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Sustainable Energy for Security - SE4S

Solar PV with storage

Presented by Elie Maalouf – Operations Manager ECOsys an ITG Company

8-12-2021

Project objectives:

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The objective of this project is to provide a sustainable source of electricity through the installation of Solar Photovoltaic Hybrid systems for the Lebanese Army Sites at the North Eastern borders, in order to reduce the facilities' dependence on diesel generators, and to provide an Eco-friendly technology for power system

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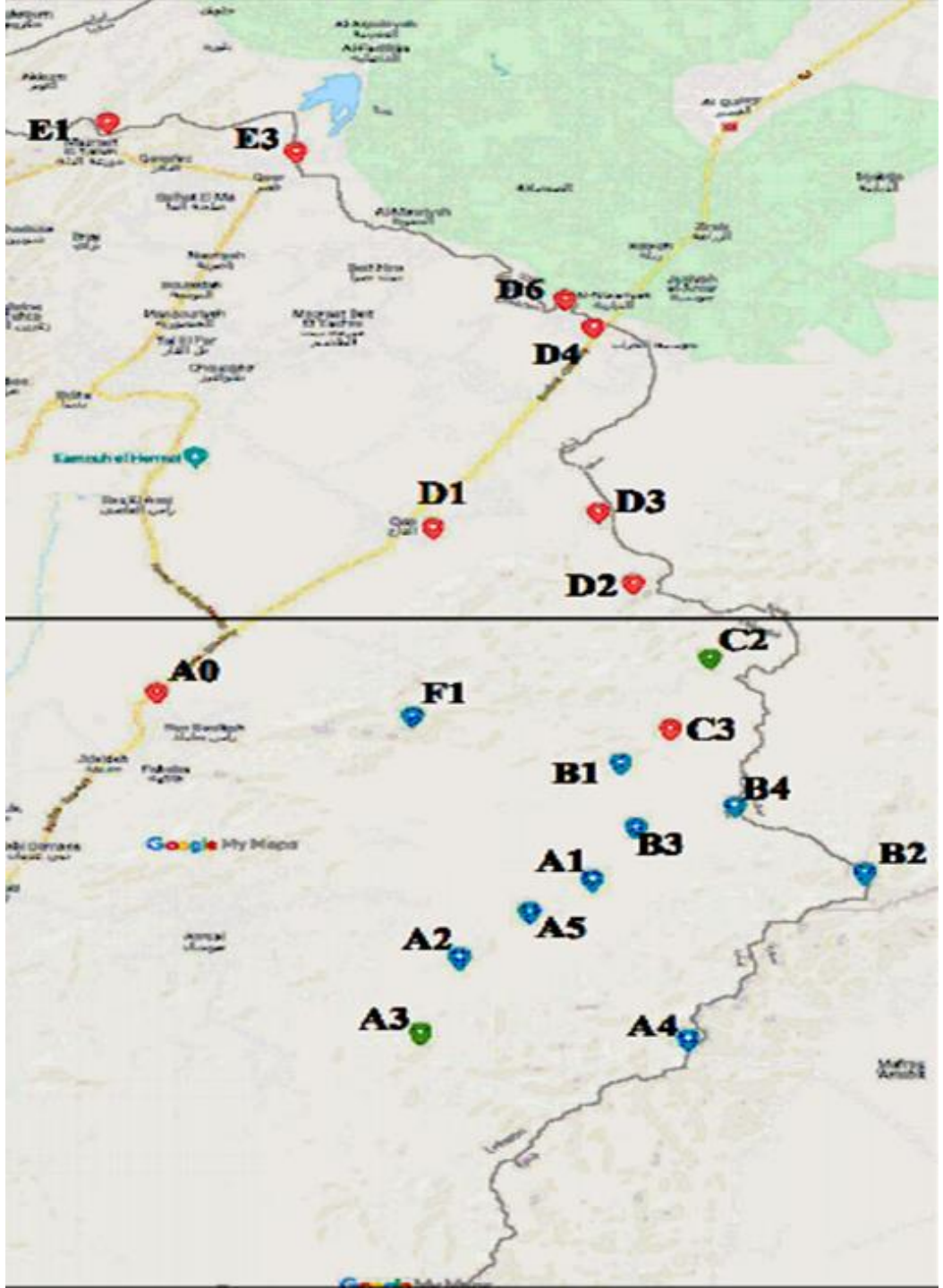
Sites location:
Sites are located at a strategic army area, at Lebanese – Syrian Borders, the solar system installation will provide security, and electricity to the army



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As shown on the maps:

- The project will be implemented on 20 different sites
- The project was initially divided into 3 bids:

  Bid 1: Locations in red

  Bid 2: Locations in Green

  Bid 3: Locations in Blue

Hybrid System Overview

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Hybrid systems combine solar and battery storage. This systems are able to store solar energy that is generated during the day and using it at night. Hybrid systems are also able to charge the batteries using the available grid

Project Overview

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Items	Quantity	Brand
PV Panels	461	Jinko 535 Wp panels
Lithium Batteries	90	Narada 48NPFC200, 48NPFC100, and 48NPC160
Solar Charger	34	Victron Smart Solar
Inverters	50	Multiplus 48/5000 and 48/3000
PV Mountings	-	Schletter

Project Overview

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Required work per facilities PV bid 1

Facility	Minimum PV (kWp)	PV type	Minimum total Inverter (min. continuous kW @ T=25C)	Min. Battery (Min. kWh @25°C @80%DoD @C20	Mounting type	Cabling Ref. to CAD dwg	ATS needed (qty)	MDB	C/O	Technical room	Air Condition
A2	10	Off grid (3 phase)	10	35	Roof	UG	1	Rewiring	New	New 3x2.5x2.4	No
A1	10	Off grid (3 phase)	6	30	Roof	UG	1	Rewiring	New	Existing	No
A4	6	Off grid (3 phase)	6	20	Elevated Structure	on fence	1	Rewiring	New	New 3x2.5x2.4	Yes
A5	8	Off grid (3 phase)	6	35	Roof	UG	1	Rewiring	New	New 3x2.5x2.4	Yes
B1	16	Off grid (3 phase)	15	60	Roof	UG	1	Rewiring	New	Existing	No
B2	8	Off grid (1 phase)	8	30	Elevated Structure	On fence and structure	0	Rewiring	New	New 3x2.5x2.4	Yes
B3	8	Off grid (3 phase)	6	30	Roof	UG	0	Rewiring	New	New 3x2.5x2.4	Yes
B4	8	Off grid (3 phase)	6	30	Ground mounted	UG	2	Rewiring	New	New 3x2.5x2.4	Yes
F1	10	Off grid (3 phase)	8	35	Roof	UG	1	Rewiring	New	New 3x2.5x2.4	Yes

Project Overview

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Required work per facilities Solar bid 2

Facility	Minimum PV (kWp)	PV type	Minimum total Inverter (min. continuous kW @ T=25C)	Min. Battery (Min. kWh @25°C @80%DoD @C20	Mounting type	Cabling Ref. to CAD dwg	ATS needed (qty)	MDB	C/O	Technical room	Air Condition
A0	80	Hybrid: (On-grid, diesel)	Min. 20 (On-grid)	N/A	Roof	Aerial	2	New	None	Existing	N/A
C3	8	Off grid (3 phase)	6	30	Roof	UG	2	Rewiring	New	New 3x2.5x2.4	Yes
E1	10	Dual mode (3 phase)	10	25	Elevated Structure	Aerial	3	Rewiring	New	New 3x2.5x2.4	Yes
E3	4	Dual mode (3 phase)	4	10	Roof	UG	2	Rewiring	New	New 3x2.5x2.4	Yes
D1	10	Dual mode (1 phase)	10	25	Elevated structure	On Building	3	New	New	New 3x2.5x2.4	Yes
D2	6	Off grid (3 phase)	6	20	Roof	On fence	1	Rewiring	New	Existing	Yes
D3	10	Off grid (3 phase)	8	35	Elevated Structure	On fence	0	Rewiring	New	New 3x2.5x2.4	Yes
D4	8	Dual mode (3 phase)	8	15	Elevated Structure	UG	2	Rewiring	New	New 3x2.5x2.4	Yes
D6	8	Off grid (3 phase)	6	25	Roof	On Fence	0	Rewiring	New	New 3x2.5x2.4	Yes

Products Overview

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Panels Distribution Per site:

Ref	Quantity	Unit Capacity	Total Capacity
A2	21	535	11,235
A1	20	535	10,700
A4	12	535	6,420
A5	16	535	8,560
B1	30	535	16,050
B2	18	535	9,630
B3	14	535	7,490
B4	14	535	7,490
F1	20	535	10,700
A3	12	535	6,420
C2	12	535	6,420
C3	16	535	8,560
E1	20	535	10,700
E3	8	535	4,280
D1	16	535	8,560
D2	12	535	6,420
D3	20	535	10,700
D4	14	535	7,490
D6	16	535	8,560
A0	150	535	80,250

Products Overview

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Solar Charger Distribution Per site:

Ref	Model	Quantity	Unit Capacity	Total Capacity
A2	250/85	2	85	170
A1	250/85	2	85	170
A4	250/100	1	100	100
A5	250/70	2	70	140
B1	250/85	3	85	255
B2	250/85	2	85	170
B3	250/70	2	70	140
B4	250/70	2	70	140
F1	250/85	2	85	170
A3	250/100	1	100	100
C2	250/100	1	100	100
C3	250/70	2	70	140
E1	250/85	2	85	170
E3	250/70	1	70	70
D1	250/70	2	70	140
D2	250/100	1	100	100
D3	250/85	2	85	170
D4	250/70	2	70	140
D6	250/70	2	70	140
A0	---	---	---	---

Products Overview

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Inverters Distribution Per site:

Ref	Model	Quantity	Unit Capacity	Total Capacity
A2	Multiplus 5000	3	5000	15000
A1	Multiplus 3000	3	3000	9000
A4	Multiplus 3000	3	3000	9000
A5	Multiplus 3000	3	3000	9000
B1	Multiplus 3000	6	3000	18000
B2	Multiplus 3000	3	3000	9000
B3	Multiplus 3000	3	3000	9000
B4	Multiplus 3000	3	3000	9000
F1	Multiplus 3000	3	3000	9000
A3	Multiplus 3000	3	3000	9000
C2	Multiplus 3000	3	3000	9000
C3	Multiplus 3000	3	3000	9000
E1	Multiplus 5000	3	5000	15000
E3	Multiplus 5000	1	5000	5000
D1	Multiplus 3000	3	3000	9000
D2	Multiplus 3000	3	3000	9000
D3	Multiplus 3000	3	3000	9000
D4	Multiplus 3000	3	3000	9000
D6	Multiplus 3000	3	3000	9000
A0	KACO BP50	2	50000	100000

Products Overview

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Batteries Distribution Per site:

Ref	Model	Quantity	Unit Capacity	Total Capacity
A2	48NPFC200	4	200	38400
A1	48NPFC100	7	100	33600
A4	48NPFC100	4	100	19200
A5	48NPFC200	4	200	38400
B1	48NPFC200	7	200	67200
B2	48NPFC100	7	100	33600
B3	48NPFC100	7	100	33600
B4	48NPFC100	7	100	33600
F1	48NPFC200	4	200	38400
A3	48NPFC200	3	200	28800
C2	48NPFC100	7	100	33600
C3	48NPFC100	7	100	33600
E1	48NPFC200	3	200	28800
E3	48NPFC200	1	200	9600
D1	48NPFC100	4	100	19200
D2	48NPFC100	4	100	19200
D3	48NPFC200	4	200	38400
D4	48NPFC100	3	100	14400
D6	48NPFC200	3	200	28800
A0	---	---	---	---

Products Overview

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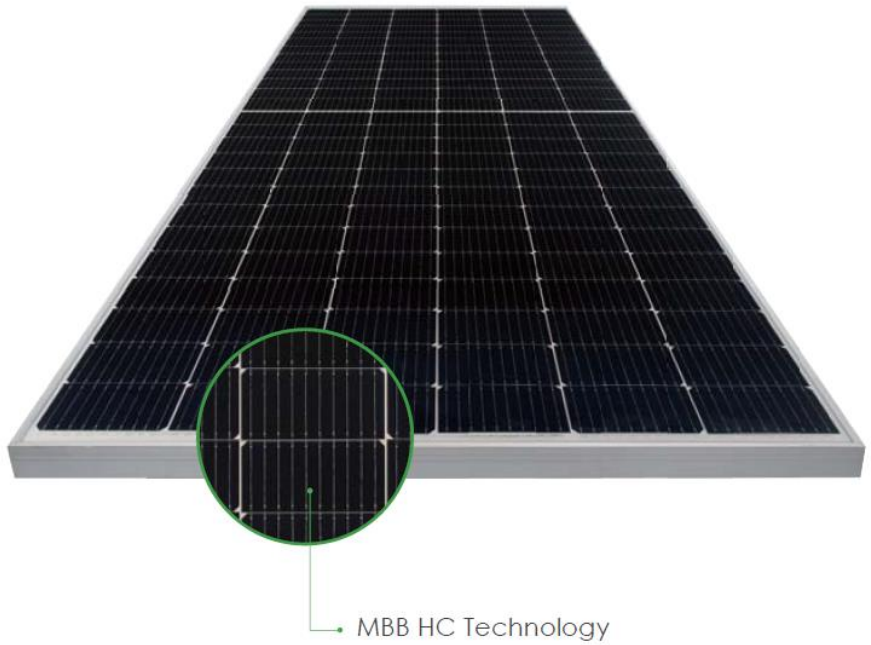
1. PV Panels:

Specification*	Value
Module Type	JKM535M-72HL4
Maximum Power	535 Wp
Maximum Power Current	13.17 A
Maximum Power Voltage	40.63
Short-circuit Current	13.79 A
Open-circuit Voltage	49.34



* at STC Conditions

Production Overview:

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2. Hybrid Inverter: Victron

Specification*	Value
Module Number	MultiPlus-II 48/5000
Output Power	5000 VA
Output Voltage	230 VAC
Frequency	50 Hz
Maximum AC input current	50 A
Cont. output power at 25°C	4000 W

Products Overview

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3. Solar Charger: Victron

Specification*	Value
Module Number	250/100
Battery voltage	48 V
Nominal PV Power	5800 W
Max PV open-circuit voltage	250 V
Rated Charge Current	50 Hz
Maximum AC input current	100 A
Maximum efficiency	99 %

SmartSolar Charge Controller
MPPT 250/100-Tr VE.Can
with optional pluggable display

Products Overview

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4. Batteries: Narada

Specification*	Value
Rated Voltage	48 V
Rated Capacity	200 Ah, 160 Ah, 100 Ah
Discharge Current (Max)	100 A
Charge Current (Max)	100 A
Charge Voltage	54 ±0.5 V
Typical Weight	80.0 kg, 80 kg, 38.5 kg

Products Overview

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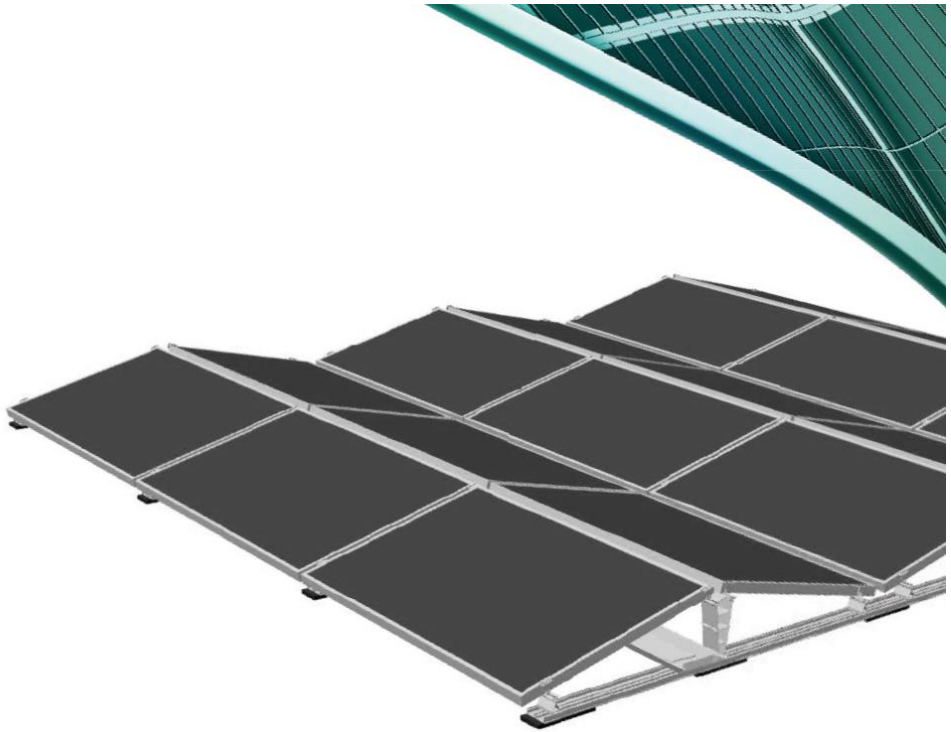
5. PV mountings:

- Leading German manufacturer of PV mountings structure
- The latest generation of flat roof systems at any scale
- Inclination: 6° to 13°
- No roof penetration



Case Example

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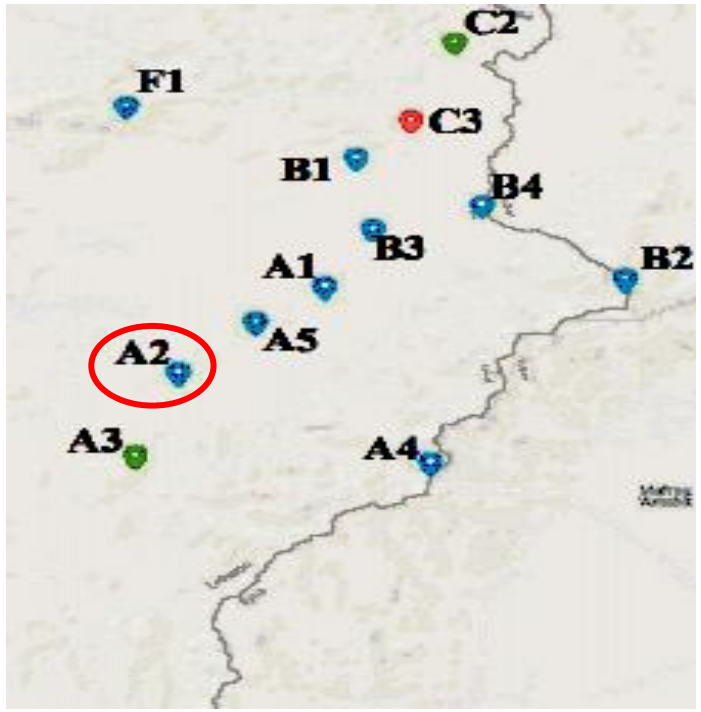
Site Location:

Facility A2

Elevation: 1720 m



Case Example

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Products summary

Item	Quantity	Rated Capacity
PV Panels: JKM535M-72HL4	21	11,235 Wp
SOLAR CHARGERS: Victron 250/85	2	170 A
Lithium Batteries: 48NPFC200	2	38.4 kWh
Hybrid Inverter: Mutiplus 5000	3	15000 VA
PV Mounting: Fix Grid 18	-	Inclination: 13° South-East

Case Example

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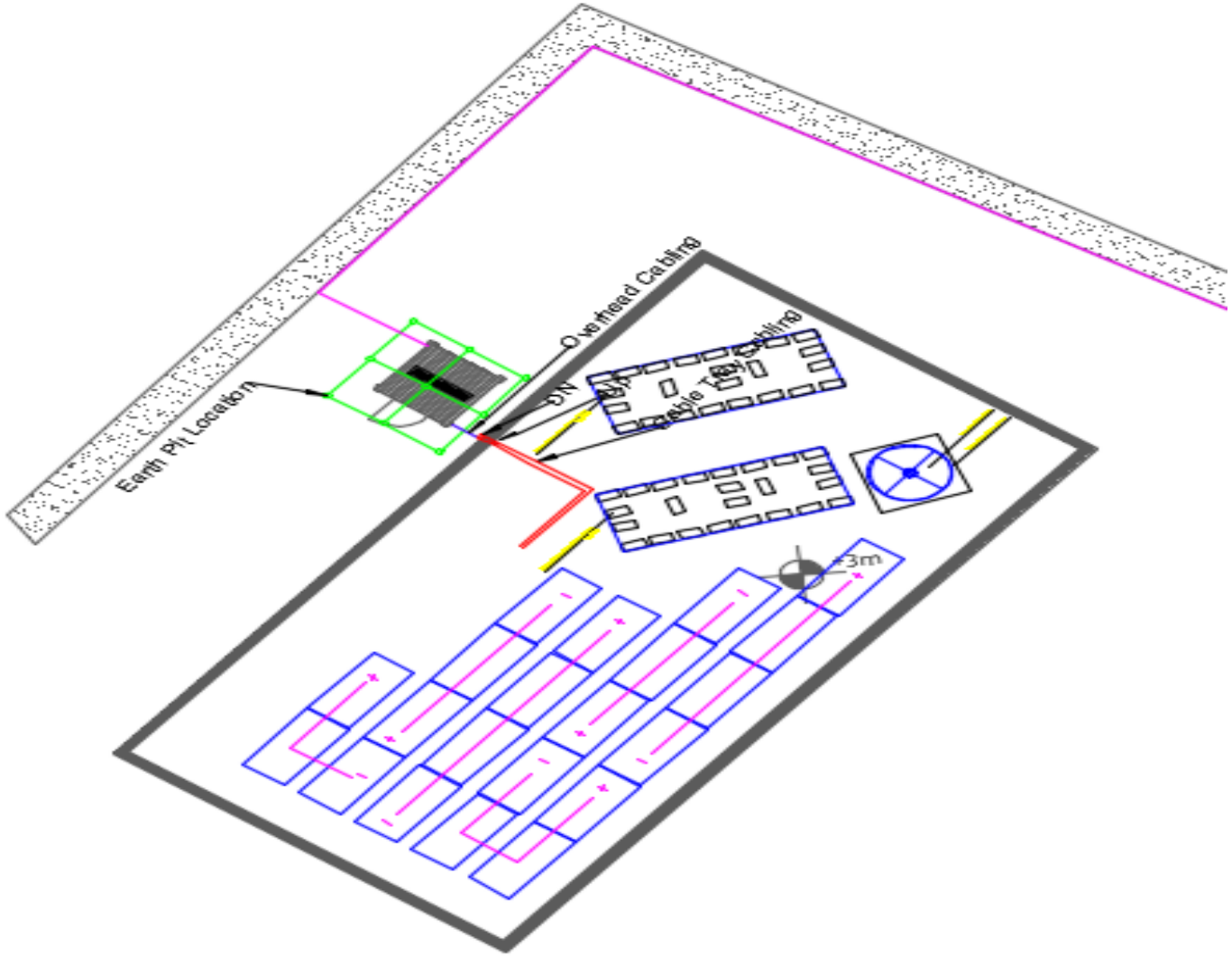
Overall Layout



Case Example

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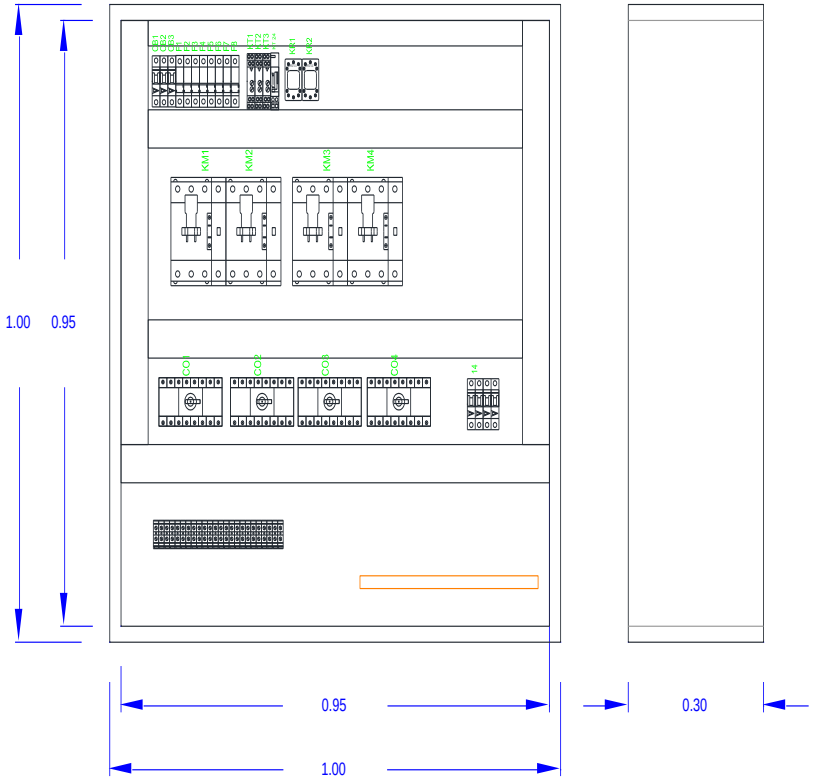
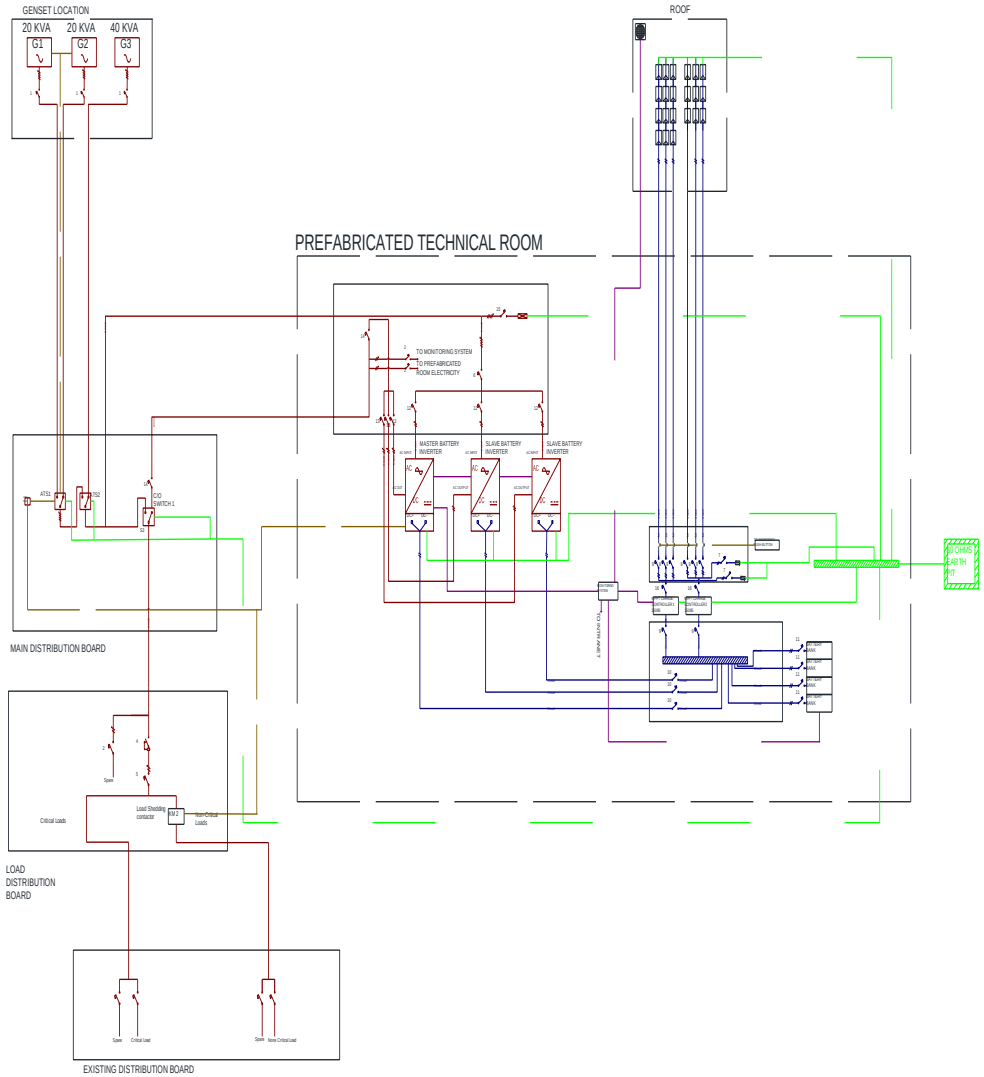
Single line diagram

Main Distribution Box





Systems installation

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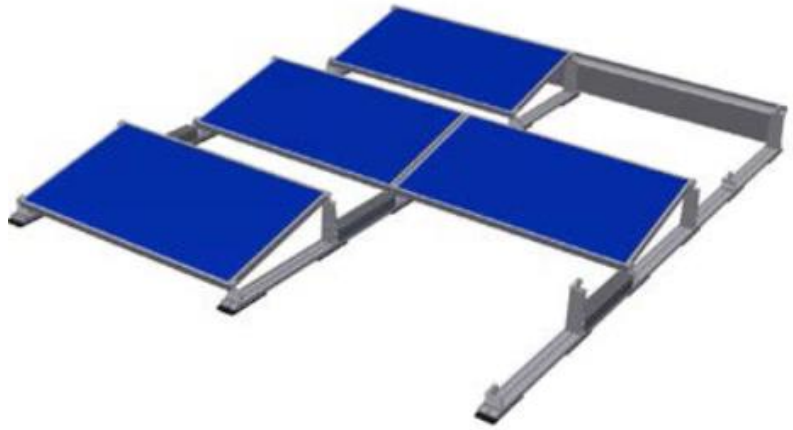
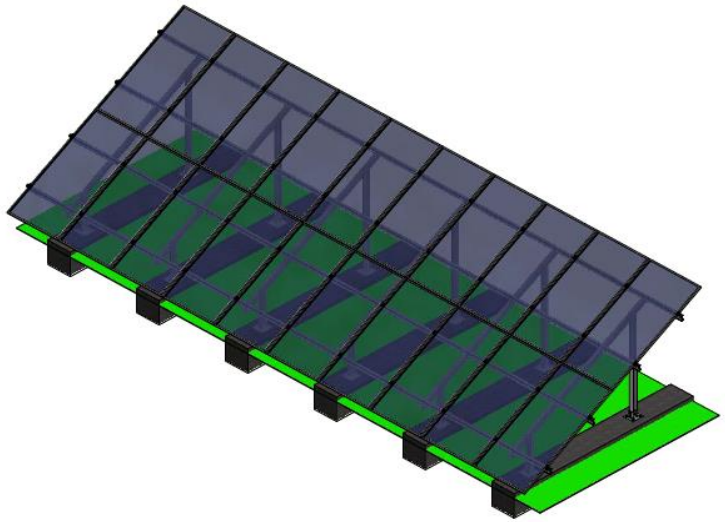
1. Solar Panels

PV panels will be installed on an aluminium structure from Schletter, taking into consideration snow and wind load for each site



Fix Grid 18



Elevated Structure

Systems installation

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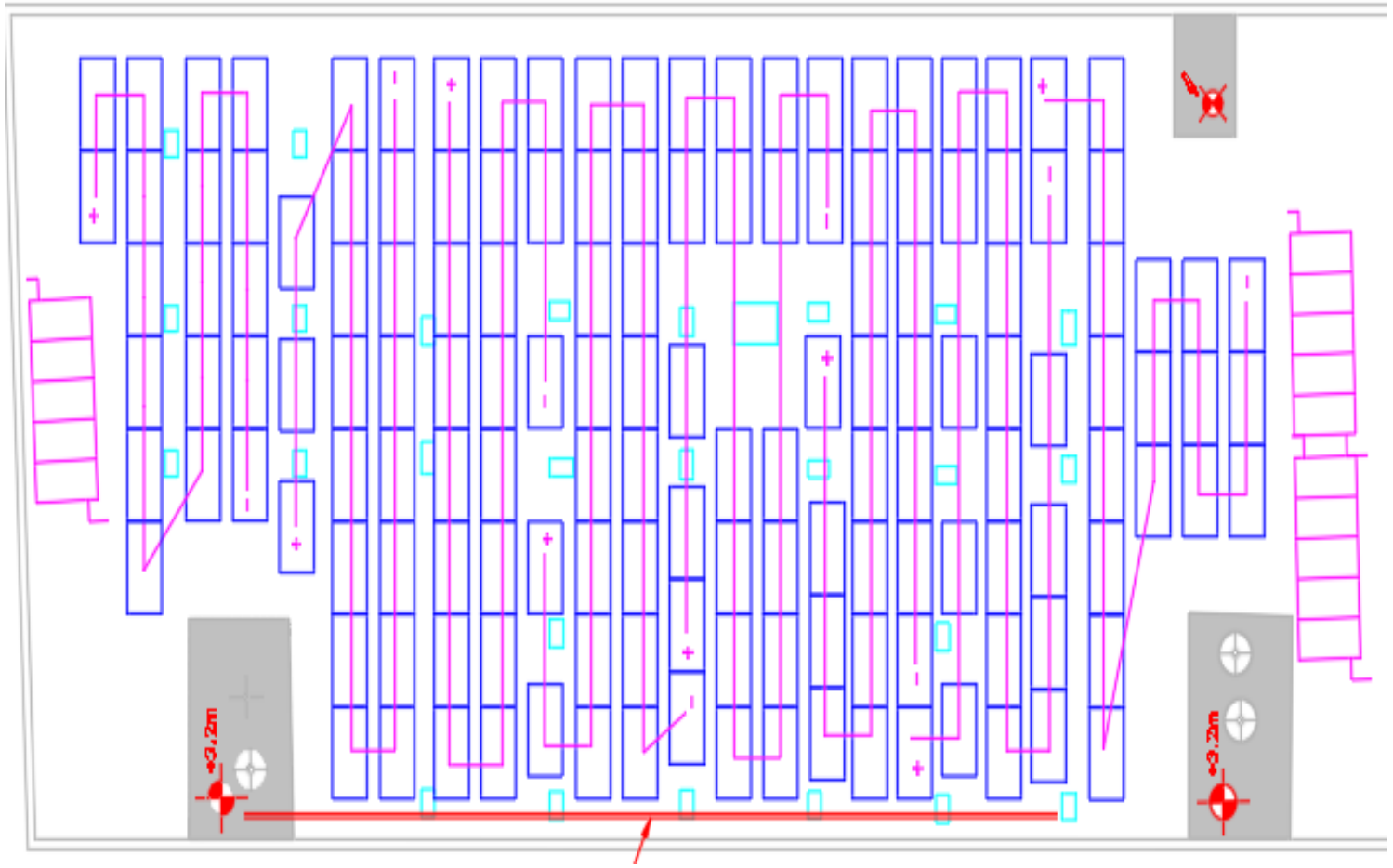
1. Solar Panels

Site A0 layout :

- Fix Grid 18 structure for flat roof
- Strings are connected to the inverter inside a cable tray
- A maximum of 19 panels in series per string



Systems installation

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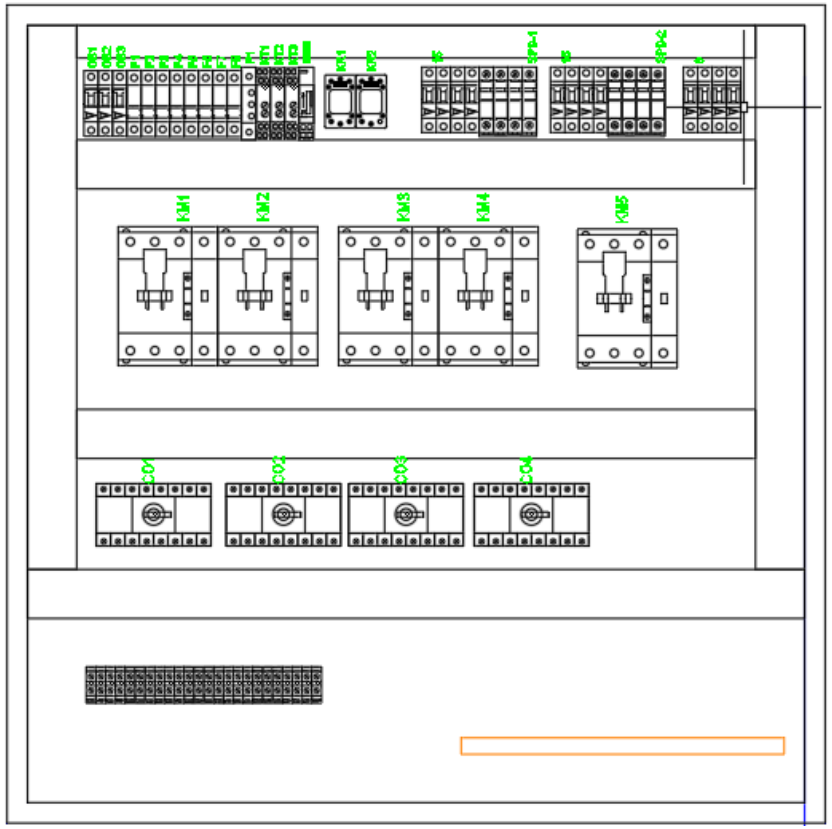
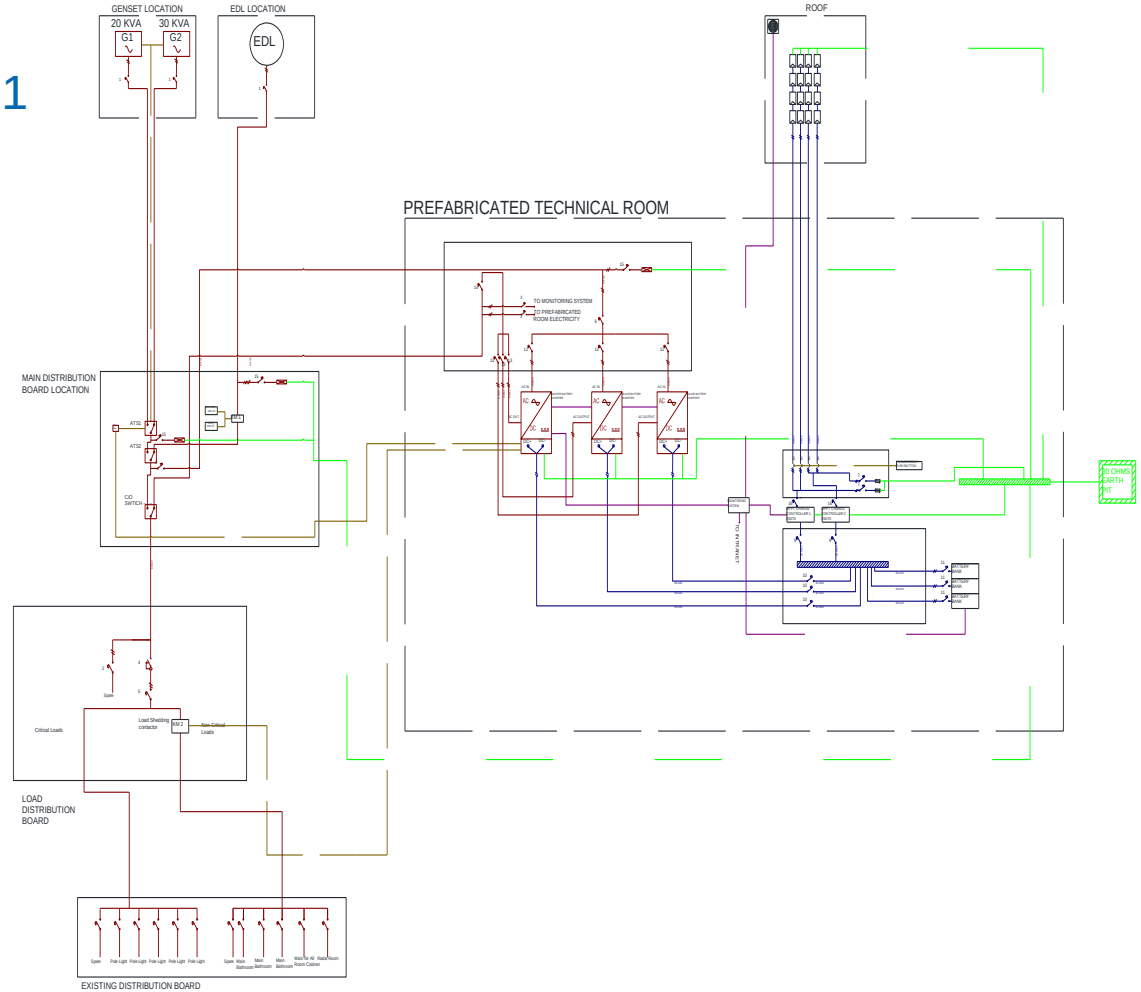
2. Electrical system

Single Line Diagram and main distribution box at site D1





Systems installation

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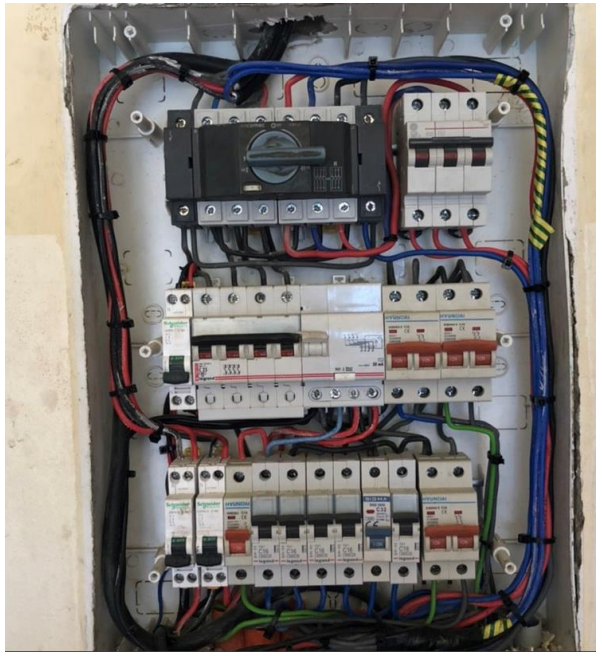
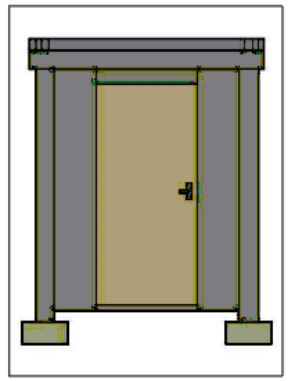
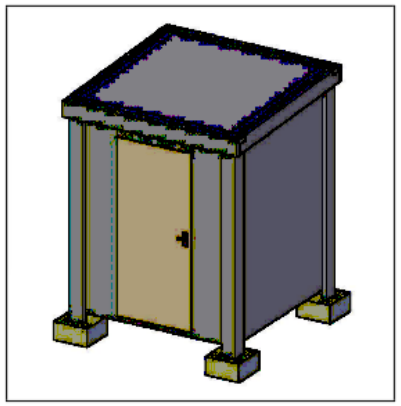
2. Electrical system

LV electric board will be installed in a Pre-fab Unit locally manufactured

This project includes also the maintenance of facilities electric boards







Systems installation

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All installations have been performed according to:

- Executive design
- Technical specification for the Works
- Applicable Laws
- National and local standard
- Products installation manual

Project difficulties

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- Logistics, procurement, and transportation: Due to Covid 19 pandemic the global logistics and transportation sector consisted a real challenge
- The available electrical installation in each site has several technical and safety problems, therefore ECOsys has upgraded and redesigned the available electrical panels before system installation
- Sites elevation, location and geotechnical problems
- Lack of Areas for PV Panels installation and electrical system, which force the contractor to use elevated structure and Pre-fab units

Project difficulties

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- Increased raw material prices, difficulty to find raw material whether in Lebanon or abroad
- Elevation and weather on sites which caused us to halt the installations until spring
- Integration with Lithium given it is a new technology

Thank you