitudinal joints, the construction dummy and expansion joints not sawn shall be carefully finished with an edging tool having radius of at least 5mm. The tools, the special accessories for cutting impressed joints and methods of workmanship shall be such as will produce a joint whose edges are of the same quality of concrete as the other portion of the pavement. Methods and workmanship which make use of excess mortar or grout in this area shall be eliminated. Unnecessary tool marks shall be eliminated during work, and the edges left smooth and true to line.

Striking Forms

Forms shall remain in place at least 12 hours after the concrete has been placed. When working conditions are such that the early strength gain of the concrete is delayed, the forms shall remain in place for a longer period, as directed by the Engineer. Bars or heavy load shall not be used against the concrete when still in the forms. Any damage to concrete resulting from form removal shall be repaired promptly by the Contractor as directed by the Engineer without any additional payment to the Contractor

Curing Concrete

Unless otherwise ordered by the Engineer, curing of concrete shall be done by any method specified in the Section "Reinforced Concrete".

Cleaning and Sealing Joints

After completion of the required curing and before opening of the pavement to traffic, all joints shall be thoroughly cleaned of all concrete aggregate fragments or other materials.

After removal of side forms, the ends at transverse expansion joints at the edges of the pavement shall be carefully cleaned of any concrete within the expansion spaces for the entire depth of slab, care being taken not to injure the ends of the joints. Expansion and contraction joints shall then be poured with a hot joint sealer to the depth as indicated on the Drawings. Joint sealer shall be poured using approved hand pouring pots, with liquid at a temperature not less than that recommended by the approved manufacturer.

Opening to Traffic

The pavement shall be closed to traffic, including the vehicles of the Contractor, for a period of 10 days after the concrete is placed or longer if in the opinion of the Engineer, the weather conditions make it necessary to extend this time. The Contractor shall furnish, place and maintain satisfactory barricades and lights as directed, to exclude all traffic from the pavement.

Any damage to the pavement due to traffic shall be repaired or replaced at the expense of the Contractor. Paving mixers, mechanical concrete spreaders and finishers and other heavy paving equipment shall not be operated on completed concrete lanes in order to construct alternate lanes until after the regular curing period is completed. Even then, planks shall be laid on the finished pavement or other precautions taken to prevent damage to the concrete pavement.

Pavement Smoothness, Thickness and Tolerance

Portland cement concrete pavement shall be constructed to the designed level and transverse slope shown on the Drawing. The allowable tolerance shall be as listed hereunder:

1.	Permitted variation from design thickness of layer	+ - 5mm
2.	Permitted variation from design level of surface	+ - 5mm

The thickness of the pavement will be determined by measurement of cores from the completed pavement in accordance with AASHTO T 148.

The completed pavement shall be accepted on a lot basis. A lot shall be considered as 2,500 sq.m of pavement. The last unit in each slab constitutes a lot in itself when its length is at least ½ of the normal lot length. If the length of the last unit is shorter than ½ of the normal lot length, it shall be included in the previous lot.

Other areas such as intersections, entrances, crossovers, ramp, etc., will be grouped together to form a lot. Small irregular areas may be included with other unit areas to form a lot.

ITEM 13 : MASONRY WORKS

GENERAL

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

SCOPE OF WORK

This Section includes the furnishing of all labor and materials to complete the work as shown on the drawings and specified herein. The works shall include but not necessarily be limited to the following:

1. Supply and installation of concrete hollow block (CHB) walls with reinforcement

2. Plastering

3. Installing temporary works like scaffolding, platforms, steps, etc.

GENERAL PROVISIONS

The following publications of the issues below but referred to thereafter by basic designation only form a part of these specifications to the extent indicated by the reference thereto:

American Society for Testing and Materials (ASTM) Publications:

A 615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

A 33 Concrete Aggregates

C 129 Specification for Non-Load Bearing Concrete Masonry Units C

144 Specification for Aggregate for Masonry Mortar

C 270 Mortar for Unit Masonry

MATERIAL REQUIREMENTS

Materials shall conform to the respective specifications and other requirements specified below

CONCRETE HOLLOW BLOCKS (CHB)

CHB shall be of standard manufacture, machine vibrated with fine and even texture and well-defined edges and conforming with the requirements of ASTM C 129. Unless otherwise specified on the Drawings, it shall have a minimum compressive strength of 4.14 MPa (600 psi). CHB shall be non-load bearing uniform and essentially smooth as normally achieves by standard molding methods and shall be free from any cracks, flaws or other defects.

BEDDING MORTAR

Mortar shall be composed of 1 part of Portland cement, 3 parts of sand and ½ part of lime. It shall have a compressive strength of [14 MPa (2,000 psi)] at 28 days and shall comply with property specifications for type N mortar set forth in ASTM Specification C 270 and as modified herein,

proportioned and tested in an approved laboratory at the expense of the Contractor. When tested for water retention, the mortar shall have a flow after suction of 75 percent or more when mixed to an initial flow of 125 to 140 percent. When tested for compressive strength, mortar shall be mixed to a flow of 100 to 115 percent. Aggregate for mortar shall conform to ASTM C 144.

PLASTER

Plaster shall comply with the same specifications as those for bedding mortar and will include the use of synthetic fibrous reinforcement of type and dosage recommended by the manufacturer.

REINFORCING STEEL BARS AND RODS

Minimum yield strength of reinforcement shall conform with the specifications in Section of Reinforced Concrete.

SAMPLES AND TESTING

1. The following shall be submitted for approval and in addition, representative samples shall be taken periodically from on-the-site stockpiles as required for testing or checking during the progress of the work.

Anchors and ties	:	Two of each type proposed for use
Concrete Hollow Blocks	:	Shapes, sizes and kinds in sufficient numbers to show full range of quality and texture.

2. Sampling and testing, unless otherwise specified, shall be performed by an approved independent commercial testing laboratory at the expense of the Contractor. Certified copies of laboratory test reports, including all test data, shall be submitted at least 10 days before delivery of the units or mortar materials represented by the tests to the project site.

3. Mortar shall be laboratory-proportioned and tested. Certified copies of approved laboratory-established proportions shall be submitted with the required test reports and test data. Approved laboratory-established proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in mortar for the work unless additional evidence is furnished that the mortar meets the specified requirements.

EXECUTION

1. GENERAL

No unit having a film of water on its surface shall be laid. Masonry shall be laid plumb, true to line, with level courses accurately spaced. Bond pattern shall be kept plumb throughout. Corners and reveals shall be plumb and true. Vertical joints shall be shoved tight. Each unit shall be adjusted to final position while mortar is still soft and plastic. Any unit that is disturbed after mortar has stiffened shall be removed and relaid with fresh mortar. Courses shall be so spaced that backing masonry will level off, flush with the face work at all joints where ties occur. Chases and rake-out joints shall be kept free from mortar or other debris.

2. Anchorage to concrete. Anchorage to abutting columns shall be provided only where indicated. Details shall be as indicated including anchorage to underside of beams and slabs.

3. Cutting and fitting, including that required to accommodate the work of others shall be done

by masonry mechanics. Wherever possible, full units of the proper size shall be used in lieu of cut units. Cut edges shall be clean, true and sharp. Openings shall be carefully cut, formed or otherwise neatly made for recessed items and for electrical, plumbing, or other mechanical installations so that wall plates, cover plates, or escutcheons required by the installation will completely conceal the openings and will have bottoms in alignment with lower edge of masonry joints. Webs of hollow masonry units shall be cut to the minimum required for the installation. Reinforced masonry lintels shall be provided as indicated above openings over 300mm wide, for pipes, ducts and cable trays, unless steel sleeves are used.

4. Embedded Items

Spaces around built-in items shall be filled with mortar. Openings around flush-mounted electrical outlet boxes in wet locations shall be pointed flush with mortar including flush joints above the boxes. Anchors, ties, accessories, flashing, pipe sleeves and other items required to be built-in shall be built-in as the masonry work progresses. Anchors, ties, and joint reinforcement shall be fully embedded in mortar.

5. Unfinished work shall be stepped back for jointing with new work. Toothing may be resorted to only when specifically approved. Before laying new work, loose mortar shall be removed, and the exposed joint shall be thoroughly cleaned.

6. Protection

Surfaces of masonry not being worked on shall be properly protected at all times. At the end of each workday period and when rain is imminent, the top of exposed masonry shall be covered with a strong non-staining waterproof membrane well secured in place and in a manner that will prevent moisture. Adequate provisions shall be made during construction to prevent damage by wind.

7. Mortar

Materials shall be accurately measured in laboratory-established proportions and mixed with as much water as may be necessary to produce the wettest workable consistency possible. Mortar shall be placed in final position within one hour after mixing. Mortar not used or that has started to set within this time interval shall be discarded.

8. Jointing

Joints in exposed-to-view except control joints, joints to be pointed or caulked or sealed, and openings around flush-mounted electrical outlet boxes in wet locations shall be tooled slightly concave with the mortar thoroughly compacted and pressed against the edges of the units. Tooling shall be done when the mortar has been thumbprint hard. The tooled joint shall be finished to uniformly straight and true lines and surfaces, smooth and free of tool marks.

9. Placing Reinforcing Steel

Prior to placing grout, all reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout or other coating which might destroy or reduce its bond with grout. Details of reinforcement shall be as indicated in the drawings. Reinforcing shall not be bent or straightened in a manner injurious to the steel. Bars with kinks or bends not shown on the drawings shall not be used. Placement of reinforcement shall be inspected and approved prior to placing grout. One-piece vertical bars extending from floor to floor or roof above shall be provided. Vertical bars shall be spliced only where indicated.

a. Positioning Bars

Vertical bars shall be positioned accurately at the centerline of the wall. A minimum clearance between the bars and masonry units of 12mm and between parallel bars of one diameter of the reinforcement shall be maintained. Vertical reinforcing shall be held in place using metal supports, centering clips, spacers, ties or caging devices located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement.

b. Splices

Splices shall be located only as indicated. Splices shall be staggered in adjacent bars at least 600mm. Bars shall be lapped a minimum of 40 diameters of the reinforcement.

PAINTING AND CLEANING

Mortar daubs or splashing, before setting or hardening, shall be completely removed from masonry unit surfaces that will be exposed or painted. Before completion of the work, all defects in joints or masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Masonry surfaces shall not be cleaned, other than removing excess surface mortar until mortar in joints has hardened. Masonry hardened surfaces shall be left clean, free of mortar daubs, dirt, stain and discoloration, including scum from cleaning operations and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

ITEM 14 : DRAINAGE WORKS

SCOPE OF WORK

The works shall consist of excavation, backfilling and construction of lateral drains, construction of manholes, reconnection to existing lateral and other related works in accordance with the dimensions, size, elevation and grade as shown on the drawing and shall conform with the Specification.

At least thirty (30) days before the start of any construction related to drainage works, the Contractor shall submit to the Engineer for his approval, shop drawings of the drainage work he intends to construct. The shop drawings shall include the materials and the general method of installation he intends to employ.

MATERIAL REQUIREMENTS

BACK FILL

Fill shall be in accordance with Item "Reclamation and Fill".

GRAVEL BEDDING

Gravel Bedding/gravel base shall be in accordance with the specifications of Crushed Course Aggregates in "Reinforced Concrete".

SAND BEDDING

Sand bedding shall be in accordance with Item "Reinforced Concrete (Fine Aggregates)".

CONCRETE

Mixing/Casting and steel reinforcements shall be in accordance with Item "Reinforced Concrete" while the dimensions shall be as shown on the Drawings.

CEMENT MORTAR

Cement mortar shall consist of one part Portland cement to two parts of fine aggregate with water added as necessary to obtain the required consistency.

REINFORCED CONCRETE PIPE

The fabrication of reinforced concrete pipes shall conform to the Specifications of ASTM C 76 while the testing requirements shall conform to ASTM C 497. The Engineer reserves the right to inspect and test the pipe delivered for intended purpose. Defects that are discovered after acceptance of delivery of the pipe but before installation shall be a cause for rejection.

Standard reinforcement details and concrete strength shall be in accordance with DPWH "Standard Two Meter Concrete Pipe Culvert".

STEEL GRATING

All materials shall be compliant with ASTM A36 or equivalent and Hot Dip Galvanizing shall be in accordance with ASTM A123 with minimum average coating of 610gms/sq.m.

The gratings shall be fusion welded type and non-manually fabricated with loading capacity equivalent to HS20-44. Loads and deflection shall be in accordance with AS3990 and the fabrication shall be covered by the requirements of AWS D1.1.

EXECUTION

EARTHWORKS

All earthworks for concrete pipe culvert shall conform to the lines, grades and elevations shown on the drawings or as directed by the Engineer.

The lateral drain shall be excavated to the depth, grade and width established by the Engineer. The bedding surface shall provide a firm foundation of uniform density throughout the entire length. Soft, spongy, or otherwise unstable material encountered that will not provide a firm foundation for the concrete drainage shall be removed to the full width of the trenches and replaced by suitable material to a depth of not less than 30 cm. 100mm thick gravel bedding shall be used as foundation or otherwise as specified.

PIPE LAYING

The pipe shall be tested for watertightness of joints before backfilling the trench. Unsatisfactory work shall be corrected without additional cost to the PPA. The collar shall have set sufficiently prior to backfilling.

Methods of installation and typical bedding for pipe conduits if not included in the plans, shall conform to DPWH "Standard Two Meter Reinforced Concrete Culvert".

LATERAL DRAIN

Concrete cover and the steel gratings shall be set to the required elevations as shown on the drawings to fit the adjoining surfaces and shall be installed after the adjoining concrete is struck off and finished, and the fit on the frames shall be such that there is no rocking.

All completed structures shall be thoroughly cleaned of any accumulations of silts, debris or foreign matter of any kind, until finally accepted and put into service.

CATCH BASIN INLETS, MANHOLES AND OUTLETS

Lid frames shall be set to the required elevations as shown on the drawings to fit the adjoining surfaces. Lids shall be installed after the adjoining concrete is struck off and finished, and the fit on the frames shall be such that there is no rocking.

Where reconstruction of existing catch basin inlets, manholes, outlets, or similar structures are indicated, the work shall be in accordance to the details and elevations as shown on the drawings, including re-installation of existing metal frames, grates and lids, or replacing of concrete covers instead of grates that may have been lost or found lacking. All completed structures shall be thoroughly cleaned of any accumulations of silts, debris or foreign matter of any kind, until finally accepted and put into service.

FIELD DENSITY TEST

Field Density tests to determine the percent of compaction of the fill material shall be conducted until a field density of at least 95 percent of the maximum dry density in accordance with AASHTO T180, Method D has been achieved. In place density determination shall be made in accordance with AASHTO T191.

CLEARING AND DISPOSAL

Dumping or disposal of un-used excavated materials shall be coordinated to PMO. If the excavated materials are determined for disposal, the contractor will provide all necessary works and expenses for its completion in concurrence by the Engineer.

ITEM 15A : FINISHES

GENERAL

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

SCOPE OF WORK

The work covered by this section consists of furnishing all labor, materials, equipment, tools, and incidentals necessary to undertake, and complete all finishing works as indicated on the drawings and as specified herein.

Wall, floor, ceiling and other finishing works shall include but are not limited to the following:

WALLS

For Guard House and Gate

Exterior

a. Plain cement finished painted with elastomeric paint.

Location as shown in the plans and elevations.

Interior

a. Plain cement finished painted with elastomeric paint.

b. 300mm x 600mm Unglazed Ceramic Wall Tile

For Power House

Exterior

a. Plain cement finished painted with elastomeric paint.

Location as shown in the plans and elevations.

Plain Cement Finish

a. Surface Preparation

All surfaces shall be cleaned and projections, dust, loose particles, and other materials, which would prevent good bond, shall be removed.

Plaster shall not be applied directly to concrete, and masonry surfaces coated with bituminous compounds and surfaces previously painted or plastered.

All surfaces shall be thoroughly wetted before plastering.

b. Trial Mix

A trial mix of at least three (3) different water-cement ratios for a proposed mix shall be prepared under full-scale conditions and adequate workability. The proportions by weight of cement to the weight of sand shall not be less than one part of Portland cement to two parts of sand.

The proportion of cement, sand and water necessary to produce the cement plaster

of the required consistency shall be subject to the approval of the Engineer. Such approval may be withdrawn at any time and a change in proportions may be required. Based on the approved mix proportions, the Contractor shall prepare a list showing the number of kilograms of the various materials to be used in the cement plaster finish mix.

No cement plaster finish shall be started without an approved trial mix by the Engineer.

c. Cement Finish Application

A brown coat with sufficient pressure shall be applied to fill the gaps, and to secure a good bond. Moistened for 48 hours, each coat of cement plaster shall be kept after application and allow to dry.

A finish coat shall be applied after the brown coat has set. The brown coat shall be moistened before application of the finish coat. Finish coat shall be floated to plumb, even planes and surfaces.

Final plaster finishes shall be rubber sponged.

d. Tolerance

The Contractor shall finish plaster work plumb, level, square and true within tolerance of 3mm in 3 meters, without cracks and other imperfections.

e. Patching and Cleaning

Upon completion of the building, and when directed, all loose, cracked, damaged or defective plastering shall be cut out and re-plastered in a satisfactory and approved manner.

Painting Works

a. Surface Preparation

Allow new masonry to dry for 14 days (for exterior surfaces) to 28 days (for interior surfaces) under normal conditions before painting. Surface to be painted should be clean and dry, free from oil, grease, dirt, dust, contaminants, and all loose grit and mortar.

Without mesh:

1st Coat: Elastomeric Wall Covering Sealer

2nd and 3rd Coat: Elastomeric Wall Covering Basecoat

4th Coat: Elastomeric Wall Covering Topcoat

With mesh:

1st Coat: Elastomeric Wall Covering Sealer

2nd Coat: Elastomeric Wall Covering Basecoat
Reinforcing Membrane: Fiberglass Matting

3rd and 4th Coat: Elastomeric Wall Covering Basecoat

5th Coat: Elastomeric Wall Covering Topcoat

Wall Ceramic Tiles

a. Wall tiles shall be glazed ceramic tiles color as per Architect's approval.

b. Trimmers and moulding shall be lustrous, glazed with size and color corresponding to wall tiles.

c. Portland cement, sand, bonding compound, lime and water shall conform with the requirements.

FLOORS
For Guard House

1. 600mm x 600mm Unglazed Ceramic Tile Finish
Locations are shown in the plan.

2. Water Proof Finish
a. All Toilets
Locations are shown in the plan.

For Power House

2. Water Proof Finish
a. All Toilets
Locations are shown in the plan.

a. Floor tiles shall be color varies and as shown on the drawings or to be designated by the Architect.

b. Portland Cement, sand, water, and adhesive shall conform to the requirements.

c. Floor tiles shall be delivered in the manufacturer's original unbroken packages or containers that are labeled plainly with the manufacturer's name and brand. Containers shall be grade scaled. Materials shall be stored in dry weathertight enclosures and shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness.

EXECUTION

Floor Tiles

a. Mortar Preparation

Mortar mix proportion and preparation shall be in accordance with the requirements.

b. Surface Preparation

Surfaces to receive the tiles shall be clean, free of dust, dirt, oil, grease, and other deleterious substances. Floor tile operations in spaces receiving wall tile shall not be started until wall tile installation has been completed. Before tile is applied with a dry set mortar bed, the structural floor shall be tested for levelness or uniformity of slope by flooding it with water. Areas where the water ponds shall be filled and leveled with mortar and shall be retested before the setting bed is applied.

c. Placing of Setting Beds and Floor Tile

Mortar setting beds shall have a minimum thickness of 20mm for floors. The structural concrete slab shall be soaked thoroughly with clean fresh water on the day before the setting bed is to be applied. Immediately preceding the application of the setting bed, the structural slab shall again be wetted thoroughly, but no free water shall be permitted to remain on the surface.

A skim coat of neat Portland cement mortar shall then be applied not more than 4mm thick. The mortar shall be spread until its surface is true and even and thoroughly compacted, either level or sloped uniformly for drainage, as the case requires. A setting bed, as large as can be covered with tile before the mortar has reached its initial set, shall be placed on one operation; but in the event that more setting mortar has been placed than can be covered, the unfinished portion shall be removed and cut back to a clean beveled edge.

All mounted tiles shall be soaked in clean water a minimum of one hour before they are set. Absorptive mounted tile shall be dampened by placing sheets on a wetted cloth in a shallow pan before setting. No free water shall remain on the tiles at the time of setting. Before the initial set has taken place in the setting bed, a skim coat of neat Portland cement mortar, 0.7mm to 1.6mm thick, shall be trowelled or brushed over the setting bed and/or the back of the tile, or a thin layer of Portland cement, 0.79mm to 2mm thick, may be hand-dusted uniformly over the setting bed and worked lightly with a trowel or brush until thoroughly damp.

The tiles shall then be pressed firmly upon the setting bed, and beaten into the mortar until true and even with the plane of the finished floor line. Beating and leveling shall be completed within one hour after placing tiles or sheets. Borders and defined lines shall be laid before the field or body of the floor. Where floor drains are provided, the floors shall be sloped to drain properly to the drains. Intersections and returns shall be formed accurately.

Cutting of tile, where necessary, shall be done along the outer edges of the floor. As far as practicable, no tiles of less than half size shall be used. Cutting and drilling of tiles shall be done neatly without marring the tile surfaces. The cut edges of tile against trim, bases, thresholds, pipes, built-in fixtures and similar surfaces shall be ground and jointed carefully. Tile shall fit closely and neatly at all plumbing fixtures and around electrical outlets, pipes, and fittings so that cover plates or escutcheons will overlap the tiles properly. Tiles shall be secured firmly in place and lose tiles or tiles sounding hollow shall be removed and replaced. All lines shall be kept straight, parallel, and true, and all finished surfaces brought to true and even planes. The inner edges of borders shall be kept straight and, where practicable, shall form right angles at all returns. The paper and glue shall be removed from the mounted tile, without using excess water, within one hour after installing the tiles.

Joints shall be parallel and uniform in width, plumb, level, and in alignment. End joints in broken-joint work shall be made as far as practicable, on the center lines of adjoining tiles. Except in special arrangement and design, as indicated or specified, square tiles shall be set with straight joints, and oblong tiles shall be set with broken joints.

Joint widths shall be uniform and spaced to accommodate the tile in the given spaces with a minimum of cutting. Tiles shall be wetted, if they have become dry, before applying grout. Joints 3.2 mm or less in width shall be grouted with a neat Portland cement grout of the consistency of thick cream. Other joints shall be pointed with mortar consisting of one part Portland cement and two parts pointing sand. The grout or mortar for joints on floors shall be white Portland cement or as specified by the Engineer. Grout painting mortar shall be forced into joints by using trowel, brush or finger application. Before the grout or mortar sets, the joints of cushion edge tile shall be struck or tooled to the depth of the cushion, filling all skips or gaps, and the joints of square edged tiles shall be filled completely flush with their surface. Dark cement shall not be seen through grouted white joints.

All surplus mortar or grout shall be removed before it has set or hardened.

d. Cleaning and Curing

Floors shall be covered with waterproof paper with all joints lapped at least 96 mm and allowed to damp cure for at least 72 hours before foot traffic is permitted thereon.

All completed tile work shall be thoroughly sponged and washed diagonally across joints, and finally polished with clean, dry cloth. Acid cleaning of unglazed tile, when necessary, shall not be done within ten days after setting the tile. All metal shall be covered with approved grease and the tile shall be wetted with clean water before tile is cleaned with 10% muriatic acid solution. After acid cleaning, the tile shall be flushed with clean water, and the grease coating on metal shall be removed.

Finished tile floors shall be covered with clean building paper before foot traffic is permitted on them. Board walkways shall be placed on floors that are to be continuously used as passageways by workmen. Thresholds shall be covered with

boards. Tiles vertical outside corners (external angles) shall be protected with board corners strips in areas used as passage by workmen.

Ceiling

For Guard House

1. Interior

    1. C1 - 12 mm thick Gypsum Board, on 0.40mm thick galvanized steel ceiling suspension system at 0.40 meter on center (furring) 0.60 meter on center (Carrying Channel), and 1.20 meters on center both ways

        The location is shown in the plan.

For Power House

1. Exterior

    1. C2- Spandrel Ceiling

        The location is shown in the plan.

SUBMITTAL

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

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

3. Samples of all walls finishes, measuring not less than 1000mm x 1000mm shall be submitted to the Engineer for approval as to its finish texture and workmanship.

INSTALLATION OF DOORS / GLASS PANELS

1. Surface Preparation

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

    DOORS

    For Guard House

    D-1 - 1.5mm thk. Aluminum Powder Coated Finish Sliding Door with 8mm thick Clear Glass (0.85m x 2.50m)

    D-2 - PVC Door with Vent Louver (0.70m x 2.15m)

    For Power House

D-1 - Roll -up Door, GA 18 Galvalume Finish, 1-ton Chain Block with Locking Mechanism for Pull Chain (2.50m x 3.00m)

D-2 - 44mm thk. 2 leaf Metal Door with Fixed Metal Louver in Quick-drying enamel Paint Finish, GA. 16 Steel (0.90m x 2.10m)

INSTALLATION OF WINDOWS

1. Surface Preparation

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

For Guard House

W-1 - 1.5mm thk. Aluminum Powder Coated Finish Casement Window with 8mm thk. Reflective Glass (0.346m x 1.20m)

W-2 - 1.5mm thk. Aluminum Powder Coated Finish Casement Window with 8mm thk. Reflective Glass (0.80m x 1.20m)

W-3 - 1.5mm thk. Aluminum Powder Coated Finish Casement Window with 8mm thk. Reflective Glass (0.55m x 1.20m)

W-4 - 1.5mm thk. Aluminum Powder Coated Finish Casement Window with 8mm thk. Reflective Glass (0.60m x 0.50m)

For Power House

W-1 - Fixed Metal Louver Window GA 18 in Quick-drying Enamel Finish including GA 16 channel Windows (2.50m x 2.00m)

Mirror Glass

Mirror glass shall be of high-quality float glass free from imperfections and impurities, 6.3 mm (1/4 inch) thick. Silvering shall be performed by modern continuous operation under controlled conditions. The coating shall be of pure silver and of adequate thickness to provide reflectivity of 83% or more of incident light, and shall be without pinholes or other defects visible to the naked eye.

Refer to plans for locations, dimensions and details.

ITEM 15B: PAINTING

GENERAL

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

SCOPE OF WORK

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

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

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

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

STANDARD

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

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

SUBMITTAL

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

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

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

STORAGE AND DELIVERY

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

    a. Seals shall remain unbroken until after inspection and acceptance of material by the Project-In-Charged.

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

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

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

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

MATERIAL REQUIREMENTS

PAINT

Paints for the protective coating system shall be the product of a manufacturer approved by the Project-In-Charged.

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

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

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

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

SCHEDULE OF PAINTING

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

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

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

EXECUTION

SURFACE PREPARATION OF STEEL

1. Steel surfaces shall be cleaned as follows:

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

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

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

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

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

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

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

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

SURFACE PREPARATION OF WOOD

1. Wood surfaces shall be sanded to a fresh surface. Surface mould where present, shall be removed by washing, rubbing down and burning off as necessary. Resinous exudation

and large knots shall be removed and replaced with filler or other materials approved by the Project-In-Charged.

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

SURFACE PREPARATION OF CONCRETE AND PLASTER

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

SURFACE PREPARATION FOR FIBER CEMENT SURFACES

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

ALUMINUM FRAMES FOR DOORS AND WINDOWS

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

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

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

Handling

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

Storage and Delivery

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

WOOD REPAIR

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

1. Epoxy Wood Repair

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

2. Epoxy Consolidant and Epoxy Paste

   Epoxy liquid wood consolidant shall be used:

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

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

MIXING AND THINNING

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

WEATHER CONDITION

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

APPLICATION

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

All painting shall be done by thoroughly experienced workmen.

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

Plain enamel and varnish shall be applied carefully with good clean brushes or approved spraying equipment, except that the initial coat on any surface shall be applied with brush.

Sufficient time shall be allowed between coats to assure thorough drying and each coat shall be in proper condition before receiving the next coat.

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

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

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

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

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

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

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

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

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

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

TOUCH-UP PAINTING

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

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

During touch-up painting, only loose, cracked, brittle or non-adherent paint shall be removed during cleaning. All exposed edges shall be feathered. Touch-up painting shall be performed in a

manner that will minimize damage to sound paint. Rust spots shall be thoroughly cleaned and edges of the existing paint shall be scraped back to sound material.

DRYING

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

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

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

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

HANDLING

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

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

INSPECTION

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

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

ITEM 15C: ALUMINUM COMPOSITE PANEL

I.INTRODUCTION

A. MATERIAL COMPOSITION

Aluminum Composite Panel (ACP) is a lightweight durable panel made of laminated aluminum and polyethylene core compound, coated with an advanced fluorocarbon paint Polyvinylidine Flouride (PVDF) to ensure the excellent durability of the surface finish. It is an excellent material for exterior and
Interior cladding of new building construction as well as retro fit applications. It also has a high degree of levelness top reserve the fine architectural design and can be roller bent to suit various design shapes. The laminated structure of ACP ensures exceptional strength of the panel.

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

B. CHARACTERISTICS

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

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

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

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

SPECIFICATION

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

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

III. The ACP composition

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

IV. PVDF coating finish adhere to the following standards.

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

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

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

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

Methodology

II.SUBMITTALS

A. PRODUCT DATA

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

B. SHOP DRAWINGS

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

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

C. SAMPLES

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

2. Sample of panel assembly.

D. TEST REPORTS (as requested)

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

III. QUALITY ASSURANCE

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

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

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

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

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

IV. DELIVERY, STORAGE, and HANDLING

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

B. Leave protective covering in place until final cleaning of the building.

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

D. Store panels and accessories in a dry, secure location and protected from weather.
E. Protect finish and edges of panel.

V. LOADING AND UNLOADING

A. Panels must be handled carefully to prevent damage
B. Panels may buckle if they are not properly supported.
C. A forklift may be used for panels up to 10 feet (3 meters) long. However, some means of supporting the panel load over a longer distance from the forks may be used.

VI. PREPARATION

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

VII. ACCESSORIES

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

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

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

D. Fasteners are not exposed except where unavoidable.

ACP Color / Thickness/ Location

Gate

Column - 4mm thk. Aluminum Composite Panel

Details are shown in the plans.

Guard house

Exterior Wall - 4mm thk. Aluminum Composite Panel (Metallic Grey)

Details are shown in the plans.

ITEM 15D: STONE CLADDING

GENERAL

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

BACKGROUND

Deco stone collection is an innovative lightweight and thin manufactures stone veneer, very easy in its application. Its color palette consists of versatile earthly colors, complementing a variety of architectural styles and space arrangements. Colors and patterns are subject for approval by the Architect.

Locations as indicated on plans

DELIVERY AND STORAGE

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

EXECUTION

INSTALLATION

Installation of stone cladding shall be in accordance with approved shop drawings and manufacturer's installation and directions.

Surface Preparation

All backgrounds before glueing should be properly well-cured, have a proper load bearing capacity, constant and homogenous structure, be even, dry and cleaned from the paint, adhesive agents and lubricants remaining – the non-stabile coatings should be removed.

- Before glueing a wall should be, whenever needed, levelled with a levelling mortar.
- The background should be primed with thistle bond – surface primer – you can also buy at our store
- The background should be satisfactorily stable like e.g. concrete, brick, particleboards, aerated concrete, plasterboards, etc.

Tiles Preparation

- The differences in colors and sizes between the elements in one box are consciousness and gives an elevation a natural appearance.
- The tiles should be selected from several boxes simultaneously in order to achieve a homogenous distribution of the color gradation.
- Clean of all tiles removing the excess

Stone Application

The ambient temperature during gluing and within 48h after gluing should not be lower than +5oC and higher than +25oC.

1.Lay the stones out on the floor first.

2. Start installing the stones, beginning in the bottom corners or the most visible places.

3. The adhesive should be applied with the spatula in 3-4 sites on the tile. Then we press the tile slightly moving it up to the moment of the even distribution of the adhesive.

4. Turn any trimmed edges either directly up or down, away from the focal point. Press the stones into the mortar, twisting them slightly to squeeze out some of the excesses and strengthen the bond. Use a trowel, joint tool, or brush to remove any excess adhesive that has been forced beyond the finished joint, or onto the surface of the stone itself.

5. Glueing should be started from the bottom part. In the case of missed even horizontal support for the tiles, you should start glueing with adjusting using a level and a level staff at the height of circa 11 cm above the floor.

6. The best effect is obtained by glueing the tiles shifted in relation to each other. We recommend a shift of circa 1/3 of the tile length above the floor. One should not glue tiles one below the other.

7. During the installation stone tiles can be cut and formed according to you needs. Cutting of the tiles may be performed with a saw for wood.

8. If you need, you can paint the panels with most types of paints. Panels should be primed before painting to create a better surface for the paint.

ITEM 15E: FURNITURES, TABLES AND CHAIRS OF VARIOUS TYPES INCLUDING ACCESSORIES

GENERAL

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

SCOPE OF WORK

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

FURNITURE

Type of Furniture & Appliances	*Unit*	*Quantity*
Modular Worktop	set	1.00
Chair	set	1.00
Mobile Cabinet	set	1.00

SUBMITTAL

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

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

EXECUTION

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

ITEM 15F: ROOFING AND TINSMITHRY

SCOPE OF WORK

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

MATERIAL REQUIREMENTS

ROOFING SHEETS

Horizontal Metal Roof Panel

Base Metal thickness :	Cold rolled high grade steel	
Zinc Aluminum coating	:	Lock forming quality galvanizing that meets ASTM, JIS and PNS Quality Standard
Total Coated Thickness	:	Available in 0.50 & 0.60 mm
Roof Pitch	:	Minimum of 20 degrees roof slope
Length	:	up to transportable length

EXECUTION

ROOFING SHEETS

1. Roof

The spacing of purlins safe at 1.0m to 1.2m.

At least 28 days before laying of roofing sheet start, the Contractor shall submit for approval of the Project-In-Charged, shop drawings indicating materials and method of installation. No roofing sheets laying work shall commence without the Project-In-Charged approval of the shop drawings and work method.

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

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

HANDLING AND STORAGE

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

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

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

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

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

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

Bundles shall not be left exposed to the weather.

C CHANNEL

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

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

ITEM 15G: SIGNAGES

SCOPE OF WORK

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

SAMPLE AND SHOP DRAWINGS

The Contractor shall submit samples for approval by the Architect. Notify the Architect for any changes, clarifications and discrepancies.
For the room I.D. full size lettering layout and installation method shall be submitted to the Architect for approval before start of work.

MATERIAL REQUIREMENTS

1. PPA LOGO

    - Hot dipped cut out 4.5 mm thick Metal sheet screwed with Backlit
    - 12.5mm thk. Colored Acrylic Plastic Sheet Screwed with backlit for PPA Logo

EXECUTION

WORKMANSHIP

Workmanship shall be executed in high quality comparable with artworks.

MOUNTING

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

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

INSTALLATION

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

ITEM 16 : PLUMBING AND SANITARY WORKS

SCOPE OF WORK

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

MATERIAL REQUIREMENTS

SUBMITTAL

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

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

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

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

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

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

STANDARDS

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

MATERIALS

1. Identification of Materials

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

2. Alternative Materials

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

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

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

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

4. Jointing Material

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

5. Water Supply Pipes

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

6. Cleanouts, Plugs and Tee

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

7. Pipe Sleeves

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

8. Downspout

All downspouts shall be unplasticized polyvinyl chloride (uPVC) pipe class DWV conforming to ASTM D2729 or ASTM D1784 for sanitary pipes, Series 1000.

9. Splash Block

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

10. Roof Strainers

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

11. Shower, Floor and Urinal Drain

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

12. Pipe hangers, Inserts and Support

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

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

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

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

13. Unions

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

14. Valves

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

15. Fixtures

a. Water Closets

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

b. Lavatories

b. 1. Lavatory (Wall Hung)

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

c. Urinals

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

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

flush system.

d. Soap Holder

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

e. Faucet for lavatory

Faucet for lavatory shall be in chrome-finish.

f. Bidet Spray Combination

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

16. Concrete, Reinforcing Steel, Pipe and Steel Plate

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

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

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

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

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

17. Non-reinforced Concrete Pipe

Non-reinforced concrete pipe shall be as shown on the Drawings and shall conform with the requirements of non-reinforced concrete pipes AIC latest edition. Concrete shall be with a 28-day minimum compressive strength of 20.7 MPa.

EXECUTION

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

EXCAVATION, TRENCHES AND BACKFILLING

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

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

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

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

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

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

INSTALLATION OF SOIL, WASTE DRAINS OR VENT PIPES

1. Horizontal Drainage Pipe and Vent Piping

Horizontal waste pipes 75mmØ and smaller shall have a minimum grade of 6.5mm per 0.30m and for 100mmØ and larger, 3.2mm per 0.30m. All main vertical soil and waste stacks shall be extended full size above the roof line as vents, except where otherwise specifically shown.

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

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

2. Fittings

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

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

3. Joints

a. PVC Soil Pipe

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

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

4. Cleanouts

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

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

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

5. Flashings

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

6. Traps

Each fixture and piece of equipment requiring connections to the drainage system, except fixtures with continuous waste, shall be equipped with a trap. Traps shall be specified to be supplied with the fixtures. Each trap shall be placed as near to the fixtures as possible.
Traps installed on threaded pipes shall be recessed drainage pattern.

7. Pipe Sleeves, Hangers, and Supports

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

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

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

INSTALLATION OF WATER PIPES, FITTINGS, AND CONNECTIONS

1. Gate Valves and Outlets

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

2. Mains, Branches, and Runouts

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

All pipes above ground shall be run parallel with the lines of the building unless

otherwise shown on the drawings. Branch pipes from service lines may be taken off on top of mains, bottom of mains, or side of mains, using such cross-over fittings as may be required by structural or installation conditions.

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

The use of long screws and bushings is prohibited.

3. Joints

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

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

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

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

4. Unions

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

5. Tests

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

a. Tests for Drainage and Venting System

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

b. Sterilization

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

c. Pressure Test for Water Lines

1. After the pipe has been installed, the joints are completed and with joints

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

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

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

d. Leakage Test for Water Lines

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

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

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

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

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

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

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

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

e. Defective Work

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

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

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

ASSEMBLY, INSTALLATION AND CONNECTION OF FIXTURES

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

Where wood screws are used, screws shall go into solid pieces set between studs. Where through-bolts are used, bolts shall be provided with plates or washers at back set, so that they will be concealed by plaster. Bolts and nuts shall be hexagonal and exposed nuts, cap nuts, and screw heads shall be provided with chromium plated brass washers.

PROTECTION OF FIXTURES

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

FIXTURES AND FASTENING

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

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

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

GUARANTEE

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

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

CLEANING UP

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

PLUMBING, FIXTURES AND TOILET ACCESSORIES INSTALLATION

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

ITEM 17 : ELECTRICAL WORKS

A. General Description

The work to be done under this Specifications consists of the fabrication, furnishing, delivery and installation, complete in all details of the Electrical Work, at the subject premises and all work materials incidental to the proper completion of the installation, except those portions of the work which are expressly stated to be done by others. All works shall be in accordance with the governing Codes and Regulations and with the specifications, except those where same shall conflict with such Codes, etc., which latter shall then govern. The requirements with regards to materials and applications necessary for complete installation of the work specified herein and indicated in the drawings. The Specifications are intended to provide a broad outline of the required equipment, but are not intended to include all details of design and construction.

B. Site of Work

The work shall be located at Port of Dumaguete, Dumaguete, Negros Oriental

C. Scope of Work

Under these Specifications, provide all labor, materials and equipment and perform all the work necessary for the complete execution of all the Electrical Work as shown on Electrical Drawings.

Scope of Work shall include but not limited to the following principal items of work:

1. Test, supply and install Dry Type Transformer and Pad Mounted Transformer including all wiring accessories and terminations as indicated on the drawing.

2. Test, supply and install low voltage switchgear, synchronizing panel including all necessary intelligence unit and all interconnecting cables, cable support and connectors.

3. Test, supply and install brand new Stand-by Generator Set including all necessary accessories.

4. Furnish and install all civil work items related to the electrical installation including concrete pedestal, concrete encasement of conduits, manholes, hand holes, equipment pads, cable tray, trench, metering equipment pedestal, etc.

5. Termination of all feeders at Low Voltage Switchgears inclusive of wires and cables and the necessary cable connectors.

6. Furnish and install primary lines, power and auxiliary system feeders, branch circuits and equipment inclusive of all conduits, fittings, wirings and accessories and the termination of the same.

7. Furnish and install all exterior and interior lighting and power wirings including conduits, boxes, gutters, fittings, wiring accessories, and terminations.

8. Furnish and install all wiring devices as shown on the plans.

9. Furnish and install dry type transformer including mounting brackets and terminations.

10. Furnish and install panelboard, bus bar, disconnect switches and protective devices as shown on plans and drawings.

11. Furnish and install all interior and exterior lighting fixtures as shown in the drawings including installation brackets, stem and termination.

12. Provide Lightning Protection as shown in the plan.

13. Complete testing and commissioning of all supplied equipment and installed electrical system.

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

    The work under this specification is to be installed according to the requirements of the latest edition of the Philippine Electrical Code, the rules and regulations of the local authorities of Port of Dumaguete, Negros Oriental Electric Cooperative (NORECO).

    All necessary permits and electrical fees required for this work shall be obtained by and at the expense of the Contractor. The contractor shall furnish the Engineers and the Owner final certificate of electrical inspection and approval from the proper government authorities after completion of the work. The Contractor shall prepare all as-built plans and all forms and documents required by the approving authorities.

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

15. If anything has been omitted of any item of work, materials, usually furnished which are necessary for the completion of the electrical works as outline herein before, then such items must be and hereby included in this section of work.

QUALITY ASSURANCE

A. Qualification of Manufacturer's:

Furnish manufacturer's electrical equipment of the types and sizes specified which has successfully operated for not less than the past two years. Manufacturer for Power Transformer and Generator Set shall be a public listed power generation manufacturing company and shall have a Certificate of ISO 9001 certified company.

B. Factory Tests are required for all electrical equipment and assemblies. Perform factory tests in accordance with the codes and standards specified as applicable to the equipment. Items to be factory tested before ship/deliver to site shall include:

1. Power Transformer

2. Dry Type Transformer
3. Low Voltage Switchgear
4. Automatic Synchronizing Panel
5. Generator Set

C. Factory Inspection:

PPA's representative/s may inspect fabricated electrical equipment at the factory. Notify PPA's representative/s in sufficient time so that factory inspection can be arranged. Factory inspection will be made after manufacturer has performed satisfactory checks, adjustments, tests and operations. Approval of equipment at the factory only allows the manufacturer to ship/deliver the equipment to the site, and does not constitute final acceptance. All expenses required for this work shall be obtained by and at the expense of the contractor.

SUBMITTALS:

Specific items requiring submittals shall be as specified in each individual item of work. Shop drawings shall be submitted and approved before procurement, fabrication, or delivery of such items to the job site. Partial submittals will not be acceptable; such submittals will be return without review.

A. Manufacturer's Data:

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

B. Shop Drawings:

Shop drawings shall show types, sizes, accessories, elevations, floor plans, sectional views, installation details, elementary diagrams, and wiring diagrams. Wiring diagrams shall identify circuit terminals and shall indicate the internal wiring for each item of equipment and the interconnection between the items. Drawings shall also indicate adequate clearance for operation, maintenance and replacement of operating equipment devices. If any equipment is disapproved, the drawings shall be revised to show acceptable equipment and may be resubmitted.

C. Standard Compliance:

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

If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified in the individual item of work. In lieu of the label or listing, the Contractor shall submit a certificate from an independent testing organization,

which is competent to perform acceptable test and is approved by the Engineer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods that the item conforms to the specified organization's standard. For materials and equipment whose compliance with organizational standards or specifications is not regulated by an organization using its own listing or label as proof of compliance, a certificate of compliance from the manufacturer shall be submitted for approval.

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

D. Operation and Maintenance Manual:

The Contractor shall furnish an operation and maintenance manual for each electrical system and for each piece of equipment. Three copies of the complete manual bound in hardback binders or an approved equivalent shall be provided to the Owner. One manual shall be furnished before the contract is completed. The following identification shall be inscribed on the cover; the words **"OPERATING AND MAINTENANCE MANUAL",** the name and location of the project and name of Contractor. The manual shall include the name, addresses, and telephone number of each subcontractor installing the equipment and systems, and of the local representatives for each item of equipment and each system. The manual shall have a table of contents and be assembled to conform to the table of contents with the tab sheets shall be legible with large sheets of drawing folded in. The manual shall include, but not be limited to the following: a system layout showing circuits, devices and controls; wiring and control diagrams with data to explain detailed description of the function of each principal component of the system, the procedure for operating; shutdown instructions, installation instructions; maintenance instructions; test procedures; performance data; and parts list. The parts list for equipment shall indicate the source of supply recommended spare parts, and the service organization which are reasonably convenient to the building site. The manual shall be complete in all respects for all equipment, controls, and accessories provided.

PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery:

Deliver electrical materials and equipment in manufacturer's original cartons or containers with seals intact, as applicable. Unless otherwise specified, deliver conductors in sealed cartoons or on sealed reels, ends of reeled conductors factory sealed. Deliver large multi-component assemblies in sections that facilitate field handling and installation.

B. Storage:

Unless designed for, outdoor exposure, store electrical materials off the ground and under cover. Prevent corrosion, contamination or deterioration.

C. Handling:

Handle materials and equipment in accordance with manufacturer's recommendations. Lift large or heavy items only at the points designated by the manufacturer. Use padded slings and hooks for lifting as necessary to prevent damage.

CATALOGUED PRODUCTS

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

MANUFACTURER'S RECOMMENDATIONS

Where installation procedures are specified to be in accordance with the recommendations of the manufacturer of the material or equipment being installed, printed copies of these recommendations shall be furnished to the engineer prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

A. Manufacturer's Certified Report:

The equipment manufacturer, or his authorized representative shall submit a notarized written report with respect to his equipment certifying that (1) the equipment has been properly installed, wired, and connected under his supervision, (2) the equipment is in alignment, (3) he was present when the equipment was placed in operation, (4) he has checked, inspected and adjusted the equipment as necessary, (5) the equipment has been operated under full load conditions and operated satisfactorily, and (6) the equipment is fully covered under the terms of the guarantee. Reports shall be submitted for the following:

1. Power Transformer
2. Dry Type Transformer
3. Low Voltage Switchgear
4. Automatic Synchronizing Panel
5. Generator Set

B. Demonstration and Final Operation Test Plans and Results:

Submit a written plan for demonstrating that each item of equipment provided to meets the specified operational requirements. Submit a written plan for procedures to be used in final operation testing of entire systems including a description of each system, test methods and materials, testing instruments and

recorders, and list of the equipment involved with the functional parameters to be recorded on each item. Submit three (3) copies of test results and records for all final operation tests.

C. Accessory and Maintenance Materials:

Furnish items as specified herein and other item of works. Deliver to owner as directed with an itemized list in a letter of transmittal accompanying each shipment.

1. Special Tools and Accessories

Furnish special tools, instruments and accessories for maintaining equipment requiring periodic repair and adjustment. Also, furnish special lifting and handling devices for equipment requiring such devices.

2. Maintenance Materials and Spare Parts

Deliver in manufacturer's original containers labeled to completely described contents and equipment for which it is furnished.

COORDINATION

Electrical work shall be coordinated with other trades involved in the construction of this project. All work shall be carefully laid out in advance, coordinating electrical features with architectural and structural features of construction.

CODES, INSPECTIONS, PERMITS AND FEES:

A. The work under this Contract is to be installed according to the requirements of the latest edition of the Philippine Electrical Code, the rules and regulations of the local authorities of the Dumaguete City, Negros Oriental and the requirements of the Negros Oriental Elective Cooperative (NORECO) Local Power Company.

B. All permits and electrical fees required for this work shall be obtained by and at the expense of the Contractor. The Contractor shall furnish the Engineers and the Owner final certificates of electrical inspection and approval from the proper government authorities after completion of the work. The Contractor shall prepare all as-built and all forms and documents required by the approving authorities.

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

Record Drawings:

The Contractor shall, during the progress of the work, keep a careful record of all changes where the actual installation differs from that shown on the Contract drawings. Upon completion, the Contractor shall, in a neat and accurate manner, finalize "As-Built" drawings on tracing paper. These drawings shall be submitted to the Engineers for approval. Final payment will be withheld until receipt of the

approved record drawings showing circuit runs and pull boxes with sufficient information for future rewiring, maintenance and identification. The final submittal of record drawings shall be in original and three (3) sets of prints of "As-Built Drawings" of Electrical Works. The print copies shall be duly signed and sealed by a Professional Electrical Engineer. This approved final submittal shall become the property of the Owners.

Minor Modifications:

The plans as drawn are based upon architectural/structural plans and details and show conditions as accurately as it is possible to indicate them in scale. The plans are diagrammatically and do not necessarily show all fittings, etc., necessary to fit the project conditions. The location of equipment and apparatus shown on them are approximate. This Contractor shall be responsible for the proper location in order to make them fit with architectural/structural details and instruction from Owner's representative at the site.

Guarantees:

A. The Contractor shall guarantee that the electrical systems are free from all grounds and from all defective workmanship and materials and will remain so for a period of one year from date of acceptance of work. Any defects, appearing within aforesaid period, shall be remedied by the Contractor at his own expense.

B. The Contractor shall indemnify and save harmless the Owner, and the Engineers from and against all liabilities for damages arising from injuries or liabilities to persons or damage to property occasioned by any act or omission of the Contractor or any of his Sub-Contractors, including any and all expenses, legal or otherwise, which may be incurred by the Owner, or the Engineers, in the defense of any claim, action or suit.

Subcontract, Etc:

The Contractor shall be held fully responsible for the work of any Subcontractor or manufacturer performing work or supplying materials and ascertain that the Electrical Work, when finally delivered to the Owner, shall be ready in every respect for satisfactory and efficient operation.

Workmanship:

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

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

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

Field Quality Control:

A. Manufacturer's Supervision and Field Installation Check. Where specified, the electrical equipment manufacturer shall furnish the services of an authorized representative especially trained and experienced in the installation of his equipment to (1) supervise the equipment installation in accordance with the approved submittals and manufacturer's instruction, (2) be present when the equipment is first put into operation, (3) inspect, check, adjust as necessary, and approved the installation, (4) repeat the inspection, checking and adjusting until all trouble or defects are corrected and the equipment installation and operation are acceptable, and (5) prepare and submit the specified Manufacturer's Certified Report. Include all costs for representative's services in the Contract Price.

B. Operational Demonstrations

Demonstrate that performance of installed electrical materials and equipment complies with requirements specified in Section 40. Operate equipment through entire no-load to full-load range for not less than 24 hours unless a longer period is specified elsewhere. Immediately correct defects and malfunctions with approved methods and materials in each case, and repeat the demonstration. Conform to approved demonstration plan.

C. Final Operation Tests

Test all electrical systems for not less than 168 hours, with no interruptions except for normal maintenance or corrective work. It shall conform to the approved test plan.

1. Testing Materials

Furnish labor, instruments, recorders, gauges, materials and power for tests as required.

2. Testing Methods

Operate systems continuously 24 hours a day under constant inspection of trained operators. Cause variable speed equipment to cycle through the applicable speed range at a steady rate of change. Induce simulated alarm and distressed operating conditions, and test controls and protective devices for correct operation in adjusting system functions or causing system shutdown. Perform other final operation tests as may be required under Section 40.

3. Defects

Immediately correct all defects and malfunctions disclosed by tests. Use new parts and materials as required and approved. Add the interruption time for corrective work to the specified total test period.

4. Test Records

Furnished approved instruments, gauges, chat recorders and other devices as required. Continuously record all function and operation parameters during entire test period. Submit data to PPA.

Instruction of PPA's Personnel to Operate:

Where specified under individual item of work of this Section 40, conduct an instruction program for up to five persons designated by the PPA's District/PMO's Office jurisdiction. Furnish the services of qualified instructors from the applicable equipment manufacturers to include instruction covering basic operation theory, routine maintenance and repair and "hands on" operation of equipment. Base duration of the program on the complexity of equipment involved, and obtains PPA's approval of instruction adequacy before terminating the program. Schedule instruction periods at PPA's convenience.

Contract Drawings:

A. The location of outlets, apparatus and equipment indicated on the drawings are shown as accurately as possible. However, the small scale drawings are diagrammatically and that such locations, as shown, are subject to slight adjustment, as the work is installed which may be made, however, without the approval in writing of the Engineers.

B. The Contractor shall examine and study the architectural/structural scale drawings, large scale and full size details, the approved shop drawings of other parties and he shall frequently consult with them to ascertain any changes that may have been made and he shall be guided accordingly before establishing the precise location of conduit runs, pull and junction boxes and devices. All outlets covered or partially covered by ducts, piping, etc., shall be extended laterally or to underside of same so that the fixtures may be properly installed.

C. The Contractor shall effectively protect his own work from damage during and as may be necessary after installation, and shall likewise protect adjoining work of other parties from damaged resulting from his installation.

Location of Wiring and Outlets:

A. The Contractor shall coordinate his work with all parties involved so that exact locations for all outlets and equipment's and wiring may be obtained. Care should be exercised where running a common neutral that

phase wire are of different color so that the multi-circuit will be balanced around the neutral conductor.

B. The location of equipment shown on diagrammatically wiring plans shall be considered as approximate and it shall be incumbent upon the Contractor.

Building Provision:

Certain provision have been made in the power house building for the accommodation of electrical installation, these provisions include space allocation, holes through beams and structural slabs, etc. The provisions so made are shown on the drawings. Before proceeding with the works, the Electrical Contractor is to check and confirm that the provisions are satisfactory for the works, and where necessary, additional information is to be provided.

It is the Electrical contractor's responsibility to insure that all holes, openings etc., are provided correctly during construction of the power house building. He shall inform the project manager and the civil contractor of all holes and/or pipe chase required in the structure.

Material Proposed:

The tendered is required to state in his tender the manufacturer and type proposed for all materials to be used for the Works. Any alternative offer shall be indicated and highlighted and submitted at time of tender.

Samples of the materials to be used shall be submitted to the Engineers for approval before procurement and/or installation.

Spares:

The Contractor shall include in his proposal the price for the supply of the items of materials as spares as on every item of work under this Section.

Interpretation of Specification and Drawings:

Any queries regarding the interpretation of the specification of the drawings relevant thereto may be addressed to the Engineers in writing before submission of tender and the Contractor will be deemed to have satisfied himself that he is able to comply in all respects with the plans and specification to a degree acceptable to the Engineers.

Maintenance and Defective Liability Period:

The defective liability period shall be twelve (12) months starting from the date of practical completion of the work and/or acceptance of the works by the owner.

If any defects or signs of deterioration occur to the said work within such period, the Contractor shall be liable to make good all such defects at his own expense and to the satisfaction of the Owner. The period of maintenance of such repaired work shall be extended further to three (3) months.

Commencement and Completion of Work:

The Contractor shall commence the electrical installation within 14 days from the date of receipt of the written acceptance of the tender or the notice to proceed.

Submittal Requirements:

A. All submittals shall be submitted within 90 days from the issuance of a notice to proceed.

B. Materials and equipment requiring samples, catalogue data, shop drawings and manufacturer's certification shall be as indicated in material status log and in respective sections of specifications.

C. Material samples shall be fixed on 6mm (1/4 inch) thick plywood of sufficient size and fully labeled.

D. Quantity of submittals shall be six (6) sets plus one (1) sepia prints for shop drawings and seven (7) sets for catalogue data and manufacturer's certification.

E. Submittals of the Contractor shall be reviewed and returned within a minimum of 21 days, each stamped "REVIEWED" and "A", "B", or "C", "ACTION". The review action are as follows:

"A" ACTION means that fabrication, manufacture, or construction may proceed provided submittal complies with the Contract Documents

"B" ACTION means that fabrication, manufacture, or construction may proceed provided submittal complies with the Owner notations and the Contract Documents. If, for any reason, Contractor cannot comply with the notations. Contractor shall resubmit as described for submittals stamped "C" ACTION.

"C" ACTION means that submittal does not comply with the Contract Documents and that fabrication, manufacture, or construction shall not proceed. Submittals stamped "C" ACTION are not permitted on job site. Contractor shall make revisions and resubmit.

PAD MOUNTED TRANSFORMER

GENERAL REQUIREMENTS

A. Perform as indicated in this specification

B. Install the substation equipment as indicated on the project drawings, the approved shop drawings and as specified herein. Installation of the equipment shall be supervised by the equipment supplier representatives

C. Touch up all surfaces as required with paint and procedures approved by the manufacturer of the substation.

D. Site tests shall be carried out by the Contractor and witnessed by the Engineer and/or the Owner. Test equipment shall be complete with all current calibration certification. Test procedures shall be submitted for approval a minimum of four weeks before the planned test date. The test results shall be recorded on manufacturer's standard test certificates. Site tests shall include the following:

i Power frequency voltage test on both windings to BS 171 / IEC 76
ii Insulation resistance test prior to and after the pressure test for each winding to earth and between windings
iii Oil test to IEC 296
iv Voltage ratio test on all tap positions
v Vector group test
vi Tests on thermal trip devices

PRODUCTS

Continuous rating under site conditions	750 KVA
HV Input	13.2 KV
LV Output	480Y / 240V
Frequency	3Ø, 60 Hz.

Maximum top oil temperature rise shall be 60 degrees Centigrade

General

Transformer shall be of the outdoor, oil-immersed, naturally circulated, naturally cooled, hermetically sealed pad mounted type, and shall be installed within the substation. The transformer shall be from a standard range of distribution transformer complying with the requirements of BS 171 / IEC 76, ANSI – C57, IEEE – C7.12 or similar and approved. They shall be capable of delivering full rated output under the site climatic conditions.

Construction

The transformer tank shall be of sheet steel construction suitably stiffened so that the transformer may be lifted and transported without permanent deformation or oil leakage. The transformer shall be fitted with lugs suitable for lifting and jacking the complete oil-filled unit and provided with a skid under-base with removable wheels to allow the transformer to be moved in any direction.

Tanks and covers shall be designed such that there are no external pockets in which water can collect and no internal pockets in which oil can remain when draining the tank or in which air can be trapped when filling the tank. The design shall also be such that they provide easy access for painting.

Tank and terminal box joints shall prevent entry of water and leakage of oil. Gaskets shall be of a non-absorbent material. Joint faces shall fit properly and no additional thickness or jointing shall be used to make good irregularities. The top cover shall have a substantial flange and adequate number of bolts fixing the cover to a similar substantial flange on the transformer tank. The gasket provided at this joint shall be of synthetic rubber bonded cork.

The top cover seal shall be located above cold oil level, sufficient space being provided above the oil level to allow for expansion. The initial filling of oil shall be carried out at such a temperature that the pressure in the tank is at a minimum.

Instrumentation

The transformer shall be provided with a thermometer at the top of the tank, having a re-settable pointer for registering the maximum oil temperature and an oil level gauge to indicate the oil level at both 30 degrees centigrade and the level when the oil temperature has risen to the maximum permitted limit.

The transformer shall be provided with a rating and diagram plate made from stainless steel.

Earthing

The transformer shall be earthed by means of substantial connections to the tank. A terminal for this purpose shall be provided at the base of each unit for connection to the earthing system.

Cable Boxes

Cable boxes shall be provided for cable connections to the primary and secondary windings. The cable boxes shall be suitable for use outdoors and for bottom entry cabling. The boxes shall be air-insulated type, suitable for XLPE/PVC/SWA/PVC or XLPE/PVC/AWA/PVC. The cables shall be terminated using the heat shrink sleeve method.

Surface Treatment

The inside of the tank shall be grit-blasted and treated to the manufacturer's standard finish. The exterior of the tanks shall receive the surface finish suitable for a minimum of 10 years in an outdoor marine environment.

DRY TYPE TRANSFORMER

GENERAL REQUIREMENT

Provide and delivery to jobsite new dry type transformer for indoor use.

SUBMITTAL

A. Shop Drawings and Manufacturer's Data:

It shall indicate but not limited to the following:

1. Overall dimension
2. Impedance Value
3. Tap Ratings

B. Certificates of Compliance:

1. Sound level data

C. Operating and Maintenance Manuals:

D. Certificate test Reports:

1. Routine Tests
2. Design Tests

INSTALLATION

Shall be in accordance with the code and requirements specified herein.

GROUNDING

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

FIELD TEST AND INSPECTION

A. Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations. Perform work in a careful and safe manner so as not to endanger personnel or equipment. Acceptance checks and test shall include, but not limited to the following:

1. Inspect devices, equipment, etc. for damage or maladjustment caused by handling during shipment or installation.

2. Verify minimum resistance to ground of grounding lugs and grounding connections.

3. Transformer Test:

   Test transformer secondary voltages and adjust the voltage at the transformer to provide a secondary voltage of 230V.

4. Final Testing:

   Upon completion of acceptance checks and tests, show by demonstration in service that transformers and devices are in good operating condition and properly performing the intended function.

PRODUCTS

a. Dry Type Transformer shall be two-winding type, 60Hz., 150 degrees centigrade rise above 40 degrees centigrade ambient.

   Transformer shall be self-cooled and in NEMA 1

b. Rating shall be as shown on the plans and rated 10 KV BIL.

c. Voltage rating shall be 480V, three phase, primary and 240V, three phase, secondary, 60Hz or as indicated on the plans. Transformer secondary shall have a corner ground. The core should be visibly

grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable NEMA and NEC Standards.

d. Sound level:

Shall be an average of 3.0db lower than the NEMA standard sound levels for the transformer size indicated.

e. Transformer shall be provided with 2 of 2 ½% taps above normal (FCAN) and 4 of 2 ½% taps below normal (FCBN). Transformer shall be UL listed.

DIESEL ENGINE GENERATOR SET

GENERAL REQUIREMENTS

A. Provide diesel engine electric generating unit with accessories, auxiliary equipment and associated work as specified.

B. The generator set shall consist of a diesel fueled engine directly coupled to an electric generator, together with the necessary switchgear, controls and accessories, to automatically provide continuous electric power for the duration of any failure of the normal utility power supply.

C. QUALITY AND EXPERIENCE

All materials and parts of the generator set shall be new and unused. Each component shall be of current manufacture from a firm regularly engaged in the design and production of such equipment. Unit and components offered under these specifications shall be covered by the manufacturer's standard warranty or guarantee on new machines.

D. PARTS AND SERVICES

Bids shall be accepted only on electric generator sets which can be properly maintained and serviced without causing the purchaser either to carry expensive parts stock or to be subjected to the inconvenience of long periods of interrupted service because of lack of available parts. Supplier/Contractor shall have in the Philippines an authorized representative office to which all inquiries can be made and parts and service are available.

E. The system shall be designed, assembled, tested and shipped by one manufacturer so that there is one source of supply and responsibility on all components supplied with the system.

F. Acoustic performance shall not exceed published OSHA standards of 90 dBA at 3 meters.

G. The standby diesel oil fueled generating set shall mounted on anti-vibration mounts on a substantial steel fabricated and welded base frame which shall provide for attachment

H. The specified standby KVA ratings shall be for continuous electrical service during interruption of the normal power utility source. These ratings must be substantiated by performance curves and net of all power consumed by auxiliary equipment such as reefer outlet and power house. Special ratings or maximum ratings are not acceptable.

I. All equipment shall be designed, assembled and tested to conform to applicable standards of ASA, IEEE, ASME, ASTM, and NEMA or VDE and DIN.

SUBMITTAL

A. MANUFACTURE'S DATA

1. Diesel engine driven electric generator set
2. Valves
3. Engine Muffler
4. Storage Battery
5. Battery Charger
6. Radiator

B. CERTIFIED TEST REPORTS

1. Diesel engine factory test
2. Generator factory set test

C. MANUALS

Provide five sets of operation and maintenance manual for equipment. Identification symbols for all replaceable parts and assemblies shall be included. Information in manuals shall be comprehensive and specific.

INSTALLATION

A. Installation shall conform to the requirements of the Code.

B. Testing

The generator set shall receive the manufacturer's standard factory load testing.

1. Prior to acceptance of the installation, equipment shall be tested for 24 hours continuous operation without any failure to show if it is free of any defects, will easily start, and be subjected to full load test. Should full (generator rated load) load not be available at the site, the Contractor or supplier shall furnish the equipment necessary for such full load test. Full load test can be performed at the supplier's shop or factory and witnessed by the PPA's representative/s. Should failure occur during the testing, the Contractor shall rectify the deficiencies and shall repeat testing procedure at his own expense and to the satisfaction of PPA.

2. On completion of the installation, start-up shall be performed by a factory-trained supplier or dealer representative. Actual operation and maintenance shall be conducted to the PPA"s operating

personnel. Operating and maintenance instruction books shall be submitted to PPA.

PRODUCTS

A. ENGINE

The engine to be furnished under this specification shall be a high-speed water cooled diesel engine, four-stroked. The maximum speed of the engine in the service anticipated shall not exceed 1800 RPM

The complete diesel engine generator unit shall be free from critical and torsional vibration within the operating speed range. The engine is to be furnished complete with the following accessories.

1. The injection system shall be electronically controlled, high-pressure injection with unit injection pumps.

2. It shall be equipped with an electronic engine management monitoring and control system.

3. Heavy duty electric starter for automatic starting, generator, and voltage regulator, batteries and line operated trickle charger.

4. Suitable engine mounted instrument panel, including the following instruments:

    - Ammeter with selector switch
    - Voltmeter with selector switch
    - Frequency meter
    - Auto trickle battery charger
    - Buzzer
    - Emergency stop button
    - Fuses
    - Relays
    - Current transformers
    - Terminal block etc.
    - Water temperature gauge
    - Oil pressure gauge
    - DC voltmeter
    - Hour run meter
    - Auto start with manual key switch
    - Timers for delay relay start, multiple cranks and cooling run
    - Fault shutdown and alarm indicator for low oil pressure, high engine temperature and over speed.

    This panel shall have digital or analog read-outs and contain the voltage regulator.

5. Critical type silencer and required number of spring type vibration isolators

6. Air Intake and Exhaust System:

Provide air intake and exhaust systems for the engine. Include piping, fittings and expansion joints necessary to interconnect equipment with the engine. Arrangement of air intake and exhaust system shall be similar to that indicated and modified, as required, to suit the engine furnished, subject to the approval of the Engineer.

a. Air Intake Filter:

Provide oil bath or dry type air intake filter for the engine. Filter shall be capable of remosing a minimum of 92 percent of dirt and abrasive 3 microns and larger from intake air. Size filter to suit engine requirements at 110 percent of rated full load. The unit shall be designed to permit easy access to the filter for maintenance purposes.

b. Air Intake Silencer:

Provide air intake silencers for the engine to limit noise of intake air system to a level below the audible mechanical noise level of the engine. Silencers shall be as recommended by the silencer manufacturer for the engine furnished.

c. Exhaust Silencers:

Provide an exhaust silencer for the engine. Arrange the silencer with inlet as indicated. Design silencer for degree silencing complete with handhole openings, and all necessary brackets for supporting purposes. The size and type shall be in accordance with the manufacturer's recommendations.

d. Expansion Joints:

Provide suitable sections of multiply corrugated piping for each engine to absorb expansion strains and vibration in the piping. Air intake expansion joints shall be as specified for the exhaust or may be metal reinforced rubber type.

e. Exhaust Piping:

Provide piping for the engine complete with necessary fittings, flanges, gaskets, bolts and nuts. Pipe shall be open-hearth, lap-welded, or seamless steel pipe conforming to ASTM A 53. Exhaust piping shall have wall thickness not less than 9mm and shall slope away from engine. Flanges shall be 150 pound slip-on forged steel welding flanges conforming to ANSI B16.5, with material in accordance with ASTM A 181, Grade 1. Fittings may be used. Fittings shall be of same material as pipe. Miter angles of each individual section shall not exceed 22 ½ degrees total and not more than 11 ¼ degrees relative to the axis of the pipe at any

cut. Gaskets for piping shall be of high temperature non-asbestos. Bolting material for exhaust flanges shall be alloy steel bolt-studs conforming to ASTM A 193, and alloy-steel nuts conforming to ASTM A 194. Bolts shall be of sufficient length to obtain full bearing on the nuts and shall project not more than two full threads beyond the nut.

7. Radiator:

Provide each engine with a radiator of the forced air type with horizontal air discharge. Radiator fan shall be driven through multiple V-belts from an extended shaft connected to the engine crankshaft. Mount the radiator on the structural skid and integrally pipe into the cooling systems. The radiator shall be in accordance with the engine manufacturer's standard design for the engine furnished except that the tube cores shall be non-ferrous metal other than the aluminum. Radiator unit shall have ample capacity to remove not less than the total Btu per hour of heat rejected by its respective engine at 110 percent full rated load to the jacket water, lubricating oil, and inter cooler systems. Rate radiator capacity at optimum temperature of the cooling medium leaving the engine as recommended by the engine manufacturer with a dry bulb air temperature of 95 degrees F (35 degrees C). Sizing shall be based on water as the cooling medium.

Pressure drop through the radiator shall not exceed 8 psi when circulating the maximum required water flow. Radiator air velocity shall be a maximum of 2,000 feet per minute. Fans shall be propeller-type with multi-blade construction, four blades or more, and operated at a tip speed not to exceed 15,000 feet per minute. Total fan drive kva required for each radiator unit shall be not more than 6 percent of the full load gross kva rating of the diesel engine for which it is furnished.

GENERATOR

1. The generators to be supply shall be two (2) 880 KVA standby rating, 480 volts, 3 phase, 60 hertz, 0.80 power factor, 1800 RPM, and shall have two bearings sleeve type or single bearing type and shall be direct connected to the engine flywheel with flexible coupling or approved equal. The generator voltage drop on sudden application of 100 percent rated load shall be less than 10 percent.

2. A suitable solid state exciter and automatic voltage regulator capable of maintaining rated voltage at 200 percent rated current and sustaining under short circuit conditions 400 percent rated current shall be provided. The automatic voltage regulator shall be provided with manual control capable of setting the regulated output voltage to any value between rated and plus or minus 10 percent.

3. The steady state regulation of the output voltage shall be within plus or minus two percent. Output voltage complete recovery time

after sudden application or rejection of rated load shall be within 0.3 second.

4. Voltage regulator shall be of same manufacturer as generator, with manual/automatic switch.

5. Generator shall be open, drip-proof construction with an overall efficiency of at least 90 percent at full load.

6. The generator shall have full rated brought out at the terminals for system use.

ENGINE STARTING BATTERY

Batteries shall be provided, adequate to supply the engine starting system when electric starting is employed. Battery shall be high discharge rate load acid, heavy-duty industrial type. Total number of cells to be provided shall be 12 cells. Battery shall have a voltage rating of not less than 24 volts. The voltage and ampere-hour rating of the battery shall be sufficient to provide 5 cranking operation at zero degrees F while retaining a battery voltage of 2.0 volt or more per cell. Each operation consisting of 5 cranks with in-between off loads of 30 seconds. Battery shall be complete with connectors and cable terminals and shall be firmly anchored in racks in a battery compartment. Racks and compartment shall be finished in a manner to permanently resist corrosion.

BATTERY CHARGER

Battery charger shall be enclosed, wall mounted, constant-voltage type, heavy duty, dual rate industrial type. Charger shall be suitable for automatically keeping the diesel engine starting batteries in a charged condition during periods when the engine is idle. Rectifier elements shall be silicon diodes capable of continuous operation at full rated load with convection cooling in ambient temperatures up to 120 degrees F. Control charger output by a magnetic amplifier or semi-conductor device which shall maintain 1.4 to 1.45 volts per cell within plus or minus one percent, from zero to full load current, when operating at the float voltage setting, and during variations in supply voltage of plus or minus 10 percent. Charger output shall be continuously adjusted automatically depending on state of charge of battery. Charger shall be able to provide continuous float charge of 1.4 to a.45 volts per cell and 1.55 volts per cell to fully charged the discharged batteries. Provide timer adjustable from 0-24 hours for the high charge. Provide voltmeter and ammeter to show charger output. Voltmeter dial shall have red markings to show lower and upper limits to the normal operating range. Provide pilot lamps for main supply, float equalize circuit, to disconnect the AC supply to the charger during engine cranking and to ensure against charger failure upon resumption of charging following a cranking operation. The charger shall automatically shut down if the outgoing voltage exceeds the adjusted limit and an alarm shall be initiated. Charger enclosure shall be of corrosion-resistant material with sheet metal thickness of not less than 2mm. The charger shall be provided with input and output circuit breakers. Charger shall be suitable for application to nickel cadmium batteries as specified. Provide ground terminal for grounding the charge unit.

LOW VOLTAGE SWITCHGEAR

GENERAL REQUIREMENTS

Under this section of the specifications, the contractor shall supply the low voltage switchgear as described herein and as shown in the drawings.

SUBMITTAL

A. MANUFACTURER'S DATA:

1. Low Voltage Switchgear
2. Circuit Breakers
3. Ammeter, Voltmeter, Watthour meter with Demand Register, Watt Meter, Power Factor Meter, etc.

B. SHOP DRAWINGS:

Furnish drawings for the low voltage switchgear including, but not limited to the following:

1. Overall dimensions, front view and sectional views
2. Bus arrangements including dimensions and ampere ratings for all bus bar
3. Type and spacing of bus supports
4. Maximum short circuit bracing
5. Elementary diagrams and wiring diagram with all terminals identified and indicating prewired interconnections between items of equipment and the interconnection between the items
6. One-line diagram

C. In addition, submit the manufacturer's published time-current curves on full size logarithmic paper on main circuit breaker and branches to allow designer to provide settings which will insure that proper protection and coordination will be achieved.

D. SPARE PARTS DATA:

As soon as practical after approval of materials and equipment, furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies, and source of supply.

INSTALLATION

A. Install the switchgear as indicated on the project drawings, the approved shop drawings and as specified herein in the presence of the equipment supplier representatives.

B. TOUCH-UP PAINTING

Touch-up all surfaces as required with paint and procedures approved by the manufacturer of the switchgear.

FIELD TEST AND INSPECTION

A. ACCEPTANCE CHECKS, SETTINGS AND TEST

Perform all tests and inspections with the presence of PPA's representative/s in accordance with the manufacturer's recommendation and the latest IEEE standards unless specified otherwise. Perform work in a careful and safe manner so as not to endanger personnel or equipment. Perform tests in such a way as to obtain information about the performance of the breakers and wiring together as a unit, as well as separately. Except where specified otherwise, give the PPA's representative/s at least five (5) working days advance notice of the dates and times for all checks, settings, inspections and tests.

B. ACCEPTANCE CHECKS AND TESTS: Include the following:

1. Compare actual connections and wiring diagrams. If differences are found, determine if error is in diagram or in actual wiring and correct as necessary.

2. Inspect all devices, equipment, and other materials for damage or maladjustment caused by shipment or installation.

3. Assure that tightness of bolted bus joint are in accordance with manufacturer's recommendations (use calibrated torque wrench).

4. Perform all mechanical operator and contact alignment tests in manufacturer's recommendations. Make adjustment as necessary.

5. Measure breaker contact resistance and perform minimum pick-up voltage tests on all trip and closing coils. Make adjustments as necessary to stay within manufacturer's acceptable range.

6. Remove wedges, ties, and blocks installed by the manufacturer to prevent damage during shipment.

7. Check all circuit breakers in accordance with manufacturer's instruction.

8. Verify minimum resistance to ground of all grounding systems.

9. Verify meter connections and ensure calibration.

C. FOLLOW-UP VERIFICATION

Upon completion of all acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that all circuits and devices performing their intended function. Circuit breakers shall be tripped by operation of each protective device. Test shall be such that each item will perform its function not less than three (3) times.

PRODUCTS

A. The low voltage switchgear shall be metal enclosed indoor assembly rated 600 volts AC and arrange for service on a 480 volts, 3Ø, 3 wire line with ground bus on free standing assembly.

B. CONSTRUCTION:

1. The low voltage switchgear section shall consist of completely enclosed, self-supporting vertical structures bolted together to form one sheet metal enclosure. It shall be provided with front and rear channels. The ends, top and rear shall be covered with removable, screw-on-steel plates not less than 12 gauge. Switchgear shall include all protective devices and equipment as listed with necessary interconnection, instrumentation and control wiring, terminal blocks, and mechanical type solderless connectors for terminals.

2. Protective devices shall be individual drawers or compartments, and necessary bus connection straps. Devices shall be modular sized and so arranged as to be individually removable and readily interchangeable. Each device shall be provided with cardholder and card for identification.

3. Bus bar shall be silver plated copper with ampere rating not lower than the main breaker ampere rating. It shall be mounted on insulator supports on high impact, non-tracking, high quality insulation material and adequately braced to withstand the mechanical forces exerted during short circuit conditions. Branch circuit bushing shall connect directly to bus structure. All bushings shall be arranged so as not to obstruct straight-in wiring to the protective devices. All bus work shall consist of sufficient cooper to limit temperature rise to 60 degrees C at an ambient of 40 degrees C temperature. Bus bar shall be insulated from the devices so that only exposed energized parts will be at point of connection to devices.

4. Bus bar shall be arranged to permit future. It shall be mounted on insulator supports on high impact, non-tracking, high quality insulation material and adequately braced to withstand the mechanical forces exerted during short circuit conditions up to 75,000 amperes RMS symmetrical short circuit at 480 volts. Bus bars shall be silver plated bushing shall connect directly to the bus structure. Branch circuit bushing shall connect directly to bus structure. All bushings shall be arranged so as not to obstruct straight-in wiring to the protective devices. All bus work shall consist of sufficient cooper to limit temperature to 40 degrees C ambient temperature.

5. Small wiring, necessary fuse blocks and terminal blocks within each vertical structure shall be furnished as needed. All control and metering conductors shall be marked and color coded for proper identification.

6. All hardware's shall have suitable protective finish.

7. Metal surfaces shall be chemically cleaned and treated. Chemical treatment shall provide a bond between paint and metal surfaces and help prevent entrance of moisture and formation of rust under the paint film.

The vertical structure shall be finished in ASA No. 49 medium-light-gray, the hinged doors over the protective devices on the front in ASA No. 61 light grey.

Switchgear shall be completely assembled and wired at the factory. Rigid inspection by PPA's representative/s before and after assembly shall assure correctness of design and workmanship. All groups of control wires leaving equipment shall be provided with terminal blocks with suitable numbering strips.

8. Switchgear supports for anchoring and for providing proper alignment shall be furnished and installed on the floor or par by others.

9. A ground bus shall be furnished secured to each vertical structures and shall extend the entire length of the low voltage switchgear. Grounding terminals shall be provided.

10. Where space provisions only for future breaker is called for, all studs, copper work and provisions for mounting the breaker shall be provided so that when breaker is added, no additional parts or changes to the structure on bus work is required.

11. Switchgear outgoing feeders shall be bottom exit.

12. Engraved metal nameplates shall be provided for each device. The letters or numerals on the nameplate shall be a minimum of 5mm in height with light colored, enameled characters on a dark background. The legend on the strips shall be so composed as to clearly indicate the name of the feeder and/or equipment served by the protective devices, etc.

13. Bases, frames and channels of the switchgear which come in contact with concrete shall be corrosion resistant and shall be fabricated of in hot dipped galvanized steel.

CIRCUIT BREAKERS

1. The branch circuit breakers shall be power breaker type. Cases for molded case circuit breakers are constructed of a glass-reinforced material that provide high dielectric strength. Ratings of circuit breakers including spaces shall be as indicated in the drawings. All protective devices shall meet NEMA and Underwriter's Laboratories, Inc. specifications.

2. Circuit breakers shall consist of a quick-make, quick-break type entirely trip-free operating mechanism with contacts, ARC-interrupter, and thermal magnetic trip unit for each pole. The thermal magnetic trip shall provide time delayed or short circuit current in any one pole. It also equipped with a Push-To-Trip button to manually trip the circuit breaker. It can be mounted and operated in any position. The thermal-magnetic trip unit shall provide time-delayed or short circuit current in any one pole.

3. Thermal-magnetic circuit breakers have a permanent trip unit that contains a factory preset thermal trip element and a magnetic trip element to each pole. The thermal trip element is rms sensing. In circuit breaker with frame sizes greater than 100A, the magnetic trip element is field adjustable. A single adjustment simultaneously adjusts the instantaneous trip point in each pole.

4. All factory installed mechanical type lugs are UL Listed to accept solid or stranded conductors and can be used with wire rated at at 60 deg. C, 75 deg.C and 90 degC.

5. Testing of circuit breakers shall comply with UL 489 test procedures.

OWNER METERING

The low voltage switchgear (LVS) shall be equipped with an AC ammeter, an ammeter selector switch, an AV voltmeter, a voltmeter selector switch, a watt-hour meter with demand register, a wattmeter and power factor meter. All meter shall be switchboard type.

Meters, selector switches including instrument transformer shall be installed at the low voltage metering section before the main overcurrent protective devices.

AUTOMATIC TRANSFER SWITCH

GENERAL REQUIREMENTS

A. Provide Automatic Transfer Switches (ATS) for generator power supply system with accessories, auxiliary equipment and associated work as specified.

B. All materials and parts of the ATS shall be new and unused. Each component shall be a current manufacture from a firm regularly engaged in the design and production of such equipment. Units and components offered under these specifications shall be covered by the manufacturer's standard warranty or guarantee on new equipment.

C. The system shall be designed, assembled, tested and shipped by one manufacturer as the generator set and automatic synchronizing panel so that there is one source of supply and responsibility on all components supplied with the system.

D. All equipment shall be designed, assembled and tested to conform with applicable standards of UL, ASA, IEEE, ASME, ASTM and NEMA or VDE and DIN.

SUBMITTALS

A. MANUFACTURER'S DATA

1. Automatic Transfer Switch (ATS)

B. SHOP DRAWINGS AND CALCULATION

1. Electrical elements, schematics and wiring diagrams, including details of the interlocking system.

C. CERTIFIED TEST REPORTS

1. Components shop test

2. System operation and control tests.

PRODUCTS

A. The automatic transfer switch shall be coordinated with manufacturer of the automatic synchronizing panel and standby AC power generator to maintain system compatibility and local service responsibility for the complete standby power system.

B. The Automatic Transfer Switch (ATS) shall be mounted/built-in in low voltage switchgear suitable for use on all types of load.

C. Transfer switch shall have withstand, closing and interrupting ratings sufficient for the voltage employed and the available short circuit at the point of application.

D. Automatic Transfer Switches (ATS) shall be mechanically held and electrically operated with inherent interlocked construction rated 800A, 3P, 60 Hz. 3Ø, 3 wire 65 KRMS symmetrical withstand at 600Vac.

INSTALLATION

A. Installation shall conform to the requirements of the Code.

B. Testing

1. The ATS shall receive the manufacturer's standard factory testing prior to delivery with the witness of PPA's representative/s.

2. Prior to acceptance of the installation of the installation, equipment shall be tested on-site together with the generator set and automatic synchronizing panel without any failure to show it is free of any defects, and subjected to full load test or that load which is available at the job site. Should failure occur during the testing, the Contractor shall rectify deficiencies and shall repeat

testing procedure at his own expense and to the satisfaction of the Owner.

3. On completion of the installation, start-up shall be performed by a factory-trained supplier or dealer representative. Comprehensive training on the operation, principle and maintenance of the system shall be conducted to the PPA"s operating personnel.

AUTOMATIC SYNCHRONIZING PANEL

GENERAL REQUIREMENTS

A. Provide Automatic Synchronizing Panel for generator power control system including intelligence unit, monitoring, protection, control, master controller and all associated work as specified.

B. All materials and parts of the automatic synchronizing panel shall be new and unused. Each component shall be a current manufacture from a firm regularly engaged in the design and production of such equipment. Units and components offered under these specifications shall be covered by the manufacturer's standard warranty or guarantee on new equipment.

C. The system shall be designed, assembled, tested and shipped by one manufacturer as the generator set and automatic synchronizing panel so that there is one source of supply and responsibility on all components supplied with the system.

D. All equipment shall be designed, assembled and tested to conform with applicable standards of UL, ASA, IEEE, ASME, ASTM and NEMA or VDE and DIN.

SUBMITTALS

A. MANUFACTURER'S DATA

1. Automatic Synchronizing Panel

B. SHOP DRAWINGS AND CALCULATION

1. Electrical elements, schematics and wiring diagrams, including details of the interlocking system.

C. CERTIFIED TEST REPORTS

1. Components shop test

2. System operation and control tests.

PRODUCTS

A. The automatic synchronizing panel shall be coordinated with manufacturer of the automatic transfer switch and supplier of standby AC