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## **1 SCOPE**

The E-House is a factory fabricated and assembled prefabricated substation. It is a portable structure for outdoor installation, totally self supporting from the base and can be mounted directly to a framework, piers, pads or foundations with all the necessary equipment installed. The design intends to allow for the fabrication, testing and commissioning ex works.

This specification covers standards required for the manufacturing of an E-House to be used to house Electrical Switchgear, Equipment and Instrumentation. The design of the E-House shall allow for a lifetime of 30 years.

## **2 DEFINITIONS**

For the purpose of this specification the definitions in IEC 60050, the International Electrotechnical Vocabulary (IEV) shall apply.

In addition the following definitions shall apply:

APPROVED	:	Approved by the Engineer in writing
IEC	:	International Electrotechnical Commission
LV	:	Voltage not exceeding 1kV
MV	:	Voltage exceeding 1kV but not exceeding 52kV
HV	:	Voltage exceeding 52kV

## **3 STRUCTURAL COMPONENTS**

### **3.1 GENERAL**

The E-House shall conform in general to IEC 62271-202.

### **3.2 STEEL STRUCTURES**

The framework shall be manufactured from Steel suitably selected for the relevant load and operating conditions. All external joints including frame shall be a continuous weld.

The factors of safety used in the design must at least take the following aspects into account:

- Lifting.
- Permanent position operating requirements.
- Transport to site.
- Roof Load – Snow Loads to Local Climatic Conditions (if applicable).
- Wind Loads

Lifting lugs shall be so positioned on the structure to avoid the necessity to use a spreader bar and to prevent damage to equipment already installed in the E-House as a result of beam deflection.

The proposed factors of safety shall be clearly identified in the tender bid by the prospective contractor.

### **3.3 E-HOUSE ROOF**

The E-House roof must be designed to cater for a double wall filled with insulation. The roof shall provide a water tight finish.

### **3.4 TROPICAL ROOF**

Provision shall be made for the following aspects (As Required in Data Sheet):

- The purpose of the second roof is to tropicalise the structure and to reduce heat loading.
- Sloped roof to comply with accepted building standards for the type of material used to construct the roof.
- Roof shall provide a watertight finish.
- The tropical roof shall preferably make use of industrial grade IBR selected and designed to minimise joints and occurrence of overlapping edges.
- An overhang extending past the lower roof, of at least 600mm, shall be provided in the entire circumference of the substation.
- Adequately support steelwork shall be provided to support the roof under adverse weather conditions.
- The roof should be readily removable, complete with lifting holes and shall be finished off in a framework to provide a pleasing appearance.

### **3.5 FLOORS**

The floor construction shall be designed to withstand all anticipated loads on the structure including that of transportation of completed units, including all internal equipment. The floor should be fabricated from mild steel.

#### **3.5.1 E-HOUSE Floor**

This is a mild steel floor for foot traffic within the E-House. This floor has penetration under the equipment for cable entry. Removable access plates are to be provided adjacent to the equipment to access the sub floor cable zone. Underside of floor to be corrosion protected.

- E-House Floor – Non Slip Steel or Aluminium.
- Each switchboard shall be mounted directly on top of the above mentioned flooring. Portions of the cable slot which are unused (i.e. at each end) should be covered with strips of similar sized flooring in a manner which facilitates removal and trimming back for switchboard extensions.

When selecting the type of floor covering the following preferences should be noted:

- M.V. – Preference to be given to Fixed Pattern Switchgear otherwise a provision is to be made to allow the withdrawal of switchgear carriages on a smooth surface. Due regard needs to be given to the prevention of slipping on this surface.
- Floor support steelwork spacing needs to be co-ordinated with the switchgear requirements.

### **3.5.2 Cable Floor (As Required in Data Sheet)**

- Below the MV/LV area of the E-House is a “Cable Floor”. This cable floor is fixed to the underside of the cross members of the chassis providing a void for cable transit. There are penetrations in the cable floor for cable access. These penetrations are fitted with 6mm aluminium gland plates, which can be sealed to the cable floor after the cable glanding is complete.

## **3.6 DOORS**

There will be a minimum of two steel doors positioned to facilitate an emergency exit route from the E-House.

The doors shall be equipped with:

- An emergency Panic Bar.
- A locking facility, lockable from exterior, but can always be opened from the interior, under all conditions.
- Spring loaded pressurization louvers shall be provided at top of the door.
- A provision to latch the doors in the open position.

All doors shall open outwards and shall open onto landings and not directly onto stairs.

### **3.6.1 Double Doors for Equipment Installation (If Required)**

A double door shall be provided on both short sides of the unit which should facilitate the installation of equipment. Two double doors shall be provided on one long side of the container to house the Cooling System equipment (if Applicable). The minimum width of the door should be 1800mm and the minimum height should be 2400mm. It shall not be possible to open this door from the outside and panic bolts shall be fitted on the inside to allow the rapid egress of personnel in the event of an electrical fault within the enclosure. These double doors shall not be lockable from the inside. The only door latching mechanism shall be the above mentioned panic bolt installation.

### **3.6.2 Personnel Access Doors**

On the same side of the above mentioned double doors single personnel access doors shall be installed. A single access door shall be provided to house the Fire Fighting equipment (if applicable). These doors shall be lockable from the outside by means of a padlock. It shall not be lockable from the inside. The dimensions of the door shall be a minimum of 800mm wide by 2000mm high.

### **3.6.3 Access Stairways**

Access stairways fitted with non slip stairs shall be installed at all access doors. It can be assumed that each unit will be installed a minimum of 1 meter above nominal ground level and the access stairways should accommodate this installation height.

Access stairways for the air conditioning floor (on roof of E-House) shall be provided where applicable.

Handrails shall be provided on all outside edges of stairways and roof as per specification.

### **3.7 WALLS**

Walls shall be constructed in a 'sandwiched' arrangement comprising rigidised sheet steel on the outside and suitable filler on the inside, this should include a vapour barrier. The filler should be in the form of expanded polyurethane or similar material. Full details of the proposed filler material shall be submitted at tender stage. The performance of the filler material under fire conditions shall also be stated including, amongst other things, the nature of all emissions that could be expected in the case of a fire.

Internal wall joints should be durable and aesthetically pleasing. Design to cater for a double wall. The contractor shall state:

- Design clearance between walls - preferred minimum 60mm.
- Thickness of outer wall – preferred minimum 3mm.
- Thickness of inner wall – preferred minimum 1mm.
- Insulation type.

The purpose of the above mentioned filler is to provide both rigidity, strength, and, in particular, thermal installation.

Wall constructions that allow post-installation extensions would be preferred.

### **3.8 INSULATION**

The Manufacturer shall state the type of insulation and coefficient of heat transfer of the insulation material used.

The following areas of the containers shall be insulated.

- Walls.
- Doors.
- Roof/Ceiling.

### **3.9 CLASS OF PROTECTION**

The container shall have an IP rating of no less than IP 55.

## **4 SUPPORT POINTS**

The unit shall be designed to be supported at the four corners of the unit (for 6metre container) on 200 x 200 brick, concrete or steel piers. Seating points for these four piers shall be provided accordingly on the underside of each unit. Middle supports will be required for longer containers. The Manufacturer is to advise on total mass of container including installed equipment for loading purposes.

## **5 AIR CONDITIONING (IF APPLICABLE)**

The air conditioning system is designed to maintain the E-House at approx 25 deg C, given the ambient temperatures normally expected in the installed region.

If one of the units fail, the remaining units must be able to maintain the room temperature below 30 deg C, given the average summer high temperatures.

Thermal load due to solar radiation to be considered

For transport purposes the A/C units are to be packed separately

## **6 SIGNS**

Composite signs including the following information shall be provided at each entry point into the substation:

- Main Name- Identification board with voltage rating
- Fire Extinguisher location signage
- Unauthorised Entrance prohibited at all entrances
- 5 in one (Unauthorised entrance, No unauthorised handling of equipment, Fire procedure with no water, Electrocutation and CPR, Electric flash)
- No Smoking
- Voltage identified on switchgear
- Emergency phone number at telephone/intercom

Fire extinguisher signs and location chevrons.

Provision for four units per E-House shall be provided.

A sign identifying emergency telephone numbers shall be provided.

A notice board shall be provided onto which the reticulation diagram can be mounted. The size of the board shall allow for A1 drawings to be displayed.

## **7 WALKWAYS**

Walkways where applicable shall be designed in accordance with the IEC 62271 and roof layout - Galvanized.

## **8 LOADING**

The mass of equipment to be installed on the outside of the E-House shall be shown on the drawings.

The above mentioned equipment shall be transported inside the container and shall be mounted on site and should not exceed the safe loading limits of the E-House.

## **9 TRANSPORTATION**

The E-House shall be constructed to be suitable for transportation by road on flat cars secured by chains or by the corner fittings. E-House Units being transported by rail shall be secured by its lower castings.

On flat car transportation wooden beams to be placed at the E-House ends, and must be of sufficient volume and length to suit the flat car.

E-House Units with non standard dimensions require specific means of transportation. In this case an arrangement will have to be discussed and approved with the transport contractor and the relevant transport authorities.

If transportation is by sea freight, the required regulations for seaworthy E-House Units shall be adhered to as per ISO 1496.

## **10 PAINTING**

### **10.1 EXTERNAL FINISHES**

The contractor shall ensure all surfaces are cleaned free of dust, grease and oil, using compressor dry air (free of oil and water).

- Walls - Painted to AA CPS 132 Colour: Refer Data Sheet
- Top roof (if applicable) - Heavy duty galvanized sheeting
- E-House roof - Painted to AA CPS 132 Colour: Refer Data Sheet
- Walkways - Galvanized
- Handrails - Painted to AA CPS 132 Colour: Refer Data Sheet
- Support Steel Bottom of E-House - Painted to AA CPS 132 Colour: Refer Data Sheet

### **10.2 INTERNAL FINISHES**

- Floor - Painted to AA CPS 122 Colour: Refer Data Sheet
- Walls and doors - Painted to AA CPS 122 Colour: Refer Data Sheet

## **11 FIRE RATING**

The total structure shall not have a rating less than 1 hour.

## **12 FIRE SYSTEM**

### **12.1 FIRE DETECTION**

Standard: Smoke Detection, Alarm Panel with Remote Alarm

**12.2 FIRE SUPPRESSION (REFER TO DATA SHEET)**

- E-House
- Cable Compartment

**12.3 PORTABLE**

- Portable 4.5kg CO<sub>2</sub>, or other type, fire extinguishers (FE) shall be installed on each unit for locations refer to appendices "D", "E", "F" and "G".

**13 CABLE ACCESS**

Refer section (3.5).

**14 MATERIAL SELECTION**

Manufacturer to list what equipment will be used in the various applications and submit Material Safety Data Sheets where applicable e.g. Tropical Roof:- Heavy industrial grade Galvanized IBR sheeting.

**15 EQUIPMENT**

All equipment required for the purpose of this specific Project to be installed in E-House.

**15.1 MOUNTING TOLERANCES**

Requirement for Electrical Equipment is 1mm/m over the full length of the E-House floor.

**15.2 INTERNAL ARC CLASSIFICATION**

Requirement - IAC-AB as per IEC 62271-202

Any equipment above 1kV for VSD, Cycloconverter should be regarded as control gear as specified in IEC 62271-202

**15.3 E-HOUSE AUXILIARY EQUIPMENT**

The following equipment must be supplied and installed by the Manufacturer and shall conform to local standards:

- Lighting
- Lighting distribution board
- Conduit
- Wiring
- Switched Socket Outlets.
- Switches
- Photocells
- Air Conditioning and Ventilation where applicable
- Lifting facilities
- Labels

- Fire Protection if applicable
- Fire Extinguishers

## **16 LIGHTING AND SMALL POWER**

### **16.1 POWER SUPPLIES AND EQUIPMENT**

Raw power as per Data Sheet.

UPS power as per Data Sheet.

### **16.2 DISTRIBUTION BOARDS**

Refer to clause 15.3

### **16.3 LIGHTING**

Each E-House shall be equipped with a lighting and small power installation complying with IEC 62271-202.

All Lighting and Small Power shall be in galvanized steel conduit, surface mounted.

Lux level inside E-House shall be 300 lux minimum maintained.

#### **Lighting type:**

- Internal - 3 x Fluorescent electronic start 2x58 W.  
2 x Fluorescent 2 x 58 Watt (emergency battery back-up)
- External - 4 x 70W HPS Bulkhead luminaires or approved equivalent to be mounted above doors.

2 Way switching for lighting circuits per E-House mounted outside.

Photocell lighting control.

4 x switch socket outlets (as per local requirements)

1 x Air temperature sensor for E-House temperature monitoring.

The abovementioned lighting and small power installation shall be wired using 2.5mm<sup>2</sup> PVC insulation wire for the socket outlets and 2.5mm<sup>2</sup> PVC insulated wire for the light fittings. The wiring shall all be run in surface mounted galvanised 20mm diameter electrical conduit.

Installation to be issued with a Certificate of Compliance or Equivalent.

## **17 EARTHING**

### **17.1 E-HOUSE LIGHTNING PROTECTION**

Four earthing connection points allowing connections of the E-House to the earth mat shall be provided on the outside of the main steel structure and shall be positioned to allow:-

- Extension of E-House.
- Diagonally opposite each other.

**17.2 SAFETY EARTH BAR**

- An earth bar shall be provided underneath the main structure, arranged as per AA STD 543010, Earthing Systems.
- The earth bar shall be positioned to prevent damage in transport.

**18 CLIMATIC CONDITONS**

General conditions as per Data Sheet.

**19 TESTING**

The pre-testing of equipment prior to shipping:

- Mandatory Type Tests as per IEC 62271-202.
- Visual Examination.
- Insulation Test.
- Control System Test.
- PLC Test.
- Complete Functional Tests to Prove Satisfactory Operation of the Assembly.

**20 DOCUMENTATION DELIVERABLES DURING TENDER**

The contractor shall provide the following information with the tender:

- Total mass and calculated load at each support plinth.
- Proposed position of support plinths.
- Detail layout and dimensions.
- Electronic Copies and hard copies.

**21 FINAL CONTRACT DOCUMENTATION DELIVERABLES**

- Drawings
- Lighting and small power
- DB SLD
- General Arrangement
- Data Book
- Operating/Maintenance Manuals

**APPENDIX A: RELATED DOCUMENTS**

AA\_SPEC\_543002, E-House

- DIN 15190 T.101 : Freight Container - external dimensions, corner fittings and testing.
- DIN / ISO 1161 : ISO-Container series 1, corner fittings specification.
- ISO 830 : Terminology
- ISO 6346 : Freight Containers – coding, identification and marking.
- IEC 62271-202 : High Voltage Switchgear and Control Gear – Part 202 High Voltage/Low Voltage Prefabricated Substations.
- IEC 61936-1 : Power Installations exceeding 1kV AC Part 1 Common Rules.
- IEC 60050-826 : Electrical Installations
- IEC ISO 9001 : Quality management and quality assurance standards Part 1: Guidelines for selection and use
- ISO 830 : Freight Containers - Vocabulary
- ISO 6346 : Freight Containers – Coding, Identification and Marking
- ISO 1161 : Freight Containers – Corner Fittings Specification
- ISO 668 : Freight Containers – Classification, Dimensions and Ratings
- ISO 1496 : Freight Containers – Specification and Testing

Laws, regulations, recommendations and standards relevant to Country of Installation (Refer Data Sheet)

**APPENDIX B: RECORD OF AMENDMENTS**

Issue 0 : New Document (E. Gilfillan, September 2010)

**APPENDIX C: DATA SHEET**

TECHNICAL AND OPERATING DATA (shall be read in conjunction with Specification 543002)

**A. DATA TO BE SUPPLIED BY CLIENT**

MINE: .....  
 LOCATION: .....  
 PROJECT NO: .....  
 E-HOUSE DESIGNATION(S): .....  
 COMPLETED BY: ..... DATE: .....

**1 CLIMATIC CONDITIONS**

In project documentation otherwise:

YES		NO	
-----	--	----	--

1.1 Ambient maximum temperature

	°C
--	----

1.2 Ambient minimum temperature

	°C
--	----

1.3 Humidity

	%
--	---

**2 ROOF**

Tropicalise

YES		NO	
-----	--	----	--

**3 CABLE FLOOR**

YES		NO	
-----	--	----	--

**4 AIR CONDITIONING**

Type as specified in preferred equipment specification

YES		NO	
-----	--	----	--

**5 PAINTING - FINAL COLOUR**

INTERNAL:

Walls


Floor

Doors

EXTERNAL:

Walls

Top Roof

Handrails

Support Steel


**6 FIRE SUPPRESSION TYPE**

E-House

HFC227(FM200)	
IG55 (Argonite)	
OTHER	

Cable Compartments

HFC227(FM200)	
IG55 (Argonite)	
OTHER	

**7 POWER SUPPLIES AND EQUIPMENT**

Raw Power

 V

UPS Power

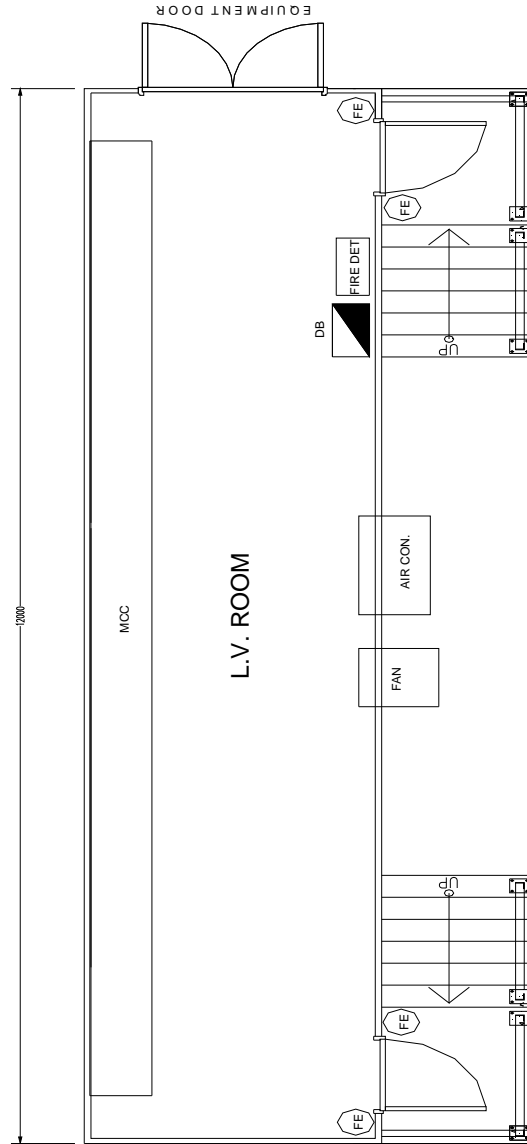
 V**8 LAWS, REGULATIONS, RECOMMENDATIONS AND STANDARDS**

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**9 Other requirements:**

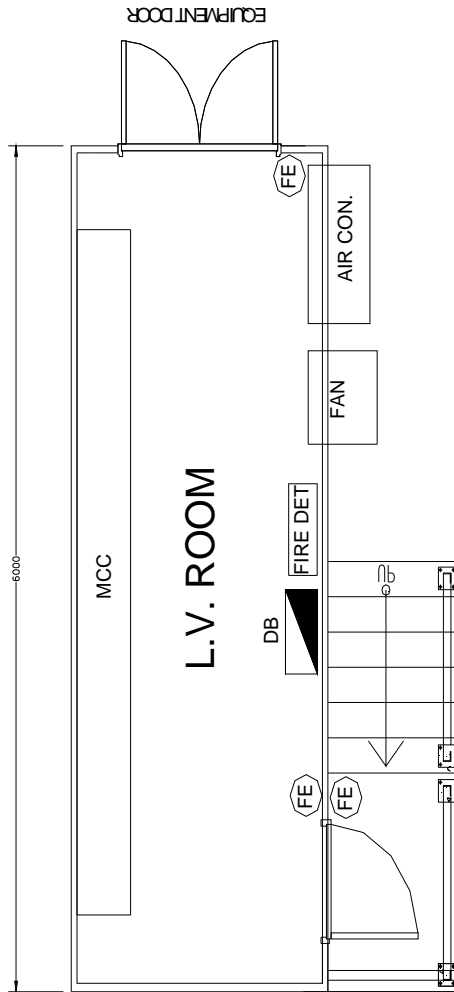
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APPENDIX D: DRAWING TYPICAL E-HOUSE L.V. ROOM (12M)



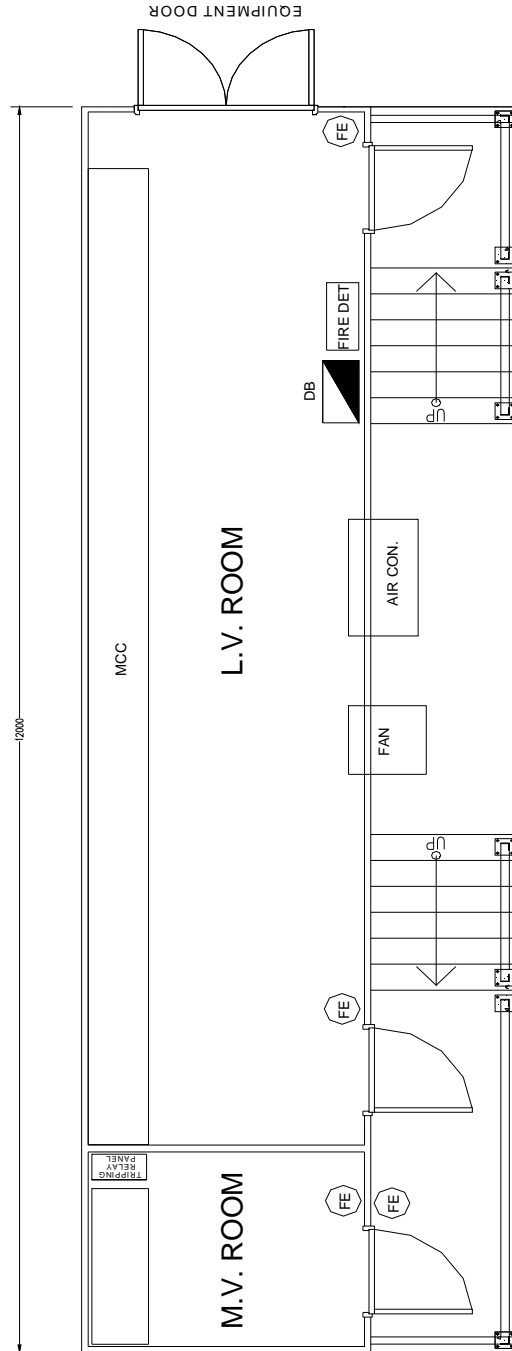
TYPICAL E-HOUSE SUBSTATION  
L.V. ROOM

APPENDIX E : DRAWING TYPICAL E-HOUSE L.V. ROOM (6M)



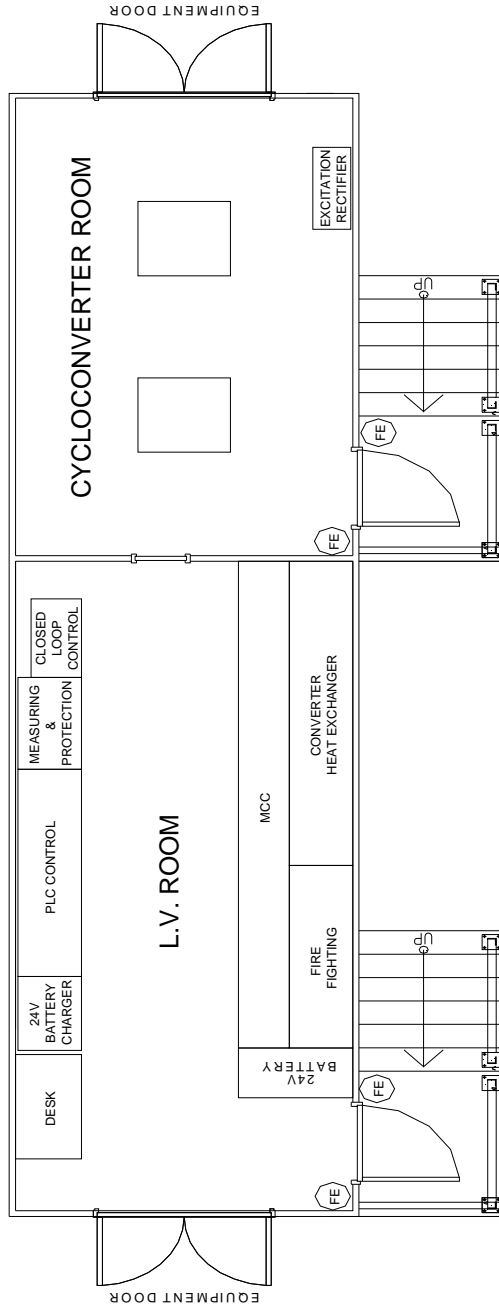
TYPICAL E-HOUSE SUBSTATION  
L.V. ROOM

APPENDIX F: DRAWING TYPICAL E-HOUSE H.V. ROOM & L.V. ROOM



TYPICAL E-HOUSE SUBSTATION  
M.V. ROOM & L.V. ROOM

APPENDIX G: DRAWING TYPICAL E-HOUSE L.V. ROOM & CYCLOCONVERTER



TYPICAL E-HOUSE SUBSTATION  
L.V. ROOM & CYCLOCONVERTER ROOM