

RENEWABLE ENERGY

**PHOTOVOLTAICS SOLAR SYSTEM
AND
MINBU SOLAR POWER PLANT
CONNECTED TO 230KV GRID SYSTEM**

PRESENTATION

BY

U HTAY MYINT

MANAGING DIRECTOR

ELECTRIC POWER ENGINEERING COMPANY LIMITED

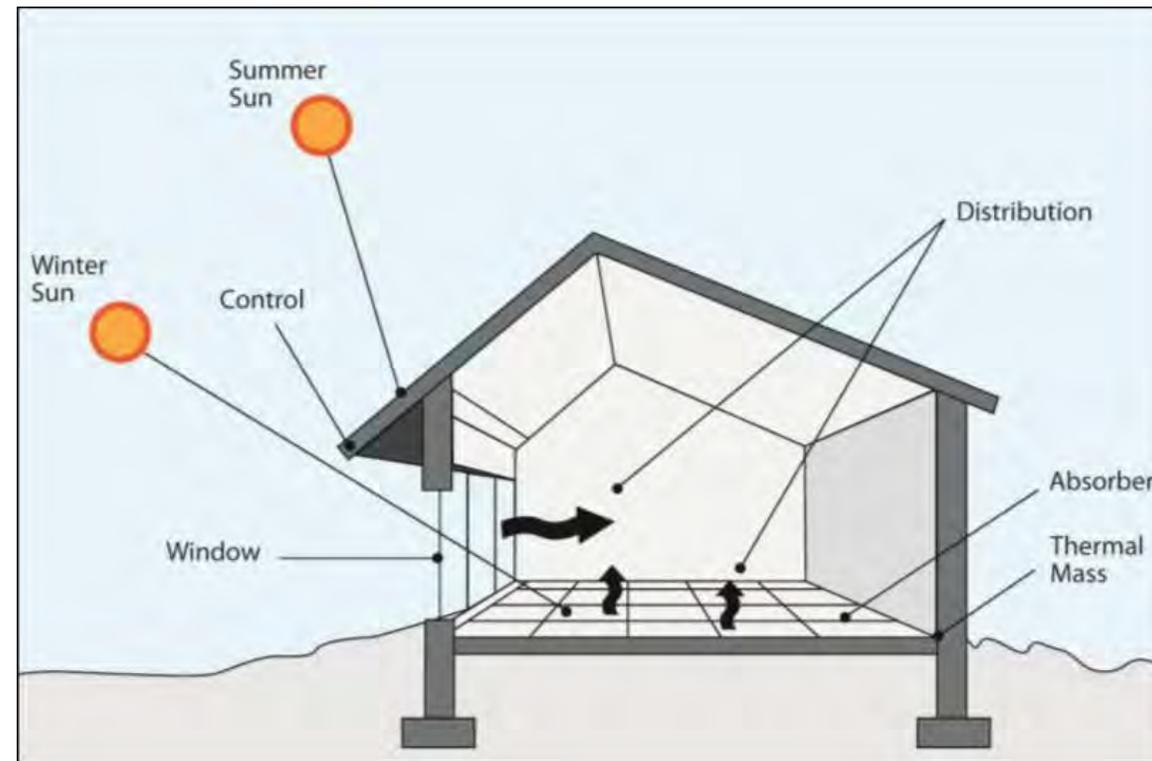
Date-27.7.2024

SOLAR ENERGY

- Solar energy is radiant light and heat from the Sun that is harnessed using a range of technologies such as solar power to generate electricity, solar thermal energy including solar water heating, and solar architecture.
- The challenge is to collect a share of this heat and radiant energy. The two most common ways of looking at solar energy and its type are how solar energy is converted into useful energy and the type of energy it is converted into.
- Two types of how solar energy is converted into useful energy are:
 - Passive Solar Energy
 - Active Solar Energy

PASSIVE SOLAR ENERGY

- Passive solar energy is the type of harnessing the sun without the use of mechanical devices. Using sun-facing windows to get natural lighting and heat the homes are an example of using passive solar energy.

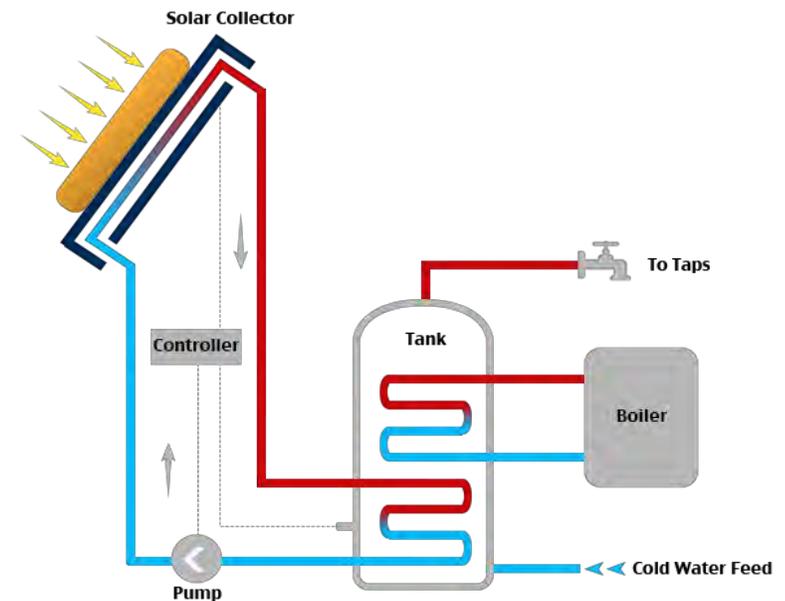


ACTIVE SOLAR ENERGY

- Converting the solar energy into useful energy using mechanical devices, collection, storage and distribution of energy to be used in the future is called the active solar energy. There are several useful ways active solar energy can be used to take advantages from.
- There are three most useful types which are:
 - Solar Thermal Energy
 - Concentrating Solar Power
 - Photovoltaic Solar Power

SOLAR THERMAL ENERGY

- Solar thermal energy is the energy collected from the sun and used to generate heat. This heat is usually concentrated using mirrors and used for heating water later. This heat is used directly (low-temperature solar thermal) or converted into mechanical energy and in turn electricity (concentrated solar power – CSP).



SOLAR THERMAL SYSTEM (HOT WATER)

CONCENTRATING SOLAR POWER

- Concentrating solar-thermal power (CSP) systems use mirrors to reflect and concentrate sunlight onto receivers that collect solar energy and convert it to heat, which can then be used to produce electricity or stored for later use. It is used primarily in very large power plants.



DUBAI 950 MW WORLD'S LARGEST CSP FARM

PHOTOVOLTAICS SOLAR POWER

- When the sun shines onto a solar panel, energy from the sunlight is absorbed by the PV cells in the panel. This energy creates electrical charges that move in response to an internal electrical field in the cell, causing electricity to flow.



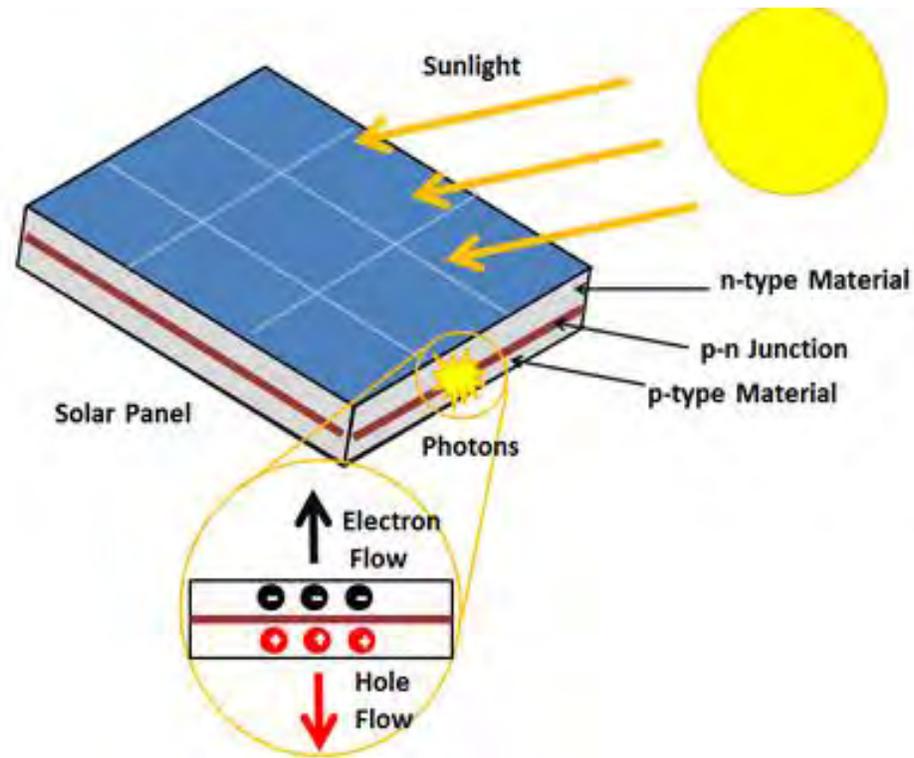
PHOTOVOLTAICS SOLAR FARM



MINBU SOLAR POWER PLANT

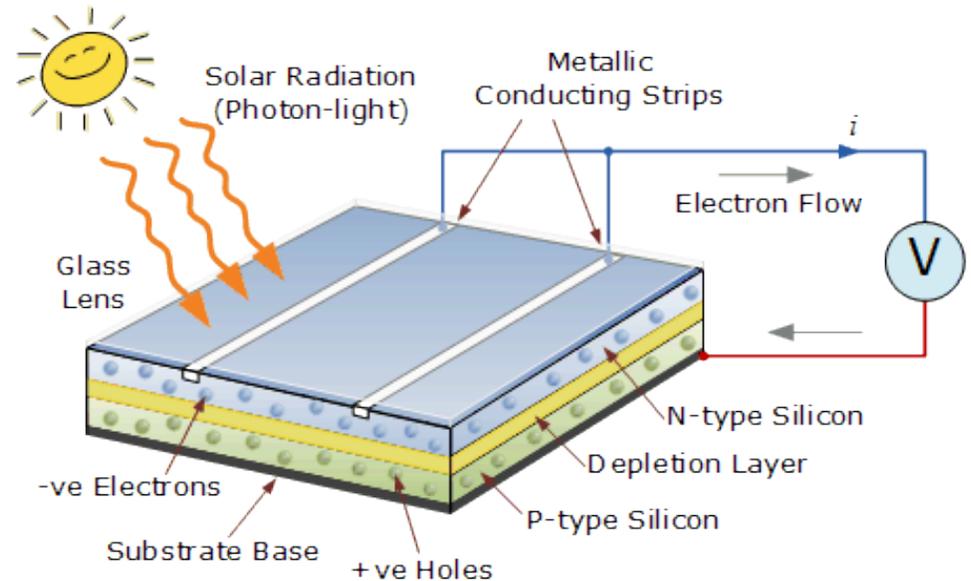
What is Solar Cell?

- Solar cell is a device or a structure that converts the solar energy i.e. the energy obtain from the sun, directly into the electrical energy.



How is Solar Cell constructed?

- Mainly Solar cell is constructed using the crystalline Silicon that consists of a n-type semiconductor. This is the first or upper layer also known as emitter layer. The second layer is p-type semiconductor layer known as base layer. Both layers are sandwiched and hence there is formation of p-n junction between them. The surface is coated with anti-reflection coating to avoid the loss of incident light energy due to reflection.



PHOTOVOLTAIC SYSTEM TYPES

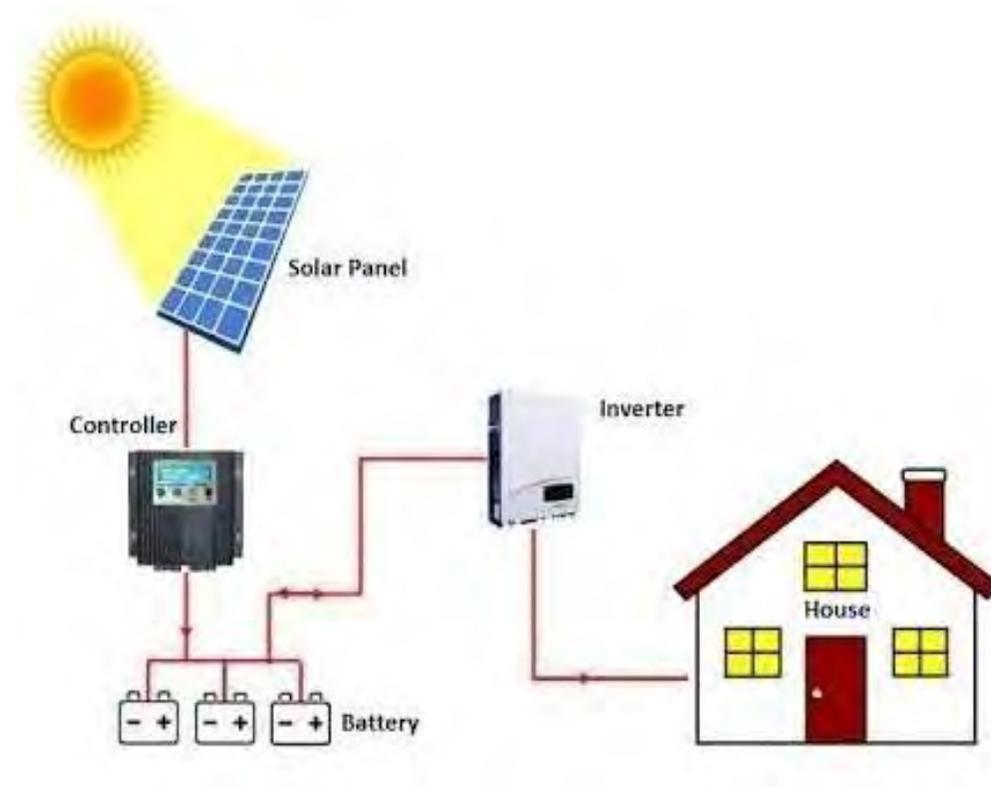
Photovoltaic systems can be generally divided into two basic group:

- Photovoltaic systems not connect to the network, stand-alone system (off-grid),
- Photovoltaic systems connected to the public electricity network (on-grid).

There are lots of different subtypes of photovoltaic systems according to type and method of connecting to the network, or a way of storing energy on independent systems.

STANDALONE SYSTEMS (OFF-GRID) OR ISOLATED SYSTEM

- These systems are used in rural areas where there is no electricity network and infrastructure. The systems are connected to a reservoir of energy (battery) by a control over the filling and reusing. The inverter can also be used to provide alternating current for standard electrical equipment and appliances.



STANDALONE SYSTEMS WITH BI-DIRECTIONAL INVERTER

- These systems are used in frequent power failure & usages are at night time. Stand-alone system, which are also called off-grid systems, rely on solar power only. These systems consist of the PV module and a load only or they can include batteries for energy storage. When using batteries charge controller from the PV modules when they are fully charged, and may disconnect the load to prevent the batteries.



NETWORK-CONNECTED HOME SYSTEMS (ON-GRID)

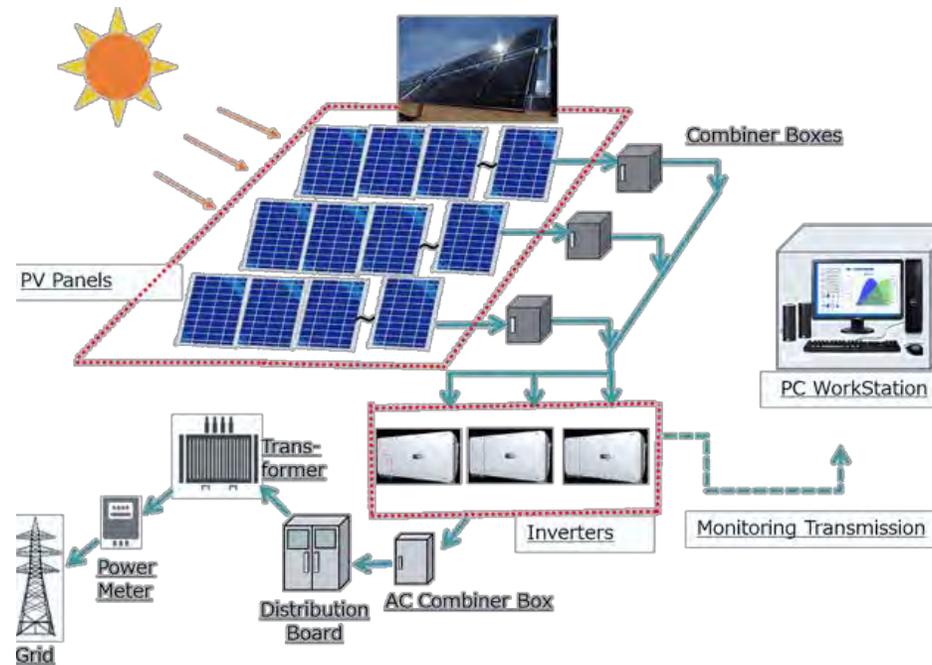
- These are the most popular types of solar photovoltaic systems that are suitable for home and commercial installations in developed and urban areas. Connection to the local electricity network allows selling to the local distributor of electric energy any excess of electricity generated and not used in the household consumption, because the PV system is connected to the network via a home installation in parallel operation with the distribution system.



PHOTOVOLTAICS SOLAR POWER

NETWORK-CONNECTED SOLAR POWER PLANTS (FARMS)

- These systems, also connected to the network, are generating large amounts of electricity by a photovoltaic installation on a localized area. The power of such photovoltaic power ranges from several hundred kilowatts to tens of megawatts, recently up to several hundred megawatts. Some of these installations can be located on large industrial facilities but more often on large barren land surfaces.



220MW_{DC} MINBU SOLAR POWER PLANT

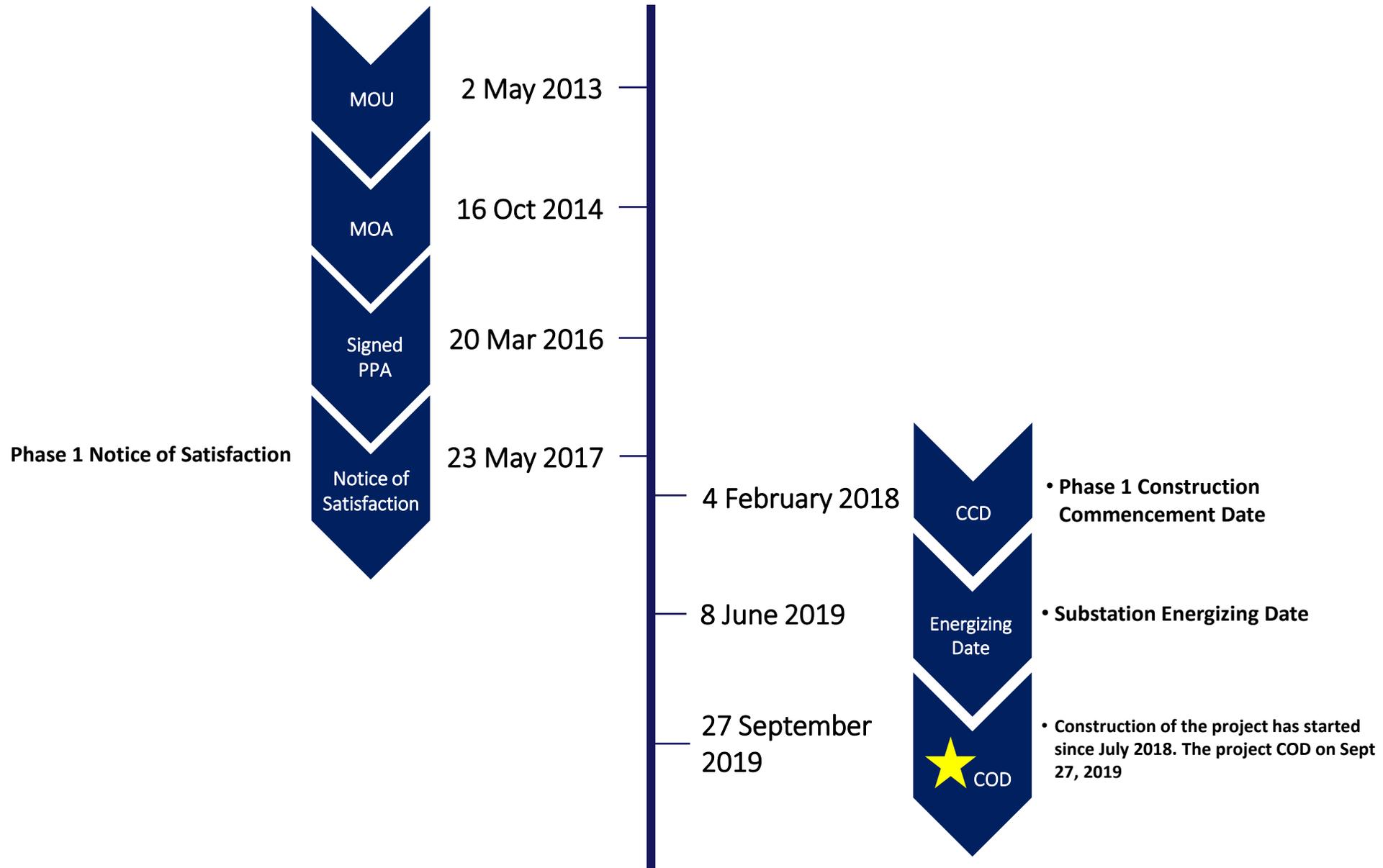


230KV TRANSMISSION LINE, SUBSTATION AND PV AREA AT MINBU SITE

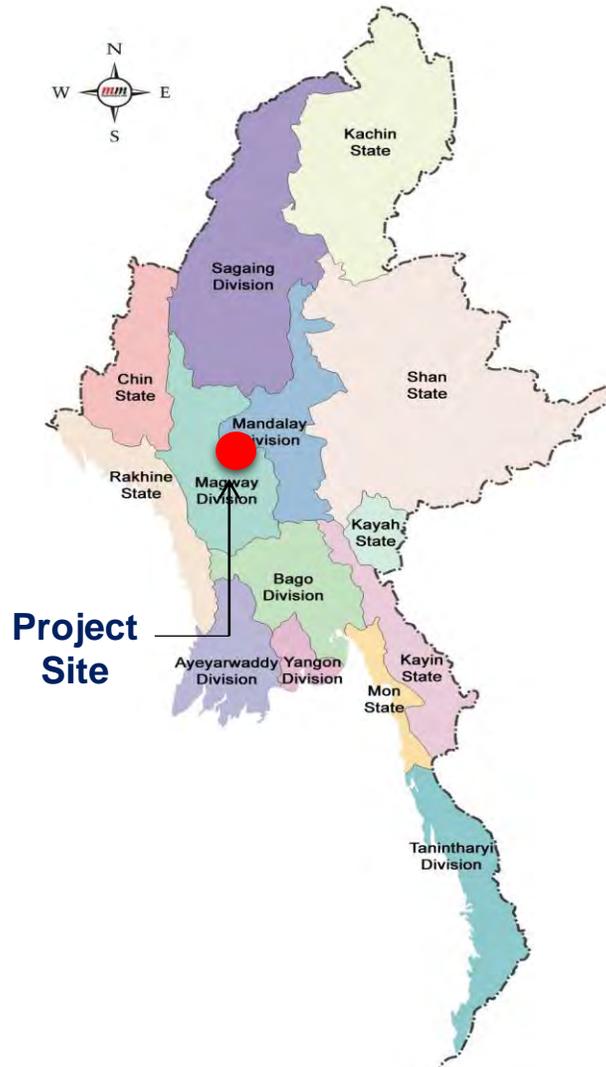
- The Project's 230 kV transmission line has been completed, energized and handed over to the government of Myanmar since July 2017
- The Mann-Ann National Grid Line has 800MW capacity with current use only from our Project
- Connected to Mann and Ann substations of MOEE distributing our power nationwide



Project Development Timeline



PROJECT OVERVIEW – MINBU SOLAR POWER PLANT



Location

- Sagu Township, Minbu District, Magway Region

Capacity

- Approx. 220 MW_{DC} (Phase I 50 MW_{DC}, Phase II 50 MW_{DC}, Phase III 50 MW_{DC} and Phase IV 70 MW_{DC})

Land

- Total - 836 Acres
- Phase 1 – 168 Acres
- Phase 2 – 160 Acres
- Phase 3 – 160 Acres
- Phase 4 – 200 Acres

- The total PV laying area will be 688 acres for the whole project. The remaining 148 acres will be used for internal road, access road and drainage system.

Energy Production and Payment

- Approx. 350 million kWh/year

Construction Time

- 48 months (Phase I 50 MW_{DC} :12months, Phase II 50 MW_{DC} :12months, Phase III 50 MW_{DC} :12 months and Phase IV 70 MW_{DC} :12 months)

Grid Connection

- 230 kV Transmission Line construction complete and handed over to EPGE
- The 1.3 mile in/out transmission line connection connected to the national grid line

Reduction of CO2

- Nearly 200,000 Metric Ton Per Year (after completion of 4 phases)

PROJECT FACTS

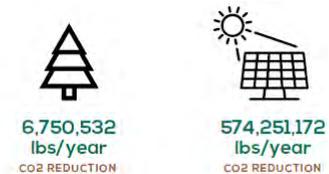
Electricity generation to supply power over 200,000 households



The largest of Solar Power Plant in Southeast Asia with land area as large as 528 football stadiums



CO₂ greenhouse emission reduction over 570 million lbs./year, or equivalent to planting 6.75 million trees.



Promote Renewal energy source in Myanmar of up to 30% by 2030 (support COP-21 Paris agreement)

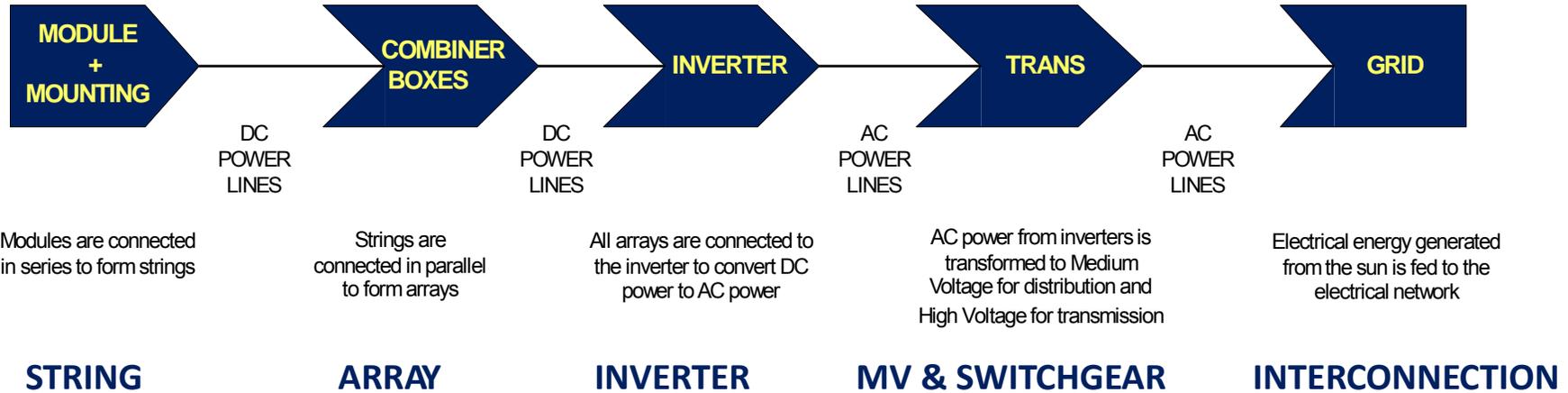


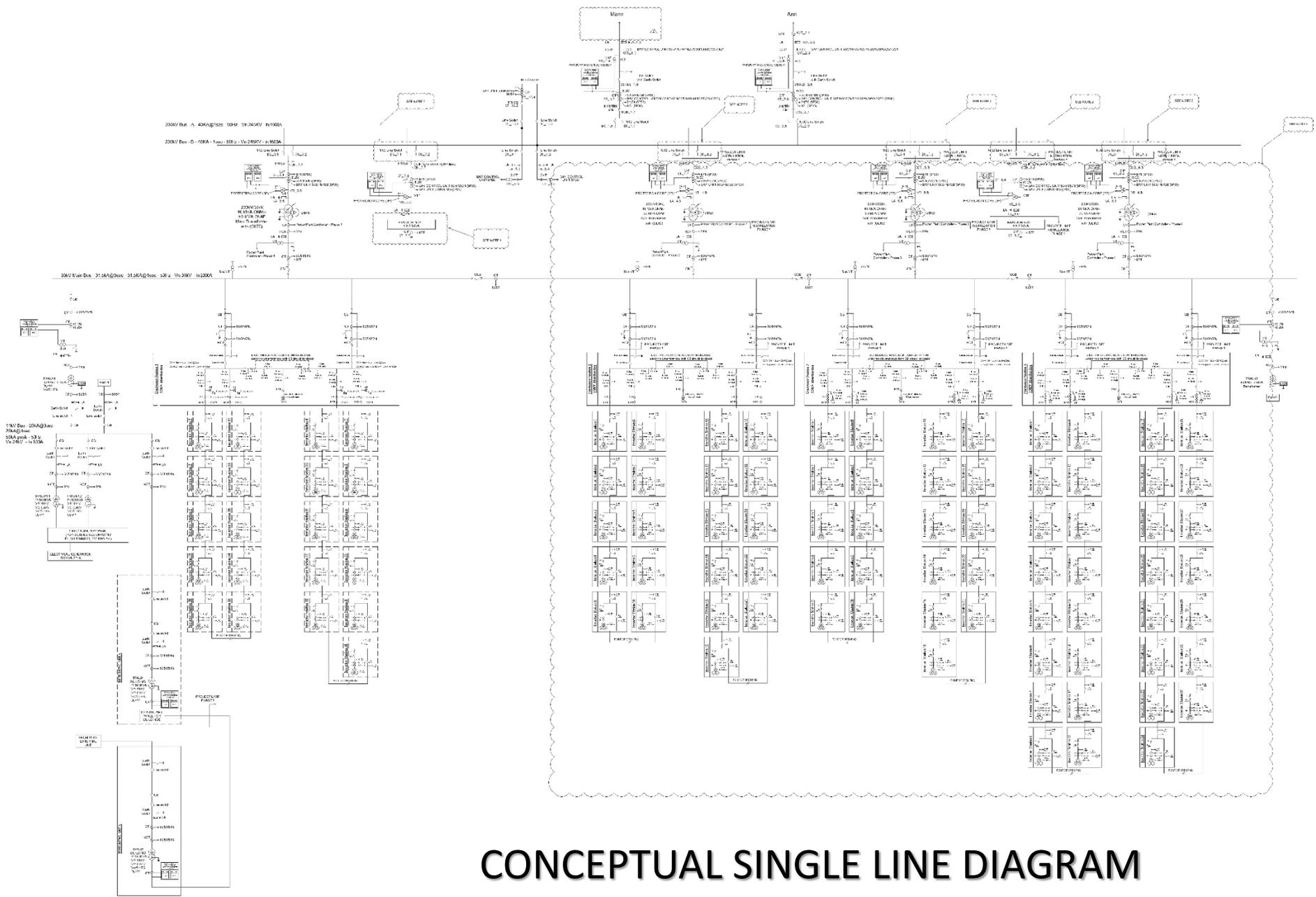
220MW_{DC} MINBU SOLAR POWER PLANT

PV AREA



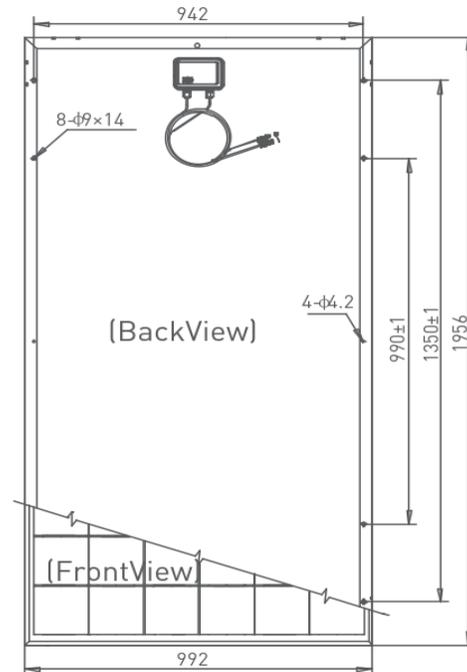
PHOTOVOLTAIC PLANT DESIGN





CONCEPTUAL SINGLE LINE DIAGRAM

POLY-CRYSTALLINE SOLAR MODULE



Specification

- **Jetion** Poly-Crystalline Panel JT310PAg, JT315PAg and JT320PAg
- 310, 315, and 320 Pm(W)
- Open Circuit Voltage: 45.5, 45.8 and 46.1 Voc(V)
- Short Circuit Current: 8.93, 8.98 and 9.03 Isc(A)
- Module efficiency: 16.1, 16.3 and 16.6%

System Design Parameter

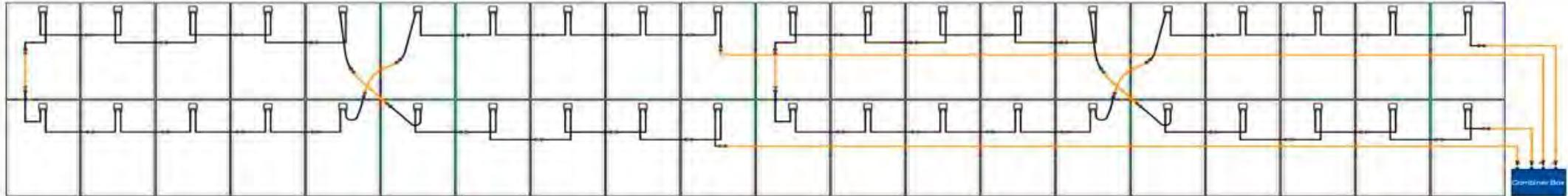
- 20 Modules per String
- Row Pitch 7.20 m.
- Collector Width 3.91m
- 18° Fixed Tilt
- -21° Array Azimuth Angle
- 2 Module in Portrait Racking Configuration
- Total number of Modules for 4 Phases: 699,600 Modules
- **159,000 Modules** for Phase 1
 - Jetion 310: 31,480 Modules
 - Jetion 315: 112,280 Modules
 - Jetion 320: 15,240 Modules
- 278530 m² Cell area



MODULE INTERCONNECTION SCHEME

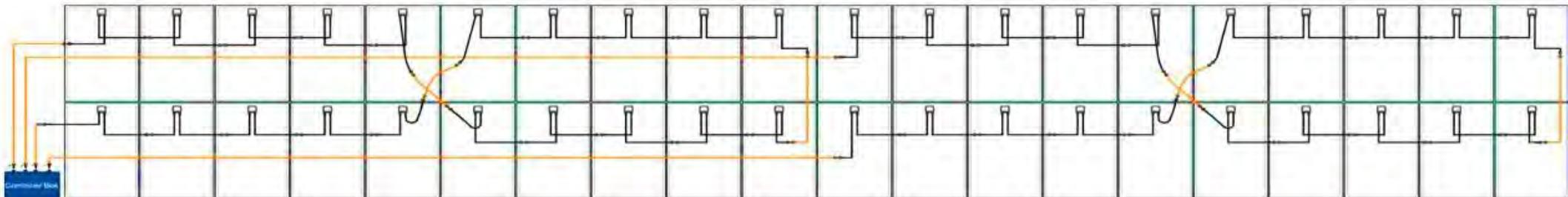
TYPICAL CONNECTION - 40 MODULE TABLES
STRINGS CLOSING ON THE RIGHT

BACK VIEW
OF MODULES



TYPICAL CONNECTION - 40 MODULE TABLES
STRINGS CLOSING ON THE LEFT

BACK VIEW
OF MODULES



— ADDITIONAL CABLE CONNECTION

INVERTER

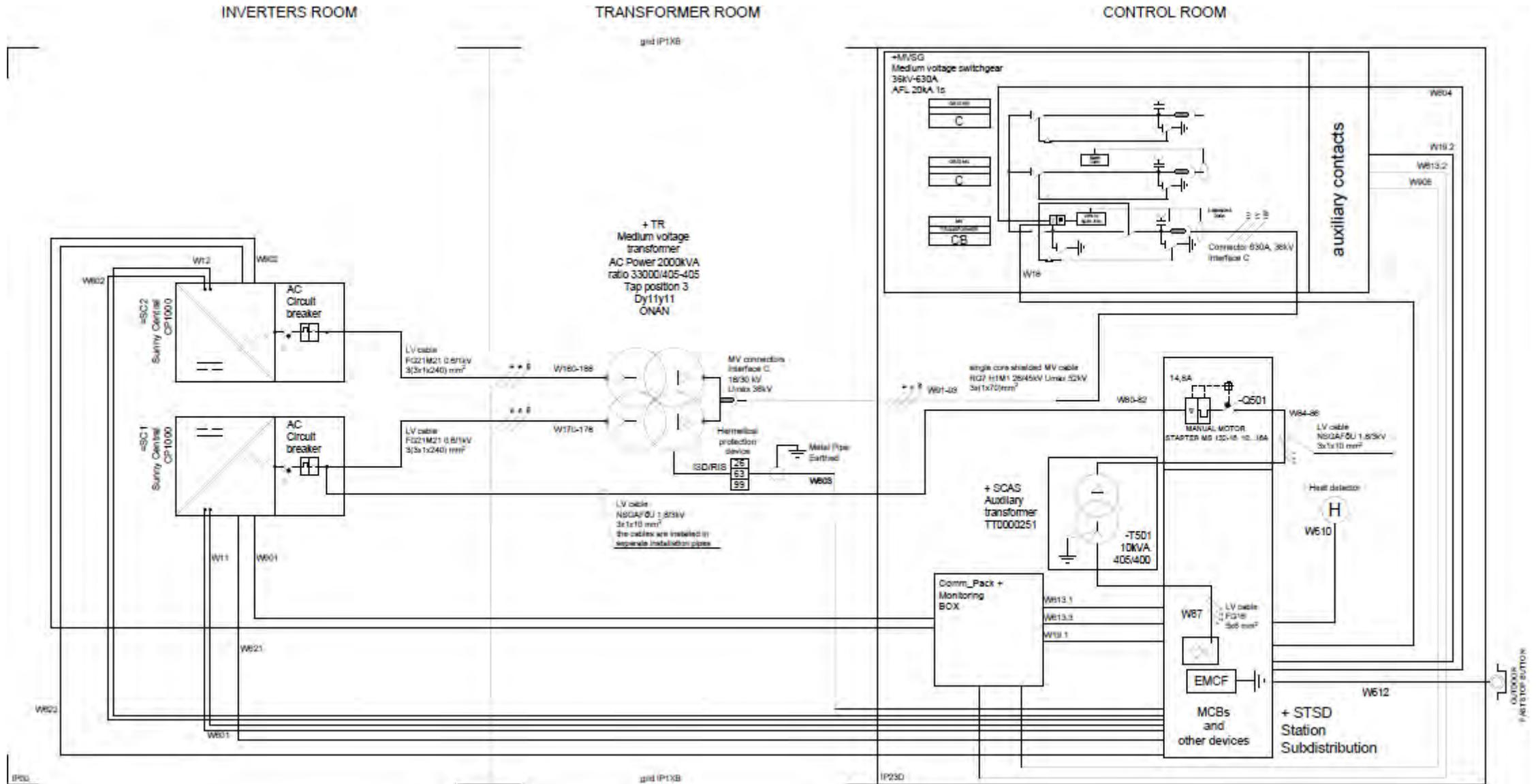


Sunny Central 1000CP XT



- Dimension (W / H / D): 2,562 / 2,272 / 956 mm
- Weight: 1900 kg.
- Operating temperature range: -25°C to 62°C / -13°F to 144°F
- Noise emission: 68 db(A)
- Max. self-consumption (operation) / Self-consumption (night): 1950 W / < 100 W
- Efficiency: 98.7% / 98.4% / 98.5%
- 25 Year Product Warranty
- Operating Voltage: 596-850 V
- 110 kVA Unit Number Power
- Inverter Loading Ratio: 1.22
- String DC Voltage: 1,000 Vdc
- **Features**
 - DC connection / AC connection: Ring terminal
 - Display: HMI touch display
 - Communication / protocols: Ethernet (optical fiber optional), Modbus
 - SC-COM
 - Configurable grid management functions: Power reduction, reactive power set point, dynamic grid support (e.g. LVRT)
- **Input (DC)**
 - Max. DC power (@ cos = 1): 1,122kW
 - Max. input voltage : 1,000 V
 - MPP voltage range (@ 25°C / @ 40°C / @ 50°C): 688 to 850 V³ / 625 to 850 V³ / 596 to 850 V³
- **Output (AC)**
 - AC power (@ 25°C / @ 40°C / @ 50°C): 1,100kVA / 1,000kVA / 900kVA
 - Nominal AC voltage / nominal AC voltage range: 405 V / 365 V to 465 V

SINGLE LINE DIAGRAM OF MAIN CIRCUIT



POWER PLANT CONTROLLER



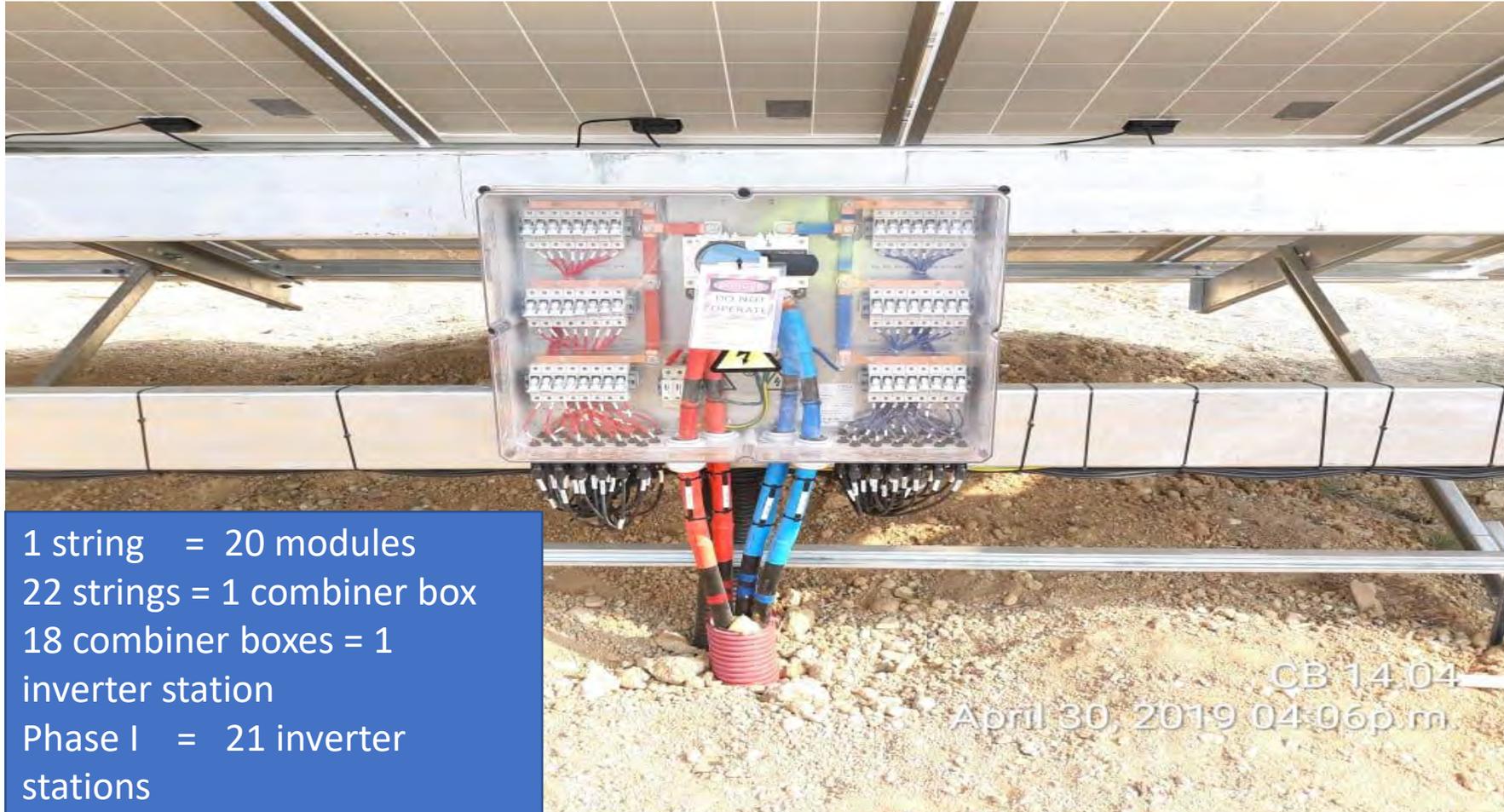
Control Functions

- Closed-loop control: Controls voltage, active power, reactive power and power factor at the feed-in point
- Output Limitation: Curtails instantaneous power to desired value
- Output limitation: Offsets power fluctuations caused by events such as rapid increase in solar irradiation intensity
- Automatic active power adjustment: Adjusts instantaneous power if frequency increases or decrease (APR)
- Character curve control: Characteristic curved such as for $Q(U)$, $\cos(P)$, $P(F)$, APR

Communication

- System communication with grid operator, SCADA and inverters: 2 separate Ethernet parts with integrated switches for external communication; 10 BASE-T and 100 BASE-T(X)
- Communication protocols: Modbus / TCP, Modbus / UDP, FTP server, optional: IEC 61850, IEC 60870-5-101 / -104, DNP 3
- Alerts: Sending alarm message via the network to host and supervisory system.

COMBINER BOX

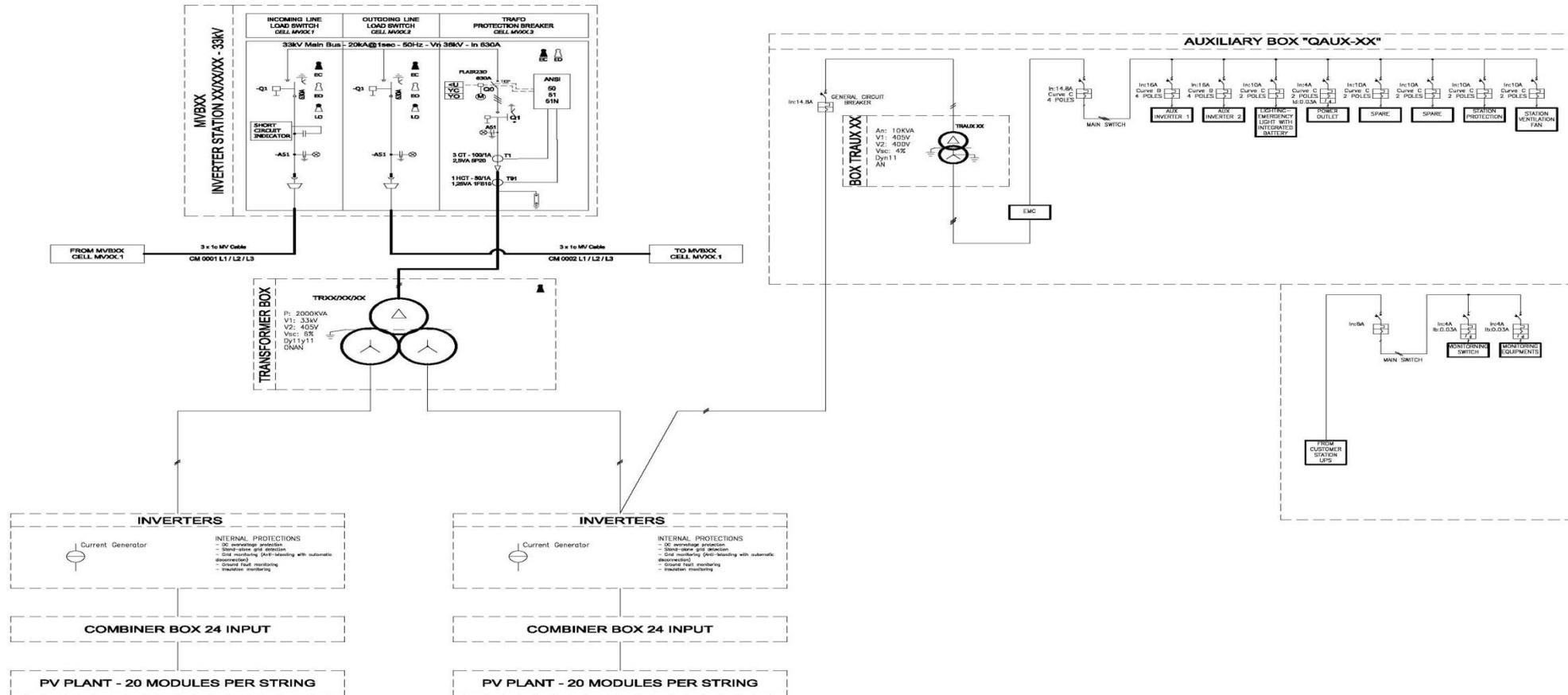


INVERTER STATION



INVERTER STATION SINGLE LINE

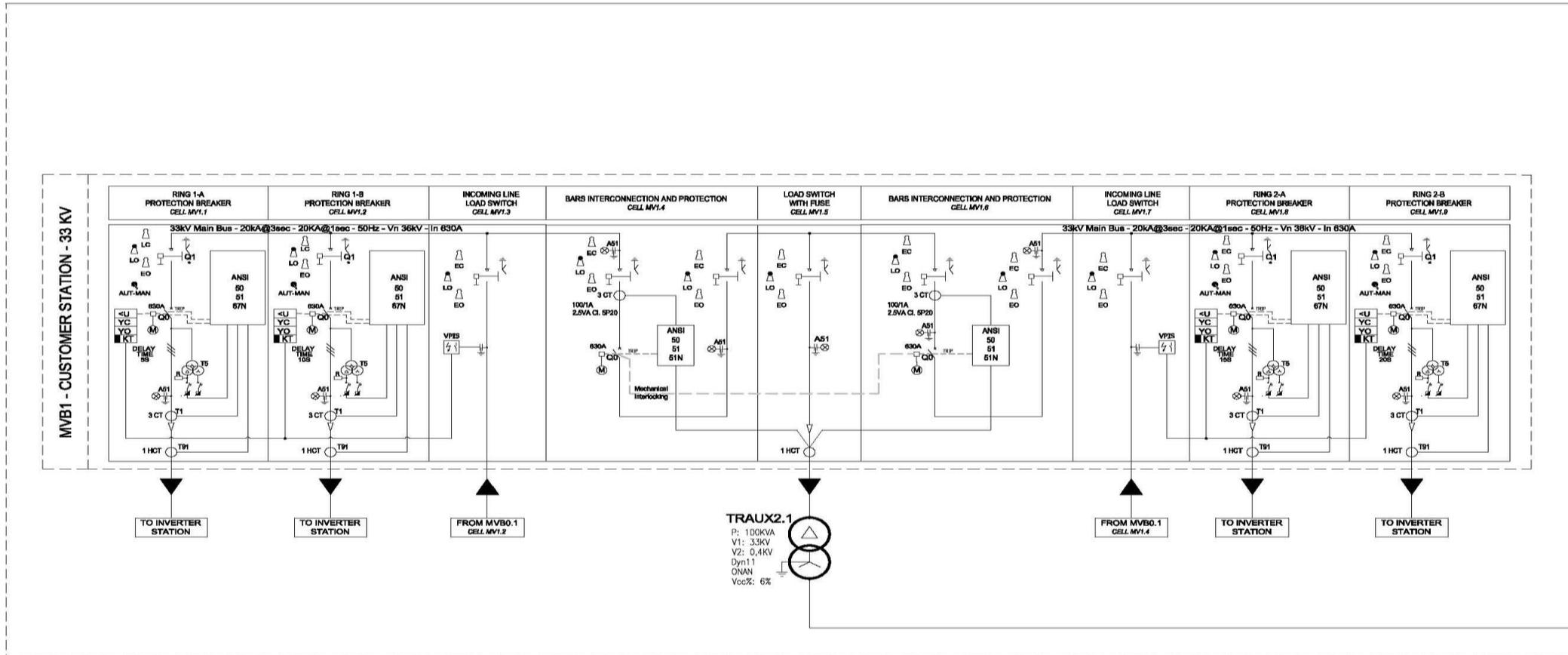
PHASE 1 - INVERTER STATION 1 TO 20



CUSTOMER STATION



CUSTOMER STATION SINGLE LINE



AREA SETTING OUT



PILLING



FRAMING



PANELING



TRENCH EXCAVATION



CABLE LAYING



MC4 CONNECTION AND 4MM² CABLE LAYING



MC4 CONNECTOR INSTALLATION



BACKFILLING OF DC CABLE LAYING

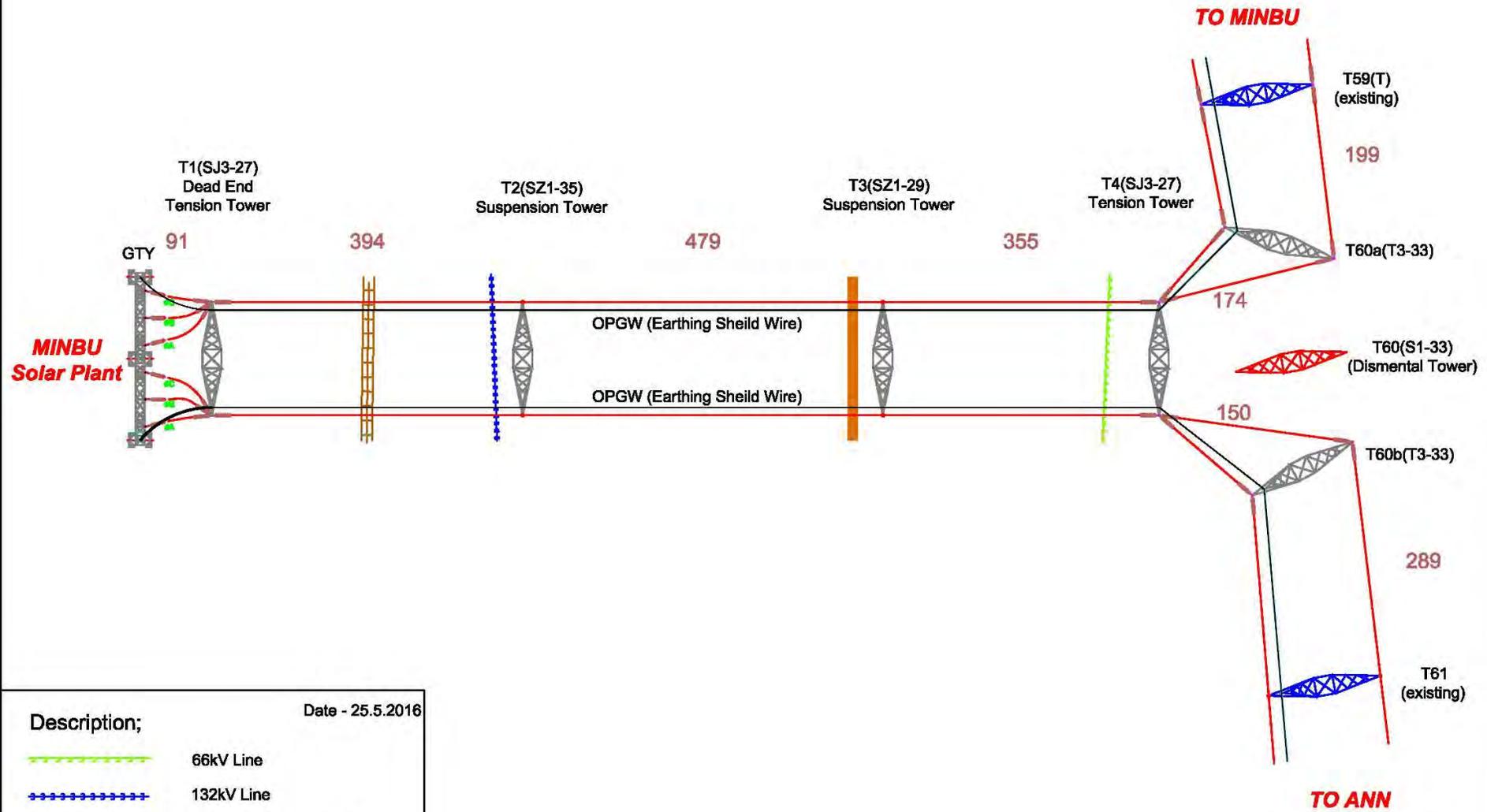
AC CABLE AND DC CABLE TERMINATION



220MW_{DC} MINBU SOLAR POWER PLANT

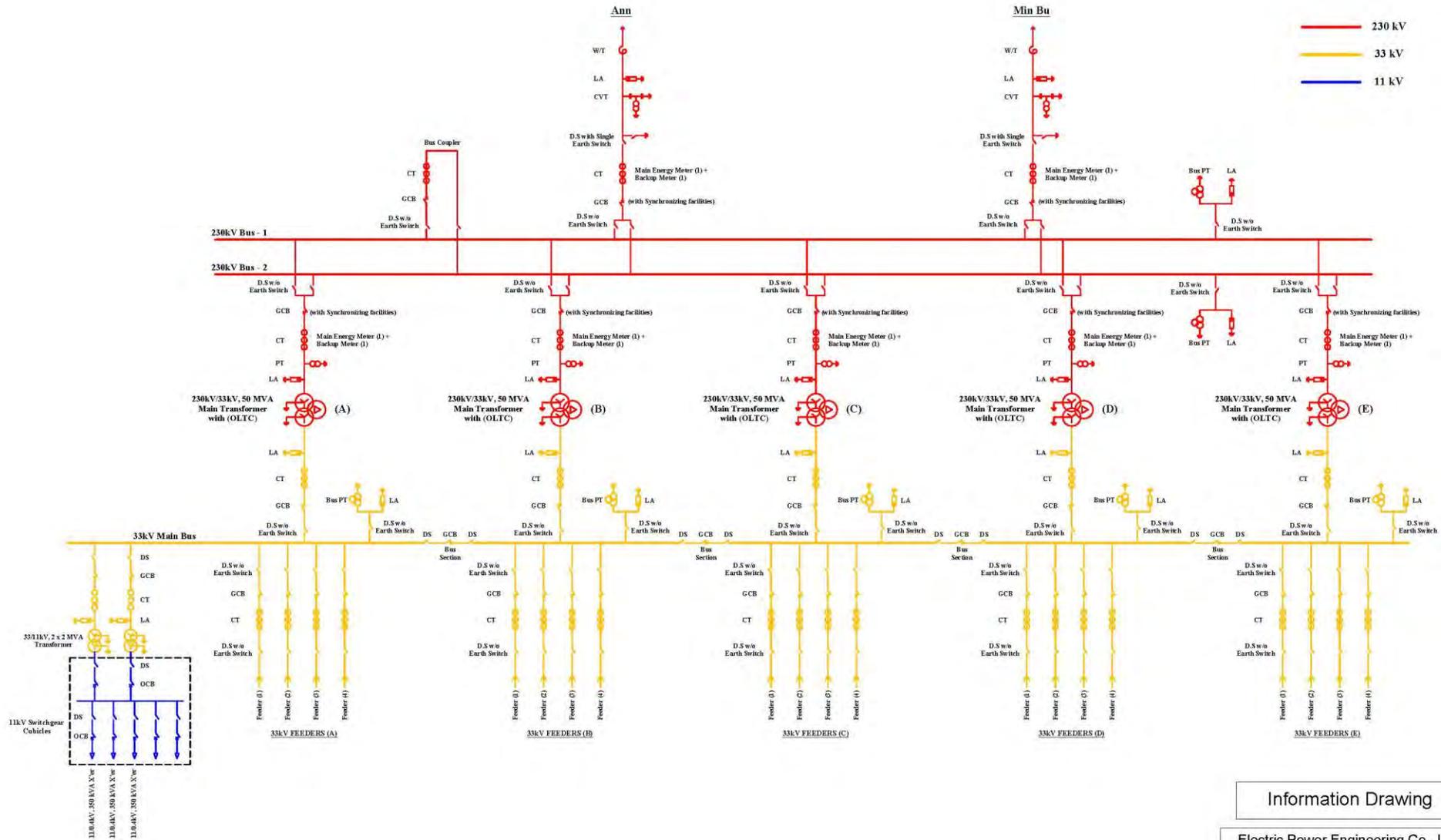
HHV SUBSTATION AREA

MINBU Solar Plant 230kV Transmission Line (IN & OUT) Project Plan



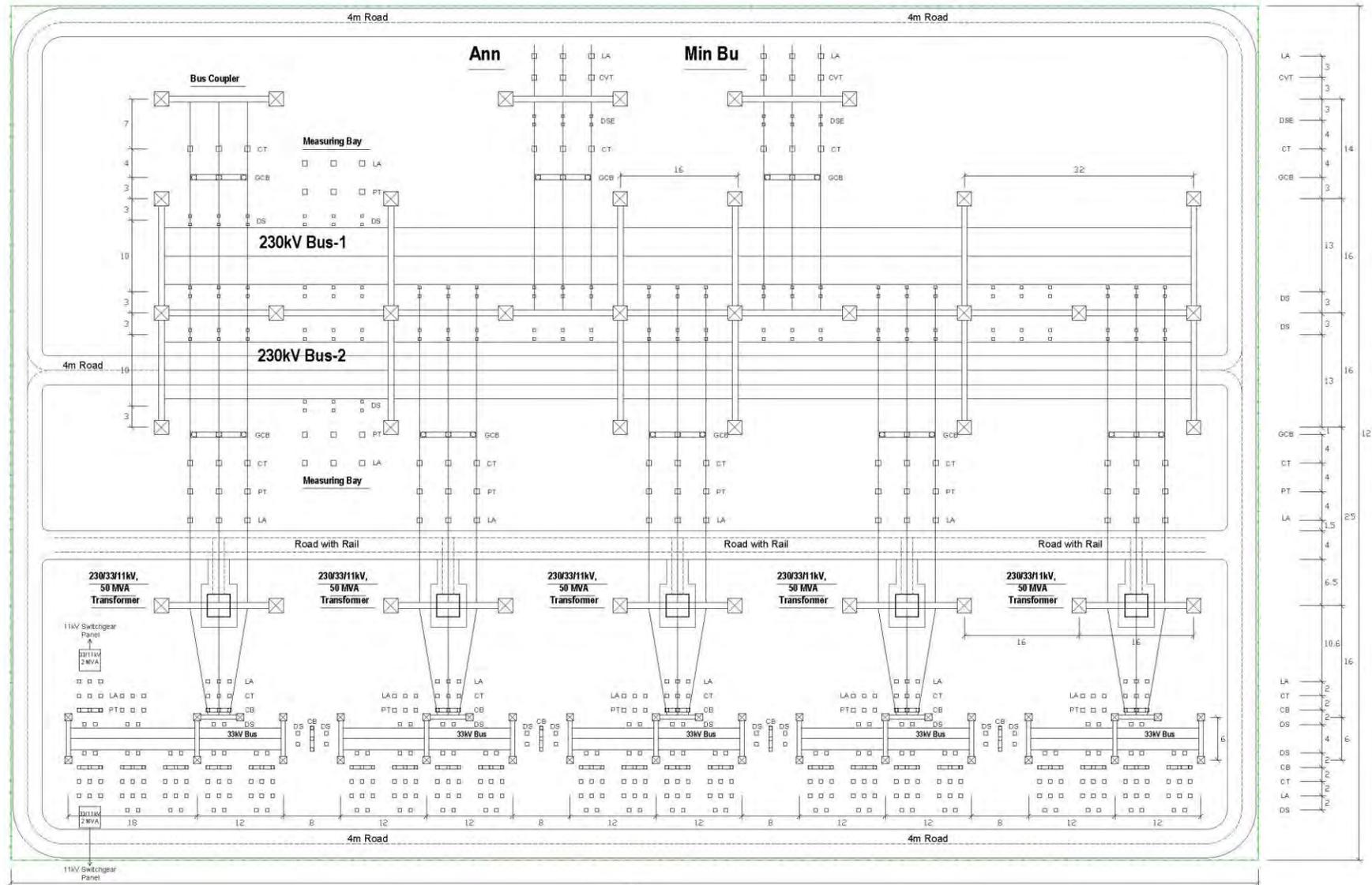
230/33 kV, 5 x 50 MVA Minn Bu Solar Plant Substation.

Single Line Diagram



Information Drawing

Electric Power Engineering Co., Ltd.	
Drawn By	Si Thu Aung
Approved By	Htay Myint
Drawing No.	001 / EPE

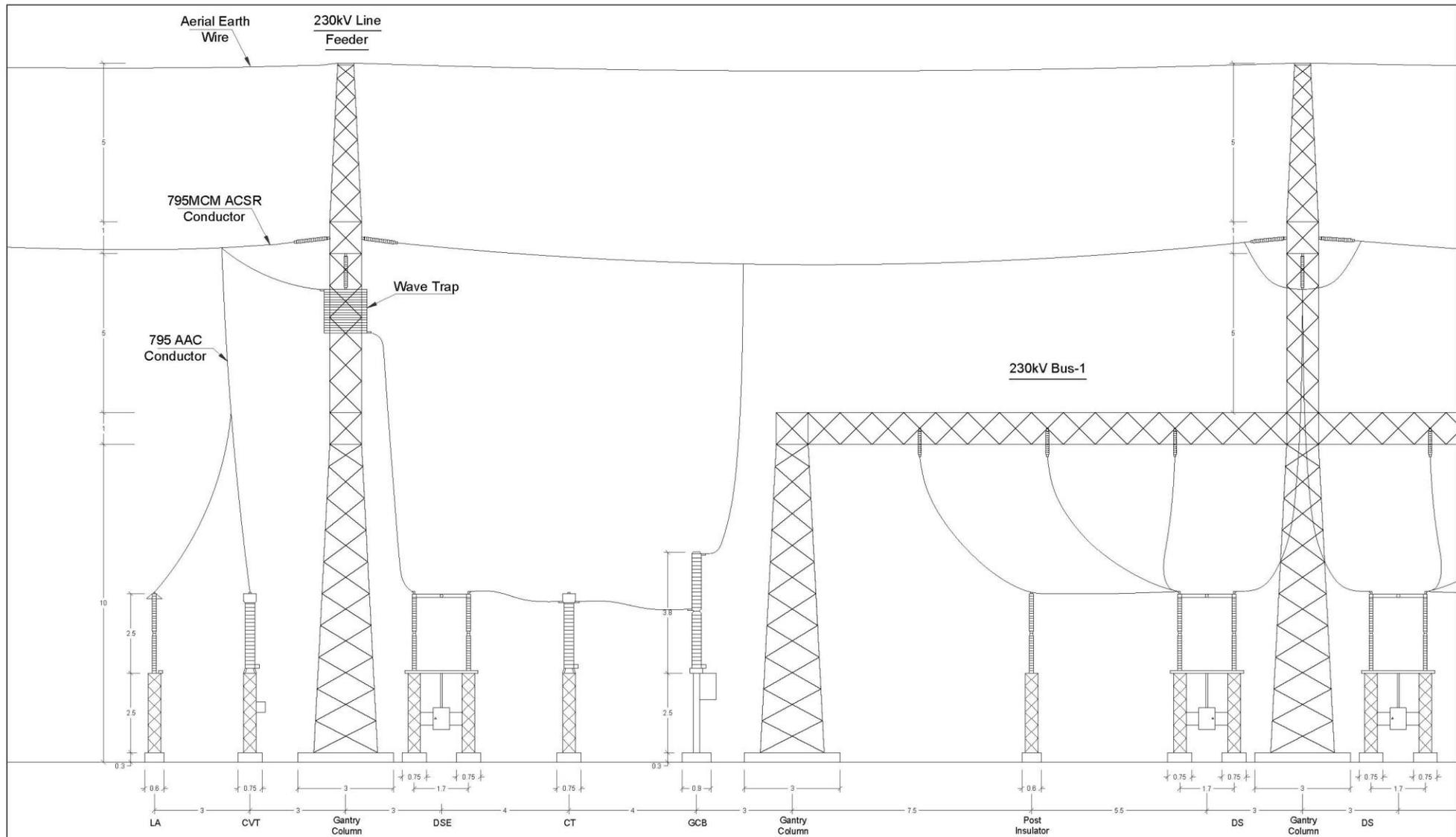


174

230/33 kV, 5 x 50 MVA Min Bu Solar Plant Substation
Switchyard Layout Plan

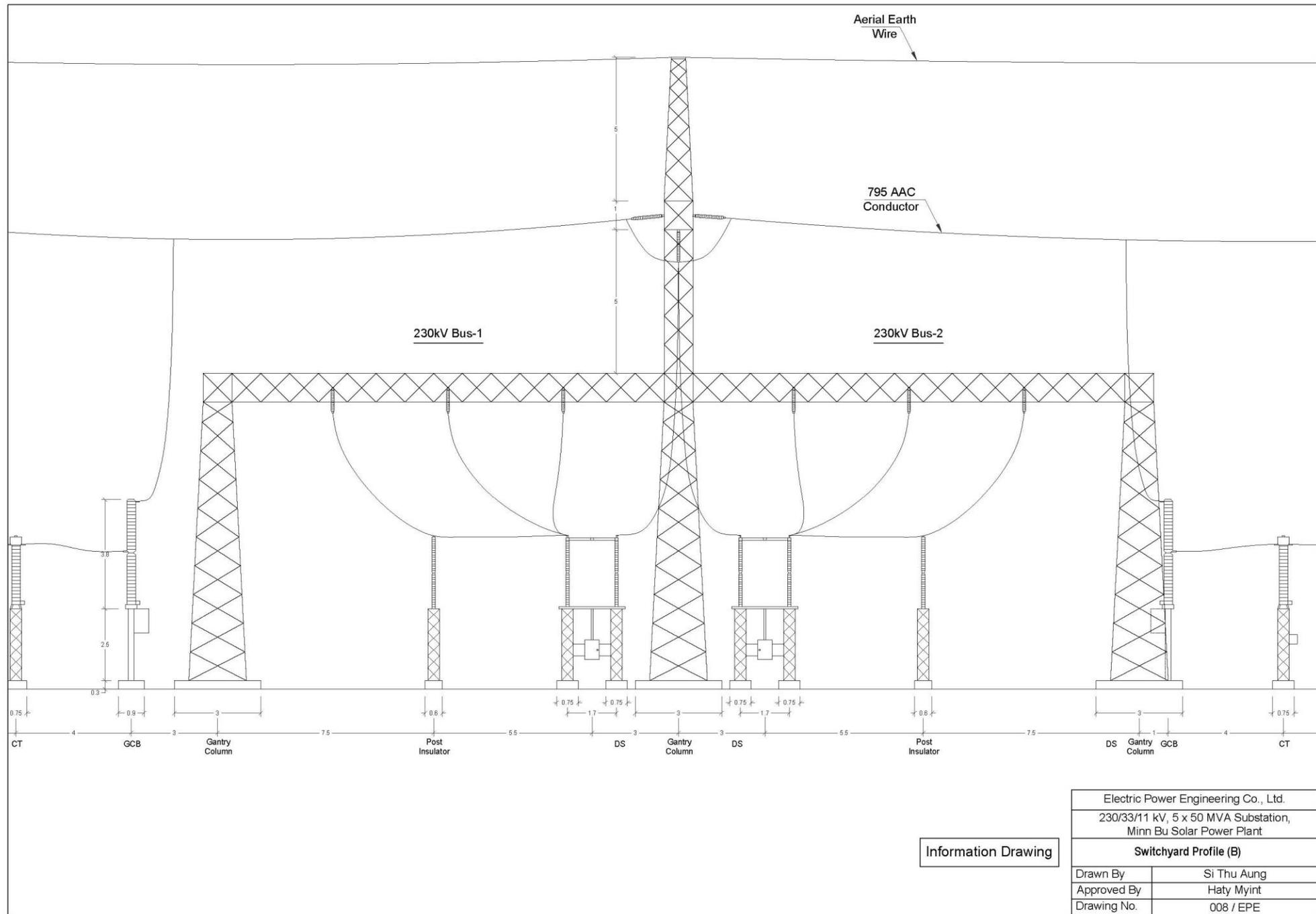
Information Drawing

Electric Power Engineering Co., Ltd.	
Drawn By	Si Thu Aung
Approved By	Htay Myint
Drawing No.	004 / EPE



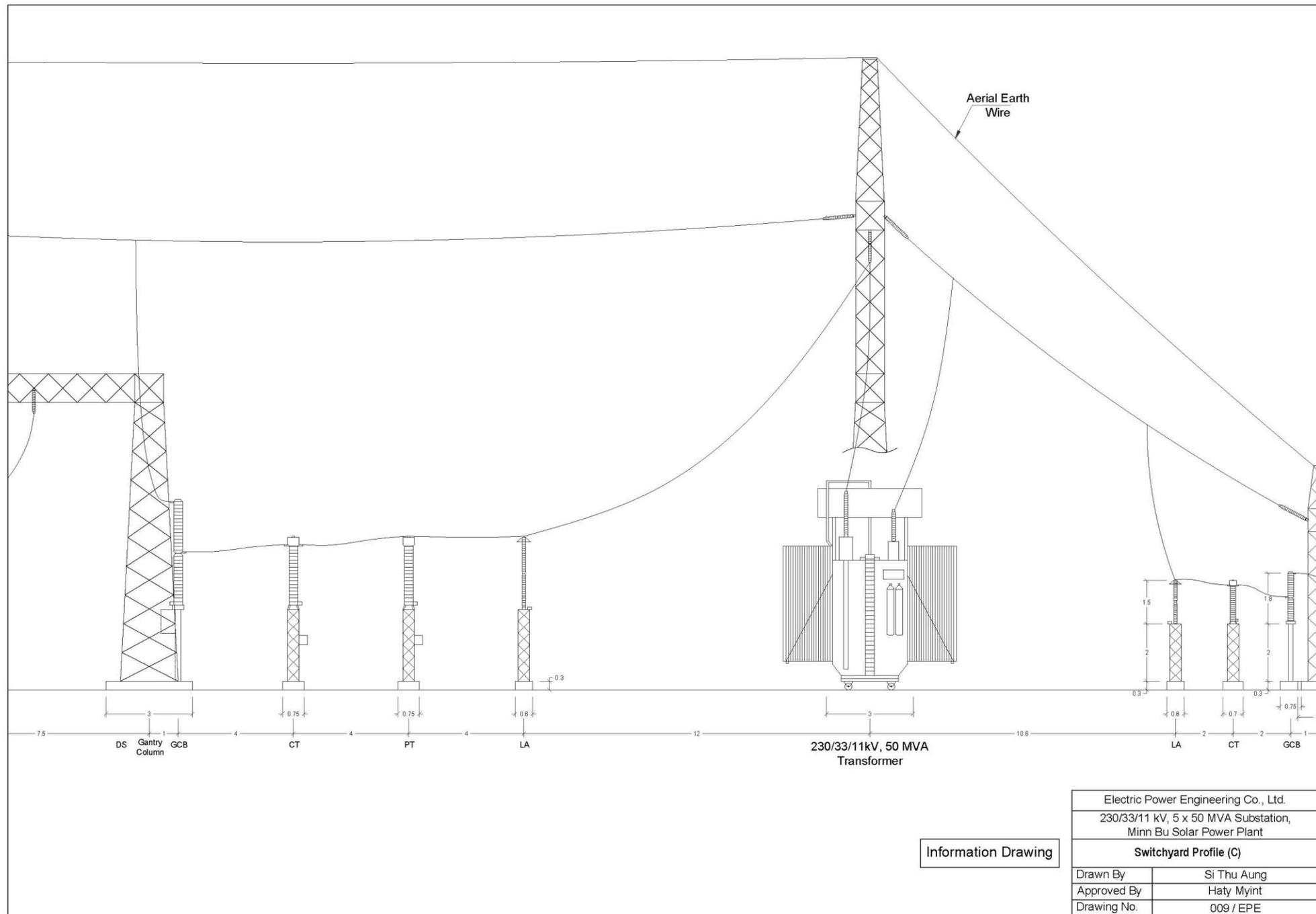
Information Drawing

Electric Power Engineering Co., Ltd.	
230/33/11 kV, 5 x 50 MVA Substation, Minn Bu Solar Power Plant	
Switchyard Profile (A)	
Drawn By	Si Thu Aung
Approved By	Haty Myint
Drawing No.	007 / EPE



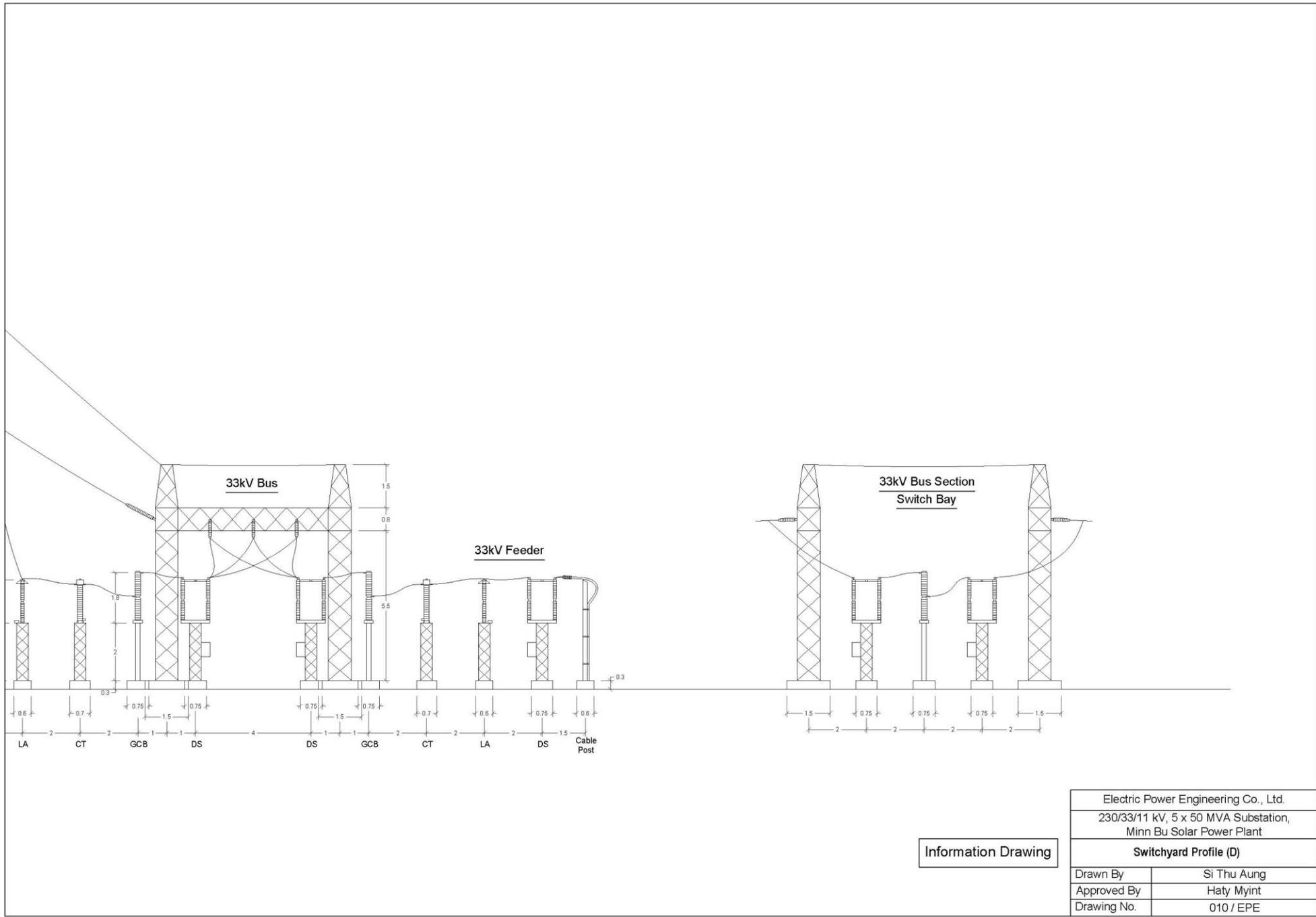
Information Drawing

Electric Power Engineering Co., Ltd.	
230/33/11 kV, 5 x 50 MVA Substation, Minn Bu Solar Power Plant	
Switchyard Profile (B)	
Drawn By	Si Thu Aung
Approved By	Haty Myint
Drawing No.	008 / EPE



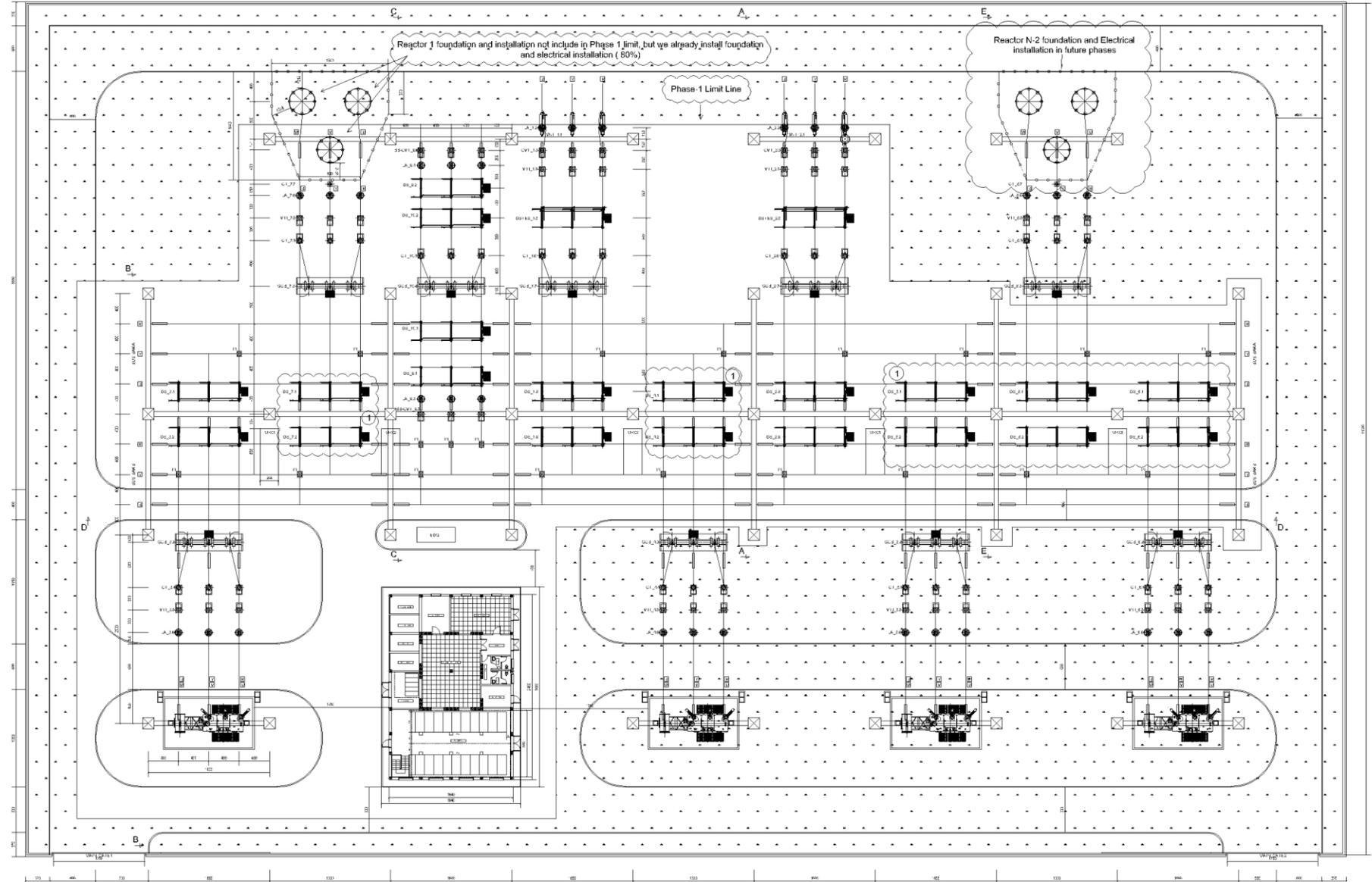
Information Drawing

Electric Power Engineering Co., Ltd.	
230/33/11 kV, 5 x 50 MVA Substation, Minn Bu Solar Power Plant	
Switchyard Profile (C)	
Drawn By	Si Thu Aung
Approved By	Haty Myint
Drawing No.	009 / EPE



Information Drawing

Electric Power Engineering Co., Ltd.	
230/33/11 kV, 5 x 50 MVA Substation, Minn Bu Solar Power Plant	
Switchyard Profile (D)	
Drawn By	Si Thu Aung
Approved By	Haty Myint
Drawing No.	010 / EPE



HHV SUBSTATION OVERVIEW



HHV SUBSTATION OVERVIEW



HHV SUBSTATION



HHV SUBSTATION



HHV SUBSTATION

HHV Area - Substation



Ann Bay

Mann Bay



Neat and Tidy work at 50MVA Transformer



2019 at 8:28 AM
A Transformer 1



Trench Cover Closing at HHV Area



Network: 13 May 2019 09:52:42 GMT+06:30
Local: 13 May 2019 09:52:41 GMT+06:30
Remark: Kyaw Thu QC Manager

HHV SUBSTATION



VDF & MDF PANEL



400V AUX PANEL



400V DISTRIBUTION PANEL (PC1)



DC DISTRIBUTION PANEL (PC2)

HHV SUBSTATION



11/0.4kV, 500kVA Transformer



33/11kV, 2MVA Transformer



SCADA & COMMUNICATION PANEL



BATTERY CHARGER

HHV SUBSTATION



11kV SWITCHGEAR



33kV SWITCHGEAR



BATTERY BANK



BATTERY BANK

Q & A

Thank You