FINAL PROJECT

FOR THE CONSTRUCTION OF

A PHOTOVOLTAIC SYSTEM OF 343,2 kWp

NAMED

Photovoltaic system SolarLands

SITE IN THE CIY OF

Alacant

A-79

03114 - Alicante

CUSTOMER:

John Smith SolarLands

Alcant

A-79 03114 - Padova

Attachments:

- *Single-line diagram of the plant*;
- *Planimetric scheme.*

DATE

25/10/2017

THE TECHNICAL

Black Joe
Sun Power Ltd

PLANT GENERAL INFORMATION

This project relates to the construction of a plant producing electricity through photovoltaic conversion, with a peak power equal to 343,2 kWp.

CUSTOMER	
Customer:	Smith John SolarLands
Address:	A-79 03114 Alcant
Tax code/VAT number:	01245632974
Phone number:	049 874561;+44 049 874561
Fax:	
E-mail:	john @solarlands.com

SITE OF INSTALLATION

The plant Photovoltaic system SolarLands has the following characteristics: Photovoltaic system ground mounted.

DATA ON THE LOCATION OF INSTALLATION	
Location:	Alacant 03114 A-79
Latitude:	038°18'55"
Longitude:	000°-32'-57"
Altitude:	31 m
Source climate data:	Electro Graphics
Albedo:	View table

ALBEDO TABLE		
January	20 %	Dry grass
February	20 %	Dry grass
March	26 %	Green grass
April	26 %	Green grass
May	26 %	Green grass
June	26 %	Green grass
July	26 %	Green grass
August	26 %	Green grass
September	20 %	Dry grass
October	30 %	Dead leaves
November	20 %	Dry grass
Dicember	30 %	Dead leaves

DIMENSIONING OF THE PLANT

The amount of producible electricity will be calculated on the basis of radiometric data indicated in the standard ElectroGraphics.
For plants will meet the following conditions *(to be done for each "photovoltaic generator", understood as a set of photovoltaic modules with the same slope and same orientation)*:
at startup of the photovoltaic system, the relationship between the energy or power produced into alternating current and the energy or power producible in alternating current (determined as a function of solar radiation incident on the surface of the modules, rated system and the operating temperature of the modules) must be at least greater than 0.78 when using inverter power up to 20 kW and 0.8 in the case of using higher power inverters, under the conditions of measurement and calculation methods described in EN 60904-2.
It will not be admitted to the parallel strings that are not perfectly identical to each other for exposition, and/or brand, and/or model, and/or number of modules used. Each module, then, will be equipped with bypass diode.

DESCRIPTION OF THE PLANT

The photovoltaic system consists of No. 1 photovoltaic generators composed of No. 1320 photovoltaic modules and No. 3 inverters with type of realization Ground-mounted .
The total rated power is 343,2 kWp for an annual production of 490.119,2 kWh distributed over an area of 2.125,2 m².
Method of connection to the network Threephase in Medium voltage with power supply voltage 20.000 V.

EMISSIONS

The plant reduces emissions into the atmosphere annually as reported in the following table:

Equivalent thermal generation	
Sulphur dioxide (SO_2):	343,49 kg
Oxides of nitrogen (NO_x):	432,41 kg
Powders:	15,34 kg
Carbon dioxide (CO_2):	255,61 t

Equivalent geothermal generation	
Hydrogen sulfide (H_2S) (geothermal fluid):	15,02 kg
Carbon dioxide (CO_2):	2,89 t
Tonne of oil equivalent (TOE):	112,73 TO

SOLAR RADIATION

The evaluation of the available solar resource was carried out according to standard ElectroGraphics, taking as reference the location that has historical data of solar radiation in the immediate vicinity of Alacant.

TABLE OF SOLAR RADIATION ON HORIZONTAL

Month	Total per day [MJ/m^2]	Total per month [MJ/m^2]
January	8,35	258,85
February	11,34	317,52
March	15,3	474,3
April	19,26	577,8
May	21,64	670,84
June	24,37	731,1
July	24,62	763,22
August	21,71	673,01
September	16,67	500,1
October	12,2	378,2
November	8,68	260,4
Dicember	7,13	221,03

ENERGY PRODUCTION TABLE

Month	Total per day [kWh]	Total per month [kWh]
January	879,631	27268,552
February	1097,969	30743,143
March	1364,859	42310,643
April	1563,374	46901,216
May	1637,679	50768,034
June	1785,178	53555,335
July	1828,045	56669,389
August	1713,396	53115,275
September	1428,367	42851,001
October	1153,507	35758,728
November	892,05	26761,503
Dicember	755,367	23416,388

EXPOSURE

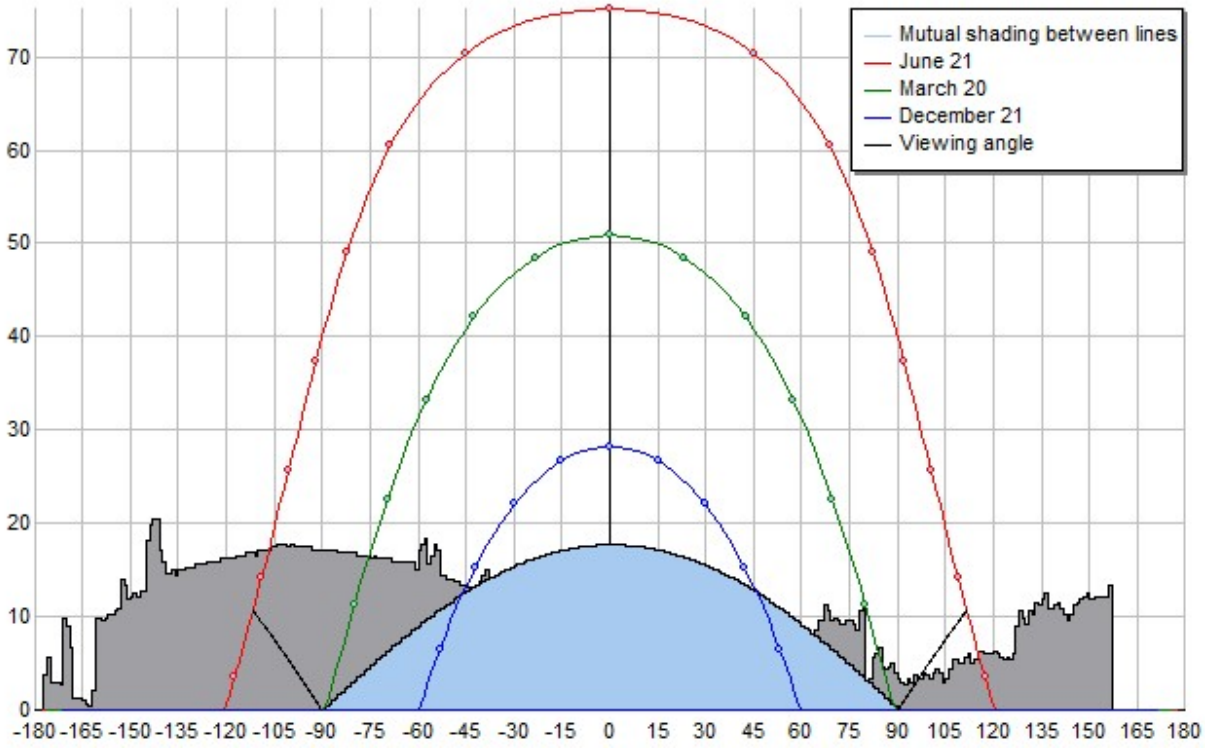
The photovoltaic system consists of 1 distributed generators on 1 exposures as defined below:

Description	Type of construction	Type of installation	Azimut	Tilt	Shad.
On ground system	Ground-mounted	Fixed tilt	0°	27°	2,43 %

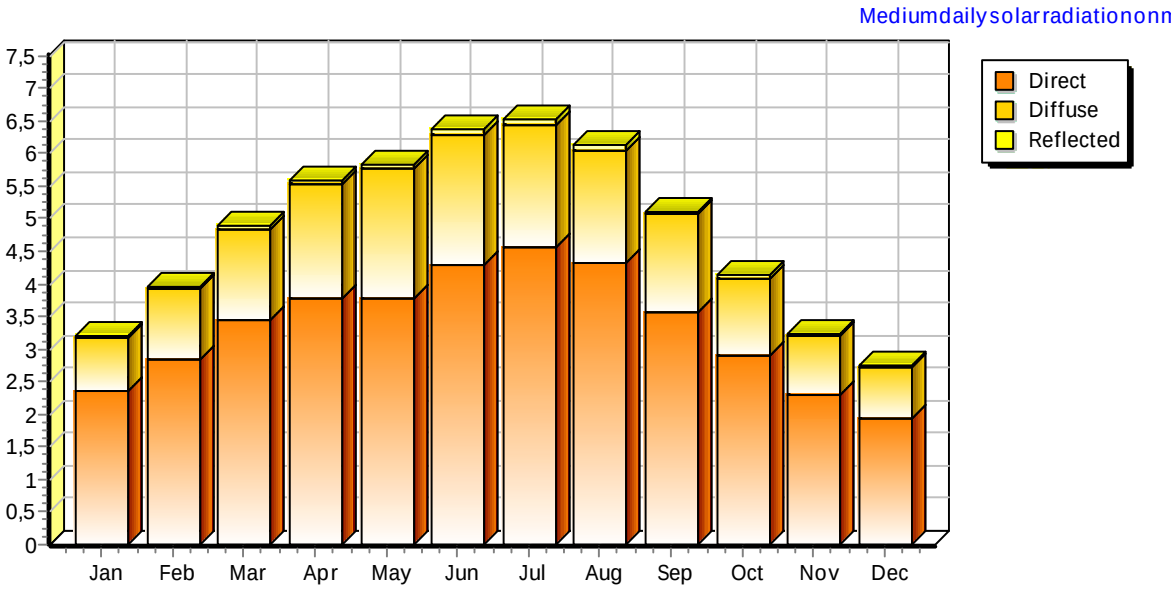
On ground system

On ground system will be exposed with a 0,00° orientation (azimuth) with respect to the south and will be exposed with a 27,00° tilt respect of the horizontal.
The energy production of the exposure On ground system is conditioned by shading factors that determine a reduction of solar radiation as far 2,43 %.

SHADING DIAGRAM



SOLAR RADIATION DIAGRAM



SOLAR RADIATION TABLE

Month	Direct Radiation [kWh/m^2]	Diffuse Radiation [kWh/m^2]	Reflected Radiation [kWh/m^2]	Total per day [kWh/m^2]	Total per month [kWh/m^2]
January	2,346	0,825	0,025	3,196	99,071
February	2,838	1,081	0,034	3,952	110,666
March	3,436	1,399	0,06	4,895	151,74
April	3,783	1,728	0,075	5,586	167,588
May	3,781	1,974	0,085	5,84	181,031
June	4,301	1,967	0,096	6,364	190,907
July	4,565	1,855	0,097	6,517	202,027
August	4,308	1,723	0,085	6,117	189,625
September	3,548	1,517	0,05	5,116	153,466
October	2,901	1,184	0,055	4,14	128,329
November	2,308	0,895	0,026	3,229	96,868
Dicember	1,946	0,764	0,032	2,742	85,006

SUPPORT STRUCTURES

The modules will be mounted on the galvanized steel supports with a tilt of 27°, will all have the same exposure. The anchors of the structure will need to withstand winds up to speeds of 120 km/h.

Generator ground mounted

Generator ground mounted. Modules face south and tilt 27°; mounted on support structures fixed-tilt.
The generator consists of No. 1320 type modules Policrystalline silicon with an estimated useful life of more than 20 years and degradation of production due to aging of 0,8 %% per annum.

CHARACTERISTICS OF PHOTOVOLTAIC GENERATOR	
Type of realization:	Ground-mounted
Number of modules:	1320
Number of inverter:	3
Rated power:	343200 W
Performance ratio:	79,3 %

CONSTRUCTION DATA OF MODULES	
Manufacturer:	CSI CANADIAN SOLAR INC
Series / Ref-mark:	CS6P CS6P-260P
Manufacturing technology:	Policrystalline silicon
Electrical characteristics	
Maximum power:	260 W
Efficiency:	16,2 %
Rated voltage:	30,4 V
No-load voltage:	37,5 V
Rated current:	8,6 A
Short-circuit current:	9,1 A
Dimensions	
Dimensions:	982 mm x 1638 mm
Weight:	18,5 kg

The voltage values at various operating temperatures (minimum, maximum and operating) fall within the acceptable range allowed by the inverter.

The electrical line that arrives from photovoltaic modules is grounding by appropriate Surge Protection Devices with "out of service" optical indicator, to guar.

ENERGY CONVERSION SYSTEM

The conversion system consists of static converters (inverters).
The converter DC/AC used is fit for the transfer of power from the PV array to the network of the distributor, in accordance with the technical regulatory requirements and safety standards. The values of input voltage and input current of this device are compatible with those of the respective photovoltaic field, while the values of output voltage and output frequency are compatible with those of the network that is connected to the system.
The main features of the the conversion system are:

- Forced switching inverter with PWM technique (pulse-width modulation), no clock and / or internal reference of voltage or current, similar to "system is not adequate for the voltage and frequency in the normal range".
- DC input side of the photovoltaic generator manageable with poles not connected to the ground, ie IT system.
- Compliance with general standards on EMC and RF emission limitation: according to EN 55014-1, EN 55011, EN 50082-1.
- Protections for disconnection from the network for values outside the threshold voltage and line frequency and overcurrent fault in accordance with the requirements of the local electrical distributor. Automatic reset of the protections for predisposition to automatic start.
- CE Mark compliance.
- Degree of protection suitable to the location near the PV field (IP65).
- Declaration conformity of the product to applicable technical regulations, issued by the manufacturer, with reference to standard tests performed on the component at an authorized and recognized certification body.
- Input voltage range appropriate to the output voltage of the PV generator.
- Maximum efficiency >= 90% at 70% of the nominal power.

The conversion system is composed of 3 inverter.

Construction data of the inverters	
Manufacturer:	ABB Spa
Series / Ref-mark:	PLUS PVI-110.0-TL M-M
Trackers:	2
Inputs per tracker:	1
Electrical characteristics	
Rated power:	110 kW
Maximum power:	112,8 kW
Maximum power per tracker:	56,4 kW
Rated voltage:	850 V
Maximum voltage:	1000 V
Minimum voltage per tracker:	485 V
Maximum voltage per tracker:	950 V
Outpu rated voltage:	320 Vac
Rated current:	246 A
Maximum current:	246 A
Maximum current per tracker:	123 A
Efficiency:	0,98

Inverter 1	MPPT 1	MPPT 2
Modules in series:	20	20
Parallel strings:	11	11
Exposures:	On ground system	On ground system
MPP voltage (STC):	608 V	608 V

Numeber of modules:	220	220

Inverter 2	MPPT 1	MPPT 2
Modules in series:	20	20
Parallel strings:	11	11
Exposures:	On ground system	On ground system
MPP voltage (STC):	608 V	608 V
Numeber of modules:	220	220

Inverter 3	MPPT 1	MPPT 2
Modules in series:	20	20
Parallel strings:	11	11
Exposures:	On ground system	On ground system
MPP voltage (STC):	608 V	608 V
Numeber of modules:	220	220

DIMENSIONING

The power rating of the generator is given by:

P = Pmodule * N°modules = 260 W * 1320 = 343200 W

The total energy produced by the STC (radiation modules of 1000 W/m² at 25 °C of temperature) is calculated as:

Exposure	N° modules	Solar radiation [kWh/m²]	Energy [kWh]
On ground system	1320	1.800,15	617.811,27

E = En * (1-Disp) = 490119,2 kWh

where
Disp = Power losses obtained from:

Shading losses:	3,0 %
Temperature increasing losses:	6,7 %
Mismatching losses:	5,0 %
DC current losses:	0,6 %
Other losses (dirt, tolerances...):	5,0 %
Conversion losses:	2,3 %
Total losses:	20,7 %

SHADING LOSSES TABLE

Month	Without obstacles [kWh]	Real production [kWh]	Losses [kWh]
January	27799,0	27268,6	-1,9 %
February	31052,6	30743,1	-1,0 %
March	42577,9	42310,6	-0,6 %
April	47024,7	46901,2	-0,3 %
May	50796,8	50768,0	-0,1 %
June	53568,0	53555,3	0,0 %
July	56688,2	56669,4	0,0 %
August	53208,1	53115,3	-0,2 %
September	43062,1	42851,0	-0,5 %
October	36008,7	35758,7	-0,7 %
November	27180,8	26761,5	-1,5 %
Dicember	23852,5	23416,4	-1,8 %
Year	492819,3	490119,2	-0,5 %

ELECTRICAL CABLES AND WIRINGS

The electrical wiring will be done using cables with insulated copper conductors with the following requirements:

- Section cores of copper calculated in accordance with rules IEC
- Type FG21 if outdoors or FG7 if in underground conduits
- Type N07V-K if inside conduits within buildings

To ensure the safety of those working on the plant during the verification, or adjustment, or the maintenance, the conductors will have the following colors:

- Protection conductor: yellow-green (mandatory)
- Neutral conductor: light blue (mandatory)
- Phase conductor: grey / brown
- Conductor for DC circuits: signed with a clear indication of the positive "+" and negative "-"

As it is possible to see from the above requirements, conductor cross-sections of the photovoltaic systems are certainly oversized for the current and the limited distances involved.
With these sections the voltage drop is contained within 2% of the measured value from any module to the conversion system.

Wiring: **String cable**

Description	Value
Identification:	FG21M21 1x4 red FG21M21 1x4 black
Total length:	1320 m
Dimensioning length:	20 m
Proximity circuits:	1
Ambient temperature:	30°
Table:	IEC 60364-5-52 Ed.3
Lay:	4(B1) - Insulated conductors or single-core cables in conduit on a wooden or masonry wall
Disposition:	Bunched in air, on a surface, embedded or enclosed
Type of cable:	Single-core
Material:	Copper
Designation:	FG21M21 (1800Vcc)
Type of insulation:	PVC
Formation:	2x(1x4)
N° conductors positive/phase:	1
Sect. positive/phase:	4 mm²
N° conduttors negative/neutral:	1
Sect. negative/neutral:	4 mm²
N° conductors PE:	
Sect. PE:	
Rated voltage:	608 V
Working current:	8,6 A
Short-circuit current of modules:	91,2 A

Wiring: **String - Field C.**

Description	Value
Identification:	FG7R 0.6/1 kV - 1X6 FG7R 0.6/1 kV - 1X6
Total length:	2949,09 m
Dimensioning length:	71,34 m
Proximity circuits:	1
Ambient temperature:	30°
Table:	IEC 60364-5-52 Ed.3
Lay:	71(D1) - Single-core cable in conduit or in cable ducting in the ground
Disposition:	Bunched in air, on a surface, embedded or enclosed
Type of cable:	Single-core
Material:	Copper
Designation:	FG7R 0.6/1 kV
Type of insulation:	EPR
Formation:	2x(1x6)
N° conductors positive/phase:	1
Sect. positive/phase:	6 mm²
N° conduttors negative/neutral:	1
Sect. negative/neutral:	6 mm²
N° conductors PE:	
Sect. PE:	
Rated voltage:	608 V
Working current:	8,6 A
Short-circuit current of modules:	91,2 A

Wiring: **Field C. - Inverter C.**

Description	Value
Identification:	FG7R 0.6/1 kV - 1X70 FG7R 0.6/1 kV - 1X70
Total length:	213,07 m
Dimensioning length:	59,73 m
Proximity circuits:	4
Ambient temperature:	30°
Table:	IEC 60364-5-52 Ed.3
Lay:	71(D1) - Single-core cable in conduit or in cable ducting in the ground
Disposition:	Bunched in air, on a surface, embedded or enclosed
Type of cable:	Single-core
Material:	Copper
Designation:	FG7R 0.6/1 kV
Type of insulation:	EPR
Formation:	2x(1x70)
N° conductors positive/phase:	1
Sect. positive/phase:	70 mm²

N° conduttors negative/neutral:	1
Sect. negative/neutral:	70 mm²
N° conductors PE:	
Sect. PE:	
Rated voltage:	608 V
Working current:	94,2 A
Short-circuit current of modules:	100,3 A

Wiring: **Inverter C. - Parallel C.**

Description	Value
Identification:	FG7R 0.6/1 kV - 1X95 FG7R 0.6/1 kV - 1X50
Total length:	14,46 m
Dimensioning length:	6,19 m
Proximity circuits:	1
Ambient temperature:	30°
Table:	IEC 60364-5-52 Ed.3
Lay:	30(C) - Single-core cables on unperforated tray run horizontally or vertically
Disposition:	Bunched in air, on a surface, embedded or enclosed
Type of cable:	Single-core
Material:	Copper
Designation:	FG7R 0.6/1 kV
Type of insulation:	EPR
Formation:	3x(1x95)+1G50
N° conductors positive/phase:	1
Sect. positive/phase:	95 mm²
N° conduttors negative/neutral:	0
Sect. negative/neutral:	50 mm²
N° conductors PE:	1
Sect. PE:	50 mm²
Rated voltage:	320 V
Working current:	198,4 A

Wiring: **Parallel C. - Meter C.**

Description	Value
Identification:	FG7R 0.6/1 kV - 1X185 FG7R 0.6/1 kV - 1X50
Total length:	1,24 m
Dimensioning length:	1,24 m
Proximity circuits:	1
Ambient temperature:	30°
Table:	IEC 60364-5-52 Ed.3
Lay:	4(B1) - Insulated conductors or single-core cables in conduit on a wooden or masonry wall
Disposition:	Bunched in air, on a surface, embedded or enclosed

Type of cable:	Single-core
Material:	Copper
Designation:	FG7R 0.6/1 kV
Type of insulation:	EPR
Formation:	3x(3x185)+1G50
N° conductors positive/phase:	3
Sect. positive/phase:	185 mm²
N° conduttors negative/neutral:	0
Sect. negative/neutral:	95 mm²
N° conductors PE:	1
Sect. PE:	50 mm²
Rated voltage:	320 V
Working current:	595,3 A

Wiring: **Meter C. - LV/MV Cabinet**

Description	Value
Identification:	FG7R 0.6/1 kV - 1X185 FG7R 0.6/1 kV - 1X50
Total length:	10 m
Dimensioning length:	10 m
Proximity circuits:	1
Ambient temperature:	25°
Table:	IEC 60364-5-52 Ed.3
Lay:	30(C) - Single-core cables on unperforated tray run horizontally or vertically
Disposition:	Bunched in air, on a surface, embedded or enclosed
Type of cable:	Single-core
Material:	Copper
Designation:	FG7R 0.6/1 kV
Type of insulation:	EPR
Formation:	3x(3x185)+1G50
N° conductors positive/phase:	3
Sect. positive/phase:	185 mm²
N° conduttors negative/neutral:	0
Sect. negative/neutral:	95 mm²
N° conductors PE:	1
Sect. PE:	50 mm²
Rated voltage:	320 V
Working current:	595,3 A

Table of cables							
Ref-mark	Description	Form.	Des.	Code	Origin	Dest.	Lc
W00	String cable 1	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 1	20 m
W01	String cable 1-Q.1	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 1	Q.1	59,97 m
W02	String cable 2	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 2	20 m
W03	String cable 2-Q.1	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 2	Q.1	40,33 m

W04	String cable 3	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 3	20 m
W05	String cable 3-Q.1	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 3	Q.1	20,69 m
W06	String cable 4	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 4	20 m
W07	String cable 4-Q.1	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 4	Q.1	62,81 m
W08	String cable 5	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 5	20 m
W09	String cable 5-Q.1	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 5	Q.1	43,17 m
W10	String cable 6	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 6	20 m
W11	String cable 6-Q.1	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 6	Q.1	23,53 m
W12	String cable 7	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 7	20 m
W13	String cable 7-Q.1	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 7	Q.1	65,66 m
W14	String cable 8	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 8	20 m
W15	String cable 8-Q.1	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 8	Q.1	46,02 m
W16	String cable 9	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 9	20 m
W17	String cable 9-Q.1	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 9	Q.1	26,38 m
W18	String cable 10	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 10	20 m
W19	String cable 10-Q.1	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 10	Q.1	68,5 m
W20	String cable 11	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 11	20 m
W21	String cable 11-Q.1	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 11	Q.1	48,86 m
W22	String cable 12	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 12	20 m
W23	String cable 12-Q.2	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 12	Q.2	23,54 m
W24	String cable 13	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 13	20 m
W25	String cable 13-Q.2	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 13	Q.2	59,97 m
W26	String cable 14	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 14	20 m
W27	String cable 14-Q.2	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 14	Q.2	40,33 m
W28	String cable 15	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 15	20 m
W29	String cable 15-Q.2	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 15	Q.2	20,69 m
W30	String cable 16	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 16	20 m
W31	String cable 16-Q.2	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 16	Q.2	62,81 m
W32	String cable 17	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 17	20 m
W33	String cable 17-Q.2	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 17	Q.2	43,17 m
W34	String cable 18	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 18	20 m
W35	String cable 18-Q.2	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 18	Q.2	23,53 m
W36	String cable 19	2x(1x4)	FG21M21	CVPRY193		String 19	20 m

			(1800Vcc)	CVPRY192			
W37	String cable 19-Q.2	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 19	Q.2	65,66 m
W38	String cable 20	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 20	20 m
W39	String cable 20-Q.2	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 20	Q.2	46,02 m
W40	String cable 21	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 21	20 m
W41	String cable 21-Q.2	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 21	Q.2	26,38 m
W42	String cable 22	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 22	20 m
W43	String cable 22-Q.2	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 22	Q.2	68,51 m
W44	String cable 23	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 23	20 m
W45	String cable 23-Q.3	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 23	Q.3	40,33 m
W46	String cable 24	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 24	20 m
W47	String cable 24-Q.3	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 24	Q.3	20,69 m
W48	String cable 25	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 25	20 m
W49	String cable 25-Q.3	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 25	Q.3	62,82 m
W50	String cable 26	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 26	20 m
W51	String cable 26-Q.3	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 26	Q.3	43,18 m
W52	String cable 27	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 27	20 m
W53	String cable 27-Q.3	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 27	Q.3	23,54 m
W54	String cable 28	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 28	20 m
W55	String cable 28-Q.3	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 28	Q.3	65,66 m
W56	String cable 29	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 29	20 m
W57	String cable 29-Q.3	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 29	Q.3	46,02 m
W58	String cable 30	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 30	20 m
W59	String cable 30-Q.3	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 30	Q.3	26,38 m
W60	String cable 31	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 31	20 m
W61	String cable 31-Q.3	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 31	Q.3	68,5 m
W62	String cable 32	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 32	20 m
W63	String cable 32-Q.3	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 32	Q.3	48,86 m
W64	String cable 33	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 33	20 m
W65	String cable 33-Q.3	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 33	Q.3	29,22 m
W66	String cable 34	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 34	20 m
W67	String cable 34-Q.4	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 34	Q.4	59,97 m
W68	String cable 35	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 35	20 m

W69	String cable 35-Q.4	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 35	Q.4	40,33 m
W70	String cable 36	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 36	20 m
W71	String cable 36-Q.4	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 36	Q.4	20,69 m
W72	String cable 37	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 37	20 m
W73	String cable 37-Q.4	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 37	Q.4	62,82 m
W74	String cable 38	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 38	20 m
W75	String cable 38-Q.4	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 38	Q.4	43,18 m
W76	String cable 39	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 39	20 m
W77	String cable 39-Q.4	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 39	Q.4	23,54 m
W78	String cable 40	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 40	20 m
W79	String cable 40-Q.4	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 40	Q.4	65,66 m
W80	String cable 41	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 41	20 m
W81	String cable 41-Q.4	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 41	Q.4	46,02 m
W82	String cable 42	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 42	20 m
W83	String cable 42-Q.4	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 42	Q.4	26,38 m
W84	String cable 43	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 43	20 m
W85	String cable 43-Q.4	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 43	Q.4	68,51 m
W86	String cable 44	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 44	20 m
W87	String cable 44-Q.4	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 44	Q.4	48,86 m
W88	String cable 45	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 45	20 m
W89	String cable 45-Q.5	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 45	Q.5	20,69 m
W90	String cable 46	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 46	20 m
W91	String cable 46-Q.5	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 46	Q.5	62,81 m
W92	String cable 47	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 47	20 m
W93	String cable 47-Q.5	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 47	Q.5	43,17 m
W94	String cable 48	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 48	20 m
W95	String cable 48-Q.5	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 48	Q.5	23,53 m
W96	String cable 49	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 49	20 m
W97	String cable 49-Q.5	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 49	Q.5	65,66 m
W98	String cable 50	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 50	20 m
W99	String cable 50-Q.5	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 50	Q.5	46,02 m
W100	String cable 51	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 51	20 m
W101	String cable 51-Q.5	2x(1x6)	FG7R 0.6/1	CVPIR1505	String 51	Q.5	26,38 m

			kV	CVPIR1505			
W102	String cable 52	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 52	20 m
W103	String cable 52-Q.5	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 52	Q.5	68,5 m
W104	String cable 53	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 53	20 m
W105	String cable 53-Q.5	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 53	Q.5	48,86 m
W106	String cable 54	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 54	20 m
W107	String cable 54-Q.5	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 54	Q.5	29,22 m
W108	String cable 55	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 55	20 m
W109	String cable 55-Q.5	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 55	Q.5	71,34 m
W110	String cable 56	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 56	20 m
W111	String cable 56-Q.6	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 56	Q.6	40,33 m
W112	String cable 57	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 57	20 m
W113	String cable 57-Q.6	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 57	Q.6	20,69 m
W114	String cable 58	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 58	20 m
W115	String cable 58-Q.6	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 58	Q.6	62,82 m
W116	String cable 59	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 59	20 m
W117	String cable 59-Q.6	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 59	Q.6	43,18 m
W118	String cable 60	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 60	20 m
W119	String cable 60-Q.6	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 60	Q.6	23,54 m
W120	String cable 61	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 61	20 m
W121	String cable 61-Q.6	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 61	Q.6	65,66 m
W122	String cable 62	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 62	20 m
W123	String cable 62-Q.6	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 62	Q.6	46,02 m
W124	String cable 63	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 63	20 m
W125	String cable 63-Q.6	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 63	Q.6	26,38 m
W126	String cable 64	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 64	20 m
W127	String cable 64-Q.6	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 64	Q.6	68,51 m
W128	String cable 65	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 65	20 m
W129	String cable 65-Q.6	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 65	Q.6	48,87 m
W130	String cable 66	2x(1x4)	FG21M21 (1800Vcc)	CVPRY193 CVPRY192		String 66	20 m
W131	String cable 66-Q.6	2x(1x6)	FG7R 0.6/1 kV	CVPIR1505 CVPIR1505	String 66	Q.6	29,23 m
W132	Cable Q.1-inverter I.1	2x(1x70)	FG7R 0.6/1 kV	CVPIR1511 CVPIR1511	Q.1	inverter I.1	11,27 m
W133	Cable Q.2-inverter I.1	2x(1x70)	FG7R 0.6/1 kV	CVPIR1511 CVPIR1511	Q.2	inverter I.1	22,65 m

W134	Cable Q.3-inverter I.2	2x(1x70)	FG7R 0.6/1 kV	CVPIR1511 CVPIR1511	Q.3	inverter I.2	29,83 m
W135	Cable Q.4-inverter I.2	2x(1x70)	FG7R 0.6/1 kV	CVPIR1511 CVPIR1511	Q.4	inverter I.2	41,21 m
W136	Cable Q.5-inverter I.3	2x(1x70)	FG7R 0.6/1 kV	CVPIR1511 CVPIR1511	Q.5	inverter I.3	48,37 m
W137	Cable Q.6-inverter I.3	2x(1x70)	FG7R 0.6/1 kV	CVPIR1511 CVPIR1511	Q.6	inverter I.3	59,73 m
W138	Cable inverter I.1-p.c..	3x(1x95)+1 G50	FG7R 0.6/1 kV	CVPIR1512 CVPIR1510	inverter I.1	p.c..	3,46 m
W139	Cable inverter I.2-p.c..	3x(1x95)+1 G50	FG7R 0.6/1 kV	CVPIR1512 CVPIR1510	inverter I.2	p.c..	4,82 m
W140	Cable inverter I.3-p.c..	3x(1x95)+1 G50	FG7R 0.6/1 kV	CVPIR1512 CVPIR1510	inverter I.3	p.c..	6,19 m
W141	Cable p.c.-m.c..	3x(3x185)+ 1G50	FG7R 0.6/1 kV	CVPIR1515 CVPIR1510	p.c.	m.c..	1,24 m
W142	Meter C. - Power Grid	3x(3x185)+ 1G50	FG7R 0.6/1 kV	CVPIR1515	Meter C.	Power Grid	10 m

Summary Table of cables					
Code	Manufacturer	Form.	Des.	Description	Lc
CVPRY193	PIRELLI CAVI e SISTEMI SPA	2x(1x4)	FG21M21 (1800Vcc)	FG21M21 1x4 red	1320 m
CVPRY192	PIRELLI CAVI e SISTEMI SPA	2x(1x4)	FG21M21 (1800Vcc)	FG21M21 1x4 black	1320 m
CVPIR1505	PIRELLI CAVI e SISTEMI SPA	2x(1x6)	FG7R 0.6/1 kV	FG7R 0.6/1 kV - 1X6	5898,18 m
CVPIR1511	PIRELLI CAVI e SISTEMI SPA	2x(1x70)	FG7R 0.6/1 kV	FG7R 0.6/1 kV - 1X70	426,14 m
CVPIR1512	PIRELLI CAVI e SISTEMI SPA	3x(1x95)+ 1G50	FG7R 0.6/1 kV	FG7R 0.6/1 kV - 1X95	43,38 m
CVPIR1510	PIRELLI CAVI e SISTEMI SPA	3x(1x95)+ 1G50	FG7R 0.6/1 kV	FG7R 0.6/1 kV - 1X50	14,46 m
CVPIR1515	PIRELLI CAVI e SISTEMI SPA	3x(3x185) +1G50	FG7R 0.6/1 kV	FG7R 0.6/1 kV - 1X185	101,16 m
CVPIR1510	PIRELLI CAVI e SISTEMI SPA	3x(3x185) +1G50	FG7R 0.6/1 kV	FG7R 0.6/1 kV - 1X50	11,24 m

ELECTRICAL PANELS

- **Field cabinet for direct current side**

It is planned to install an upstream cabinet for each converter to the parallel connection of strings, sectioning, measuring and controlling of the output data from the generator.

- **Parallel cabinet for alternating current side**

It is planned to install an alternating parallel cabinet within a box located downstream of static converters for measurement, connection and control of the inverter output variables. Within this cabinet, the network interface system will be added, in addition of the output counter of the electricity distribution company Endesa.

GALVANIC SEPARATION AND GROUNDING

Must be provided electrical isolation between the DC plant and network, and this separation can be replaced by a protection sensitive to direct current if the total power production does not exceed 20 kW.

Technical solutions different from those suggested above, shall be adopted, provided in compliance with applicable laws and rules of good art.
The PV array will be operated as an IT system, or with no polarity connected to earth. The strings will be, formed by a series of individual photovoltaic modules and individually sectionable, equipped with a blocking diode and surge protectors.
For safety, if the user network or part of it is considered unfit to bear the greater intensity of current available (due to the contribution of the PV system), the network itself or the party concerned should be appropriately protected.
The support structure will be regularly connected to the existing earth.

MONITORING AND CONTROL SYSTEM (MCS)

The control and monitoring system, allows by using a computer and dedicated software, to query the plant at any time to verify the functionality of the installed inverters with the ability to view the technical data (voltage, current, power etc. ..) of each inverter.
It is also possible read all the electrical data of bygone days in the event log of the converter.

VERIFICATION

Once complete, the installer of the system will check the following technical and functional areas:

- correct operation of the photovoltaic plant in different conditions of power generated and in the manner provided by the group of conversion (power, power failure, etc.).
- electrical continuity and connections between modules;
- grounding of the masses and drains;
- isolation of electric circuits from the masses;

At startup of the photovoltaic system, the relationship between the energy or power produced into alternating current and the energy or power producible in alternating current (determined as a function of solar radiation incident on the surface of the modules, rated system and the operating temperature of the modules) must be at least greater than 0.78 when using inverter power up to 20 kW and 0.8 in the case of using higher power inverters, under the conditions of measurement and calculation methods described in EN 60904-2.

The generator Generator ground mounted satisfies the following conditions:

Voltage limits

Minimum voltage Vn to 70,00 °C (493,2 V) greater than Vmpp min. (485,0 V)

Maximum voltage Vn to -10,00 °C (697,3 V) lower than Vmpp max. (950,0 V)

No-load voltage Vo to -10,00 °C (839,3 V) lower than inverter maximum voltage (1000,0 V)

No-load voltage Vo to -10,00 °C (839,3 V) lower than maximum isolating voltage (1000,0 V)

Current limits

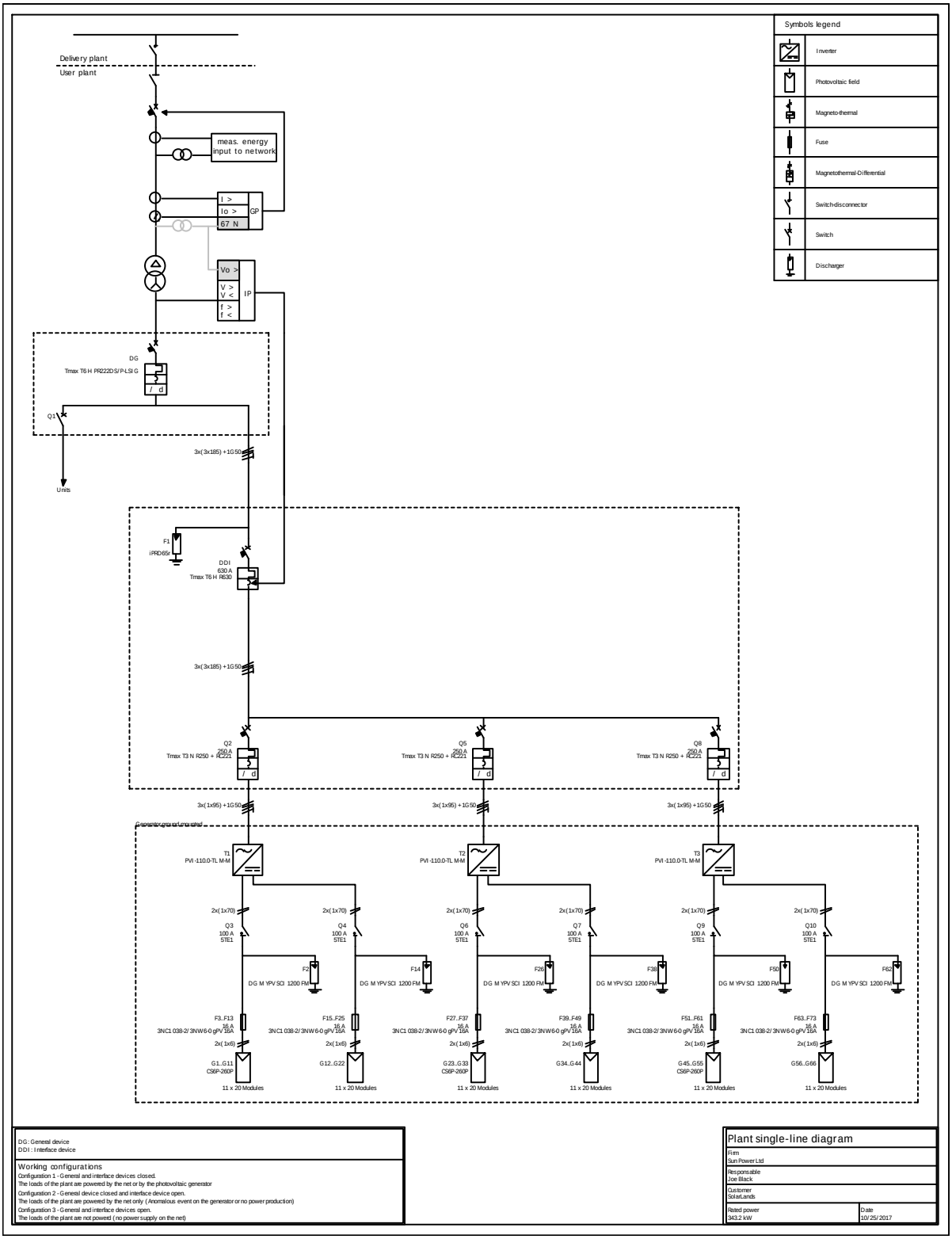
Input maximum current according to Isc (100,3 A) lower than inverter maximum current (123,0 A)

Power limits

Power dimensioning (101,4%) between 80,0% and 120,0% [INV. 1/MPPT 1]

LAYOUT OF THE GENERATOR

SINGLE-LINE DIAGRAM OF THE PLANT



CONCLUSIONS

Must be issued and released by the installer the following documents:

- operating and maintenance guide, inclusive of the recommended schedule of maintenance;
- executive project in version "as built", accompanied by data sheets of installed material;
- statement of executed verifications and its outcome;
- certification issued by an accredited laboratory on the compliance with standard EN 61215 for crystalline silicon modules, and EN 61646 by thin film modules;
- certification issued by an accredited laboratory on the compliance of the dc/ac converter with current regulations;
- warranty statements relating to the equipment installed;
- warranty on entire system and its operating performance.

The installation company, as well as thoroughly build as described in this project, will perform all work in compliance with the rules of art.