

Description

This Form contains the checklists for the Final Design evaluation.

Information to be Submitted with the Single Line Diagram

Below is a checklist that summarises the information submitted:

Table 1 – Required information from Single Line Diagrams

DESCRIPTION	NOTES
Title Block	
Date (Year, Month, Day)	With any updates
Author (affiliation if any)	With any updates
Signature	With any updates
Name of the project	
Subject ("Electric SLD" or similar)	
Reference (e.g. sequence number)	
Content	
Lines and symbols according to international standards (ISO and IEC). They should be visible, clear and fully understandable	
The size of the drawing proportionate to the extent of the	
design	
The writings are clear and understandable	
Components identified with its abbreviation	



Information required from Site Plans

Below is a checklist to verify the information from site plans and their updates:

Table 2 – Required information from Site Plans

DESCRIPTION	NOTES		
Title Block			
Date (Year, Month, Day)	With any updates		
Author (affiliation if any)	With any updates		
Signature	With any updates		
Name of the project			
Subject ("Site Plan")			
Scale of the drawing			
Reference (e.g., sequence number)			
Content			
Lines and symbols according to international standards (ISO			
and IEC). They should be visible, clear and fully			
understandable			
The size of the drawing proportionate to the extent of the			
design			
The writings are clear and understandable			
Any meaningful part identified with a name or description			
Drawings with all the components and equipment properly			
represented and connected each other with electric lines			
Specific details may be represented on an extended scale	The scale shall be indicated		
when necessary			



Checklists for Final Design Evaluation

Information required from PV System Supporting Structures

Below is a checklist that summarises the information required information from PV System Supporting Structures:

Table 3 – Required information from PV System Supporting Structures

DESCRIPTION	NOTES
Title Block	
Date (Year, Month, Day)	With any updates
Author (affiliation if any)	With any updates
Signature	With any updates
Name of the project	
Subject ("PV System Layout" or similar)	
Scale of the drawing	
Reference (e.g. sequence number)	
Content	
Lines and symbols according to international standards (ISO and IEC). They should be visible, clear and fully understandable	
The size of the drawing proportionate to the extent of the design	
The writings are clear and understandable	
Any meaningful part identified with a name or description	
Drawings with all the components and equipment properly	
represented and connected each other with electric lines	
Supporting structures represented in different views (top, front, side)	
Specific details may be represented on an extended scale when necessary	The scale shall be indicated

Public



Information required in the Final Design Report

Below is a checklist that summarises the information required in the Final Design Report:

DESCRIPTION	NOTES
Frontpage	
Name of the project	
Subject ("Design Report" or similar)	
Author (affiliation if any)	With any updates
Signature	With any updates
Date (Year, Month, Day)	With any updates
Content	
Site-related data (Geographical coordinates, monthly averages of solar radiation, temperature, wind speed, and other specific characteristics)	
Electric data (voltage and frequency at POC, specific characteristics of POC)	
Detailed characteristics of the PV modules	
Detailed characteristics of the Inverters	
The main characteristics of the relevant components and	
equipment are Interface Protection, transformers (if present),	
MV switchgears (if present), and Combiner boxes.	
A detailed description of the PV System electrical design	
DC calculations: voltages, currents, voltage drops, cable sizes, MPPT voltages verification.	
Main characteristics of the DC components and equipment	
AC calculations, currents, cable sizes, overcurrent, short-	
circuit, dimensioning of switches, fuses, RCDs, transformers (if	
present), MV circuit, and equipment (if present).	
Calculation of the supporting structures (when necessary).	Fixed or tracker system
Description of the monitoring system	
Calculation of the monthly and yearly energy production	
Commissioning plan	
Maintenance plan	



Checklist to Evaluate the Final Design Documentation

The following Table is a minimum information verification checklist for Kahramaa in order to check the completeness and adequacy of the documentation delivered.

Data name	Result / Value
a) Consumer Information	
Application ID	🗆 Yes 🗆 No
Account Number	
AC Output Power Capacity (kW)	
b) Completeness of the documentation	
Basic System Information	
Information on Solar REG Designer	
Information on Solar REG Installer	
Design Report	
Wiring Diagrams (Single Line and Multi Line)	
Planimetry and string layout	
PV module datasheet	
Inverter datasheet	
Interface Protection datasheet	
Mechanical design information	
Emergency systems	
Estimate of the yearly energy production	
Project Implementation Schedule – Detailed	
Expected date of installation/energisation	
Operation and Maintenance Manual	
c) Evaluation of the documentation	
Are the DC and AC power capacity of the Solar REG equal to the Initial Enquiry?	□ Yes □ No
In case one or both have been changed, have they been reduced?	□ Yes □ No
Production details (at least kWh per annum) provided?	□ Yes □ No
d) Verification of the completeness of the Design	n Report – Foreword
PV module installation	Ground Building Canopy Other
Building Installation (in case of PV module	□ Flat rooftop □ Roof flap
installation on the building)	□ Facade □ Other
PV Technology	Crystalline Silicon
	□ Thin Film
Mounting structure	
	1-axis Tracker
	2-Axes Tracker

Table 5 – Checklist for Evaluation of the Final Design documentation



Data name	Result / Value
Are the above data consistent with the PV	□ Yes □ No
Application?	
e) Verification of the completeness of the Design	
DC combiner boxes description	
Interface protection description	
Monitoring system description	
f) Verification of the completeness of the Design Dimensioning	Report – System architecture and
The general architecture of the system	
Characteristics of the PV strings and PV array(s)	
Verification of compliance for PV strings/array(s) and inverters	
g) Verification of the completeness of the Design	Report – DC Section
Verification of compliance for DC cables	
Measures to prevent overcurrent in parallel PV strings	
Characteristics of the DC disconnectors	□ Yes □ No □ N/A
<i>h)</i> Verification of the completeness of the Design	
Description of measures to prevent electric shocks	
from direct contacts	
Description of measures to prevent electric shocks	
from indirect contacts	
Characteristics of the main AC devices	
AC calculations (verification of compliance for AC	
devices and cables)	
Interface Switch description	🗆 Yes 🗆 No
Backup Switch description	□ Yes □ No □ N/A
UPS description	
RCD Protection device(s)	
External Lightning Protection System (LPS)	🗆 Yes 🗆 No
<i>i)</i> Verification of the completeness of the Design installation	Report – Civil and mechanical
Description of the mounting structures	
Structural calculations	□ Yes □ No □ N/A
j) Certifications required	
PV modules	□ Yes □ No
Inverters	
Interface protection	
Other	
Was the Design Evaluation successful?	Passed



Checklist for Evaluation of Final Design Evaluation of PV Systems ≤ 11 kW

The following Table contains the verification list for the Final Design Evaluation of PV Systems \leq 11 kW.

Checklist for Final Evaluation of PV System with P _N ≤ 11 kW Field Result / Value Notes Wring Diagram – General Contents Inclusion of the Solar PV System in the existing installation is clearly indicated in the wiring diagrams Yes No Single line diagram, with details of metering and protection system (relays, CTs and VTs when adopted, e.g. for MV network connections) Yes No Wiring diagram Field Result / Value Notes Type of PV modules Yes No Notes Tot. number of PV modules per string Yes No No Number of PV modules per string Yes No N/A Connection strings / inverters Yes No N/A String cable size and type Yes No N/A String overcurrent protective device – type and voltage/current protective device – type and solar model Yes No N/A Obtimer boxes: Locations, manufacturer and model Yes No N/A N/A Combiner boxes: Location and rating (V/A), manufacturer and model Yes No N/A DC switch disconnector: Location and rating (V/A), manufacturer and model	Table 6 – Checklist for Evaluation of Final Design of PV Systems ≤ 11 kW			
Wiring Diagram – General Contents Inclusion of the Solar PV System in the existing installation is clearly indicated in the wiring diagrams Yes No Single line diagram, with details of metering and protection system (relays, CTs and VTs when adopted, e.g. for MV network connections) Yes No Wiring diagram Yes No No Wiring diagram Yes No Notes Type of PV modules Yes No No Tot. number of PV modules per string Yes No No Number of FV modules per string Yes No No Connection strings / inverters Yes No No String outpreactive device – type and voltage/current protective device – type and voltage/current ratings No N/A Blocking diode type Yes No N/A Array main cable: Size, type, manufacturer, model and internal electric diagram Yes No N/A Combiner boxes: Locations, manufacturer and model Yes No N/A Other arrays with electronic protective circuitry: Type, location, rating, manufacturers and models Yes No N/A AC overcurent protective device: Location, type, rating, manufacturer and mod	Checklist for Final Evaluation of PV System with $P_N \le 11 \text{ kW}$			
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Backup switch: Location, type, rating, manufacturer and model Yes No N/A	Interface switch: Location, type, rating, manufacturer and			
	Backup switch: Location, type, rating, manufacturer and	□ Yes □ No □ N/A		
	Details of all earth/bonding conductors – size and type	🗆 Yes 🗆 No		
Details of array frame equipotential bonding cable				



Field	Result / Value	Notes
Details of any connections to an existing LPS	□Yes □No □N/A	
Details of any surge protection device installed	🗆 Yes 🗆 No	
Check of Connection Requirements		
Is the proposed diagram compliant with Kahramaa applicable rules, particularly the Technical Standards for the Connection of Small-Scale Solar PV Systems to the LV and MV Distribution Networks?	□ Yes □ No	
If three-phase inverters are not used, is the maximum power imbalance limited to the values specified in the Technical Standards for the Connection of PV Systems to the LV and MV Distribution Networks?	□ Yes □ No	
Planimetry and String layout		
Site setting out plan showing details of proposed works, PV modules layout, meter location(s), etc.	□ Yes □ No	
Indication of tilt and orientation	🗆 Yes 🗆 No	
Sources of shading are clearly indicated	□ Yes □ No □ N/A	
Layout drawing showing how the array is split and	□ Yes □ No □ N/A	
connected into strings		
Sizing of the Solar PV System		
Is the compatibility between the strings and the Inverter been verified?	□ Yes □ No	
Is the sizing of the PV system elements (inverters, solar cables, cables, panels, etc.) correct?	□ Yes □ No	
In the case of installation on buildings, is the maximum string voltage ≤ 1000 Vdc?	□ Yes □ No	
In the case of ground-mounted installation, is the maximum string voltage \leq 1500 Vdc?	□ Yes □ No	
Protection against overcurrent: Are there suitable provisions of the Building Code taken into consideration during the installation?	□ Yes □ No	
In case of use of transformer with fewer inverters, has an RCD (Residual Current Device) of Class B (Class A is sufficient in case of inverters which cannot inject DC currents) been considered on AC side?	□ Yes □ No	
Lightning protection: Is there a need for LPS to be evaluated, and, if required, relative provisions have been taken?	□ Yes □ No	



Checklist for Final Evaluation of PV System with $P_N \le 11 \text{ kW}$			
Field	Result / Value	Notes	
Details on PV modules for each kind employed in the plant (Manufacturer, Model reference, Efficiency, Warranty years for manufacturing defects, Peak capacity per single PV module [Wp], Surface per single PV module [m ²], Orientation (South= 0°, East= -90°, West=90°), Tilt angle (inclination to horizontal), Number of modules of this type)	□ Yes □ No		
Compliance (to applicable Standard) certificate of the modules	🗆 Yes 🗆 No		
Details on Inverters, for each kind employed in the plant (Number of inverters of each type, Manufacturer, Model reference, Compliance with the Inverters approved by Kahramaa, Warranty years, Rated AC power, Nominal power factor and adjustable range, Maximum DC input voltage, AC output voltage, Connection phases, Total Current Harmonic Distortion, Synchronisation method with Kahramaa network, Environmental protection rating (IP), Means to avoid dust penetration in the installation room (if any)	□ Yes □ No		
The Inverter AC Output Voltage is compatible with the LV Distribution Networks of Kahramaa with which the Solar PV System is connected to	□ Yes □ No		
The Inverters are compliant with Technical Standards for the Connection of Small-Scale Solar PV Systems to the LV and MV Distribution Networks (¹)	□ Yes □ No		
Degree of Protection IP of the Inverter compatible with the location of installation (Indoor min IP41 ; Outdoor IP54)	□ Yes □ No		
Miscellaneous			
Ground Floor and/or typical floor layout indicating Location of Electrical rooms, MDB / SMDB, DB, Inverters, etc.	□ Yes □ No		
Dimensional layout of electrical RMU rooms, LV switch rooms with the arrangement of the panels, metering rooms or enclosures	□ Yes □ No □ N/A		
Array mounting system documentation	🗆 Yes 🗆 No		
Documentation of any emergency systems			
Other drawings/technical specification as applicable, complete	□ Yes □ No		
Result	□ Passed □ No Pas	ssed	

¹ In future the proposed inverters shall be included in the list of those approved by Kahramaa.



Checklist for Evaluation of Final Design Evaluation of PV Systems > 11 kW

The following Table contains the verification list for the Final Design Evaluation of PV Systems > 11 kW.

Field	Result / Value	Notes
Design Report – Foreword		
Type of solar system, integration if relevant, fixed	🗆 Yes 🗆 No	
mounting or tracking, technology		
Short description of the purpose of the project	🗆 Yes 🗆 No	
information for all bodies responsible for the design	🗆 Yes 🛛 No	
information for all bodies responsible for the installation	🗆 Yes 🛛 No	
Design Report – Input data		
Definitions		
Most relevant laws and standards applicable	🗆 Yes 🗆 No	
Solar and environmental data of the site	🗆 Yes 🛛 No	
Geological and environmental constraints	□ Yes □ No □ N/A	
Characteristics of the distribution network at POC	🗆 Yes 🗆 No	
Design Report – Characteristics of the main devices a	and equipment	
PV modules	🗆 Yes 🗆 No	
Inverters	🗆 Yes 🗆 No	
DC combiner boxes	□ Yes □ No □ N/A	
Interface protection	□ Yes □ No □ N/A	
Monitoring system	□ Yes □ No □ N/A	
Design Report – System architecture and dimensionir	ng	
It explain how the DC and AC capacity is obtained?	🗆 Yes 🗆 No	
General architecture of the system	🗆 Yes 🗆 No	
Characteristics of the PV strings and PV array(s)	□ Yes □ No □ N/A	
Verification of compliance for PV strings/array(s) and	🗆 Yes 🗆 No 🗆 N/A	
inverters		
Description of the grid connection and power delivery		
Design Report – DC section		
Verification of compliance for DC cables	□ Yes □ No □ N/A	
Measures to prevent overcurrent in parallel PV strings	□ Yes □ No □ N/A	
Design Report – AC section		
Description of measures to prevent electric shocks from direct contacts		
Description of measures to prevent electric shocks from indirect contacts		
Public	Page 10 of 14	

Table 7 – Checklist for Evaluation of Final Design of PV Systems > 11 kW



Checklist for Final Evaluation of PV System with $P_N > 2$	11 kW	
Field	Result / Value	Notes
Characteristics of the main AC devices		Notes
AC calculations (verification of compliance for AC		
devices and cables)		
Design Report – Civil and mechanical installation		
Description of the mounting structures	🗆 Yes 🛛 No	
Structural calculations		
Design Report – Performance calculations		
Calculation of the solar radiation on the PV system	🗆 Yes 🛛 No	
Energy Yield (monthly and yearly)	🗆 Yes 🛛 No	
CO2 saved	🗆 Yes 🛛 No	
Wiring Diagram – General Contents		
The inclusion of the Solar PV System in the existing	🗆 Yes 🗆 No	
installation is clearly indicated in the wiring diagrams		
Single line diagram, with details of metering and	🗆 Yes 🛛 No	
protection system (relays, CTs and VTs when adopted,		
e.g. for MV network connections)		
Wiring diagram		
Type of PV modules	🗆 Yes 🛛 No	
Tot. number of PV modules	🗆 Yes 🛛 No	
Number of strings	🗆 Yes 🛛 No	
Number of PV modules per string	🗆 Yes 🛛 No	
Connection strings / inverters	□ Yes □ No □ N/A	
String cable size and type		
String overcurrent protective device – type and	□ Yes □ No □ N/A	
voltage/current ratings		
Blocking diode type	□ Yes □ No □ N/A	
Array main cable: Size, type, manufacturer and model	□ Yes □ No □ N/A	
Combiner boxes: Locations, manufacturer, model and	□ Yes □ No □ N/A	
internal electric diagram		
DC switch disconnector: Location and rating (V/A),	□ Yes □ No □ N/A	
manufacturer and model		
Other arrays with electronic protective circuitry: Type,	□ Yes □ No □ N/A	
location, rating, manufacturers and models		
AC isolator location: Type, rating, manufacturer and model	□ Yes □ No	
AC overcurrent protective device: Location, type, rating,	🗆 Yes 🛛 No	
manufacturer and model		
Residual current (where fitted): Device location, type and rating	□ Yes □ No □ N/A	
Interface protection: Type, manufacturing and model	□ Yes □ No □ N/A	
menace protection. Type, manufacturing and model		



Field Result / Value Notes Interface switch: Location, type, rating, manufacturer and model Internal Internal Internal Backup switch: Location, type, rating, manufacturer and model Yes No N/A Details of all earth/bonding conductors – size and type Yes No N/A Details of array frame equipotential bonding cable Yes No N/A Details of array frame equipotential bonding cable Yes No N/A Details of array frame equipotential bonding cable Yes No N/A Details of array connections to an existing LPS Yes No N/A Details of any connections to an existing LPS Yes No N/A Details of any connections to an existing LPS Yes No N/A Details of any connections to an existing LPS Yes No N/A Details of any connections to an existing LPS Yes No N/A Distribution Networks? Interface Yes No So Sthe Interface Protection and the undervoltage Yes No So So Is the Interface Protection and the undervoltage	Checklist for Final Evaluation of PV System with $P_N > 11 \text{ kW}$		
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model			
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Indication of tilt and orientation		-	
		🗆 Yes 🗆 No	
	Are the sources of shading clearly indicated?	□ Yes □ No □ N/A	



Checklist for Final Evaluation of PV System with $P_N > 2$	11 kW	
Field	Result / Value	Notes
Layout drawing showing how the array is split and connected into strings	□ Yes □ No □ N/A	
Sizing of the Solar PV System		
Is the compatibility between the strings and the Inverter checked?	□ Yes □ No	
Is the sizing of the PV system elements (inverters, solar cables, cables, panels, etc) correct?	□ Yes □ No	
In the case of installation on buildings, is the maximum string voltage ≤ 1000 Vdc?	□ Yes □ No	
In the case of ground-mounted installation, is the maximum string voltage ≤ 1500 Vdc?	□ Yes □ No	
Protection against overcurrent: have suitable provisions in the agreement with Building Code Section 407 been taken during the installation?	□ Yes □ No	
In case of use of transformer with fewer inverters, has an RCD (Residual Current Device) of Class B (Class A is sufficient in case of inverters which cannot inject DC currents) been considered on the AC side?	□ Yes □ No	
Lightning protection: Is there a need for LPS to be evaluated, and, if required, relative provisions have been taken?	□ Yes □ No	
Datasheets and Certification		
Details on PV modules for each kind employed in the plant (Manufacturer, Model reference, Efficiency, Warranty years for manufacturing defects, Peak capacity per single PV module [Wp], Surface per single PV module [m ²], Orientation (South= 0°, East= -90°, West=90°), Tilt angle (inclination to horizontal), Number of modules of this type)	□ Yes □ No	
Compliance (to applicable Standard) certificate of the modules	□ Yes □ No	
Details on Inverters, for each kind employed in the plant (Number of inverters of each type, Manufacturer, Model reference, Compliance with the Inverters approved by Kahramaa, Warranty years, Rated AC power, Nominal power factor and adjustable range, Maximum DC input voltage, AC output voltage, Connection phases, Total Current Harmonic Distortion, Synchronisation method with Kahramaa network, Environmental protection rating (IP), Means to avoid dust penetration in the installation	□ Yes □ No	



Checklist for Final Evaluation of PV System with $P_N > 11 \text{ kW}$		
Field	Result / Value Notes	
The Inverter AC Output Voltage is compatible with the LV Distribution Networks where the PV System is connected	□ Yes □ No	
The Inverters are compliant with Technical Standards for the Connection of Small-Scale Solar PV Systems to the LV and MV Distribution Networks ²	□ Yes □ No	
Are the Harmonic Currents generated by the inverters retrievable from the received datasheets? (Solar PV Systems > 50kW)	□ Yes □ No	
Degree of Protection IP of the Inverter compatible with the location of installation (Indoor min IP54; Outdoor min IP65)	□ Yes □ No	
Details of external Interface Protections (Number, Manufacturer, Model reference, Compliance with the protections approved by Kahramaa)	□ Yes □ No	
Compliance to Kahramaa and International Standard certificate of the external interface protection (if not in the list of the already approved ones) (until transitional rules are no more in force)	□ Yes □ No	
Miscellaneous		
Plan of substation location (in case of MV connection)		
Ground Floor and / or typical floor layout indicating location of Electrical rooms, MDB / SMDB, DB, Inverters, etc.	□ Yes □ No	
Is there a dimensional layout of electrical RMU rooms, LV switch rooms with an arrangement of the panels, metering rooms or enclosures?	□ Yes □ No □ N/A	
Is the array mounting system documentation clear and complete?		
Documentation of any emergency systems	□ Yes □ No □ N/A	
Are other drawings/technical specification as applicable complete?		
Operation and Maintenance criteria and main planned actions in agreement with Kahramaa's recommendations	□ Yes □ No	
Result	Passed No Passed	

² In future the proposed inverters shall be included in the list of those approved by Kahramaa.