Annex I: New Switching Station (sub-station) Scope and Specifications

Contents

1 OVERVIEW

1.1 Objective of the document

The purpose of this document is to present the conceptual design of a new substation (New Switching Station) for MEC, the previous one has only 3 distribution feeders.

The conceptual design includes:

1. Sizing of the building where the switchgear, SCADA room, operators' room and battery room will be installed.
2. Switchgear pre-selection considering area availability, preliminary technical specifications.

<u>This document does not represent a detailed design to be included in a bidding process.</u>

<u>The following should be confirmed with the detailed design:</u>

a) Simplify the design of the Tie Circuit from two CB or cable to one CB + cable + cable to one disconnecting switch.
b) Capacity of each circuit breaker (A)
   Substation busbars, Incoming Lines from the power stations and Busbar sectionalize Breaker must be capable to carry minimum nominal current 1250 A. Minimum rated current for the outgoing feeders must be 630A, although considering future consumption growth and possible interconnections between the feeders rise nominal current for some of the breakers up to 1250 A.
   A decision must be taken.
c) Interrupting capacity of each circuit breaker (kA) The levels of short circuit currents must be determined by studies in order to select the appropriate level of circuit breaker interruption.
d) Bus bar capacity (A)
   Substation busbar should be capable of accepting power from both power stations. Moreover, capacity of the power station busbars and Incoming Lines is 1250 A. Given this Substation busbar rate also must be 1250 A.
e) Electrical protection system of each circuit, of each busbar and of the switching station.
   Protection System of part of substation equipment including breakers for Incoming Lines will be already in place provided in the frame of the "Design, Supply, Installation and Commissioning of Distribution Protection System" project.
   Grounding system: This refers to the building's grounding mesh and lightning arresters.
f) Ventilation and air-conditioning system.
g) Lighting and sockets system
h) Electrical supply system for auxiliary systems.
i) DC System (Batteries and Charger)
j) Civil construction

1.2 MEC requirements

MEC requires to build a new 13.8 kV substation, with more Circuit Breakers, as indicated in the table below.

Table 1-1 Feeders Requirements

#	Feeder	Description	Load MW
1	Feeder 1	Power Plant to Laura	
2	Feeder 2	Power Plant to Rita	
3	Feeder 3	Power Plant to Hospital	
4	Feeder 4	Power Plant to Oceanside Industrial zone	Potentially 2 MW
5	Feeder 5	Power Plant to Lagoon side Industrial zone	Potentially 4 MW
6	Feeder 6	Power Plant to Port Zone	Potentially 4- 5 MW
7	Feeder 7	Power Plant to MEC Tank farm Zone	Potentially 500 – 600 kW
8	Feeder 8	Spare	
9	Feeder 9	Spare	
10	Feeder 10	Spare	
11			
12			
13			

Please see the next map that show the zones.

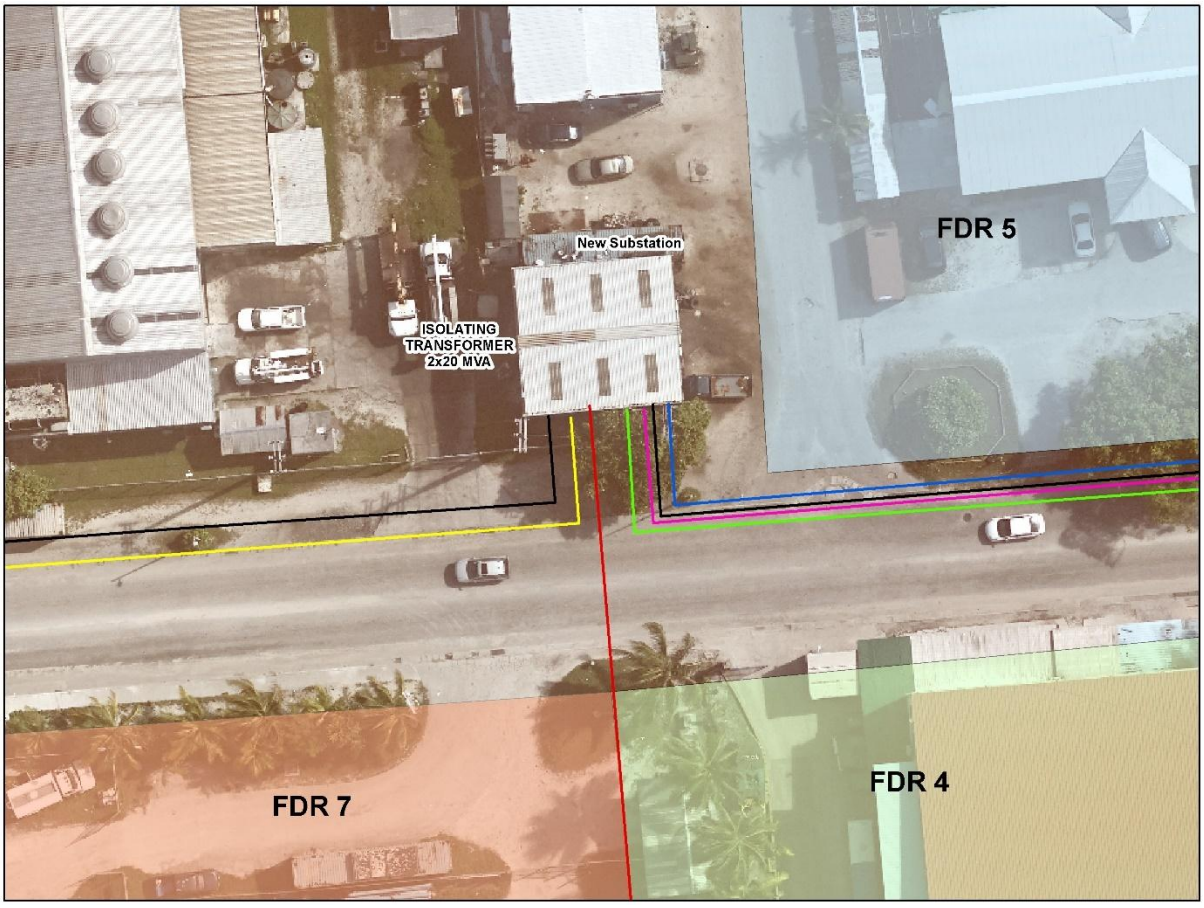


Figure 1-1 New Substation

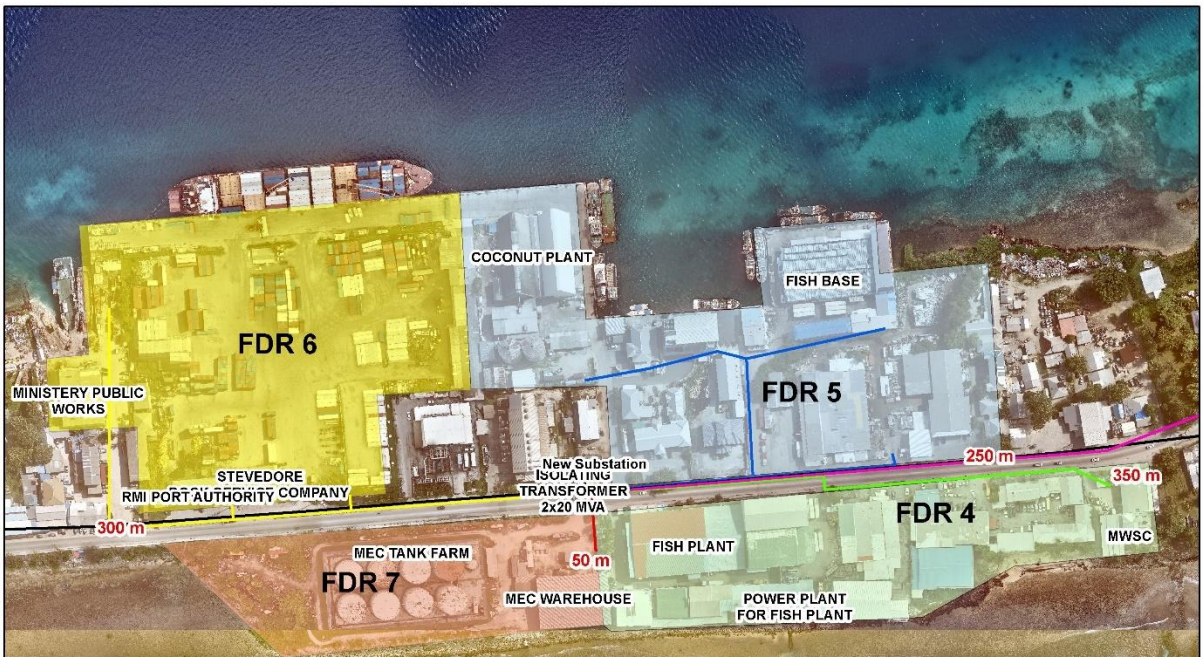


Figure 1-2 Map A Feeders 1 to 7

Figure 1-3 Feeders 4 and 5

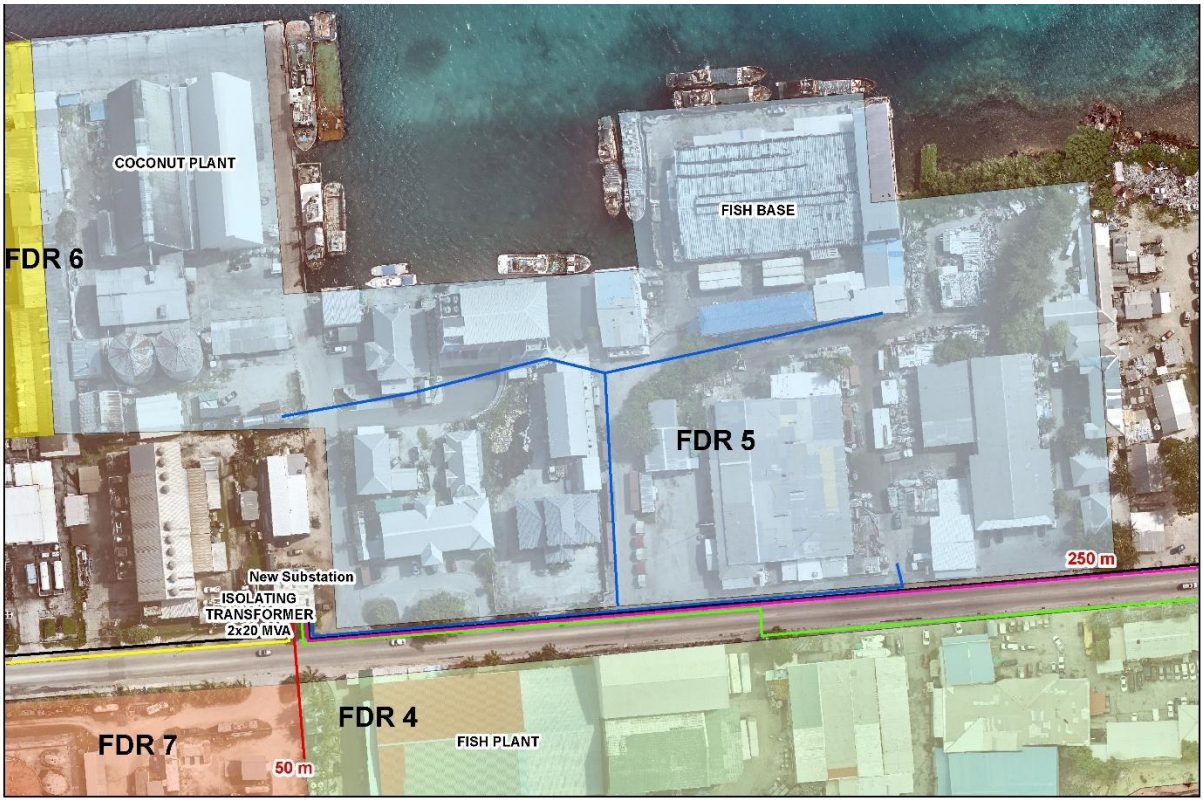


Figure 1-4 Feeder 5

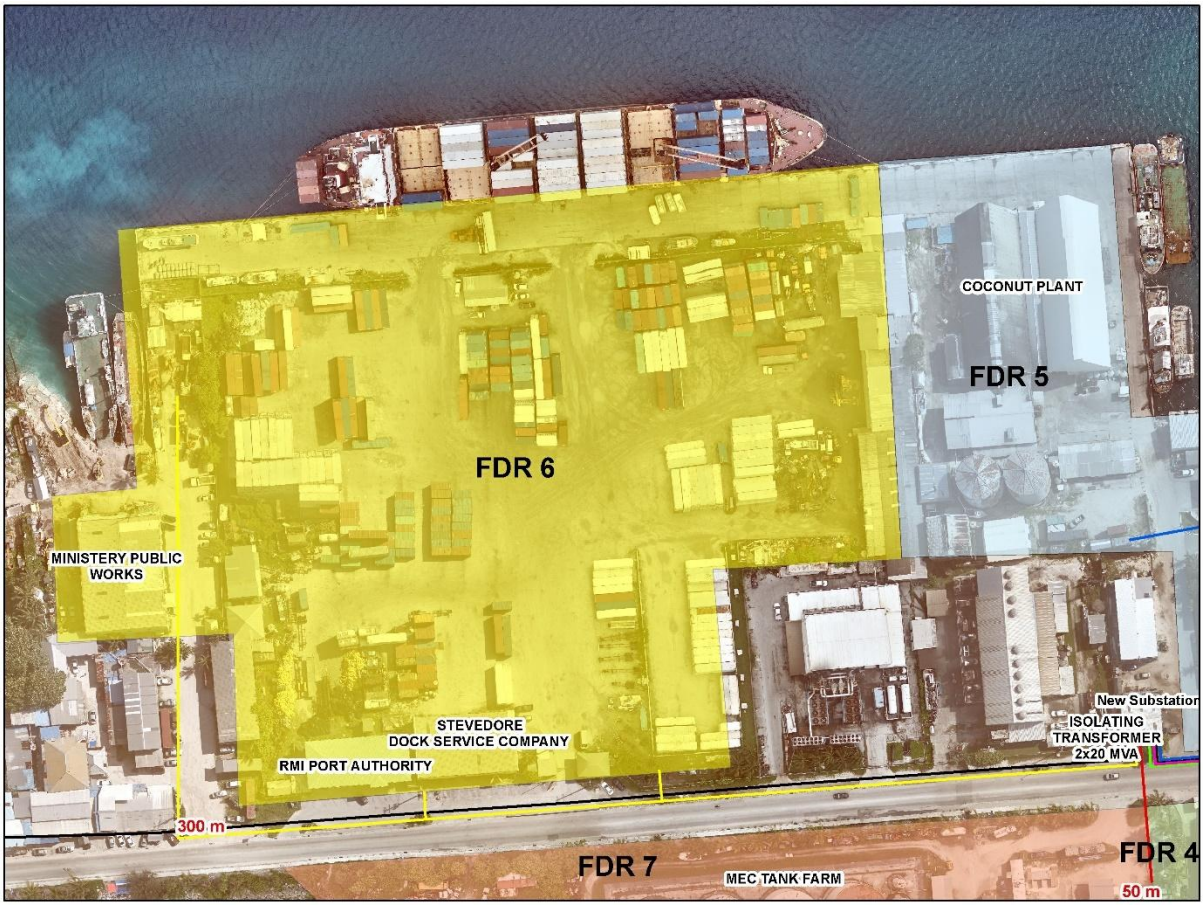


Figure 1-5 Feeder 6

Figure 1-6 Feeder 7

2 PROPOSED NEW (SWITCHING STATION) SUBSTATION

The capacity and space at the switching station at the power station is limited. This does not allow for installation of step-up transformer/isolation transformer for the generators and creation of additional feeders for distributing or connecting new loads such as Majuro Port and Fist Processing Plant. The switching station and the related switchgear needs to be designed to meet the current and future requirement.

3 NEW SUBSTATION MAIN COMPONENT

This diagram shows the main components of a substation what to consider when designing a substation.

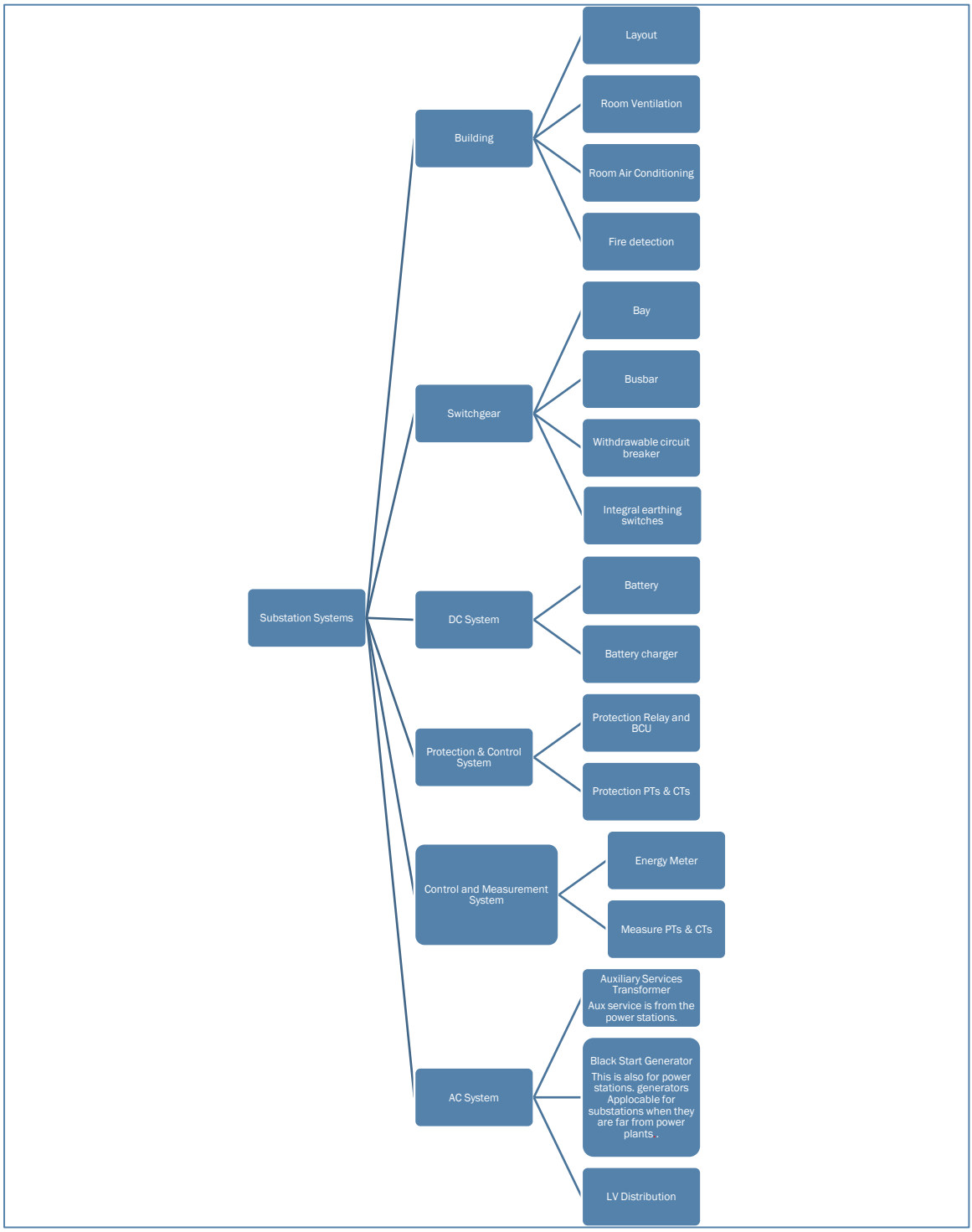


Figure 3-1 New Substation Main Components (Indicative)

4 NEW SUBSTATION LOCATION

4.1 Site conditions

The following site conditions are to be used for design purposes and equipment selection.

Table 4-1 Site Condition

Characteristic	Value
Ambient Temperatures	95°F (35°C) summer daytime (Max) 77°F (25°C) winter nighttime (Min)
Mean Daily Solar Exposure	53.8 kWh/sq. ft/ day (5 kWh/m²/day)
Precipitation	Mean annual rainfall more than 118" (3000mm)
Humidity	Average relative humidity 80%
Mean Barometric pressure	14.6 psi

4.2 Available land area

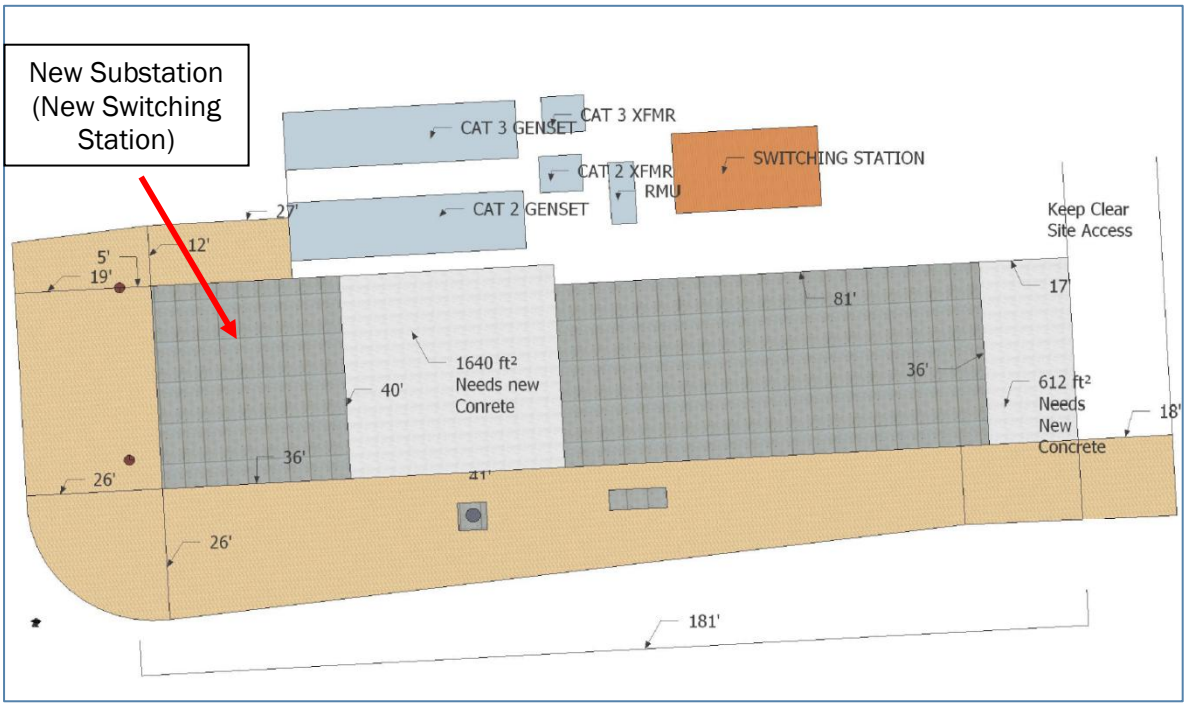


Figure 4-1 New Substation Location

The available land area is 36 ft (10.97 m) x 40 ft (12.19 m), but it must be considered that a space must be left between the boundary of the land and the space for the stairway to the second floor.

The walls will be built with 8" blocks, so the internal dimensions are 28.5 ft (8.7 m) x 27 ft (8.28 m).

Due to space constraints, we considered compact switchgear from the following manufacturers:

Table 4-2 Switchgear dimensions vs Maximum number of bays

Maker	Model	(B) Wide mm	(C) Depth mm	(A) Height mm	Room width mm	Minimum Aisle mm	Total Minimum Aisle mm	Available width for switchgear	Maximum number of bays in the Switchgear
A	1	650	1,340	2,675	8,700	1,500	3,000	5,700	8.8
B	1	800	1,860	2,460	8,700	1,500	3,000	5,700	7.1
C	1	914	2,572	2,445	8,700	1,500	3,000	5,700	6.2
C	1	800	1,900	2,600	8,700	1,500	3,000	5,700	7.1

See details of the dimensions in the following figure

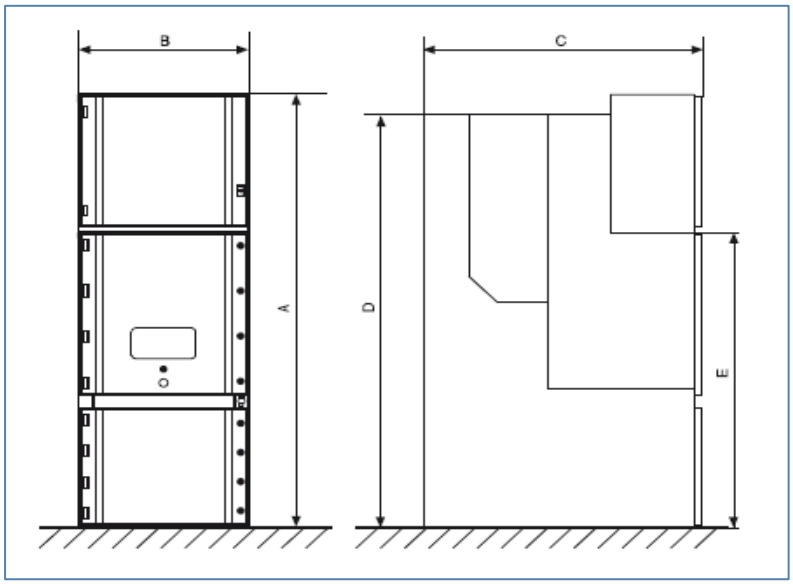


Figure 4-2 Switchgear dimensions (Indicative)

For the purposes of this conceptual design, the specifications of the Maker A model1 or similar can be used because it is a compact switchgear with these dimensions Wide: 650 mm, Depth: 1,340 mm and Height: 2,675 mm

If the final selection is with another maker, the number of total bays will be adjusted according to the final dimensions of each bay.

5 SWITCHGEAR DETAILS

The following figure illustrates the configuration of a switchgear (five bays are shown with five circuit breakers inside).

Figure 5-1 Medium-voltage air-insulated switchgear (indicative)

Figure 5-2 Switchgear unit compartments (indicative).

5.1 Panel design and equipment

The basis for the switchgear shall be the incoming/outgoing feeder panel with vacuum circuit breaker using insertion technology. It is divided into busbar compartment, circuit-breaker compartment, cable compartment and control cabinet for the secondary equipment. Apart from this, there are variants for all operating needs.

5.2 Enclosure and partitioning

- The enclosure and internal partitions of the panels should be of 2 mm thick high quality galvanized steel sheets.

- The three high voltage compartments (busbar compartment, circuit-breaker compartment and cable connection compartment) should be equipped with top-mounted and secured pressure relief flaps. These open in the case of overpressure due to an internal arc fault.

- The front of the panel should closed off by pressure resistant doors which open to an angle of 130°.

- Cable and circuit-breaker compartments to have their own doors.

- The circuit-breaker compartments to be equipped with inspection windows made of security glass.

- Neighboring panels to be partitioned from one another by the side walls of each panel and, as a result of the design, the air cushion remains between these walls when the panels are jointed together.

- The enclosure is completed above by top-mounted pressure-relief flaps which, according to the rated branch conductor current, should be made of sheet steel or expanded metal and below by means of floor covering, made of sheet metal which cannot be magnetized.

- The pressure-relief flaps should be secured with steel screws on one longitudinal side and on the other longitudinal side with plastic screws.

- In the case of internal overpressure, the plastic screws should be the point of rupture.
- Arc fault current limitation can be achieved by undelayed circuit-breaker release, carried out by auxiliary switches operated by the pressure wave.

- The necessary safety measures to counteract the effects of an internal arc fault must be ensured in relation to the ceiling height. In individual cases, this may require additional operator protection measures on the switchgear panels. These measures include:
  - Mounting a pressure relief duct on the top of the switchgear, with further channels leading out of the switchgear room in a form appropriate for the design of the building. The shock wave and arc discharge are channeled off in ducts;
  - Mounting a pressure relief duct with blow-out apertures located above the duct at the ends of the switchgear and pointing towards the center of the switchgear (diverter duct). The shock wave and arc discharge then emerge in an extremely attenuated form and in a location which is not critical for the operating personnel.

- The internal metallic partitioning should make safe access to the circuit-breaker and cable compartments possible even when the busbars are live.

- The low voltage compartment for the secondary equipment should be protected from the high voltage area.

- Doors, rear walls as well as the cover plates should be treated against corrosion before receiving a high-quality double coating of paint.

- The standard finishing coat should be RAL 7035 color (special colors by agreement).

- The circuit-breaker compartment and cable connection compartment doors should be pressure resistant and can either be fitted with screws or manual closing systems (central handle).

5.3 Ventilation of the panels

- Openings in the outer enclosure are needed for the purpose of ventilation in the case of certain rated currents in the busbars and branch bars.
- For incoming air to the circuit-breaker compartment, the horizontal partition is provided with air-vents IP54 degree of protection and safety in the case of any release of hot gas due to an arc fault are provided by flap in the horizontal partition.
- The shape and size of the vents in expanded metal provide the IP54 degree of protection.
- In cases of higher ambient temperature (>40 °C) and/or increased frequency (60 Hz) it may be necessary to install a fan in the horizontal partition.
- It is necessary to use forced fan ventilation in 3600 A and 4000 A panels for 12/17.5 kV rated voltage and in 2500 A panels for 24 kV rated voltage.

5.4 Busbar compartment

- The busbars should have a flat cross-section made of copper and should be laid in sections from panel to panel.
- According to the current rating, either single or double configuration should be used. They are held by flat branch conductor 2 and, if installed, by busbar bushings 29. No special connection clamps are needed.
- Busbars and branch conductors for 17.5 kV are insulated by means of shrink-on sleeves.
- The bolt connections in the 17.5 kV busbars system are covered by insulating covers. The busbars for 12 kV units up to 2,000 A are without any covers. Flat busbars 2,500 A and D-shaped busbars 3,150, 3,600 and 4,000 A are insulated and the connections are covered.
- By means of bushing plates and busbar bushings partitions can be created between panels. These partitions are necessary for higher rated short-time currents.

5.5 Technical Data

5.5.1 Rated capacity

- MEC Operating voltage: 13.8 kV
- Circuit Breaker Rated voltage: 17.5 kV
- The interrupting capacity will then be defined on the basis of short-circuit studies.
- Frequency: 60 Hz

6 NEW SUBSTATION 13.8 KV SWITCHGEAR

The proposed new switching station will have two busbars A and B. Table 6-1 and Table 6-2 outline the various bays and connections as well as spares for future requirement.
Due to the limits of the available land dimensions, the switchgear will be in two sections Busbar A and Busbar B and interconnected by a pair of Tie-breakers and a conductor.

The location (order) of the loads will then be arranged to balance the Busbar A and Busbar B loads.

Table 6-1 Table of Bays (Busbar A)

Busbar A 13.8 kV							
Bay A1	Bay A2	Bay A3	Bay A4	Bay A5	Bay A6	Bay A7	BayA8
CB1		CB2	CB3	CB4	CB5	CB6	CB7
1,250 A		630 A	630 A	630 A	630 A	630 A	1,250 A
Tie Breaker A	Measure VT A	Feeder 1	Feeder 2	Feeder 3	Feeder 4	Feeder 5	Incomer 1
		Power Plant to Laura	Power Plant to Rita	Power Plant to Hospital	Power plant to Oceanside Industrial zone (PPF to MWSC) (Potentially 2 MW)	Power Plant to Lagoonside Industrial Zone (Tobolar to MIFV/PII) (Potentially 4 MW)	From PS1

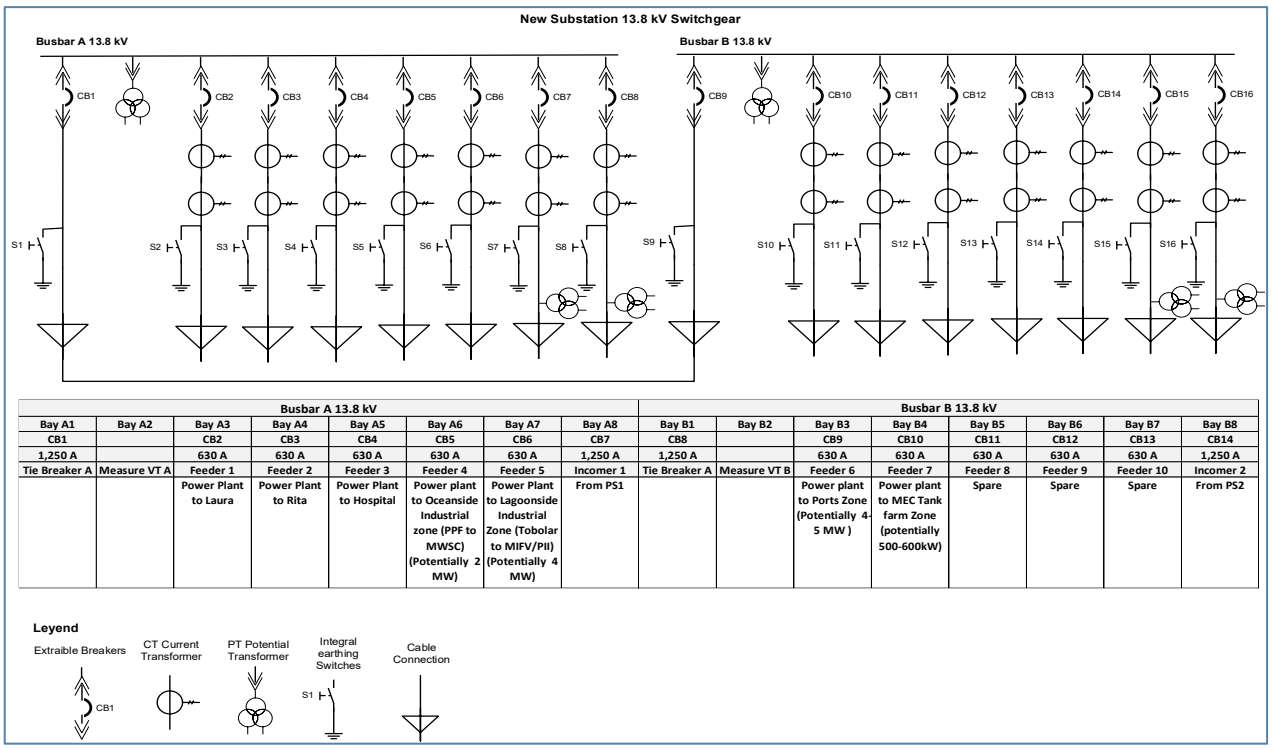
Table 6-2 Table of Bays (Busbar B)

Busbar B 13.8 kV							
Bay B1	Bay B2	Bay B3	Bay B4	Bay B5	Bay B6	Bay B7	Bay B8
CB8		CB9	CB10	CB11	CB12	CB13	CB14
1,250 A		630 A	630 A	630 A	630 A	630 A	1,250 A
Tie Breaker B	Measure VT B	Feeder 6	Feeder 7	Feeder 8	Feeder 9	Feeder 10	Incomer 2
		Power plant to Ports Zone (Potentially 4-5 MW)	Power plant to MEC Tank farm Zone (potentially 500-600kW)	Spare	Spare	Spare	From PS2

6.1 Auxiliary service supply

The supply for the auxiliary services of the new substation (New Switching Station) will be provided by the auxiliary services of power station PS1 or PS2, the contractor must submit a table with the load requirements of the auxiliary services of the New Switching Station.

6.2 New Substation 13.8 kV Swichgear Single Line Diagram SLD



Busbar A 13.8 kV								Busbar B 13.8 kV							
Bay A1	Bay A2	Bay A3	Bay A4	Bay A5	Bay A6	Bay A7	Bay A8	Bay B1	Bay B2	Bay B3	Bay B4	Bay B5	Bay B6	Bay B7	Bay B8
CB1		CB2	CB3	CB4	CB5	CB6	CB7	CB8		CB9	CB10	CB11	CB12	CB13	CB14
1,250 A		630 A	630 A	630 A	630 A	630 A	1,250 A	1,250 A		630 A	630 A	630 A	630 A	630 A	1,250 A
Tie Breaker A	Measure VT A	Feeder 1	Feeder 2	Feeder 3	Feeder 4	Feeder 5	Incomer 1	Tie Breaker A	Measure VT B	Feeder 6	Feeder 7	Feeder 8	Feeder 9	Feeder 10	Incomer 2
		Power Plant to Laura	Power Plant to Rita	Power Plant to Hospital	Power plant to Oceanside Industrial zone (PPF to MWSC) (Potentially 2 MW)	Power Plant to Lagoonside Industrial Zone (Tobolar to MIFV/PII) (Potentially 4 MW)	From PS1			Power plant to Ports Zone (Potentially 4-5 MW)	Power plant to MEC Tank farm Zone (potentially 500-600kW)	Spare	Spare	Spare	From PS2

Figure 6-1 New Substation 13.8 kV Switchgear Single Line Diagram SLD

Note: the details of the TCs and PTs required in this diagram will be determined in the detailed design, those indicated here are the minimum required.

6.3 Building of the substation

Due to limitations of available land area for the substation, the building should be on three floors.

- First floor – cable room
- Second floor – switchgear, and
- Third floor – battery room and charges; operator room; SCADA room.

The staircase between the third floor, the second floor and first floor is external and is not shown in the layout plans.

Note: These drawings are indicative, the contractor shall submit the detailed design to the client for review and approval.

6.4 MEC Substation Second Floor Layout

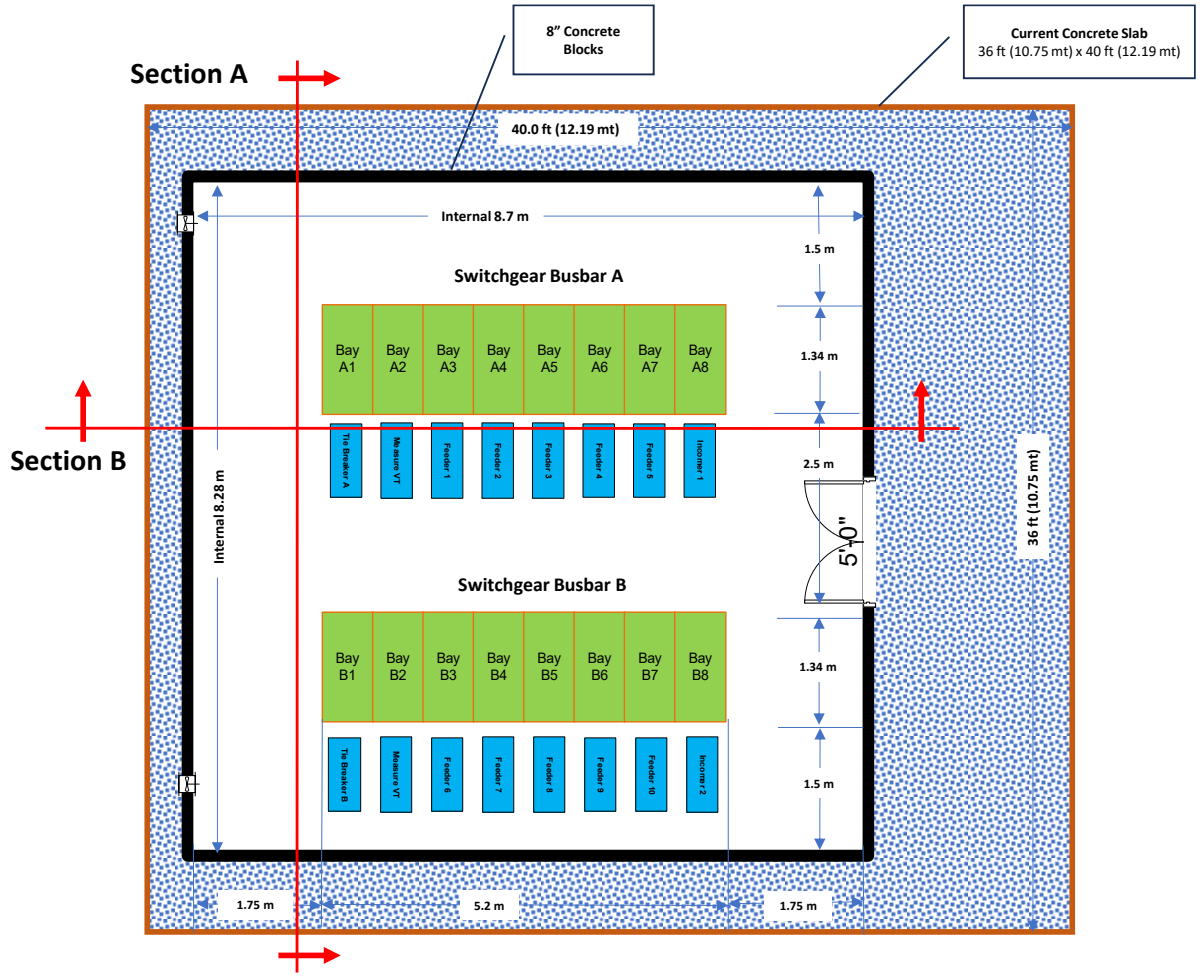


Figure 6-2 MEC New Substation Second Floor Layout Plan

6.5 MEC Substation Section A

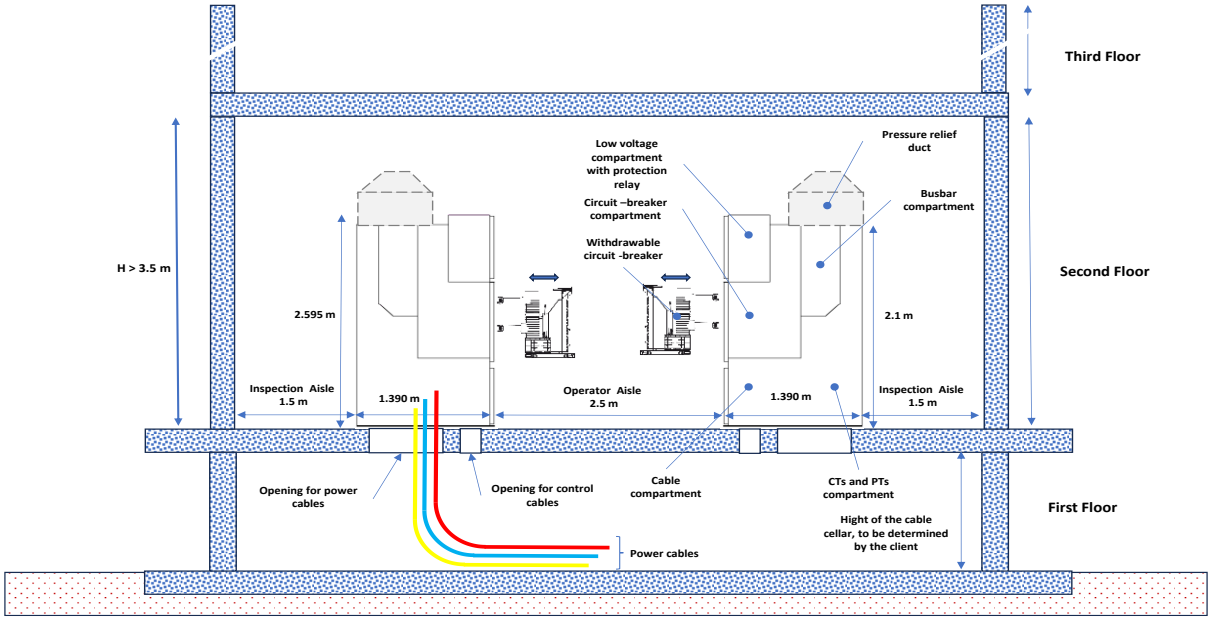


Figure 6-3 MEC New Substation Section A

6.6 MEC Substation Section B

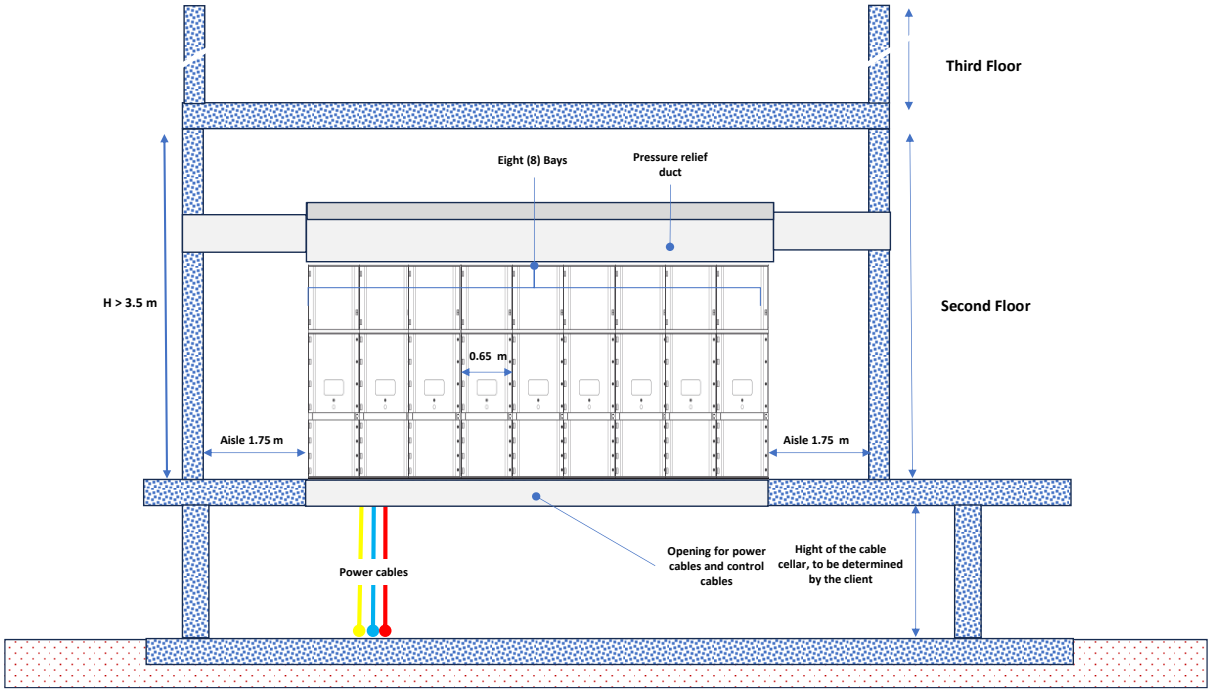


Figure 6-4 MEC New Substation Section B

6.7 MEC Substation Third Floor Layout

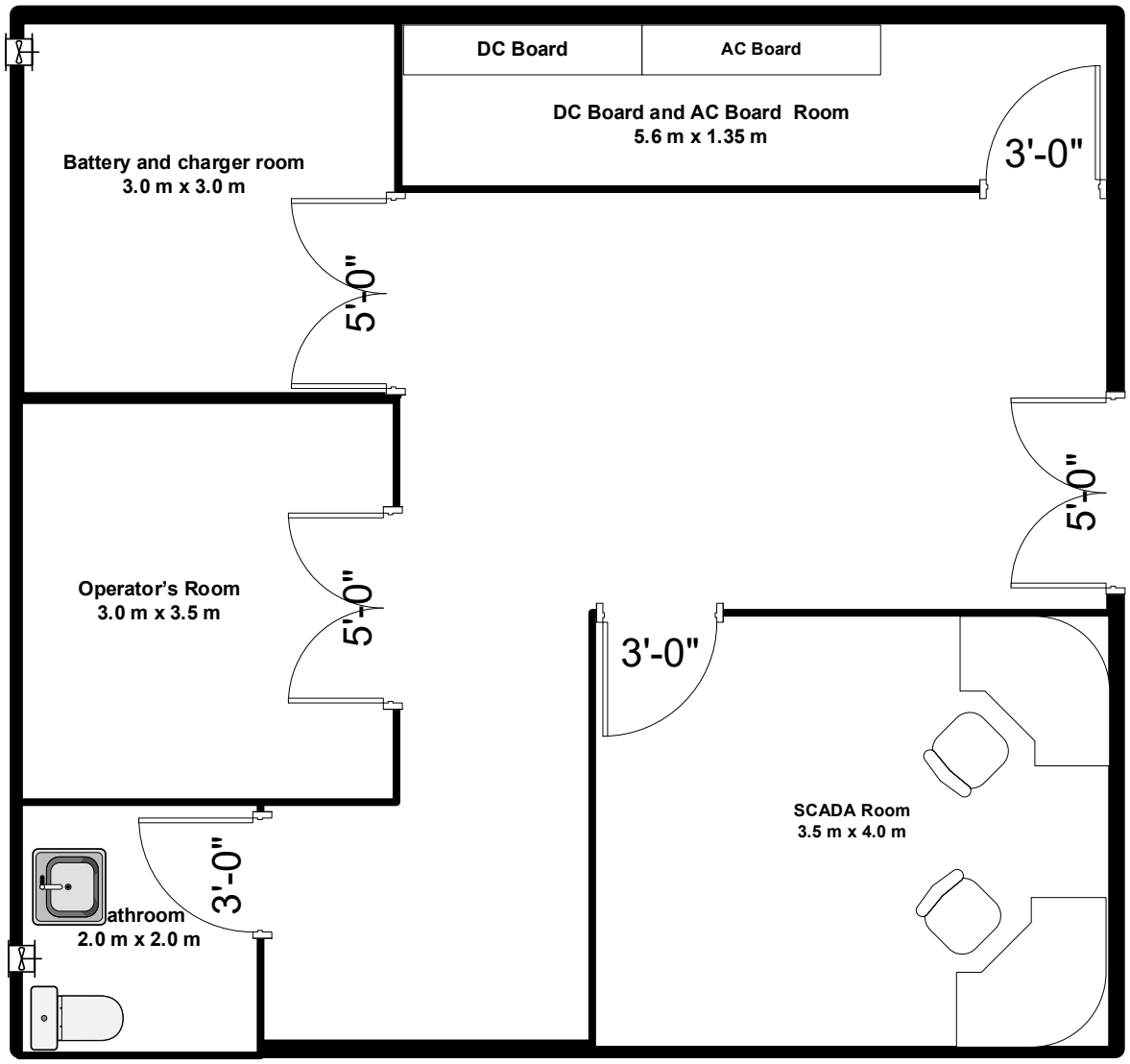
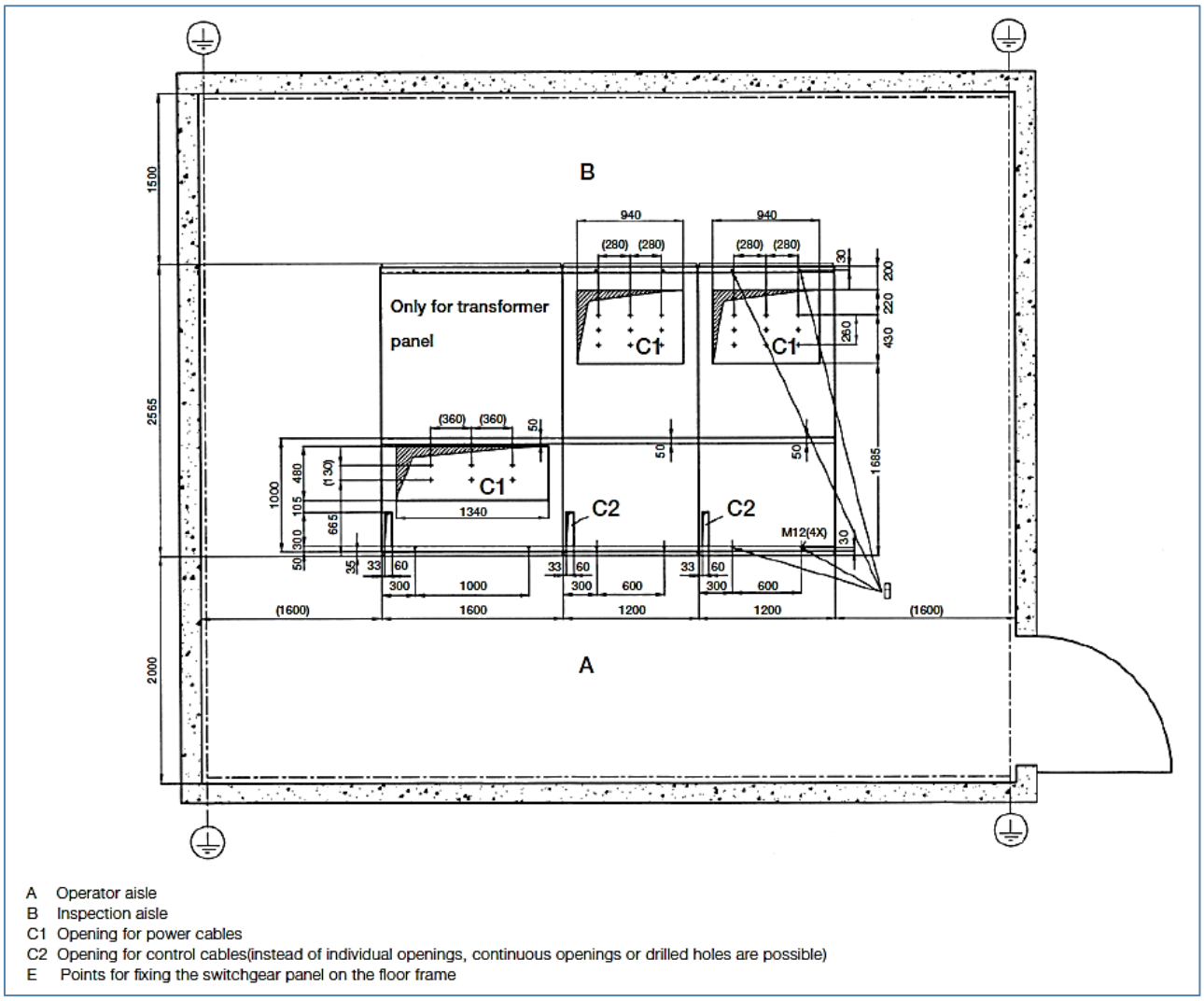


Figure 6-5 MEC New Substation Third Floor Layout

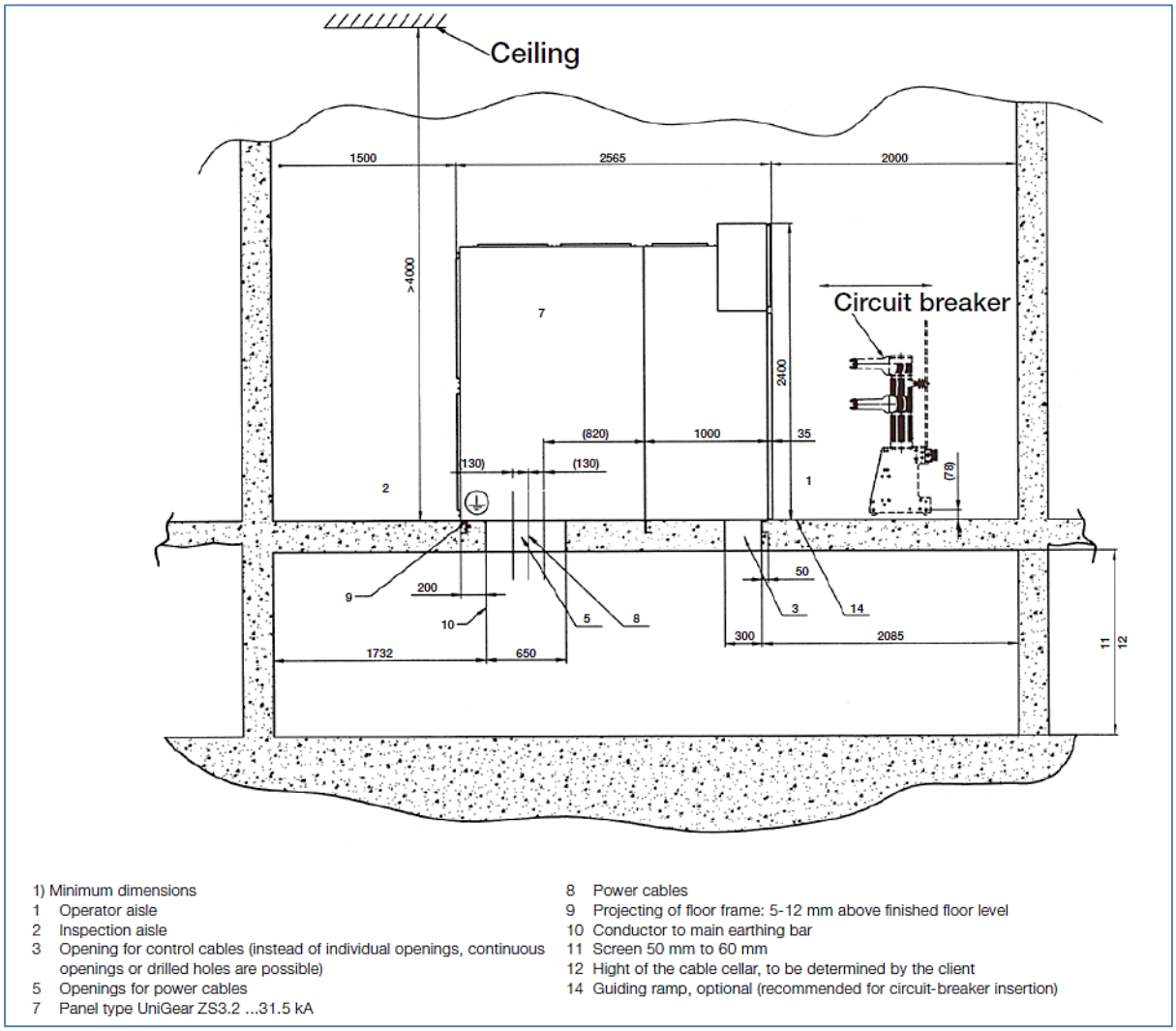
6.8 Assembly of the switchgear at site

This section shows some details of the location of the switchgear inside the building, such as corridors, distance between floors, pressure relief duct, and the pressure relief duct.



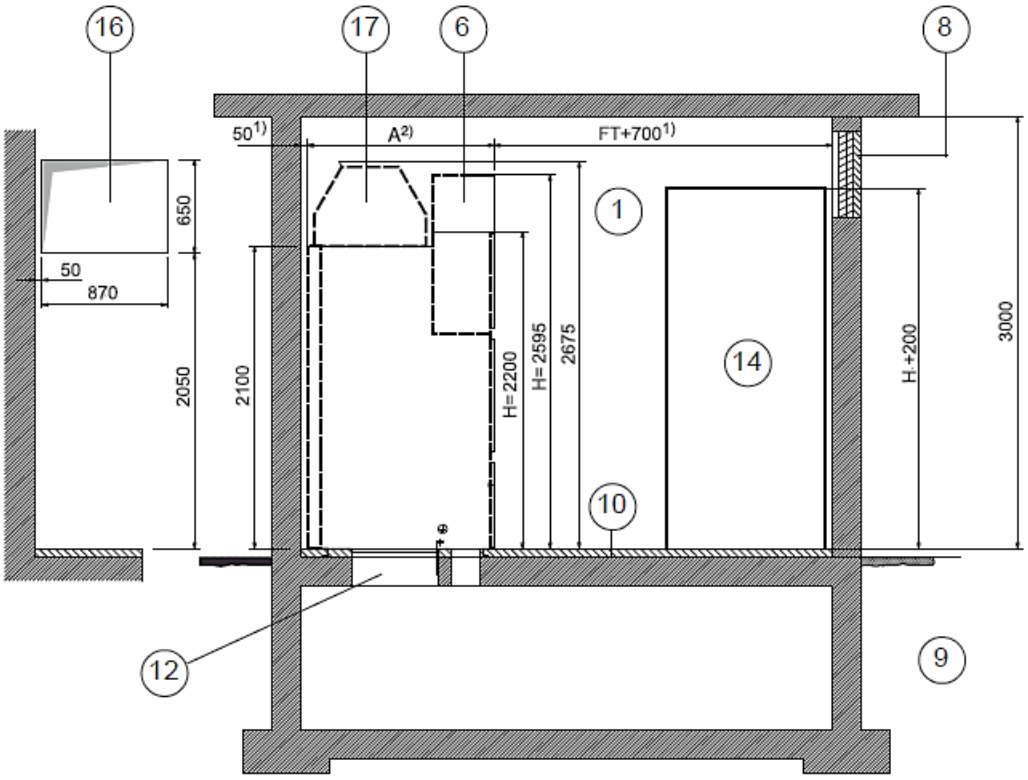
A Operator aisle
B Inspection aisle
C1 Opening for power cables
C2 Opening for control cables(instead of individual openings, continuous openings or drilled holes are possible)
E Points for fixing the switchgear panel on the floor frame

Figure 6-6 Guideline structural data for foundation frame in concrete floor.



1) Minimum dimensions
1 Operator aisle
2 Inspection aisle
3 Opening for control cables (instead of individual openings, continuous openings or drilled holes are possible)
5 Openings for power cables
7 Panel type UniGear ZS3.2 ...31.5 kA
8 Power cables
9 Projecting of floor frame: 5-12 mm above finished floor level
10 Conductor to main earthing bar
11 Screen 50 mm to 60 mm
12 Hight of the cable cellar, to be determined by the client
14 Guiding ramp, optional (recommended for circuit-breaker insertion)

Figure 6-7 Elevation assembly of the switchgear at site.



Example of 12/17.5 kV switchgear on foundation frame on concrete floor.
Panel with pressure relief to the outside.

A	Panel depth
1)	Minimum dimensions
2)	The dimension must be verified according to the documentation of the relevant order
1	Operator aisle
6	Control cabinet (optional)
8	Opening for ventilation
9	Height of cable base - as required
10	Concrete - see also fig. 5/8
12	Opening for power cables
14	Door
16	Wall opening for pressure relief
17	Pressure relief duct

Figure 6-8 Elevation assembly of the switchgear at site (details of pressure relief duct)

6.9 Considerations for temperature rise in enclosed switchgears.

The design of the switchgear must comply with the following considerations.

- Electrical equipment in switchgears gives off loss heat to the ambient air. To ensure fault-free function of this equipment, the specified limit temperatures must be maintained inside the switchgear.

- When installed on a wall, the panel should have 8 to 10 cm clearance from the wall to allow for effective heat dissipation.

6.10 Ventilation of switchgear and transformer rooms

The design of the switchgear rooms must comply with the following room ventilation design criteria

The air in the switchgear room must not to exceed the permissible temperature, humidity and air quality limits. The normal service condition specified in art. 2 of IEC 6227-1 or equivalent standards must me maintained.

A. Temperature condition
   Switchgears and gas-insulated switchgear must not exceed a short-term maximum temperature of 40 °C and a maximum value of 35 °C for the 24-hour average.

B. The humidity conditions must be the following:
   The average relative humidity value measured over a period of 24 hours must not exceed 95%.
   The average relative humidity value measured over a period of 1 month must not exceed 90%;

C. The ambient quality
   The ambient air must be free from pollution by dust, smoke/fumes, salts, corrosive or inflammable gases or vapors.

The bidder must consider spatial options for ventilation including chimney's and HVAC etc as applicable.

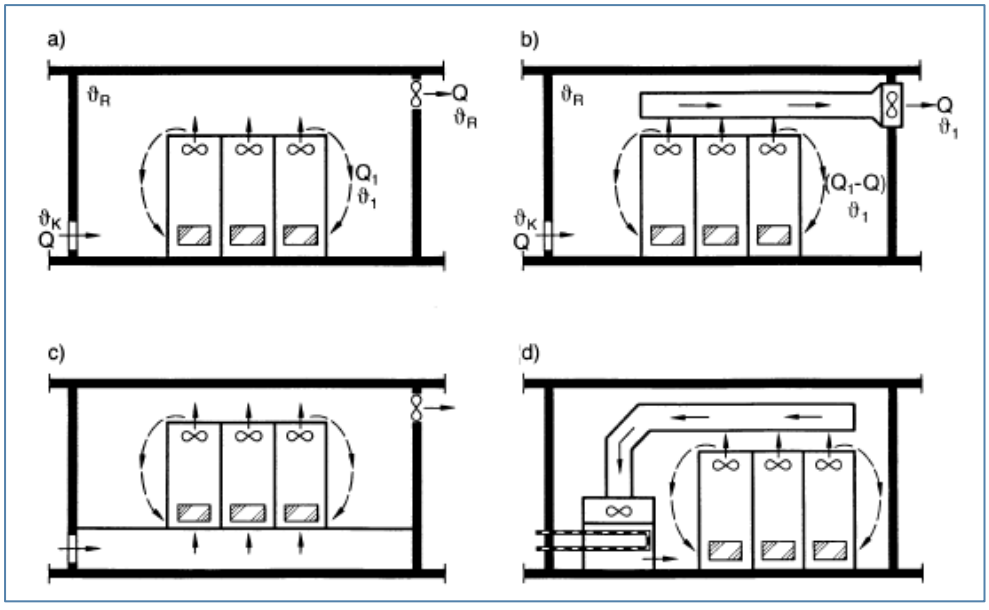


Figure 6-9 Examples of switchgear room ventilation.

Compartment ventilation examples for reference:

a) Simple compartment ventilation,
b) compartment ventilation with exhaust hood above the switchgear,
c) ventilation with false floor,
d) ventilation with recirculating cooling system.

6.10.1 Fans for switchgear and transformer rooms

Ventilation fans must compensate for the pressure losses in the air and provide blow-out or dynamic pressure for cooling airflow. Resistances in the ventilation ducts and supplementary system components, such as dust filters, must be considered. For sufficient air circulation, a minimum clearance between the equipment and the wall must be kept (i.e, auxiliary transformers about 0.4 m; power transformers about 1 m).

7 FEEDER PROTECTION RELAY

7.1 Feeder Protection Multifunction Relay

Each circuit breaker must be equipped with a multi-function protection relay. The diagram below indicates an example of protection relays for 13.8 kV substation equipment:

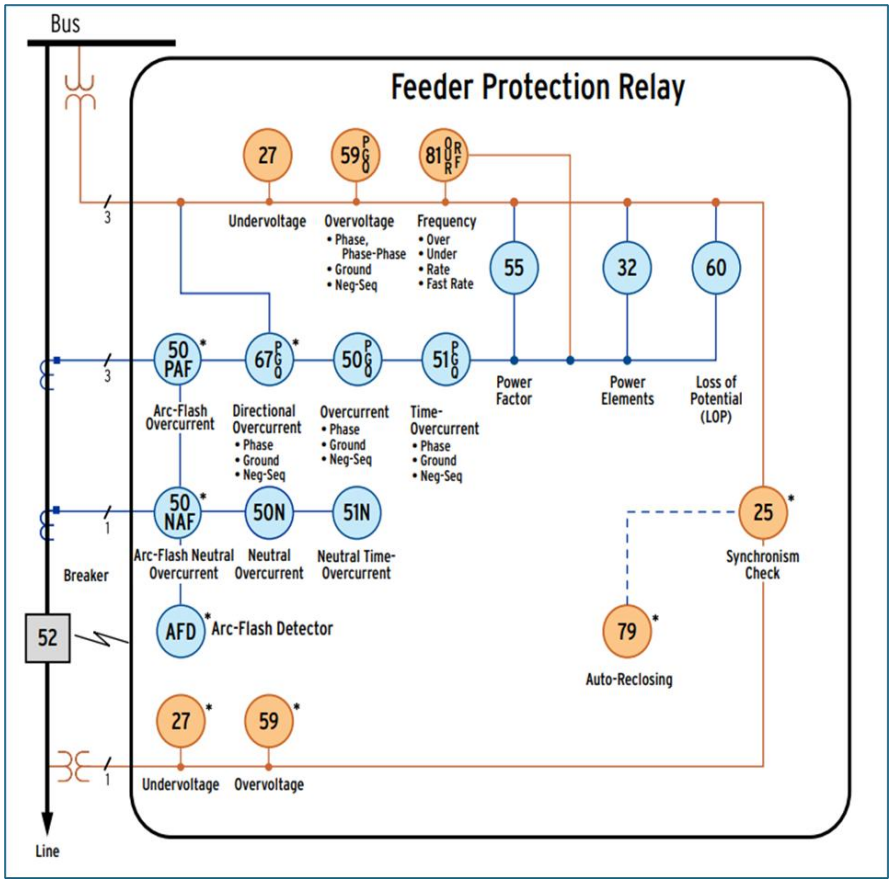


Figure 7-1 Feeder Protection Relay (indicative)

7.2 ANSI Standard Device Numbers

The protection functions embedded in the relay are indicated in this table.

Table 7-1 ANSI Standard for protection functionality

Device No.	Description
25	Synchronizing or Synchronism-Check Device
27	Undervoltage Relay
32	Directional Power Relay
50	Instantaneous Overcurrent Relay
50P	Phase Instantaneous Overcurrent
50G	Ground Instantaneous Overcurrent
50_2	Negative Sequence Instantaneous Overcurrent
50N	Neutral Instantaneous Overcurrent
51	Ac Time Overcurrent Relay
51P	Phase Time Overcurrent
51G	Ground Time Overcurrent
51_2	Negative Sequence Time Overcurrent
51N	Neutral Time Overcurrent
52	Ac Circuit Breaker
55	Power Factor Relay
59P	Phase Overvoltage
59G	Ground Overvoltage
59_2	Negative Sequence Overvoltage
60	Voltage or Current Balance Relay
67	Ac Directional Overcurrent Relay
67P	Phase Directional Overcurrent
67G	Ground Directional Overcurrent
67_2	Negative Sequence Directional Overcurrent
79	Ac Reclosing Relay / Auto Reclose
81	Frequency Relay
81O	Over Frequency
81U	Under Frequency
81R	Rate-of-Change Frequency

8 MV SWITCHGEAR SPECIFICATIONS

8.1 Scope

This section of the Specification covers the design, manufacture, testing at works, supply, delivery, installation and commissioning of:

- Fourteen (16) 13.8 kV, three (3) phase, 60Hz, switchgear with withdrawable circuit breakers and integrated protection systems, and two (2) measuring bays. as described in this Specification.
- One (1) set of special tools, gauges, and appliances necessary for the installation, erection, testing and maintenance of the supplied switchgear and circuit breakers,
- At least one (1) set of spare parts to suit the supplied switchgear and circuit breakers, but Contractors are requested to recommend a suitable spare parts quantity based on the number of circuit breakers offered,
- One complete spare withdrawable assembly circuit breaker with minimum rated capacity 630 Amp.
- One complete spare withdrawable assembly circuit breaker with minimum rated capacity 1,250 Amp.
- One set of PTs
- One set of CTs low range
- One set of CTs high range

- At least on protection relay with all protection functions required for this project.

The switchgear proposed shall have integral earthing switches with each circuit breaker.

The equipment shall be suitable for continuous operation under the conditions specified and shall be in accordance with this Specification and the switchgear and circuit breaker design parameters defined in the Schedule of Specific Requirements.

The Contractor shall provide details in the Technical Schedule of the MV switchgear proposed to be supplied. The information supplied shall be typical only but of sufficient detail to allow the Owner to assess suitability for the application specified.

8.2 General

The 13.8kV switchgear with integrated circuit breakers shall be an indoor type, metal clad, three phase, 60Hz, vacuum insulated circuit breakers. The switchgear and associated circuit breakers shall be supplied complete with all accessories that are required by the Specification.

The switchgear and equipment shall be designed to the parameters as detailed in Section 8.26A Schedule of Specific Requirements

8.3 Normal Service Conditions

For Indoor Switchgear the condition are as follows:

1. The equipment shall be suitable for continuous operation, without corrosion, deterioration, or degradation of performance, under the conditions listed in the site conditions.

2. The switchgear be located in a switch room in a new building, intended to be airconditioned, during normal operations, to a temperature not exceeding 77°F (25°C). There may be times when the air conditioning is not functional, but it is expected that the room temperature during these times will not exceed 104°F (40°C) and its average value, measured over a period of 24 hours, does not exceed 95 °F (35 °C).

3. The ambient air is not significantly polluted by dust, smoke, corrosive and/or flammable gases, vapors or salt.

4. The conditions of humidity are as follows:
   - The average value of the relative humidity, measured over a period of 24 h, does not exceed 95%.
   - The average value of the water vapor pressure, measured over a period of 24 h, does not exceed 2.2 kPa.
   - The average value of the relative humidity, measured over a period of one month, does not exceed 90%.
   - The average value of the water vapor pressure, measured over a period of one month, does not exceed 1.8 kPa.

   For these conditions, condensation may occasionally occur.

   NOTE 1: Condensation can be expected where sudden temperature changes occur in periods of high humidity.

   NOTE 2: To withstand the effect of high humidity and condensation, such as breakdown od insulation or corrosion of metallic parts, switchgear designed for such conditions and tested accordingly should use.

NOTE 3: Condensation may be prevented by special design of the building or housing, by suitable ventilation and heating of the station or by the use of dehumidifying equipment.

In tropical indoor conditions, the peak value of relative humidity measured during a period 24 h can be 98%.

8.4 Auxiliary AC & DC supplies

Auxiliary AC supply will be 480 / 280V solidly earthed. Auxiliary DC supply will be 48V DC.

8.5 Busbars and Busbar Connections

Busbars shall be of high conductivity, hard drawn copper such that temperature rise does not exceed 104°F (40°C) for continuous operation at rated current, with all joints in accordance with Appendix B of AS 2067 (other applicable standards such as BS 159, IEC 619360), and of uniform cross-sectional area and rating for its entire length.
The busbars shall be designed, and provision be made so that the extension of the busbars will require a minimum of outage duration. All tapes, shrouds, etc. necessary for jointing busbars during installation shall be supplied.

8.6 Circuit Breaker and switchgear insulating system.

The 13.8kV switchgear busbar arrangement will be air insulated or resin insulated, with appropriately rated insulated tape or epoxy material used in areas where reduced clearances require such additional insulation and be completely self-contained in separate segregated sections of the switchgear with busbar clearances in accordance with the relevant Standards (i.e., IEC 61936 or equivalent IEC, BS or other standards)

The 13.8kV circuit breakers may employ vacuum as the insulating and interruption medium.

A device for checking the vacuum pressure level, during service, with visual indication of the available pressure, or lack thereof, in the circuit breaker interruption chamber, and the minimum and maximum limits admissible for correct operation, shall be provided. It shall be properly fitted to prevent leakage.

8.7 Requirements for Vacuum Circuit Breakers

An appropriate means shall be provided for checking contact wear in-situ.

The maximum current chopping shall be minimal and expected to be less than 5 amperes for unity power factor. Evidence of tests shall be supplied to demonstrate this criterion has been met. It shall not be necessary to fit surge arresters to limit switching overvoltage generated by the vacuum interrupters.

The level of X-rays emitted under all operating and test conditions shall not constitute a health hazard to any personnel working on the particular switch panel or adjacent panels. Contractors are to specify the level of radiation expected under overvoltage and test conditions and where the exposure level would be experienced.

The detailed procedure for replacing a vacuum bottle shall be provided in the instruction manual.

8.8 Tenders shall include the following information:

a. Source of the vacuum bottles,
b. Statements of the experience of the vacuum bottle's manufacturer,
c. History of performance of the particular vacuum bottles

d. Evidence of testing (including accelerated ageing tests) of the particular vacuum bottles.
e. Level of X-radiation emitted under all likely operating and test conditions.
f. The vacuum bottle shall be sealed for life. Contractors shall state the method by which the Owner may carry out in-situ tests on the integrity of vacuum in the bottles.

Tenderers shall state the consequences of loss of vacuum on:

a. The voltage withstands capacity of an open circuit breaker.
b. The ability of the circuit breaker to switch load current.
c. The ability of the circuit breaker to switch fault current.

8.9 Requirement for Arc Fault Venting

The switchgear is required to protect all personnel from the effects of internal arc faults. The switchgear must include internal systems that can detect internal arcing and switch off the power supply so as to limit the fault duration, including but not limited to electromechanical detectors and/or optical detectors.

The switchgear must also include fully enclosed metal vents or ducts between the switchgear and the external environment that shall divert any hot gases that are the result of internal arcing faults away from personnel within the switch room.

8.10 Circuit Breaker Operation Counters

Each circuit breaker shall be fitted with a non-resettable operation counter to record each opening operation.

8.11 Circuit Breaker HV Cable Compartment and Cable Terminations

The cable compartment/box shall be air insulated and accessible only by unbolting metal panels.

Cable boxes shall be downward pointing. The cable boxes shall be arranged for cable entry to be vertical from below the switchgear.

The cable boxes shall comply with the recommendations of AS 2067 where appropriate, and be supplied complete with all glands, armor clamps, ferrules, expansion fittings etc. Full details of cable boxes such as dimensional drawings, cable box type with HV power cable terminated shall be included in the Tender to allow full assessment of the Contractors proposal.

The cable box entry for single core cables shall be designed to minimize the possibility of eddy current heating.

Cable boxes shall permit the termination of the required number of HV cables as required.
The cable boxes shall be dust and vermin proof. They shall be fitted with a removable gland plate for each cable to allow the cable to be laid into or removed from the box without the need to thread the cable through the gland entry.

Where a bolted connection, which is preferred, is provided, flat terminal palms shall be provided for fixing cable lugs. The height of the cable box from the center line of the lower fixing hole of the terminal palm to the base of the box shall be a minimum of 3441/64” (880 mm).

Tenderers whose equipment would normally use HV cable plugs for terminating HV cables shall include in their scope of supply all materials, installation tools and equipment, instructions and drawings necessary for proper termination and insulation of the HV power cables.

Undrilled gland plate shall be fitted. The gland plate shall be made of 15/64” (6mm) brass as a preference, or aluminum of suitable thickness.

The minimum distance from the bottom of the cable gland to floor level shall be 11 13/16" (300 mm).

8.12 Circuit Breaker Dependent Power Operation

Clause 5.5 of IEC 62271.200 is applicable with the following additions:

a. The switching device contacts shall be positively driven in both directions.
b. Where necessary, the mechanism shall be designed to permit maintenance of the associated switching device. If this requires the manual slow operation of the switching device, the facility provided shall be quite separated and distinct from that associated with Normal operation.
c. Any separate component associated with maintenance slow operation shall be labelled "FOR MAINTENANCE PURPOSES ONLY".

8.13 Circuit Breaker Stored Energy Operation

Clause 5.6 of IEC 62271.200 is applicable with the following additions:

a. Pneumatic or hydraulic operating mechanism requiring a central air compressor plant or pump will not be accepted.
b. No movement of the main contacts is permissible before the release of stored energy. However, in the case of earthing switches, such movement is permissible provided that the contact movement shall not reduce any electrically stressed gap to below that which will withstand the rated insulation levels.
c. For manual operation it shall only be possible to operate a mechanism by using a dedicated operating handle applied in the correct manner.
d. Clear indication shall be given of the direction of motion of an operating handle to complete the operation.
e. Motor-charged spring-operated, stored energy mechanisms shall be provided with means for charging the springs safely by hand.

8.14 Circuit Breaker Manual Operation

8.14.1 Independent Manual operation

Clause 5.7 of IEC 62271.200 is applicable with the following additions:

a. It shall not be possible to charge the closing springs with the switching device in the closed position.
b. During an 'open' or 'close' operation, none of the energy from an incomplete operation shall remain in the mechanism. In addition, movement of an operating handle against an interlock shall not commence the charging of any spring.
c. Except for independent manual, independent motor and dependent manual operation:
    i. It shall be possible to re-charge the closing springs when the switching device is closed and if the springs can be and are released the device shall not open nor shall this operation result in mechanical damage to any component. If the springs are recharged after the switching device has been closed, they shall not be discharged by the shock of a short circuit interruption or accidental knocks and impacts.
    ii. A visible mechanical indicating device shall be mounted on the switching device to indicate the state of the spring and shall be inscribed "SPRING CHARGED" in red letters on white background, when the spring is charged, and "SPRING DISCHARGED" in black letters on white background, when the spring is discharged.
d. Provision shall be made for this information to be displayed remotely.

8.14.2 Dependent Manual Operation

It shall not be possible to remove an operating handle from a dependent manual operating mechanism unless an 'open' or 'close' operation is completed.

8.15 Circuit Breaker Operation of Release

Clause 5.8 of IEC 62271.200 is applicable with the following additions:

a. Stored energy operation mechanisms shall be fitted with a local manual release for opening and closing operation with the compartment door closed.
b. No movement of the spring charging handle shall occur as a result of the release of spring energy to operate the mechanism.

8.16 Interlocking Devices and Padlocking Facilities

Clause 5.11 of IEC 62271.200 are applicable with the following additions:

8.16.1 Interlocking Devices.

Interlocking shall be by mechanical, key or electro-mechanical, in order of preference, and when manually operated, they shall be provided with labels which are readily visible, and which contain clear concise instructions for operation.

Clearly labelled mechanical interlocks shall be provided to prevent:

a. The removal from or replacement of a circuit breaker to the service and earth positions with the front door open.
b. The opening of the circuit breaker compartment front door unless the circuit breaker is in the out of the service position or in the earth position.
c. Tripping by attempting isolation.
d. The removal of a circuit breaker secondary wiring plug connection from its socket on the stationery housing when the circuit breaker is in the racked-in position.

The electrical tripping of a circuit breaker that has been prepared for an earthing operation shall be inoperative both during closing and when closed. In addition, it shall not be possible to return to normal service duty without restoring the operation of the electrical tripping circuit.

In the case of Metal-enclosed switchgear and control gear with removable parts

- The withdrawal or engagement of a circuit-breaker. switch or contactor shall be prevented unless it is In the open position
- The operation of a circuit-breaker, switch or contactor shall be prevented unless it is only in the service, disconnected, removed, test or earthing position.
- The Interlock shall prevent the closing of the circuit-breaker, switch or contactor in the service position unless any auxiliary circuits associated with the automatic opening of these devices are connected. Conversely, it shall prevent the disconnection of the auxiliary circuits with the circuit-breaker closed in the service position.

8.16.2 Circuit and Busbar Earthing Interlocks

Where earths are applied through a circuit breaker, it must not be possible to trip it electrically whilst it is being used to apply the earth. It shall also be possible to padlock a circuit breaker to prevent the removal of an earth by mechanical means.

Each circuit earth shall be mechanically interlocked with its associated circuit breaker such that the circuit earth cannot be applied until the circuit breaker is open and fully isolated. Conversely, it shall not be possible to remove the circuit isolation whilst the circuit earth is applied.

Busbar earth switches shall be interlocked such that the busbar earth(s) cannot be applied unless all potential sources of in-feed to the section of busbar (including all outgoing feeders on the section) have been opened and isolated. Conversely, it shall not be possible to remove any point of isolation from the busbars whilst busbar earths are applied. Most importantly, the interlocking shall be fail safe.

Where busbar earthing is achieved by closing the circuit breaker onto an already prepared circuit earth, a padlock able captive device, labelled “MOVE BEFORE BUSBAR EARTHING” (black letter on Signal Red background) shall be provided to remove the normal interlock, which must be moved before it is possible to engage and close the circuit breaker.

8.16.3 Padlocking Facilities

It shall be possible to meet all padlocking requirements by means of a padlock.

Padlocking facilities, each requiring the use of a single padlock without additional loose devices, shall be provided so that:

a. A switching device can be prevented, independently of other operations, from being closed by local manual operation of the mechanism when it is open. This facility shall not lock mechanically any closing mechanism having electrical release.
b. A switching device can be prevented, independently of other operations, from being opened by local manual operation of the mechanism when it is closed. This facility shall not lock mechanically any trip mechanism having electrical release.
c. Busbar, circuit or VT shutters can be independently locked closed to provide a point of isolation which must remain undisturbed whilst other operational work (earthing or testing) is being carried out.
d. Any test access cover can be independently locked closed.
e. Circuit and busbar earthing facilities can be independently locked to prevent inadvertent earthing.
f. A voltage transformer assembly fitted with an isolating feature can be locked in the isolated position.
g. VT secondary fuses/links when removed can be padlocked off to prevent reinsertion. Any bar used for this purpose should be captive and non-conductive.
h. When in use, it shall not be possible to remove any covers, when part of an interlocking/padlocking facility.

8.17 Circuit Breaker Position Indication.

Clause 5.12 of IEC 62271.200 is applicable with the following additions:

a. All switching devices with non-visible main contacts shall be fitted with positively driven mechanical indication of the operating position.
b. Only one indicator shall be visible at any one time and should not be wholly visible until the operation is completed.

8.18 Protective, Control and Indicating equipment.

8.18.1 Current Transformer requirements

Current transformers shall comply with the requirements of IEC 60044.1

All current transformers shall have short time ratings not less than those specified for the complete switchgear. They shall also all be capable of withstanding the making capacity of their corresponding circuit breaker.

All current transformers shall have a thermal rating of at least 120% of the highest CT ratio on both the primary and secondary windings, and this information shall be displayed on the nameplate.

The current transformers shall be of the bar primary type, using cast resin or similar insulation.

The individual cores of current transformers in the same enclosure shall be magnetically and electrically separate from each other except for a common primary bar.

Multiple ratios shall be obtained by the use of multiple secondary tapping.

All current transformer tapping's shall be brought out to a readily accessible terminal block.

Shorting terminals shall be provided in the secondary circuits of all current transformers having multiple tapping's to facilitate tap changing on live equipment.

Where current transformers are not capable of withstanding the high voltage dc or ≤ 0.1 Hz cable test, bolted links shall be provided to permit their isolation for cable test.

All current transformers are to be accommodated within the switchgear, instead of current transformers fitted over the high voltage cables.

All current transformers fitted to circuit breakers shall be installed with the P1 terminal located nearest to the circuit breaker contacts.

Each current transformer shall be provided with two (2) nameplates, one of which shall be mounted on or adjacent to the current transformer in a readable position and the other in the LV compartment in a position clearly visible with the panel door open.

8.18.2 Voltage Transformer requirements

The voltage transformers shall be constructed from three single-phase transformers complying with the requirements of IEC 60044.2.

Voltage transformers shall be of the 'dry' type utilizing cast resin or similar insulation.

Suitably rated fuses shall be provided on the HV side and in each phase of the low voltage windings.

All live HV parts, and the HV fuses shall only be accessible when the voltage transformer is fully disconnected.

Provision shall be made for locking the voltage transformers in the "Service" and "Isolated" positions.

Secondary winding fuses shall be fitted as close as practical to their corresponding windings and shall be accessible with the switchgear fully energized.

All individual metering and protection circuits shall be separately fused.

Star connected secondaries shall have all three phases plus the star point (neutral) brought out. The star point shall be earthed via a link.

Each voltage transformer shall be provided with two (2) nameplates, one of which shall be mounted on or adjacent to the voltage transformer in a readable position and the other in the associated LV compartment in a position clearly visible with the panel door open.

8.18.3 Local Circuit Breaker Electrical Control

Each circuit breaker shall be provided with:

a. Local 'trip-close' push buttons or switch. When push buttons are provided, they shall be colored RED for tripping and GREEN for closing
b. An operation selector switch which shall have three positions as below.
c. 'Local'. In this position tripping and closing of the circuit breaker shall only be possible by means of the local 'trip-close' push-buttons or switch on the circuit breaker and the protective relays.

d. ii. ‘Maintenance’. In this position tripping and closing of the circuit breaker shall not be possible.
e. iii. ‘Remote’. In this position tripping and closing of the circuit breaker shall only be possible by means of remote devices and the protection relays.
f. The switch shall also provide clean contacts for indication of switch in ‘Local’ and ‘Maintenance’ positions to the SCADA system.

8.18.4 Protection & control Marshalling cubicle.

Each 13.8kV circuit breaker shall be fitted with a marshalling cubicle or enclosure suitable to terminate all wiring required for the correct functioning of that circuit breaker and its associated protection and control equipment. The marshalling cubicle shall be securely mounted, integral with the circuit breaker, located in a readily accessible position, and facilitate ease of termination and connection of multicore cables.

The cubicle shall be provided with:
a. Anti-condensation heaters supplied by 120 V AC.
b. Lighting controlled by a door switch.
c. Shorting link type terminals for CT wiring.

The cubicle shall be provided with a vertically hinged door or doors that are secured by an approved locking facility that can be locked closed by a padlock. The door/s shall cover the full height and width of the cubicle and be capable of being opened greater than 120° to permit access to all parts of the cubicle.

The equipment accommodated in the cubicle shall be mounted on a hinged panel and all terminals shall be effectively shrouded to provide safe access to equipment and terminations located behind the panel.

All equipment shall be labelled to show its function using white-black-white trifoliate or equivalent labels.

All secondary wiring shall be marked with a circuit number at both ends by approved ferrules that cannot fall off if the wire is removed from the terminal.

8.18.5 AC Supplies

A single three phase, four wire, 480/208 volt 60Hz supply shall be cabled directly to terminals to be provided in the auxiliary marshalling box or enclosure for running motor control circuitry and other auxiliary apparatus.

8.18.6 DC Supplies

A nominal 48V dc supply shall be used for the switchgear for protection and alarm monitoring. Provision shall be made for terminating this supply in each cubicle.

8.19 Check and Test Facilities

Means shall be provided to allow a check, by means of an approved voltage detector, to verify the main circuit is not live and to allow for phasing out.

8.19.1 Voltage Presence Indicating System (VPIS)

A voltage presence indicating system in accordance with IEC 61958, shall be provided for each phase of each busbar and each main circuit to indicate the busbar and the cable side of the circuit are in service or isolated, and to allow phase comparison to be carried out between adjacent main circuits.

If cable compartments are at the rear, an additional indication of voltage presence shall be provided for each circuit at the rear of the panel.

The indicating system shall be designed for maximum service reliability, maintenance free and shall not need external power.

8.19.2 Test Facilities

Each circuit breaker shall allow for the following tests:

a. Circuit fault location and testing
b. Phase identification
c. Voltage testing on circuits.
d. Testing the integrity of a vacuum interrupter when the requirements are specified in the manufacturer's instructions.
e. Protection testing including primary and secondary injection.

These test facilities may be provided by the insertion of a portable test device. For withdrawable equipment the test device may be inserted into orifices vacated by the withdrawal of the associated switching device.

For testing connections, all parts of the main circuit which cannot be disconnected from the test connections, and any associated devices shall be capable of withstanding the dc withstand voltage for 15 minute period.

To assist in cable fault location the contact resistance measured from the terminals for connecting test leads to the connection to the main outgoing cables shall not be greater than 100 micro-ohms.

Integral test contact shall be so designed and constructed as to ensure that component parts do not become detached during normal use.

Test access cover shall be clearly identified. Test access for plug-in test device shall not be positioned on the top surface of the equipment.

Where equipment carries a mimic of the main circuit, the test point shall be clearly shown as part of the mimic.

The opening of test access covers, designed specifically for access to test contacts, shall not be possible when the equipment is in any position other than "EARTH ON".

When it is necessary, for testing purposes, to remove a cover not designed solely for test access, e.g. a cable compartment cover, an interlock shall be provided to prevent removal of the cover when the equipment is in any position other than "EARTH ON".

In all cases it is preferred that the test access should be at the front of the switchgear. When the test access is at the rear of the switchgear a mechanical/electro-mechanical interlock or linkage shall be provided which enables an operator to be sure that the correct access has been opened and provides a physical indication at the front of the switchgear that a test access is open.

When the test access cover is open, all parts which may be live shall be so shielded or protected that an operator using the normal test devices cannot make contact with live parts.

It shall not be possible to close or replace the test access cover with any test device in position.

It shall not be possible to close associated switchgear with the test access open.

Test facilities intended for voltage testing instruments shall have a minimum access of 223/64" (60 mm) diameter.

8.19.3 Test Devices

Provision shall be made to secure test devices positively in position when in use. Where the test device is in the form of a plug-in bushing, then the method of securing the device in position and its removal shall not require the use of any tools and, additionally, dismantlement of any part of the device shall require the use of non-standard tools. Plug-in bushings shall be designed and constructed to ensure component parts do not become detached during normal use.

Portable testing devices shall be identified by manufacturer and type, uniquely serial numbered, marked with their test voltage and current rating and provided with a suitable container.

8.20 Construction

8.20.1 Tanks, Covers, housings, and Enclosures

All circuit breaker tanks and enclosures shall be constructed from robust metallic material and protected from the elements by coating or galvanizing.

In general, all equipment housings should be constructed/reinforced to withstand without distortion transport, handling or excess pressure during fault conditions. Circuit breaker tanks or enclosures shall be designed to withstand the stress of the filling gas or of the vacuum, whichever method is chosen. Contractors shall state in their Tender if the circuit breakers offered complies with this requirement.

All surfaces on which water could accumulate shall be sloped and drained to prevent the accumulation of any water.

Where the equipment housing is constructed of corrosion resistant material the joints shall have similar corrosion resistant properties to the parent metal.

All exposed bolts, nuts and washers shall be hot-dip galvanized or stainless steel.

8.20.2 Protective Coatings

All external surfaces of the equipment are to be treated with a coating that provides protection against corrosion induced by water, salt laden atmosphere and low levels of industrial pollutants.

The protective coating shall comply with the following requirements:

a. Finished coatings shall be oil resistant, heat resistant and non-corrosive.
b. All coatings shall be painted to the Manufacturer's standard unless otherwise specified.
c. All coatings shall be capable of being maintained on-site.
d. The materials used, and method of application shall be suitable for the base metal to be coated, shall be supplied by a reputable Manufacturer, and shall be applied in accordance with their recommendations for this particular application.

The Contractor shall guarantee that after three years from acceptance the extent of corrosion at any one site on the equipment shall not exceed an area of five square centimeters nor penetrate the base metal by more than one tenth of the thickness of the base metal.

The Contractor shall supply sufficient details to allow evaluation of the protective coating by the Owner, and shall include:

a. Description of base metals to be coated.
b. Make and type of materials used for cleaning, priming and finishing.

c. Details of the surface cleaning process used for removing rust, oil, grease, dirt and other foreign matter and of the surface preparation process.
d. Recommendations for on-site repair of damaged coating, e.g. scratches, chips, etc. from handling, necessary to achieve the estimated life of the protective coating.

8.21 Fittings

In addition to the standard fittings called for in other parts of the Specification, the following additional shall be provided.

8.21.1 Circuit Breaker Lifting Facilities

Lifting lugs shall be provided suitable for lifting each complete circuit breaker assembly when assembled and ready for service. The lugs shall be arranged so that any slings attached thereto do not foul any part of the circuit breaker and when suspended by them, the circuit breaker shall hang without tilting.

8.21.2 Earthing Lugs

A suitable stainless-steel earthing lug with a 9/16" (14 mm) diameter hole shall be provided for each circuit breaker and for each switchgear bus section.

8.21.3 Gland Plates

All drop boxes are to have a 15/64" (6mm) Brass gland plate complete with earth stud.

8.22 Earthing

8.22.1 Earthing of main circuit

To ensure personnel protection during maintenance work, all parts of the main circuit to which access is required or provided shall be capable of being earthed prior to becoming accessible This does not apply to removable parts which become accessible after being separated from the switchgear and control gear.

8.22.2 Earthing of the enclosure

The earthing conductor (or earth busbar) referred to in sub-clause 5.3.2 of IEC 62271.200 shall be secured to the enclosure and located so as to provide convenient facilities for use with any earthing leads.

The earth busbar shall have a cross sectional area not less than 0.1 sq. in. (70mm2) and shall be of flat high conductivity hard drawn copper busbar. The earth busbar shall run the full length of the switchgear.

8.22.3 Earthing of earthing devices

Where earthing connections have to carry the full three-phase short-circuit current (as in the case of the short-circuiting connections used for earthing devices), these connections shall be dimensioned accordingly.

8.22.4 Earthing of withdrawable and removable parts

The metallic parts of a withdrawable or removable part which are normally earthed shall be connected to the earthing conductor on approach to, and whilst engaged in the "Service" and "Earth" locations. The earth connection shall be completed prior to engagement of the main circuit contacts by not less than 11/32" (26mm).

Provision shall be made for each cable sheath/screen earth terminal to be connected to the earthing conductor.

The normally earthed metallic parts of a withdrawable part shall remain connected to earth In the test and disconnected positions and in any intermediate position. Connections to earth in any. position shall provide a current-carrying capability not less than that required for enclosures (see 5.102 .1).

On Insertion, the normally earthed metallic parts of a removable part shall be connected to earth prior to the making of the contacts of the fixed and removable parts of the main circuit.

If the withdrawable or. Removable part includes any earthing device, intended to earth the main circuit, then the earthing connection in the service position shall be considered as part of the earthing circuit with associated rated values (see 4.5, 4.6 and 4.7) .

8.23 Rating and Terminal Marking Plates

The Rating and Terminal Marking plates shall be in accordance with AS 2650 and location and wording of labels will be to the Owner's approval.

The name plates shall be stainless steel stamped with the equipment number and title, as specified by the Owner, in a minimum of 15/32" (12mm) high letters.

8.24 Inspections and Tests

The Contractor shall successfully carryout routine testing on the equipment, as required by relevant Australian Standards, as well as any additional type or special tests requested by the Owner which may be required to verify that the equipment conforms to the Specification, the Tender, subsequently approved construction drawings and performance data.

Complete and accurate records of all tests shall be kept by the Contractor and copies supplied to the Owner. Three (3) certified copies of all test results for all components shall be supplied to the Owner immediately upon completion of the tests and before the delivery. All test certificates shall state the equipment serial numbers. An indication only that equipment has passed a test or exceeded a required value is not acceptable. The circuit breakers and switchgear shall not leave the works until the test certificates have been received, considered and approved by the Owner.

The proper functioning of all protective, indicating and alarm devices shall be demonstrated to the satisfaction of the Owner.

The Contractor shall notify the Owner at least three weeks in advance of commencement of testing at the Contractors works and the reserves the right to witness all such tests.

The Contractor shall advise the tests they consider should be carried out at site and on commissioning.

The Owner shall have the right to carry out such other tests as they deem necessary to prove the compliance of the equipment with the Contract. In the event of these check tests proving that the equipment is satisfactory, all costs will be borne by the Owner, but in the case of faulty plant, the Contractor shall bear the costs of replacing or modifying the equipment and further tests in connection therewith. Any expense by the Contractor in having representatives present shall be borne by the Contractor.

8.25 Technical Schedule MW Switchgear Details

8.26 A Schedule of Specific Requirements

The values with the note “To be defined later” are indicative, the detailed engineering design will define the final values.

Parameter Description	Units	Requirements
Circuit Breakers		
Minimum Rated voltage	kV	15
Rated frequency	Hz	60
Number of poles		3
Fixed or withdrawable circuit breaker		Withdrawable
Metal enclosed class		Indoor
Rated insulation level – LIWV/PFWV	kVp/kV	95/36 To be defined later
Rated current		
Incomer circuit breakers	A	2000 To be defined later
Outgoing Feeder circuit breakers	A	1000 To be defined later
BESS	A	1000 To be defined later
Substation Auxiliary Supply	A	1000 To be defined later
Bus-tie circuit breakers	A	2000 To be defined later
Rated short time current for 1 sec	kA	25 To be defined later
Rated peak withstand current	kAp	80 To be defined later
Rated short circuit breaking current		
ac/percentage dc components	kA/%	31.5/33 To be defined later
Rated short circuit making current	kA	80 To be defined later
Rated line charging & cable charging breaking currents	A	Table 5 IEC 62271
First-pole-to-clear factor		Table 5 IEC 62271
Rated TRV for terminal faults & out-of-phase	kVp	Table 1a IEC 62271 100
Rated operating sequence		0 – 0.3sec – CO – 3min – CO
Interrupting medium		Vacuum
Electrical endurance classification		E2 with auto-reclose
Switchgear Busbar Ratings		
Rated voltage	kV	15
Rated frequency	Hz	60
Number of poles		3
Busbar type		Single
Metal enclosed class		Indoor
Rated insulation level – LIWV/PFWV	kVp/kV	95/36 To be defined later
Rated current	A	4000 To be defined later
Rated short time current for 1 sec	kA	25 To be defined later
Number of circuit breakers:		
Outgoing feeder CB	Ea.	10 x 1000A To be defined later
Incomer CB	Ea.	2 x 1000A To be defined later
Bus-Tie CB	Ea.	2 x 2000 A To be defined later

Parameter Description	Units	Requirements
No of bus sections		2 x 2000A To be defined later
Protection Current Transformers:		
Type		Inductive, single phase – 3 phase set
Position		As per Spec.
Rated Frequency	Hz	60
Class		5P
Rated Secondary current	A	1
Highest Voltage Um	kV	15
Burden	VA	10
Number and class of cores		
Voltage Transformers:		
Type		Single phase – 3 phase set
Rated Frequency	Hz	60
Class		0.1 / 3P
Rated Primary Voltage	kV	13.8
Rated Secondary Voltage	V	110
No of Secondary Windings		1
Ratio		13800/110V
Burden	VA	50
Metering Current Transformers:		
Type		Inductive, single phase – 3 phase set
Position		As per Spec.
Rated Frequency	Hz	60
Class		0.1
Rated Secondary current	A	1
Highest Voltage Um	kV	15
Burden	VA	10