Short-Course

Solar PV System Installation and Maintenance

NTQF Level III

Learning Guide -13

Unit of Competence	**Install off-grid solar PV system**
Module Title	**Installing off-grid solar PV system**
LG Code	**EIS PIM3 M10 0120 LO1-LG13**
TTLM Code	**EIS PIM3 TTLM 0120v1**

LO 1: Calculate Energy Demand – 13

Instruction Sheet	Learning Guide:-13

This learning guide is developed to provide you the necessary information, knowledge, skills and attitude regarding the following content coverage and topics:

- Reading and interpreting electrical drawings
- Preparing Installation of the system
- Determining the nature and location of the work
- Identifying siting limitations and customer system requirements
- Planning location of system components
- Assessing energy demand & recommending efficient utilization
- Checking procedures for planning and preparation of work

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to:-

- Read and interpret electrical drawings
- Prepare Installation of the system
- Determine the nature and location of the work
- Identify siting limitations and customer system requirements
- Plan location of system components
- Assess energy demand & recommending efficient utilization
- Check procedures for planning and preparation of work

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below:
3. Read the information written in the information Sheet 1 (page: 3), Sheet 2 (page: 12), Sheet 3 (page: 15), Sheet 4 (page: 18), Sheet 5 (page: 21), Sheet 6 (page: 30), Sheet 7 (page: 32),
4. Accomplish the Self-Check 1 (page: 11), Self-Check 2 (page: 14), Self-Check 3 (page: 17), Self-Check 4 (page: 20), Self-Check 5 (page: 29), Self-Check 6 (page: 31), Self-Check 7 (page: 33),

LO1. Plan and prepare off-grid PV system installation

Information Sheet 1	Reading and interpreting electrical drawings

1 Reading and interpreting electrical drawings

1.1 Introduction

Before installation of a system, the installation needs to be carefully planned and prepared. See Figure 1: Installation Process for a high level overview of the process that will be followed in Module 10. LO1 (in yellow) deal with understanding exactly what needs to be done and to prepare a process to do the work.

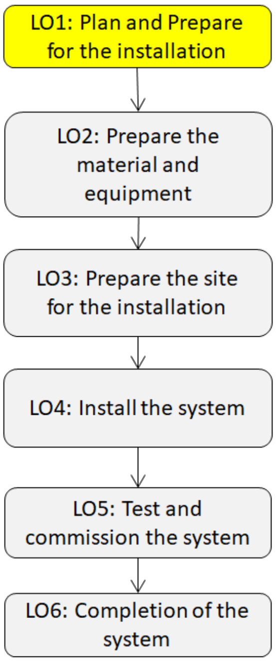


Figure 1: Installation Process

1.2 Electrical Drawing

Electrical drawings are a formal and precise way of communicating information about the layout, the dimensions, features and precision of electrical installation.

Drawings are the universal language of engineering. It is necessary to familiarise with the standard conventions, rules and symbols used in various types of electrical drawings.

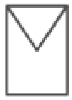
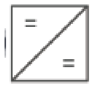
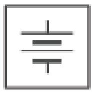
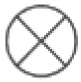
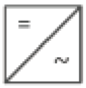
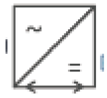
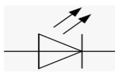
Reading electrical diagrams can be simple and complex.

All diagrams have: -

- Symbols
- Words
- Numbers

- Lines
- Symbols

Table 1: Symbols used in solar Off-grid PV installation diagram

PV Module		
Charge Controller		
Battery		
Load/consumer		
Inverter		
Inverter/Charger		
DC/AC Cables		—
Fuse		
LED lamp		
Switch		

1.3 Wiring diagram

A wiring diagram is a simplified conventional pictorial representation of an electrical circuit. It shows the components of the circuit as simplified shapes, and the power and signal connections between the devices.

A wiring diagram usually gives information about the relative position and arrangement of devices and terminals on the devices, to help in building or servicing the device. This is unlike a schematic diagram, where the arrangement of the components' interconnections on the diagram usually doesn't correspond to the components' physical locations in the finished device. A pictorial diagram would show more detail of the physical appearance, whereas a wiring diagram uses a more symbolic notation to emphasize interconnection over physical appearance.

A wiring diagram is often used to troubleshoot problems and to make sure that all the connections have been made and that everything is present.

A system wiring diagram should be drawn up. This can be used as guide during installation and kept as part of the system documentation.

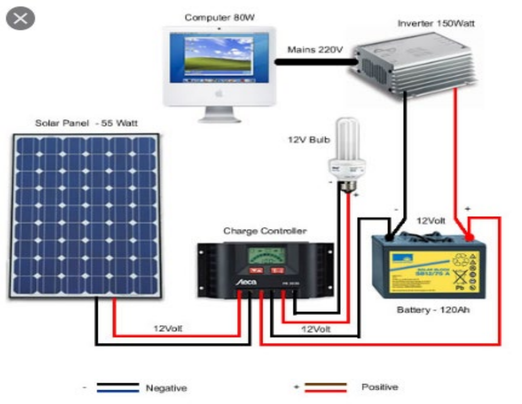


Figure 2: Wiring Diagram (DGS, 2010)

1.4 Schematic Diagram

A schematic diagram shows connections in circuit in a way that is clear and standardized. It is a way of communicating to other engineers exactly what components are involved in a circuit as well as how they are connected. Some Schematic will show component names and values, and provide labels for sections or components to help communicate the intended purpose. These drawings are also referred to as Single Line Drawings (SLD).

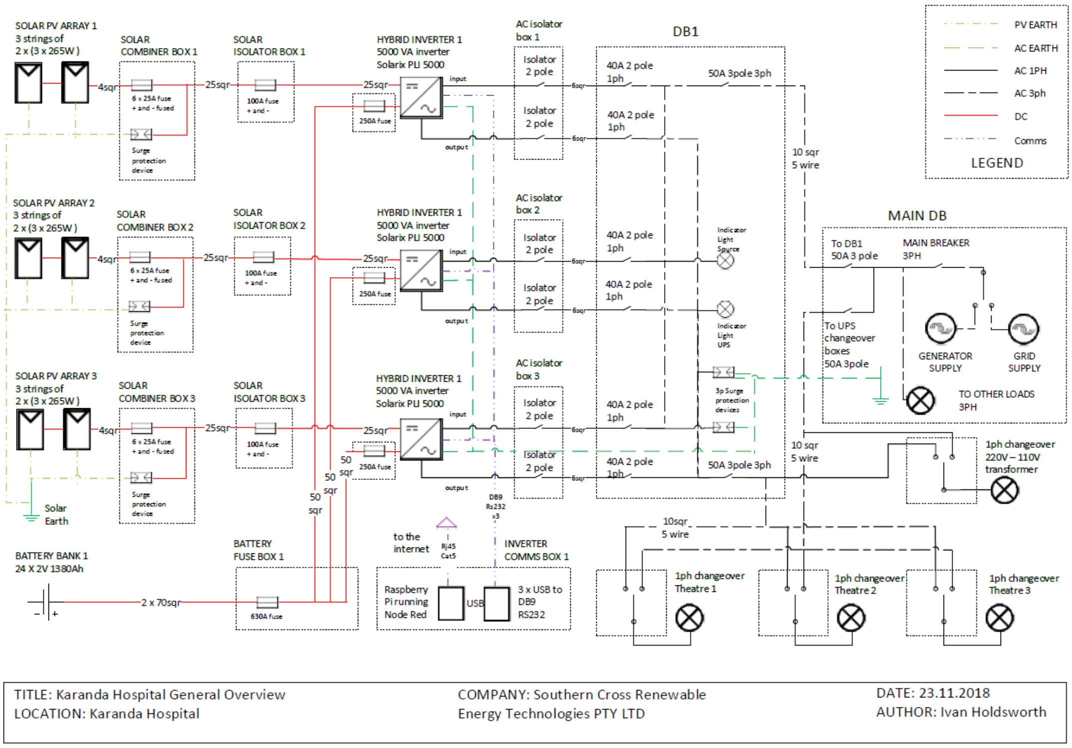


Figure 3 : Schematic Diagram (SCRET/2018)

Source- Southern Cross Renewable Energy Technologies PTY LTD

1.5 Reading a specific diagramme

1.5.1 System with Hybrid Inverter

Figure 5: Hybrid Inverter SLD and Figure 6: Hybrid Inverter PVSoL SLD shows a SLD for a system that make use of a hybrid inverter.

This is based on a 5kW system to be installed in Adama, Ethiopia.

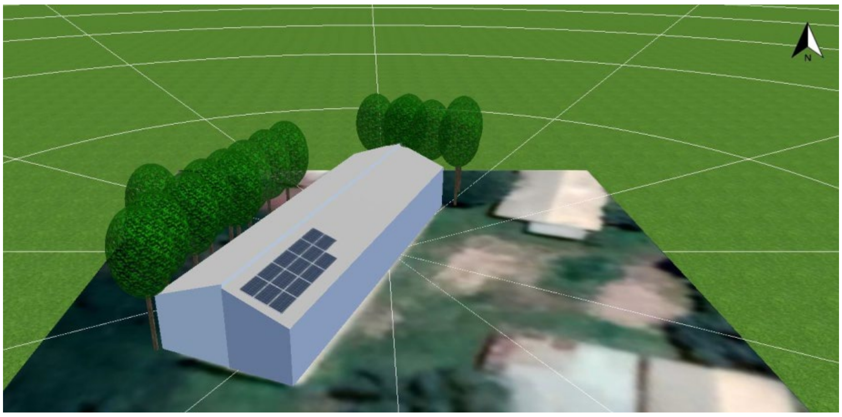


Figure 4: PVSoL Design for Adama

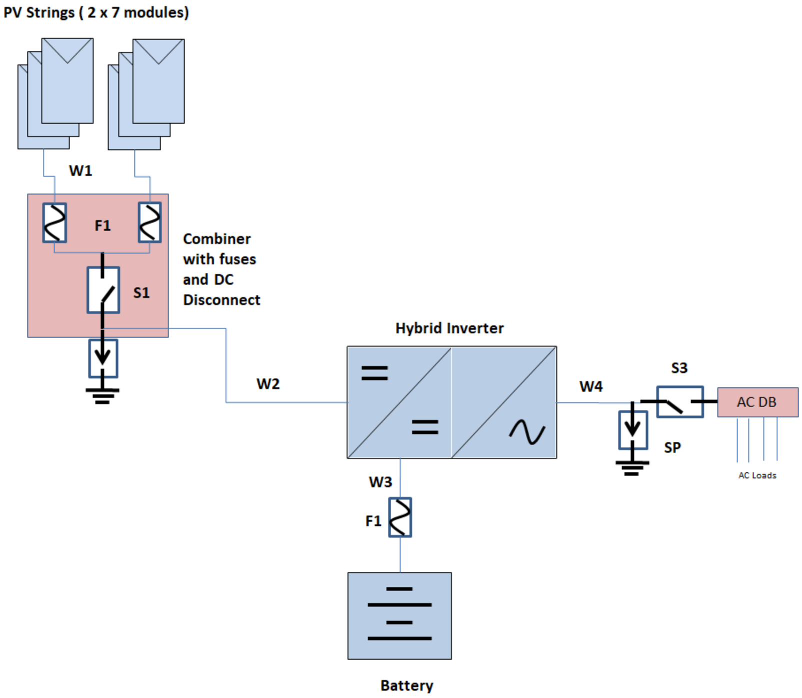


Figure 5: Hybrid Inverter SLD

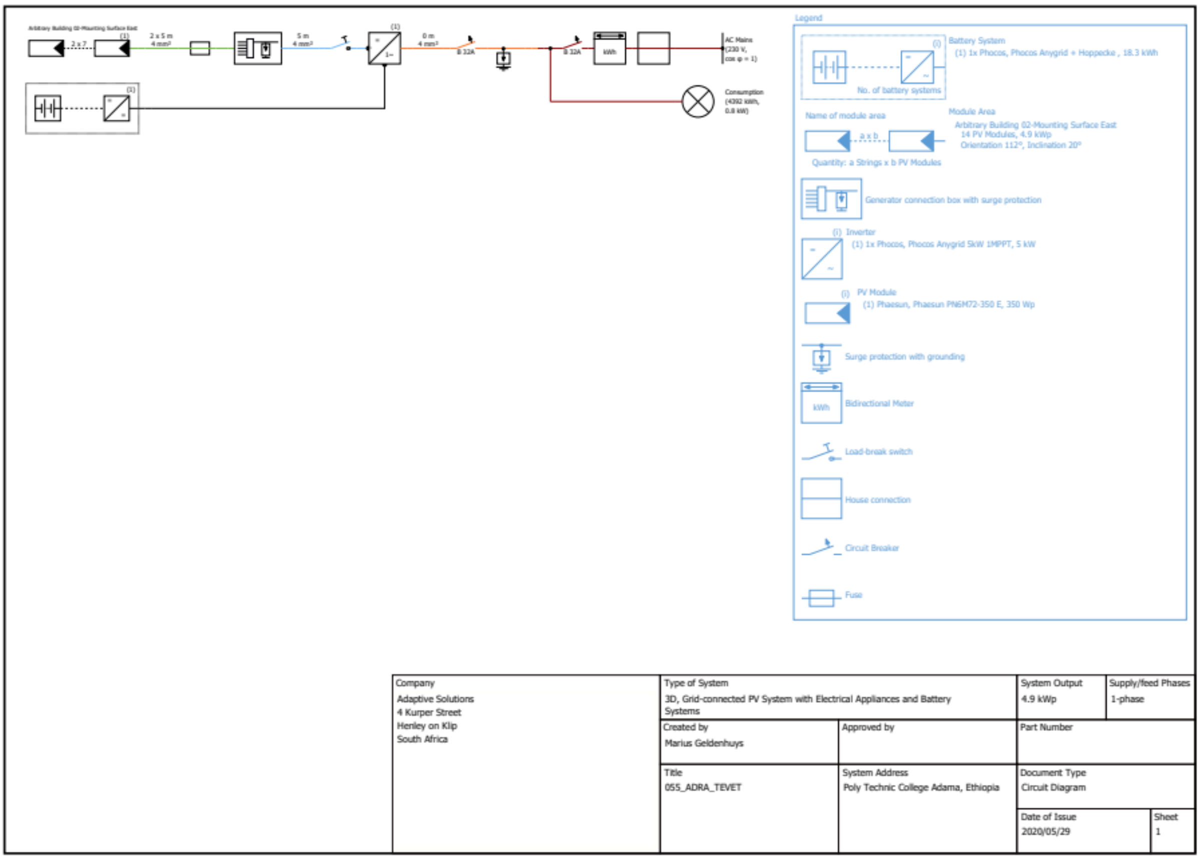


Figure 6: Hybrid Inverter PVSoL SLD

The first item to look at is the PV string connections: As can be seen in Figure 7: String connections, there are two stings of 7 modules each. Each string is connected via a fuse to a combiner box with DC isolator and surge protection. From the combiner box it goes to the input of the hybrid inverter. The hybrid inverter has 1 MPPT inputs.

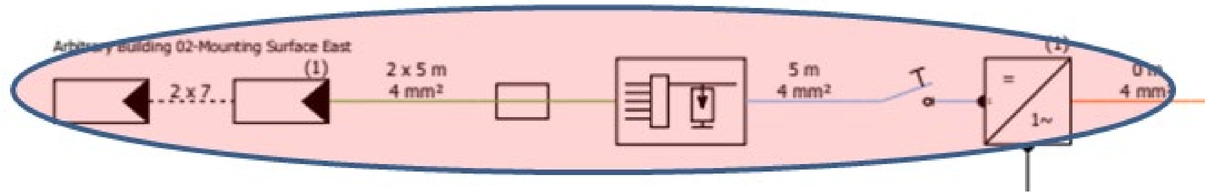


Figure 7: String connections

Next we can see in Figure 8: Battery connection the battery connection to the hybrid inverter.

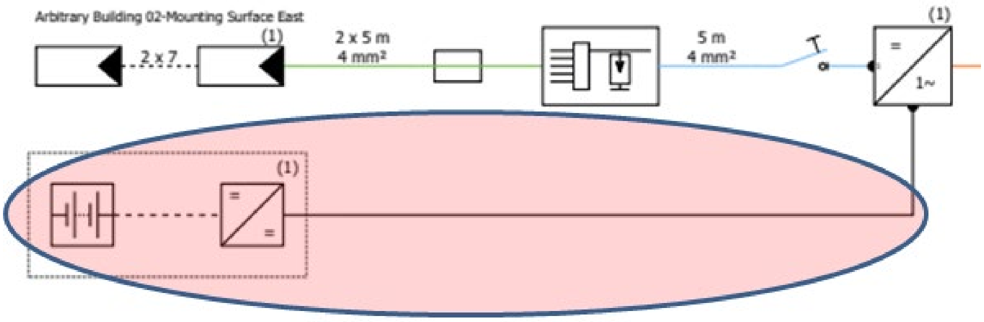


Figure 8: Battery connection

Next we consider the AC output of the Hybrid Inverter. Figure 9: Hybrid inverter AC output shows that there is an AC isolator and surge protection.

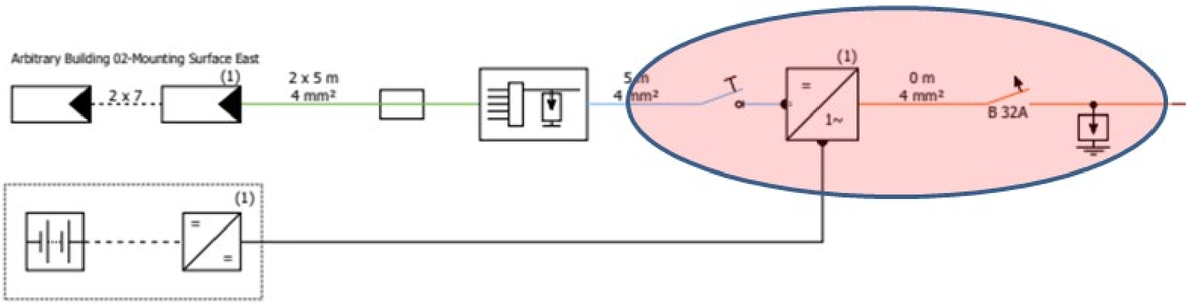


Figure 9: Hybrid inverter AC output

Figure 10: Connection to the loads highlight the connection to the loads (consumption). Also shown is the connection to the AC Grid via a kWh meter. This system is not strictly off-grid as it is connected to the grid, therefore referred to as a Grid-tied backup system.

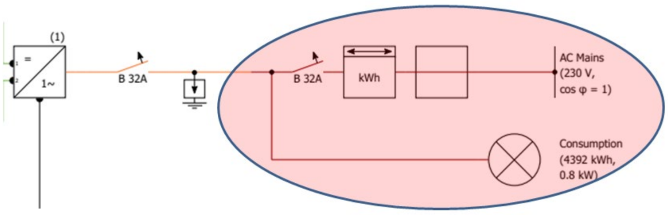


Figure 10: Connection to the loads

1.5.2 SLD for a Charge Controller System

Figure 11: System with Charge Controller SLD shows a typical SLD for an off-grid system with a charge controller and off-grid inverter. The following information is shown:

- The PV Strings
- Connections to the combiner box;
- Fuses inside the combiner box;
- A DC Disconnect Switch inside the combiner box;
- The Charge Controller;
- The Fuse between charge controller and battery;
- The Battery;
- The fuse between battery and off-grid inverter;
- The Off-grid inverter;
- The AC DB Board

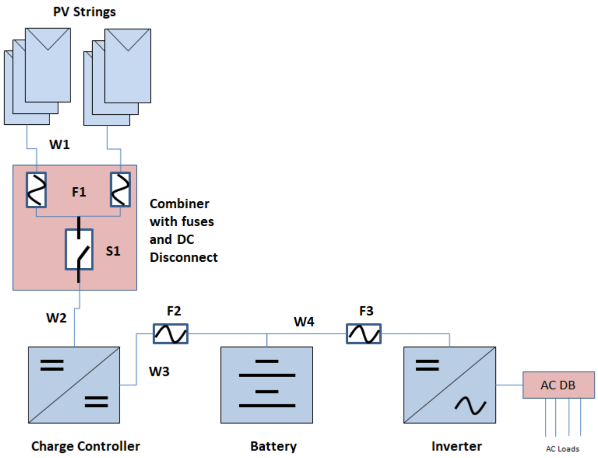
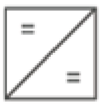


Figure 11: System with Charge Controller SLD

Self-Check - 1	Written Test

Instruction: Follow the below selected instruction

Answer all the questions listed below. Use the Answer sheet provided in the next page:

N°	Questions and answers
1	For what are we using this symbol? 
2	For what are we using this symbol? 
3	For what are we using this symbol? 

Note: the satisfactory rating is as followed

Satisfactory	3 points
Unsatisfactory	Below 2 points

Answer Sheet

Score = ___________

Rating: ____________

Name

Date

Information Sheet 2	Preparing installation of the system

2 Preparing installation of the system

2.1 Introduction

Once the PV design has been done, preparation can start for the installation of the system. There are many considerations to take into account during the preparation process. Some of these considerations are:

2.2 Permits and certifications

In many countries, permits are required from the local authorities before a system may be installed. The permits can be some of the following:

- Building permit when a structure needs to be erected for the PV modules;
- Electrical installation permit (specifically when connecting to an existing grid);
- Roof permit;
- In some housing complexes, permission must be obtained from the governing bodies of the complex.
- If there is any doubt about the ability of the roof structure to hold the weight of the PV modules, a structural engineer should inspect it first.
- Some authorities require sign-off of a PV System by a person with certain qualifications. Part of the planning process is to find a suitable person in the area where the installation will be done (if it is not an in-house skill).

Obtaining permits can take potentially a long time and should be started as soon as possible not to delay the project too much.

2.3 Logistics

Logistics are quite important if the site is far away. Travel and accommodation arrangements needs to be made and transport may have to be arranged for equipment to site.

- **Site Access**: All aspects around the location of the site need to be considered. If it is a remote site and/or the road conditions are poor, proper planning must be done to minimise travel.
- **Transport**: Depending on the location and road conditions, transport can be very expensive. It is also important to ensure proper packaging of sensitive equipment like batteries and modules. Where possible, let the supplier deliver to site and inspect equipment on arrival.
- **Climate**: Certain areas have very harsh winters or rainy seasons that can make it very difficult to install a PV system. Schedule the install to ideally avoid these periods.
- **Health and Safety**: Depending on the site, health and safety can add costs or delay projects. Familiarise yourself with the site and assess the need for special

tools and equipment e.g. scaffolding. Also consider diseases that are local to the area and take precautions e.g. malaria.

2.4 Procurement

Procurement can also potentially take a long time if there are components with long lead times. Critical components should be ordered as soon as possible.

- **Supply chain**: The non-availability of components and material can delay projects. It is important to ensure that all components and material are available before commencing.
- **Local Support**: Ideally there should be local support for the more critical components like inverter, charge controller etc. Local support can be invaluable when problems arise. Try to source components that are carried in stock locally in case of failures. It is not uncommon to have failures very early or even out of box. Where possible, get the local suppliers to update all relevant firmware on all components.

2.5 Installation Teams

Depending on the scope of work (covered in the next information sheet), a team needs to be put together with the right skills to do the installation job effectively.

- **Labour**: If local labour will be used, make sure that there is good communications as misunderstandings can happen. Also make sure that local labour regulations are adhered to.

Self-Check - 2	Written Test

Answer all the questions listed below. Use the Answer sheet provided in the next page:

N°	Questions and answers
1	**Name 5 activities to consider when scoping the job**

Satisfactory	4 points
Unsatisfactory	Below 3 points

Answer Sheet

Score = ___________

Rating: ____________

Name

Date

Information Sheet 3	Determining the nature and location of the work

3 Determining the nature and location of the work

3.1 Introduction

Before starting the PV system installation, it is important to know what kind of system is being installed. There are differences between smaller and larger PV systems: Larger systems need more space, more time for the installation and usually have more complex components. In the following chapters only PV systems up to 5 kWp are considered.

3.2 Nature or scope of work

The following paragraphs were taken/adapted from (Isiolaotan, 2017)

Before beginning installation activities, during the site assessment phase it is important to have a clear idea of how many tradesmen are needed to complete the installation within the agreed time frame. Activities to consider include:

- Equipment delivery to site
  - Before beginning to install system components, ensure that the PV modules, batteries, inverter, charge controller, etc. are available on site or are made available.
- Identification of installation tasks
  - For you to be able to adequately plan a work schedule and know the type of professionals required, you should identify all necessary tasks to complete the installation of the photovoltaic system.
- Complexity of each installation task
  - Once you have identified each task, the next step is for you to determine the complexity of each task. This gives you the necessary information to determine the number of personnel that you require to complete the installation job.
- Required tools and materials
  - Before you begin installation, ensure that all necessary tools and equipment to complete the installation are available on site. For example, you do not want to be in the middle of installation process only to discover that you forgot to order a ladder and are therefore unable to install the PV modules on the roof because it is inaccessible.

3.3 Location of the work

The physical location of the work site will determine dictate the flowing:

- If it is too far to travel to daily, accommodation needs to be arranged for the installation team;

- If it is a remote area with bad access roads, special arrangements needs to be made for the delivery of equipment to site (e.g. use of 4x4 vehicles etc.)
- If it is a different country, passport or visa arrangements may have to be made. Is there local support close to the site? If not, consider taking spare equipment in case of failures.
- If the installation is in areas of high seasonal rain etc., installations should be scheduled for a more moderate time if possible.

3.4 Importance of location

The PV array output depends on the geographical locations and time of the year. That is why it is very important to select a proper site based on solar resources.

Ethiopia is located near the equator; its solar resource is of significant potential. The annual average daily radiation in Ethiopia reaching the ground is estimated to be 5.5kWh/m²/day which vary from a minimum of 4.5kWh/m 2 /day in July to a maximum value of 6.5kWh/m 2 /day in February and March.

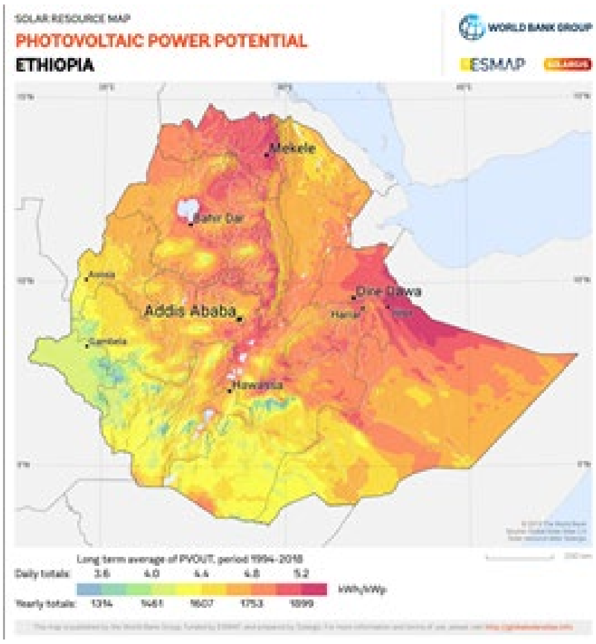


Figure 12 : Photovoltaic Power Potential, Ethiopia [world bank]

When planning and designing a solar system, it is essential to select a suitable location where the solar modules are exposed to the best amount of sunlight. In the site assessment (see Module 07), a suitable solar PV mounting location is evaluated.

Self-Check - 3	Written Test

Answer all the questions listed below. Use the Answer sheet provided in the next page:

N°	Questions and answers
1	**Name 5 activities to consider when scoping the job**

Satisfactory	4 points
Unsatisfactory	Below 3 points

Answer Sheet

Score = ___________

Rating: ____________

Name

Date

Information Sheet 4	Identifying siting limitations and customer system requirements

4 Identifying site limitations and customer system requirements

4.1 Introduction

A part of the planning of the installation is to identify the site limitations and to consider the customer requirements.

4.2 Site limitations

During the site survey (See MO7 – Site Assessment.), suitable locations would have been identified for the placement of the PV modules. A final selection needs to be made based on:

- Trees and vegetation that can cause shading;
- The customer's preferences;
- Security of the system against vandalism and theft;
- Potential damage caused by animals;
- Safety of children;
- Ease of access for cables e.g. the need for trenching or overhead access, access through roofs and walls etc.
- Aesthetics.

Additional site limitations that can influence the install are access roads, remote location, rainfall etc.

To identify the possible location for the installation of a solar PV modules, a final decision needs to be made ROOF or on the GROUND installations.

The most critical parameter is the identification of a shadow free location. It is to ensure that the solar PV array is installed in an area where no object casts a shadow on the array. For example, if there is a tall tree or a huge building in the vicinity of the selected location, then probably this is not a good location for the installation of the solar PV array. For more detail, refer to MO7 – Site Assessment.

Figure 13 : Roof mounted solar module

Sometimes it is not possible to put the solar panels on a roof. Reasons could be that the orientation or angle is unsuitable, that the roof can't carry the weight of the panels, that the space on the roof is not sufficient or personal preferences of the owner.

An alternative option is ground mounting of the solar array. Ground mounted systems are typically used for large home systems or applications like water pumps, where there is no roof available to mount the modules on. The modules are secured to racks fixed in concrete foundations and may be fenced off to protect the array from animals and curious people. Under normal circumstances, one- or two-module systems are not ground mounted. For one or two modules a pole is usually the better choice as it is more affordable than ground mounting with a concrete foundation.

When building a ground mounted system, it is necessary to check the orientation. The correct orientation, usually straight South, can be checked with a compass. Fixed mounts should always be aligned in a north–south direction with the surface of the modules facing south. Also, use an inclinometer to make sure the array is at the proper tilt. A rule of thumb is to mount modules facing the equator at an angle that equals the site's latitude plus 10°.

In Ethiopia, the optimal tilt of a solar array is between 10 (South and central Ethiopia) and 20° (Northern parts).

Figure 14: Ground mounted solar modules

4.3 Customer's preferences

The customer's preferences should be taken into account when planning the installation of the system. The customer may have preferences regarding:

- Where to put the array if there are multiple feasible options available;
- Where to install the equipment;
- The path of the cable run (e.g. to prevent digging up his garden or dig up concrete slabs etc.);
- The aesthetics of the system (hiding cables etc.

Self-Check - 4	Written Test

Answer all the questions listed below. Use the Answer sheet provided in the next page:

N°	Questions and answers
1	**Explain site limitations for Solar PV installation.**

Satisfactory	5 points
Unsatisfactory	Below 3 points

Answer Sheet

Score = ___________

Rating: ____________

Name

Date

Information Sheet 5	Planning location of system components

5 Planning location of system components

5.1 Introduction

Besides the solar modules, the charge controller, batteries and inverter need to be installed on site. It is necessary to identify a suitable place. Furthermore, lamps and wiring need to be planned and installed.

5.2 Floor Plan

A drawing of the floor plan of the house or institution should indicate where all the components are installed. The drawing should be to scale if possible, so that you can estimate cable lengths. The longer cable, the lower is the efficiency.

Indicate clearly where each lamp, socket and switch will be, and the position of the battery, charge controller, inverter and solar module.

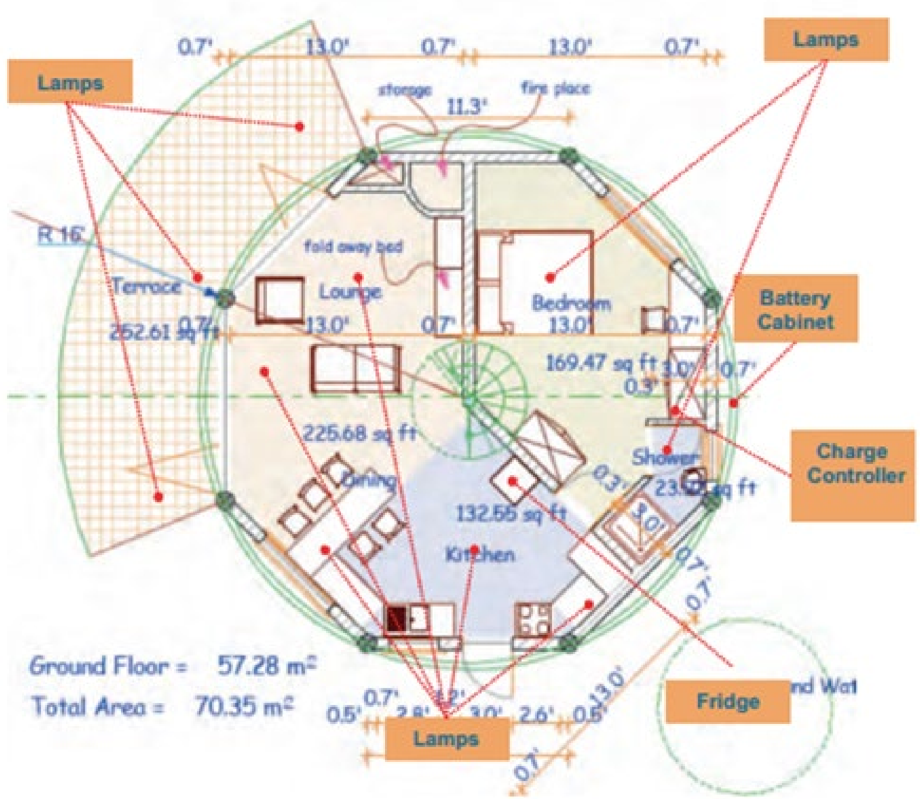


Figure 15: Floor plans (Hankins, 2010)

Batteries, charge controllers and inverters location should be:

- Water and weather proof;
- Not affected by direct sunlight;
- Insulated to protect against extremes of temperature;
- Facilities to ventilate gases from the batteries;

- Protected from sources of ignition;
- Away from children, pets and rodents

(Boxwell, 2017);

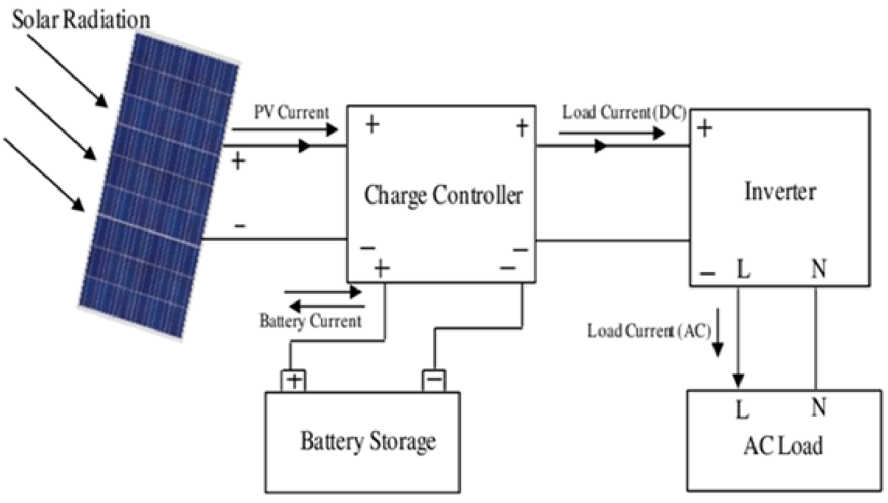


Figure 16: Off-Grid PV System **(researchgate)**

5.3 Installation data sheets

It is vitally important to consult the installation datasheet before planning the component layout as the data sheets contain valuable information.

5.3.1 Module Installation Data Sheet

Module installation data sheets or manuals contain information relating to:

- Safe handling of the modules;
- Safety measures during installation;
- Grounding;
- Mechanical installation;
    - The correct clamping or mounting of the modules and loads (e.g. Figure 19: Canadian Solar Module Clamping Zones).
    - Distance to the roof;
    - Spacing between modules.
- Cleaning;
- Transport and storage.

5.3.2 Charge Controller Installation Sheet

The Charge Controller installation manual contains information related to:

- The battery type selection and charging curves (See Figure 17: Victron CC battery type selector);
- Understanding indicators and displays and error indications;
- Mounting information including space for airflow around the device;
- Vital safety information.

Battery Type Selector Settings.
(Switch position "7" is the default factory setting).

Switch Position	Description	12 Volt		24 Volt		Remarks
		Float voltage(V)	Absorption/ Equalize voltage (V)	Float voltage(V)	Absorption/ Equalize voltage (V)	
0	Equalize 1	13.2	15	26.4	30	Apply to flooded batteries only
1	Equalize 2	13.2	15.5	26.4	31	Apply to flooded batteries only
2	Deep cycle Lead Acid 1	13.3	15	26.6	30	OPzS tubular plate
3	Lead Calcium 1	13.6	14.3	27.2	28.6	Sealed type car batteries
4	Gel Cell 1	13.7	14.4	27.4	28.8	Standard Gel
5	Gel Cell 2	13.5	14.1	27	28.2	OPzV tubular plate gel
6	Lead Calcium 2	13.2	14.3	26.4	28.6	Sealed type car batteries
7	**AGM (Default Setting)**	13.4	14.6	26.8	29.2	Standard AGM
8	NiCad 1	14	16	28	32	10 cells resp. 20 cells
9	NiCad 2	14.5	16	29	32	10 cells resp. 20 cells

Figure 17: Victron CC battery type selector

5.3.3 Batteries

Batteries can be very dangerous if not handled properly. Lithium-Ion batteries for solar systems are sophisticated electronic devices and it is very important to consult the installation manual. These manuals provide information like:

- Safe handling and safety gear;
- Installation location
- Mounting instructions;
- Battery and communication cable connections (e.g. Figure 18: Pylontech cable connections);
- Power-on sequences;
- Troubleshooting;

- Emergency procedures;
- Airconditioning (passive or active).

5.3.4 Inverter Installation Manual

The inverter installation manual contains information related to the installation, function, operation and maintenance of the inverter.

- Safety information and warnings;
- LED/Screen status and interpretation;
- Switch settings;
- Installation and mounting (e.g. see Figure 20: Mounting instructions for Steca Solaris);
- Connections, cable sizes and fuses;
- Operation;
- Maintenance and service;
- Airconditioning (passive or active);
- Troubleshooting.

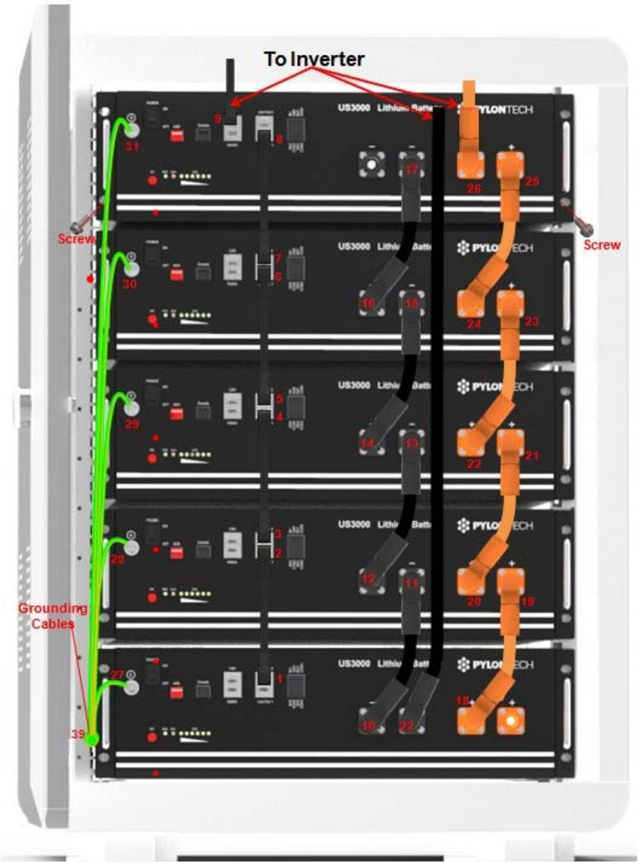
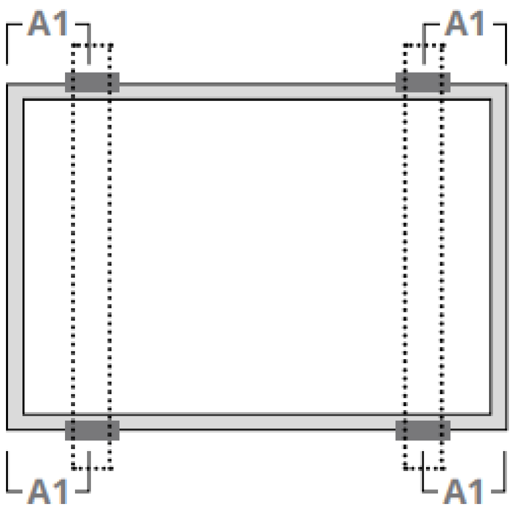


Figure 18: Pylontech cable connections

Table A
CS3U-P, CS3U-MS, CS6U-P and CS6U-M



Use four clamps on the long side. Mounting rails run perpendicularly to the long side frame.
A1 range = (340 – 550) mm Maximum Load: Uplift load ≤ 2400 Pa Downforce load ≤ 2400 Pa
A1 range = (410 – 490) mm Maximum Load: Uplift load ≤ 3600 Pa Downforce load ≤ 5400 Pa

Figure 19: Canadian Solar Module Clamping Zones

4 Installation

4.1 Mounting

4.1.1 Mounting location

- ▶ Ensure that the mounting location satisfies the following requirements:
- Mount in a dry, dust-free indoor room.
- Mount on even surface.
- Mount upright on the wall, on concrete or on any other non-flammable surface.
- The mounting location must be protected from unauthorized access, especially by small children.
- Distance between inverter and battery: please note that the pre-fitted cables must not be extended.
- Minimum clearance of approx. 20 cm above and below to allow free air circulation.
- Sufficient distance to the side such that the type plate remains visible in installed condition.

4.1.2 Mounting the inverter

- ▶ Mark and drill the upper holes (Ø 8 mm).
- ▶ Insert the dowels and screw in the screws. Do not yet screw tight!
- ▶ Hang the inverter on the two screws and mark the lower holes.
- ▶ Remove the inverter and drill the two lower holes.
- ▶ Insert the dowels.
- ▶ Hang the inverter on the two upper screws and screw in the lower screws.
- ▶ Screw all screws tight.
  - ▷ *The mounting of the inverter is now complete.*

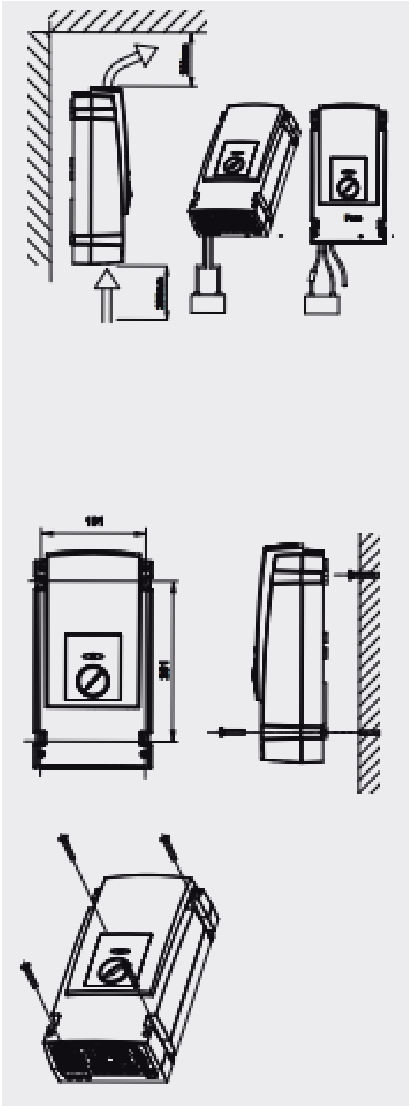


Figure 20: Mounting instructions for Steca Solaris

Once all the installation data sheets are properly understood, the physical layout of the components can commence. This layout will take into consideration all the information and restrictions in the installation manuals.

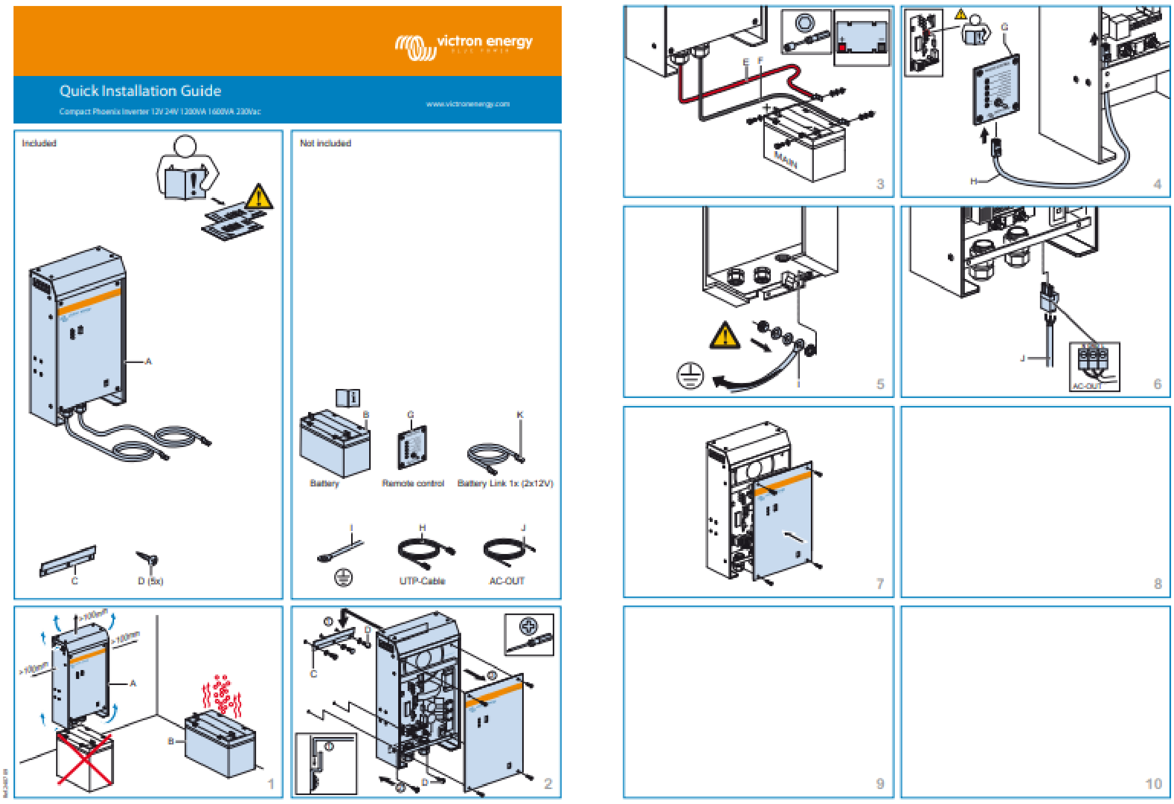


Figure 21: Victron inverter quick installation guide

Self-Check - 5	Written Test

Answer all the questions listed below. Use the Answer sheet provided in the next page:

N°	Questions and answers
1	**Where should we locate batteries, charge controllers and inverters?**

Satisfactory	6 points
Unsatisfactory	Below 4 points

Answer Sheet

Score = ___________

Rating: ____________

Name

Date

Information Sheet 6	Assessing energy demand & recommending efficient utilization

6 Assessing energy demand & recommending efficient utilization

Energy demand is considered before designing a system. Understanding a customer's energy demand is critical to size the system correctly:

- Equipment power consumption and quantity;
- Duration of energy demand for each equipment;

The above information is very important to understand customer energy demand and to prepare proper solar equipment. Often, decisions have to be made to remove some equipment from the backup system as it may use too much energy, resulting in a big and expensive system.

The following is a summary of the energy usage captured for the system to be installed at Adama, Ethiopia:

Table 2: Load Assessment

No.	Existing Consumers	Power in Watt	Amount	Operation Hours per day	Usage Time	Consumption [Energy]	Total Power in Watt
		[W]	[qty.]	[h/d]	day/night	[Wh/d]	[W]
1	Illumination/light	18	20	4	night	1440	360
2	Illumination/light	18	9	12	night	1944	162
3	Computer	250	3	8	Day	6000	750
4	Printer	700	1	1	Day	700	700
5	Projector	300	1	6	Day	1800	300
6	Internet	15	1	24	Day/Night	360	15
7	Router	15	1	24	Day/Night	720	30
TOTAL						**12964 Wh/d**	**2317W**

Depend on the above energy demand requirement; the solar power system sizing should be done properly. Solar system sizing will be covered in ‘’**Module 7 – Site Assessment.**’’

We use consumption to size the PV array and batteries, while we use total power to size the inverter.

Self-Check - 6	Written Test

Answer all the questions listed below. Use the Answer sheet provided in the next page:

N°	Questions and answers
1	Why do we need to determine daily consumption and total power? (4)

Satisfactory	4 points
Unsatisfactory	Below 3 points

Answer Sheet

Score = ____________

Rating: _____________

Name

Date

Information Sheet 7	Checking procedures for planning and preparation of work

7 Checking procedures for planning and preparation of work

7.1 Site Assessment and planning

Site visit is key to a successful installation in the planning stage to finalize the system design and to determine the lay out of the equipment at the site. By visiting the site first and do proper planning, the system designer will avoid many costly mistakes allowing for a trouble-free installation.

The most important first step in the planning stage is to have proper documentation of the system design including electrical schematic if available along with information on the major components such us modules, controllers, Inverter etc.

The designer should be familiar with the overall system design, the major components and other considerations specific to the project before visiting the site. In planning a PV system installation, the system designer should account for the following general and specific conditions. ((GSES, 2014) Chapter 14)

7.2 General Installation Considerations

- Be familiar with all relevant documentation on the system including schematic, information on the various components, system operation, etc.
- Make provisions to meet all permits and codes
- Make sure to follow proper installation and operation safety procedures
- Plan to consider aesthetics and architectural compatibility

7.3 Specific System Considerations

- Review system sizing and load data and compare with the design data considered.
- Consider shading and aesthetics in choosing the array mounting locations.
- Plan for lightening protection: grounding, surge arresters, etc.
- Plan to locate batteries, controls, inverters and electronic components such in that they are protected and access is controlled.
- Plan to protect PV panels from animals, people and falling objects. Consider fencing surrounding the array and structure.
- Consider the shortest possible wire runs, to minimize voltage drop/wire sizes and wire protection, in the placement of equipment.

Self-Check - 7	Written Test

Answer all the questions listed below. Use the Answer sheet provided in the next page:

N°	Questions and answers
1	Name 4 of the main components to consider (4)
2	**Name 2 of BOS components to consider (2)**

Satisfactory	5 points
Unsatisfactory	Below 3 points

Answer Sheet

Score = ____________

Rating: _____________

Name

Date