



**Federation of Myanmar Engineering Society**

**Experience on Large Scale Solar Power Plants**

**Date- 27-7-2024**

**Presented By U SHWE  
BE(EP) 1977(Nov) PE 0063(BS)  
ACPE 00700/MM  
Fed-Mes Member – 020646 – M/EP**

# **TYPE OF SOLAR SYSTEM**

**GROUND MOUNTED FIXED TYPE SOLAR SYSTEM**

**GROUND MOUNTED HORIZONTAL SINGLE AXIS SOLAR TRACKING SYSTEM**

**GROUND MOUNTED DUAL AXIS SOLAR TRACKING SYSTEM**

**FLOATING MOUNTED SOLAR SYSTEM (FIXED TYPE)**

**ROOF TOP SOLAR SYSTEM**

GROUND MOUNTED **FIXED TYPE** SOLER SYSTEM



GROUND MOUNTED **DUAL AXIS** SOLAR TRACKING SYSTEM



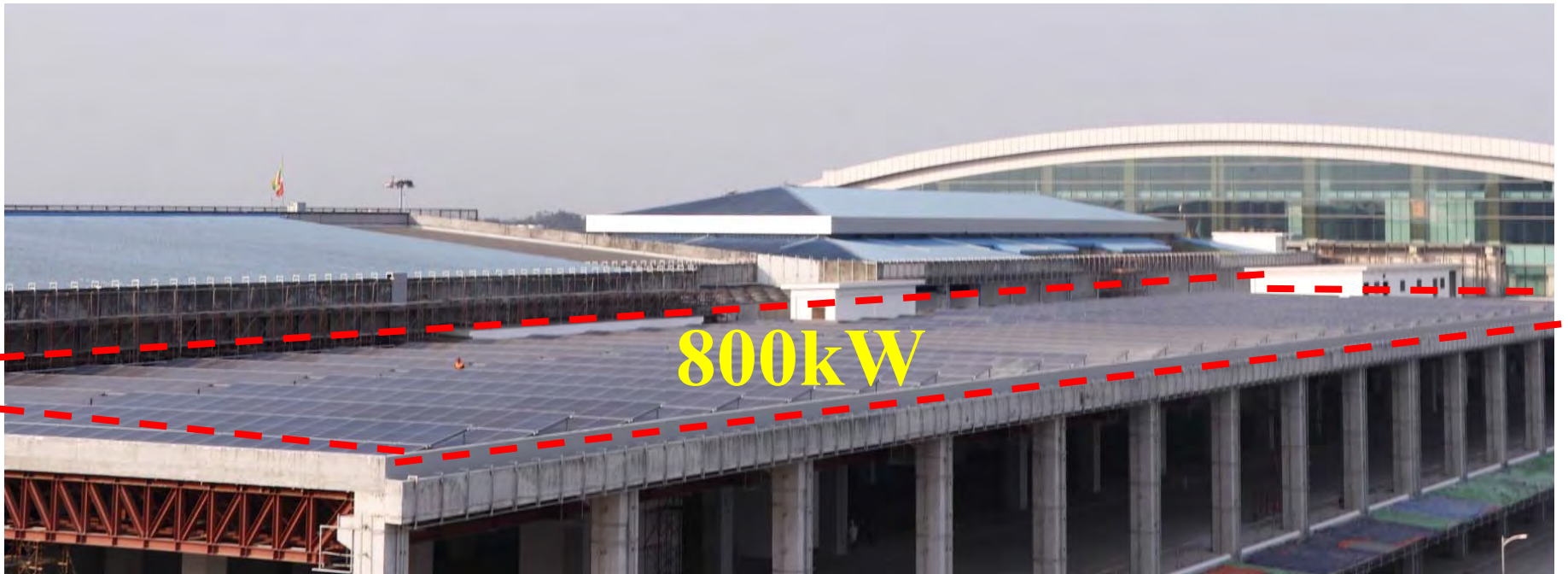
GROUND MOUNTED HORIZONTAL  
**SINGLE AXIS** SOLAR TRACKING SYSTEM



**FLOATING MOUNTED** SOLAR SYSTEM



## ROOF TOP SOLAR SYSTEM



# Solar power generation Projects



**1.30MW SOLAR POWER PLANT** GROUND MOUNTED HORIZONTAL SINGLE AXIS SOLAR TRACKING SYSTEM  
Strings Inverters

**2.20MW SOLAR POWER PLANT** GROUND MOUNTED HORIZONTAL SINGLE AXIS SOLAR TRACKING SYSTEM  
Strings Inverters

**3.30MW SOLAR POWER PLANT** GROUND MOUNTED HORIZONTAL SINGLE AXIS SOLAR TRACKING SYSTEM  
with 13.761MWh BESS  
Central Inverters

**4.30MW SOLAR POWER PLANT** GROUND MOUNTED HORIZONTAL SINGLE AXIS SOLAR TRACKING SYSTEM  
with 13.758 MWh BESS  
Strings Inverters

# 30MW GROUND MOUNTED SOLAR POWER PLANT

Project 1



Naypyitaw

January 15, 2023

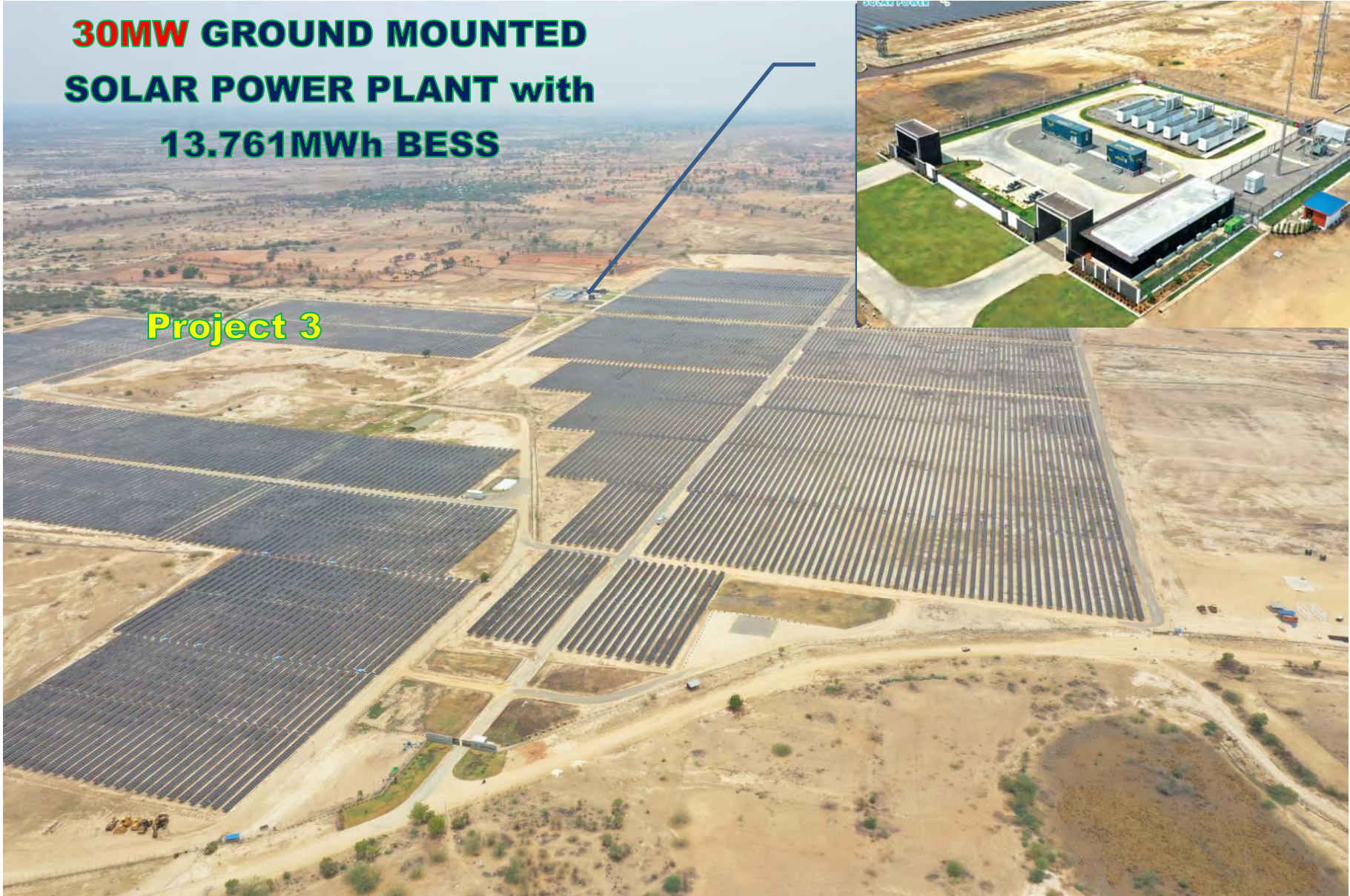
## 20MW GROUND MOUNTED SOLAR POWER PLANT

Project 2



**30MW GROUND MOUNTED  
SOLAR POWER PLANT with  
13.761MWh BESS**

**Project 3**





**30MW GROUND MOUNTED  
SOLAR POWER PLANT with  
13.761MWh BESS**

**Project 4**



# Important Points for Engineering

- (1) Geographic Location ( N, E )
- (2) Weather condition
- (3) Solar Energy Resources
- (4) System Voltage
- (5) Capacity limitation of regional Substation.
- (6) Install Capacity (A C)
- (7) Install Capacity (D C)
- (8) Geotechnical Information
- (9) Project area preparing of design requirement
- (10) Electrical Design Standards
- (11) Selection of main equipment
- (12) Solar Panel arrangement
- (13) Power House

- (14) Transmission Line**
- (15) Receiving Main Power Station**
- (16) Solar Control System**
- (17) Testing sequences and power energizing to Box-type transformer**
- (18) How to Synchronize Solar power generating to Grid system**
- (19). How to control entire Solar Power generation system**
- (20) Bracket type selection of Photovoltaic Array depends on fixed or tracker**
- (21) BESS(Battery Energy Storage System)**
- (22) Battery Rack Container Construction Images**
- (23) SCADA Home screen and Monitoring Screens**
- (24) Other System in Solar plants**
- (25) Implementations and Construction Process**

# Important Points for Engineering

## (1) Geographic Location ( N, E )

**Project ( 1 )**

(20° 58' 39.33"N, 96° 0' 45.20"E)

**Project (2 )**

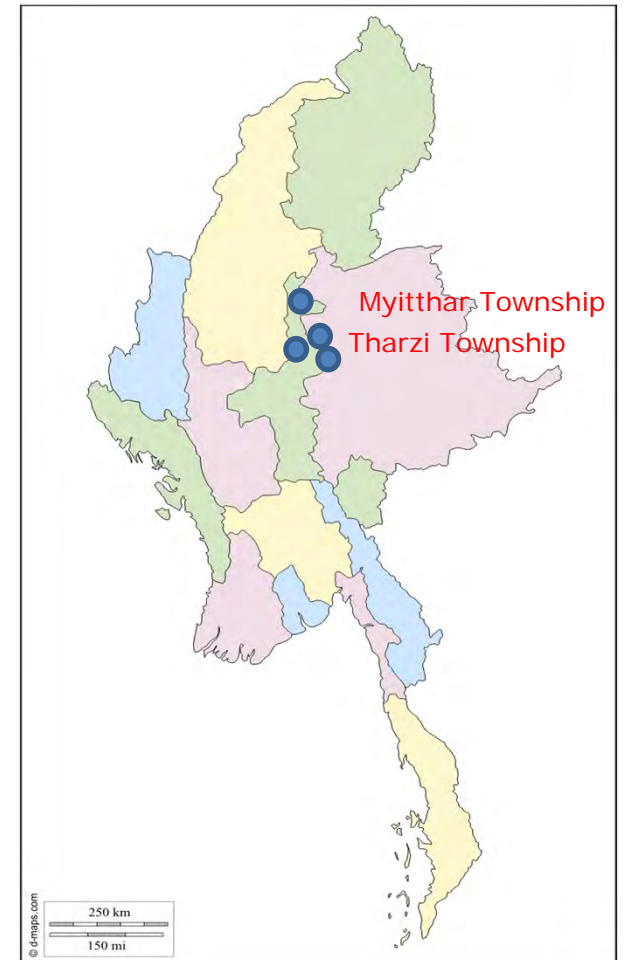
(21° 30' 10" N, 96° 14' 56" E)

**Project ( 3 )**

(20° 98' 10" N, 96° 02' 56" E)

**Project ( 4 )**

(20° 51' 33.8" N, 96° 03' 21.04" E)



## (2) Weather condition

**Weather Station (project 1)**



**Weather Station (project 2 )**



### **Weather station**

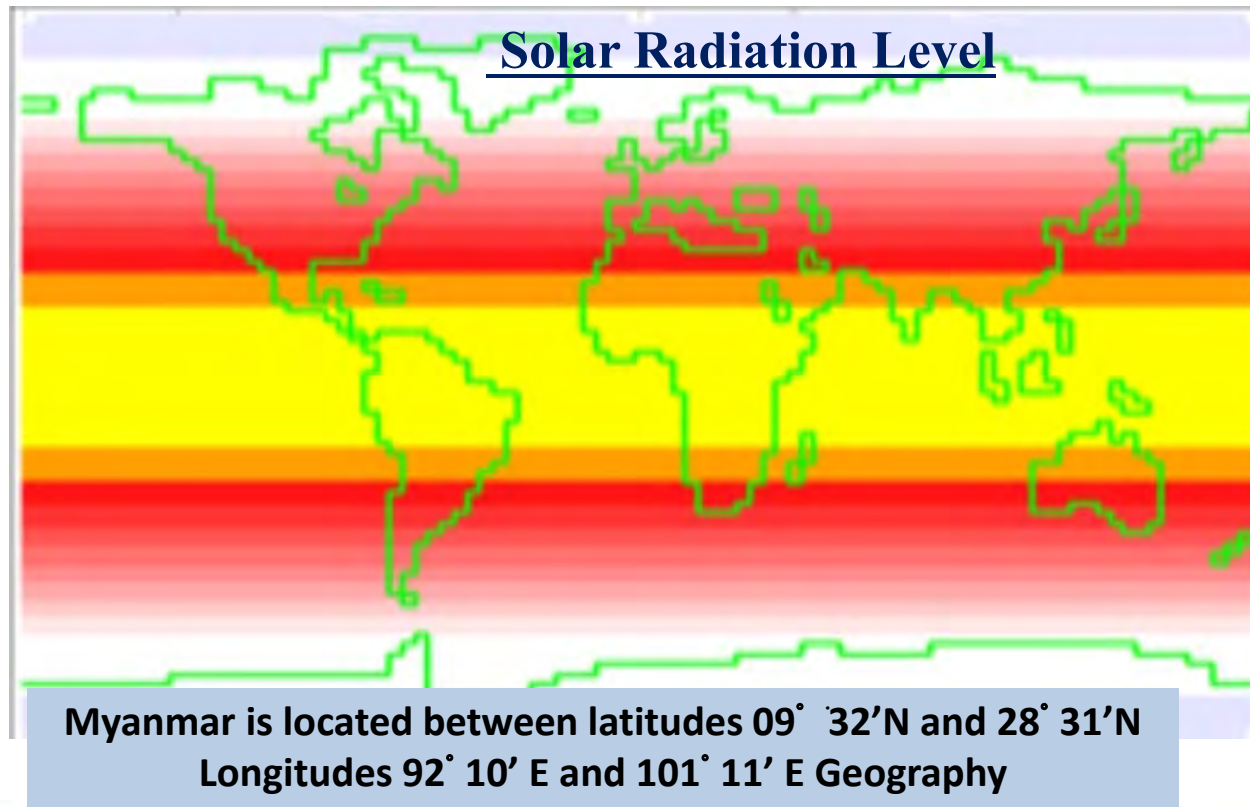
- Global horizontal irradiance (GHI)
- Plane of the array irradiance (POA)
- Ambient temperature
- Wind direction and wind speed
- Humidity
- Atmospheric pressure, etc.

## Weather Status Show on SCADA system



### (3) Solar Energy Resources

Study about annual average horizontal global radiation and diffuse radiation of project area.

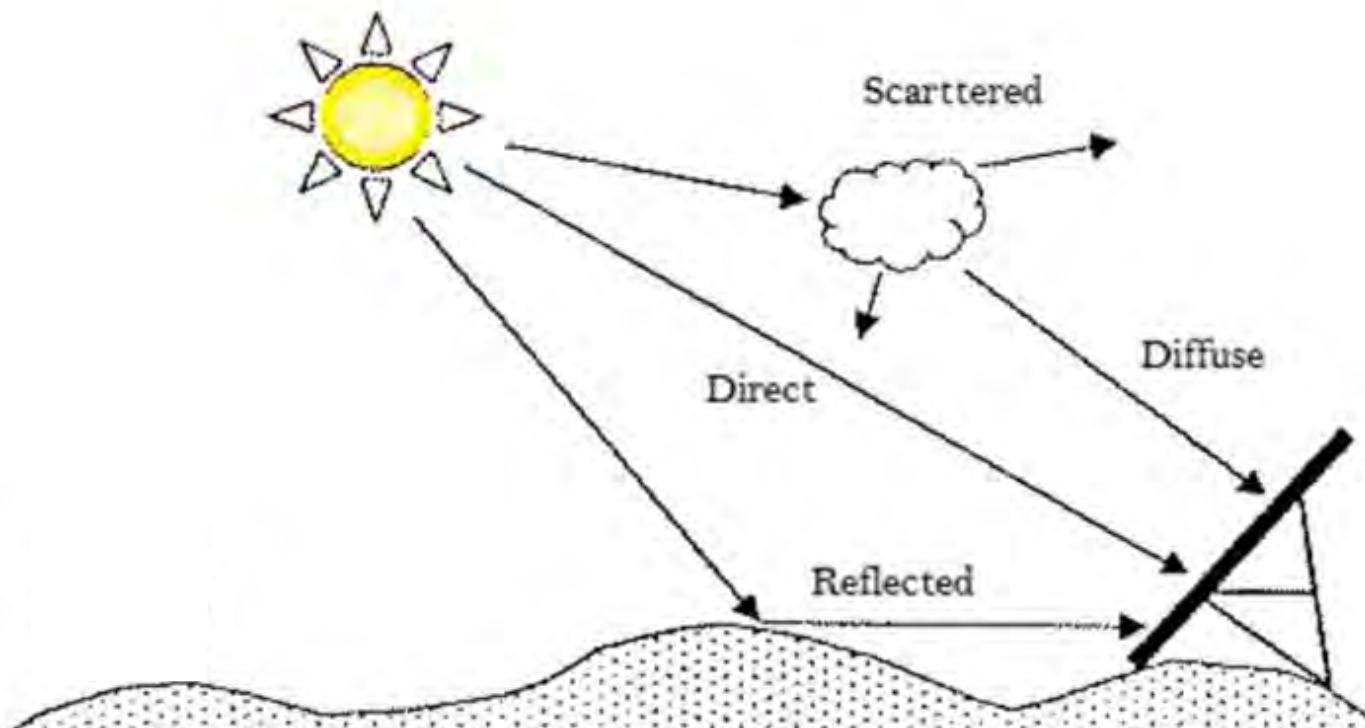


### Monthly Average Solar Radiation Level at project site(project 1)

	Global Horizontal (kWh/m2)	Diffuse Horizontal (kWh/m2)	T_Amb °C
January	147.40	42.04	21.68
February	144.2	52.15	23.79
March	172.1	71.13	27.64
April	178.0	83.14	30.82
May	178.5	91.68	29.11
June	163.0	91.74	27.78
July	153.5	92.11	27.62
August	134.2	85.82	27.58
September	144.9	79.73	27.20
October	148.6	68.25	27.20
November	140.00	43.45	24.38
December	146.30	32.42	22.14
Year	1850.5	833.69	26.42

**Solar irradiation (1850.5kwh/m2 and 833kwh/m2 respectively)**

## Direction of irradiation



#### (4) System Voltage

Consider on project region's substation

33kV

#### (5) Capacity limitation of regional Substation.

Consider on project region's substation requirement.

30MW

#### (6) Install Capacity (A C)

Design on project region's substation requirement.

30MW

20MW

30MW+3 MW BESS

30MW+3 MW BESS

#### (7) Install Capacity (D C)

Photovoltaic panel capacity (DC)

37.27MW

25.06MW

40.88MW

40.88MW

## (8) Geotechnical Information

**-Topography of project site is relatively**

**Flat(or )**

Not Flat Land

**Farmland (or)**

Not Farmland

**Hill (or)**

Included hill

**Others Terrain**

**-Altitude**

Included hill, Valley and waste un-agriculture lands

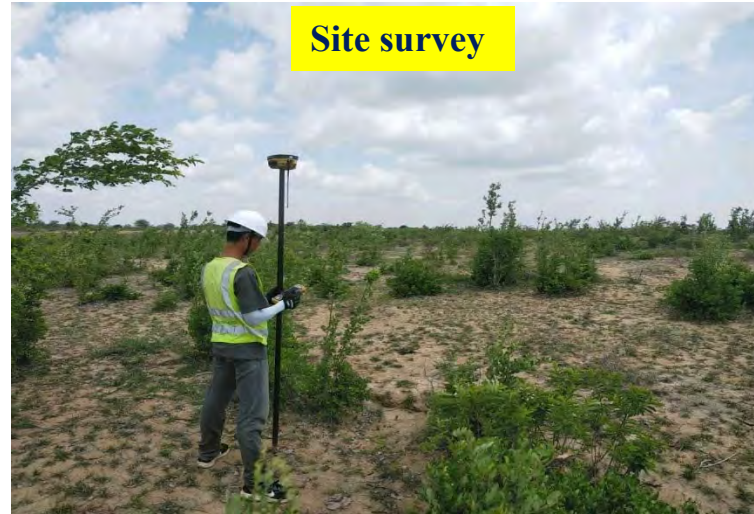
Need to Support all data to designer.

## (9) Project area preparing of design requirement

**Project 1 view before starting the project**



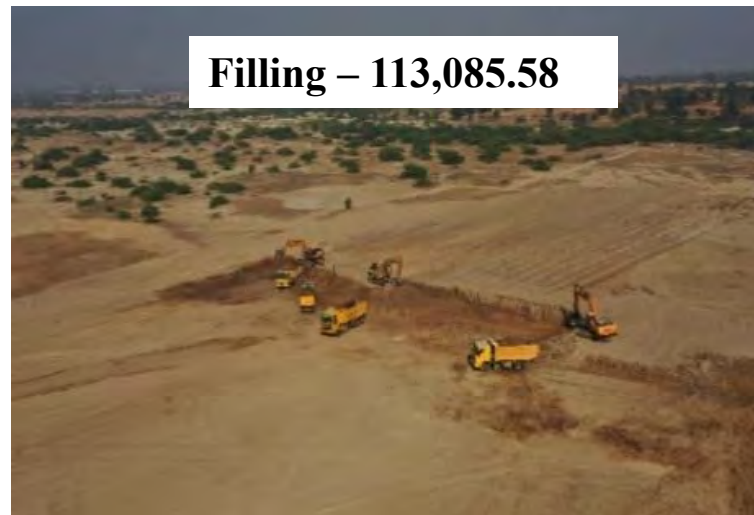
**Site survey**



**Cutting – 133,133.93 m3**



**Filling – 113,085.58**



## Project Site implementation



## (10) Electrical Design Standards

### (10.1) Main design Standards and Codes (IEC standard)

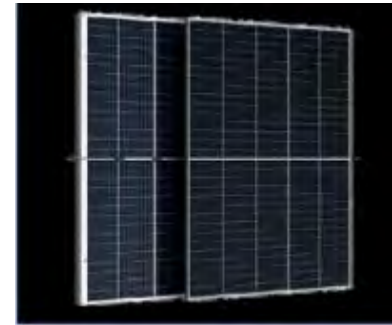
- IEC 61836, 2007 Ed 3, IEC/TS 61836 Ed. 3.0, Solar photovoltaic energy systems - Terms, definitions and symbols.
- IEC 60891, 2009 Ed 2, IEC 60891 Ed. 2.0, Photovoltaic devices - Procedures for temperature and irradiance corrections to measured I-V characteristics.
- IEC 60904-1, 2006 Ed 2, Photovoltaic devices-Part 1: Measurements of PV current-voltage characteristics.
- IEC 60904-2, 2007 Ed 2, Photovoltaic devices-Part 2: Requirements for reference solar devices.

- IEC 60904-3, 2008 Ed 2, Photovoltaic devices-Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data
- IEC 60904-4, 2009 Ed 1, Photovoltaic devices-Part 4: Reference solar devices - Procedures for establishing calibration traceability
- IEC 60904-5, 2011 Ed 2.0, IEC 60904-5 Ed. 2.0, Photovoltaic devices-Part 5: Determination of the equivalent cell temperature (ECT) of photovoltaic (PV) devices by the open-circuit voltage method.
- IEC 60904-7, 2008 Ed 3, Photovoltaic devices-Part 7: Computation of the spectral mismatch correction for measurements of photovoltaic devices.
- IEC 60904-8, 1998 Ed 3, IEC 60904-8 Ed. 3.0 Photovoltaic devices - Part 8: Measurement of spectral response of a photovoltaic (PV) device
- IEC 60904-9, 2007 Ed 2, Photovoltaic devices -Part 9: Solar simulator performance requirements.
- IEC 60904-10, 2009 Ed 2, Photovoltaic devices -Part 10: Methods of linearity measurement.

- 
- IEC 61215, 2005 Ed 2.0: Scope of the work in progress includes design qualification and type approval for crystalline silicon terrestrial PV module, Ed 3; publish 4Q 2011.
  - IEC 61345, 1998 Ed 1, UV test for photovoltaic (PV) modules.
  - IEC 61646, 2008 Ed 2, Thin-film terrestrial photovoltaic (PV) modules - Design qualification and type approval.
  - IEC 61701: 1995 Ed 1.0: Scope of the work in progress includes salt mist corrosion testing of PV modules for Edition 2; publish 4Q 2010.
  - IEC 61730-1: 2004 Ed 1.0: Scope of the work in progress includes PV module safety qualification requirements for construction for Part 1/Amendment 1; publish 4Q 2010.
  - IEC 61730-2, 2004 Ed 1, Photovoltaic (PV) module safety qualification-Part 2: Requirements for testingÂ Amendment 1 in process; publish 2Q 2011.
  - IEC 61829, 1995 Ed 1.0: Scope of the work in progress includes on-site measurement of I-V characteristics for crystalline silicon PV array, Ed 2; publish 1Q 2011.
  - IEC 61853-1: Ed 1.0: Scope of the work in progress includes irradiance and temperature performance measurements and power rating for PV module performance testing and energy rating, Part 1; publish 1Q 2011.

## (10.2) Electrical Primary

- Total install capacity on the AC( Alternative Current)
- Total Install capacity on the DC (Direct Current) depends on Solar specification



### Project 1 ( 30MW)

SY#P rqxch  
 Eudgg#Qdp h #Wulqd  
 Pd{lp xp #Srzh#S#p d{,# 778Z "6 (  
 W|sh #Elidfld#p rqrfu|wdolgh#vldfrq  
 Glp hqvlrq #4373{5444{63p p  
 Wrwdg#Txdqwlw| #;6:85#Sfv1

GF#Fdsdflw|#@#778{#;6:85,#@#6:15:P Z

### Project 2 (20MW)

SY#P rqxch  
 Eudgg#Qdp h #Wulqd  
 Pd{lp xp #Srzh#S#p d{,# 878Z  
 W|sh #Elidfld#p rqrfu|wdolgh#vldfrq  
 Glp hqvlrq #43<9{56;7{#68p p  
 Wrwdg#Txdqwlw| #78<;3#Sfv

GF#Fdsdflw|#@#878{#78<;3,#@#58139#P Z

**Project1**  $37.27\text{MW}/30\text{MW} = 1.24$

**Project2**  $25.06\text{MW}/20\text{MW} = 1.25$

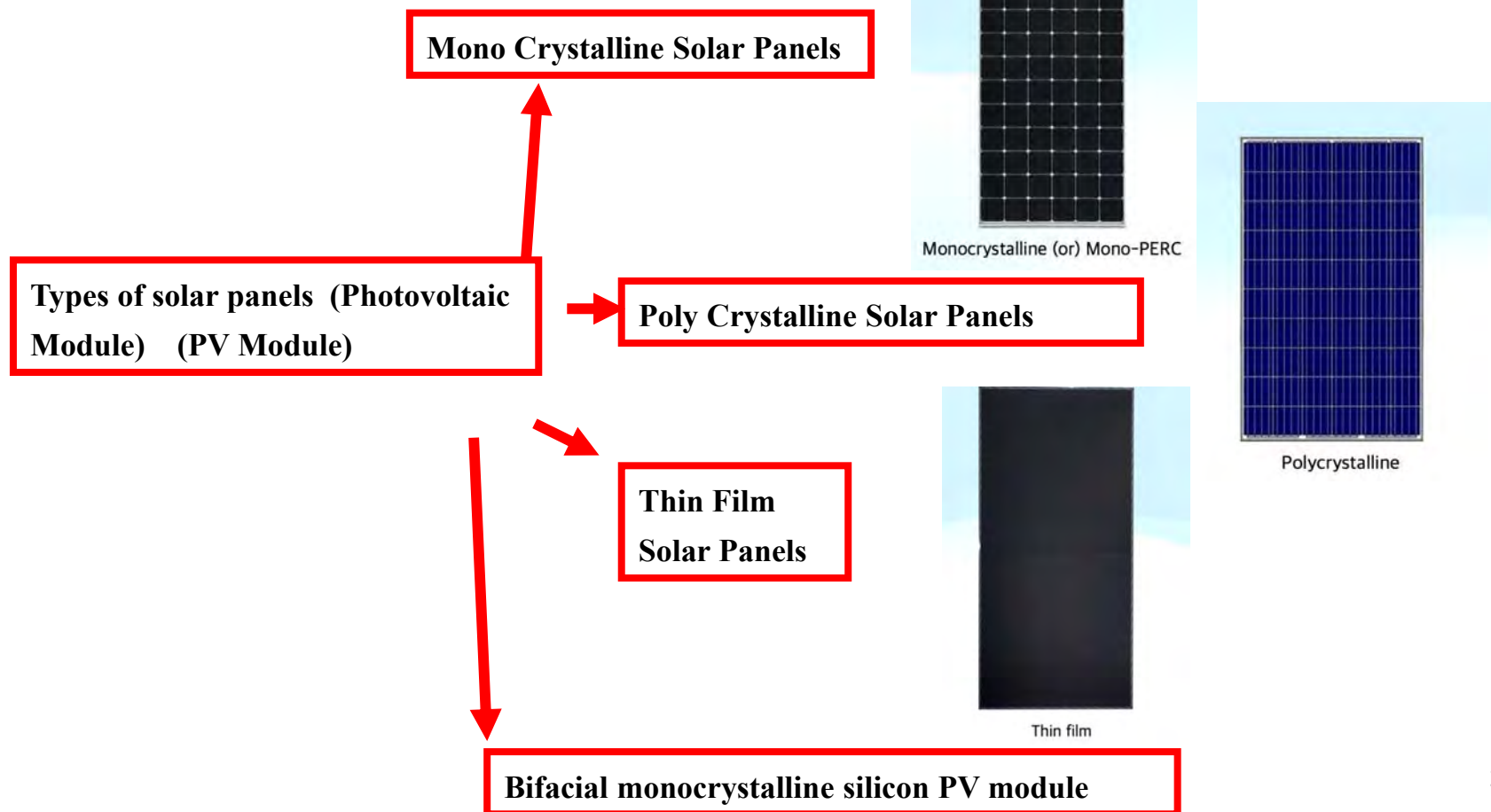
**Project3**  $40.88\text{MW}/33\text{MW} = 1.24$

**Project4**  $40.88\text{MW}/33\text{MW} = 1.24$

**DC install capacity(PV module) should be install about~25% more than AC capacity**

## (11) Selection of main equipment

### Solar Panels (Photovoltaic Module) (PV Module)



### (11.1) PV Module selection



Morning

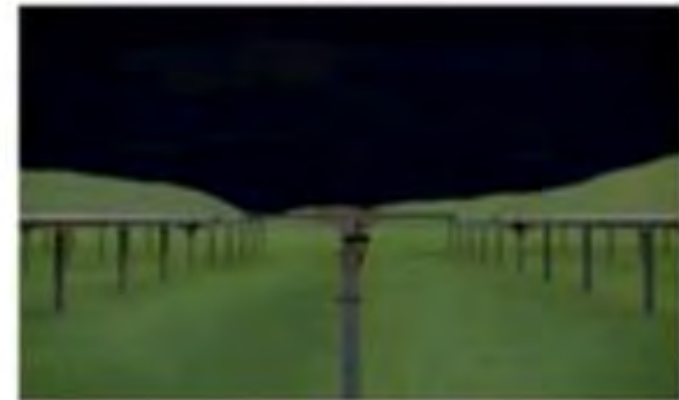


Afternoon

### Bifacial photovoltaic Module ( Bifacial Solar Panel)

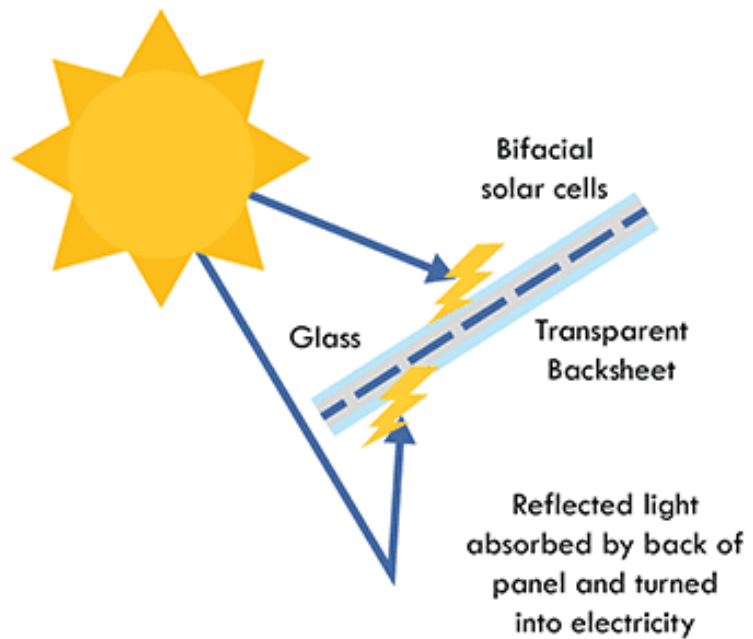


Noon

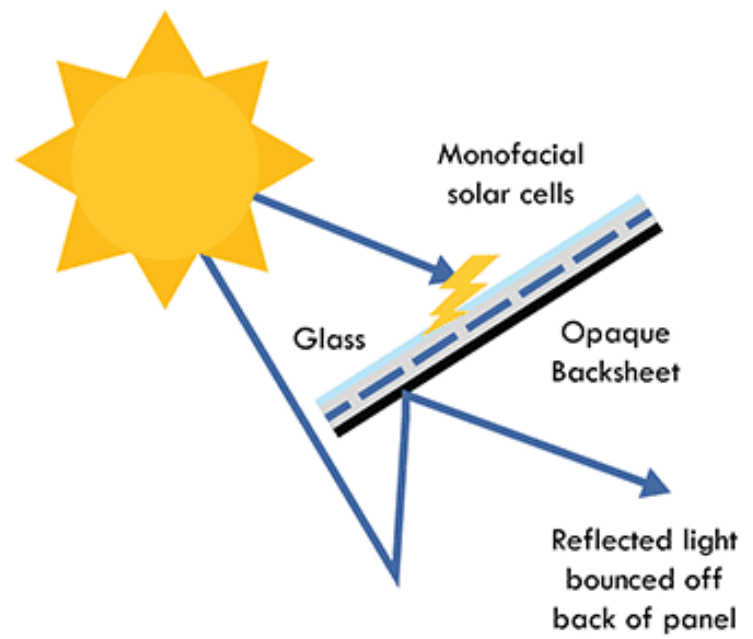


Evening

### Bifacial Solar Panel



### Monofacial Solar Panel



## Solar Panels Record photos



## Data of Solar panels of four projects

Project	Product Name	Watt (W)	Open circuit Volt (Voc)	Voltage at Pmax (Vmax)	Current at Pmax (Imp)	Short circuit current (Isc)	Maximum System Voltage (V) dc	Total Qty	Unit generation milKWh	Install DC watt (MW)
<b>Project ( 1 )</b> (30MW)	Trina	445	49.3	41.1	10.75	11.32	1500	83752	66	37.27
<b>Project ( 2 )</b> (20MW)	Trina	545	49.3	37.9	17.2	18.0	1500	45980	45	25.06
<b>Project ( 3 )</b> (33MW)	Longi	550	49.8	41.95	13.12	13.99	1500	74340	74	40.887
<b>Project ( 4 )</b> (33MW)	Longi	550	49.8	41.95	13.12	13.99	1500	74340	74	40.887

LR5-72HBD-550M



WARNING ELECTRICAL HAZARD

Tested to IEC 61215: 2016 and IEC 61730: 2016

STC: AM1.5 1000W/m<sup>2</sup> 25°C

Rated Maximum Power (P<sub>max</sub>) 550 W

Power Tolerance 0 ~ 3%

Voltage at P<sub>max</sub> (V<sub>mp</sub>) 41.95 V

Current at P<sub>max</sub> (I<sub>mp</sub>) 13.12 A

Open-Circuit Voltage (V<sub>oc</sub>) 49.80 V

LONGI

LR5-72HBD-550M  
WARNING ELECTRICAL HAZARD  
Tested to IEC 61215: 2016 and IEC 61730: 2016

STC: AM1.5 1000W/m<sup>2</sup> 25°C  
Rated Maximum Power (P<sub>max</sub>) 550 W  
Power Tolerance 0 ~ 3%  
Voltage at P<sub>max</sub> (V<sub>mp</sub>) 41.95 V  
Current at P<sub>max</sub> (I<sub>mp</sub>) 13.12 A  
Open-Circuit Voltage (V<sub>oc</sub>) 49.80 V

Short-Circuit Current (I<sub>sc</sub>) 13.99 A  
Voc & Isc Tolerance ±3%  
Maximum System Voltage 1500 V  
Maximum Series Fuse Rating 30A  
Operating Temperature -40°C ~ +85°C  
Protection Class Class II

LONGI Green Energy Technology Co., Ltd.  
No. 388, Middle Hangtian Road, Chang'an District,  
Xi'an, Shaanxi 710100, P. R. China



Short-Circuit Current (I<sub>sc</sub>) 13.99 A

Voc & Isc Tolerance ±3%

Maximum System Voltage 1500 V

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Xi'an, Shaanxi 710100, P. R. China

www.longi.com

Made in China

**Trinasolar**

TSM-445DEG17MC.20(II)



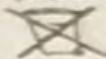
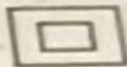
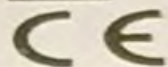
**12**

Maximum Power(P <sub>max</sub> )	445W±3%*
Maximum Power Voltage(V <sub>mp</sub> )	41.4V
Maximum Power Current(I <sub>mp</sub> )	10.75A
Open Circuit Voltage(V <sub>oc</sub> )	49.3V±3%*
Short Circuit Current(I <sub>sc</sub> )	11.32A±5%*
Maximum Series Fuse	20A
Power Selection	0~5W
Maximum System Voltage	IEC1500V
Electrical Rating At STC	AM1.5 1000W/m <sup>2</sup> T <sub>c</sub> =25°C

\*(Considering LID, the power range of the certification authority)  
For field connections, use minimum 4mm<sup>2</sup> (No. 12AWG) copper wires insulated for a minimum 150°C.

**WARNING-ELECTRICAL HAZARD**

This module produces electricity when exposed to light.  
Follow all applicable electrical safety precautions.



RoHS COMPLIANT

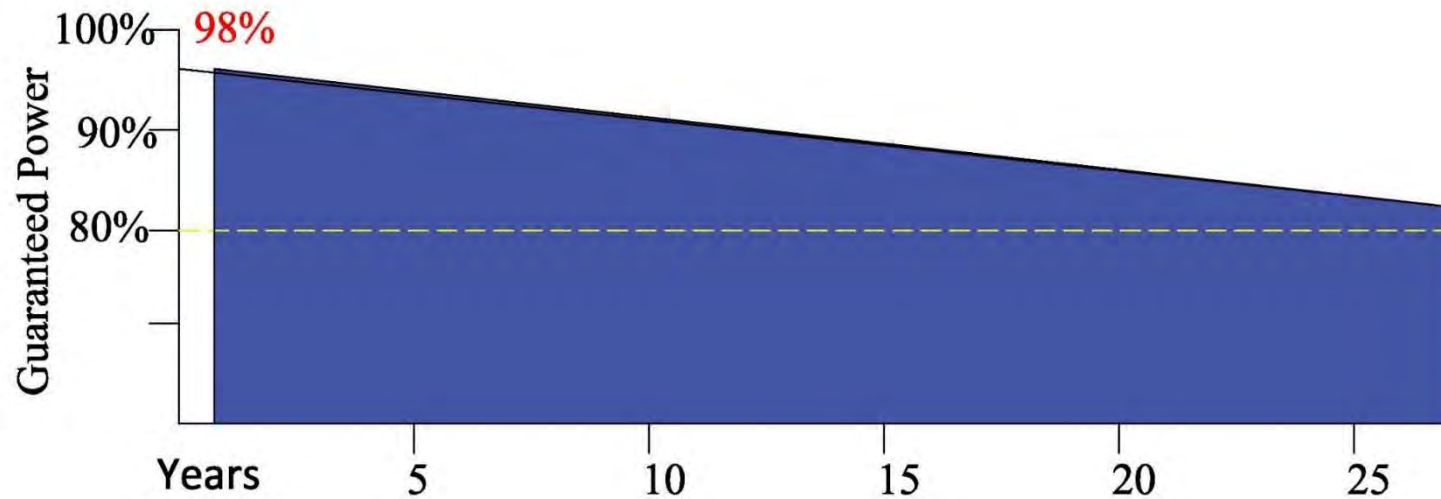
No.2 TianHe Road, Trina PV Industrial Park, New District, Changzhou  
City, Jiangsu Province 213031, P. R. China

Trina Solar Co., Ltd.

[www.trinasolar.com](http://www.trinasolar.com)

Made in China

# Solar Panel Life



## Advantages of bifacial solar panel

1. Photovoltaic Panel are bifacial solar panel, it is not one face solar panel.
2. Back side of solar panel also produce energy by reflected radiation from ground.
3. **30% more efficiency than one sided solar panel.**

# Power generation Estimate

Power generation Estimate for 1 ~ 10 years

Year	Estimated Contracted Capacity	Estimated Contractor Energy				
	Indicative MWAC	Net Year Output (MWh)	Permissible limit of generation 80%	lower annual	Maximum Generation (MWh)	Power 105%
1	30	70248	56198		73760	
2	30	68803	55042		72243	
3	30	68475	54780		71899	
4	30	68148	54518		71555	
5	30	67820	54256		71211	
6	30	67493	53994		70868	
7	30	67166	53733		70524	
8	30	66838	53471		70180	
9	30	66511	53209		69836	
10	30	66183	52947		69493	

## Power generation Estimate for 11 ~ 20 years

Year	Estimated Contracted Capacity	Estimated Contractor Energy			
	Indicative MWAC	Net Year Output (MWh)	Permissible limit of generation 80%	lower annual Maximum Generation (MWh)	Power 105%
11	30	65856	52685	69149	
12	30	65529	52423	68805	
13	30	65201	52161	68461	
14	30	64874	51899	68117	
15	30	64546	51637	67774	
16	30	64219	51375	67430	
17	30	63891	51113	67086	
18	30	63564	50851	66742	
19	30	63237	50589	66398	
20	30	62909	50327	66055	

## 11.2 Inverter Selection

### Type of Inverters

Project 1



String Inverters

Project 2



String Inverters

Project 3



Central Inverters

Project 4



String Inverters

## 11.2 Inverter Selection

	String Inverters	Central Inverters
Capacity	250 ~ 330 KW	1100 KW
Max input Voltage	1500V DC	1500V DC
Output AC Voltage	800V	630V
DC working Voltage	600~1300V DC(1500)	900~1300V DC(1500)

## Technical points of Inverters

Note that

Inverter input Voltage = 1500 V DC (Never accept exceed 1500V)

The solar panel string voltage must be less than 1500V( $29 \times 41.1 = 1191.9V$ )  
( $29 \times 49.3 = 1429.7 V$ )

In practically the peak working voltage will be reached to **1350 V DC** and it is greater than ( $29 \times 41.1 = 1191.9V$ )

So that quantity of panel selection must calculated with open circuit voltage ( $29 \times 49.3 = 1429.7 V$ )

Sungrow String Inverter Capacity = 250kW ( if power factor 1 )

Sungrow String Inverter Capacity = 250kW = (Power factor 1 )

Sungrow Central Inverter Capacity = 1100kW = (Power factor 1)

Hwawei String Inverter capacity = 330kW = (Power factor 1)

Inverter output AC voltage = **800V AC**

Inverter output AC voltage = **800V AC**

Central Inverter Output Voltage = **630V AC**

Inverter output AC voltage = **800V AC**

Present project reference1 250kW x 126 inverters = 31500kW = 31.5MW

say 30 MW

Present project reference 2 250kW x 91 inverters = 22750kW = 22.75MW

say 20 MW

Present project reference3 1100kW x 30 inverters = 33000 kW = 33MW

say 30MW + ( 13.761MWh BESS)

Present project reference4 330kW x 110 inverters = 36300 kW = 36.3MW

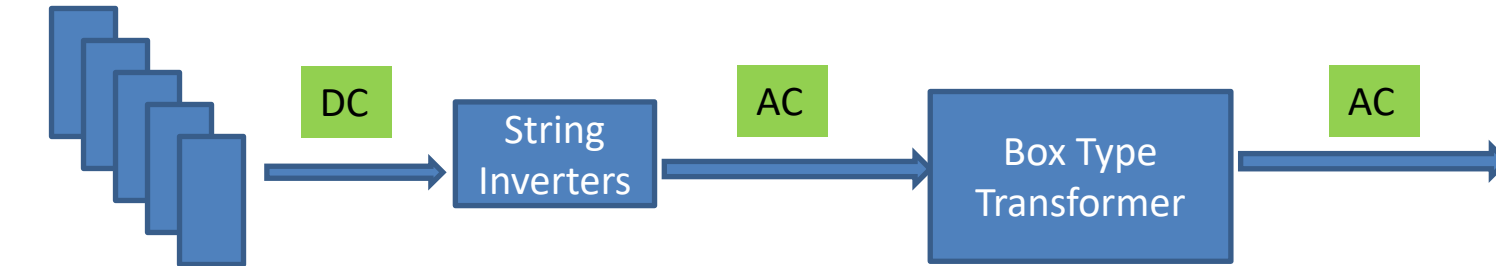
Say 30MW + ( 13.758MWh BESS)

# Equipment different on type of Inverters

Project ( 1 )



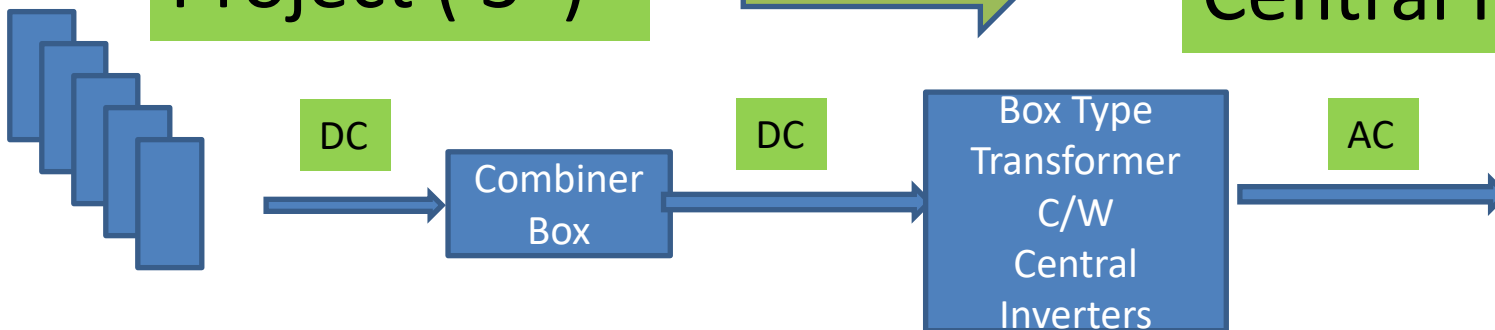
String Inverters



Project ( 3 )



Central Inverters



# Inverter output AC voltages & Grid System Voltage

## Power Conversion System

	Solar DC voltage	Inverter output AC Voltage	Step up Grid system AC Voltage	Step down For Charging AC Voltage	Charger AC/DC	Dc/DC Converter & Battery DC Voltage
Project1	600~1300 V	800 V	800 V/ 33kV	Not Include BESS		Not Include BESS
Project2	600~1300 V	800 V	800 V/ 33kV	Not Include BESS		Not Include BESS
Project3	900~1300 V	630 V	630 V/ 33kV	33kV/550 V	550V/1025 V	1025/ 1025~1500V
Project4	600~1300 V	800 V	800 V/ 33kV	33kV/800 V	800V/1025 V	1025/ 1025~1500V

## Record photos of INVERTER

Strings Inverters



Central Inverters



# Inverters Operation & Monitoring

## Inverters located in PV Sub Array:

### Analog Signals:

- DC current, voltage, power of each input
- Output AC Phase-Phase voltage, current, active power, reactive power, apparent power, power factor, frequency
- Inverter efficiency
- Daily power yields, total power yields
- Total operation time
- Internal temperature, etc.

### Status signals:

- Operation Status: Run, Stop, Initial Standby, Emergency Stop...
- Alarm state signal: Communication fault, Low Insulation resistance, Insulation plate abnormal, fault, derating run, alarm run
- Fault state: DC under-voltage, DC over-voltage, AC under-voltage, DC overvoltage, Under-frequency, Island protection, Over-temperature, Overload protection, Earth Fault protection, AC switch abnormal, DC switch abnormal...
- Device status signal: AC switch state, DC switch state, DC fuse state, etc.

**Combiner Box**

**If install Central Inverters**



# COMBINER BOX

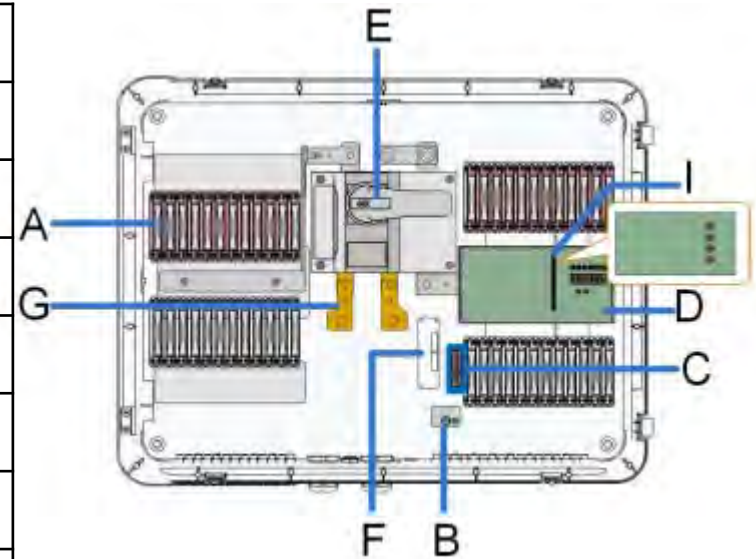
- A combiner box in a central inverter PV system serves as a connection point for multiple strings of solar panels.
- It combines the output from these strings into a single DC input that goes into the central inverter for conversion into AC electricity.
- It also have overcurrent protection devices like fuses and DC circuit breakers for safety.

## Specification

- Maximum system voltage: 1500V
- Maximum no of DC input strings: 20
- Maximum input current per string:  
11/13/15.5\*/18.5(A)
- Maximum continuous output current:  
220/280/310\*/370(A)

## INSIDE VIEW OF COMBINER BOX

A	DC fuse holder and fuse
B	Grounding point, for equipotential connection
C	RS485 communication terminal
D	Monitoring panel
E	Load switch/ Circuit breaker
F	SPD
G	DC output wiring terminal
H	Copper bar and wiring hole
I	DC PLC communication module



Type Designation	PVS-16MH	PVS-18MH	PVS-20MH	PVS-24MH
<b>Parameters</b>				
Max. PV string voltage	1500 V			
Max. PV string parallel inputs	16	18	20	24
Max. string input current	21A	20A	18.5A	15.5A
Max. output current	336A	360A	370A	372A
SPD	1500 Vdc Type II (optional: Type I+II)			
Input terminal type	PG Gland / MC4 terminal			
Output terminal type	120 – 400 mm <sup>2</sup>			
Protection class	IP65 / IP67 (optional)			
Environment temperature	-35 to 60 °C			
Environment humidity	0 – 95%			
Dimensions (W*H*D)	950*730*275 mm			
Weight	40 kg	40 kg	42 kg	44 kg
Switch disconnect handle	Internal handle			
Material	SMC			
<b>Standard Accessories</b>				
DC output load switch	Yes			
PV specific application SPD	Yes			
<b>Optional Accessories</b>				
String current and bus voltage monitoring	Optional			
RS485 communication port	Optional			
PV SPD failure monitoring	Optional			
Monitoring for load switch state	Optional			
Operator access areas IP2X	Optional			
Parallel arc fault circuit interrupter	Optional			
Wireless communication	Optional			



## EFFICIENT AND SAFE

- 1500V-Specific PV fuse, both positive and negative terminal
- 1500V-Specific PV SPD with fault alarm
- String current and voltage monitoring
- Main load switch state monitoring (optional)



## FLEXIBLE

- Optional IP67 protection, meeting the outdoor installation and usage requirements
- Self-powered power supply with lightning protection
- Output cable cross section area 120 – 400 mm<sup>2</sup> (max. 400 mm<sup>2</sup> Al cable)
- PG Gland / MC4 terminal connector



## QUALIFIED

- CE
- Highly optimize the system wiring
- Modular design, easy and quick maintenance

## **11.3      Box Type Transformer**

### **Prefabricated substation**

#### **Electrical Design requirement**

-How to boosted(Step Up) to local power system Voltage

#### **Accordance with Tender Requirement**

Local Main receiving substation that have connected with Grid  
is **33kV** voltage system.

**High Tension side of solar plant = 33kV**

## Project (1)

Er{#Wudqvirup hu##

Eudqg# #Gdtr  
 Udwhg#Fdsdflw| #916P YD  
 Glp hqvlrq #958{5;3{698fp  
 Qhw#Z hljkW #55833NJ  
 Glp hqvlrq+Irxqgdwlrq, #9;3fp #633fp #543fp  
 Wrwdc#Txdqwlw| #8#Qrv1##  
 Wrwdc#Txdqwlw| #6418P YD

## Project ( 2 )

Er{#Wudqvirup hu##

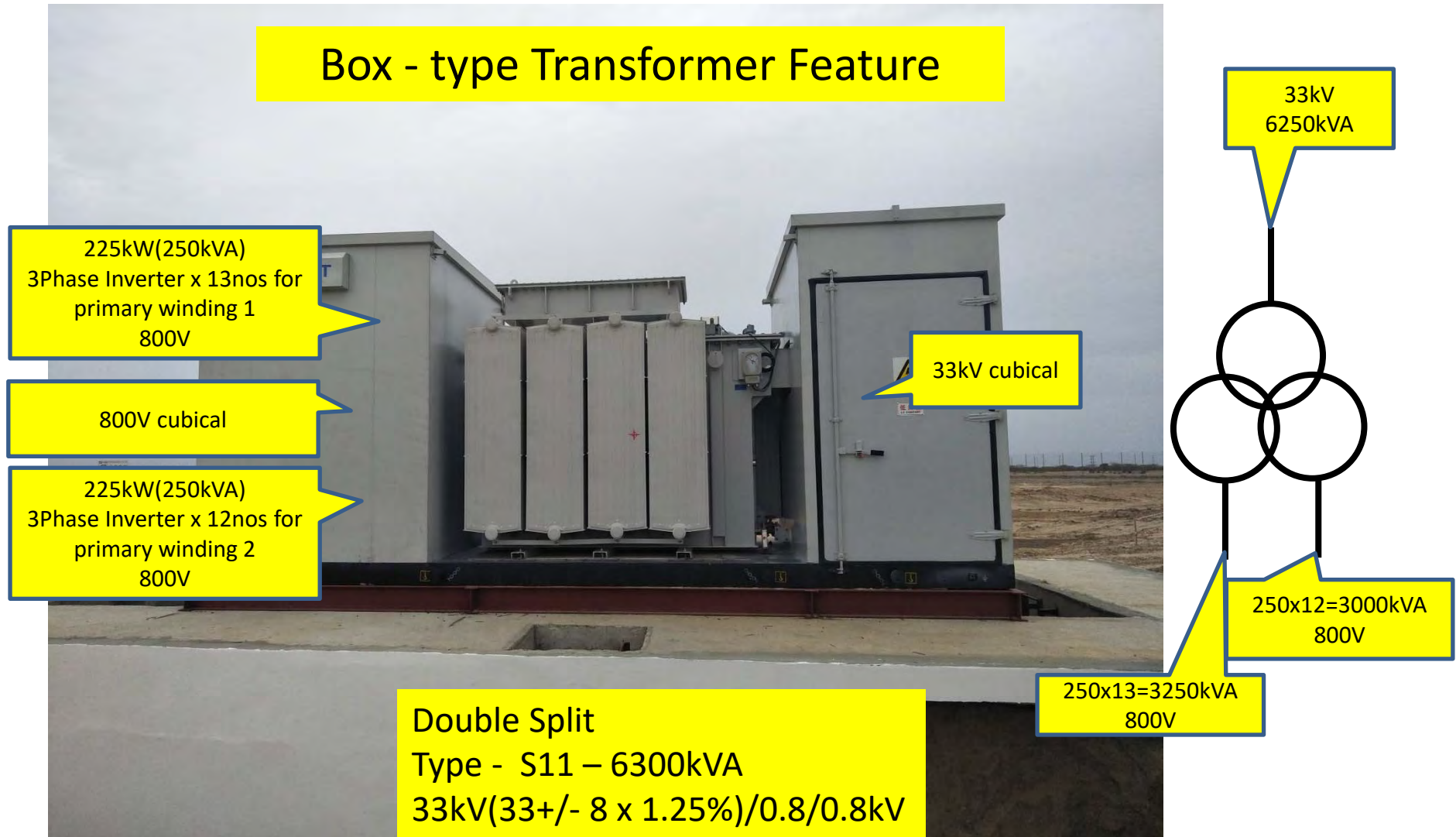
Eudqg# #Vkdqjgrqj Gdfkl  
 Udwhg#Fdsdflw| #916P YD#6#vhw#. 7P YD{#4#vhw  
 Glp hqvlrq =  
 Qhw#Z hljkW =  
 Glp hqvlrq+Irxqgdwlrq,=  
 Wrwdc#Txdqwlw| #7#Qrv1##  
 Wrwdc#Txdqwlw| #551k#P YD

**Voltage ratio 0.8-0.8/33± 2.5%KV**



## -Box typed Transformer setups and Switchgear arrangement

### Box - type Transformer Feature

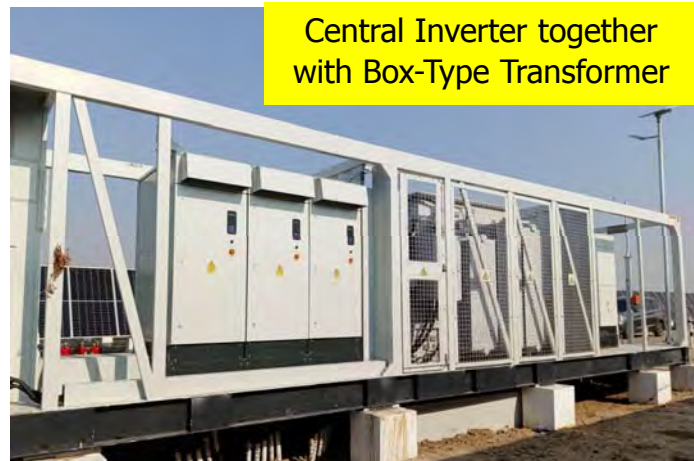


Where do we get the electrical supply for control devices inside the Box - type Transformer



Comparison Of Solar Project							
Sr No	Description	TPW_I (30MW)	TTG (20MW)		NSP (30MW)	GSE (30MW)	Remark
1	Auxiliary Trasformer	15kVA	15kVA		5kVA	5kVA	

## Box-type transformer Design



Central Inverter together  
with Box-Type Transformer

## Box transformer Monitoring

### *MV transformer*

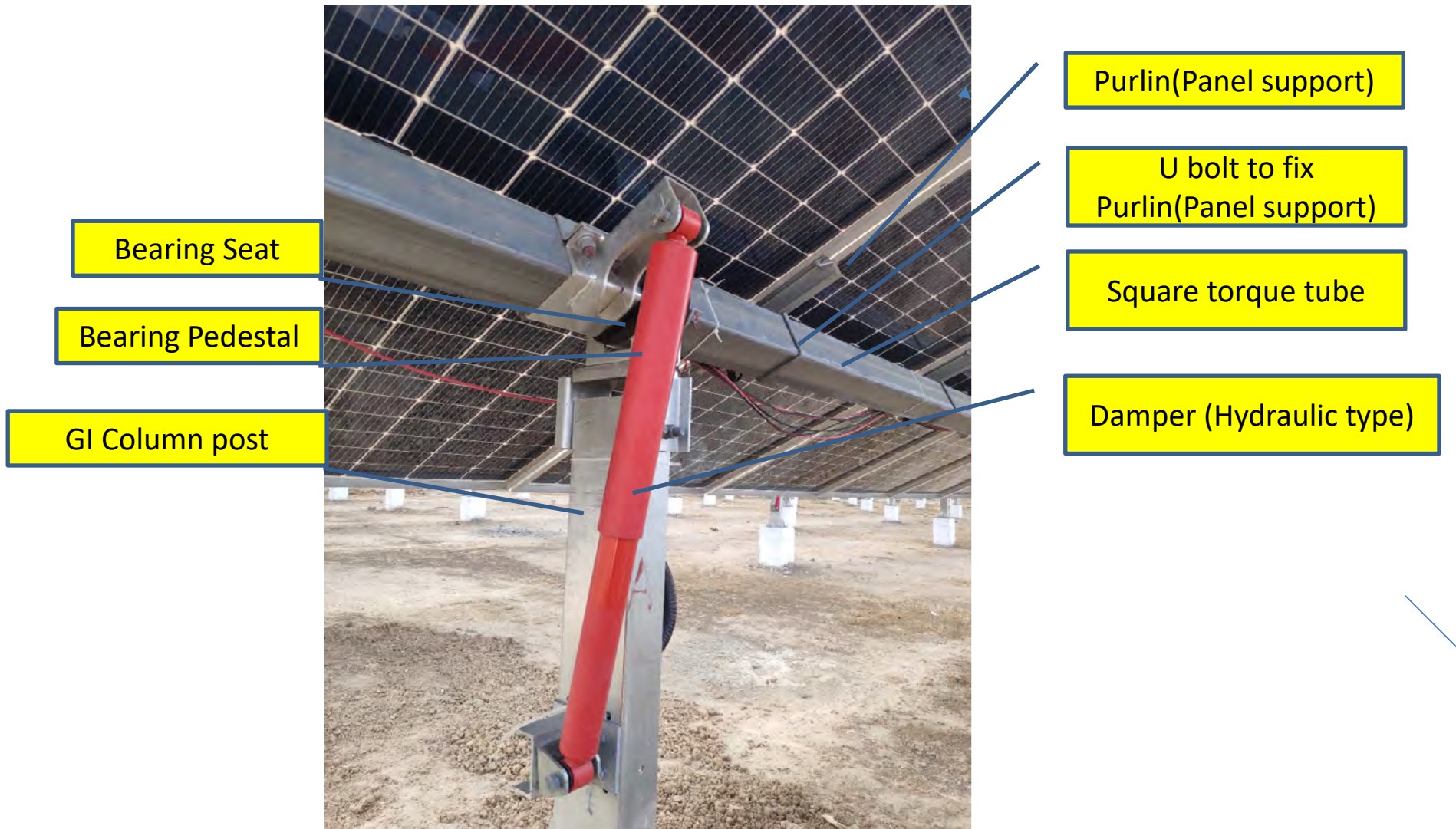
- Oil/Winding temperature alarm
- Pressure trip
- Buchholz alarm
- Buchholz trip
- Oil temperature
- Winding temperature

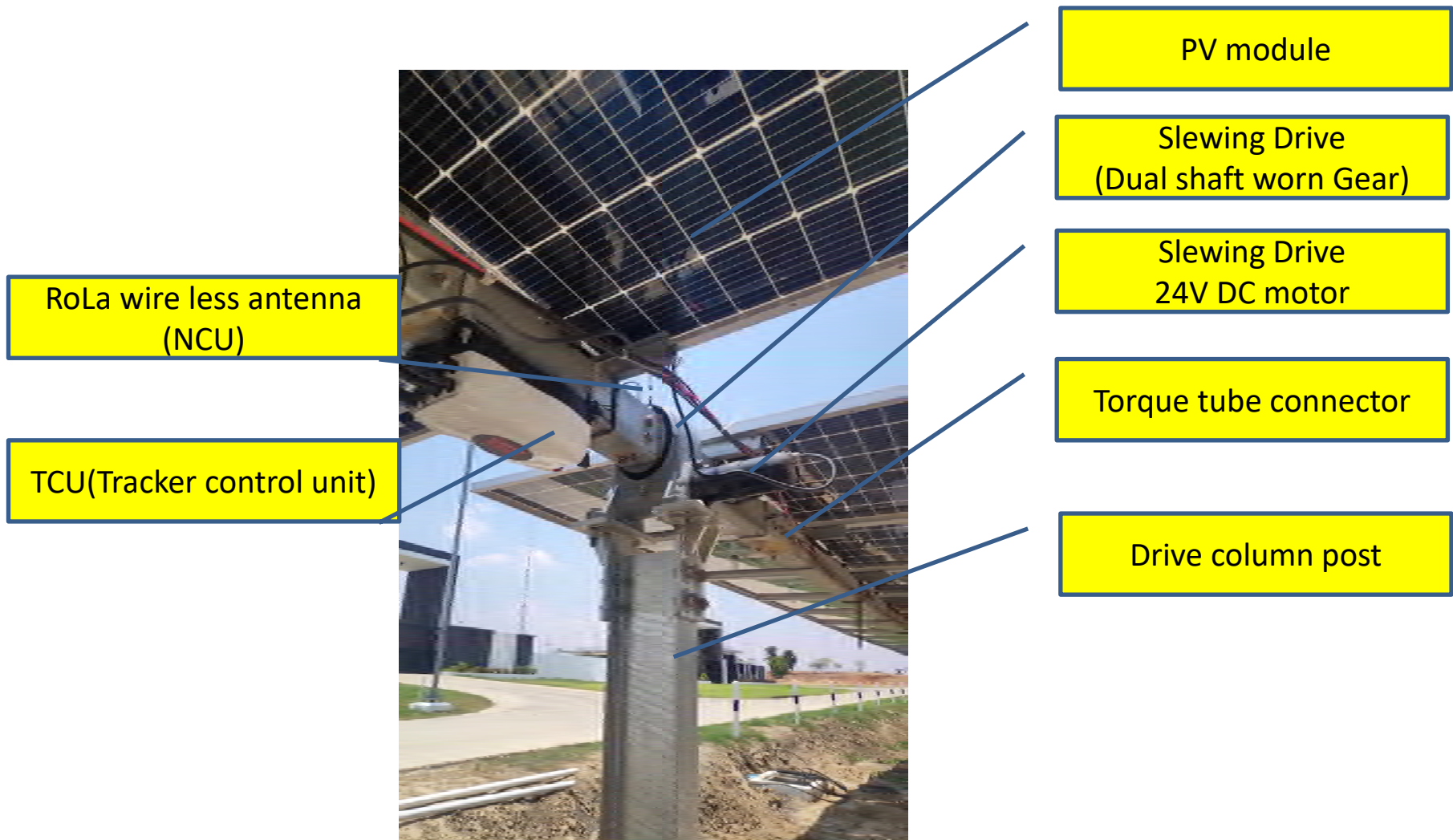
(12) Solar Panel arrangement  
Tracker System

Ground mounted single axis solar tracking system



Solar Tracker End support view





## Tracking motor drive control box wiring and program configuration.

Drive unit control box



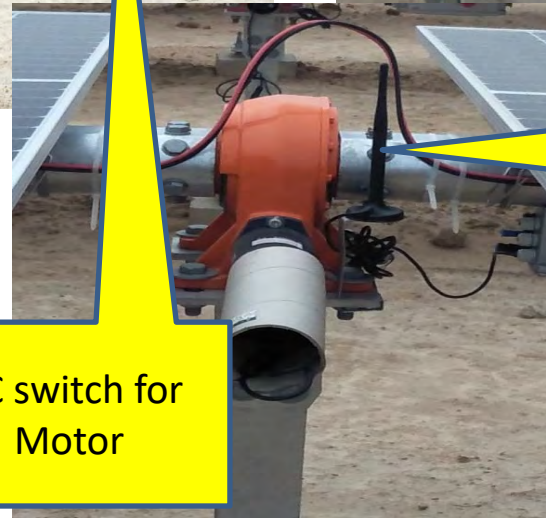
24V DC  
Power for  
drive motor  
300-600V  
/32V  
DC/DC  
converter



DC switch for  
Motor



Antenna for remote  
control  
LoRA Wi Fi



## The advantages of **Horizontal single axis tracker** system.

1. This projects are using **HORIZONTAL SINGLE AXIS TRACKER (HSAT)** system in Myanmar with advance control systems and equipments.

### **Advantages of trackings system are:-**

- a) Independent row by row trackers.
  - b) It is stable, Simple, Best cost structure.
  - c) Specially designed D-Tube and easy to install.
  - d) LoRa-wireless communication, it is long range, low power consumption.
  - e) String powered with backup li-ion battery. (**Charged by Solar power Y Termination 300-600/32 solar charge controller**)
  - f) Strong wind resistance capability.
  - g) The tracking technology uses geographic latitude, longitude, and time as the main parameters and astronomical algorithms. ( **Individual tracking program configuration**)
  - h) To avoid shadow occlusion between PV arrays, backtracking technology is provided.
- 2 We can get more power production even the same capacity rather than fixed type system.

## BACKTRACKING

During sunrise and sunset, shadow will be casted on consecutive PV arrays due to the low altitude of the Sun. Increasing row spacing can effectively reduce power caused by shadow occlusion, but it will increase investment costs such as land, cables, and construction.

Backtracking technology is a reverse-direction tracking routine. Its application in PV tracking systems can avoid shadow occlusion between PV arrays ensuring the optimisation of power generation of PV systems, and reducing the land area.



*Figure. PV arrays in the morning or evening without backtracking*



*Figure PV arrays in the morning or evening with backtracking*

## Horizontal single axis tracker Control system.

### Tracker:

NCU:

- Longitude, Latitude
- Wind speed, direction, Irradiance, rainfall, snow, water level, temperature
- General alarm, working status

TCU:

- Status, working mode, alert information
- Target angle, current angle
- Motor current

## (13) Power House

### Power House Construction & Installation



## (13.1) Electrical Primary( 33kV Switchgears)

Previous Project



Update Project



(13-2) Electrical secondary( Station power low voltage & control panels)

Previous



Update



### (13.3) SVG (Static Var Generator)



Inductance



SVG Install capacity

20% of Install capacity

Project 2 (5MVar)

Project 3 (6MVar)

Project 4 (6MVar)

## **SVG (Static Var Generator) Control system.**

### **SVG:**

#### Analog Signals:

- Total reactive power, power factor, voltage, current
- Operation mode
- Voltage limit

#### Status signals:

- Cabin door status
- Grid connection status, malfunction,
- Running status, FC and insulation status

## (14) Transmission Line

Twin Bundle Single Circuit



Single Bundle Double Circuit



## (15) Receiving Main Power Station



## Switchgear yard arrangement at Receiving Grid Power Station

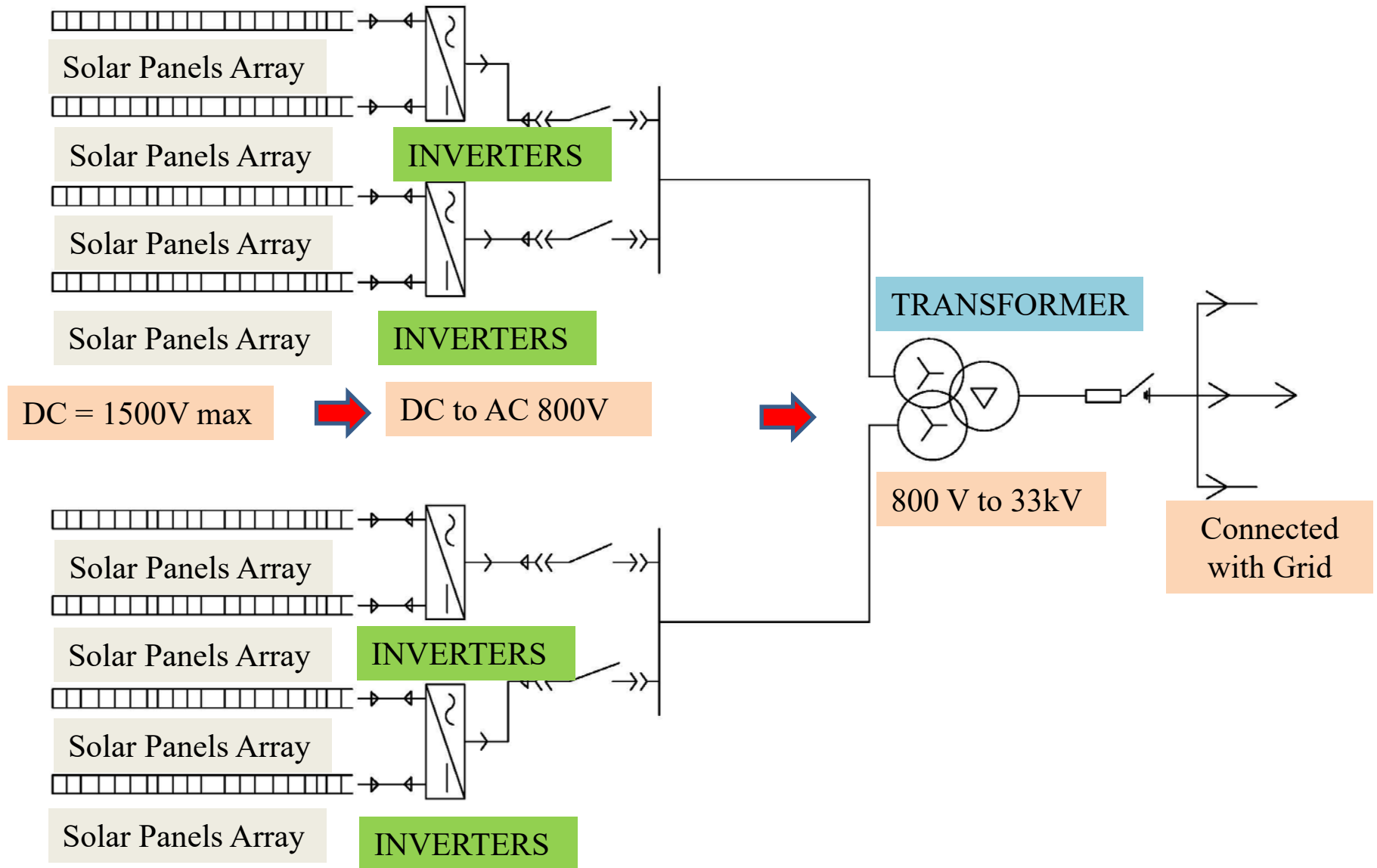


## (16) Solar Control System

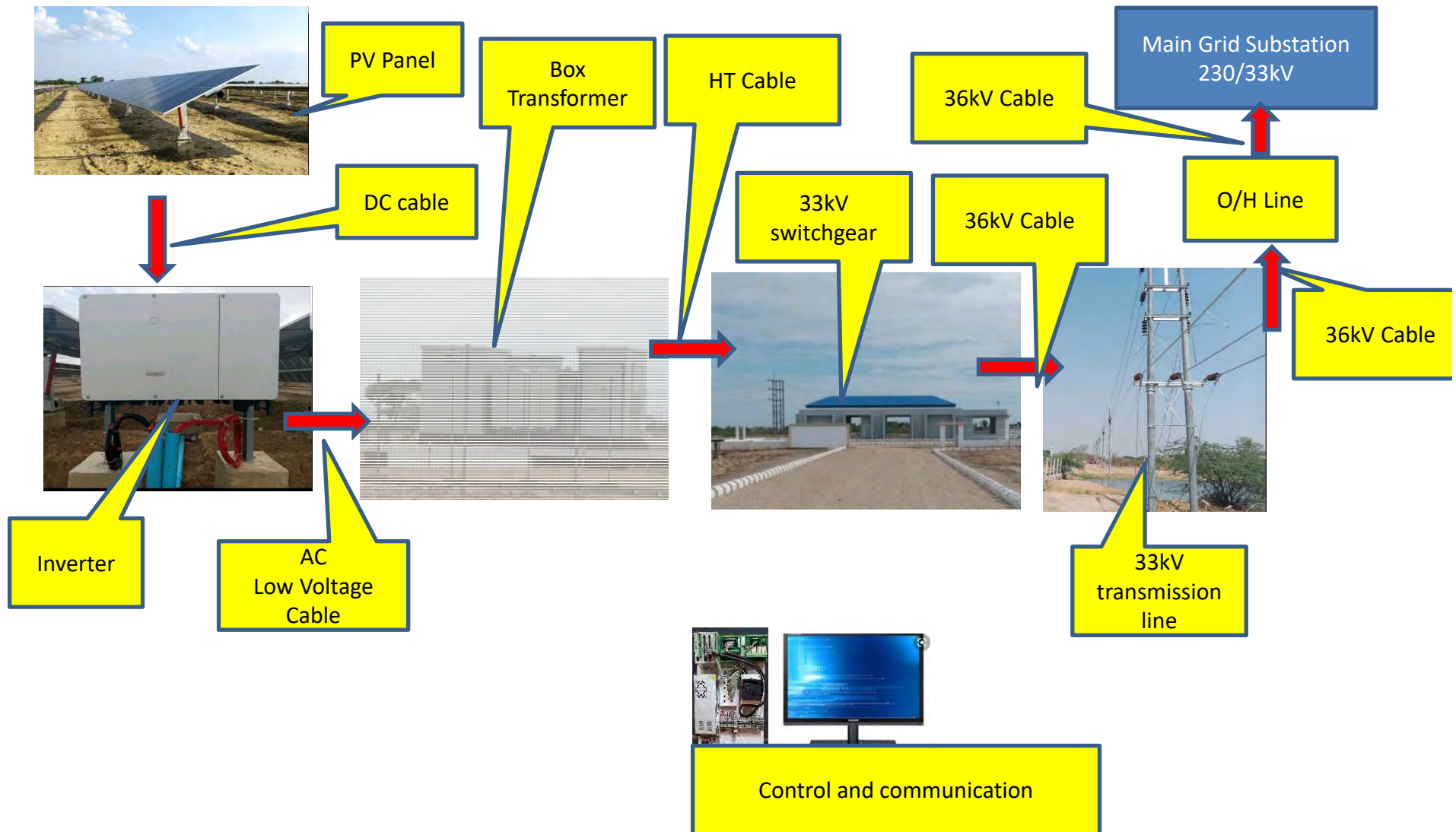
### (16.1) Operation and monitoring



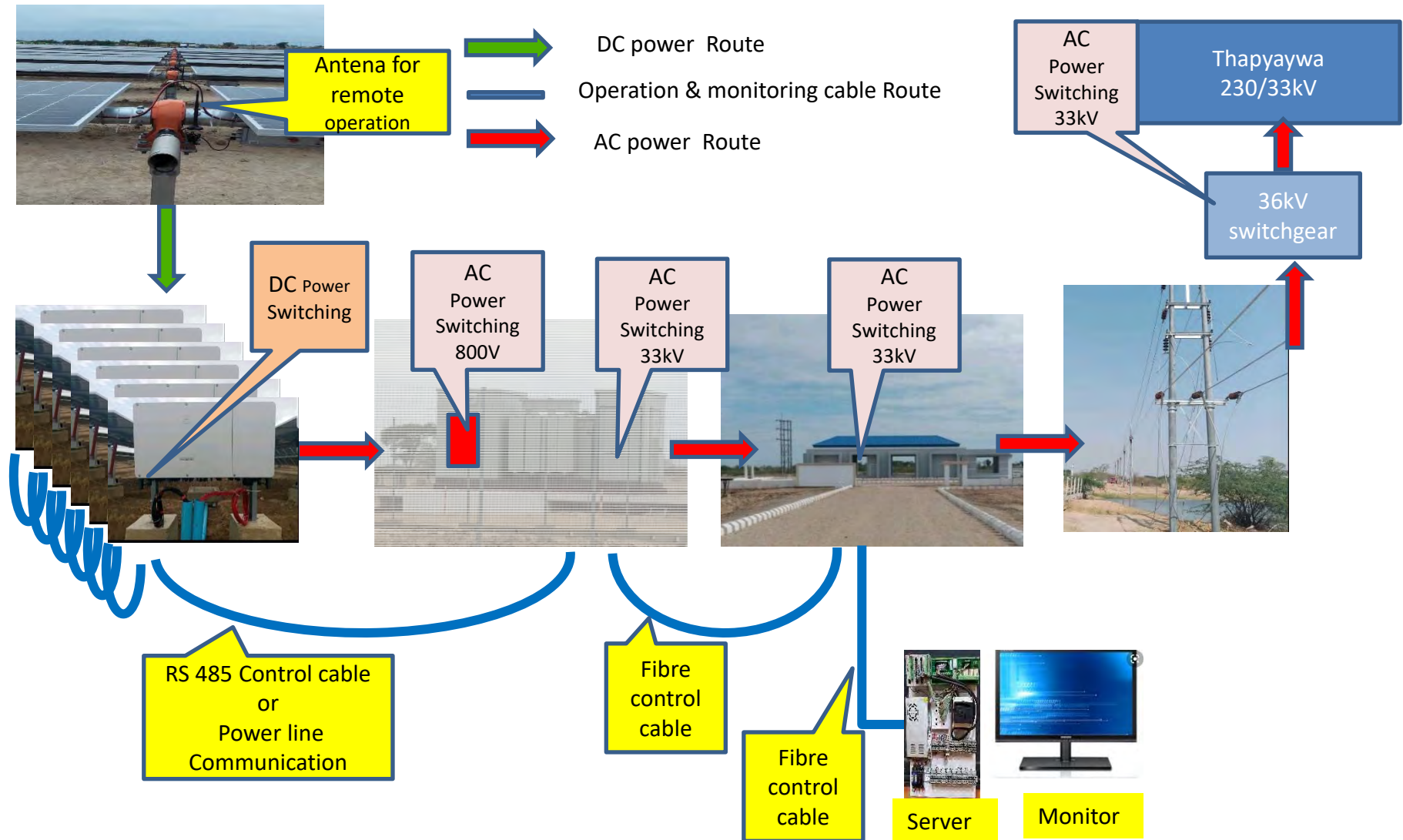
## 16.2 Basic concept of Solar power Generating System



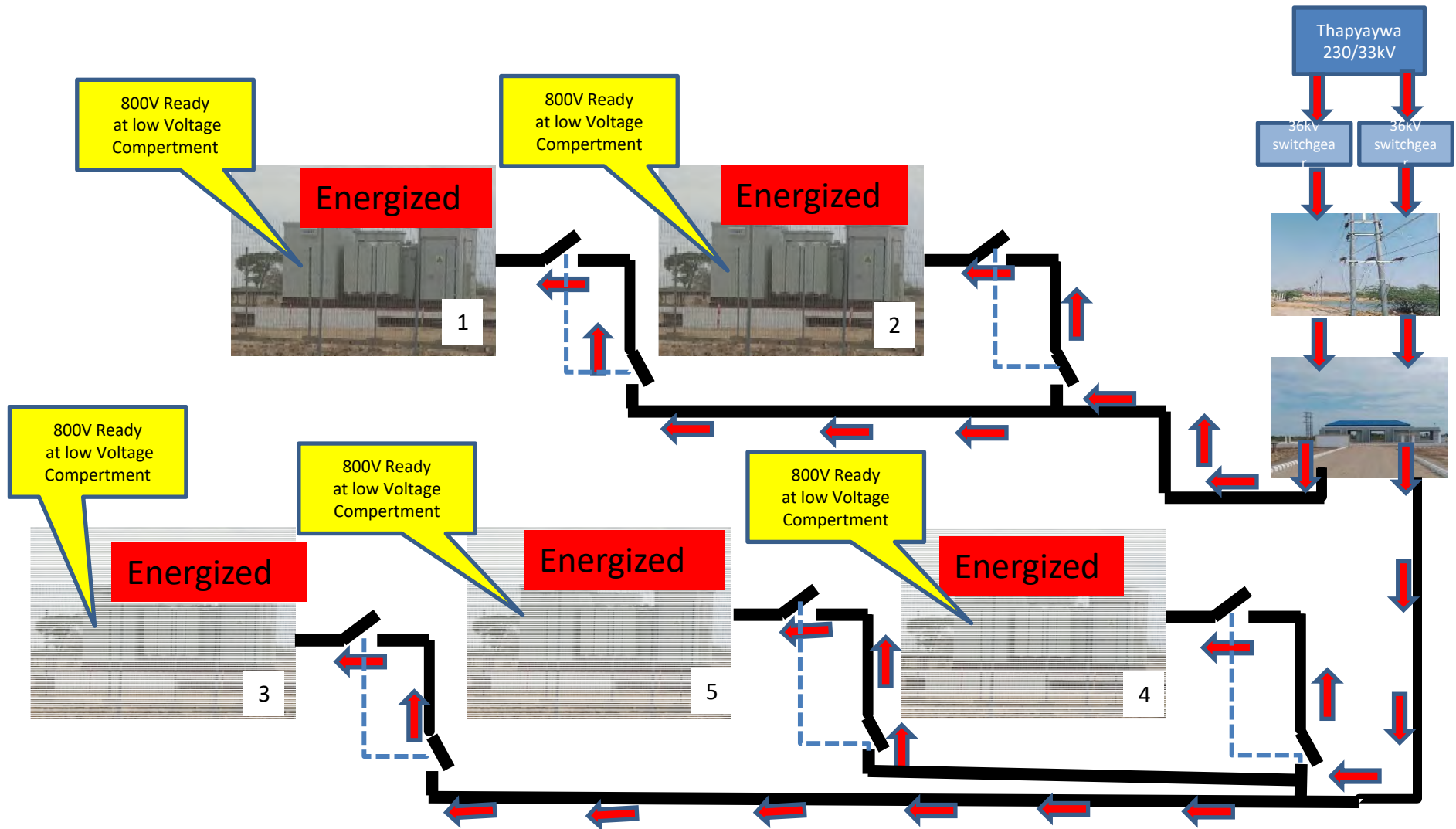
## 16.2 Basic concept of Solar power Generating System with images



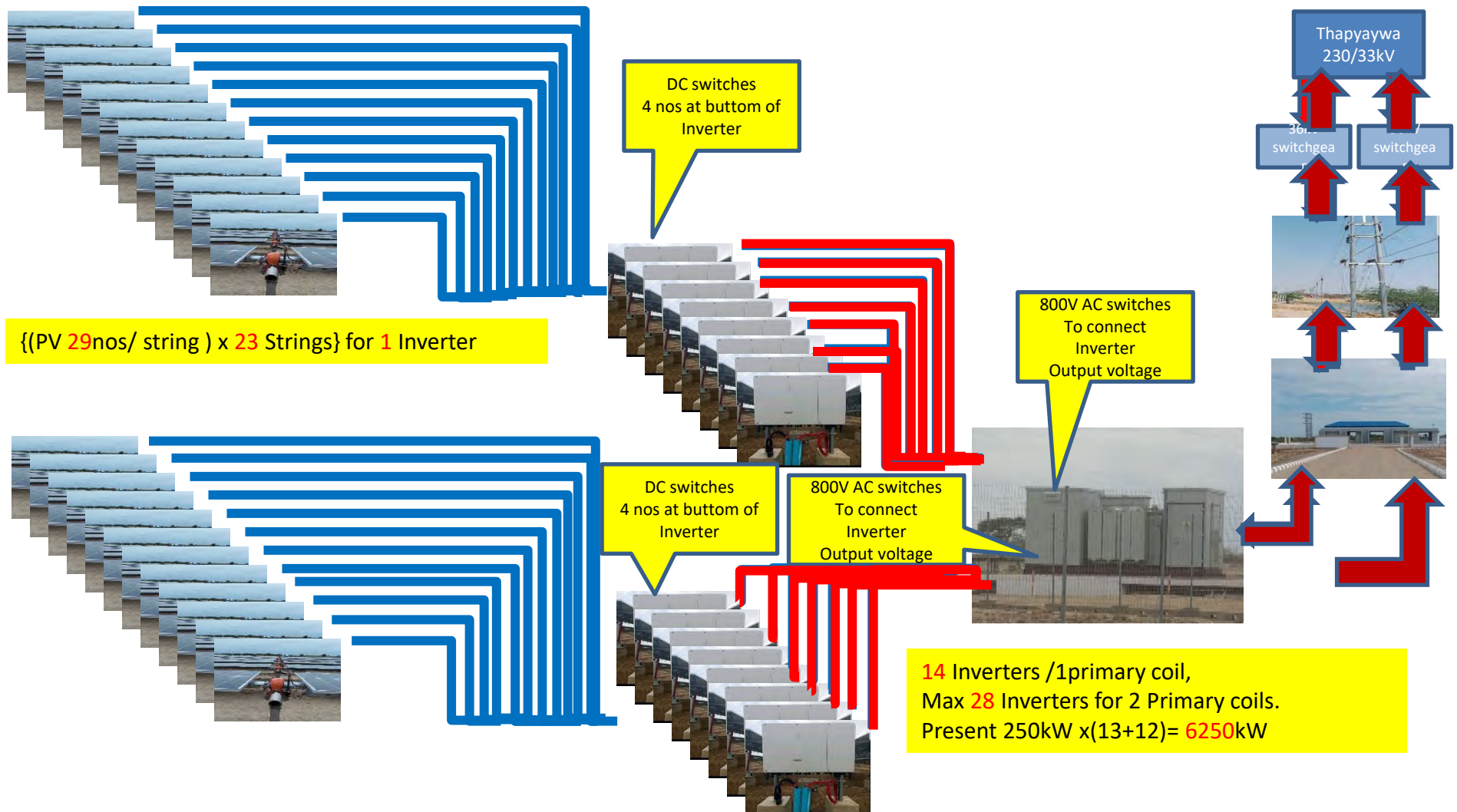
## 16.3 Tracking & power generation Control System



## 17 Testing sequences and power energizing to Box-type transformer

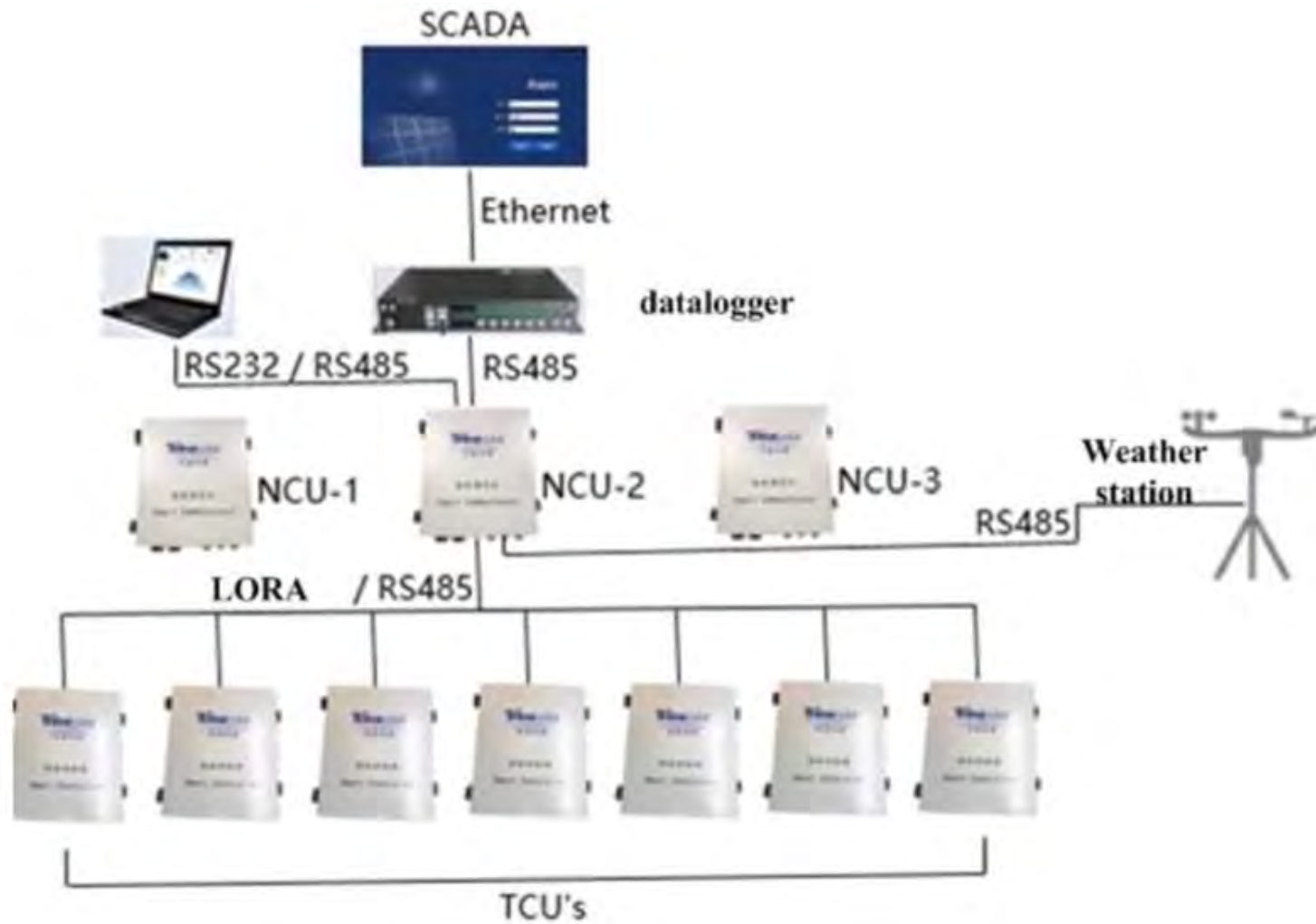


## 18. How to Synchronize Solar power generating to Grid system

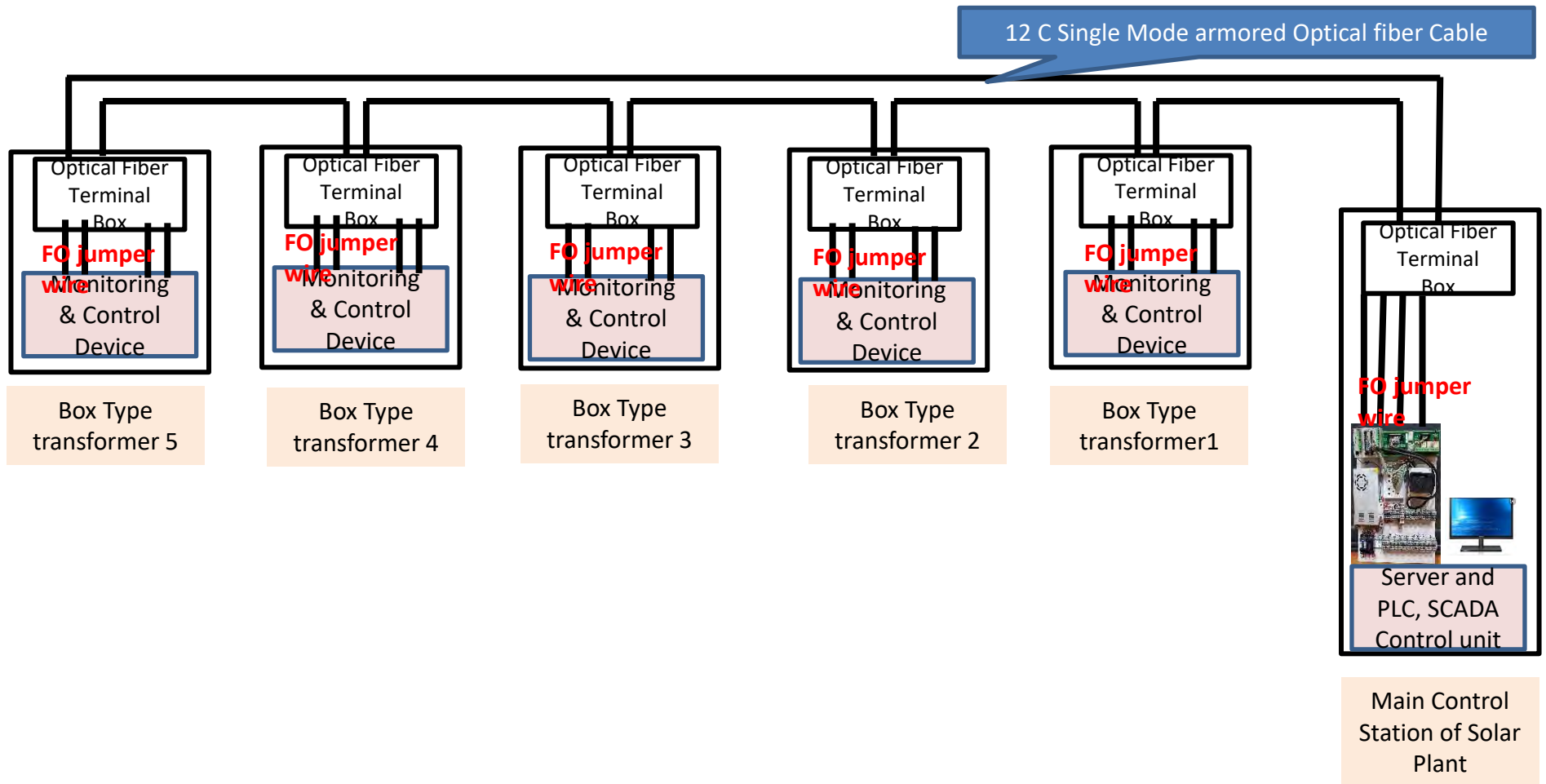


## 19. How to control entire Solar Power generation system

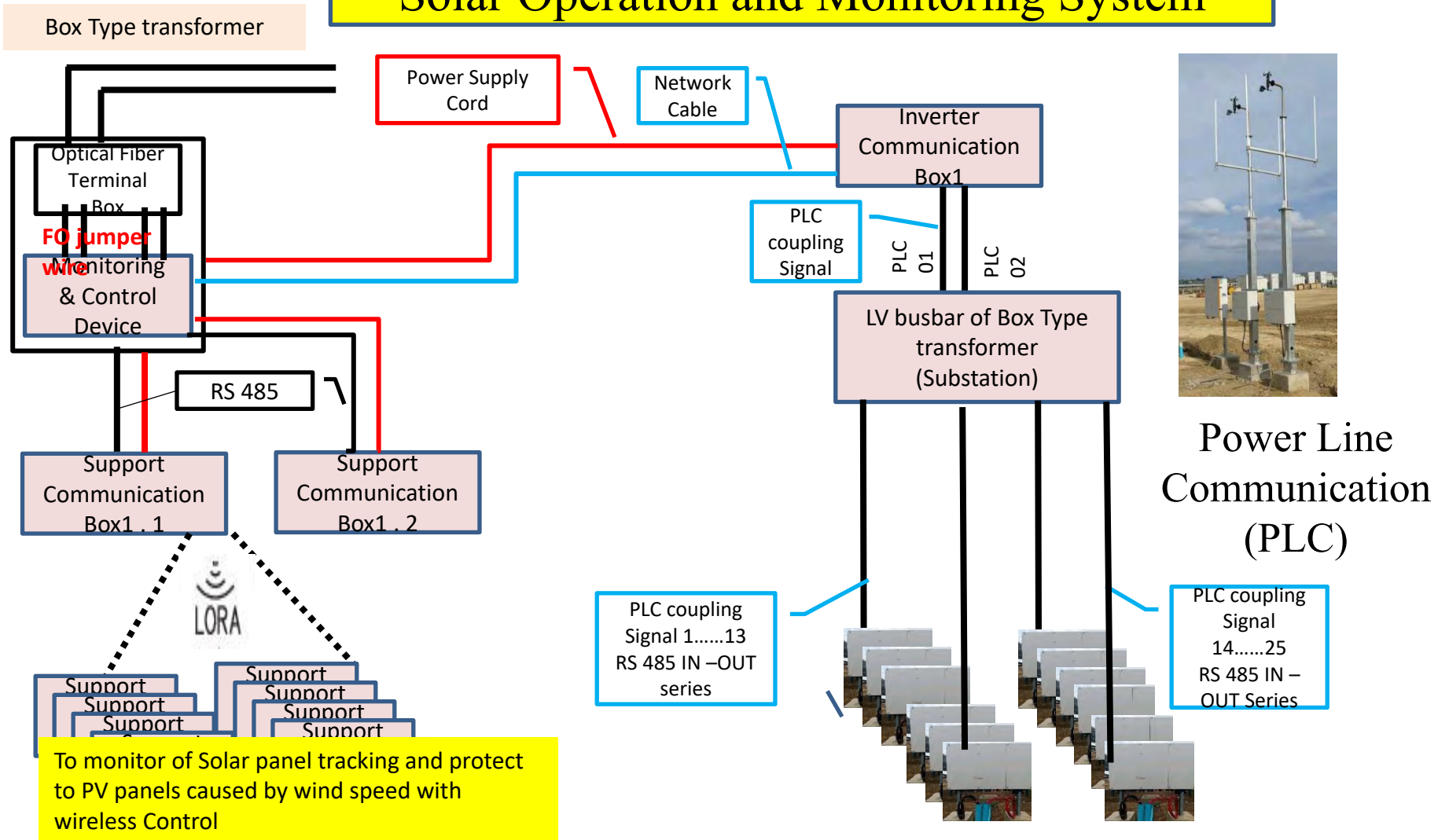
### Communication Architecture



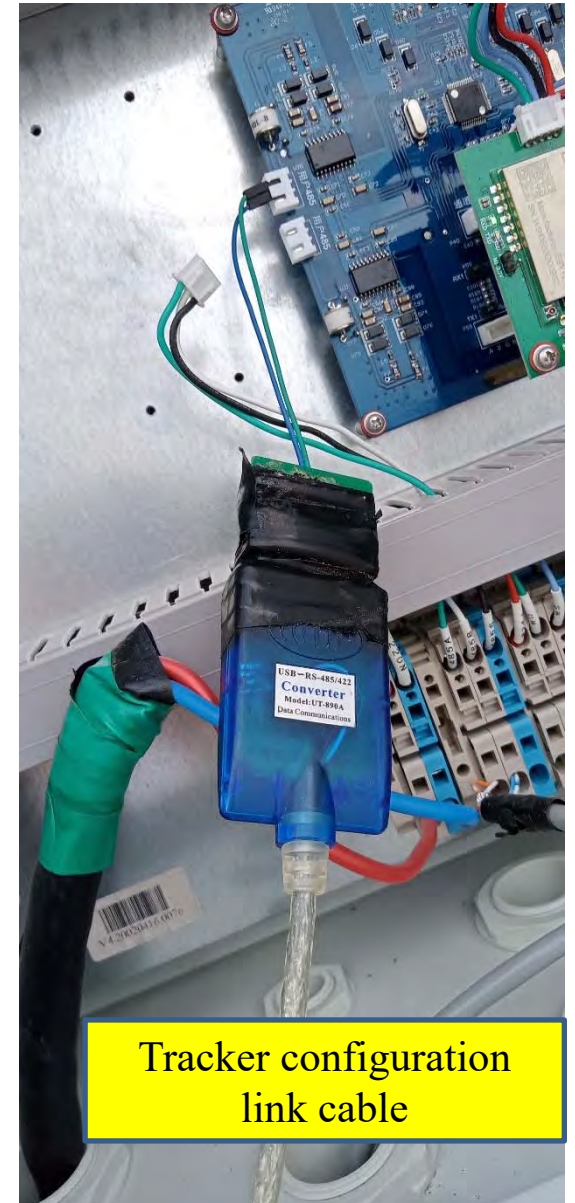
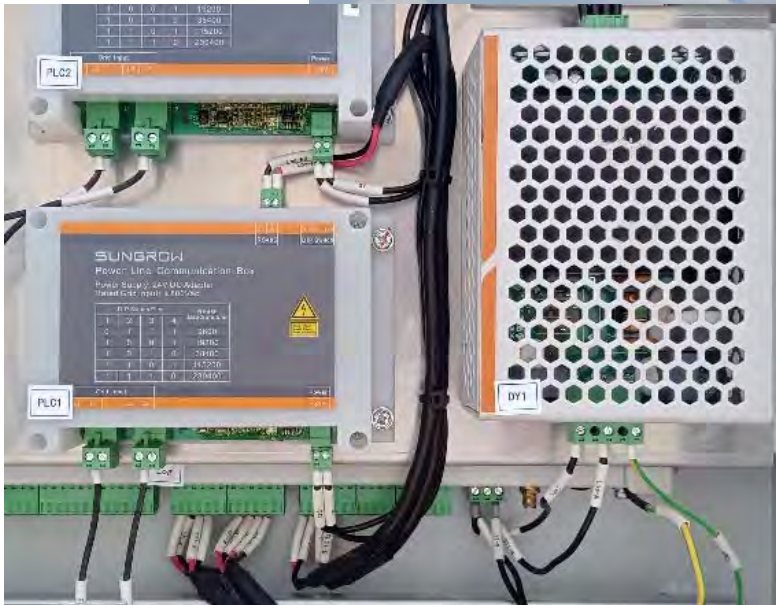
# Communication System installation at work site



# Solar Operation and Monitoring System



## Power Line Communication(PLC) and LoRA wi fi system



Tracker configuration  
link cable

## (20) Bracket type selection of Photovoltaic Array depends on fixed or tracker

### Important Points for Tracking material installation

- h) Wind resistance of column base structure design
- I) Short absorber for to maintain during turning movement
- j) Stronger support column for 24V DC drive gear motor fixing
- k) Do not forget detail accessories of solar panel supporting structure such as anchor bolts , nuts & washer, bearing rings & brackets, solar panel supporting bars, panel fixing brackets, bolts & nuts, washers,..etc.
- L) Total support structure's Earth Quack resistance



## **Function of solar Tracking system**

According to the local longitude, latitude and time, solar tracking system developed the tracker control box.

The program automatically calculates the sun's motion trajectory and the location of the azimuth Angle and Angle at the time.

In the tracking stage, the system automatically issues instructions according to the tracking range

Controls the operation of the motor actuator, and adjusts the tracking Angle every period of time

So that the PV module is always aligned with the current position of the sun.

The System enters the phase of anti-shadow tracking to avoid the shadow occlusion of the bracket, when the solar altitude Angle is low.

The tracker communication box is to collect the data of all the control boxes, send it to the background server, and send the control instructions of the background server to all the control boxes.

At the same time the communication box collects meteorological information such as wind speed, snow thickness and radiation, automatically determines bad weather and issue warning instructions to all control boxes

So that the control box can push the motor and support to make corresponding actions to avoid bad weather.

The communication box also incorporates the intelligent algorithms to increase the generation of photovoltaic panel

## Solar Tracker Control Position

Wind Protection



CPE 16m/s NSP 14m/s GSE 14m/s

Snow Protection



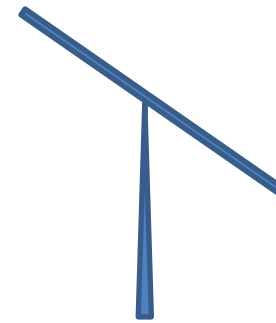
Night Drop



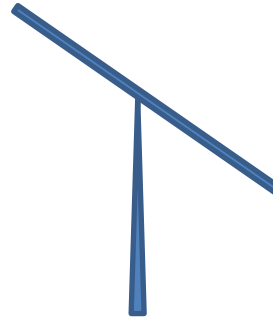
Operation



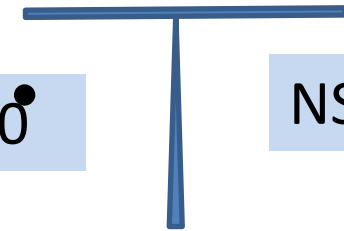
Earth Quake 8



West 120°



CPE 120°



NSP 90°

East 150°

West 150°

## (21) BESS(Battery Energy Storage System)

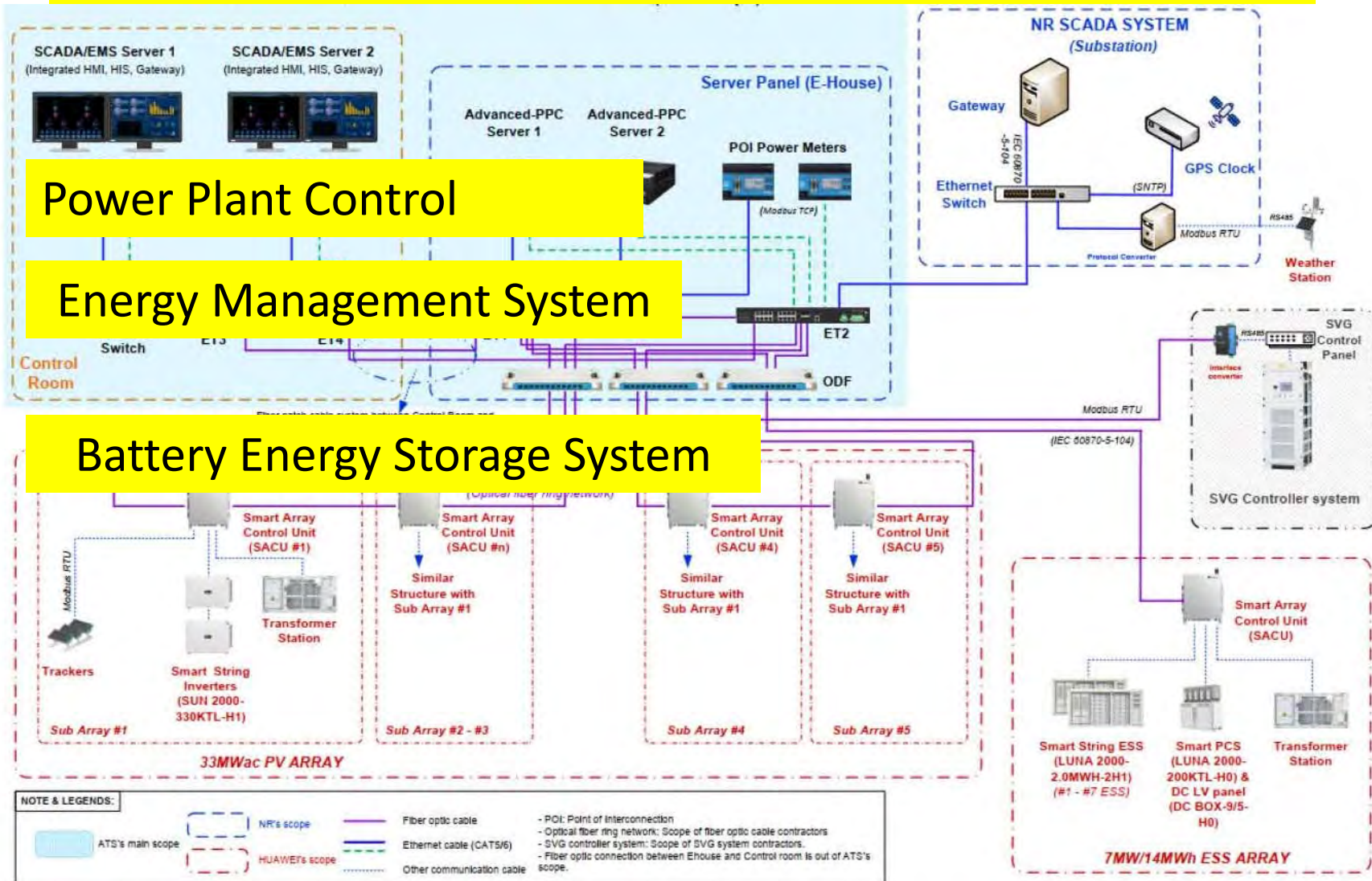
21-1 How to Charge Solar power to storage batteries and discharging to Grid system

# Over view of SCADA control system of PPC,EMS, BESS

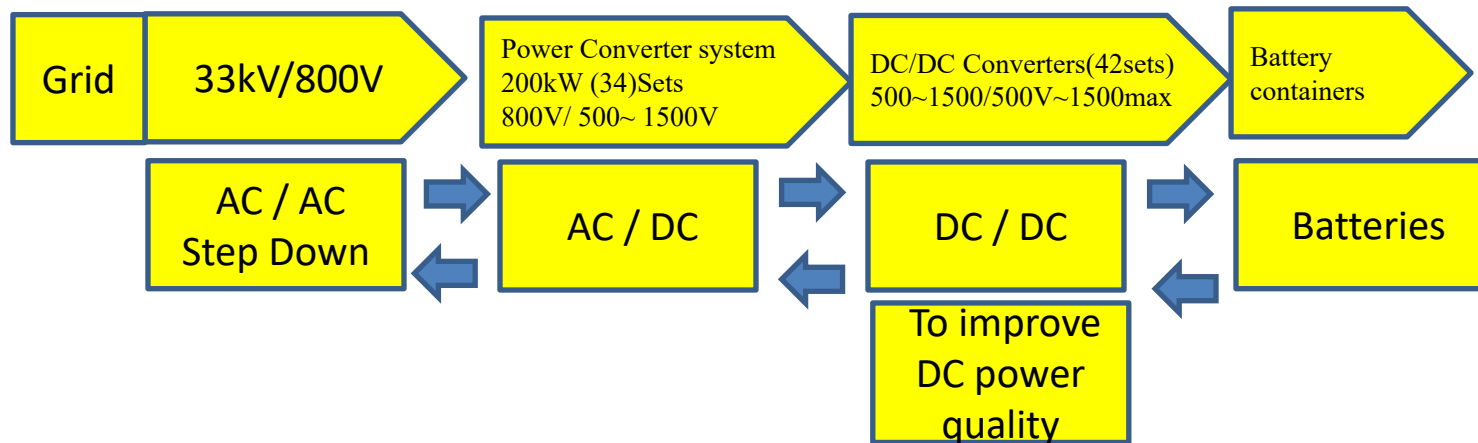
Power Plant Control

Energy Management System

Battery Energy Storage System



## 21.2 Battery Energy Storage System Charging & Discharging



### Battery Energy Storage System Charging & Discharging Control Mode

Can Select operation requirement

**Peak Shaving**

**Schedule**

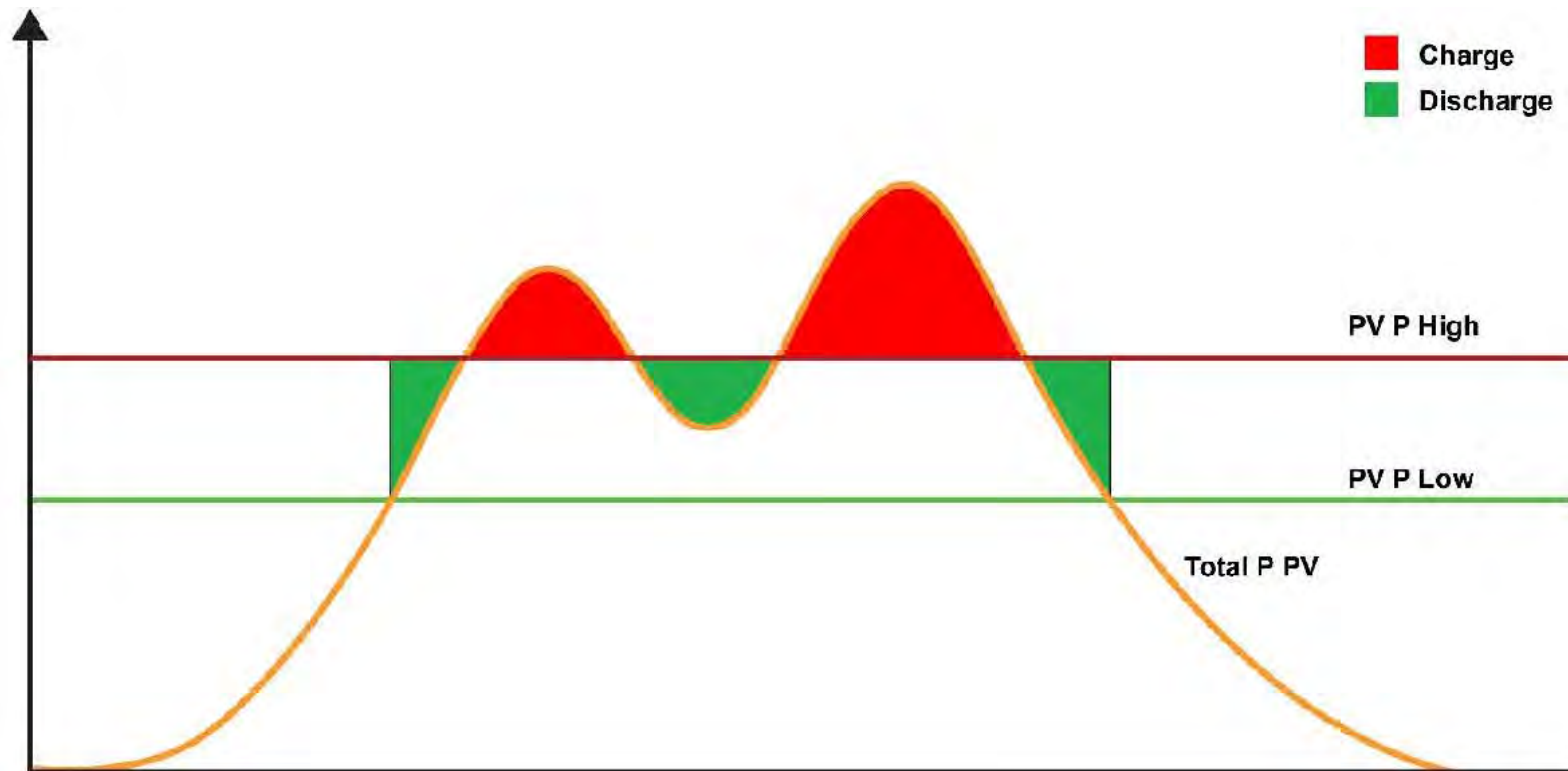
**Fluctuation**

**Manual**

# Peak Shaving setting



# Peak Shaving setting



## Power Conversion System (PCS) control in BESS

PCS in BESS sub array: **Power conversion system**    **AC to DC and DC to AC**

Analog Signals:

- Output AC Phase-Phase voltage, current, active power, reactive power, apparent power, power factor, frequency
- Internal temperature, etc.

Status signals:

- Operation Status: Run, Stop, Initial Standby, Emergency Stop...
- Alarm state signal: Communication fault, Low Insulation resistance, Insulation plate abnormal, fault, derating run, alarm run
- Fault state
- Device status signal: AC switch state, DC switch state, DC fuse state, etc.

## Converter Monitoring unit (DC/DC converter) monitoring

### **CMU in BESS sub array:**

Analog Signals:

- Output Energy, Fan speed, auxiliary meter
- Internal temperature, etc.

Status signals:

- Alarm: UPS alarm, Fire alarm, battery cabin door alarm, temperature alarm,

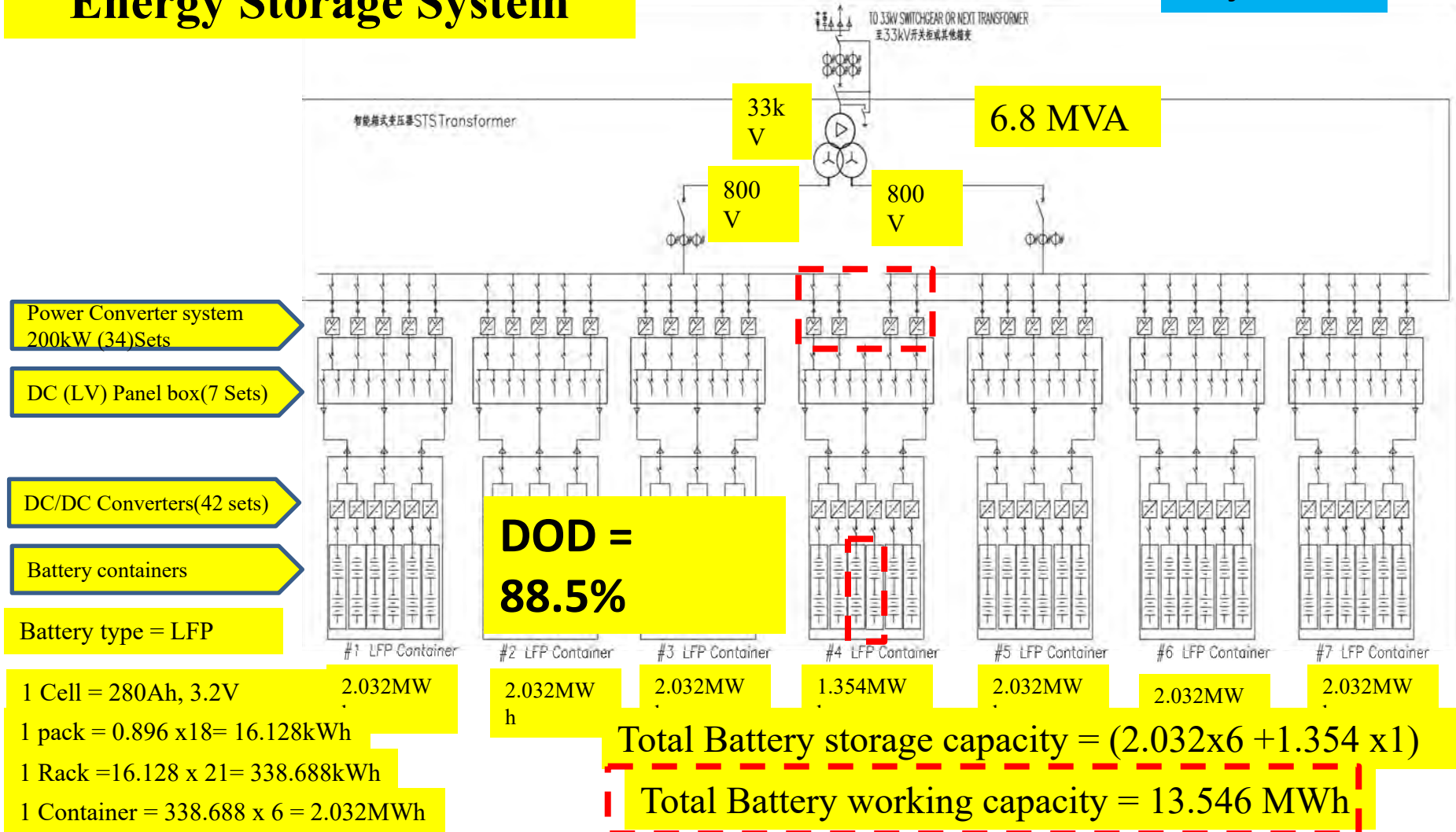
### **Battery Pack in BESS sub array:**

Analog Signals:

- DC bus side voltage, current
- DC bat side voltage, current
- Rack 1-2 voltage, current, SOC, capacity, energy

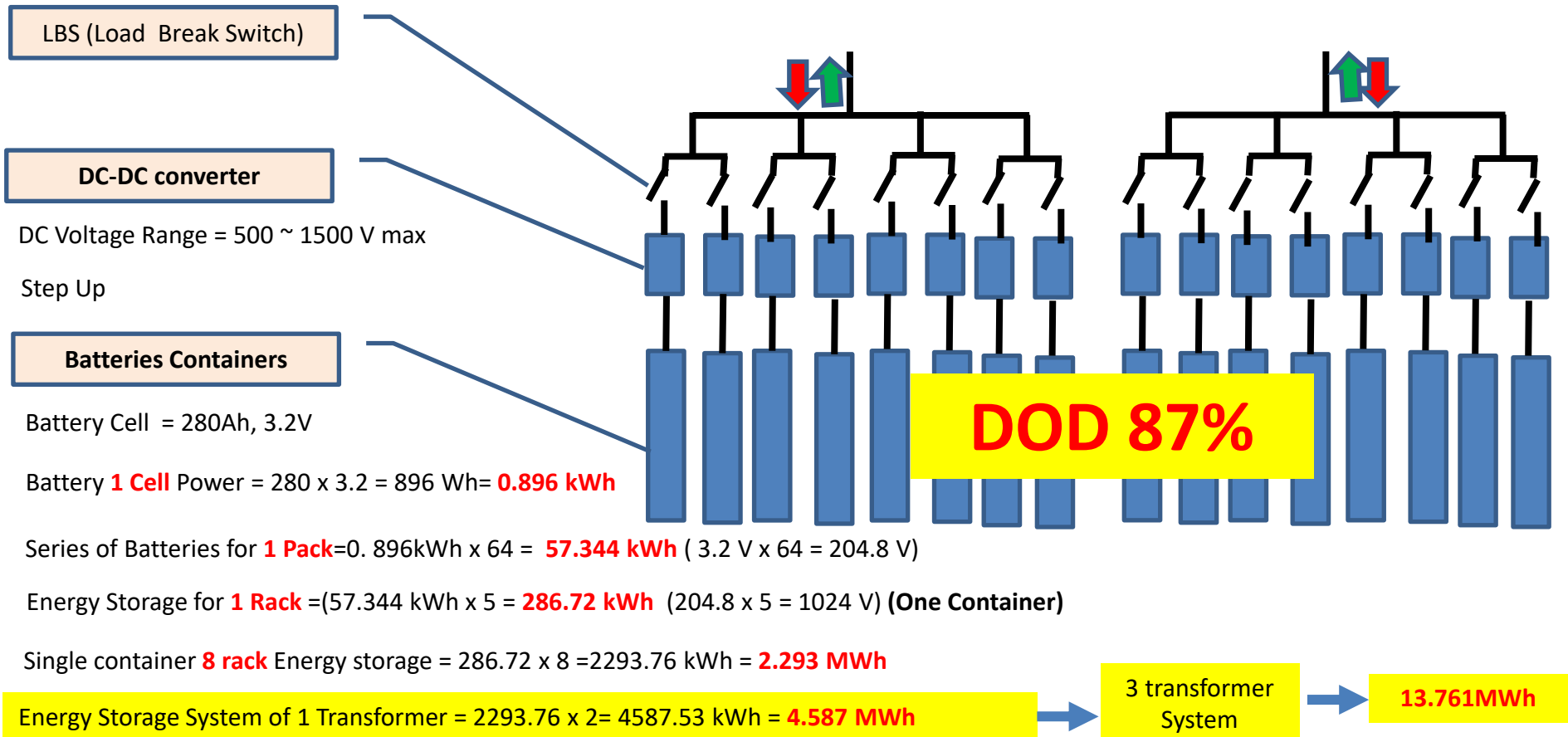
# Energy Storage System

## Project 4

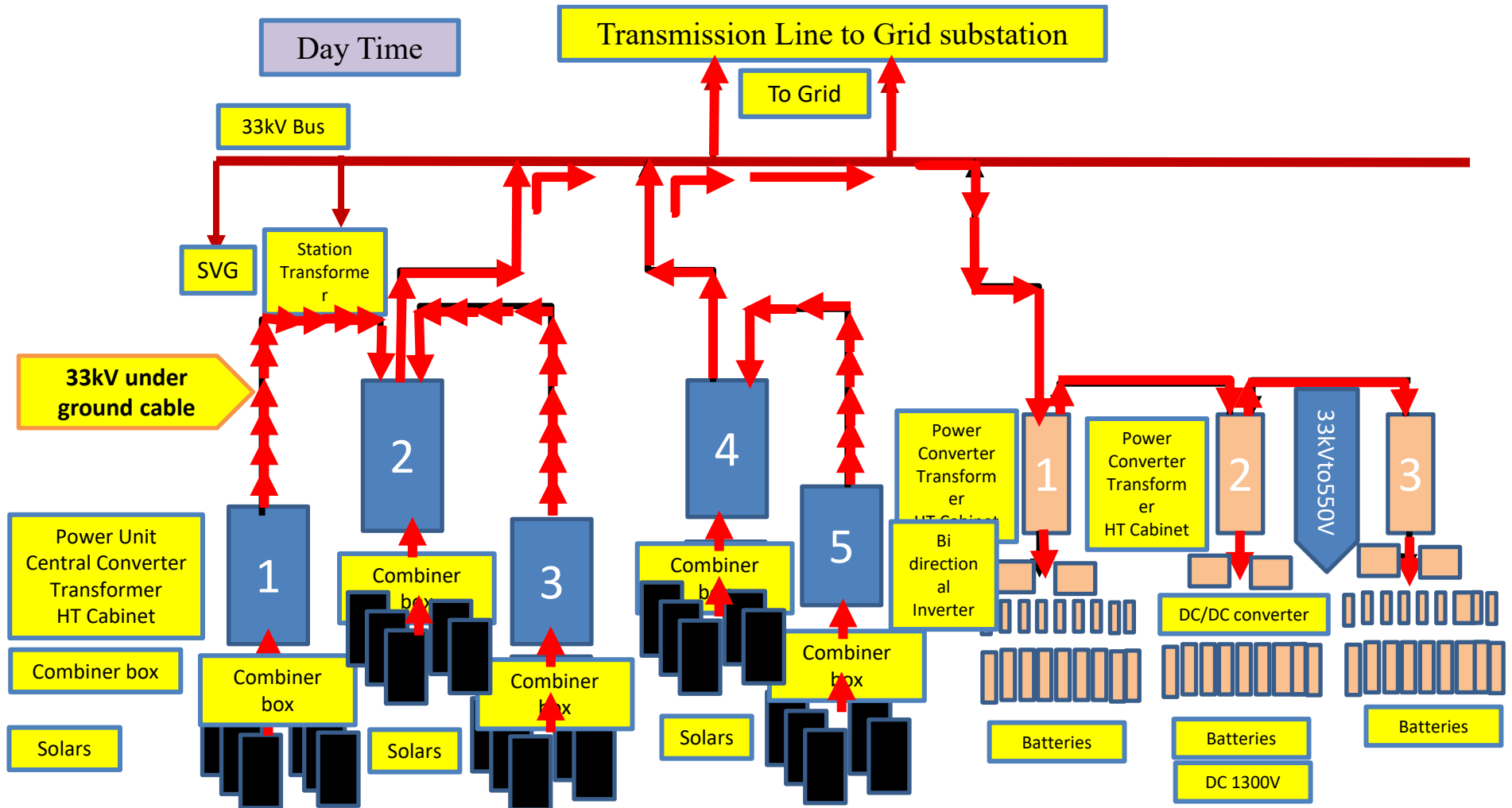


# Function of DC/DC Converter and LFP Batteries Container

## Project 3



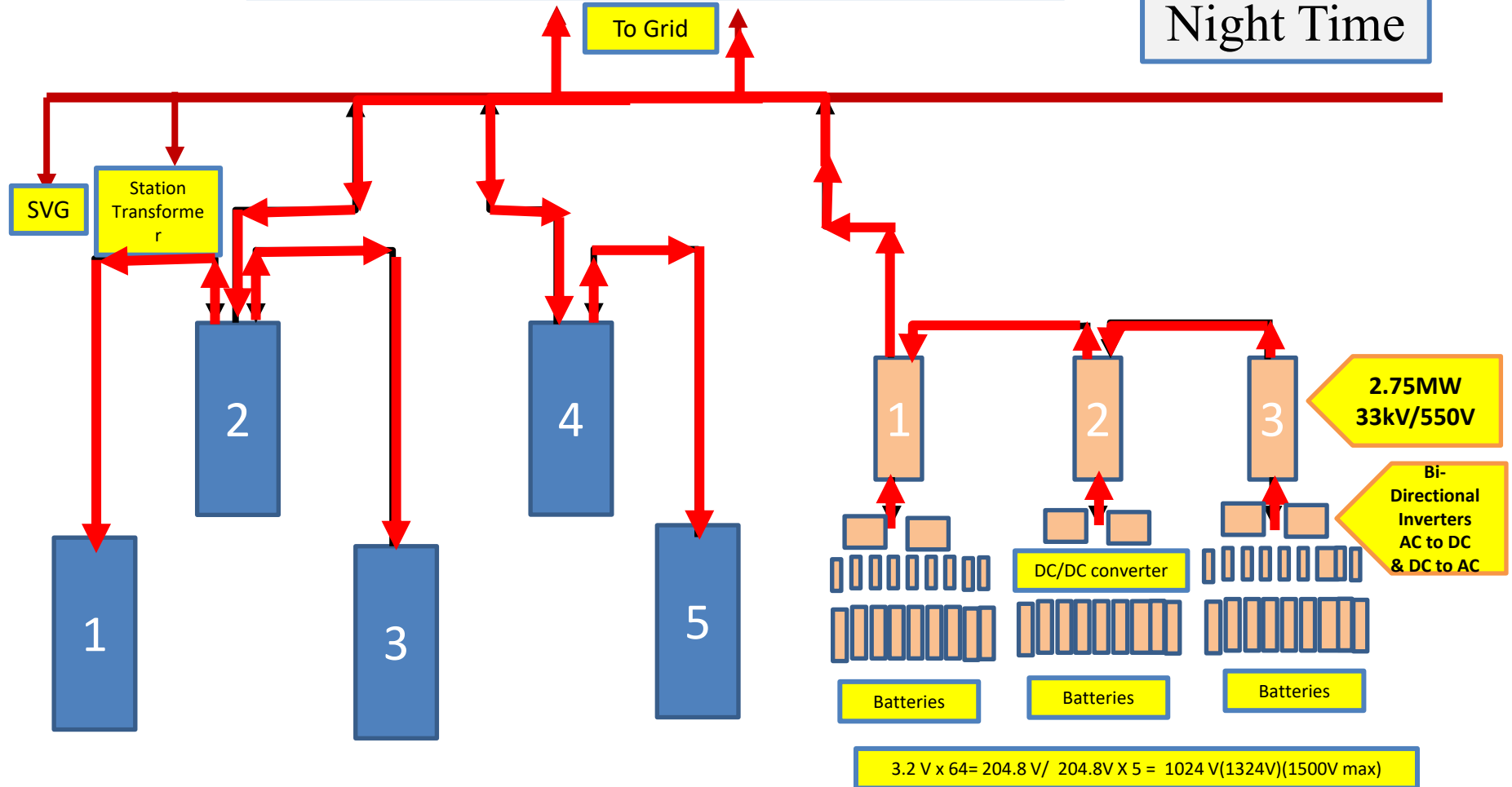
## 21.3 Concept of Solar power generation , Connected to Grid, battery charging and discharging



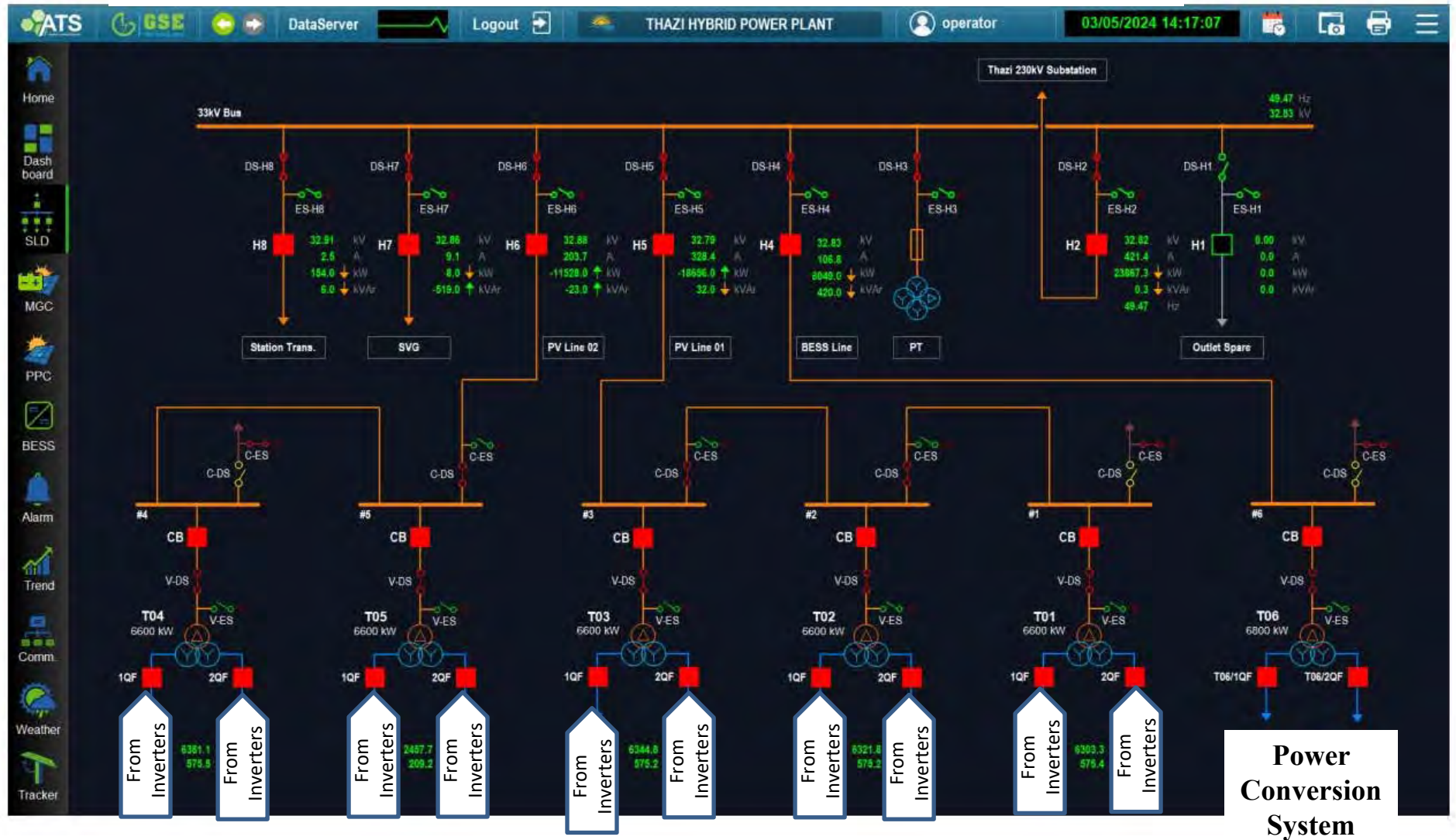
Transmission Line to Grid substation

To Grid

Night Time



# Main Single Line Diagram of Solar Power Plant



## Battery status overview on SCADA Screen



#2 LFP - MONITORING

## Battery status overview



SOC = State of Charge( %)

DOD = Dead Of Discharge(%)

SOH = State of Health (%)

## Battery condition ask to ChatGPT

In lithium iron phosphate (LFP) batteries, internal resistance tends to increase over time as the battery ages. This increase in internal resistance is due to various factors, including the degradation of electrode materials, the formation of solid electrolyte interphase (SEI) layers, and the accumulation of side reaction products within the cell.

### Internal Resistance Comparison: New vs. Old LFP Batteries

#### 1. New LFP Battery:

1. **Lower Internal Resistance:** A new LFP battery typically exhibits low internal resistance because its electrodes are in pristine condition, and there is minimal buildup of degradation products. This low resistance enables efficient charge and discharge cycles with minimal energy loss.

#### 2. Old LFP Battery:

1. **Higher Internal Resistance:** As an LFP battery ages, the internal resistance increases. This is due to several factors such as:
  1. **Electrode Degradation:** Over time, the active materials in the electrodes may degrade, leading to reduced conductivity and higher resistance.
  2. **SEI Layer Formation:** The SEI layer on the anode grows thicker with each charge-discharge cycle, which increases resistance.
  3. **Electrolyte Degradation:** The electrolyte can degrade, reducing its ionic conductivity.
  4. **Mechanical Stress and Fatigue:** Repeated cycling can cause mechanical stress and fatigue, leading to microcracks in the electrodes and current collectors, further increasing resistance.

### **Implications of Increased Internal Resistance**

- Reduced Performance:** Higher internal resistance in an old LFP battery leads to reduced power output and slower charging times. It can also cause more heat generation during operation, which can further accelerate degradation.
- Efficiency Loss:** Increased resistance means that more energy is lost as heat during charging and discharging, reducing the overall efficiency of the battery.
- Capacity Fade:** Alongside increased internal resistance, the battery's capacity may also fade, meaning it can hold less charge over time.

### **Measurement of Internal Resistance**

Internal resistance can be measured using techniques such as Electrochemical Impedance Spectroscopy (EIS) or by applying a known current and measuring the voltage drop. Regular monitoring of internal resistance is crucial for understanding the health and performance of the battery over its lifecycle.

### **Conclusion**

The internal resistance of an old LFP battery is greater than that of a new LFP battery due to the various forms of degradation that occur over time. This increased resistance negatively impacts the battery's performance, efficiency, and longevity.

The internal resistance of a new lithium iron phosphate (LFP) battery can vary depending on the specific design, quality, and manufacturer of the battery. However, for high-quality new LFP batteries, the internal resistance is typically in the range of:

### **Internal Resistance for New LFP Batteries**

•**Typical Range:** 1 to 5 milliohms per ampere-hour ( $\text{m}\Omega/\text{Ah}$ )

#### **Detailed Breakdown**

##### **1.High-Quality New LFP Batteries:**

1. **Internal Resistance:** Around 1 to 3  $\text{m}\Omega/\text{Ah}$
2. **Example:** For a 50 Ah battery, this translates to an internal resistance of approximately 50 to 150 milliohms.

##### **2.Standard New LFP Batteries:**

1. **Internal Resistance:** Around 3 to 5  $\text{m}\Omega/\text{Ah}$
2. **Example:** For a 100 Ah battery, this would be about 300 to 500 milliohms.

## Factors Influencing Internal Resistance

- 1. Battery Design:** Different manufacturers may use various materials and construction techniques, leading to differences in internal resistance.
- 2. Quality of Materials:** Higher quality materials typically result in lower internal resistance.
- 3. Capacity and Configuration:** The internal resistance is often lower in larger capacity cells due to the higher current-carrying capabilities.

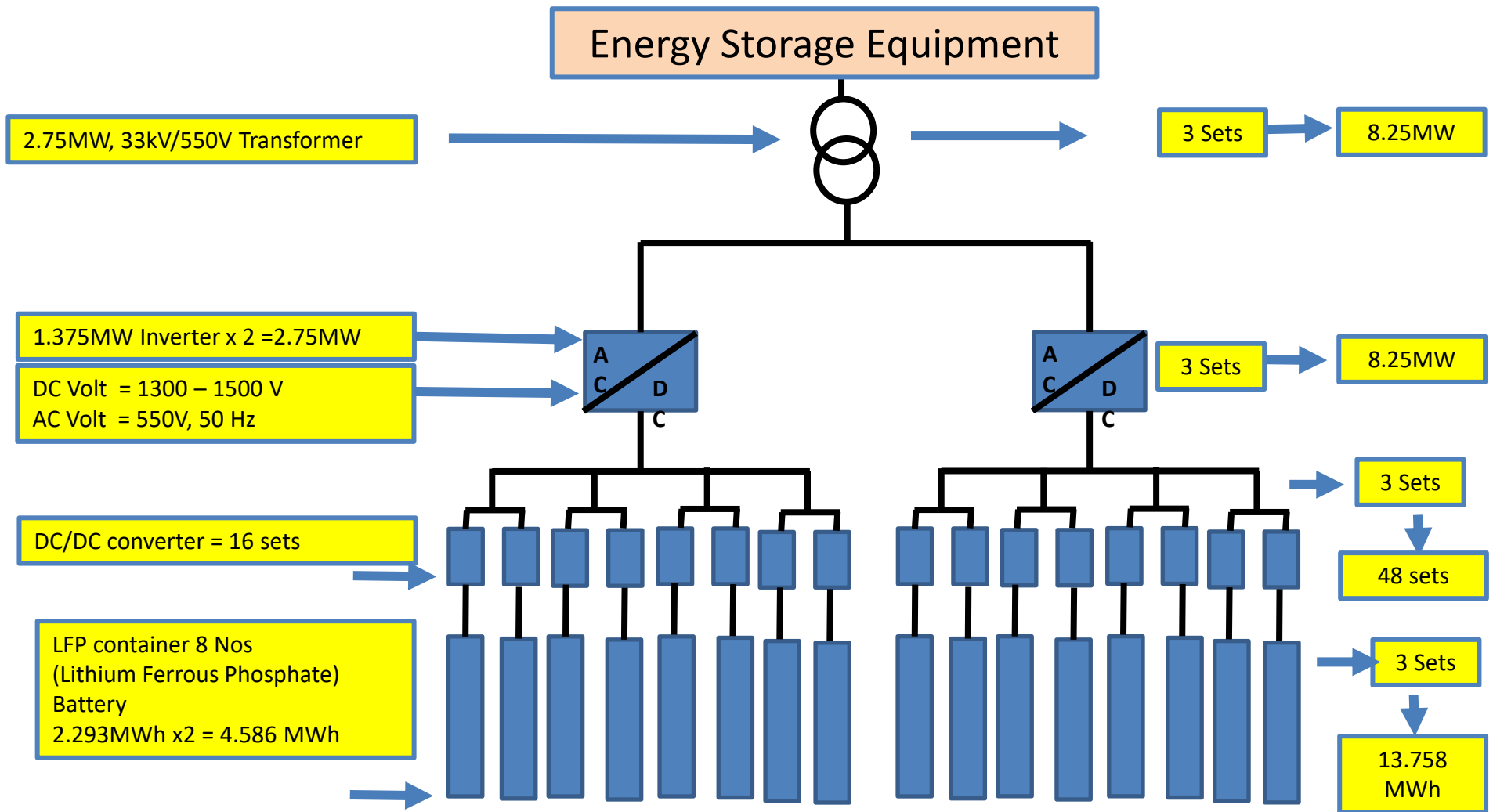
## Practical Implications

- **Efficiency:** Lower internal resistance in new batteries ensures higher efficiency with less energy lost as heat.
- **Performance:** Batteries with lower internal resistance can deliver higher power outputs and support faster charging rates.

## Example Manufacturers and Specifications

- **A123 Systems:** Known for producing LFP batteries with very low internal resistance, often in the lower end of the 1-3 mΩ/Ah range.
- **BYD and CATL:** Other leading manufacturers also producing high-quality LFP batteries with competitive internal resistance values.





# Concept of Charging & Discharging

Day Time Function

Night Time Function

To Grid

33kV Bus

From Solar Farm

Primary

33kV

Secondary

33kV

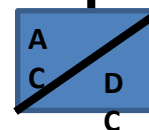
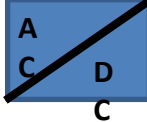
2.75 MW

Primary

550 V

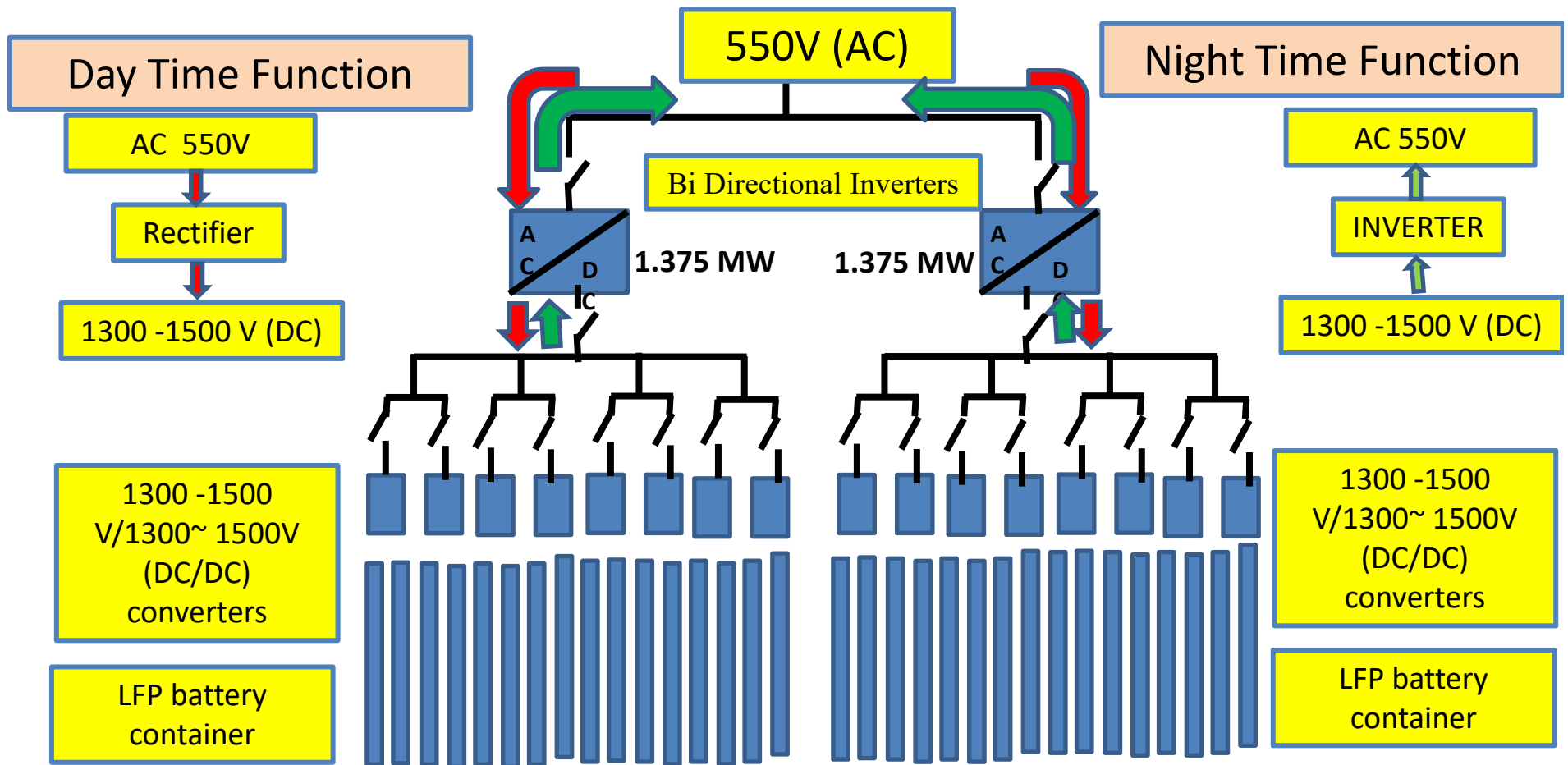
Secondary

550 V



## Function of AC/DC Equipment

### Project 3



## Single line diagram of 1 Box Transformer

Transformer Capacity = 6.6 MW,  
33/0.8 -0.8kV

Inverter Capacity = 300 kW

Inverter Quantity = 22 sets

Polysilicon bifacial solar module 550Wp

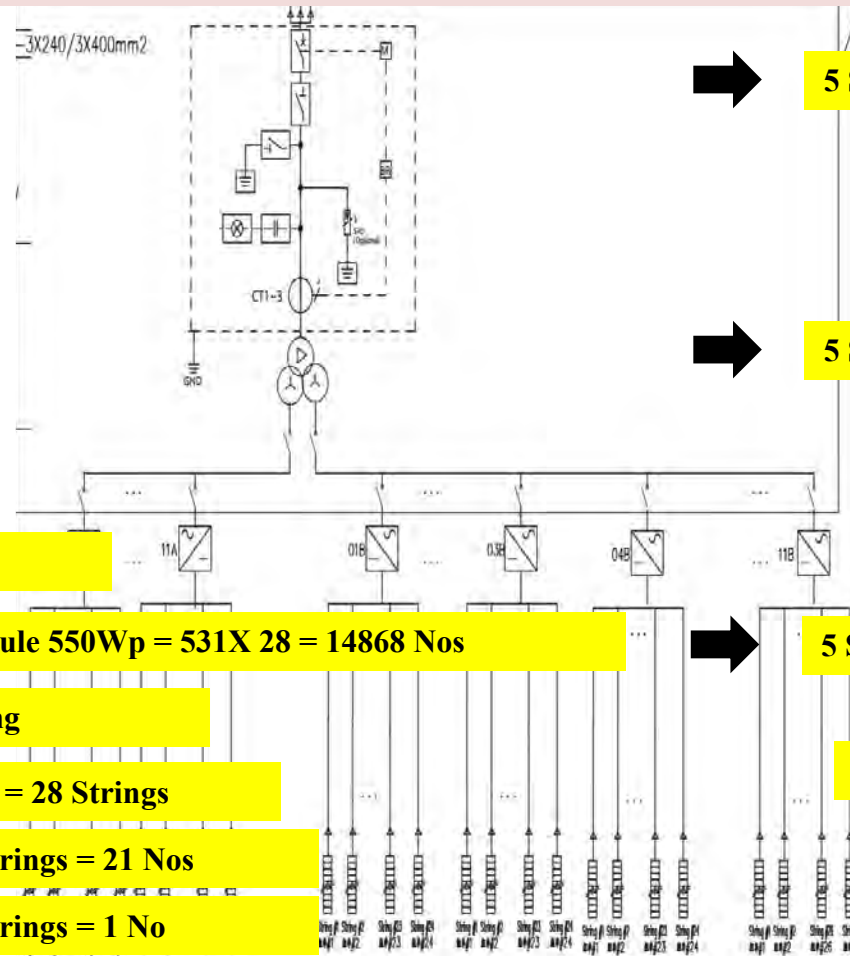
Total Nos of Polysilicon bifacial solar module 550Wp =  $531 \times 28 = 14868$  Nos

Total String for 1 Transformer = 531 String

Maximum connected String for 1 Inverter = 28 Strings

Nos of Inverters that connected with 24 Strings = 21 Nos

Nos of Inverters that connected with 27 Strings = 1 No



5 Sets

33 MW

5 Sets

110 set

33 MW

5 Sets

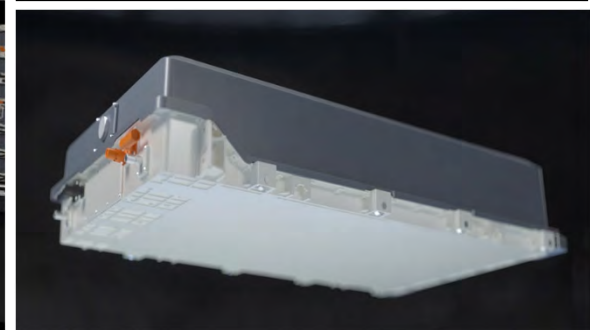
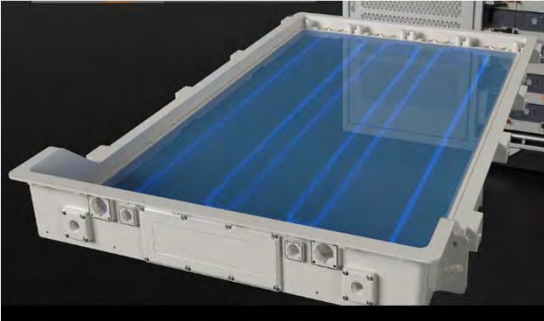
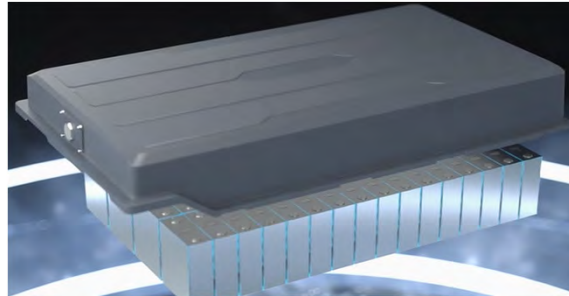
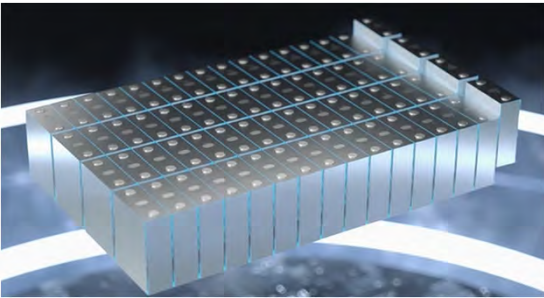
74340 Nos

DC Power =  $74340 \times 550\text{Wp}$

40.887MW

## **(22) Battery Rack Container Construction Images**

# Battery Pack assembly



## Container 1#လုံး#အတွက်လျှပ်စစ်သိုလှောင်စွမ်းအား

## Project 3

Battery cell တစ်ခု၏# capacity နှင့်#ဗို့အား##

#? **280Ah, 3.2V**

Battery Cell တစ်ခု၏သိုလှောင်လျှပ်စစ်စွမ်းအား#(  $280 \times 3.2 = 896 \text{ Wh}$  ) = **0.896 kWh**#

Battery cell 64 ခုကို##1 Packing ထုပ်ထားသည့်###လျှပ်စစ်စွမ်းအား#

\*0.896 kwh x 64)

####=**57.344kWh**

1 pack Voltage (3.2 Vx 64 nos series)

####=**204.8V**#

Battery pack 5 ခုကို##1 Rack တပ်ဆင်ထားသည့်###လျှပ်စစ်စွမ်းအား#

\*57.344 kwh x 5)

=**286.72kWh**

1 rack Voltage (204.8 Vx 5 nos series)

= **1024V**#

**Container#တလုံးလျှင်#8 racks ပါရှိပြီး#စုစုပေါင်း#လျှပ်စစ်သိုလှောင်စွမ်းအားမှာ? #2.293MWh**  
( $286.72 \times 8 \text{ racks} = 2293.76 \text{ kWh} = 2.293 \text{ MWh}$ )#

**Container 6#လုံး#အတွက်လျှပ်စစ်သိုလှောင်စွမ်းအား?  $2.293 \text{ MWh} \times 6 = 13.758 \text{ MWh}$ #**

## Front view of battery container



## Internal view of battery container

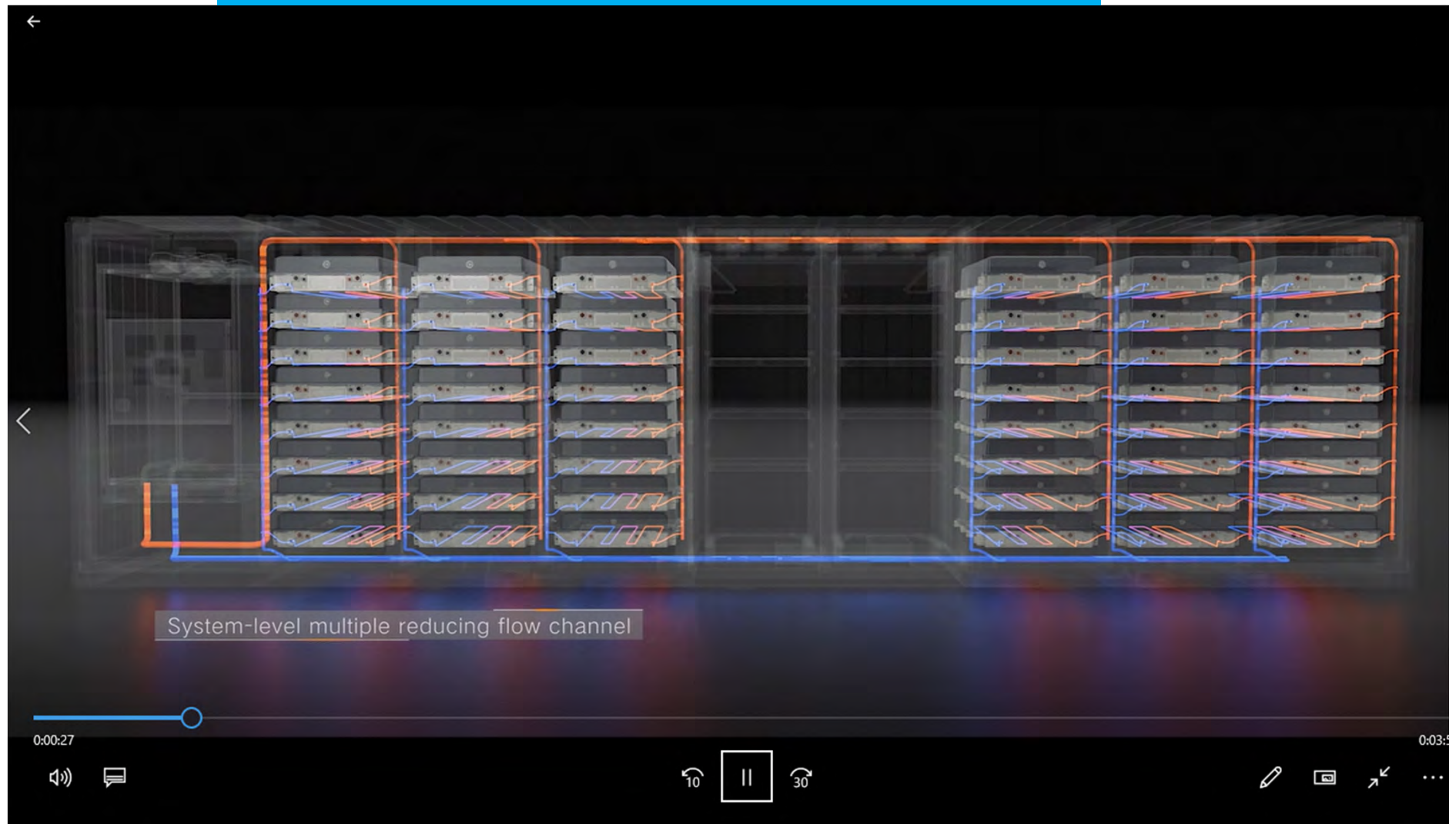


## Internal view of battery container with full battery packs



Cell temperature difference  $\leq 2.5^{\circ}\text{C}$

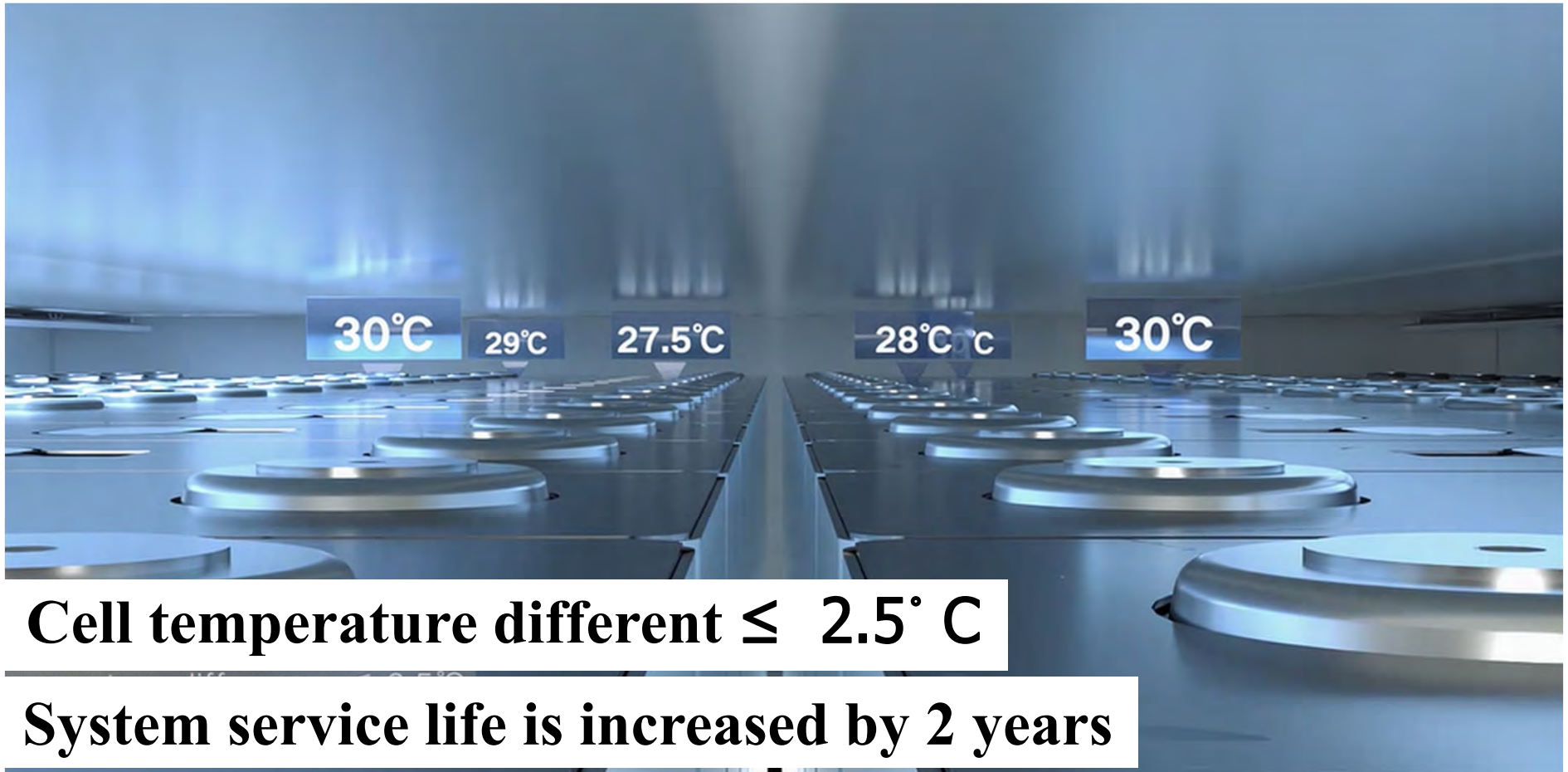
# Battery pack cooling system





**Cell temperature different  $\leq 2.5^{\circ}\text{C}$**

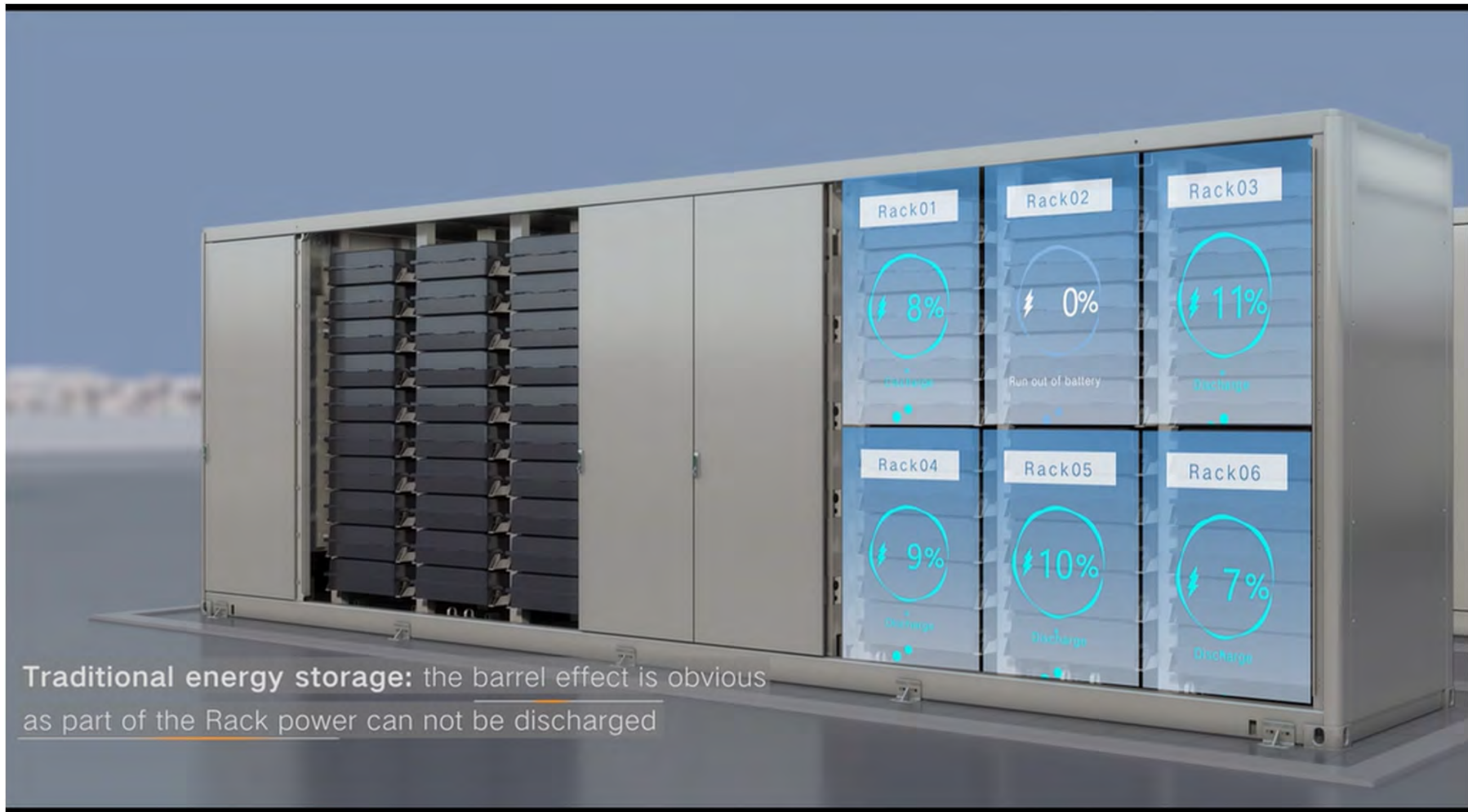
**System service life is increased by 2 years**

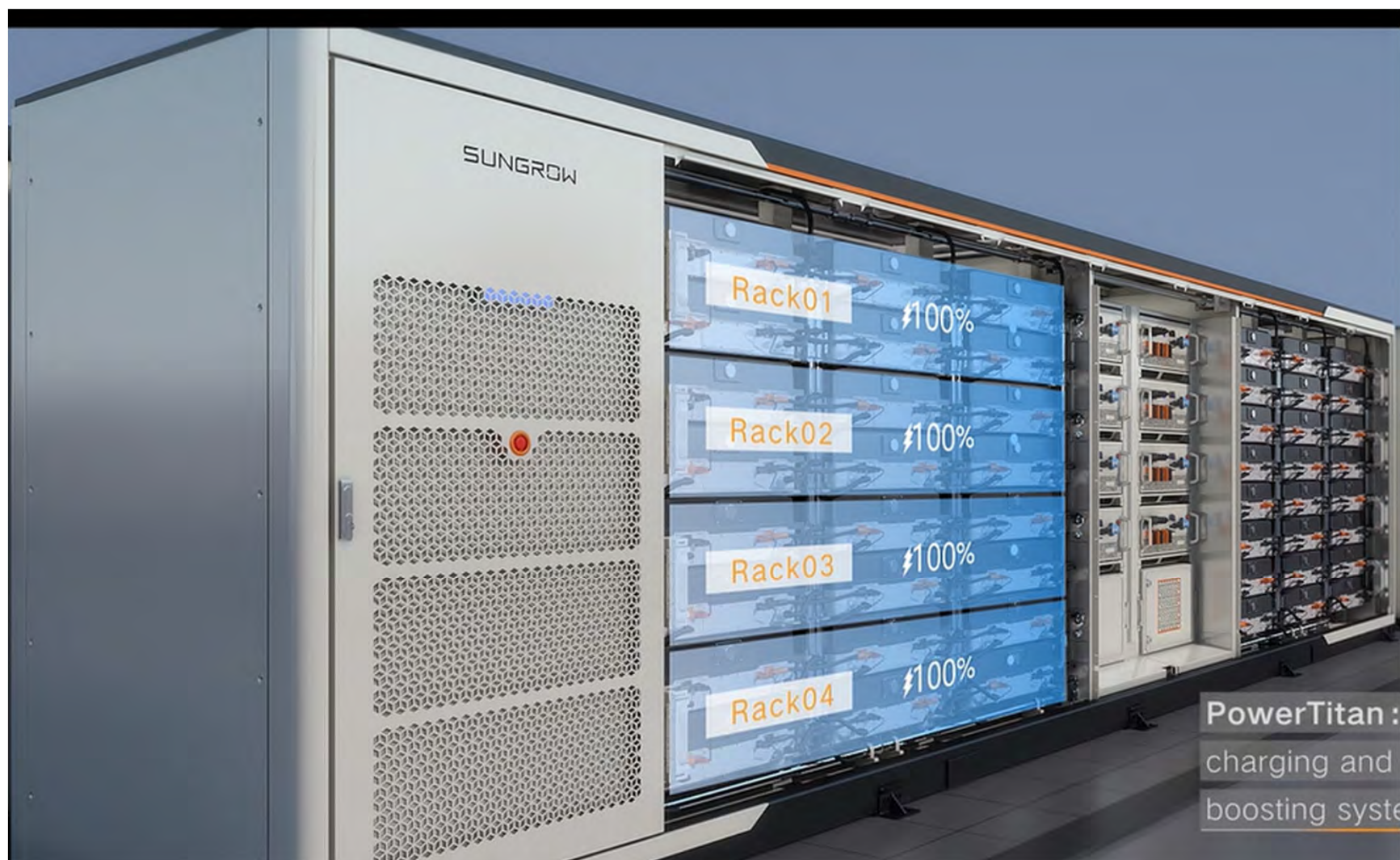




**Intelligently adjust the power consumed  
for thermal management and reduce  
energy loss by 30%**







PowerTitan :  
charging and  
boosting system

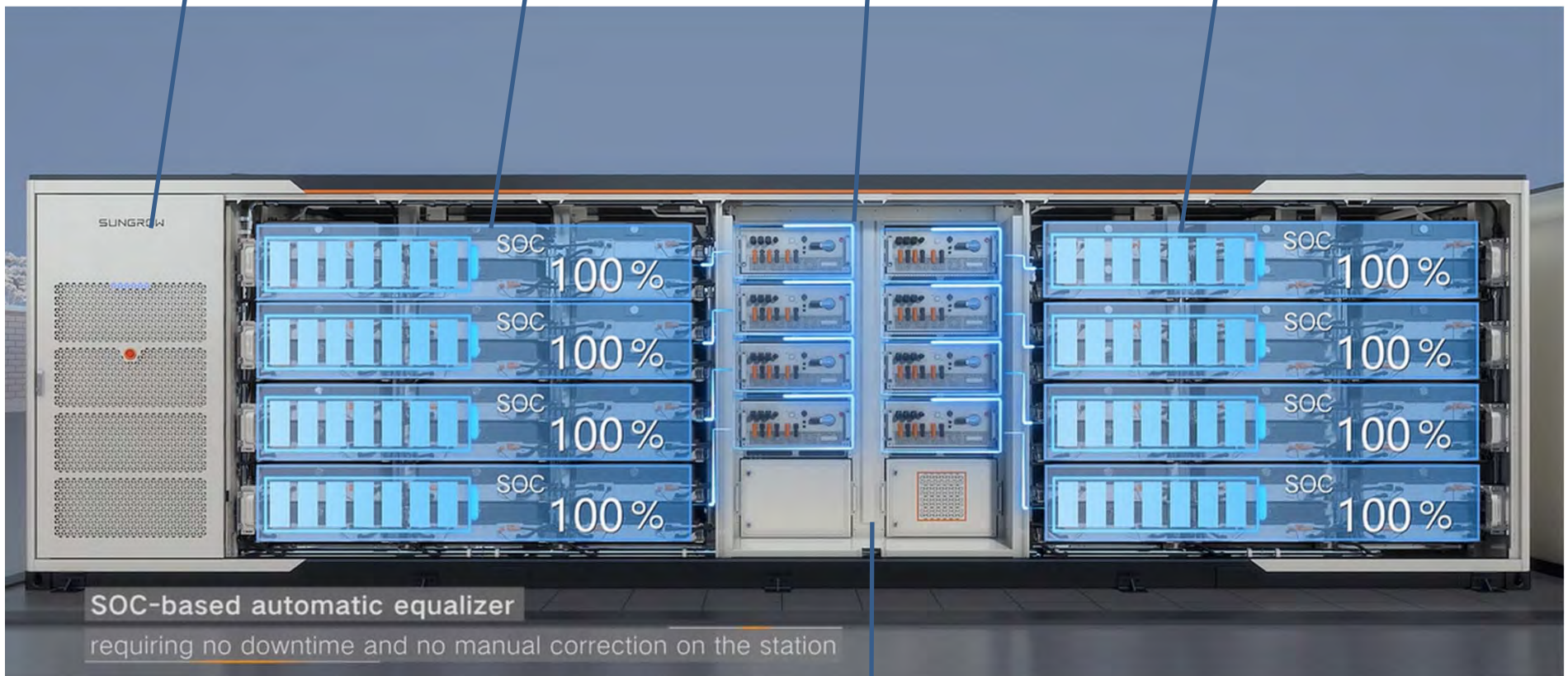


- Liquid Cooling System Chamber

- Battery Racks

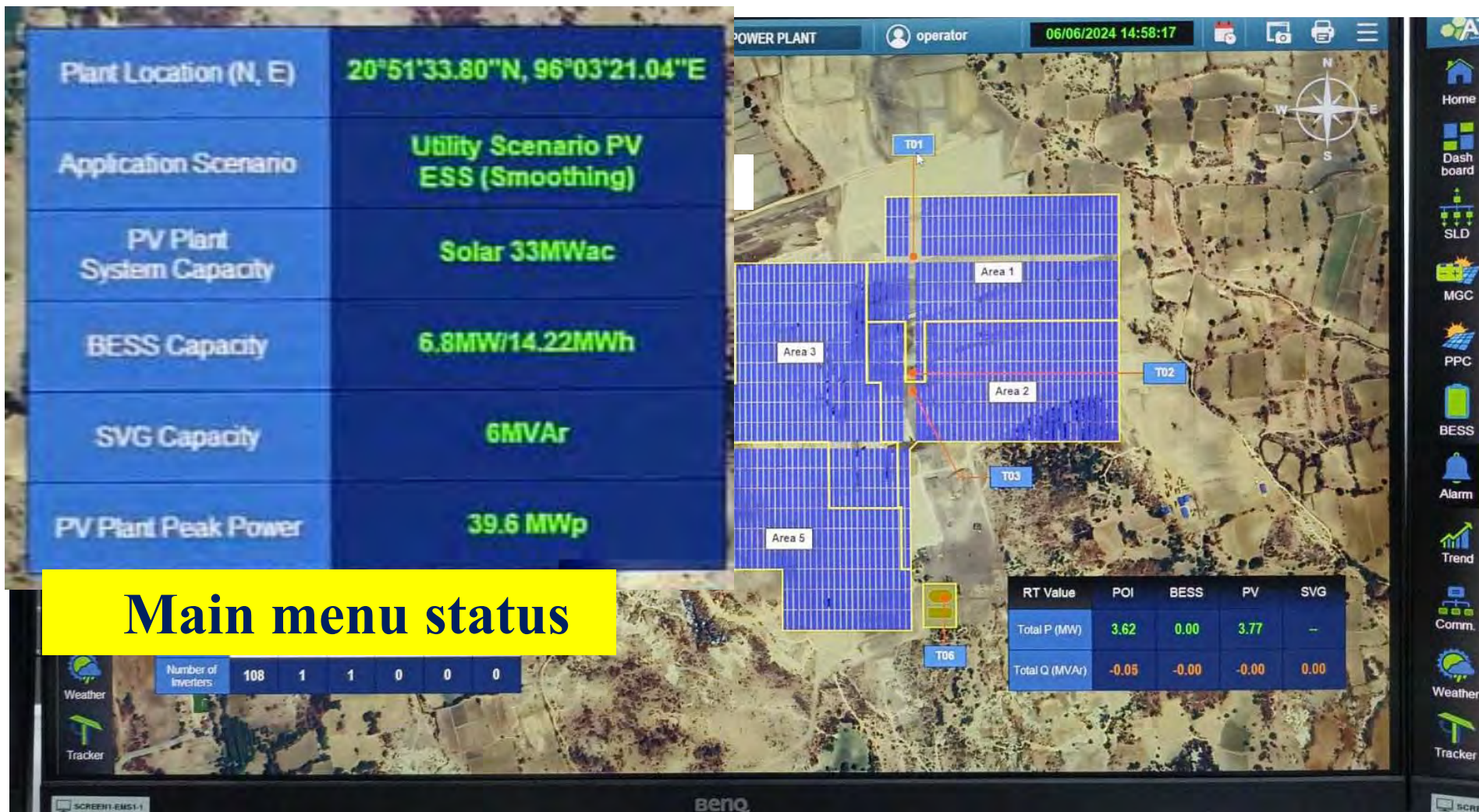
- DC/DC Converters

- Battery Racks



- DC Cable Termination panel

## **(23) SCADA Home screen and Monitoring Screens**

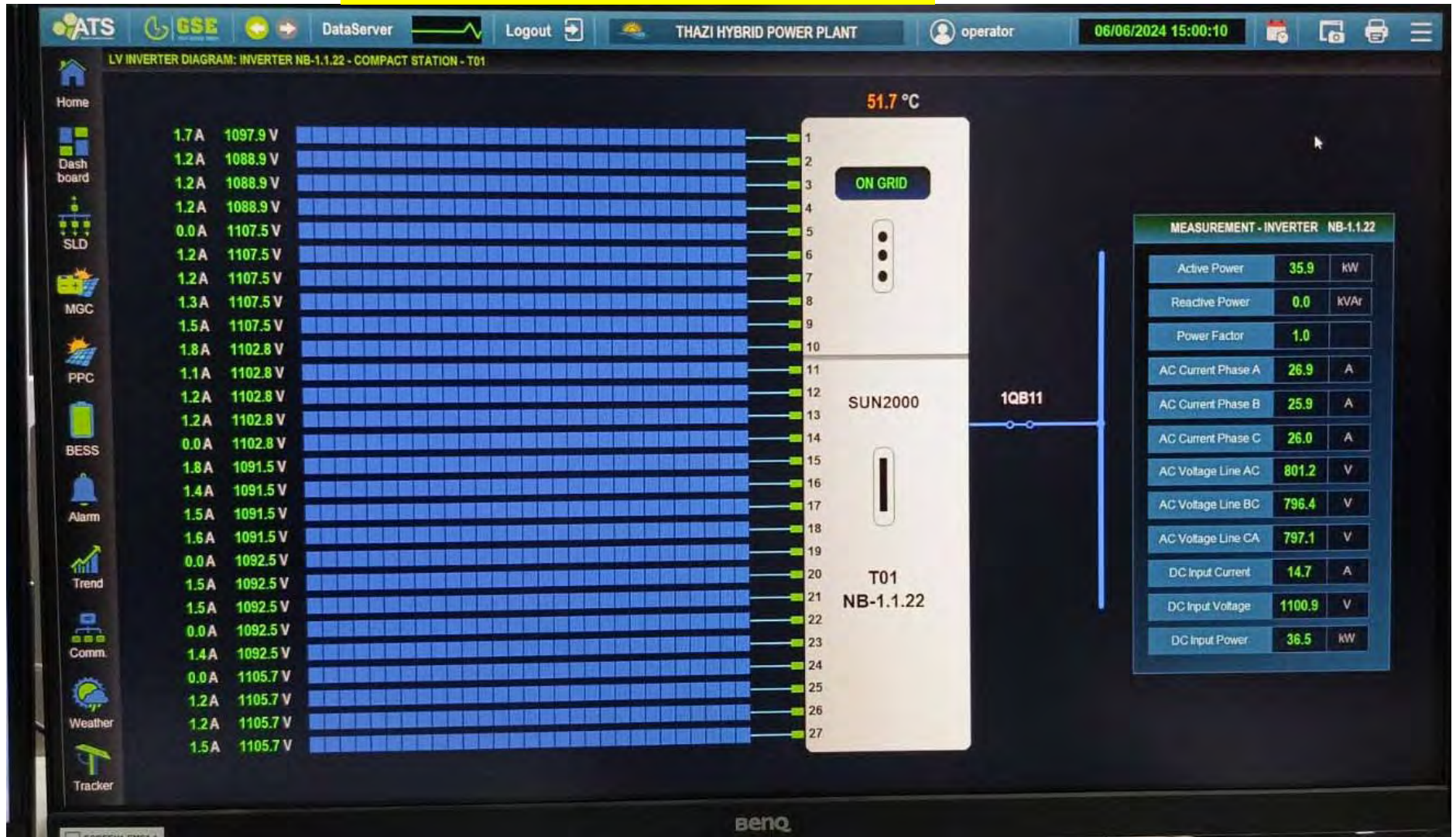


Main menu status

# Box type transformer Status



# Solar String Status



# String Inverters Status



# Alarm Status

COMMON BCU			
PT_Cabinet_BCU_Fail	PQM_channel_alarm	DC_rectifier_fault	DC_fedder_panel_AC_serial_into_DC
PT_Cabinet_BCU_Alarm	PQM_device_alarm	DC_monitor_fault	NVR_Alarm
PT_Cabinet_DC_MCB_Fail	PQM_DC_power_MCB_Trip	Comm_power_module_fault	Fire_alarm
33kV_line_control_panel1_AC_MCB_Trip	PQM_AC_power_MCB_Trip	Comm_power_system_alarm	Fire_host_fault
33kV_line_control_panel1_DC_MCB_Trip	DFR1_Fail	comm_mon_and_ctrl_unit_alarm	AC_Module_Alarm
33kV_line_control_panel1_PT_MCB_Trip	DFR1_Alarm	comm_mon_and_ctrl_unit_fault	AC_Module_fault
33kV_line_control_panel1_F871_or_F511_device_fault	DFR1_AC_MCB_Trip	UPS_mon_and_ctrl_unit_alarm	SSDF_incoming_AC_Fault
33kV_line_control_panel1_F871_or_F511_device_fault	DFR2_DC_MCB_Trip	UPS_mon_and_ctrl_unit_fault	SSDF_incoming_AC_Fault
33kV_line_control_panel1_F871_or_F511_device_fault	Energy_meter_panel_DC_MCB_Trip	UPS_inv_out	33kV_line_control_panel2_AC_MCB_Trip
33kV_line_control_panel1_F871_Prot_Trip	Energy_meter_panel_VT_MCB_Trip	UPS_bypass_out	33kV_line_control_panel1_DC_MCB_Trip
33kV_line_control_panel1_CB1_Auto_reclose	Energy_meter_panel_AC_MCB_Trip	UPS_AC_in_fault	33kV_line_control_panel2_PT_MCB_Trip
33kV_line_control_panel1_DTT_Trip	Power_acquisition_device_AC_fail	UPS_DC_fault	33kV_line_control_panel2_DC1_power_supply_fault
33kV_line_control_panel1_508F_T2_trip	Power_acquisition_device_DC_fail	UPS_overload	33kV_line_control_panel2_F871_or_F511_device_fault
33kV_line_control_panel1_F511_Prot_Trip	Power_acquisition_device_fault	UPS_inv_fault	33kV_line_control_panel2_K861_relay_operated
33kV_line_control_panel1_F501_device_fault	DC_module_fault	AC_feeder_panel_AC_fault	33kV_line_control_panel2_F871_Prot_Trip
Gateway_Fail	DC_insulation_fault	AC_feeder_panel_DC_fault	33kV_line_control_panel2_CB1_Auto_reclose
Gateway_Fail	DC_charger_panel_DC_fault	Inverter_fault	33kV_line_control_panel2_DTT_Trip
Clock_Fail	DC_charger_panel_AC_fault	AC_feeder_panel_Overload	33kV_line_control_panel2_508F_T2_trip
Clock_sync_alarm	Battery_fault	DC_fedder_panel_insulation_device_failure	33kV_line_control_panel2_F511_Prot_Trip
Gateway_panel_DC_MCB_Trip	System_fault	DC_fedder_panel_Isolation_error	33kV_line_control_panel2_F501_device_fault
Gateway_panel_AC_MCB_Trip	Monitor_fault	DC_fedder_panel_voltage_error	

## **(24) Other System in Solar plants**

Fire Protection System, Fire Alarm system

CCTV and security System

Station Communication (OPGW)

Protection Relay System

## **(25) Implementations and Construction Process**

1. Consider of land Area requirement
2. Organization and Resources collection
3. Site clearing , Survey
4. Access road construction to site
5. Soil Testing
6. Enviromental Management Plan(EMP)
7. Construction Plans and Schedules.
8. Design Drawing Study and Implementation.
9. Grading earth work, Drilling, pile foundations, construction
10. Drainage and Fence construction
11. Material Delivery and Receiving
12. Solar PV panel support columns , tracker motor and brackets installation
13. Solar panels (photovoltaic (PV)) installation and alignment test
14. 33kV Overhead Line and OPGW Construction and installation from Solar plant to main Grid Power

15. Grid Power Station and receiving site switchyard installation and testing
16. Combine grounding system for entire solar plant area and LA system
17. AC (LT, HT) , DC, Communication cable laying
18. Inverters & Box typed transformers installation
19. Cables & wires testing and Terminations
20. High Voltage panels, control and monitoring system installation and wire connection.
21. Central control inside the power House.
22. Final testing of new transmission line and float charge test.
23. Individual final inspection and testing by supplier expert.
24. Power connecting with Grid
25. Combine test with both supplier and power authority inspectors
26. Combine COC Test (Contracted Operation Characteristics)
27. Operation and Training
28. Problems and Solving
29. Regular maintenance
30. General Study

### **Consider of Land Area Requirement**

Basically land requirement for PV panel =  $1\text{kW} / 6 \text{ m}^2$

For 1MW requirement is  $6000 \text{ m}^2$  = about **1.5 Acre**

Consider for row by row space for 1 MW =  $1.5 \times 2 =$  **3 Acre**

Consider for Access road, Fence, Parameter road, Site inspection road, Space for Inverters, space for Box type transformer, Drainage system, Fire protection space inside the fences , staff quarters and plant offices; etc **added 1.5 Acre**

**For 1MW solar plant =  $4 \sim 4.5$  acre**

For Thapyaywa 30MW =  $4.5 \times 30 = 135$  Acre (Present land **133.4 Acre**)

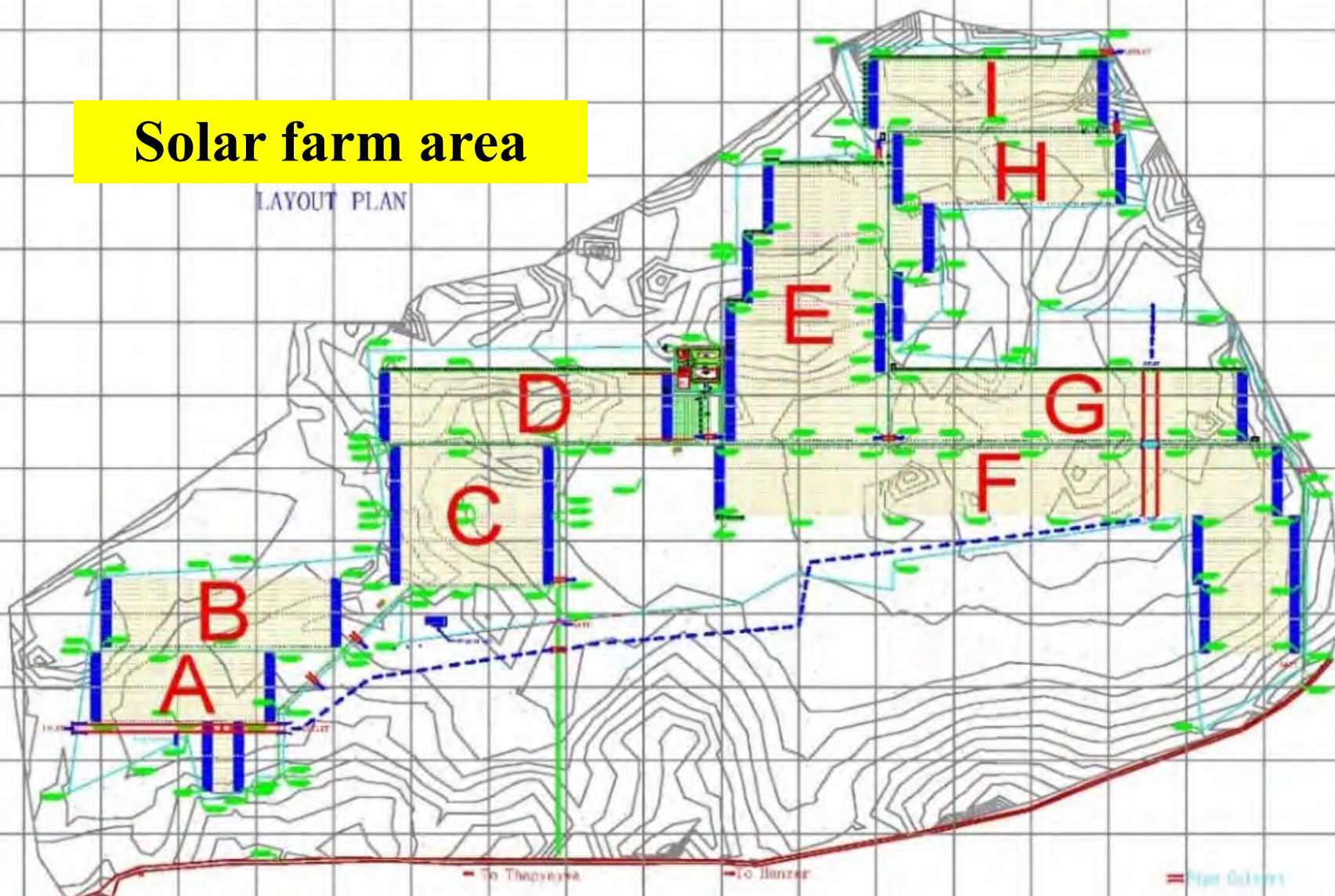
For Taung Taw Gwin 20MW =  $4 \times 20 = 80$  Acre (Present land **80 Acre**)

## Solar farm area Requirement

Particular	Project 1	Project 2	Project3	Project 4
Project Capacity	30MW	20MW	30MW 13.758MWh (BESS)	30MW 13.761MWh (BESS)
Land use	133.5 Acre	80 Acre	115 acre	115 acre
For 1MW	4.45	4.0 Acre	4 acre	4 acre

## Solar farm area

LAYOUT PLAN



## *1.Site cleanning, Survey*



## 2. Organization and Resources collection

### ROYAL VICTORY ENGINEERING SERVICES CO., LTD



**Total Vehicle and Machinery (493) units.**

**New generation Human Resources  
of  
Solar Power Energy**



## Manpower and Machinery at site

### MANPOWER AND MACHINERIES

---



TOTAL MANPOWER- 550

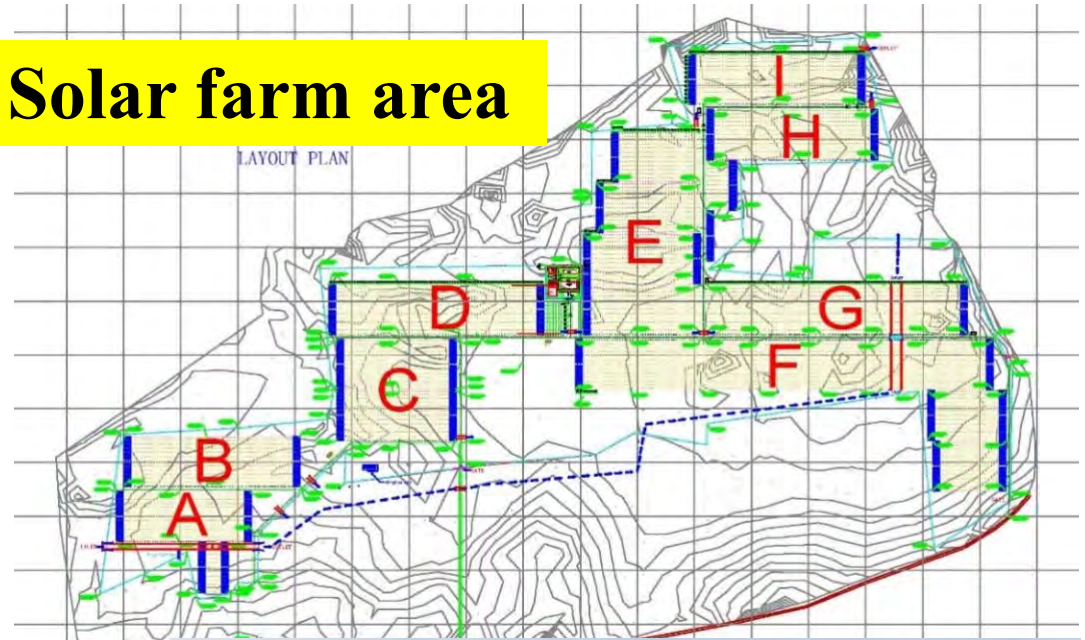


A TOTAL OF ( 60 ) VEHICLES  
AND  
MACHINERIES

### 3. Site cleaning, Survey



### Solar farm area



### Before Project Start



### Site cleaning



4. Access road to project construction site

**Access Road to Project Site**



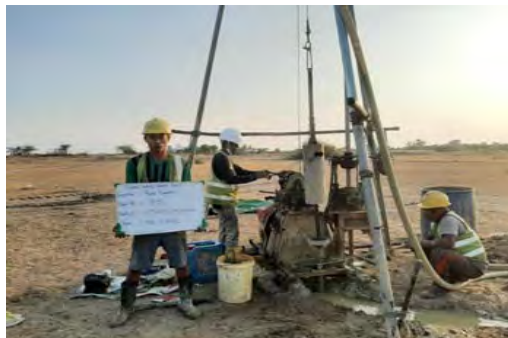
## **Access Road to Project site**



# Inspection Roads of Solar Projects



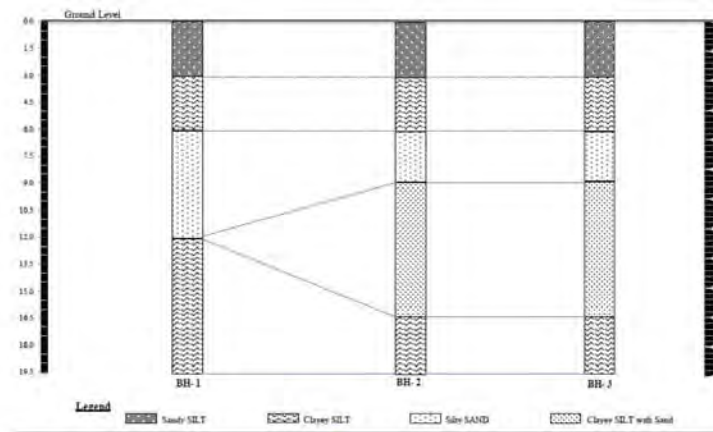
## 5. Soil testing



Drilling



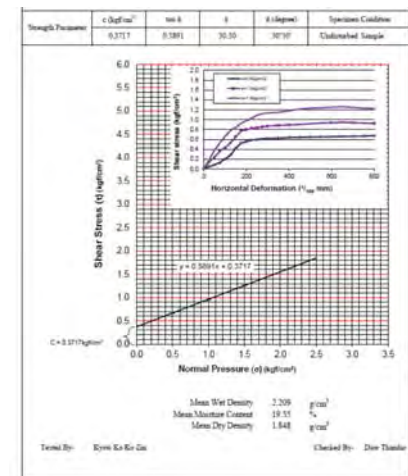
Core Sample



Cross Section Profile and Layout Plan of Bore Holes



Atterberg Limit test



Strength Parameter

## Soil test Report

### Disturbed Sample

SR. NO.	DEPTH m	GRAIN SIZE DISTRIBUTION				ATTERBERG'S LIMIT			SP. GR.	DENSITY g/cm <sup>3</sup>		MOISTURE %	SOIL TYPE
		Clay %	Silt %	Sand %	Gravel %	LL %	PL %	PI %		Wet	Dry		
1	0.0 ~ 3.45	19.00	58.00	23.00	0.00	37.50	22.01	15.49	2.67	2.00	1.71	16.75	Sandy SILT
2	4.5 ~ 6.45	27.00	68.00	5.00	0.00	49.80	24.69	25.11	2.67	2.20	1.91	15.11	Clayey SILT
3	7.5 ~ 9.45	30.50		69.50	0.00	NP			2.66	2.20	1.80	21.95	Silty SAND
4	10.5 ~ 12.45	15.00		85.00	0.00	NP			2.66	2.00	1.81	10.36	Silty SAND
5	13.5 ~ 16.95	38.50	54.50	7.00	0.00	50.20	22.03	28.17	2.69	2.00	1.64	21.76	Clayey SILT
6	18.0 ~ 19.95	38.00	52.00	10.00	0.00	48.50	21.00	27.50	2.69	2.00	1.64	22.30	Clayey SILT

### Undisturbed Sample

SR. NO.	DEPTH m	GRAIN SIZE DISTRIBUTION				ATTERBERG'S LIMIT			SP. GR.	DENSITY g/cm <sup>3</sup>		DIRECT SHEAR		MOISTURE %	SOIL TYPE
		Clay %	Silt %	Sand %	Gravel %	LL %	PL %	PI %		Wet	Dry	C Kg/cm <sup>2</sup>	Φ Degree		
1	4.0 ~ 4.5	34.00	36.00	30.00	0.00	39.80	20.14	19.66	2.68	2.20	1.84	0.3717	30° 30'	19.55	Clayey SILT
2	10.0 ~ 10.5	11.50		88.50	0.00	NP			2.66	2.00	1.69	0.0937	38° 57'	18.52	Silty SAND

## **6. Enviromental Management Plan(EMP)**



Public consultation meeting  
held on 7.1.2021 at  
MyoGyiKone Village.



Questions, Comments and Suggestions from the Attendees



Air Quality Monitoring



On-site Water Quality  
Measurement and Water  
Sampling



Noise Level Monitoring  
at Source and Receptor

## 7. Construction Plans and Schedules.

Date: 13-May-22

Item No.	Description	2022												Progress ( % )										
		March			April			May			June				July			August			September			
1	Governmental Approvals																							
	(1) MIC Permit																							100%
	(2) ESIA Report																							35%
	(3) PPA																							
2	Preliminary Survey																							100%
3	Soil Investigation																							100%
4	Machine Mobilization																							100%
5	Site Clearing																							100%
6	Levelling																							100%
7	Fencing																							90%
8	Fabrication and Shipping																							65%
9	Transportation of Equipment to Project Site																							28%
10	Civil Works																							
	(1) Box Transformer Foundation																							100%
	(2) Solar Power Station Building																							78%
	(3) Outdoor Equipment Foundation																							100%
	(4) Multi-Use Building																							100%
11	33KV New Transmission Facility Installation																							40%
12	Switch Bay																							90%
13	Drainage System																							47%
14	Equipment installation																							3%
15	New Transmission Facility Handing over																							
16	Energization																							
17	Testing for Commercial Operation																							
18	Commercial Operation Date																							
	Schedule																						56%	
	Achieve																							

## **8. Design Drawing Study and Implementation.**

### **CIVIL DRAWING LIST**

1. Box transformer foundation construction drawing.
2. Grounding and Station Transformer foundation construction drawing.
3. Construction drawing of Tracker foundation.
4. Distribution room structure construction drawing.

### **ELECTRICAL DRAWING LIST**

1. Electrical Main Equipment List
2. Overview PV Plant
3. 33kV Power Distribution device wiring and layout
4. Grounding X'mer wiring and layout
5. 400V Power single line diagram
6. Cable laying and Fire protection in Switchyard Area
7. PV Module Installation and Wire diagram
8. Principle and Installation drawing of string inverter
9. Box Transformer diagram
10. Cable layout of PV area
11. The lightning protection and earthing
12. List of power cable
13. Lighting of Switchyard
14. Electrical diagram of 33kV expansion of Thapyaywa station

## **Local Design Drawing for Projects**

### **Supporting Facility Works At 30MW Thapyaywa & 20MW Taungtawgwin Solar**

- (1) Project Area Fencing (Thapyaywa & Taungtawgwin)
- (2) Site Inspection Road (Thapyaywa & Taungtawgwin)
- (3) Construction of Bridge Myogyi Main Canal (1) (Taungtawgwin)
- (4) Drainage System
  - a. Intake Structure (Thapyaywa)
  - b. 7 Opening Box Culvert (Thapyaywa)
  - c. 7 Opening Pipe Culvert (Thapyaywa)
  - d. Side Drain of Inspection Road (Taungtawgwin)
  - e. Main Drain Work (Thapyaywa)
  - f. Outlet Gate Structure (Taungtawgwin)
  - g. Retaining Wall Between Panel Blocks (Taungtawgwin)

## 9. Grading earth work, Drilling, pile foundations, construction

❑ In accordance with the designed requirement, it's mainly emphasized-measure on Leveling.

❑ It's being implemented to withstand the earthquake magnitude scale – 8

Target days - 60 days

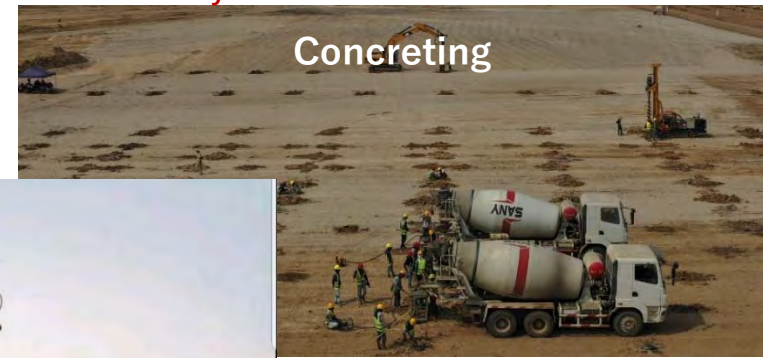
Drilling, Concreting, Footing Processing Days 50 Days



Drilling (depth- 2.5 m, 2.2 m)



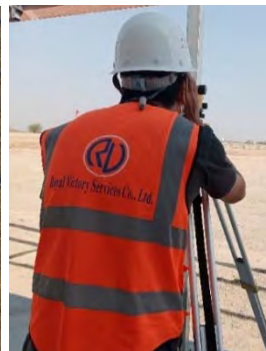
Rebar & formwork



Concreting



Footing



Levelling

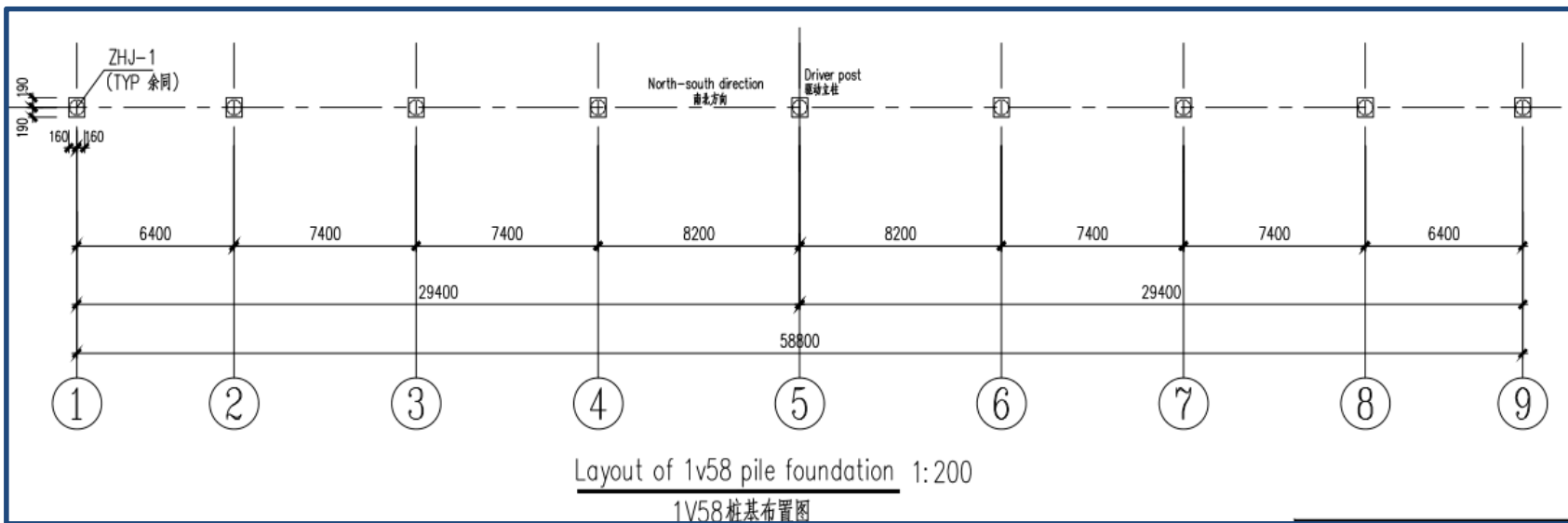


Concrete Foundation



Schedule : 12,518 nos.

## Spacing of tracker supporting column



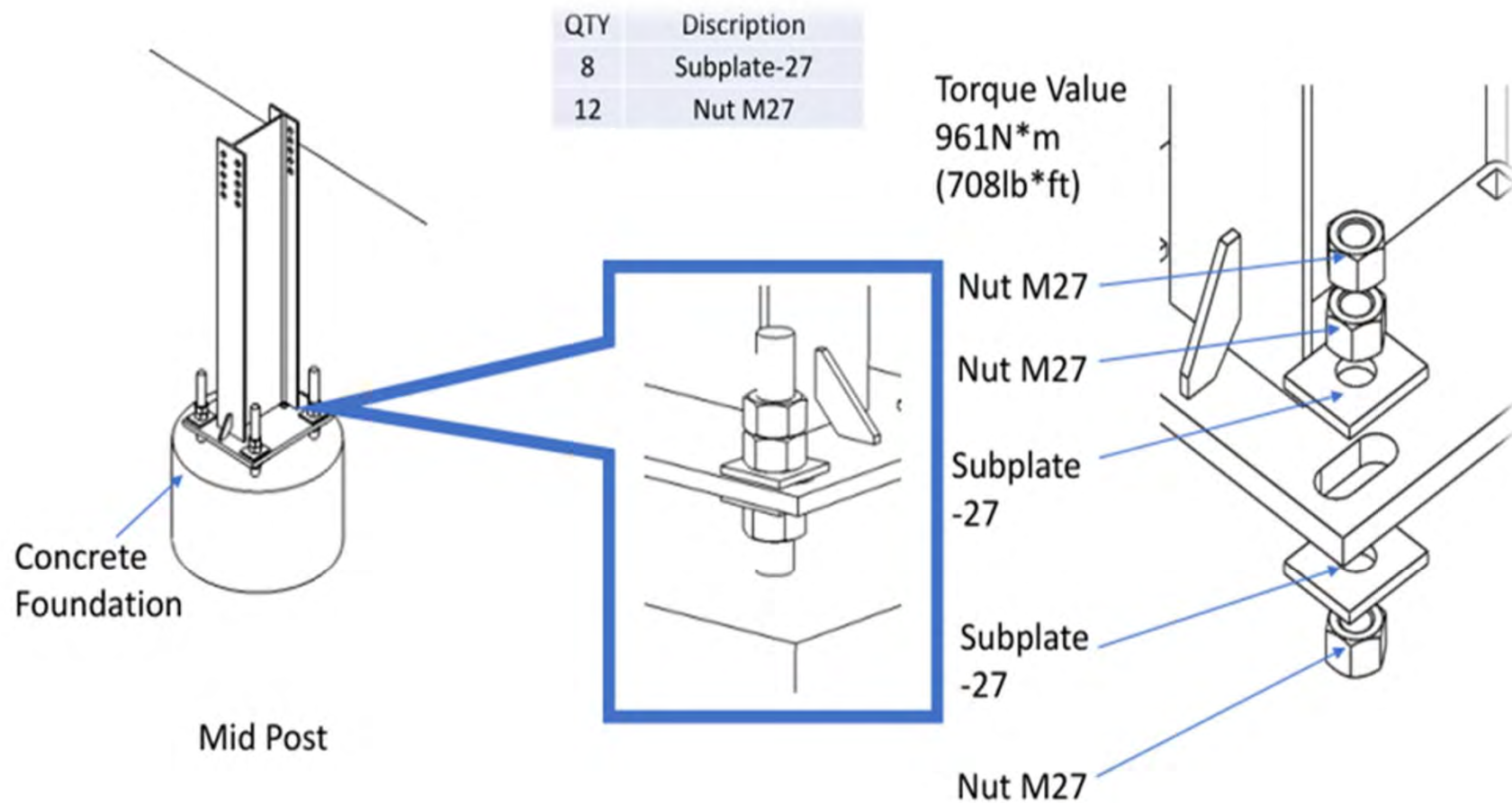
Type	Quantity	Schedule (pcs.)	Finished#(pcs.)	Balance#(pcs.)	Progress (%)
1V58 / 10 set	10 x 58	580	580	-	100
1V87 / 956 set	956 x 87	83,172	83,172	/	100
Total Quantity (PV Module)		83,752	83,752	/	100%

Solar Module supporting columns inside the water drainage canal



❑ In accordance with the designed requirement, it's mainly emphasized-measure on Leveling.

❑ It's being implemented to withstand the earthquake magnitude scale – 8



## **10 Drainage and Fence Construction**



**Drainage System Implementation Work**



**Fence Installation Work (Length 18,248 ft.)**



## Project (1 )



## Project Area fencing Work



Iron Mesh Fencing(Project 1)



Iron Mesh Fencing(Project 2)

## Inspection Road in the Project Area



30MW project



20MW Project

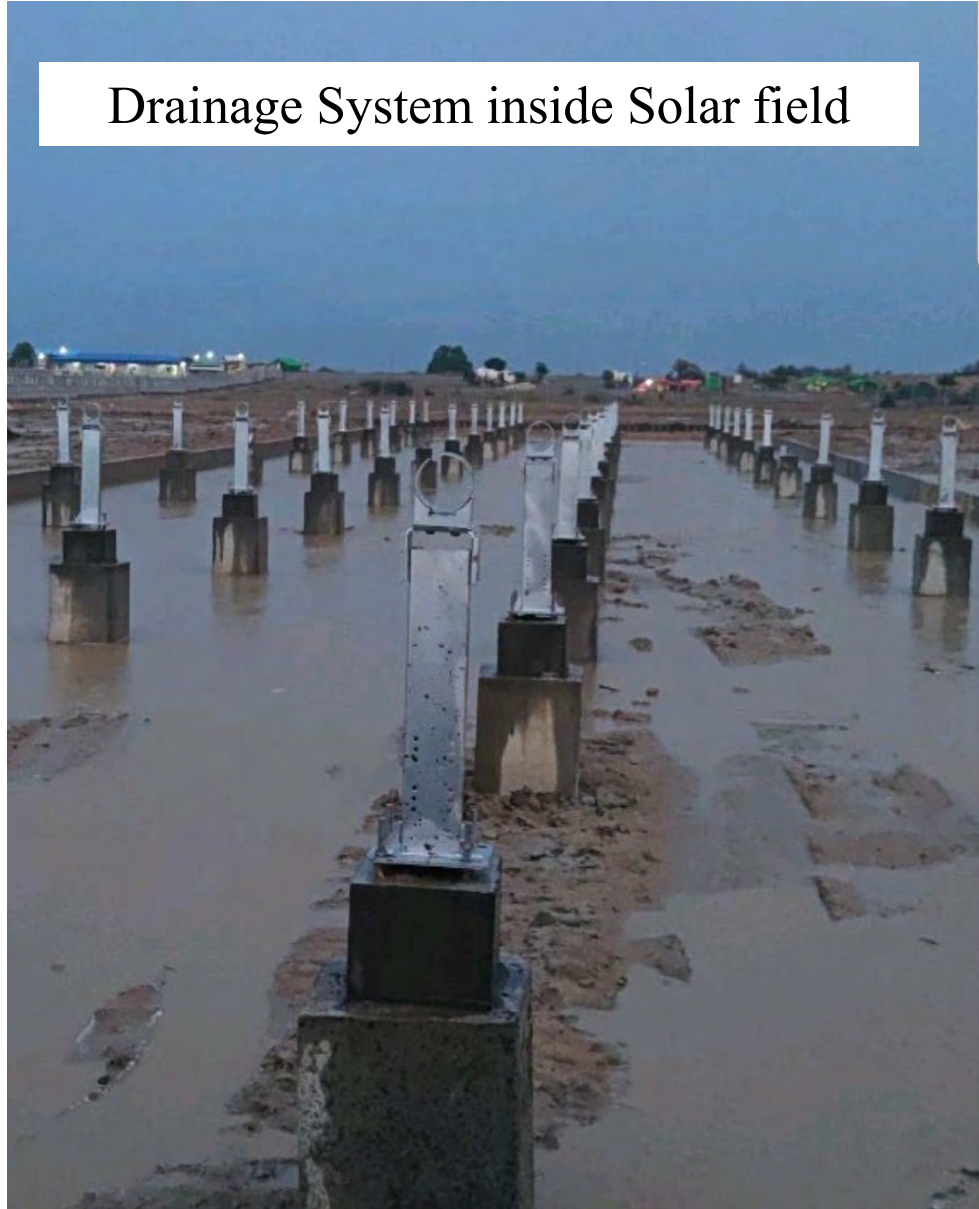


## Drainage System Pipe Culvert(7 Openings)

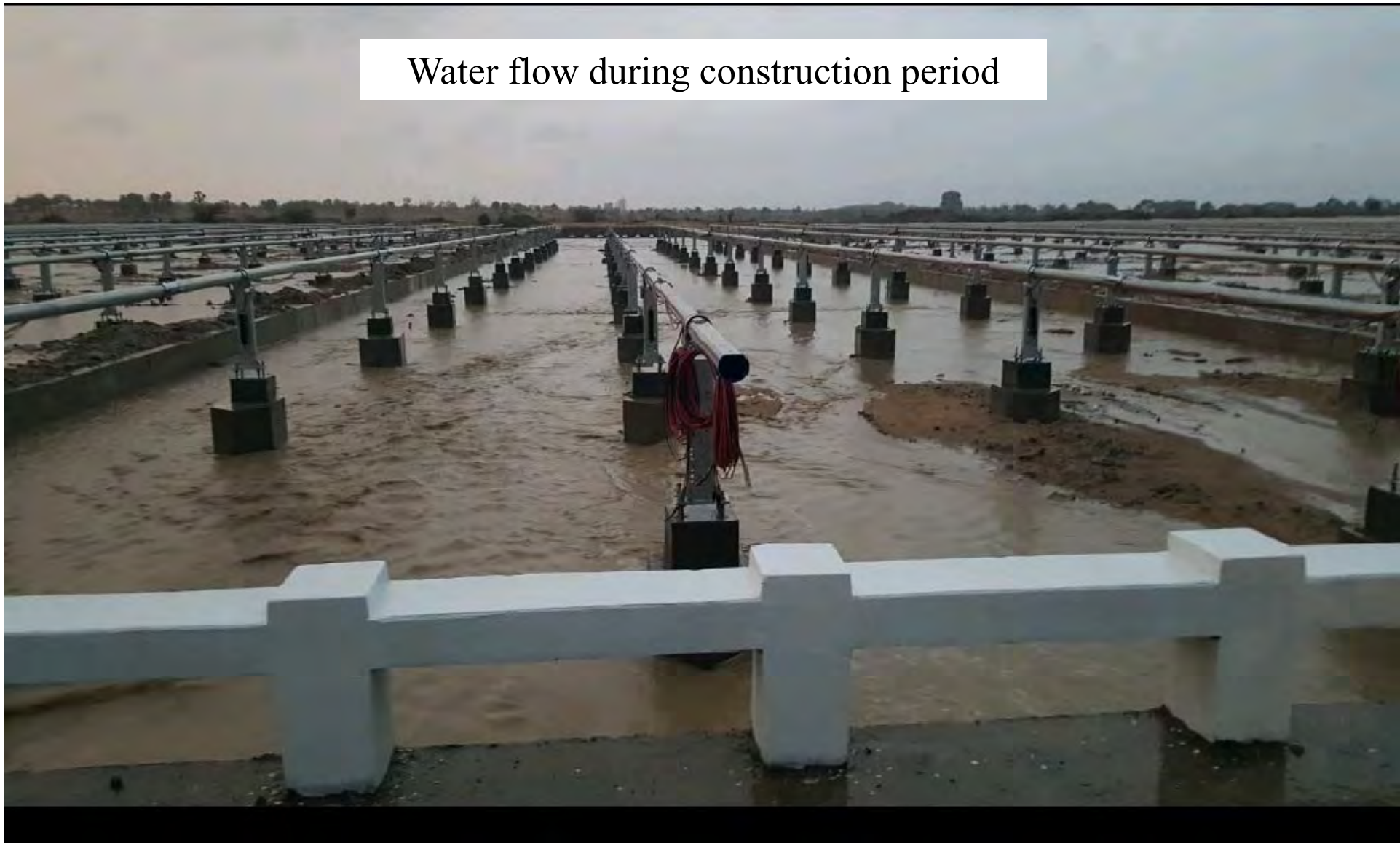




Drainage System inside Solar field



Water flow during construction period



## Construction of Bridge Across Myogyi Main Canal(1)

**Project ( 2 )**



## Drainage Intake

## Project ( 1 )



## *11 Material Delivery and Receiving*



# Facing difficulties because of epidemic Covid -19



## Material Receiving at Thapyaywa project site



## LOGISTIC OF IMPORT MATERIALS OF TAUNG TAW GWIN PROJECT



Transport by railway (from Shanghai to Linchan)



Cross-Chin Shwe Haw Border



Unloading at Chin Shwe Haw



Kunlon Bridge Crossing



Unloading at Taung Daw Gwin Project Site

Particular	Quantity
Nos. of Container (Estimate)	134 Nos.
Arrived at Chin Shwe Haw	75 Nos.
Arrived at Project Site	39 Nos.

Early March 2022 in China, many provinces and cities stopped production of factories, and logistics were interrupted due to happen a sudden and severe epidemic (including the factories that's produced the equipment for our Taungdawgwin project).

As the result, the production of equipment was inability to complete as planned and it cannot also shipped the equipment already completed production from Shanghai port in time due to the closure of Shanghai.

Lead to delay in delivery and affect on-site construction period, due to the domestic epidemic prevention and control measures and there is the time uncertainty from transportation between provinces to customs declaration at ports.

## Box-Type Transformer Arrival on Site



## **12 Solar (PV) panel support columns, Tracker motor and Bracket Installation**

### **HORIZON SINGLE AXIS TRACKING BRACKET**

- ❑ Tracker/Bracket involves motor drive system which automatically rotate backward and forward in accordance with the sun's position by control-setting.

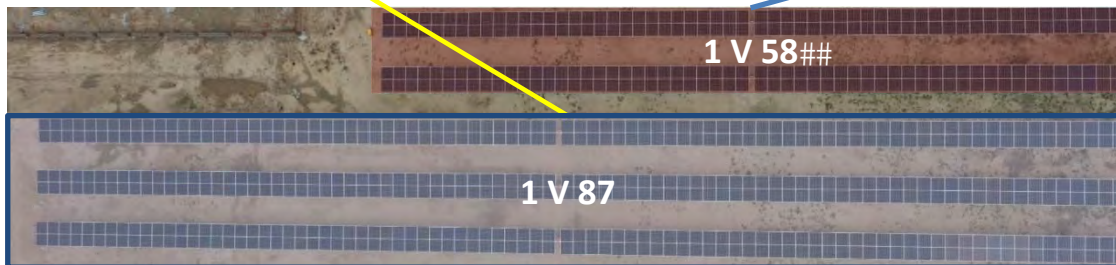
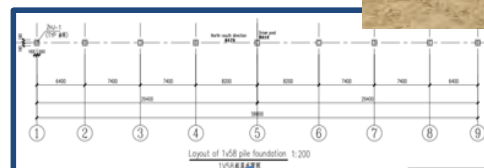
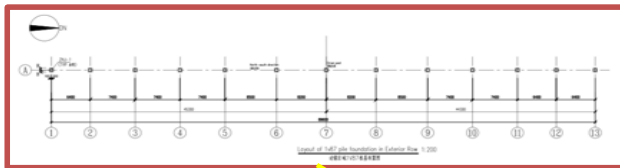


**Solar Tracking System - 966 set**



## 13 Solar (PV) panels Installation

❑ In solar installation, it involves 10 Lines of 1V/58 which is PV panels 58 pcs in one line and 956 lines of 1V87 which is PV panel 87 pcs in one line as per project designed.



Type	Quantity	Schedule (pcs.)	Finished# (pcs.)	Balance# (pcs.)	Progress (%)
1V58 / 10 set	10 x 58	580	580	-	100
1V87 / 956 set	956 x 87	83,172	83,172	/	100
Total Quantity (PV Module)		83,752	83,752	/	100%

## **14 33kV Overhead Line and OPGW Construction and installation from Solar plant to main Grid Power**

- ❑ Total Length of 3.91 Miles
- ❑ ACSR 605MCM, Single bundle, double Circuit
- ❑ Projected Timeline 60 Days of Works
- ❑ Completed Within 35 DAYS



Record photo of 33kV overhead Transmission Line

**Project (1 )**



Record photo of 33kV overhead Transmission Line

**Project ( 2 )**



**15. Grid Power Station and receiving site switchyard installation and Testing**

**Project 2 Main Power station(Grid)**

**Foundation (Switch Bay)**

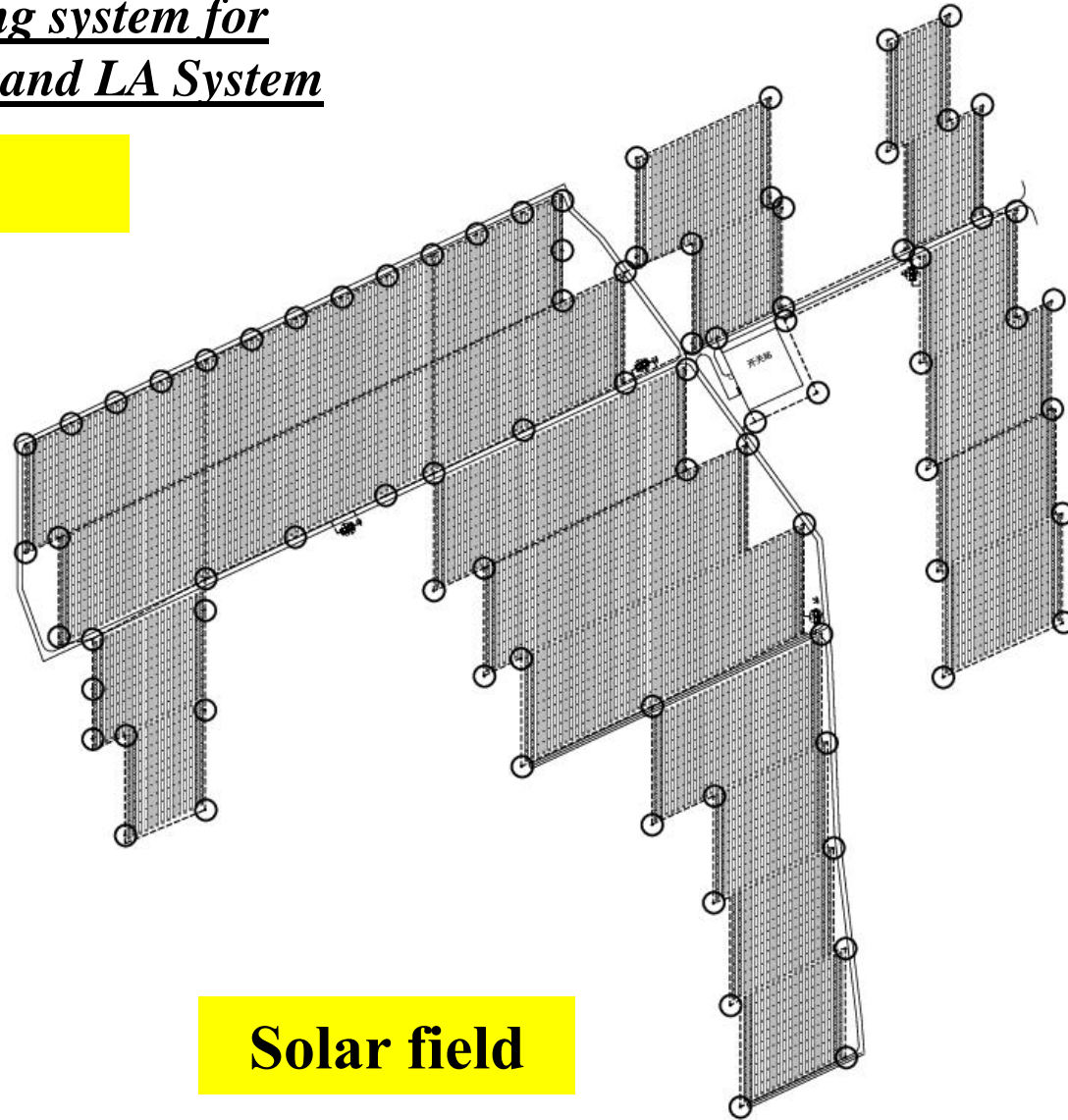


**Finished (Switch Bay) at  
Receiving Grid Substation**



**16. Combine grounding system for  
entire solar plant area and LA System**

**Project (2 )**

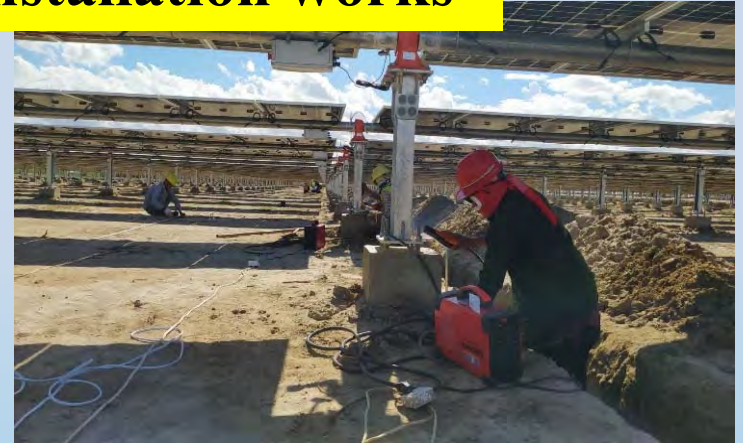


**Solar field**

## Record photos of Grounding Installation works



Grounding conductor Installation Work



Earthing Installation Work



Earthing Connection Installation Work



Lightning pole Installation

## Lightning Pole Installation



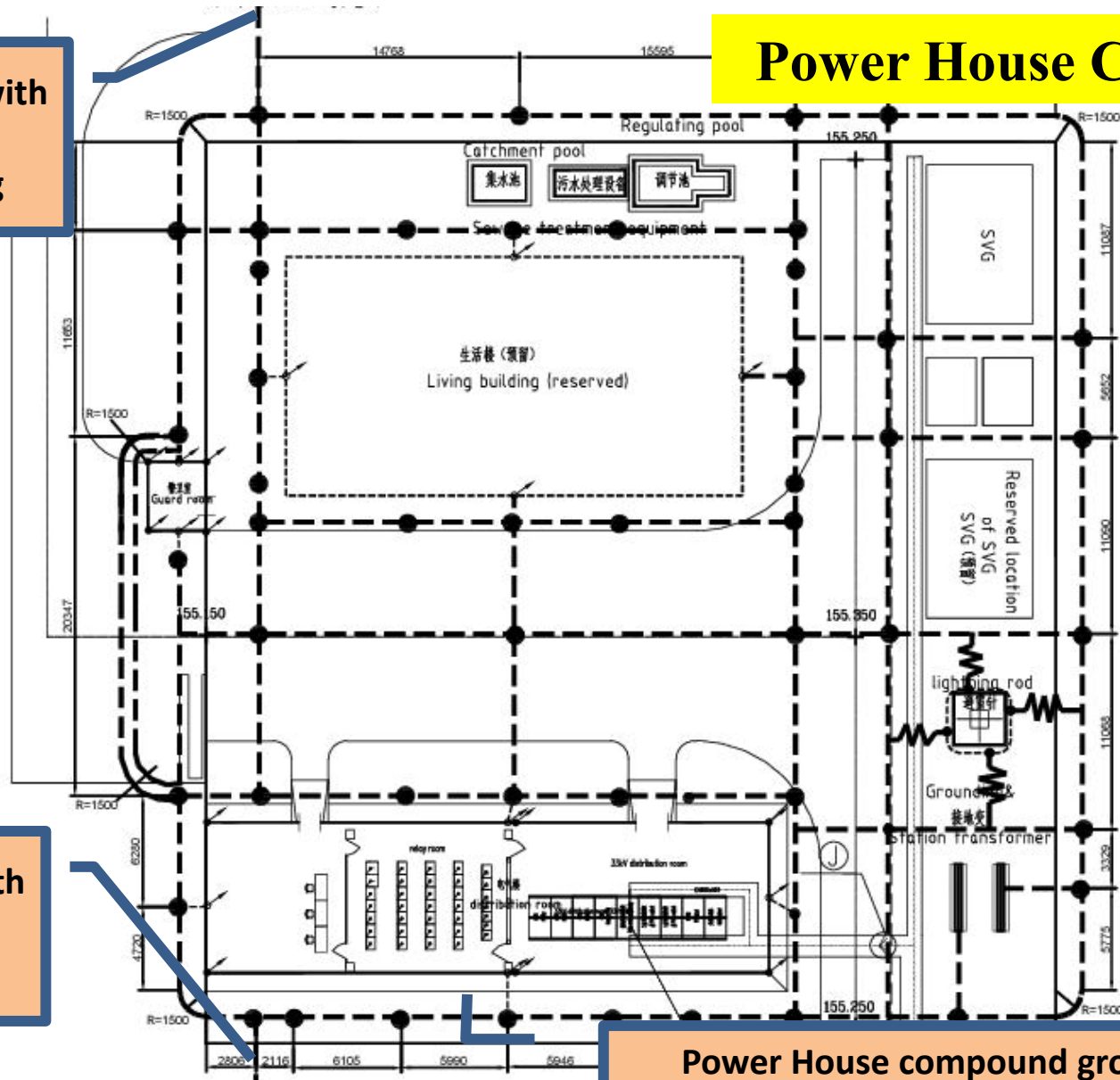
## 16. Earthing & Lightning Protection Design



# Power House Compound

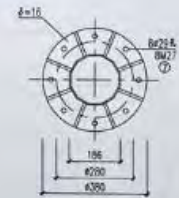
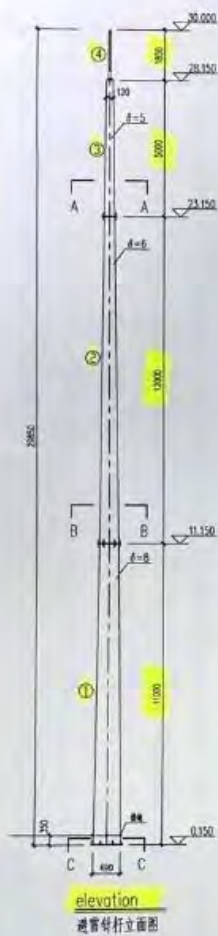
Connected with  
PV field  
grounding

Connected with  
PV field  
grounding

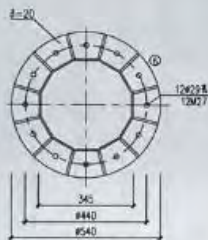


Power House compound grounding Design

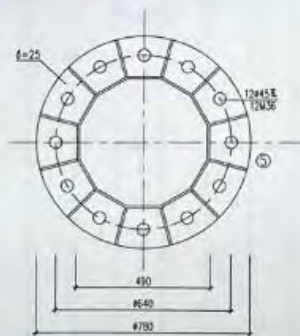
## Lightning Arrester Detail Design



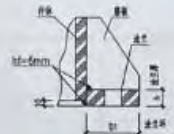
A~A放大(2块)



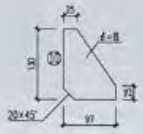
B~B放大(2块)



C~C放大(1块)



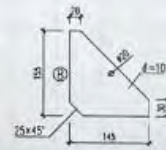
welding drawing  
法兰、杆体、隔板连接图



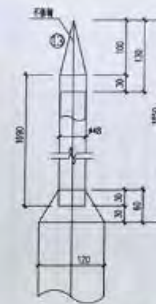
A~A 船板



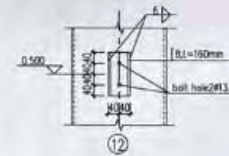
B~B 磨板



C~C 筋板  
Two of them have holes 其中二號有孔。



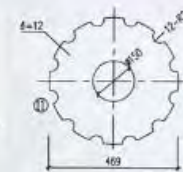
Lightning rod top  
杆顶放大图



Lightning rod bottom  
杆底放大图



Lightning rod bottom  
杆底放大图



A 部件  
One of the holes needs to be welded;  
其中一孔需焊接

**Total Height of Lightning  
Arrester Pole = 30meter**

## 17. AC (HT, LT), DC Cable laying works

## Specification of Cables

**PV to Inverter** 1 x 4 mm<sup>2</sup>

- DC Cable

### **Inverter to Box Transformer**

1.8/3kV, 3 x 150 mm<sup>2</sup>

1.8/3kV, 3 x 185 mm<sup>2</sup>

1.8/3kV, 3 x 240 mm<sup>2</sup>



- AC Medium Voltage

### **Box Transformer to Sub-Station**

26/35kV, 3 x 120 mm<sup>2</sup>

26/35kV, 3 x 150 mm<sup>2</sup>

26/35kV, 3 x 240 mm<sup>2</sup>



- AC High Voltage

### **Sub-Station**

0.6/1kV, 4 x 6 mm<sup>2</sup>

0.6/1kV, 4 x 10 mm<sup>2</sup>

0.6/1kV, 3 x 25 mm<sup>2</sup> + 1 x 16 mm<sup>2</sup>

0.6/1kV, 3 x 185 mm<sup>2</sup> + 1 x 95 mm<sup>2</sup>

0.6/1kV, 3 x 50 mm<sup>2</sup> + 1 x 25 mm<sup>2</sup>



-AC Low Volatge

**Note!**

**LT side voltage is 800 V .**

## DC cable Installation



PVC pipe Installation Work for PV Cable Supporting



Y Termination Work



Communication Box Cable installation and Piping Laying Work



Inverter Side PV Cable Termination Work

## DC cable Installation



# AC cable Installation



AC cable laying Work



Cable trenches for Cable laying works



Box transformer  
underground pipe water  
proof mud Installation Work

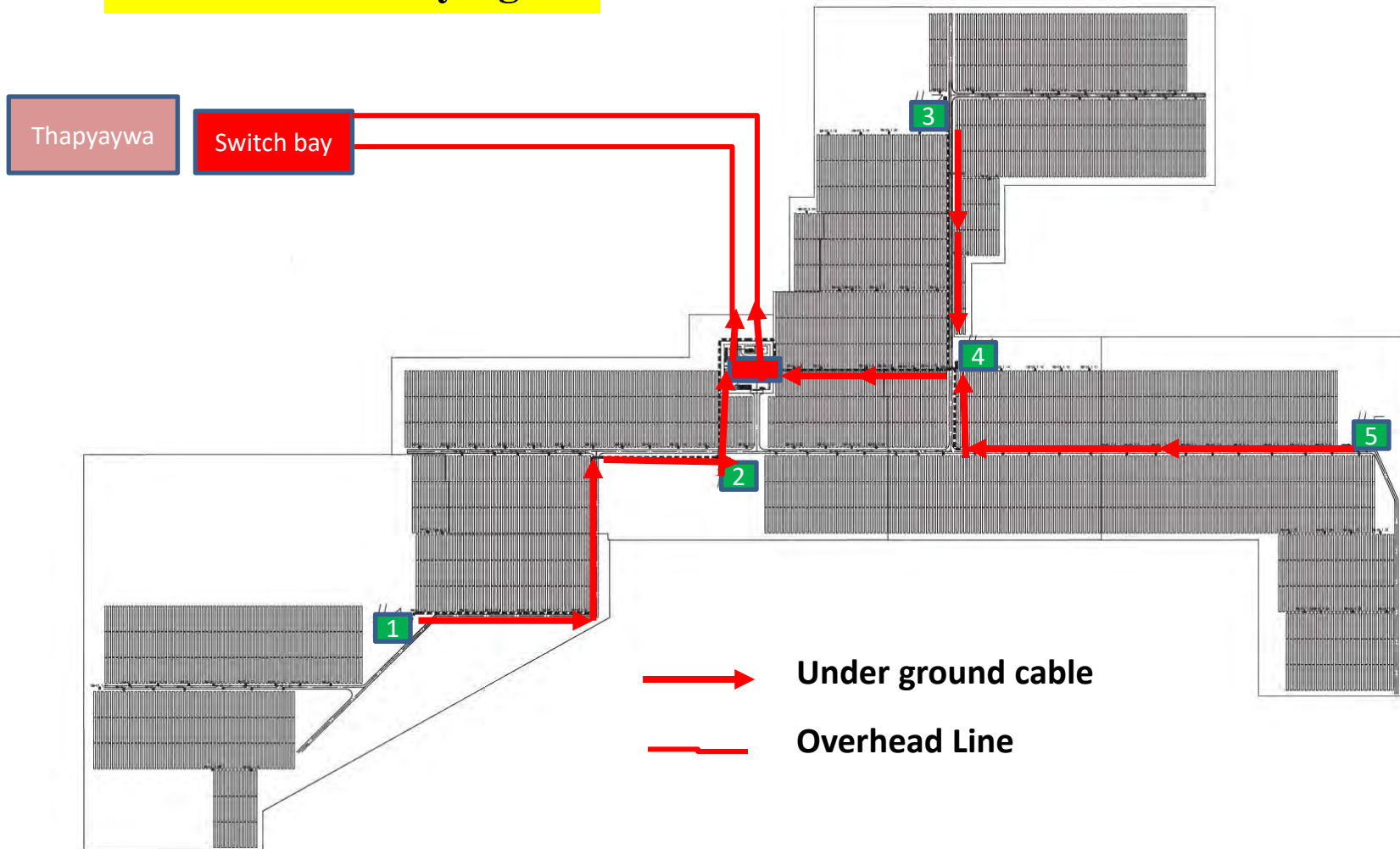


cable supporting Work

## Under ground conduit provision works



## HT Cable Laying



## Cable Laying works



## *18. Inverters & Box typed transformers installation*



### **Inverter Installation**



## Box-Typed Transformer Foundation work



Note that Need to check Pipe sleeves position (Civil foundation drawing and Electrical drawing)

## Box – Type Transformer Placing and Installation

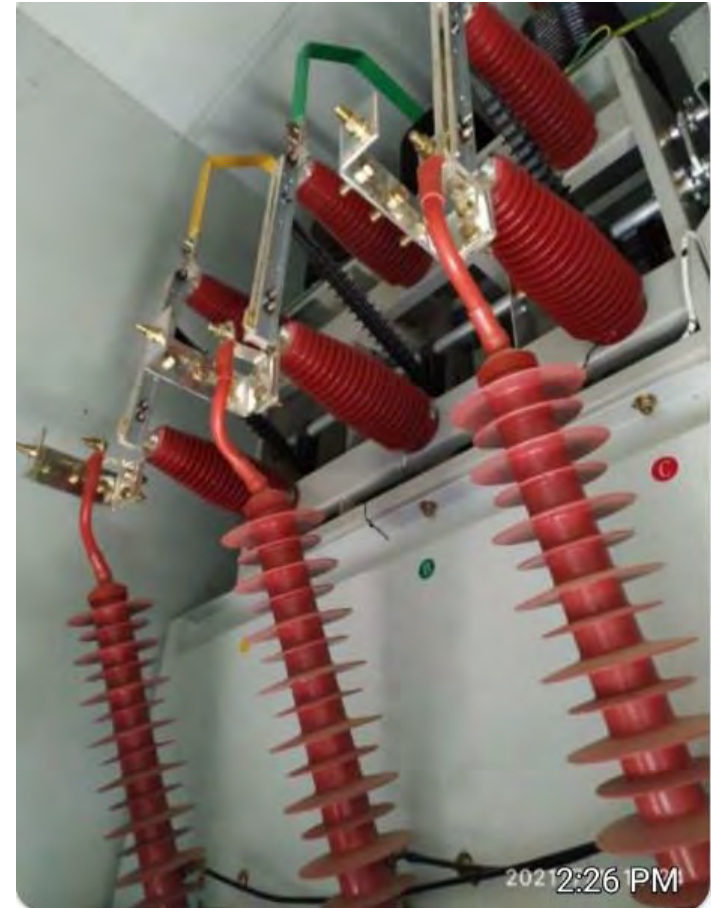


Prefabrication of suitable lifting attachment to avoid unnecessary damages.

## Box – Type Transformer unloading from transporter



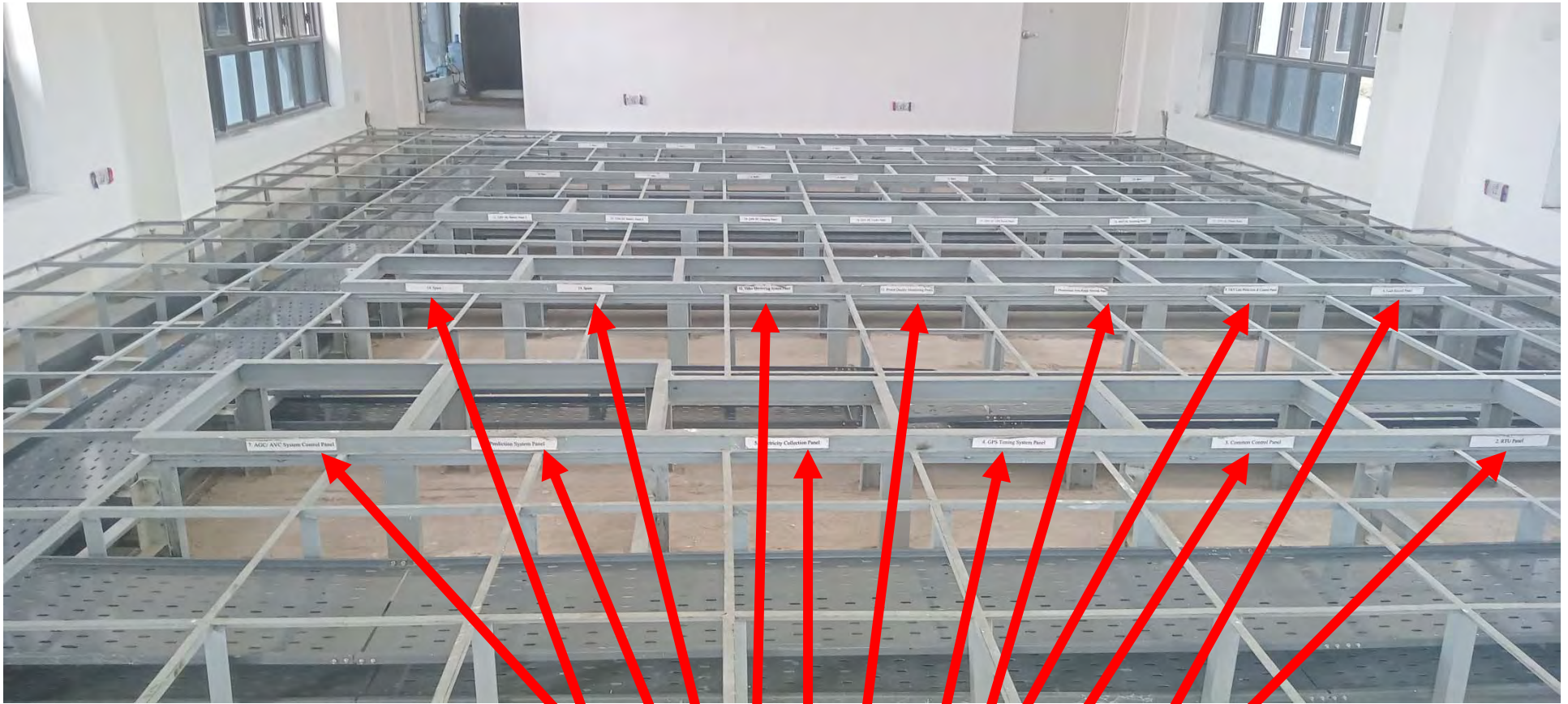
## *19. Cables & wires testing and Terminations*



**20. High Voltage panels, control and monitoring system panels installation and wire connection.**

Sr. No	Control Panel Name
1	AGC/AVC System Control Panel (GDSE 8000)
2	GYC 8000 Prediction System Panel
3	GKE 6400 Electricity Collection Panel
4	GATS-3100 GPS Timing System Panel
5	GCK 851 C-G-12 Common Control Panel
6	GYC 811-121 RTU Panel
7	GSE 8000-21 Integrated Application Server Panel
8	GXH3A-121 33KV Line Protection & Control Panel
9	Power System Dynamic Recording Device
10	GTW-8000 Photovoltaic Area Room Network Panel
11	GPQ F335 Power Quantity Monitoring Panel
12	Video Security System Panel
13	230V AC Feed Panel
14	400V AC Incoming Panel
15	220V DC Feeder Panel
16	230V AC UPS Power Panel
17	220V DC Charging Panel
18	220V DC Battery Panel-1
19	220V DC Battery Panel-2
20	PABX System
21	Optical Communication system
22	Aircon Indoor & Outdoor Fan Checking
23	Weather System Panel

## **Raise floor inside Power House**



**Control Panel Layouts to quick placing**

## **Control and Power Cables Supporting System And Termination works**



## *21. Central control inside Power House*



## *33kV Switchgear inside Power House*



## **Control panels inside Power House**



## *Control panels inside Power House*



Five Prevention input/exit

# 33kV Thapyaywa 30MW The main wiring diagram

Eliminate flash

33kV line

Inverter

Inverter control

Measurement and control 1

Network diagram

DC System

QXZ

Communication box

Measure & Control Devices

Bracket axle control

33kV Line curve

33kV Line Real time

Watthour meter

Box Transformer alarm

F	50.42	Hz
F	50.40	Hz
UAB	32.26	kV
UBC	32.45	kV
UCA	32.15	kV

IA	449.80	A
UAB	32.20	kV
P	24.85	MW
Q	-3.77	Mvar
COS	-0.99	



33kV PT



1#Into the line



2#Into the line



Grounding Transformer

IA	174.39	A
UAB	32.25	kV
P	-9.64	MW
Q	1.45	Mvar
COS	-0.99	

IA	276.64	A
UAB	32.21	kV
P	15.29	MW
Q	2.34	Mvar
COS	0.99	

IA	1.05	A
UAB	51.41	kV
P	0.07	MW
Q	-0.00	Mvar
COS	-0.99	

Output area	PF 50
All	
Tag	Occurrence
<input type="checkbox"/>	2023-05-
<input type="checkbox"/>	2023-05-

P1	4700.57	kW	P2	4000.16	kW
----	---------	----	----	---------	----


6#Start/Stop	6#Start/Stop	6#Start/Stop	6#Start/Stop	6#Start/Stop	All
7#Start/Stop	7#Start/Stop	7#Start/Stop	7#Start/Stop	7#Start/Stop	Tab
8#Start/Stop	8#Start/Stop	8#Start/Stop	8#Start/Stop	8#Start/Stop	2012-11-15

P3	3002.18	kW	P4	4390.67	kW
----	---------	----	----	---------	----

17#Start/Stop	18#Start/Stop	18#Sta	18#Start/Stop
19#Start/Stop	19#Sta	19#Start/Stop	19#Start/Stop
20#Start/Stop	20#Sta	20#Start/Stop	20#Start/Stop
21#Start/Stop	21#Sta	21#Start/Stop	21#Start/Stop
22#Start/Stop	22#Sta	22#Start/Stop	22#Start/Stop
23#Start/Stop	23#Sta	23#Start/Stop	23#Start/Stop
24#Start/Stop	24#Sta	24#Start/Stop	24#Start/Stop
25#Start/Stop	25#Start/Stop	25#Start/Stop	25#Start/Stop
			26#Start/Stop

P5	4400.70	kW
----	---------	----

P1	4700.57	kW	P2	4000.16	kW	P3	3002.18	kW	P4	4390.67	kW	P5	4400.70	kW
----	---------	----	----	---------	----	----	---------	----	----	---------	----	----	---------	----

Five Preventor input/exit 

## 33kV Thapyaywa 30MW The main wiring diagram

Returns the main wiring diagram

1 Communication box

1#YC	2#YC	3#YC	4#YC	5#YC
6#YC	1#YX	2#YX	3#YX	4#YX
5#YX	6#YX	7#YX	8#YX	9#YX
10#YX	11#YX	12#YX		

2 Communication box

1#YC	2#YC	3#YC	4#YC	5#YC
6#YC	1#YX	2#YX	3#YX	4#YX
5#YX	6#YX	7#YX	8#YX	9#YX
10#YX	11#YX	12#YX		

3 Communication box

1#YC	2#YC	3#YC	4#YC	5#YC
6#YC	7#YC	1#YX	2#YX	3#YX
4#YX	5#YX	6#YX	7#YX	8#YX
9#YX	10#YX	11#YX	12#YX	

4 Communication box

1#YC	2#YC	3#YC	4#YC	5#YC
6#YC	7#YC	1#YX	2#YX	3#YX
4#YX	5#YX	6#YX	7#YX	8#YX
9#YX	10#YX	11#YX	12#YX	

5 Communication box

1#YC	2#YC	3#YC	4#YC	5#YC
6#YC	7#YC	1#YX	2#YX	3#YX
4#YX	5#YX	6#YX	7#YX	8#YX
9#YX	10#YX	11#YX	12#YX	

Output area 

Tag	Occurrence
<input type="checkbox"/>	2023-06-
<input type="checkbox"/>	2023-06-

Returns the main wiring diagram

simulate (RLL)

## Bracket axle control

1#measure & control  
Device

1#The wind model	
1#Automatic mode	
1#Manual Angle mode	
1#Cleaning mode	
2#The wind model	
2#Automatic mode	
2#Manual Angle mode	
2#Cleaning mode	

2#measure & control  
Device

1#The wind model	
1#Automatic mode	
1#Manual Angle mode	
1#Cleaning mode	
2#The wind model	
2#Automatic mode	
2#Manual Angle mode	
2#Cleaning mode	

3#measure & control  
Device

1#The wind model	
1#Automatic mode	
1#Manual Angle mode	
1#Cleaning mode	
2#The wind model	
2#Automatic mode	
2#Manual Angle mode	
2#Cleaning mode	

4#measure & control  
Device

1#The wind model	
1#Automatic mode	
1#Manual Angle mode	
1#Cleaning mode	
2#The wind model	
2#Automatic mode	
2#Manual Angle mode	
2#Cleaning mode	

5#measure & control  
Device

1#The wind model	
1#Automatic mode	
1#Manual Angle mode	
1#Cleaning mode	
2#The wind model	
2#Automatic mode	
2#Manual Angle mode	
2#Cleaning mode	

Output area

All

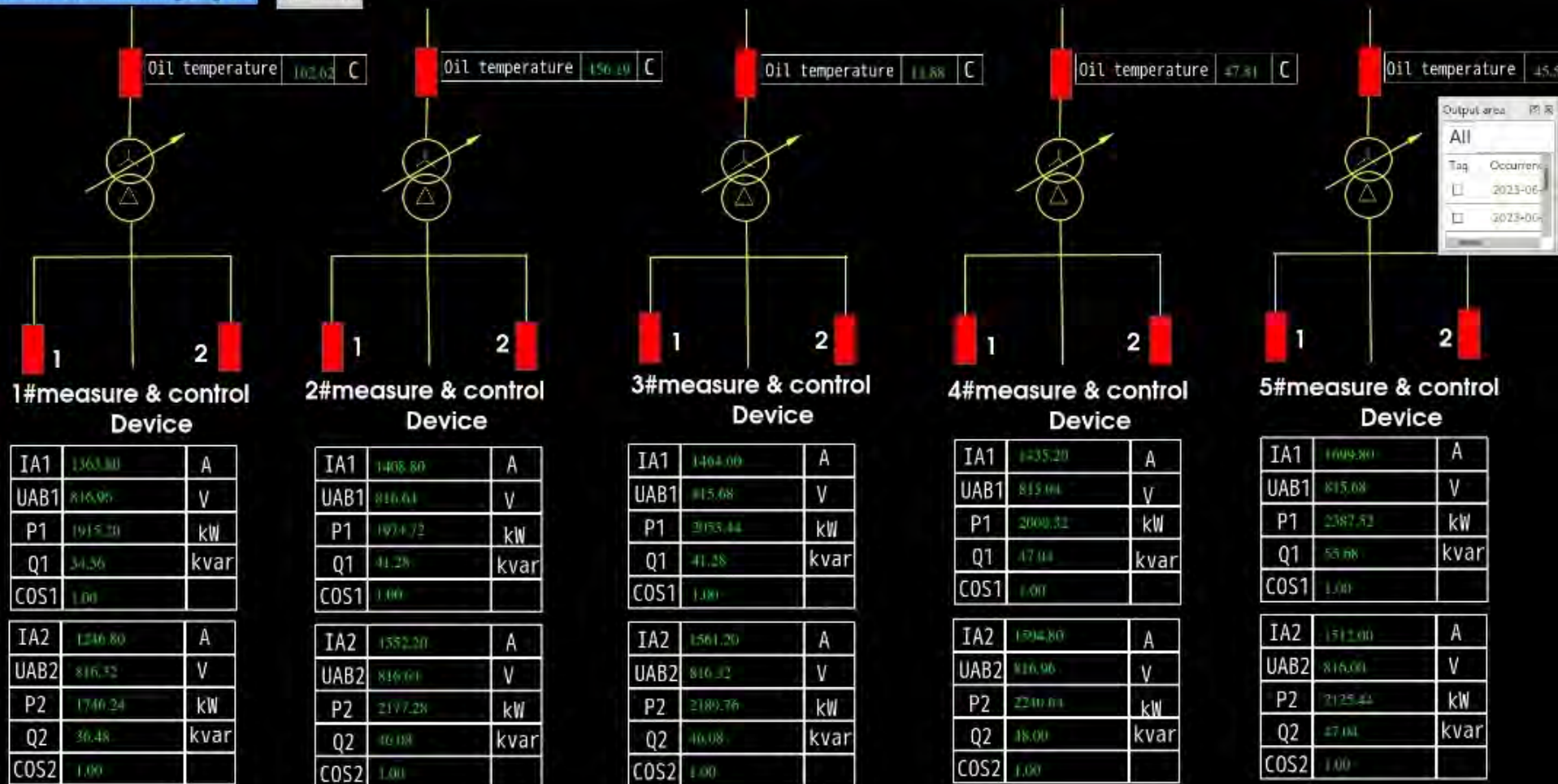
Tag Occurrence

☐ 2025-06

☐ 2025-06

Returns the main wiring diagram

Eliminate flash



Output area 图表

Tag	Occurrence
2023-06-	
2023-00-	

## Monitoring of PV generation KWH Records

1#Into line

1#Into line Positive active	11009.22	kWh
1#Into line Positive reactive	-01.58	kvar
1#Into line Reverse reactive	-000.20	kvar
1#Into line Reverse active	1.29	kWh

2#Into line

2#Into line Positive active	2004.41	kWh
2#Into line Positive reactive	00.03	kvar
2#Into line Reverse reactive	000.44	kvar
2#Into line Reverse active	0.45	kWh

Grounding Transformer

Transformer Positive active	55.01	kWh
Transformer Positive reactive	1.81	kvar
Transformer Reverse reactive	2.90	kvar
Transformer Reverse active	0.00	kWh

## Box transformer Status

Returns the main wiring diagram

1#measure & control Device	2#measure & control Device	3#measure & control Device
1XBTransformer trip over high temperature	2XBTransformer trip over high temperature	3XBTransformer trip over high temperature
1XBTransformer high Temperature alarm	2XBTransformer high Temperature alarm	3XBTransformer high Temperature alarm
1XBSwitch gas relay alarm	2XBSwitch gas relay alarm	3XBSwitch gas relay alarm
1XBSwitching gas relay trip	2XBSwitching gas relay trip	3XBSwitching gas relay trip
1XBHigh voltage load switch alignment	2XBHigh voltage load switch alignment	3XBHigh voltage load switch alignment
1XBHigh voltage load switch loci	2XBHigh voltage load switch loci	3XBHigh voltage load switch loci
1XB1# low voltage circuit breaker is closed	2XB1# low voltage circuit breaker is closed	3XB1# low voltage circuit breaker is closed
1XB1# low voltage circuit breaker switching	2XB1# low voltage circuit breaker switching	3XB1# low voltage circuit breaker switching
1XB2# low pressure side synapse	2XB2# low pressure side synapse	3XB2# low pressure side synapse
1XB2# low pressure lateral loci	2XB2# low pressure lateral loci	3XB2# low pressure lateral loci
1XBThe 1# low-voltage circuit breaker is faulty	2XBThe 1# low-voltage circuit breaker is faulty	3XBThe 1# low-voltage circuit breaker is faulty
1XBThe 2# low-voltage circuit breaker is faulty	2XBThe 2# low-voltage circuit breaker is faulty	3XBThe 2# low-voltage circuit breaker is faulty
1XBThe disconnecting switch closes	2XBThe disconnecting switch closes	3XBThe disconnecting switch closes
1XBThe ground switch is turned on	2XBThe ground switch is turned on	3XBThe ground switch is turned on
1XBNo storage of circuit breaker	2XBNo storage of circuit breaker	3XBNo storage of circuit breaker
1XBHigh-pressure chamber door status	2XBHigh-pressure chamber door status	3XBHigh-pressure chamber door status
1XBLow pressure chamber personnel in and out of the state	2XBLow pressure chamber personnel in and out of the state	3XBLow pressure chamber personnel in and out of the state
1XBMaintenance door status of low pressure chamber	2XBMaintenance door status of low pressure chamber	3XBMaintenance door status of low pressure chamber
1XBSmoke alarm status	2XBSmoke alarm status	3XBSmoke alarm status
1XBIn remote control	2XBIn remote control	3XBIn remote control
1XBRepair clamp	2XBRepair clamp	3XBRepair clamp
1XBAir sensor 1 is faulty	2XBAir sensor 1 is faulty	3XBAir sensor 1 is faulty
1XBirradiator 1 is faulty	2XBirradiator 1 is faulty	3XBirradiator 1 is faulty
1XBirradiator 2 is faulty	2XBirradiator 2 is faulty	3XBirradiator 2 is faulty
1XBirradiator 3 is faulty	2XBirradiator 3 is faulty	3XBirradiator 3 is faulty

Output area

All

Tag: Document

☐ 2024-08-08

☐ 2025-08-08

## DC System Status

returns the main wiring diagram

### DC System

Ac 1 channel A-phase voltage	253.90	V	Dc bus voltage	253.90	V	#4 rectifier module temperature	29.00	C	UPS1 AC input voltage	231.80
Ac 1 channel B-phase voltage	240.20	V	Female forward to ground resistance	600.00		Insulated bus 1 positive voltage to ground	116.90		Incoming line 1 way A phase voltage	233.80
Ac 1 channel C-phase voltage	250.40	V	#1 Rectifier module operating status	2457.60		Insulated bus 1 negative to ground voltage	117.90	V	Incoming line 1 way B phase voltage	233.70
Ac 2 channel A-phase voltage	253.90	V	#1 rectifier module voltage	253.90	V	Resistance of insulated bus 1 to ground	600.00		Incoming line 1 way C phase voltage	238.10
Ac 2 channel B-phase voltage	240.30	V	#1 rectifier module current	1.20	A	Insulated bus 1 negative resistance to ground	600.00		Incoming line 1 way AB line voltage	402.00
Ac 2 channel C-phase voltage	250.00	V	#1 rectifier module temperature	26.00	C	Resistance of insulated bus 2 to ground	600.00		Incoming line 1 way BC line voltage	405.00
Charging device output voltage	253.90	V	#2 Rectifier module operating status	2457.60		Insulated bus 2 negative resistance to ground	600.00		Incoming line 1 way CA line voltage	400.00
The rectifier outputs the total current	5.00	A	#2 rectifier module voltage	253.90	V				Incoming line 1 way A phase current	75.00
			#2 rectifier module current	0.90	A				Incoming line 1 way B phase current	60.00
			#2 rectifier module temperature	26.00	C				Incoming line 1 way C phase current	60.00
			#3 Rectifier module operating status	2457.60					Incoming line 2 way A phase voltage	17.20
			#3 rectifier module voltage	254.30	V				Incoming line 2 way B phase voltage	17.40
			#3 rectifier module current	1.20					Incoming line 2 way C phase voltage	16.90
			#3 rectifier module temperature	27.00	A				Incoming line 2 way AB line voltage	25.80
			#4 Rectifier module operating status	2457.60					Incoming line 2 way BC line voltage	29.70
			#4 rectifier module voltage	253.90	V				Incoming line 2 way CA line voltage	25.80
			#4 rectifier module current	1.30	A					0.00

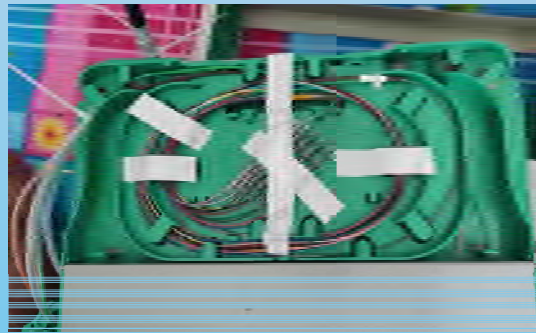
## Configuration of row by row Tracking Control Boxes



## 22. Final testing of new transmission line and float charge test.



OPGW Cable combines the functions of grounding and communications



Station and box transformer communication joining



**23. Individual final inspection and testing by supplier expert.**



## **24. Power connecting with Grid**

## SVG (Static Var Generator)

SVG (Static Var Generator) is the modern solution for power factor correction.

SVG is a power electronics-based device connected in parallel with the load that requires harmonics mitigation.



*25. Combine test with both supplier and power authority inspectors*



**Power Station HT  
Switch gear panel  
testing**



**26.Combine COC Test**  
**(Contracted Operation Characteristics)**

## COC Test procedures

### **I. Contracted Operating Characteristics(CoC) test**

1. Active power capability
2. Minimum generation
3. Reactive power capability
  - 3.1 Leading 0.95 in POI at 1.0 p.u. ( **P**oint **o**f **I**nterest) (**p**er **u**nit)
  - 3.2 Lagging 0,95 in POI at 1.0 p.u
4. Loading/De-loading rate
5. Start up and Shutdown Time
  1. Start- up from all the plant switch off
  2. Start-up from power and inverter transformers already energized
  3. Shut-down

## COC Test procedures

### II. Net Capacity Test

1. Two consecutive days test result
2. Attachment (Maximum Active Power Export, Data log)

### III. Reliability Test

#### a).Day#1 Test

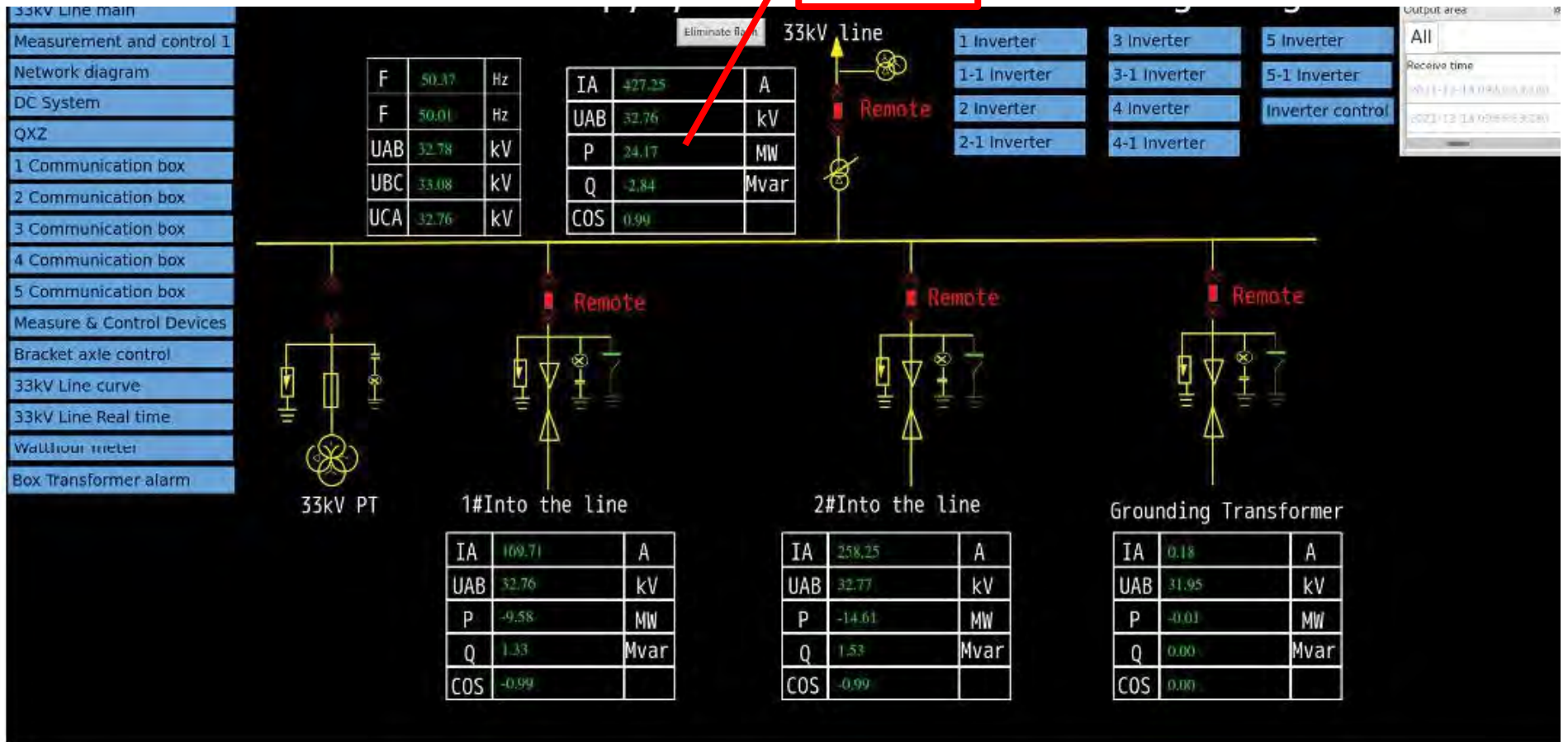
1. Inverter Communication Test
2. PLC Communication Test
3. Power Analyzer Communication Test
4. SCADA Communication Test
5. Operation mode Test
  - 5.1 Active Power Curtailment at AGC
  - 5.2 Ramp Rate Control at AGC
  - 5.3 On Demand Q at Logger
  - 5.4 Power Factor Control at Logger

## COC Test procedures

### b).Day#2 Test

1. Inverter Communication Test
2. PLC Communication Test
3. Power Analyzer Communication Test
4. SCADA Communication Test
5. Operation mode Test
  - 5.1 Active Power Curtailment at AGC (Automatic Generating Control)
  - 5.2 Ramp Rate Control at AGC
  - 5.3 On Demand Q at Logger
  - 5.4 Power Factor Control at Logger
  - 5.5 Reactive Power limitation as a function of Active Power

24.17 MW



Actual available power at POI = 24.17MW

9:40hr

# 1. Active Power Capability

Date and Time (YY/MM/DD) 2021/12/13 (hh:mm:ss)	Actual available power at POI (MW)	Test value as fraction of available power (p.u)	Test value input from SCADA Set point (MW)	Active Power measured (MW)	Passed (Yes/No)	Note
09:40:00	24.17	1.00	24.17	→ 24.17	Yes	(<+/- 10%)  Include reading error is acceptable value.
09:41:00	24.17	0.75	18.11	→ 18.52	Yes	
09:43:00	18.52	0.50	12.16	→ 12.45	Yes	
09:46:00	12.45	0.25	6.08	→ 5.85	Yes	
09:49:10	5.85	0 *	0	→ -0.02	Yes	
09:50:25	-0.02	0.25	6.08	→ 5.81	Yes	
09:53:33	5.81	0.50	12.16	→ 11.92	Yes	
09:54:35	11.92	0.75	18.11	→ 17.88	Yes	
09:56:08	17.88	1	24.32	→ 24.17	Yes	

(\*) when decreasing the power to zero, the inverter will automatically stop. When giving the new set point for increasing active power injection, wait for the inverters normal start-up.

Notes and comments;

- 1) 1<sup>st</sup> day Testing Max Power - 25.88MW./ 24.11.2021 Max Power – 29.73 MW

## 2. Minimum Generation

Day no.	Date and Time (YY/MM/DD)	Data Logger /Live (D/L)	Irradiance Reading from Weather Station (W/m <sup>2</sup> )	Temperature at PV Module (° C)	Measured output power (Min) (MW)	Passed (Yes/No)	Note
1	2021/12/13 06:45:30	Live	31	18.0	0.25	Yes	
2	2021/12/14 06:45:12	Live	8	16.3	0.17	Yes	

Notes and comments;

Irradiance reading to check the Instantaneous value of total radiation 1.

- 1) The Minimum generation, the measured output power as mentioned above the table is recorded in morning time.
- 2) According to PV module Specification is 100W/m<sup>2</sup> per I-V Curves.

### 3. Reactive Power Capability Test (Reactive and Active Power Restriction Test)

#### 3.1 Leading 0.95 in POI at 1.0 p.u

Date and Time (YY/MM/DD) 2021/12/13 (hh:mm:ss)	Active Power Available (MW)	Active Power Set Point (MW)	Power Factor Set Point (PF)	Reactive Power Measured (MVar)	Power Measured (MW)	Passed (Yes/No)	Note ** Include reading error is acceptable value
10:36:32	24.83	30	0.9	-14.66	0.86	Yes	(<+/- 10%)
10:47:50	24.28	30	0.95	-10.77	0.92	Yes	
10:56:20	25.39	30	1	-2.21	1	Yes	

Notes and comments;

- 1) Nominal reactive plant power Max/Min +/- 18.9MVar at AGC.

### 3.2 Lagging 0.95 in POI at 1.0 p.u

Date and Time (YY/MM/DD) 2021/12/13 (hh:mm:ss)	Active Power Available (MW)	Active Power Set Point (MW)	Power Factor Set Point (PF)	Reactive Power Measured (MVar)	Power Measured (MW)	Passed (Yes/No)	Note ** Include reading error is acceptable value
11:37:20	25.98	30	1.0	-2.16	1	Yes	(<+/- 10%)
11:15:33	25.12	30	-0.95	6.63	0.97	Yes	
11:24:50	24.88	30	-0.9	10.52	0.86	Yes	

Notes and comments;

- 1) Nominal reactive plant power Max/Min +/- 18.9MVar at AGC.

#### 4. Loading /De Loading rate

Date and Time (YY/MM/DD) 2021/12/13 (hh:mm:ss)	Active Power Available (MW)	Active Power Set Point (MW)	Active Power Measured (MW)	Response Time (mm:ss)	Passed (Yes/No)	Note Include reading error is acceptable value
11:54:20	24.95	24.95	24.95	11:54:22	Yes	(<+/- 10%)
11:55:10	24.93	18.70	18.44	11:56:30	Yes	
11:57:23	18.47	12.46	12.97	11:58:46	Yes	
11:58:50	12.87	0	-0.02	11:59:00	Yes	
11:59:12	-0.02	24.95	24.72	12:04:40	Yes	
12:05:10	24.72	12.46	12.45	12:06:25	Yes	
12:07:00	12.45	18.70	18.52	12:08:20	Yes	
12:10:21	18.65	24.72	24.75	12:11:22	Yes	

## 5. Start-up and Shutdown time

### 5.1 Start-up from all the plant switch off

Power Starting condition	Starting Time	Power final condition	Final Time	Duration	Passed
(MW)	(YY/MM/DD) (hh:mm:ss)	(MW)	(hh:mm:ss)	(minute/Sec)	(Yes/No)
0	13:25:00	24.09	13:35:00	10 min	Yes

## 5.2 Start-up from power and inverter transformers already energized

Power Starting condition	Starting Time	Power final condition	Final Time	Duration	Passed
(MW)	(YY/MM/DD) (hh:mm:ss)	(MW)	(hh:mm:ss)	(minute/Sec)	(Yes/No)
0	12:25:00	24.53	12:30:00	5min	Yes

5.3 Shut-down (Normal)

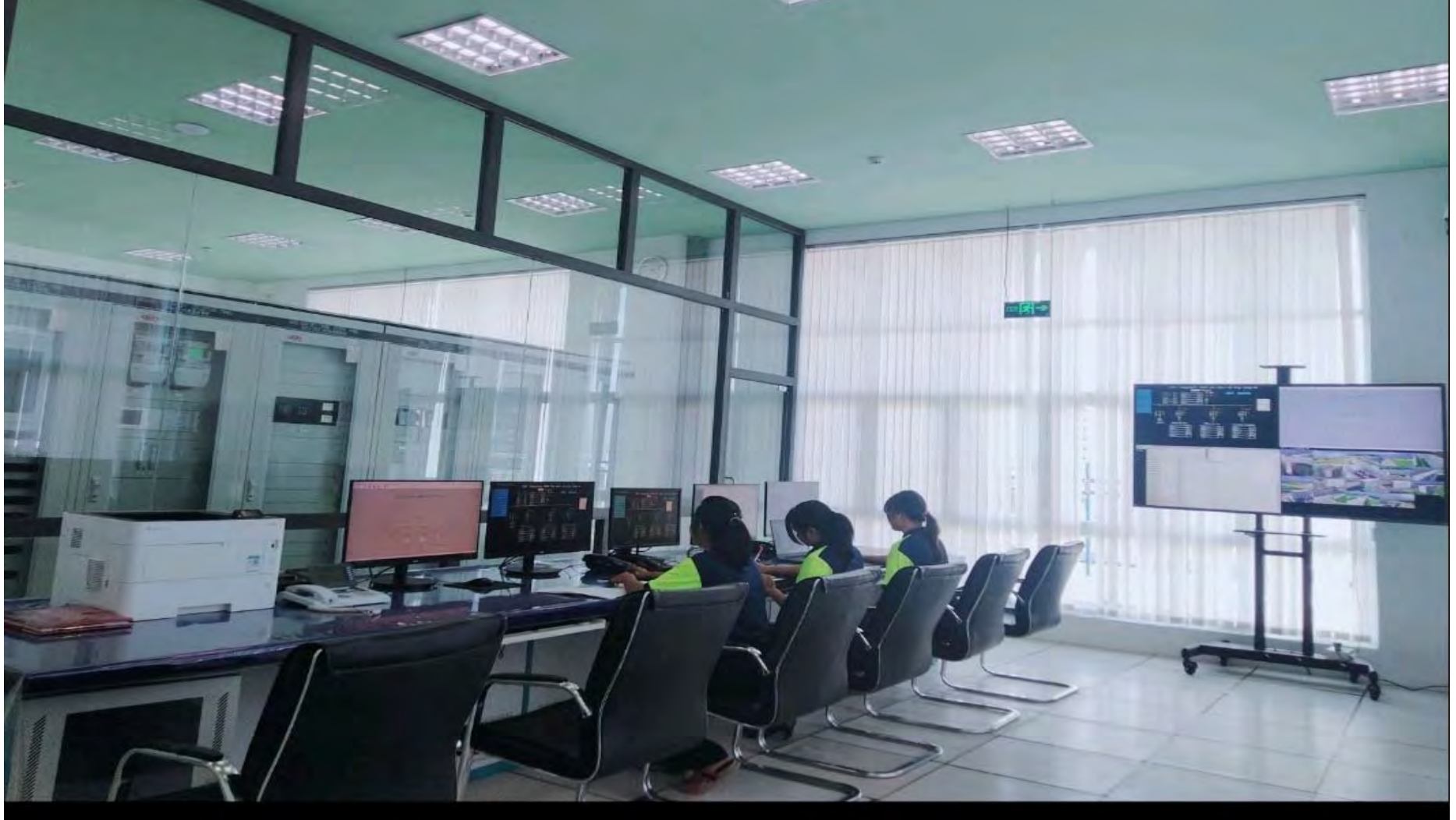
Power Starting condition	Starting Time	Power final condition	Final Time	Duration	Passed
(MW)	(YY/MM/DD) (hh:mm:ss)	(MW)	(hh:mm:ss)	(minute/Sec)	(Yes/No)
24.95	12:23:19	0	12:23:25	6 sec	Yes

#### 6.4 Shut-down (Break-down)

Power Starting condition	Starting Time	Power final condition	Final Time	Duration	Passed
(MW)	(YY/MM/DD) (hh:mm:ss)	(MW)	(hh:mm:ss)	(minute/Sec)	(Yes/No)
24.93	13:07:34	0	13:07:34	0 sec	Yes

**27. Operation**  
**and**  
**Training**

# *Operation Control Centre(Thapyaywa)*



# *Operation Control Centre (Taung Taw Gwin)*



# *Duty Engineers*



# Operation Energy Meters

## Energy Meters



I l q d # K h f n l j # r # H q h u j | # P h w h w #  
v h d d g # w # k d s | d | z d V x e 0 v d w t r q # r g #  
Q r y n p e h u # / # 5 3 5 4

Polarity Test  $P_1$  is Bus side,  $P_2$  is Line side

(a) Current Transformer

Sr. No.	Phase	Battery Polarity with Respect to CT Primary Markings	DC Ammeter Polarity with Respect to kWh Meter Term.	Ammeter Deflection	Remark
1	R	$P_1$	$S_1$	Forward	
2	Y	$P_2$	$S_2$	Forward	
3	B	$P_2$	$S_2$	Forward	

On Load Test

(a) Main Meter  $W/P 025667$   $33000/100$   $600/s$   $C.E.W.E$   
Type: 3P4W, Sr. No.  $1047201$ , VT Ratio  $210/2000$ , CT Ratio  $100/5$ , Makin: C.E.W.E  
Imp/kWh  $1047202$ , MF  $1047205$ , DTSC No.  $Y5-70599$ , Serial No.  $ME3C 1047201$   
ME3C  $1047202$ , ME3C  $1047205$ , ESE  $2408428$ , ESE  $2408428$

(b) Auxiliary Supply

(c) Measured Voltage  $V_1$   $V_2$   $V_3$   $V_4$   $V_5$   $V_6$   $V_7$   $V_8$   $V_9$   $V_{10}$   $V_{11}$   $V_{12}$   $V_{13}$   $V_{14}$   $V_{15}$   $V_{16}$   $V_{17}$   $V_{18}$   $V_{19}$   $V_{20}$   $V_{21}$   $V_{22}$   $V_{23}$   $V_{24}$   $V_{25}$   $V_{26}$   $V_{27}$   $V_{28}$   $V_{29}$   $V_{30}$   $V_{31}$   $V_{32}$   $V_{33}$   $V_{34}$   $V_{35}$   $V_{36}$   $V_{37}$   $V_{38}$   $V_{39}$   $V_{40}$   $V_{41}$   $V_{42}$   $V_{43}$   $V_{44}$   $V_{45}$   $V_{46}$   $V_{47}$   $V_{48}$   $V_{49}$   $V_{50}$   $V_{51}$   $V_{52}$   $V_{53}$   $V_{54}$   $V_{55}$   $V_{56}$   $V_{57}$   $V_{58}$   $V_{59}$   $V_{60}$   $V_{61}$   $V_{62}$   $V_{63}$   $V_{64}$   $V_{65}$   $V_{66}$   $V_{67}$   $V_{68}$   $V_{69}$   $V_{70}$   $V_{71}$   $V_{72}$   $V_{73}$   $V_{74}$   $V_{75}$   $V_{76}$   $V_{77}$   $V_{78}$   $V_{79}$   $V_{80}$   $V_{81}$   $V_{82}$   $V_{83}$   $V_{84}$   $V_{85}$   $V_{86}$   $V_{87}$   $V_{88}$   $V_{89}$   $V_{90}$   $V_{91}$   $V_{92}$   $V_{93}$   $V_{94}$   $V_{95}$   $V_{96}$   $V_{97}$   $V_{98}$   $V_{99}$   $V_{100}$   $V_{101}$   $V_{102}$   $V_{103}$   $V_{104}$   $V_{105}$   $V_{106}$   $V_{107}$   $V_{108}$   $V_{109}$   $V_{110}$   $V_{111}$   $V_{112}$   $V_{113}$   $V_{114}$   $V_{115}$   $V_{116}$   $V_{117}$   $V_{118}$   $V_{119}$   $V_{120}$   $V_{121}$   $V_{122}$   $V_{123}$   $V_{124}$   $V_{125}$   $V_{126}$   $V_{127}$   $V_{128}$   $V_{129}$   $V_{130}$   $V_{131}$   $V_{132}$   $V_{133}$   $V_{134}$   $V_{135}$   $V_{136}$   $V_{137}$   $V_{138}$   $V_{139}$   $V_{140}$   $V_{141}$   $V_{142}$   $V_{143}$   $V_{144}$   $V_{145}$   $V_{146}$   $V_{147}$   $V_{148}$   $V_{149}$   $V_{150}$   $V_{151}$   $V_{152}$   $V_{153}$   $V_{154}$   $V_{155}$   $V_{156}$   $V_{157}$   $V_{158}$   $V_{159}$   $V_{160}$   $V_{161}$   $V_{162}$   $V_{163}$   $V_{164}$   $V_{165}$   $V_{166}$   $V_{167}$   $V_{168}$   $V_{169}$   $V_{170}$   $V_{171}$   $V_{172}$   $V_{173}$   $V_{174}$   $V_{175}$   $V_{176}$   $V_{177}$   $V_{178}$   $V_{179}$   $V_{180}$   $V_{181}$   $V_{182}$   $V_{183}$   $V_{184}$   $V_{185}$   $V_{186}$   $V_{187}$   $V_{188}$   $V_{189}$   $V_{190}$   $V_{191}$   $V_{192}$   $V_{193}$   $V_{194}$   $V_{195}$   $V_{196}$   $V_{197}$   $V_{198}$   $V_{199}$   $V_{200}$   $V_{201}$   $V_{202}$   $V_{203}$   $V_{204}$   $V_{205}$   $V_{206}$   $V_{207}$   $V_{208}$   $V_{209}$   $V_{210}$   $V_{211}$   $V_{212}$   $V_{213}$   $V_{214}$   $V_{215}$   $V_{216}$   $V_{217}$   $V_{218}$   $V_{219}$   $V_{220}$   $V_{221}$   $V_{222}$   $V_{223}$   $V_{224}$   $V_{225}$   $V_{226}$   $V_{227}$   $V_{228}$   $V_{229}$   $V_{230}$   $V_{231}$   $V_{232}$   $V_{233}$   $V_{234}$   $V_{235}$   $V_{236}$   $V_{237}$   $V_{238}$   $V_{239}$   $V_{240}$   $V_{241}$   $V_{242}$   $V_{243}$   $V_{244}$   $V_{245}$   $V_{246}$   $V_{247}$   $V_{248}$   $V_{249}$   $V_{250}$   $V_{251}$   $V_{252}$   $V_{253}$   $V_{254}$   $V_{255}$   $V_{256}$   $V_{257}$   $V_{258}$   $V_{259}$   $V_{260}$   $V_{261}$   $V_{262}$   $V_{263}$   $V_{264}$   $V_{265}$   $V_{266}$   $V_{267}$   $V_{268}$   $V_{269}$   $V_{270}$   $V_{271}$   $V_{272}$   $V_{273}$   $V_{274}$   $V_{275}$   $V_{276}$   $V_{277}$   $V_{278}$   $V_{279}$   $V_{280}$   $V_{281}$   $V_{282}$   $V_{283}$   $V_{284}$   $V_{285}$   $V_{286}$   $V_{287}$   $V_{288}$   $V_{289}$   $V_{290}$   $V_{291}$   $V_{292}$   $V_{293}$   $V_{294}$   $V_{295}$   $V_{296}$   $V_{297}$   $V_{298}$   $V_{299}$   $V_{300}$   $V_{301}$   $V_{302}$   $V_{303}$   $V_{304}$   $V_{305}$   $V_{306}$   $V_{307}$   $V_{308}$   $V_{309}$   $V_{310}$   $V_{311}$   $V_{312}$   $V_{313}$   $V_{314}$   $V_{315}$   $V_{316}$   $V_{317}$   $V_{318}$   $V_{319}$   $V_{320}$   $V_{321}$   $V_{322}$   $V_{323}$   $V_{324}$   $V_{325}$   $V_{326}$   $V_{327}$   $V_{328}$   $V_{329}$   $V_{330}$   $V_{331}$   $V_{332}$   $V_{333}$   $V_{334}$   $V_{335}$   $V_{336}$   $V_{337}$   $V_{338}$   $V_{339}$   $V_{340}$   $V_{341}$   $V_{342}$   $V_{343}$   $V_{344}$   $V_{345}$   $V_{346}$   $V_{347}$   $V_{348}$   $V_{349}$   $V_{350}$   $V_{351}$   $V_{352}$   $V_{353}$   $V_{354}$   $V_{355}$   $V_{356}$   $V_{357}$   $V_{358}$   $V_{359}$   $V_{360}$   $V_{361}$   $V_{362}$   $V_{363}$   $V_{364}$   $V_{365}$   $V_{366}$   $V_{367}$   $V_{368}$   $V_{369}$   $V_{370}$   $V_{371}$   $V_{372}$   $V_{373}$   $V_{374}$   $V_{375}$   $V_{376}$   $V_{377}$   $V_{378}$   $V_{379}$   $V_{380}$   $V_{381}$   $V_{382}$   $V_{383}$   $V_{384}$   $V_{385}$   $V_{386}$   $V_{387}$   $V_{388}$   $V_{389}$   $V_{390}$   $V_{391}$   $V_{392}$   $V_{393}$   $V_{394}$   $V_{395}$   $V_{396}$   $V_{397}$   $V_{398}$   $V_{399}$   $V_{400}$   $V_{401}$   $V_{402}$   $V_{403}$   $V_{404}$   $V_{405}$   $V_{406}$   $V_{407}$   $V_{408}$   $V_{409}$   $V_{410}$   $V_{411}$   $V_{412}$   $V_{413}$   $V_{414}$   $V_{415}$   $V_{416}$   $V_{417}$   $V_{418}$   $V_{419}$   $V_{420}$   $V_{421}$   $V_{422}$   $V_{423}$   $V_{424}$   $V_{425}$   $V_{426}$   $V_{427}$   $V_{428}$   $V_{429}$   $V_{430}$   $V_{431}$   $V_{432}$   $V_{433}$   $V_{434}$   $V_{435}$   $V_{436}$   $V_{437}$   $V_{438}$   $V_{439}$   $V_{440}$   $V_{441}$   $V_{442}$   $V_{443}$   $V_{444}$   $V_{445}$   $V_{446}$   $V_{447}$   $V_{448}$   $V_{449}$   $V_{450}$   $V_{451}$   $V_{452}$   $V_{453}$   $V_{454}$   $V_{455}$   $V_{456}$   $V_{457}$   $V_{458}$   $V_{459}$   $V_{460}$   $V_{461}$   $V_{462}$   $V_{463}$   $V_{464}$   $V_{465}$   $V_{466}$   $V_{467}$   $V_{468}$   $V_{469}$   $V_{470}$   $V_{471}$   $V_{472}$   $V_{473}$   $V_{474}$   $V_{475}$   $V_{476}$   $V_{477}$   $V_{478}$   $V_{479}$   $V_{480}$   $V_{481}$   $V_{482}$   $V_{483}$   $V_{484}$   $V_{485}$   $V_{486}$   $V_{487}$   $V_{488}$   $V_{489}$   $V_{490}$   $V_{491}$   $V_{492}$   $V_{493}$   $V_{494}$   $V_{495}$   $V_{496}$   $V_{497}$   $V_{498}$   $V_{499}$   $V_{500}$   $V_{501}$   $V_{502}$   $V_{503}$   $V_{504}$   $V_{505}$   $V_{506}$   $V_{507}$   $V_{508}$   $V_{509}$   $V_{510}$   $V_{511}$   $V_{512}$   $V_{513}$   $V_{514}$   $V_{515}$   $V_{516}$   $V_{517}$   $V_{518}$   $V_{519}$   $V_{520}$   $V_{521}$   $V_{522}$   $V_{523}$   $V_{524}$   $V_{525}$   $V_{526}$   $V_{527}$   $V_{528}$   $V_{529}$   $V_{530}$   $V_{531}$   $V_{532}$   $V_{533}$   $V_{534}$   $V_{535}$   $V_{536}$   $V_{537}$   $V_{538}$   $V_{539}$   $V_{540}$   $V_{541}$   $V_{542}$   $V_{543}$   $V_{544}$   $V_{545}$   $V_{546}$   $V_{547}$   $V_{548}$   $V_{549}$   $V_{550}$   $V_{551}$   $V_{552}$   $V_{553}$   $V_{554}$   $V_{555}$   $V_{556}$   $V_{557}$   $V_{558}$   $V_{559}$   $V_{560}$   $V_{561}$   $V_{562}$   $V_{563}$   $V_{564}$   $V_{565}$   $V_{566}$   $V_{567}$   $V_{568}$   $V_{569}$   $V_{570}$   $V_{571}$   $V_{572}$   $V_{573}$   $V_{574}$   $V_{575}$   $V_{576}$   $V_{577}$   $V_{578}$   $V_{579}$   $V_{580}$   $V_{581}$   $V_{582}$   $V_{583}$   $V_{584}$   $V_{585}$   $V_{586}$   $V_{587}$   $V_{588}$   $V_{589}$   $V_{590}$   $V_{591}$   $V_{592}$   $V_{593}$   $V_{594}$   $V_{595}$   $V_{596}$   $V_{597}$   $V_{598}$   $V_{599}$   $V_{600}$   $V_{601}$   $V_{602}$   $V_{603}$   $V_{604}$   $V_{605}$   $V_{606}$   $V_{607}$   $V_{608}$   $V_{609}$   $V_{610}$   $V_{611}$   $V_{612}$   $V_{613}$   $V_{614}$   $V_{615}$   $V_{616}$   $V_{617}$   $V_{618}$   $V_{619}$   $V_{620}$   $V_{621}$   $V_{622}$   $V_{623}$   $V_{624}$   $V_{625}$   $V_{626}$   $V_{627}$   $V_{628}$   $V_{629}$   $V_{630}$   $V_{631}$   $V_{632}$   $V_{633}$   $V_{634}$   $V_{635}$   $V_{636}$   $V_{637}$   $V_{638}$   $V_{639}$   $V_{640}$   $V_{641}$   $V_{642}$   $V_{643}$   $V_{644}$   $V_{645}$   $V_{646}$   $V_{647}$   $V_{648}$   $V_{649}$   $V_{650}$   $V_{651}$   $V_{652}$   $V_{653}$   $V_{654}$   $V_{655}$   $V_{656}$   $V_{657}$   $V_{658}$   $V_{659}$   $V_{660}$   $V_{661}$   $V_{662}$   $V_{663}$   $V_{664}$   $V_{665}$   $V_{666}$   $V_{667}$   $V_{668}$   $V_{669}$   $V_{670}$   $V_{671}$   $V_{672}$   $V_{673}$   $V_{674}$   $V_{675}$   $V_{676}$   $V_{677}$   $V_{678}$   $V_{679}$   $V_{680}$   $V_{681}$   $V_{682}$   $V_{683}$   $V_{684}$   $V_{685}$   $V_{686}$   $V_{687}$   $V_{688}$   $V_{689}$   $V_{690}$   $V_{691}$   $V_{692}$   $V_{693}$   $V_{694}$   $V_{695}$   $V_{696}$   $V_{697}$   $V_{698}$   $V_{699}$   $V_{700}$   $V_{701}$   $V_{702}$   $V_{703}$   $V_{704}$   $V_{705}$   $V_{706}$   $V_{707}$   $V_{708}$   $V_{709}$   $V_{710}$   $V_{711}$   $V_{712}$   $V_{713}$   $V_{714}$   $V_{715}$   $V_{716}$   $V_{717}$   $V_{718}$   $V_{719}$   $V_{720}$   $V_{721}$   $V_{722}$   $V_{723}$   $V_{724}$   $V_{725}$   $V_{726}$   $V_{727}$   $V_{728}$   $V_{729}$   $V_{730}$   $V_{731}$   $V_{732}$   $V_{733}$   $V_{734}$   $V_{735}$   $V_{736}$   $V_{737}$   $V_{738}$   $V_{739}$   $V_{740}$   $V_{741}$   $V_{742}$   $V_{743}$   $V_{744}$   $V_{745}$   $V_{746}$   $V_{747}$   $V_{748}$   $V_{749}$   $V_{750}$   $V_{751}$   $V_{752}$   $V_{753}$   $V_{754}$   $V_{755}$   $V_{756}$   $V_{757}$   $V_{758}$   $V_{759}$   $V_{760}$   $V_{761}$   $V_{762}$   $V_{763}$   $V_{764}$   $V_{765}$   $V_{766}$   $V_{767}$   $V_{768}$   $V_{769}$   $V_{770}$   $V_{771}$   $V_{772}$   $V_{773}$   $V_{774}$   $V_{775}$   $V_{776}$   $V_{777}$   $V_{778}$   $V_{779}$   $V_{780}$   $V_{781}$   $V_{782}$   $V_{783}$   $V_{784}$   $V_{785}$   $V_{786}$   $V_{787}$   $V_{788}$   $V_{789}$   $V_{790}$   $V_{791}$   $V_{792}$   $V_{793}$   $V_{794}$   $V_{795}$   $V_{796}$   $V_{797}$   $V_{798}$   $V_{799}$   $V_{800}$   $V_{801}$   $V_{802}$   $V_{803}$   $V_{804}$   $V_{805}$   $V_{806}$   $V_{807}$   $V_{808}$   $V_{809}$   $V_{810}$   $V_{811}$   $V_{812}$   $V_{813}$   $V_{814}$   $V_{815}$   $V_{816}$   $V_{817}$   $V_{818}$   $V_{819}$   $V_{820}$   $V_{821}$   $V_{822}$   $V_{823}$   $V_{824}$   $V_{825}$   $V_{826}$   $V_{827}$   $V_{828}$   $V_{829}$   $V_{830}$   $V_{831}$   $V_{832}$   $V_{833}$   $V_{834}$   $V_{835}$   $V_{836}$   $V_{837}$   $V_{838}$   $V_{839}$   $V_{840}$   $V_{841}$   $V_{842}$   $V_{843}$   $V_{844}$   $V_{845}$   $V_{846}$   $V_{847}$   $V_{848}$   $V_{849}$   $V_{850}$   $V_{851}$   $V_{852}$   $V_{853}$   $V_{854}$   $V_{855}$   $V_{856}$   $V_{857}$   $V_{858}$   $V_{859}$   $V_{860}$   $V_{861}$   $V_{862}$   $V_{863}$   $V_{864}$   $V_{865}$   $V_{866}$   $V_{867}$   $V_{868}$   $V_{869}$   $V_{870}$   $V_{871}$   $V_{872}$   $V_{873}$   $V_{874}$   $V_{875}$   $V_{876}$   $V_{877}$   $V_{878}$   $V_{879}$   $V_{880}$   $V_{881}$   $V_{882}$   $V_{883}$   $V_{884}$   $V_{885}$   $V_{886}$   $V_{887}$   $V_{888}$   $V_{889}$   $V_{890}$   $V_{891}$   $V_{892}$   $V_{893}$   $V_{894}$   $V_{895}$   $V_{896}$   $V_{897}$   $V_{898}$   $V_{899}$   $V_{900}$   $V_{901}$   $V_{902}$   $V_{903}$   $V_{904}$   $V_{905}$   $V_{906}$   $V_{907}$   $V_{908}$   $V_{909}$   $V_{910}$   $V_{911}$   $V_{912}$   $V_{913}$   $V_{914}$   $V_{915}$   $V_{916}$   $V_{917}$   $V_{918}$   $V_{919}$   $V_{920}$   $V_{921}$   $V_{922}$   $V_{923}$   $V_{924}$   $V_{925}$   $V_{926}$   $V_{927}$   $V_{928}$   $V_{929}$   $V_{930}$   $V_{931}$   $V_{932}$   $V_{933}$   $V_{934}$   $V_{935}$   $V_{936}$   $V_{937}$   $V_{938}$   $V_{939}$   $V_{940}$   $V_{941}$   $V_{942}$   $V_{943}$   $V_{944}$   $V_{945}$   $V_{946}$   $V_{947}$   $V_{948}$   $V_{949}$   $V_{950}$   $V_{951}$   $V_{952}$   $V_{953}$   $V_{954}$   $V_{955}$   $V_{956}$   $V_{957}$   $V_{958}$   $V_{959}$   $V_{960}$   $V_{961}$   $V_{962}$   $V_{963}$   $V_{964}$   $V_{965}$   $V_{966}$   $V_{967}$   $V_{968}$   $V_{969}$   $V_{970}$   $V_{971}$   $V_{972}$   $V_{973}$   $V_{974}$   $V_{975}$   $V_{976}$   $V_{977}$   $V_{978}$   $V_{979}$   $V_{980}$   $V_{981}$   $V_{982}$   $V_{983}$   $V_{984}$   $V_{985}$   $V_{986}$   $V_{987}$   $V_{988}$   $V_{989}$   $V_{990}$   $V_{991}$   $V_{992}$   $V_{993}$   $V_{994}$   $V_{995}$   $V_{996}$   $V_{997}$   $V_{998}$   $V_{999}$   $V_{1000}$   $V_{1001}$   $V_{1002}$   $V_{1003}$   $V_{1004}$   $V_{1005}$   $V_{1006}$   $V_{1007}$   $V_{1008}$   $V_{1009}$   $V_{1010}$   $V_{1011}$   $V_{1012}$   $V_{1013}$   $V_{1014}$   $V_{1015}$   $V_{1016}$   $V_{1017}$   $V_{1018}$   $V_{1019}$   $V_{1020}$   $V_{1021}$   $V_{1022}$   $V_{1023}$   $V_{1024}$   $V_{1025}$   $V_{1026}$   $V_{1027}$   $V_{1028}$   $V_{1029}$   $V_{1030}$   $V_{1031}$   $V_{1032}$   $V_{1033}$   $V_{1034}$   $V_{1035}$   $V_{1036}$   $V_{1037}$   $V_{1038}$   $V_{1039}$   $V_{1040}$   $V_{1041}$   $V_{1042}$   $V_{1043}$   $V_{1044}$   $V_{1045}$   $V_{1046}$   $V_{1047}$   $V_{1048}$   $V_{1049}$   $V_{1050}$   $V_{1051}$   $V_{1052}$   $V_{1053}$   $V_{1054}$   $V_{1055}$   $V_{1056}$   $V_{1057}$   $V_{1058}$   $V_{1059}$   $V_{1060}$   $V_{1061}$   $V_{1062}$   $V_{1063}$   $V_{1064}$   $V_{1065}$   $V_{1066}$   $V_{1067}$   $V_{1068}$   $V_{1069}$   $V_{1070}$   $V_{1071}$   $V_{1072}$   $V_{1073}$   $V_{1074}$   $V_{1075}$   $V_{1076}$   $V_{1077}$   $V_{1078}$   $V_{1079}$   $V_{1080}$   $V_{1081}$   $V_{1082}$   $V_{1083}$   $V_{1084}$   $V_{1085}$   $V_{1086}$   $V_{1087}$   $V_{1088}$   $V_{1089}$   $V_{1090}$   $V_{1091}$   $V_{1092}$   $V_{1093}$   $V_{1094}$   $V_{1095}$   $V_{1096}$   $V_{1097}$   $V_{1098}$   $V_{1099}$   $V_{1100}$   $V_{1101}$   $V_{1102}$   $V_{1103}$   $V_{1104}$   $V_{1105}$   $V_{1106}$   $V_{1107}$   $V_{1108}$   $V_{1109}$   $V_{1110}$   $V_{1111}$   $V_{1112}$   $V_{1113}$   $V_{1114}$   $V_{1115}$   $V_{1116}$   $V_{1117}$   $V_{1118}$   $V_{1119}$   $V_{1120}$   $V_{1121}$   $V_{1122}$   $V_{1123}$   $V_{1124}$   $V_{1125}$   $V_{1126}$   $V_{1127}$   $V_{1128}$   $V_{1129}$   $V_{1130}$   $V_{1131}$   $V_{1132}$   $V_{1133}$   $V_{1134}$   $V_{1135}$   $V_{1136}$   $V_{1137}$   $V_{1138}$   $V_{1139}$   $V_{1140}$   $V_{1141}$   $V_{1142}$   $V$

## MONTHLY POWER GENERATION & PPA ENERGY

Sr. no	Month	PPA Energy	Sent out Energy	% of PPA	Remark
	For Year 2022,				
1	January	6,214,000	5,709,440	92%	
2	February	5,658,000	6,042,240	107%	
3	March	6,565,000	5,974,410	91%	
4	April	6,162,000	6,564,920	107%	
5	May	6,514,000	6,475,270	99%	
6	June	6,037,000	6,121,990	101%	
7	July	5,700,000	6,221,960	109%	
8	August	4,854,000	5,672,120	117%	
9	September	5,438,000	5,280,990	97%	
10	October	5,791,000	6,083,360	105%	
11	November	5,730,000	5,641,930	98%	
12	December	5,934,000	4,795,050	81%	
	Total	70,597,000	70,583,680	100%	

**Comparison status of  
Fix- Type and Tracker -Type**

**Tracking system is 30% more production than Fixed-type solar system**

**And**

**Peak Sun Hour of Fix Type solar is a range of 4 ~ 5.75 Hr**

**( Search From Web- Site)**

**Analyze on practical**

Fix Type solar system's average per day Peak Sun Hour = **6.265 Hr**

Tracking Type solar system's average per day Peak Sun Hour = **8.035 Hr**

In Practically found that =  **$8.035/6.265 = 1.28$  ( Mean 28% more)**

**We can confirm:**

**Solar Tracking System is 28% more efficiency than Fixed-Type Solar System**

# *Training*

This training is intended for professional technicians who are responsible for the installation, operation, and maintenance of MV grid-connected inverters. The professional technician is required to meet the following requirements:

Know electronic, electrical wiring, and mechanical expertise, and be familiar with electrical and mechanical schematics.

Should be familiar with the composition and working principles of the PV system and its front- and rear-level equipment.

Have received professional training related to the installation and commissioning of electrical equipment.

Be able to quickly respond to hazards or emergencies that occur during installation and commissioning.

Be familiar with the relevant standards and specifications of the country/region where the project is located.

# Training



# Training



# *Training*



## Electrical safety ( Part-1)

Presentation by

**U Shwe**

PE0063 (Electrical )( Building Services)

ACPE, National Counterpart

EI Certificate, (Ahtoo Ka/266)

Consultant

Triple Shwe Engineering Co., Ltd.

Contact: Mobile Ph (+95)

095007162, 09799949720

20-10-2020

## Electrical Control Systems

Presentation By U Shwe

21- 3-2018





## Meeting with Local Fire Fighting Authority



## **28) Problems and Solving**

**INVERTER OVERHEATING**

**BOX\_TRANSFORMER BUSBAR CUBICLE  
OVERHEATING**

## Problems of Inverter overheating



### Possible causes of Inverter overheating

1. Electronic components are come out heat by itself while it is running with full function operation.
2. Temperature sensor that built in electronic circuits compartment has reached to setpoint temperature (about 40 ° C) cooling fan start running to cool down for electronic compartment.
3. But the cooling air can not enough cool down to internal electronic circuit boards with built in aluminium heat -sink. Then air exhaust as a hot air about 70° C. It can become overheat caused by cooling fan clogged with dust.
4. Long time operation, internal electronic circuits are raising more temperature and become overheat an may be burnt the inverter.
5. Inverter have included protection itself by de-rating mode when internal temperature reach 65 ° C

## Supplier Instruction

Pay attention to these points in the maintenance of the inverter in summer,  
suitable temperature,  
humidity,  
ventilation,  
no dust and no interference,  
and clean the inverter inside and outside.

# Solving the Problems

Request Supplier' advise.

Cleaning the inverter cooling fan  
regular checking and cleaning



Discuss with designer to place  
inverter orientation because  
direct sunlight on inverter front  
face is more hot.



Construct additional roof on  
inverter to protect direct sunlight.



# Overheat inside the busbar Chamber



## **BOX\_TRANSFORMER BUSBAR CUBICLE OVERHEATING**

Main causes of busbar chamber is loosing bolt and nuts at busbar joints

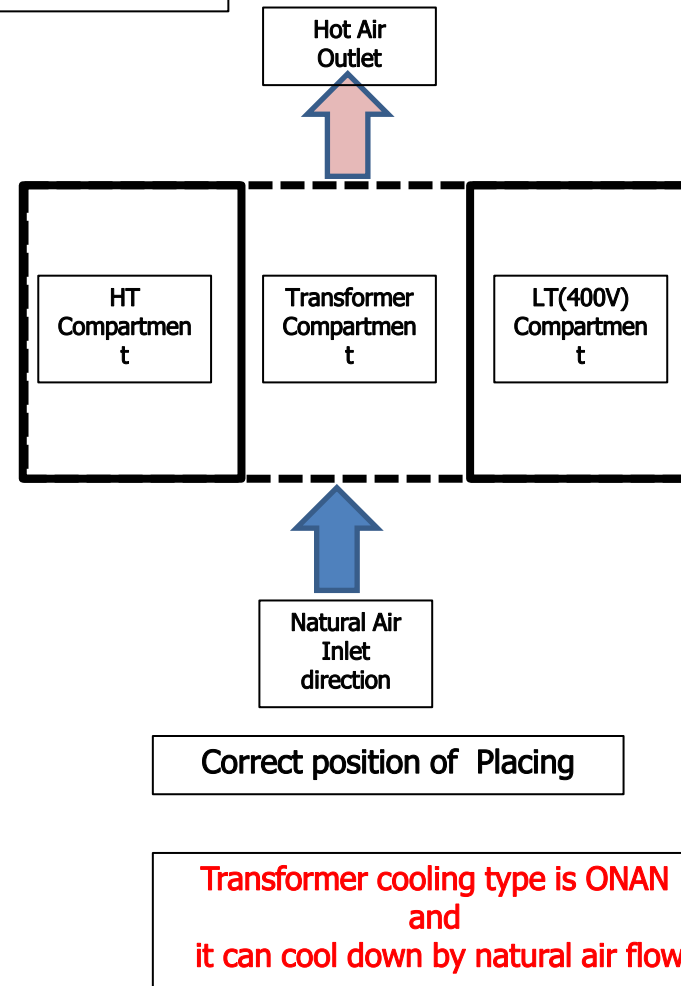
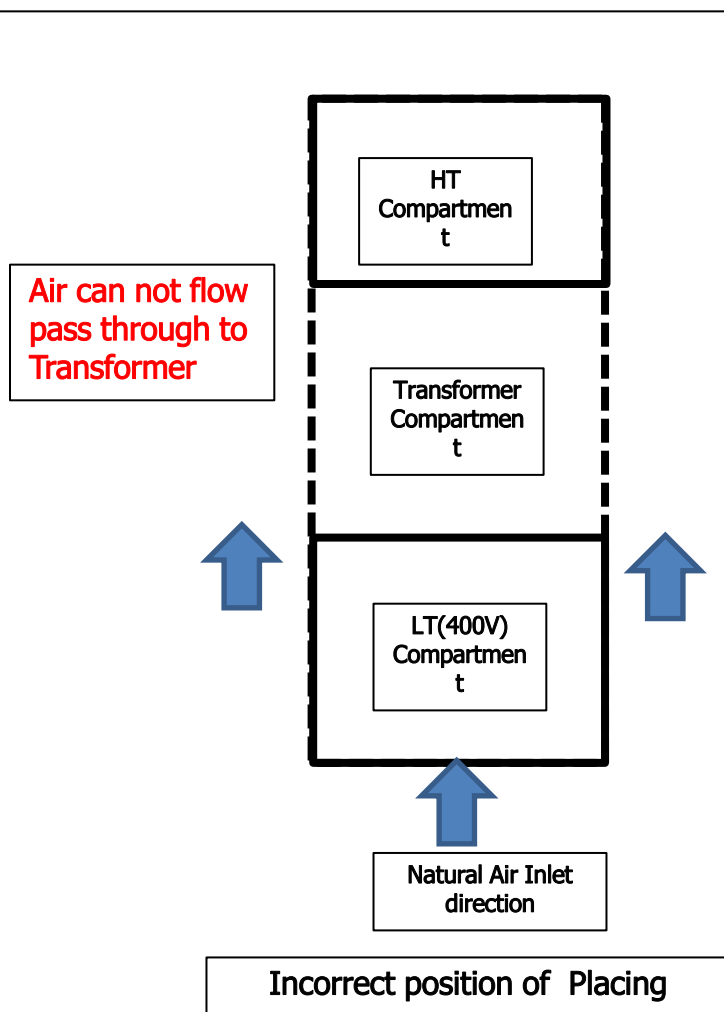
Termination Joints

Not enough cooling fan and exhaust fan.

Orientation of transformer position.

Checking the suitable size of busbar.

## Orientation Of Box type Transformer placing .



# Solving Problems

Re-tiding of all joint after permission from supplier

Add Cooling and Exhaust fan with adequate size.

For the next project pre checking and tide bolts and nuts before start operation.

## **29. Regular maintenance**

**Inverter Checking & Cleaning**



**Box Transformer Checking**



**Solar Tracking function checking**



## Solar Panel Cleaning



PV Modules Cleaning



Mowing Grass Between Solar Rows



## **(30) General Study**

**What is the different between this 2 photo's appearance.?**



**Before Cleaning of  
solar panels**

**After Cleaning of  
solar panels**



# Study of Solar Panel Cleaning work

Sr No	Box X-Mtr-1 (kWh)	Box X-Mtr-2 (kWh)	Box X-Mtr-3 (kWh)	Box X-Mtr-4 (kWh)
1	1320.4	1328.8	1317.2	1313.5
2	1335.3	1338.5	1331.3	1327.2
3	1321.9	1327.6	1321.3	1319.3
4	1317.2	1336.7	1321.3	1322.2
5	1317.3	1343.5	1328.3	1328.3
6	1315.1	1329.9	1310.5	1310.5
7	1309.8	1347.8	1327.4	1327.4
8	1313.5	1317.9	1324.7	1324.7
9	1325.4	1439.9	1319.2	1319.2
10	1312.5	1437.7	1328.7	1328.7
11	1326.8	1404.8	1310.5	1310.5
12	1319.2	1320.9	1289.3	1289.3
13	1317.9	1427.6	1311.3	1311.3
14	1322.4	1315.5	1313.1	1313.1
15	1335.6	1309.5	1314.3	1314.3
16	1323.1	1325.3	1324.7	1324.7
17	1404.4	1321.5	1325.3	1325.3
18	1423.3	1407.8	1313.1	1313.1
19	1327.6	1324.5	1325.3	1325.3
20	1319.2	1407.8	1325.3	1325.3
21	1345.9	1337	1409.4	1409.4
22	1322.4	1418.3	1327.4	1327.4
23	1325.3	1324.5	1417.6	1417.6
24	1325.3	1247.4	1417.6	1417.6
25	1325.3	1325.3	1423.3	1423.3
TOTAL	31832.6	33552.2	30680.4	21438.9
Average PV Module Cleaning Finished Each Inverter	1,340.78	1,342.09	1,424.35	1,328.93
Average PV Module Cleaning Not Finished Each Inverter	1,167.60	-	1,161.10	-

Total Average Cleaning Finished Inverter 1,361.79 kWh  
Total Average Cleaning Not Finished Inverter 1,164.35 kWh  
197.44 kWh

PV Module Cleaning Finished  
PV Module Cleaning Not Finished

Sr No	PV Module Cleaning Inverter Box X-Mtr-1 (kWh)	PV Module Cleaning Inverter Box X-Mtr-2 (kWh)	PV Module Cleaning Inverter Box X-Mtr-3 (kWh)	PV Module Cleaning Inverter Box X-Mtr-4 (kWh)
1	1375.5	1375.9	1361.7	1361.7
2	1384.6	1375.5	1394.1	1394.1
3	1374.7	1374.9	1366.6	1366.6
4	1367.6	1364.5	1371.6	1371.6
5	1367.5	1405.5	1343.3	1343.3
6	1387.2	1369.5	1376.5	1376.5
7	1350.9	1358.7	1375.9	1375.9
8	1385.2	1354.5	1372.6	1372.6
9	1374	1357.4	1362.6	1362.6
10	1382.9	1404.6	1375.6	1375.6
11	1376.6	1408.5	1355.1	1355.1
12	1369.9	1370.1	1343.3	1343.3
13	1365.9	1405.4	1403.3	1403.3
14	1371.1	1364.3	1367.1	1367.1
15	1366.4	1354.5	1409.3	1409.3
16	1382.1	1372.2	1369.4	1369.4
17	1406.7	1373.4	1367.1	1367.1
18	1476.7	1402.2	1362.4	1362.4
19	1372.5	1376.4	1362.4	1362.4
20	1371.8	1364.6	1362.4	1362.4
21	1366.7	1336.2	1350.6	1350.6
22	1484.5	1473.9	1362.4	1362.4
23	1371.8	1353.5	1357.6	1357.6
24	1399.4	1403.3	1362.4	1362.4
25	1370.5	1406.7	1362.4	1362.4
TOTAL	33022.5	34782.5	32268.5	22233.5
Average PV Module Cleaning Finished Each Inverter	1,321.02	1,391.30	1,452.61	1,369.39
Average PV Module Cleaning Not Finished Each Inverter	1,210.05	-	1,234.46	-

Total Average Cleaning Finished Inverter 1,406.13 kWh  
Total Average Cleaning Not Finished Inverter 1,217.25 kWh  
188.88 kWh

PV Module Cleaning Finished  
PV Module Cleaning Not Finished

Green Power Energy Co., Ltd.  
Solar Power Plant Project (Taung Taw Gwin)  
Version of Inverter Data (PV Module Cleaning)

Sr No	PV Module Cleaning Inverter Box X-Mtr-1 (kWh)	PV Module Cleaning Inverter Box X-Mtr-2 (kWh)	PV Module Cleaning Inverter Box X-Mtr-3 (kWh)	PV Module Cleaning Inverter Box X-Mtr-4 (kWh)
1	1594	1594.5	1593.5	1593.5
2	1590	1577.2	1593.5	1593.5
3	1594.1	1575.5	1593.5	1593.5
4	1597.6	1598.7	1593.5	1593.5
5	1597.2	1594.7	1593.5	1593.5
6	1596.1	1597.4	1593.5	1593.5
7	1595.7	1595.4	1597.1	1597.1
8	1595.6	1597.1	1597.9	1597.9
9	1579	1575.9	1593.5	1593.5
10	1590.1	1570.5	1593.5	1593.5
11	1579.3	1574.4	1593.5	1593.5
12	1571.7	1596.5	1511.7	1511.7
13	1569	1569	1593.5	1593.5
14	1577.3	1590.6	1496.4	1496.4
15	1571.2	1594.1	1593.5	1593.5
16	1567.5	1570.6	1571.3	1571.3
17	1574	1570.1	1571.3	1571.3
18	1592	1576.1	1570.3	1570.3
19	1598.9	1570.7	1593.5	1593.5
20	1595.7	1593.4	1441.2	1441.2
21	1598.6	1716.3	1593.5	1593.5
22	1570.6	1593.3	1593.5	1593.5
23	1571.2	1571.2	1593.5	1593.5
24	1593.5	1593.5	1593.5	1593.5
25	1593.5	1593.5	1593.5	1593.5
TOTAL	37886.5	39874.2	37596.7	25493.7
Average PV Module Cleaning Finished Each Inverter	1,515.46	1,594.97	1,504.43	1,503.36
Average PV Module Cleaning Not Finished Each Inverter	1,388.35	-	1,387.43	-

Total Average Cleaning Finished Inverter 1,596.94 kWh  
Total Average Cleaning Not Finished Inverter 1,387.89 kWh  
209.05 kWh

PV Module Cleaning Finished  
PV Module Cleaning Not Finished

## TAUNG TAW GWIN

Sr No	Cleaning Inverter Box X-Mtr-1 (kWh)	Cleaning Inverter Box X-Mtr-2 (kWh)	Cleaning Inverter Box X-Mtr-3 (kWh)	Cleaning Inverter Box X-Mtr-4 (kWh)
1	1575.7	1484	1593.5	1593.5
2	1481.1	1476.4	1593.5	1593.5
3	1466.5	1477.9	1593.5	1593.5
4	1469.2	1467.5	1593.5	1593.5
5	1469.2	1495.5	1593.5	1593.5
6	1457.6	1473.5	1593.5	1593.5
7	1448.7	1494	1476.9	1476.9
8	1454.5	1489.7	1494.1	1494.1
9	1472.3	1519.3	1593.5	1593.5
10	1452.3	1588.3	1489	1489
11	1472.5	1485.9	1593.5	1593.5
12	1461.3	1461.1	1496.7	1496.7
13	1463.5	1581	1593.5	1593.5
14	1468.8	1451.2	1507.4	1507.4
15	1467.6	1452.5	1593.5	1593.5
16	1481	1481.9	1593.5	1593.5
17	1500.2	1497.4	1593.5	1593.5
18	1578.2	1588.8	1492.7	1492.7
19	1467.7	1477.3	1494.6	1494.6
20	1571.5	1593.9	1593.5	1593.5
21	1484.5	1485.3	1493.5	1493.5
22	1598.9	1475.9	1546.9	1546.9
23	1481.1	1345	1493.2	1493.2
24	1593.5	1593.5	1593.5	1593.5
25	1593.5	1593.5	1593.5	1593.5
TOTAL	35293.3	37297.4	35737.9	25493.7
Average PV Module Cleaning Finished Each Inverter	1,485.30	1,491.90	1,546.40	1,593.36
Average PV Module Cleaning Not Finished Each Inverter	1,267.30	-	1,300.63	-

Total Average Cleaning Finished Inverter 1,530.01 kWh  
Total Average Cleaning Not Finished Inverter 1,298.97 kWh  
231.04 kWh

PV Module Cleaning Finished  
PV Module Cleaning Not Finished



After Cleaning

Before Cleaning

Total Average Cleaning Finished Inverter

Total Average Cleaning Not Finished Inverter

Total Average Cleaning Finished Inverter

Total Average Cleaning Not Finished Inverter

Total Average Cleaning Finished Inverter

Total Average Cleaning Not Finished Inverter

Total Average Cleaning Finished Inverter

Total Average Cleaning Not Finished Inverter

**TAUNG TAW GWIN**

**Green Power Energy Co.,Ltd**  
**20MW Solar Power Plant Project (Taung Taw Gwin)**  
**Comparsion of Inverter (kWh Output)**

Sr No	Date	<u>After</u> Cleaning of Solar Panel Average Output/Inverters (kWh)	<u>Before</u> Cleaning of Solar Panel Average Output/Inverters (kWh)	Average More Production of Inverters (kWh)	Clean of Solar Panel for Inverters/Total Inverters	Clean of Solar Panel for Inverters/Total Inverters (%)
1	13.2.2023	1361.79	1164.35	197.44	( 67/90 )	74.4%
2	14.2.2023	1406.13	1217.25	188.88	( 70/90 )	77.8%
3	15.2.2023	1596.94	1387.69	209.05	( 76/90 )	84.4%
4	16.2.2023	1530.31	1298.97	231.34	( 76/90 )	84.4%

# TAUNG TAW GWIN



Green Power  
20MW Solar Power Plant Project (Taung Taw Gwin)  
Comparison of Inverter Data (PV Module Cleaning)

Green Power Energy Co.,Ltd  
20MW Solar Power Plant Project (Taung Taw Gwin)  
Comparison of Inverter Data (PV Module Cleaning)

14.3.2023

Sr No	PV Module Cleaning Inverter Box X'mer-1 (kWh)	PV Module Cleaning Inverter Box X'mer-2 (kWh)	PV Module Cleaning Inverter Box X'mer-3 (kWh)	PV Module Cleaning Inverter Box X'mer-4 (kWh)	Total Inv; 90Nos (kWh)
1	1349	1416.9	1382.3	1395.3	5544
2	1315.6	1412.8	1358.7	1405	5492
3	1302.7	1414.1	1348.1	1403.4	5468
4	1292.9	1429.1	1348.8	1405.5	5476
5	1296.8	1323.9	1353.2	1391.2	5365
6	1292.3	1406.1	1399.7	1394.2	5492
7	1285.5	1323.9	1417.3	1398.5	5425
8	1287	1405.5	1392.1	1397.5	5482
9	1419.5	1430.8	1404.8	1394.4	5650
10	1282.3	1411.2	1369.5	1409.1	5472
11	1415.7	1402.2	1401.3	1387.4	5607
12	1287.1	1413.6	1322.5	1387.4	5411
13	1413.3	1395.4	1398.7	1504.9	5712
14	1286.1	1403.9	1333.3	1500	5523
15	1416.3	1298.2	1330.6	1514.4	5560
16	1423.1	1412.8	1321.9	1523.8	5682
17	1520.3	1407.5	1337.4		4265
18	1520.3	1398.8	1510.9		4430
19	1311.7	1407.3	1340		4059
20	1503.8	1395.7	1460.8		4360
21	1339.5	1413.9	1502		4255
22	1524.9	1388.6	1496.4		4410
23	1524.4	1318.7	1516.2		4359
24	1249.4	1445.2	1492.1		4187
25		1456.7	1500.8		2958
TOTAL	32859.3	34932.8	35039.4	22812.0	125643.5
Average PV Module Cleaning Finished Each Inverter	1,468.14	1,411.96	1,463.39	1,425.75	
Average PV Module Cleaning Not Finished Each Inverter	1,298.42	1,383.79	1,360.37	-	

Total Average Cleaning Finished Inverter 1,442.31 kWh  
Total Average Cleaning Not Finished Inverter 1,347.53 kWh  
94.78 kWh



 PV Module Cleaning Finished  
 PV Module Cleaning Not Finished

Remark: Today is Sunny.  
(14.3.2023) Max Total Radiation = 724 W/m2

15.3.2023

Sr No	PV Module Cleaning Inverter Box X'mer-1 (kWh)	PV Module Cleaning Inverter Box X'mer-2 (kWh)	PV Module Cleaning Inverter Box X'mer-3 (kWh)	PV Module Cleaning Inverter Box X'mer-4 (kWh)	Total Inv; 90Nos (kWh)
1	1424	1490.7	1457.5	1467.2	5839
2	1387.6	1484.5	1426.1	1474.7	5773
3	1374.7	1485.3	1416.3	1471.9	5748
4	1364.4	1502.4	1452.6	1471.8	5791
5	1368.6	1397.6	1479.8	1457.1	5703
6	1364.8	1476.7	1483.4	1458.7	5784
7	1357.5	1396.3	1503.1	1486.6	5724
8	1360.6	1476.7	1478.1	1465	5780
9	1498.8	1509.4	1492.9	1481.8	5963
10	1356.5	1489	1470.2	1476.2	5792
11	1495	1471.8	1489	1455.7	5912
12	1362.9	1490.5	1477.4	1455.8	5787
13	1492	1465.5	1491.8	1579.2	6029
14	1362.3	1481.7	1488.9	1577.1	5910
15	1495	1364.4	1483.1	1587.6	5930
16	1502.3	1492	1473.5	1598.7	6067
17	1605.6	1486.3	1485.9		4578
18	1606.3	1470.4	1602		4679
19	1381.7	1486.7	1422.1		4291
20	1589.3	1468.8	1548.9		4607
21	1414.5	1494.7	1592.6		4502
22	1610.3	1470.2	1585.5		4666
23	1608.4	1409.5	1606.9		4625
24	1315.7	1594.1	1575		4485
25		1605.1	1586.1		3191
TOTAL	34698.8	36960.3	37568.7	23925.1	133152.9
Average PV Module Cleaning Finished Each Inverter	1,550.30	1,503.39	1,520.30	1,495.32	
Average PV Module Cleaning Not Finished Each Inverter	1,371.13	1,446.63	1,457.61	-	

Total Average Cleaning Finished Inverter 1,517.33 kWh  
Total Average Cleaning Not Finished Inverter 1,425.12 kWh  
92.20 kWh

 PV Module Cleaning Finished  
 PV Module Cleaning Not Finished

Remark: Today is Sunny.  
(14.3.2023) Max Total Radiation = 723 W/m2

(kWh)
1424
1387.6
1374.7
1364.4
1368.6
1364.8
1357.5
1360.6
1498.8
1356.5
1495
1362.9
1492
1362.3
1495
1502.3
1605.6
1606.3
1381.7
1589.3
1414.5
1610.3
1608.4
1315.7

TAUNG TAW GWIN

1,517.33 kWh
1,425.12 kWh
92.20 kWh

Thapyaya Solar Power Station Inverters Data Record									
8.3.2023									
Sr No	Inverter No	Box X'mer-1 kWh	Box X'mer-2 kWh	Box X'mer-3 kWh	Box X'mer-4 kWh	Box X'mer-5 kWh	Total Inv 126 nos (kWh)	Remark	
1	1	1579.3	1517.8	1460.3	1452.3	1425.2			
2	2	1524.4	1509.1	1464.1	1444	1450.1			
3	3	1467.8	1513.5	1421.9	1437.5	1443.9			
4	4	1542.9	1513	1461.6	1451.6	1450.9			
5	5	1531.1	1513.3	1467.4	1448.9	1442.2			
6	6	1531.7	1516.4	1454.9	1427	1461.8			
7	7	1518.9	1504.6	1454.8	1448.9	1454.9			
8	8	1505	1503.5	1443.6	1440.9	1457.4			
9	9	1464.4	1486.1	1433.8	1429.8	1458.7			
10	10	1456.9	1486.3	1528.5	1486.6	1406.9			
11	11	1464.1	1476.1	1538.9	1433.5	1446.7			
12	12	1463.6	1462.6	1473.6	1372.7	1449.7			
13	13	1399.7	1510.8	1464.5	1500.2	1454.2			
14	14	1469.7	1514.6	1454	1326.7	1448			
15	15	1451.8	1519.6	1445.4	1515.5	1441.9			
16	16	1449.3	1492.6	1431.4	1524.4	1446			
17	17	1465.1	1503.9	1434.1	1522.2	1421.3			
18	18	1451.9	1482.3	1462	1469.6	1435.6			
19	19	1450.6	1407	1447.1	1404.5	1430.7			
20	20	1467.7	1495.4	1466.2	1414.8	1419.6			
21	21	1419.8	1507.3	1522.4	1414.6	1477.6			
22	22	1418.2	1388.7	1522.6	1425.1	1431.4			
23	23	1445.6	1402.6	1541.8	1439.9	1436.5			
24	24	1413.4	1404.2	1474	1445	1454.8			
25	25	1443.4	1400.8	1556.3	1449.3	1464.3			
26	26					1433.4			
Total (kWh)		36831.8	37221.7	36861.1	36494.9	37479.3	184888.8	184.88	
Average PV Module Cleaning Finished Each Inverter		1,528.95	1,505.97	-	1,507.66	-			
Average PV Module Cleaning Not Finished Each Inverter		1,447.07	1,399.08	1,474.44	1,441.18	1,441.01			
Total Average Cleaning Finished Inverter							1,514.19	kWh	
Total Average Cleaning Not Finished Inverter							1,440.66	kWh	



Total Average Cleaning Finished Inverter

Total Average Cleaning Not Finished Inverter

Total Average Cleaning Finished Inverter

Total Average Cleaning Not Finished Inverter

Total Average Cleaning Finished Inverter

Total Average Cleaning Not Finished Inverter

Thapyaya Solar Power Station Inverters Data Record									
14.3.2023									
Sr No	Inverter No	Box X'mer-1 kWh	Box X'mer-2 kWh	Box X'mer-3 kWh	Box X'mer-4 kWh	Box X'mer-5 kWh	Total Inv 126 nos (kWh)	Remark	
1	1	1548.7	1507.6	1548.9	1545.2	1431.3			
2	2	1487.9	1469.9	1540.9	1522.3	1422.3			
3	3	1467.5	1484.9	1555.8	1527.5	1417.8			
4	4	1514.4	1495.1	1548.8	1546.7	1422.8			
5	5	1498.4	1494.4	1557.6	1544.4	1410.2			
6	6	1498.3	1411.1	1546	1489.2	1425			
7	7	1480.3	1405.8	1551.4	1521.3	1413			
8	8	1486.3	1487	1545.6	1523.2	1407			
9	9	1523.6	1476.9	1540.2	1526	1404.6			
10	10	1520.8	1460.8	1519.8	1503.4	1466.4			
11	11	1511.5	1472.4	1514.1	1523.6	1524.6			
12	12	1437.4	1480.2	1548.9	1481.4	1526.7			
13	13	1376.4	1486.6	1546.5	1497.2	1501.6			
14	14	1439.2	1401.4	1509.6	1403.9	1521.9			
15	15	1429.2	1406.8	1526.7	1490.7	1520.1			
16	16	1425	1413.1	1529.9	1489.4	1511.8			
17	17	1501.8	1483.7	1525.2	1486.4	1488.9			
18	18	1517.4	1493.2	1540.8	1480.8	1489.6			
19	19	1522	1398.9	1542.7	1444.6	1418.7			
20	20	1525.5	1482.2	1561.4	1487.4	1387.3			
21	21	1482.8	1396.8	1512.1	1491.3	1371.5			
22	22	1484.4	1484.4	1510.8	1506.2	1370.9			
23	23	1514.4	1401.6	1628.9	1512.1	1489.3			
24	24	1414.9	1404.4	1566	1514	1422			
25	25	1412.9	1484.1	1538.8	1516.8	1440.7			
26	26					1370.6			
Total (kWh)		37077.8	36350.4	39121.5	37771.6	37638.4	187886.7	187.86	
Average PV Module Cleaning Finished Each Inverter		1,507.93	1,454.02	1,564.86	1,510.86	1,464.06			
Average PV Module Cleaning Not Finished Each Inverter		1,419.29	-	-	-	1,399.25			
Total Average Cleaning Finished Inverter							1,500.35	kWh	
Total Average Cleaning Not Finished Inverter							1,408.77	kWh	
							91.58	kWh	
		Remark : After Solar Cleaning							

Remark : After Solar Cleaning

THAPYAYWA									
Sr No	Inverter No	Box X'mer-1 kWh	Box X'mer-2 kWh	Box X'mer-3 kWh	Box X'mer-4 kWh	Box X'mer-5 kWh	Total Inv 126 nos (kWh)	Remark	
1	1	1713.7	1655.6	1710.9	1721.4	1684.5			
2	2	1676.6	1665.7	1710.7	1702.3	1589.2			
3	3	1709.8	1648	1725.5	1703.3	1568.7			
4	4	1701.1	1649.8	1715.9	1718.4	1594.1			
5	5	1692.2	1649.1	1728.9	1717	1580.3			
6	6	1691.4	1651.9	1716.4	1688.9	1597.6			
7	7	1684.6	1644	1722.4	1700.6	1589.9			
8	8	1684.3	1645.2	1715	1702.3	1577			
9	9	1685.4	1639.9	1713.6	1706.3	1574.1			
10	10	1681.8	1650.5	1765	1674.7	1543.9			
11	11	1692.2	1639.9	1760	1704.4	1707.9			
12	12	1686.3	1647.5	1705.2	1654.4	1714.4			
13	13	1620.7	1652.4	1727	1665.9	1715.5			
14	14	1684.2	1655.9	1722.4	1674.4	1686.4			
15	15	1676.6	1680.3	1716.5	1662.9	1720.1			
16	16	1675.3	1670	1710.7	1673.7	1696.6			
17	17	1716.7	1638	1718.9	1672.7	1661.8			
18	18	1682.8	1638.2	1717.4	1657.9	1671.2			
19	19	1682.7	1638.9	1706.1	1653.6	1594.4			
20	20	1685.6	1638.6	1734.6	1669.8	1558.5			
21	21	1684.1	1641.1	1780.8	1664.6	1548.4			
22	22	1656.8	1662.4	1788.5	1680.6	1540.8			
23	23	1678.9	1657.2	1802.6	1691.1	1586.3			
24	24	1636.2	1659.3	1744.3	1694.2	1602.9			
25	25	1676.5	1654	1818.8	1693.6	1598.2			
26	26					1553.9			
Total (kWh)		42025.9	41231.3	43455.6	42154.2	42088.6	210955.6	210.96	
Average PV Module Cleaning Finished Each Inverter		1,681.04	1,648.25	1,736.22	1,696.17	1,629.07			
Average PV Module Cleaning Not Finished Each Inverter		-	-	-	-	1,573.18			
Total Average Cleaning Finished Inverter							1,678.75	kWh	
Total Average Cleaning Not Finished Inverter							1,573.18	kWh	
							105.67	kWh	

1,514.19

kWh

1,440.66

kWh

73.54

kWh

1,500.35

kWh

1,408.77

kWh

91.58

kWh

1,678.75

kWh

1,573.18

kWh

105.57

kWh

# **Creation of Solar Panel Cleaning Tools**



Heavy

Can not cleaning Long Time

Motor is 24V DC , Supply is 230V AC

By using AC to DC adaptor

Water Bowser are followed behind



**Modify to Single Brush**

**Provided DC power from Batteries.**

**Created Water bucket and  
water spray pump instead of  
water bowser.**





**Creating of Thread brush with  
compressed air for day time  
cleaning**

## **Creating of Thread brush with blower air for day time cleaning**



## Care must be taken

**Mowing Grass Between Solar Rows**



**Solar Panel may crack due to mowing machine.**

**Solar panel cleaning with water at the day time  
(Power Generation Time)**



**Inverter may automatically shutdown by changes  
resistance of solar panel if water leakage into  
panel.**

**Every connection joint must be re-tiding  
after energizing**



**Connection joint can loose cause by electric  
magnetizing effect (Become overheat)**

**Take glove while checking solar panel  
and string connected wires**



**DC voltage is about 1500V, danger for electrical  
Hazards**

**Wait about 15 minutes when prepare to  
do maintenance of INVERTERs**



**Capacitance voltage will remain on electronic  
circuit cards**

**Bird dropping can become hot spot of  
solar Module**



**Daily checking and cleaning**

**Periodic cleaning of solar modules**



**Dirty solar panel can reduce power generation**

## Benefits of Solar Power

1. Location of this area is good irradiation from Sunlight in Myanmar.
2. We can use land from waste un-agriculture to become valuable.
3. These power plant are the Green & Clean Power Plants
4. Support to the development of that region and job opportunity for the people of that township.
5. Zero Carbon emission.



***BEFORE***



**30MW solar power Plant**

***AFTER***



***BEFORE***



**20MW solar power plant**

***AFTER***



*Yesterday*



*Today*



*Yesterday*



*Today*





Control Room

Primary Electrical(33KV

Secondary Electrical  
Supply power(AC,DC) &  
Control Panels)

Power Transformers

Power Converters

Series containers

## Opening Ceremony

## Project 2



**Site Visit and advised of Myanmar Engineering Council  
members and  
Federation of Myanmar Engineering Society.**



## New two projects site visit



# Solar power Plant Site Study Engineering Group



## Corporate Social Responsibility(CSR)



**Donated the construction of school and provided lighting to the village of Myo Gyi Gone**



**Donated 45 Lakhs for Htam Kan Village Lighting**



# **Records of New Solar power generating plant with BESS (2) project**

# Solar power generating plants Status

၂၀၂၄ ခုနှစ် ၊ ဧပြီ လ ၊ ၄ ရက်

စဉ်	စက်ရုံအမည်	တပ်ဆင် အင်အား (MW)	ထုတ်လုပ်မှု စုစုပေါင်း (MWh)	ပျမ်းမျှ ထုတ်လုပ်မှု (MWh)	Peak Time Load (MW)	Low Time Load (MW)	မှတ်ချက်
၁	အခြားစက်ရုံ	၄၀	၂၆၄.၀၀	၁၁.၀၀	၂၅.၁၉		
၂	သပြေဝ	၃၀	၂၂၈.၂၅	၉.၅၁	၂၃.၉၀		
၃	တောင်တော်ကွင်း	၂၀	၁၅၀.၄၁	၆.၂၇	၁၆.၁၃		
၄	အခြားစက်ရုံ	၃၀	၂၁၄.၅၁	၈.၉၄	၂၂.၄၄		
၅	အခြားစက်ရုံ	၃၀	၂၁၃.၆၁	၈.၉၀	၂၁.၉၃		
၆	အခြားစက်ရုံ	၃၀	၂၂၀.၄၉	၉.၁၉	၂၂.၀၈		
၇	သပြေဝ - (၃)	၃၀	၂၅၅.၀၄	၁၀.၆၃	၂၈.၀၅		
နေရောင်ခြည် စုစုပေါင်းချုပ်		၂၁၀	၁၅၄၆.၃၁	၆၄.၄၃	၁၅၉.၇၂		

လျှပ်စစ်စွမ်းအားဝန်ကြီးဌာန

လျှပ်စစ်ဓာတ်အားထုတ်လုပ်ရေးလုပ်ငန်း

နေရောင်ခြည်စွမ်းအင်သုံးလျှပ်စစ်ဓာတ်အားပေးစက်ရုံများ၏ နေ့စဉ်ဓာတ်အားထုတ်လုပ် ပို့လွှတ်မှုအခြေပြဇယား

၂၀၂၄ ခုနှစ်၊ ဧပြီ လ ၁၆ ရက်

စဉ်	စက်ရုံအမည်	တပ်ဆင် အင်အား (MW)	ထုတ်လုပ်မှု စုစုပေါင်း (MWh)	ပျမ်းမျှ ထုတ်လုပ်မှု (MWh)	Peak Time Load (MW)	Low Time Load (MW)	မှတ်ချက်
၁	အခြားစက်ရုံ	၄၀	၂၄၂.၆၀	၁၀.၁၁	၂၉.၉၁		
၂	သပြေဝ	၃၀	၂၀၄.၈၈	၈.၅၄	၂၄-၃၁		
၃	တောင်တော်ကွင်း	၂၀	၁၃၃.၃၂	၅.၅၆	၁၅.၁၃		
၄	အခြားစက်ရုံ	၃၀	၁၉၈.၄၂	၈.၂၇	၂၄-၉၅		
၅	အခြားစက်ရုံ	၃၀	၁၈၆.၀၀	၇.၇၅	၂၀.၈၄		
၆	အခြားစက်ရုံ	၃၀	၂၀၉.၃၆	၈.၇၂	၂၅-၂၅		
၇	သပြေဝ - (၃)	၃၀	၂၂၅.၃၈	၉.၃၉	၂၇-၉၅		
နေရောင်ခြည် စုစုပေါင်းချုပ်		၂၁၀	၁၃၉၉.၉၆	၅၈.၃၃	၁၆၈.၃၄		

# Solar power generating plants Status

၂၀၂၄ ခုနှစ်၊ ဇွန်လ ၁၈ ရက်

စဉ်	စက်ရုံအမည်	တပ်ဆင် အင်အား (MW)	ထုတ်လုပ်မှု စုစုပေါင်း (MWh)	ပျမ်းမျှ ထုတ်လုပ်မှု (MWh)	Peak Time Load (MW)	Low Time Load (MW)	မှတ်ချက်
၁	အခြားစက်ရုံ	၄၀	၂၃၃.၇၃	၉.၇၄	၃၃.၀၈		
၂	သပြေဝ	၃၀	၂၂၄.၅၂	၉.၃၆	၂၂.၁၇		
၃	တောင်တော်ကွင်း	၂၀	၁၇၁.၂၆	၇.၁၄	၂၀.၀၂		
၄	အခြားစက်ရုံ	၃၀	၂၀၀.၃၅	၈.၃၅	၂၈.၄၉		
၅	အခြားစက်ရုံ	၃၀	၁၉၉.၂၀	၈.၃၀	၂၇.၂၅		
၆	အခြားစက်ရုံ	၃၀	၁၉၂.၈၉	၈.၀၄	၂၆.၁၆		
၇	သပြေဝ - (၃)	၃၀	၂၅၀.၀၇	၁၀.၄၂	၁၁.၀၅		Solar - ၂၃၇.၇၁ MWh BESS - ၁၂.၃၆ MWh
၈	သာစည်	၃၀	၂၆၄.၄၇	၁၁.၀၂	၂၉.၇၉		Solar - ၂၅၂.၃၅ MWh BESS - ၁၂.၁၂ MWh
နေရောင်ခြည် စုစုပေါင်းချုပ်		၂၄၀	၁၇၃၆.၄၉	၇၂.၃၅	၁၉၀.၀၁		

**Q & A**

## ***Chinese Philosopher Xunzi***



**I hear and I forget,  
I see and I remember,  
I do and I understand.**

**Tell me, I forget.  
Show me, I remember.  
Involve me, I understand.**