FINAL PROJECT

FOR THE CONSTRUCTION OF

A PHOTOVOLTAIC SYSTEM OF 78 kWp

NAMED

Hybrid system for Delimart shopping center

SITE IN THE CIY OF

Port-au-Prince

Route de Delmas, 32

-

CUSTOMER:

Jason Martinez

Port-au-Prince

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Attachments:

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

DATE

25/10/2017

THE TECHNICAL

Morel Francois
Solar Haiti

PLANT GENERAL INFORMATION

This project relates to the construction of a plant producing electricity through photovoltaic conversion, with a peak power equal to 78 kWp.

CUSTOMER	
Customer:	Martinez Jason
Address:	Port-au-Prince
Tax code/VAT number:	
Phone number:	
Fax:	
E-mail:	

SITE OF INSTALLATION

The plant Hybrid system for Delimart shopping center has the following characteristics: Grid-connected hybrid system with photovoltaic modules installed on the roof of the Delimart shopping center.

The auxiliary generator is used in the evening hours as an alternative to the power grid inadequate to support the load.

Note. The rate cost used takes into account the cost for the upgrade of the distributor power line..

DATA ON THE LOCATION OF INSTALLATION	
Location:	Port-au-Prince Route de Delmas, 32
Latitude:	018°32'24"
Longitude:	-072°-20'-24"
Altitude:	283 m
Source climate data:	ElectroGraphics
Albedo:	16 % Aged asphalt, Aged concrete

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. 312 photovoltaic modules and No. 12 inverters with type of realization On roof.
The total rated power is 78 kWp for an annual production of 120.322 kWh distributed over an area of 502,32 m².
Method of connection to the network Threephase in Medium voltage with power supply voltage 8.400 V.

ENERGY STORAGE

An energy storage is installed in configuration Monodirectional DC output side equal to 43,2 kWh and efficiency of 95 %.

ENERGY STORAGE	
Manufacturer:	Fronius
Model:	Solar Battery 4.5
Electrical characteristics	
Rated capacity:	43,2 kWh
Rated power:	28,8 kW
Input power:	28,8 kW
Apparent power:	28,8 kVA
Rated voltage:	120 V
Efficiency:	95 %

AUXILIARY GENERATOR

An auxiliary generator is installed corresponding to the following characteristics:

Dimensioning	
Rated power:	60 kW
Minimum power output:	24 kW
Fuel consumption:	0,3 l/kWh
Stand by consumption:	2 l/h

Battery charger	
Type:	SOCOMEC EXCEL-CF 400/48 125A
AC/DC efficiency:	0,9

EMISSIONS

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

Equivalent thermal generation	
Sulphur dioxide (SO_2):	84,32 kg
Oxides of nitrogen (NO_x):	106,16 kg
Powders:	3,77 kg
Carbon dioxide (CO_2):	62,75 t

Equivalent geothermal generation	
Hydrogen sulfide (H_2S) (geothermal fluid):	3,69 kg
Carbon dioxide (CO_2):	0,71 t
Tonne of oil equivalent (TOE):	27,67 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 Port-au-Prince.

TABLE OF SOLAR RADIATION ON HORIZONTAL

Month	Total per day [MJ/m^2]	Total per month [MJ/m^2]
January	16,96	525,76
February	18,61	521,08
March	19,84	615,04
April	21,17	635,1
May	21,06	652,86
June	22,39	671,7
July	22,57	699,67
August	21,92	679,52
September	19,51	585,3
October	17,5	542,5
November	16,06	481,8
Dicember	15,84	491,04

ENERGY PRODUCTION TABLE

Month	Total per day [kWh]	Total per month [kWh]
January	316,969	9826,041
February	333,2	9329,606
March	339,125	10512,872
April	346,796	10403,873
May	334,423	10367,114
June	349,641	10489,243
July	354,653	10994,253
August	354,015	10974,468
September	327,426	9822,79
October	306,793	9510,595
November	294,445	8833,342
Dicember	298,64	9257,825

EXPOSURE

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

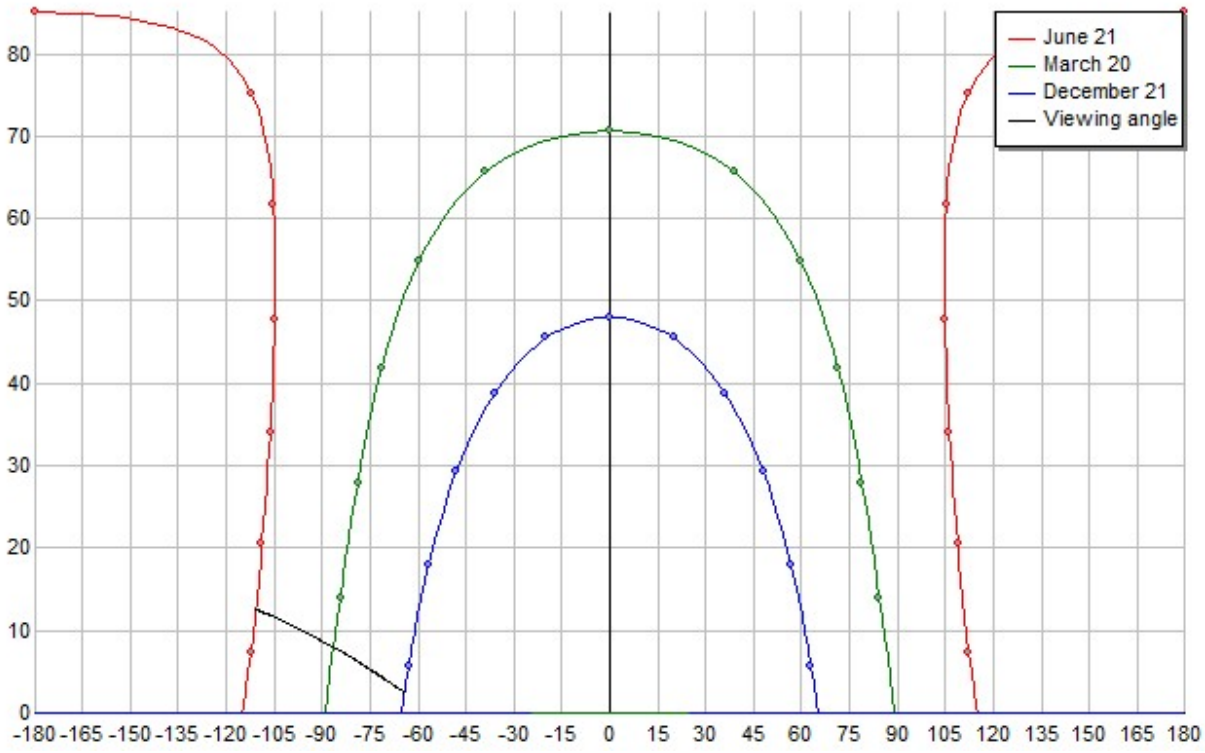
Description	Type of construction	Type of installation	Azimut	Tilt	Shad.
South exposure	On roof	Fixed tilt	35°	15°	0 %

South exposure

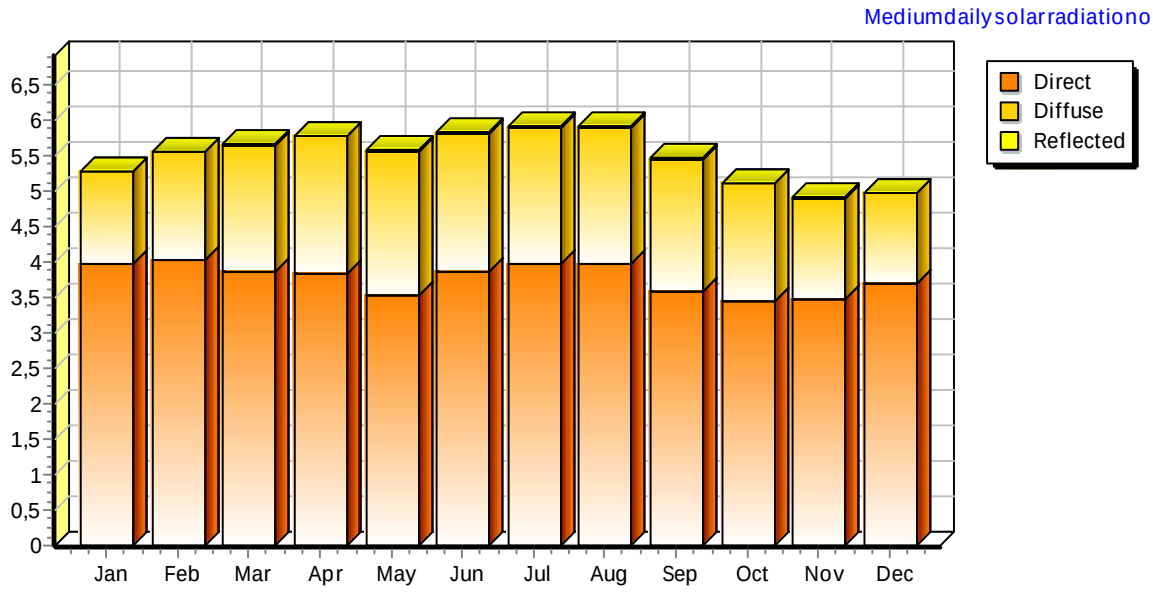
South exposure will be exposed with a 35,00° orientation (azimuth) with respect to the south and will be exposed with a 15,00° tilt respect of the horizontal.

The energy production of the exposure South exposure is conditioned by shading factors that determine a reduction of solar radiation as far 0 %.

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	3,97	1,297	0,013	5,279	163,649
February	4,023	1,512	0,014	5,549	155,381
March	3,864	1,769	0,015	5,648	175,088
April	3,83	1,929	0,016	5,776	173,273
May	3,529	2,025	0,016	5,57	172,661
June	3,847	1,96	0,017	5,823	174,695
July	3,961	1,929	0,017	5,907	183,105
August	3,977	1,903	0,016	5,896	182,776
September	3,579	1,86	0,015	5,453	163,595
October	3,427	1,669	0,013	5,11	158,396
November	3,456	1,436	0,012	4,904	147,116
Dicember	3,683	1,279	0,012	4,974	154,186

SUPPORT STRUCTURES

The modules will be mounted on the galvanized steel supports with a tilt of 15°, will all have the same exposure. The anchors of the structure will need to withstand winds up to speeds of 120 km/h.

PV generator

The generator consists of No. 312 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:	On roof
Number of modules:	312
Number of inverter:	12
Rated power:	78000 W
Performance ratio:	77 %

CONSTRUCTION DATA OF MODULES	
Manufacturer:	CSI CANADIAN SOLAR INC
Series / Ref-mark:	CS6P CS6P-250P
Manufacturing technology:	Policrystalline silicon
Electrical characteristics	
Maximum power:	250 W
Efficiency:	15,5 %
Rated voltage:	30,1 V
No-load voltage:	37,2 V
Rated current:	8,3 A
Short-circuit current:	8,9 A
Dimensions	
Dimensions:	982 mm x 1638 mm
Weight:	20 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 12 inverter.

Construction data of the inverters	
Manufacturer:	SMA TECHNOLOGIE AG
Series / Ref-mark:	Sunny Boy SB 6000TL-21 (60Hz)
Trackers:	2
Inputs per tracker:	2
Electrical characteristics	
Rated power:	6 kW
Maximum power:	6,3 kW
Maximum power per tracker:	3,1 kW
Rated voltage:	380 V
Maximum voltage:	750 V
Minimum voltage per tracker:	125 V
Maximum voltage per tracker:	500 V
Outpu rated voltage:	231 Vac
Rated current:	30 A
Maximum current:	30 A
Maximum current per tracker:	15 A
Efficiency:	0,97

Inverter 1	MPPT 1	MPPT 2
Modules in series:	13	13
Parallel strings:	1	1
Exposures:	South exposure	South exposure
MPP voltage (STC):	391,3 V	391,3 V
Numeber of modules:	13	13

ENERGY STORAGE	
Manufacturer:	Fronius
Model:	Solar Battery 4.5
Electrical characteristics	
Rated capacity:	43,2 kWh
Rated power:	28,8 kW
Input power:	28,8 kW
Apparent power:	28,8 kVA
Rated voltage:	120 V
Efficiency:	95 %

DIMENSIONING

The power rating of the generator is given by:

P = Pmodule * N°modules = 250 W * 312 = 78000 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]
South exposure	312	2.003,92	156.305,83

E = En * (1-Disp) = 120322 kWh

where
Disp = Power losses obtained from:

Shading losses:	0,0 %
Temperature increasing losses:	9,7 %
Mismatching losses:	5,0 %
DC current losses:	0,6 %
Other losses (dirt, tolerances...):	5,0 %
Conversion losses:	5,0 %
Total losses:	23,0 %

SHADING LOSSES TABLE

Month	Without obstacles [kWh]	Real production [kWh]	Losses [kWh]
January	9826,0	9826,0	0,0 %
February	9329,6	9329,6	0,0 %
March	10512,9	10512,9	0,0 %

April	10403,9	10403,9	0,0 %
May	10367,1	10367,1	0,0 %
June	10489,2	10489,2	0,0 %
July	10994,3	10994,3	0,0 %
August	10974,5	10974,5	0,0 %
September	9822,8	9822,8	0,0 %
October	9510,6	9510,6	0,0 %
November	8833,3	8833,3	0,0 %
Dicember	9257,8	9257,8	0,0 %
Year	120322,0	120322,0	0,0 %

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 - Field C.**

Description	Value
Identification:	N07G9-K 450/750 V - 1X6 brown N07G9-K 450/750 V - 1X6 black
Total length:	178,74 m
Dimensioning length:	20,8 m
Proximity circuits:	2
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:	N07G9-K
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:	391,3 V
Working current:	8,3 A
Short-circuit current of modules:	8,9 A

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

Description	Value
Identification:	N07G9-K 450/750 V - 1X6 brown N07G9-K 450/750 V - 1X6 black
Total length:	1287,02 m
Dimensioning length:	76,64 m
Proximity circuits:	2
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:	N07G9-K
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:	391,3 V
Working current:	8,3 A
Short-circuit current of modules:	8,9 A

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

Description	Value
Identification:	FG7OR 0.6/1 kV - 3G25
Total length:	48,95 m
Dimensioning length:	6,73 m
Proximity circuits:	4
Ambient temperature:	30°
Table:	IEC 60364-5-52 Ed.3
Lay:	5(B2) - Multi-core cable in conduit on a wooden or masonry wall
Disposition:	Bunched in air, on a surface, embedded or enclosed
Type of cable:	Multi-core
Material:	Copper
Designation:	FG7OR 0.6/1 kV
Type of insulation:	EPR
Formation:	3G25
N° conductors positive/phase:	1
Sect. positive/phase:	25 mm²
N° conduttors negative/neutral:	1
Sect. negative/neutral:	25 mm²

N° conductors PE:	1
Sect. PE:	25 mm²
Rated voltage:	110 V
Working current:	55,1 A

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

Description	Value
Identification:	FG7R 0.6/1 kV - 1X120 FG7R 0.6/1 kV - 1X16 FG7R 0.6/1 kV - 1X16
Total length:	2,48 m
Dimensioning length:	2,48 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(1x120)+1x16+1G16
N° conductors positive/phase:	1
Sect. positive/phase:	120 mm²
N° conduttors negative/neutral:	1
Sect. negative/neutral:	16 mm²
N° conductors PE:	1
Sect. PE:	16 mm²
Rated voltage:	191 V
Working current:	220,6 A

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

Description	Value
Identification:	FG7R 0.6/1 kV - 1X120 FG7R 0.6/1 kV - 1X16 FG7R 0.6/1 kV - 1X16
Total length:	10 m
Dimensioning length:	10 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(1x120)+1x16+1G16
N° conductors positive/phase:	1
Sect. positive/phase:	120 mm²
N° conduttors negative/neutral:	1
Sect. negative/neutral:	16 mm²
N° conductors PE:	1
Sect. PE:	16 mm²
Rated voltage:	191 V
Working current:	220,6 A

Table of cables							
Ref-mark	Description	Form.	Des.	Code	Origin	Dest.	Lc
W00	String cable 1-Q.1	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 1	Q.1	7,95 m
W01	String cable 2-Q.1	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 2	Q.1	3,69 m
W02	String cable 3-Q.2	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 3	Q.2	8,01 m
W03	String cable 4-Q.2	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 4	Q.2	3,69 m
W04	String cable 5-Q.3	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 5	Q.3	7,71 m
W05	String cable 6-Q.3	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 6	Q.3	3,35 m
W06	String cable 7-Q.4	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 7	Q.4	7,66 m
W07	String cable 8-Q.4	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 8	Q.4	3,35 m
W08	String cable 9-Q.5	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 9	Q.5	20,8 m
W09	String cable 10-Q.5	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 10	Q.5	16,49 m
W10	String cable 11-Q.6	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 11	Q.6	9,1 m
W11	String cable 12-Q.6	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 12	Q.6	16,57 m
W12	String cable 13-Q.7	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 13	Q.7	8,24 m
W13	String cable 14-Q.7	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 14	Q.7	3,96 m
W14	String cable 15-Q.8	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 15	Q.8	8,22 m
W15	String cable 16-Q.8	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 16	Q.8	3,96 m
W16	String cable 17-Q.9	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 17	Q.9	7,99 m
W17	String cable 18-Q.9	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 18	Q.9	3,66 m
W18	String cable 19-Q.10	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 19	Q.10	7,97 m
W19	String cable 20-Q.10	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 20	Q.10	3,66 m
W20	String cable 21-Q.11	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 21	Q.11	7,83 m
W21	String cable 22-Q.11	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 22	Q.11	3,52 m
W22	String cable 23-Q.12	2x(1x6)	N07G9-K	CVPIR1109	String 23	Q.12	7,83 m

				CVPIR1107			
W23	String cable 24-Q.12	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	String 24	Q.12	3,52 m
W24	Cable Q.1-inverter I.1	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.1	inverter I.1	44,3 m
W25	Cable Q.1-inverter I.1	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.1	inverter I.1	44,3 m
W26	Cable Q.2-inverter I.2	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.2	inverter I.2	30,7 m
W27	Cable Q.2-inverter I.2	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.2	inverter I.2	30,7 m
W28	Cable Q.3-inverter I.3	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.3	inverter I.3	50,98 m
W29	Cable Q.3-inverter I.3	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.3	inverter I.3	50,98 m
W30	Cable Q.4-inverter I.4	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.4	inverter I.4	37,49 m
W31	Cable Q.4-inverter I.4	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.4	inverter I.4	37,49 m
W32	Cable Q.5-inverter I.5	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.5	inverter I.5	44,34 m
W33	Cable Q.5-inverter I.5	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.5	inverter I.5	44,34 m
W34	Cable Q.6-inverter I.6	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.6	inverter I.6	56,29 m
W35	Cable Q.6-inverter I.6	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.6	inverter I.6	56,29 m
W36	Cable Q.7-inverter I.7	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.7	inverter I.7	63,34 m
W37	Cable Q.7-inverter I.7	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.7	inverter I.7	63,34 m
W38	Cable Q.8-inverter I.8	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.8	inverter I.8	49,81 m
W39	Cable Q.8-inverter I.8	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.8	inverter I.8	49,81 m
W40	Cable Q.9-inverter I.9	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.9	inverter I.9	70,03 m
W41	Cable Q.9-inverter I.9	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.9	inverter I.9	70,03 m
W42	Cable Q.10-inverter I.10	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.10	inverter I.10	56,51 m
W43	Cable Q.10-inverter I.10	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.10	inverter I.10	56,51 m
W44	Cable Q.11-inverter I.11	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.11	inverter I.11	76,64 m
W45	Cable Q.11-inverter I.11	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.11	inverter I.11	76,64 m
W46	Cable Q.12-inverter I.12	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.12	inverter I.12	63,09 m
W47	Cable Q.12-inverter I.12	2x(1x6)	N07G9-K	CVPIR1109 CVPIR1107	Q.12	inverter I.12	63,09 m
W48	Cable inverter I.1-p.c..	3G25	FG7OR 0.6/1 kV	CVPIR1547	inverter I.1	p.c..	5,19 m
W49	Cable inverter I.2-p.c..	3G25	FG7OR 0.6/1 kV	CVPIR1547	inverter I.2	p.c..	4,42 m
W50	Cable inverter I.3-p.c..	3G25	FG7OR 0.6/1 kV	CVPIR1547	inverter I.3	p.c..	3,64 m
W51	Cable inverter I.4-p.c..	3G25	FG7OR 0.6/1 kV	CVPIR1547	inverter I.4	p.c..	2,86 m
W52	Cable inverter I.5-p.c..	3G25	FG7OR 0.6/1 kV	CVPIR1547	inverter I.5	p.c..	2,08 m
W53	Cable inverter I.6-p.c..	3G25	FG7OR 0.6/1 kV	CVPIR1547	inverter I.6	p.c..	2,06 m
W54	Cable inverter I.7-p.c..	3G25	FG7OR 0.6/1 kV	CVPIR1547	inverter I.7	p.c..	2,84 m
W55	Cable inverter I.8-p.c..	3G25	FG7OR	CVPIR1547	inverter	p.c..	3,62 m

			0.6/1 kV		I.8		
W56	Cable inverter I.9-p.c..	3G25	FG7OR 0.6/1 kV	CVPIR1547	inverter I.9	p.c..	4,4 m
W57	Cable inverter I.10-p.c..	3G25	FG7OR 0.6/1 kV	CVPIR1547	inverter I.10	p.c..	5,17 m
W58	Cable inverter I.11-p.c..	3G25	FG7OR 0.6/1 kV	CVPIR1547	inverter I.11	p.c..	5,95 m
W59	Cable inverter I.12-p.c..	3G25	FG7OR 0.6/1 kV	CVPIR1547	inverter I.12	p.c..	6,73 m
W60	Cable p.c.-m.c..	3x(1x120)+ 1x16+1G16	FG7R 0.6/1 kV	CVPIR1513 CVPIR1507 CVPIR1507	p.c.	m.c..	2,48 m
W61	Meter C. - Power Grid	3x(1x120)+ 1x16+1G16	FG7R 0.6/1 kV	CVPIR1513	Meter C.	Power Grid	10 m

Summary Table of cables					
Code	Manufacturer	Form.	Des.	Description	Lc
CVPIR1109	PIRELLI CAVI e SISTEMI SPA	2x(1x6)	N07G9-K	N07G9-K 450/750 V - 1X6 brown	1465,76 m
CVPIR1107	PIRELLI CAVI e SISTEMI SPA	2x(1x6)	N07G9-K	N07G9-K 450/750 V - 1X6 black	1465,76 m
CVPIR1547	PIRELLI CAVI e SISTEMI SPA	3G25	FG7OR 0.6/1 kV	FG7OR 0.6/1 kV - 3G25	48,95 m
CVPIR1513	PIRELLI CAVI e SISTEMI SPA	3x(1x120) +1x16+1G 16	FG7R 0.6/1 kV	FG7R 0.6/1 kV - 1X120	37,44 m
CVPIR1507	PIRELLI CAVI e SISTEMI SPA	3x(1x120) +1x16+1G 16	FG7R 0.6/1 kV	FG7R 0.6/1 kV - 1X16	24,96 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 EDH.

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 PV generator satisfies the following conditions:

Voltage limits

Minimum voltage Vn to 70,00 °C (317,3 V) greater than Vmpp min. (125,0 V)

Maximum voltage Vn to -10,00 °C (448,8 V) lower than Vmpp max. (500,0 V)

No-load voltage Vo to -10,00 °C (541,1 V) lower than inverter maximum voltage (750,0 V)

No-load voltage Vo to -10,00 °C (541,1 V) lower than maximum isolating voltage (1000,0 V)

Current limits

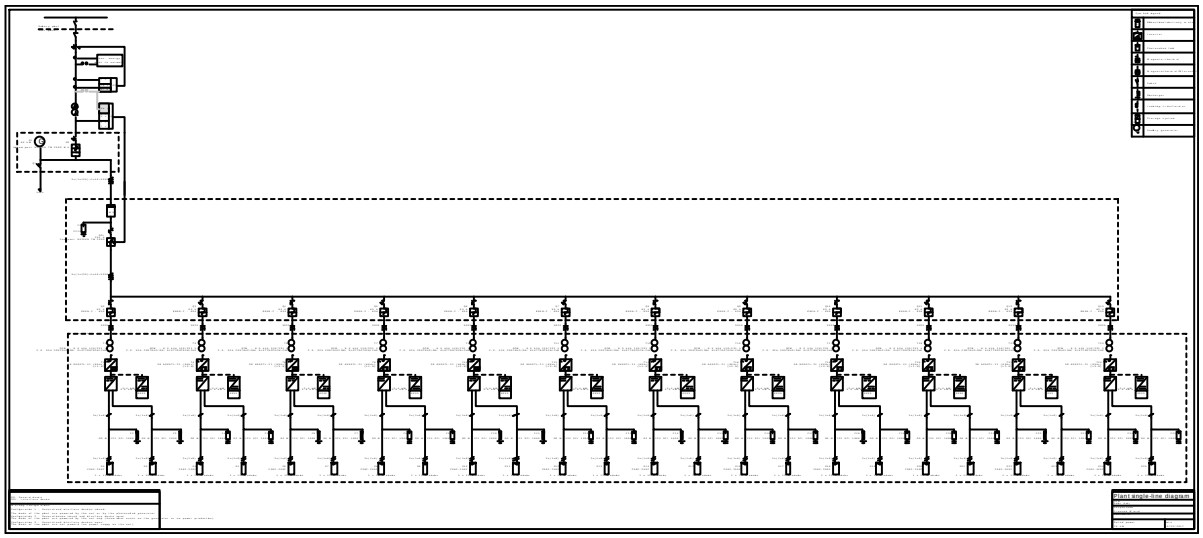
Input maximum current according to Isc (8,9 A) lower than inverter maximum current (15,0 A)

Power limits

Power dimensioning (103,5%) between 80,0% and 120,0% [INV. 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.