Private International Institute of Management and Technology

2019/2020

PHOTOVOLTAIC PANELS

THE UTILITY AND THE COMPONENT OF A PHOTOVOLTAIC PANELS AND IT'S BUSINESS ASPECT

SALIM SAYAH

ABSTRACT

The objective of this Thesis is to take care of the sourcing of new photovoltaic projects by responding to the calls for tenders present on the market.

On the other hand, to monitor the projects already in progress, to see their progress, the problems encountered and to seek solutions to these problems.

To do this, an old project was re-examined from the beginning (sizing, encryption). New tenders appeared during the training period we were treated.

The study of the different projects allowed to show the expectations of the different customers. Indeed each project has its own analysis, its problems and its way of responding according to the desired power, the available space of the sunshine of the region. Plant maintenance is important and important as it is part of the continuity of plant installation. The south of the country much more sunny than the north is in full development, many projects of installation of photovoltaic plants are in court. The main project of this report is in the south of Morocco in the village of fishermen of Lamhiriz.

Other tenders outside of Morocco were treated like that of Burkina faco. In addition this work, a catalog of the company was realized.

Keywords: Invitations to tender, Encryption, sizing, Photovoltaic, PV syst, ONP

ACKNOWLEDGEMENT

This research could not have been done without the support and assistance of many people:
First of all, I would like to thank God for giving me the strength, courage and patience to carry out this modest work.

I would like to express our sincere gratitude to Alain Degiovanni, Director of the ECINE division. But also,

To Mr eddal Hilali, Director of the ECINE pole studies for all his efforts, for having assured me this practical step, but also for his patience and perseverance despite the difficulties encountered.

My thanks also go to all the staff of Jet Energy, especially to Ismail Tadlaoui who, through his availability, his support, his patience and his supervision, has made my internship enriching and motivating

I dedicate this work:
To my dearest parents, to my sister and grandparents who are here for me every day of the year and who without them I will be nothing
To all my dear family for their support
To my friends and comrades
To all my loved ones, for their presence in my life.

GENERAL INTRODUCTION

The use of renewable energy technologies has increased considerably in previous decades. Technologies once considered strange or exotic have now become commercial realities that represent cost-effective alternatives to conventional fossil fuel systems that are associated with greenhouse gas emissions problems, high operating costs and local pollution. The difficulties facing the oil and gas sector continue to encourage those in charge in many countries, such as Morocco, to turn to renewable energy. Solar energy is one of these alternatives and has been adopted since 2000. Every day, the earth receives in the form of solar energy the equivalent of the power consumption of the whole earth for more than 20 years. Photovoltaic technology makes it possible to transform this energy into electricity through solar panels. This transformation is carried out without noise, without emission of gas: it is therefore by nature totally clean. In addition, the lack of mechanical movement gives it an unparalleled level of reliability (the average lifetime of a solar panel is estimated at more than 30 years).

The installation of a photovoltaic plant is a long way, which it is important to analyze and address all aspects of the issue in order to obtain a satisfactory result. The study will allow customers and the company to agree on the terms of the contracts so that everyone wins out of this partnership.

In a first axis there will be a general description of the company, the different stages of the response to a call for tenders and a description of the technical part of the response to this call for tenders.

In a second axis there will be the analysis of the ONP call for tender with the complete study of the response package in order to put into practice what was seen in the first axis.

SUMMARY

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1) Bibliography :

a) Jet energy :

Jet Energy is an integrated company operating in solar energy. The Energy Business Unit was born in 2012 and is a pioneer in renewable energy. Indeed, it has a subsidiary PV industry that remains the largest photovoltaic panel manufacturing line in Morocco. In 2015, Jet Energy was awarded the Agriculture and Sustainable Development Award for its solar solutions linked to agriculture. Today Jet Energy has already installed more than 180 MW of power and has many power plants in the middle of installation

Jet Energy is located in the industrial area of Ain Atiq between Temara and Skhirat.

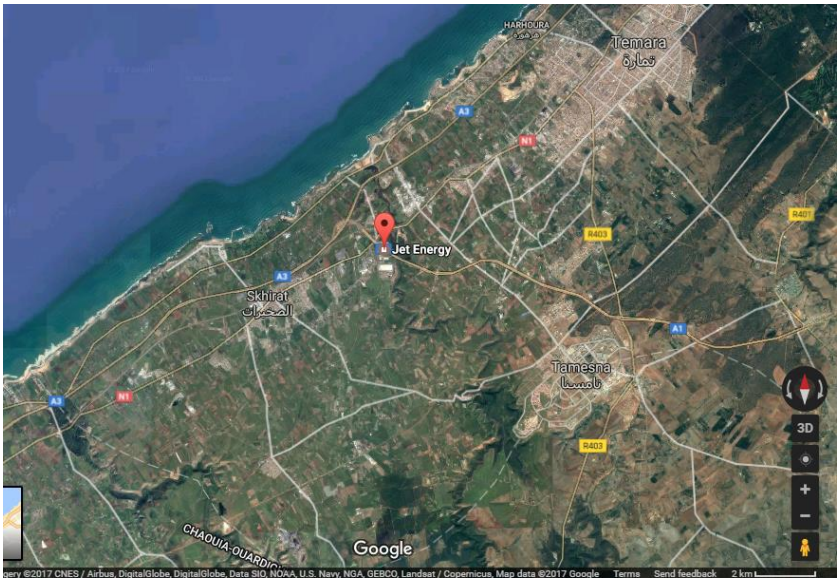


Figure 1

Figure 2

2) Project site :

In this part we will talk about the organization that launched the tender as well as the site where the photovoltaic plant will be installed.

a) National Fisheries Office :

Created in 1969, the National Fisheries Office (ONP) has undergone significant changes in its missions and a remarkable evolution of its actions to be among the major players in the development of the fisheries sector in Morocco.

During these 46 years of service to this sector, the Bureau was able to adapt its organization and intervention methods to provide its clients and partners with the support and support necessary for sustained and controlled development.

Today, in addition to fishing ports and developed sites, they also manage wholesale fish markets that are developing throughout the Kingdom. These marketing infrastructures, carried out with the support of local and institutional partners. They are intended to provide modern regional platforms for seafood distribution. In the same way, as part of its citizen action, the ONP contributes to the promotion of local trade in terms of hygiene and health standards and aims to raise awareness among citizens of the nutritional benefits of seafood.

Finally, they reaffirm their main ambition to always mobilize men and women to promote the development of the fisheries sector in particular and the national economy in general. To achieve this noble goal, they work in synergy with the different actors, above all our ministry of guardianship, which provides us with the necessary support and support to accomplish their mission. In this perspective, human capital is dedicated daily to contributing, not without pride and with great humility, to the economic and social progress of clients and partners. As this call for tenders shows, ONP is embarking on sustainable development and technology by equipping remote fishing stations with photovoltaic power plants in order to improve both the conditions of the region and the living conditions of the inhabitants of the regions. (Figuigui, 2016)

b) Fishing sites Lahmiriz :

The fishing station of Lahmiriz is located in the province of Aouserd at the level of the city of Dakhla it is a fishing village in full development in the south of Morocco. The goal of the project is to provide a decent living environment for sailors and sinners.

3) Call for tenders and answers :

A tender is the initial stage of a competitive process in which qualified suppliers or contractors are invited to submit sealed bids for construction or to provide specific and clearly defined goods or services within a time frame determined. Also known as Bid Offers. (Business Dictionary)
The tender shall be accompanied by a SPC (special conditions)

a) Social statement book :

The special conditions, also known as the draft contract, is a document which forms part of a procurement procedure. It is also known as CPS and is presented as the basis for contracting between a contracting authority and a contractor.

Since the specifications only make sense in the context of procurement, it is obvious that they are also linked to the area of tendering. In fact, the SPC is established once the RFP is issued and is the official document that links the bidding contractors to the project owners.

As a result, the SPC is developed by the SPC. The special conditions define precisely the contract concerned by the invitation to tender and serve as a tender document.

Thus the SPC contains all the information that concerns the market to which it is attached, whether from a legal, service or financial point of view. As regards the latter point, it should be noted that the special conditions contain a heading called "price list", which is to be completed by the tenderers and which contains all the financial information enabling the contracting authority to select the tenderer contractor to be awarded the contract.

As a general rule, the SPC contains the following information: financial and administrative clauses such as the subject of the tender, the description of the work, the award procedure, the registration rights, the pledge, the insurance, the documents to be provided, the rules of execution, the terms of payment and the articles on the settlement of disputes as well as the technical descriptions and of course, the price list. (web-libre)

4) The dimensioning :

a) Project start :

First of all before starting anything you have to name your project, define the site and the weather in order to launch the study.

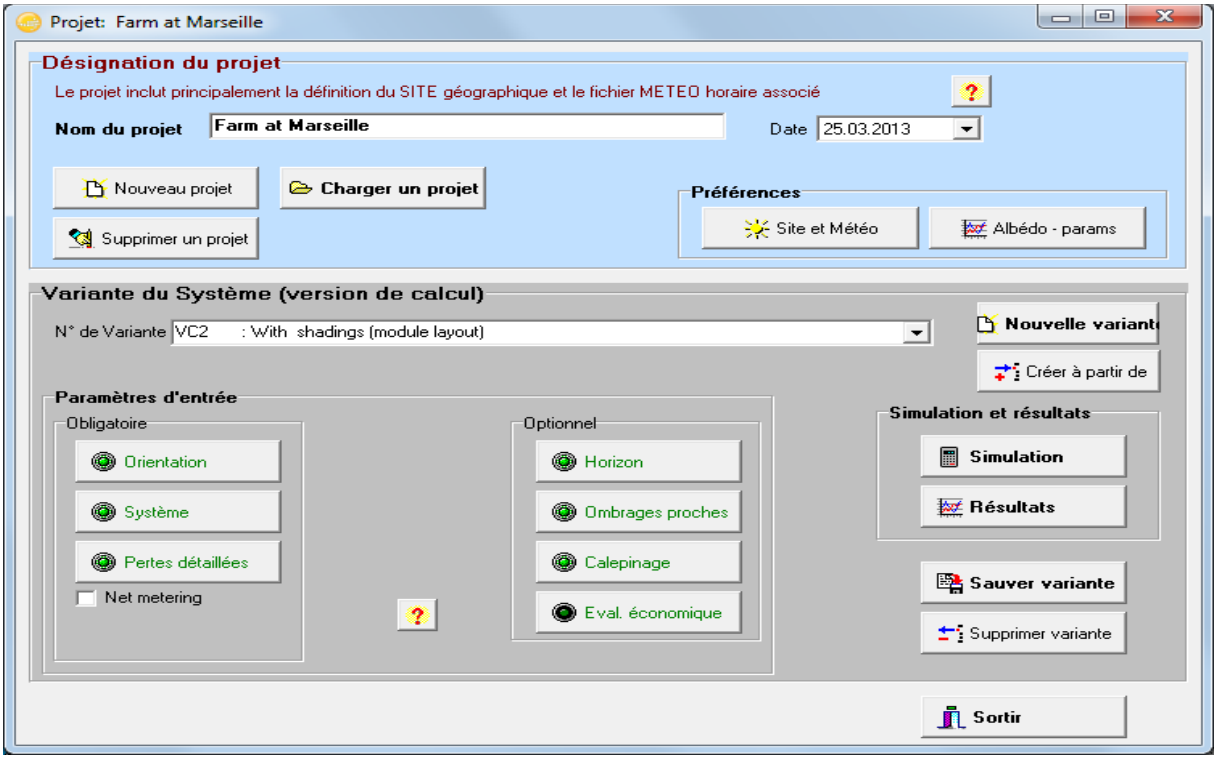


Figure 3

b) Dimensoning and conception of the system :

The system design is based on a fast and simple procedure, it is first necessary to indicate the desired power or surface at our disposal, then the PV modules must be selected from the software database and the UPS must be selected from another internal database. Thus, Pvsyst will analyze the input information and propose a first study (Pvsyst, 2011)

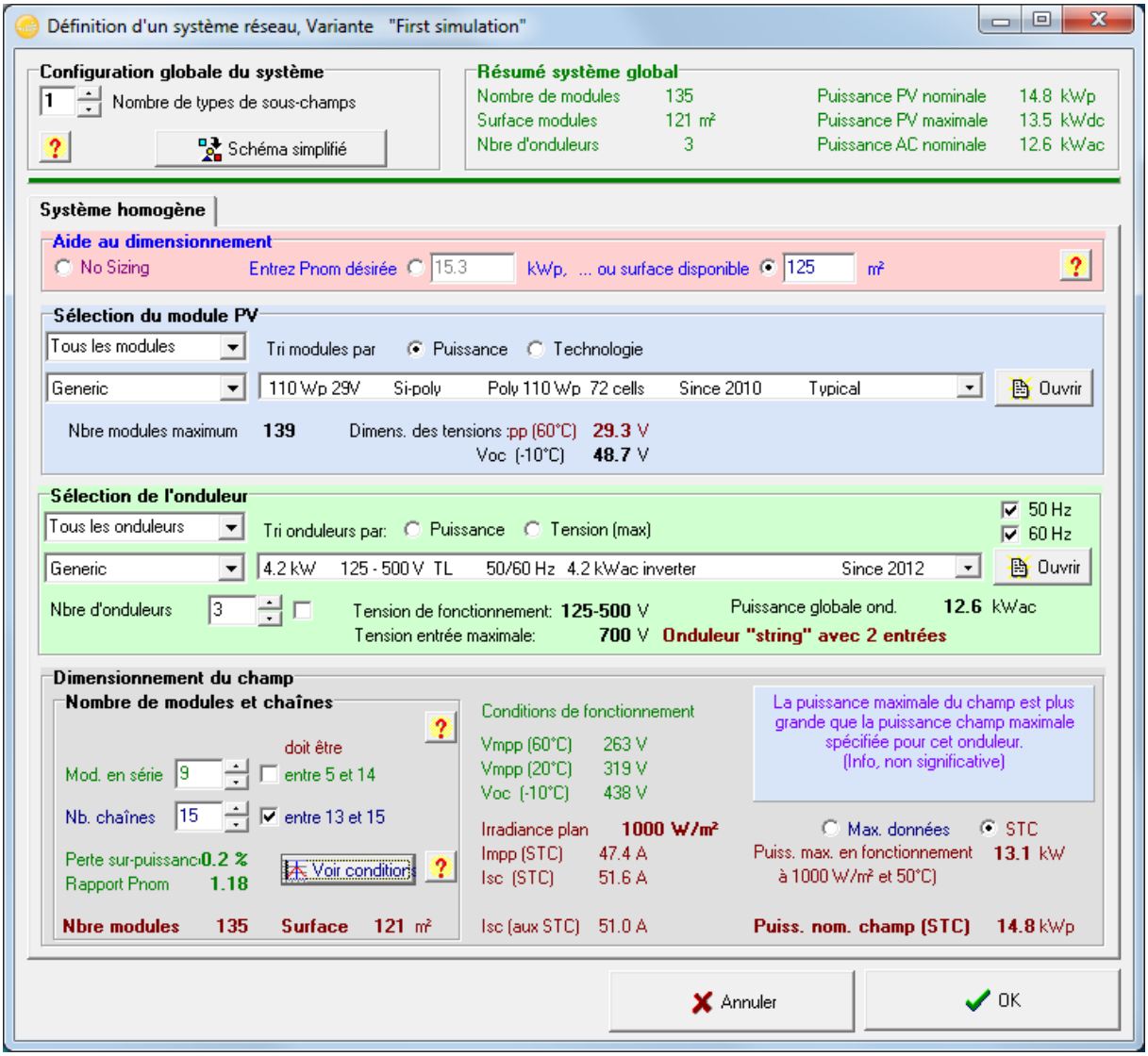


Figure 4

c) Dimensioning of the system : visual tools

A specific tool gathers all the constraints for the design of the system. For the number of modules in series, the upper diagram shows the PV field I/V curve (summer/winter) as well as the voltage constraints of the inverter (power and current constraints are also included).

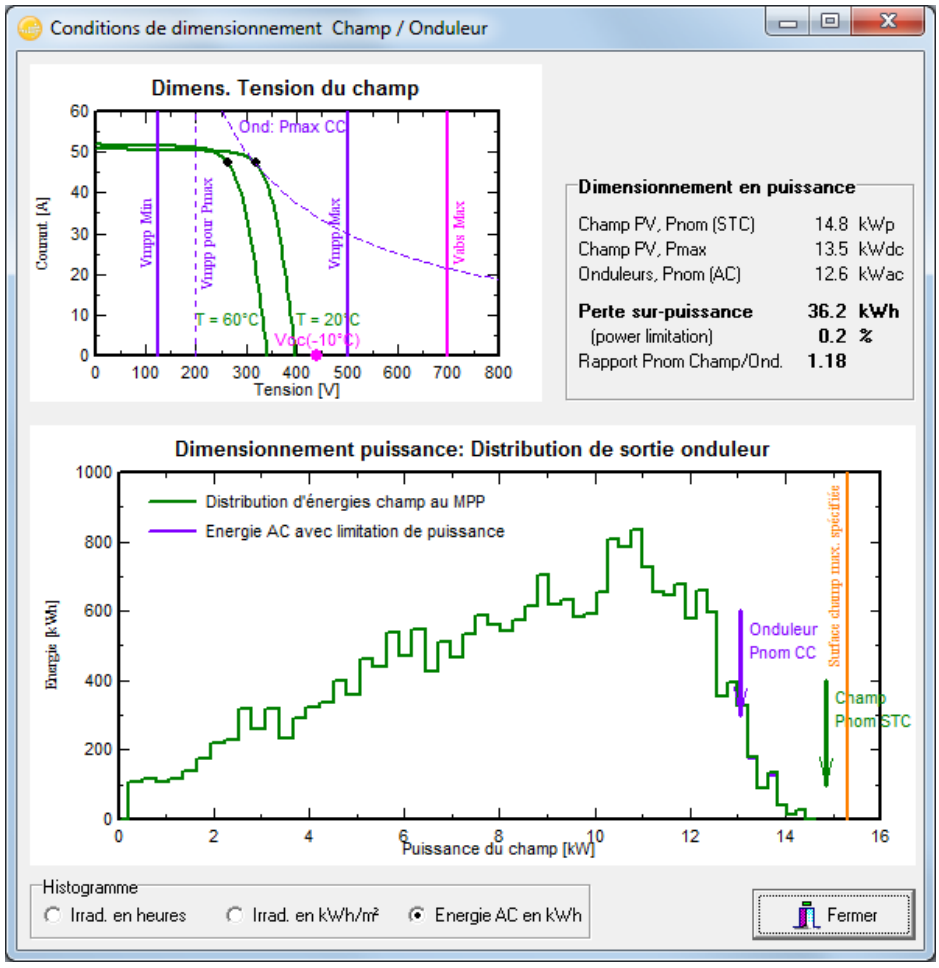


Figure 5

To properly size the inverter there is the second graph that shows the annual distribution of the MPP power of the field plus it also shows us its effective power.

To achieve an optimal design of the wave, it is necessary to rely on the acceptable loss of overload over a year. In this way, the nominal cham/UPS odor ratio of 1.25 is usually oversized. After the system has been properly dimensioned, the loss diffuses can be defined. (Pvsyst, 2011)

d) Simulation of the rapport :

Before transmitting the complete report directly to the customer it is possible to study the loss diagram which shows all the energies at the whole level of the system with the losses at different stage of the system.

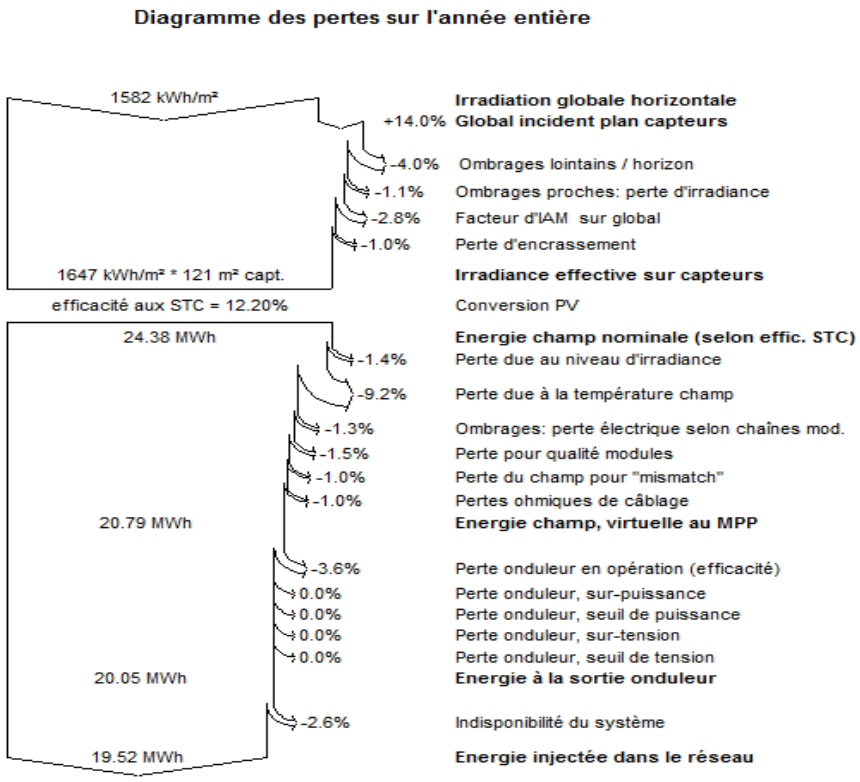


Figure 6

The simulation calculates the energy distribution throughout the year. A comprehensive report with all the parameters involved and the main results, is designed to be transmitted directly to the customer.

Main results:

1. Total energy generation (MW/year) is essential to assess the cost-effectiveness of the PV system.

2. The Performance Index (PR [%]) describes the quality of the system itself.

3. Specific energy [kWh/kWp] is an indicator of system productivity, based on available irradiation (location and orientation). (Pvsyst, 2011)

5) Project costing and organization :

After having finished the design of the project on Pvsyst, we begin the second part which consists in the creation of an Excel table gathering all the material that will be used during the work but also all the services of the company. Indeed, this Excel table makes it possible to make a logically classified summary of the project by highlighting the quantity of material needed, the cost of the project and the benefit of the company, the cost of the labor and the work of each person who works in this project.

In parallel with this document, the service provider proposes another MS Project type document or other equivalent software to show the organization of the project and the duration of each stage of the project. Thanks to this file, the client can have it at any time if the work will be done on time or if on the contrary the work will be delayed. This document is called the work schedule. (The work schedule of this project will be shown in the II).

6) Equipment :

a) Solar panels :

It is a device that converts the energy of light into electricity. It uses the photoelectric effect, by which an incident photon (light, therefore) can rip an electron from an atom.

b) Description of a photovoltaics panel :

A series of photovoltaic cells constitute the panel, it is formed of a semiconductor material in two layers, one negatively doped (N) and the other positively (P). This is a PN junction. When an electron is torn off, it instead forms a “hole”, acting as a positive charge. The electron and the hole escape on either side of this PN junction (electrons to N and holes to P), creating a potential difference (what is measured in volts). A photovoltaic cell thus produces direct electric current. (futura-science, 2001)

c) Different semiconductors :

On the market there are several types of cells but also manufacturing processes. Silicon remains the most widely used semiconductor There are different types of cells and manufacturing processes. The most widely used semiconductor is silicon. Efficiency is used to measure performance: percentage of light energy actually transformed into electricity. In the trade among the panel sold, one finds, from the cheapest to the most expensive: There is first the amorphous silicon (yield 6 to 8%) then the poly crystalline silicon (12%) and finally the poly crystalline silicon (15%). (futura-science, 2001)

d) Main characteristics reflecting quality :

The product's guarantee: the quality of a panel depends on its ability to maintain good performance, since the panels are guaranteed 25 years in performance. This means that they must keep at least 80% of their initial yield for 25 years.

Power tolerance: The higher the performance of the panel, the lower the tolerance. Indeed, in an installation the panels are mounted in series. It follows that all the panels are based on the weakest. Thus, a maximum power tolerance avoids penalising the entire PV field. (Mokhtari, Ameur, & Mokrani, 2010)

7) Inverters :

a. Definition :

An inverter allows to transform current of the direct type into alternating current, there are several uses for this device in electronics. Either it provides alternating current neck voltages of variable amplitude and frequency, or to provide one or more alternative voltages of fixed amplitudes and frequency

There are two types of inverters in the market: voltage inverters or currents depending on the sources of between continuous. The most mastered technology is that of voltage inverters.

b. Quality :

The quality of an UPS can be defined by several elements. First of all there is the maximum efficiency, in fact the efficiency of an inverter allows to translate the power losses induced by its components.

The power delivered in AC output is different from the power induced by the PV group in between DC. The performance of the UPS is expressed by the following formula:

$$\eta = \frac{P\ AC}{P\ DC} = \frac{Ueff,AC * Ieff,AC * \cos\varphi}{U\ DC * I\ DC}$$

P AC: output power

P DC: input power

Ueff,AC/Ieff,AC: Voltage/Effective Alternating Current

Cos: power factor

U DC/I DC: voltage/current delivered by the PV group

The efficiency of the inverter varies with the output power of the AC rating and with the voltage between the DC rating. The following figure illustrates these variations as a function of the input voltage delivered by the panels.

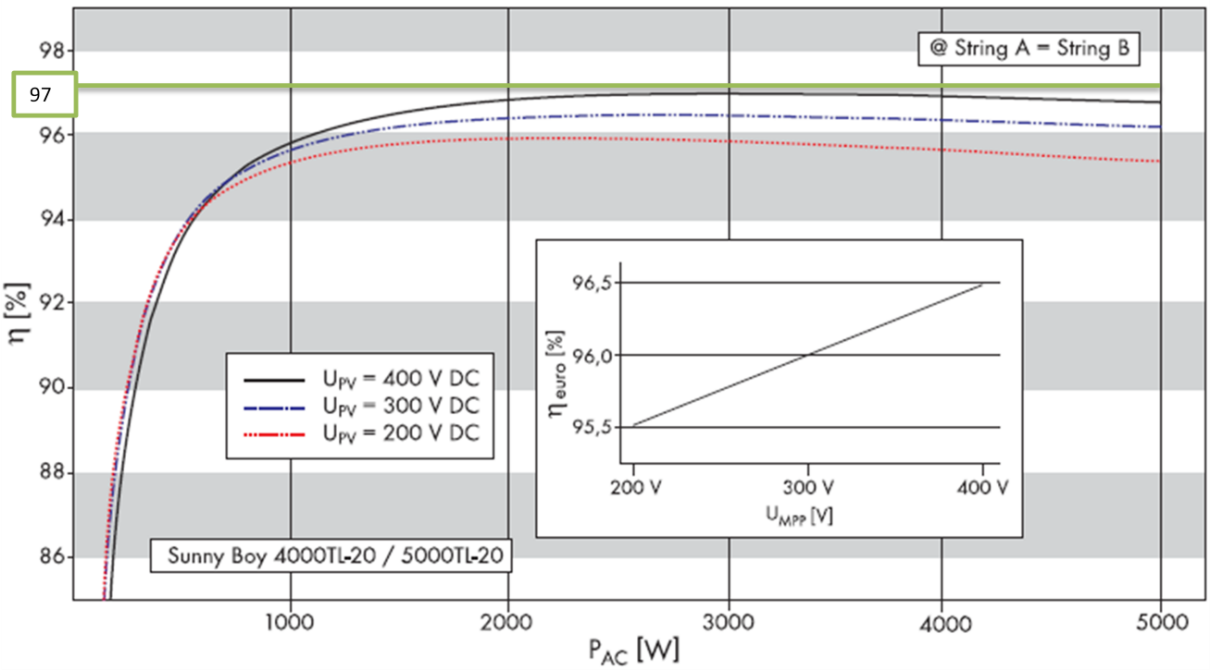


Figure 7

This figure shows 3 yield curves:

- Black for 400V DC voltage
- In blue for a DC voltage of 300V
- In red for a DC voltage of 200V

The maximum yield is 97% in the previous cases it is the highest value reached by the curve. From these curves it is deduced that the higher the DC rating input voltage the higher the efficiency of the inverter.

The guarantee is also a sign of quality, indeed the inverters are usually guaranteed 10 years up to 20 years for the manufacturer best developed.

8) Project Part :

This second part will deal with the 2016 ONP project. The object is the supply, installation and commissioning of a photovoltaic power plant in the fishing village of Lamhiriz in a single batch. The date of submission of the files is Monday 24 October 2016 at 15H00.

a) Call for tenders :

ROYAUME DU MAROC
OFFICE NATIONAL DES PECHES
WWW.ONP.MA
AVIS D'APPEL D'OFFRES OUVERT N° 37/2016

Le Mardi 25 Octobre 2016 à 10H00, il sera procédé, dans les bureaux de l'Office National des Pêches, sis au 15, rue du Lieutenant Mohamed Mahroud à Casablanca, à l'ouverture des plis relatifs à l'appel d'offres ouvert sur offres de prix ayant pour objet : la fourniture, l'installation et la mise en service d'une centrale photovoltaïque au village de pêcheurs de Lamhiriz, en lot unique.

Le dossier d'appel d'offres peut être retiré auprès de la Direction Achats et Moyens Généraux de l'ONP à l'adresse précitée. Il peut également être téléchargé à partir du portail des marchés publics : www.marchespublics.gov.ma.

Le cautionnement provisoire est fixé à la somme de : quatre-vingt mille dirhams (80 000,00 DH).

L'estimation des coûts des prestations établie par le Maître d'Ouvrage est fixée à la somme de : cinq millions cent trente-deux mille six cent trente-huit dirhams, quatre-vingt centimes toutes taxes comprises (5 132 638,80 DH TTC).

Le contenu, la présentation ainsi que le dépôt des dossiers des concurrents doivent être conformes aux dispositions des articles 27, 29 et 31 du règlement relatif aux conditions et formes de passation des marchés de l'ONP.

Les concurrents peuvent :

1) Soit déposer, contre récépissé, leurs plis dans le bureau d'ordre de l'ONP, sis au 15, rue du Lieutenant Mohamed Mahroud à Casablanca ;
2) Soit les envoyer, par courrier recommandé avec accusé de réception, au bureau précité ;
3) Soit les remettre au président de la commission d'appel d'offres au début de la séance et avant l'ouverture des plis.

Les concurrents sont tenus de présenter à la Direction des Achats et Moyens Généraux de l'ONP, sis au 15, rue du Lieutenant Mohamed Mahroud à Casablanca, au plus tard le Lundi 24 Octobre 2016 à 15H00 et conformément à l'article n°11 du règlement de consultation du dossier d'appel d'offres :

- La notice, prospectus, documents techniques des équipements conformes aux exigences techniques du CPS ;
- Le tableau de conformité attaché en annexe du dossier d'appel d'offres dûment renseigné et signé par le concurrent.

Les pièces justificatives à fournir sont celles prévues par l'article n°5 du règlement de consultation.

www.onp.ma

Figure 8 french version

المملكة المغربية
المكتب الوطني للصيد
إعلان عن طلب عروض مفتوحة رقم 2016/37

يوم الثلاثاء 25 أكتوبر من سنة 2016 على الساعة العاشرة صباحا سيتم في مكاتب مقر المكتب الوطني للصيد الكائن ب: 15 زنقة الملازم محمد محرود الدار البيضاء، فتح الأظرفة المتعلقة بتزويد ووضع وتشغيل مركز المراقبة الشمسية بقرية الصيادين بالمهيريز، في حصة وحيدة.

يمكن سحب ملف طلب العروض من مقر مديرية المشتريات والوسائل العامة للمكتب الوطني للصيد الكائن ب: 15 زنقة الملازم محمد محرود الدار البيضاء أو تحميله إلكترونيا من بوابة الصفقات العمومية: https://www.marchespublics.gov.ma./

مبلغ الضمان المؤقت محدد في: ثمانون ألف درهم (80 000 DH).

الكلفة التقديرية للخدمات المعدة من طرف صاحب المشروع محددة في: خمسة ملايين ومائة و اثنان وثلاثون ألفا وستمائة وثمانية وثلاثون درهما وثمانون سنتيما مع احتساب الرسوم (5 132 638,80 DH TTC).

يجب أن يكون كل من محتوى و عرض وتقديم ملفات المتنافسين مطابقا لمقتضيات المادة 27 و29 و31 من القانون المتعلق بتحديد شروط وأشكال إبرام الصفقات الخاص بالمكتب الوطني للصيد وكذا بعض المقتضيات المتعلقة بمراقبتها وتدبيرها.

ويمكن للمتنافسين:
- إما إيداع أظرفتهم مقابل وصل بمكتب الضبط للمكتب الوطني للصيد الكائن ب: 15 زنقة الملازم محمد محرود الدار البيضاء.
- إما إرسالها عن طريق البريد المضمون بإفادة بالاستلام إلى المكتب المذكور.
- إما تسليمها مباشرة لرئيس لجنة طلب العروض عند بداية الجلسة وقبل فتح الأظرفة.

يجب إيداع الوثائق التقنية الخاصة بالمعدات و كذا جدول المطابقة حسب المرفق الموجود بنظام الاستشارة والتي تستوجبها المادة 11 من نظام الاستشارة لملف طلب العروض بمقر مديرية المشتريات والوسائل العامة للمكتب الوطني للصيد الكائن ب : 15 زنقة الملازم محمد محرود الدار البيضاء، وذلك قبل يوم الإثنين 24 أكتوبر من سنة 2016 على الساعة الثالثة بعد الزوال.

إن الوثائق المثبتة الواجب الإدلاء بها هي تلك المقررة في المادة 5 من نظام الاستشارة.

www.onp.ma

Figure 9 arab version

b) Social statement book :

The National Fisheries Office also provides all service providers with a special specification

ROYAUME DU MAROC
OFFICE NATIONAL DES PECHES

DOSSIER D'APPEL D'OFFRES
N° 37/2016

FOURNITURE, INSTALLATION ET MISE EN SERVICE D'UNE CENTRALE PHOTOVOLTAÏQUE AU VILLAGE DE PÊCHEURS DE LAMHIRIZ.
EN LOT UNIQUE

Septembre 2016

Figure 10

In the following pages we find a set of text that we must inform in fact for the case of our company Ismail Tadlaoui Director of Jet Energy informs this text with all of his personal information and those of the company which he claims is the responsible.

Like all work it is necessary to organize the different tasks. For this work the organization was done in the following way.

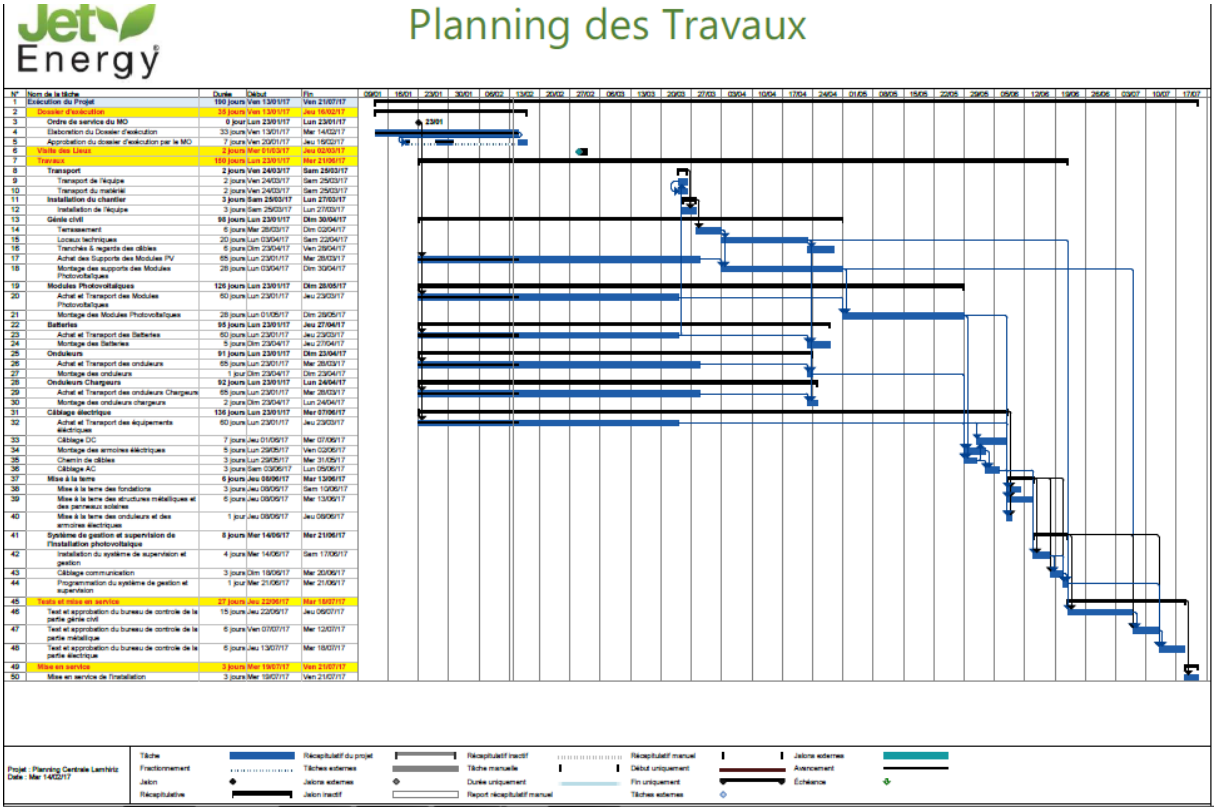


Table 1 This table is just a model

c) Dimensioning :

In a third step we carried out the sizing of the project with the software Pvsyst Here are the results obtained

Jet Energy International	PVSYST V6.51	Jet Energy	Page 1/3
	Centrale Lamhiriz		

Système couplé au réseau: Paramètres de simulation

Projet :	**Projet PV couplé au réseau at Lamhiriz**			
Site géographique	**Lamhiriz**		Pays	**Morocco**
Situation	Latitude	22.20° N	Longitude	16.77° W
Temps défini comme	Temps légal	Fus. horaire TU	Altitude	7 m
	Albédo	0.20		
Données météo:	**Lamhiriz**	Meteonorm 7.1 (1986-2005), Sat=100% - Synthétique		

Variante de simulation :	**Nouvelle variante de simulation**	
Date de la simulation	20/01/17 à 16h37	

Paramètres de simulation				
Orientation plan capteurs	Inclinaison	30°	Azimut	0°
Modèles utilisés	Transposition	Perez	Diffus	Perez, Meteonorm
Horizon	Pas d'horizon			
Ombrages proches	Sans ombrages			

Caractéristiques du champ de capteurs				
Module PV	Si-poly	Modèle	CEP4-72-310/4BB	
Original PVsyst database		Fabricant	PV Industry	
Nombre de modules PV		En série	19 modules	En parallèle 17 chaînes
Nombre total de modules PV		Nbre modules	323	Puissance unitaire 310 Wc
Puissance globale du champ		Nominale (STC)	100 kWc	Aux cond. de fonct. 89.9 kWc (50°C)
Caractéristiques de fonct. du champ (50°C)		U mpp	629 V	I mpp 143 A
Surface totale		Surface modules	626 m²	Surface cellule 566 m²

Onduleur		Modèle	ECO 27.0-3-S	
Original PVsyst database		Fabricant	Fronius International	
Caractéristiques	Tension de fonctionnement		580-850 V	Puissance unitaire 27.0 kWac
Batterie d'onduleurs		Nbre d'onduleurs	3 unités	Puissance totale 81 kWac

Facteurs de perte du champ PV				
Encrassement du champ			Frac. pertes	3.0 %
Fact. de pertes thermiques	Uc (const)	29.0 W/m²K	Uv (vent)	0.0 W/m²K / m/s
Perte ohmique de câblage	Rés. globale champ	75 mOhm	Frac. pertes	1.5 % aux STC
Perte diode série	Chute de tension	0.7 V	Frac. pertes	0.1 % aux STC
LID - "light induced degradation"			Frac. pertes	2.0 %
Perte de qualité module			Frac. pertes	1.0 %
Perte de "mismatch" modules			Frac. pertes	1.0 % au MPP
Effet d'incidence, paramétrisation ASHRAE	IAM =	1 - bo (1/cos i - 1)	Param. bo	0.05

Facteurs de perte du système				
Perte ohmique de câblage	Conducteurs: 3x50.0 mm²	131 m	Frac. pertes	3.0 % aux STC
Indisponibilité du système	7.3 jours, 3 périodes		Frac. du temps	2.0 %

Besoins de l'utilisateur : Charge illimitée (réseau)

Figure 11

Jet Energy International	PVSYST V6.51	Jet Energy	Page 2/3
	Centrale Lamhiriz		

Système couplé au réseau: Résultats principaux

Projet : Projet PV couplé au réseau at Lamhiriz

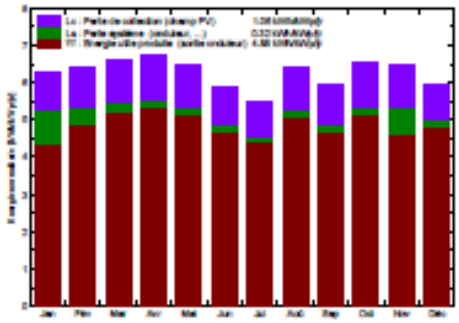
Variante de simulation : Nouvelle variante de simulation

Principaux paramètres système	Type de système	**Couplé au réseau**		
Orientation plan capteurs	Inclinaison	30°	azimut	0°
Modules PV	Modèle	CEP4-72-310/4BB	Pnom	310 Wc
Champ PV	Nombre de modules	323	Pnom total	**100 kWc**
Onduleur	Modèle	ECO 27.0-3-S	Pnom	27.00 kW ac
Batterie d'onduleurs	Nombre d'unités	3.0	Pnom total	**81.0 kW ac**
Besoins de l'utilisateur	Charge illimitée (réseau)			

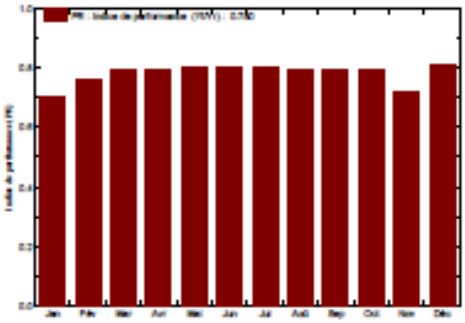
Principaux résultats de la simulation

Production du système	**Energie produite**	**178279 kWh/an**	Productible	1780 kWh/kWc/an
	Indice de performance (PR)	77.98 %		

Productions normalisées (par kWp installé): Puissance nominale 100 kWc



Indice de performance (PR)



Nouvelle variante de simulation

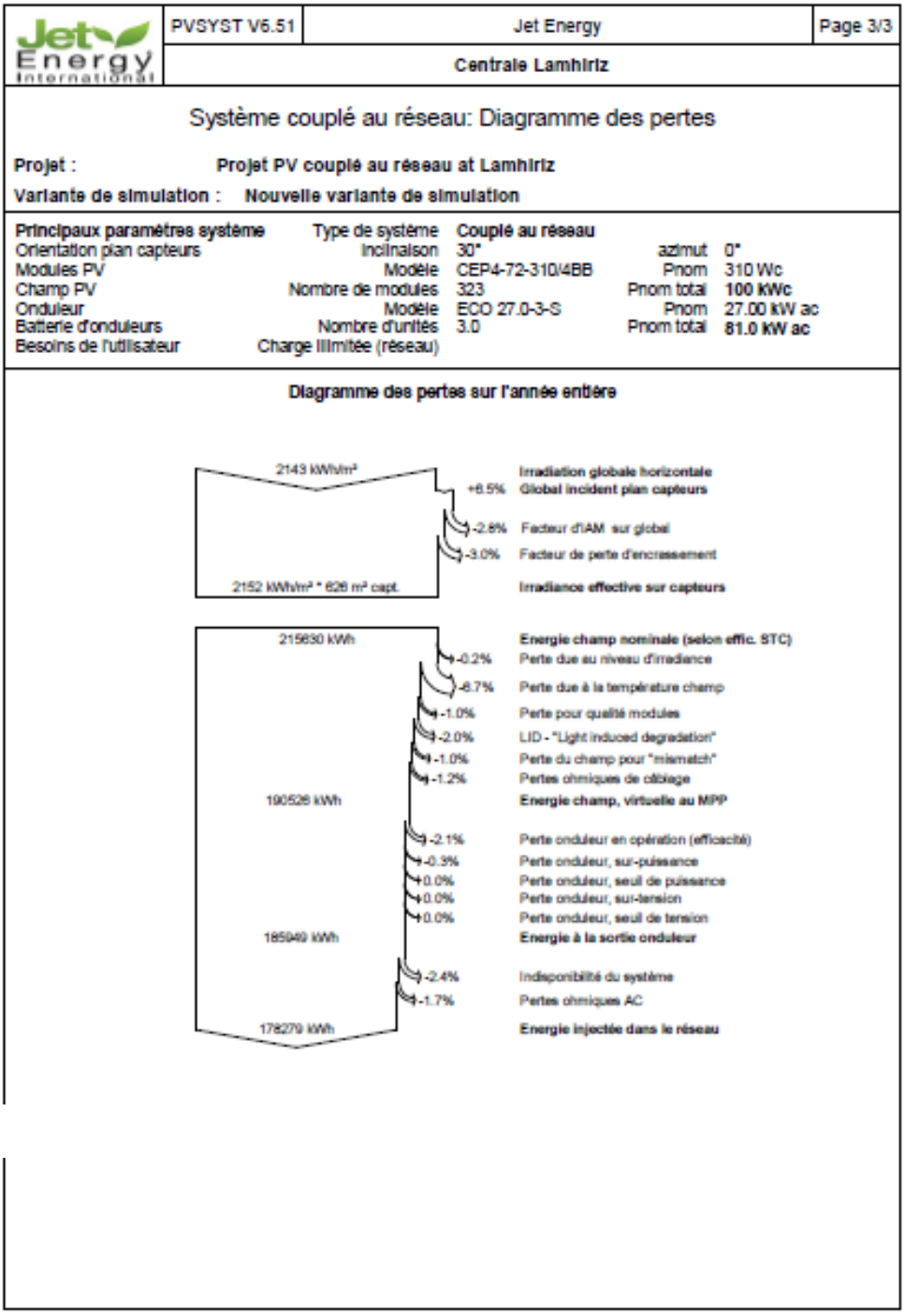
Bilans et résultats principaux

	GlobHor kWh/m²	T Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray kWh	E_Grid kWh	EffArrR %	EffSysR %
Janvier	141.1	17.91	193.0	184.0	16368	13630	13.51	11.23
Février	144.9	18.71	178.6	169.2	15013	13621	13.43	12.18
Mars	187.2	20.25	204.7	193.4	16935	16272	13.21	12.69
Avril	208.6	20.02	202.6	190.5	16770	16113	13.22	12.70
Mai	228.2	20.97	200.3	187.3	16630	16000	13.26	12.76
Juin	207.7	21.09	176.2	164.4	14651	14116	13.28	12.80
Juillet	195.9	23.07	170.6	159.6	14196	13691	13.29	12.82
Août	211.1	23.72	186.0	186.0	16340	15727	13.16	12.69
Septembre	171.0	24.01	177.5	167.2	14838	14294	13.17	12.68
Octobre	170.6	22.82	201.8	191.2	16876	16229	13.20	12.69
Novembre	145.1	20.84	194.0	184.1	16122	13993	13.27	11.52
Décembre	131.3	19.11	185.1	175.6	15597	14993	13.46	12.94
Année	2143.0	21.12	2283.1	2152.5	189958	178279	13.29	12.47

Légendes: GlobHor Irradiation globale horizontale; EArray Energie effective sortie champ
T Amb Température ambiante; E_Grid Energie injectée dans le réseau
GlobInc Global incident plan capteurs; EffArrR Effic. Eout champ / surf. brute
GlobEff Global "effectif", corr. pour IAM et ombrages; EffSysR Effic. Eout système / surf. brute

Figure 12

In addition to the design basis we are interested in batteries, we carry out calculations to prove that the two-day autonomy imposed will be assured.



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Centrale Lamhiriz

Système couplé au réseau: Diagramme des pertes

Projet : Projet PV couplé au réseau at Lamhiriz

Variante de simulation : Nouvelle variante de simulation

Principaux paramètres système	Type de système	**Couplé au réseau**		
Orientation plan capteurs	Inclinaison	30°	azimut	0°
Modules PV	Modèle	CEP4-72-310/4BB	Pnom	310 Wc
Champ PV	Nombre de modules	323	Pnom total	**100 kWc**
Onduleur	Modèle	ECO 27.0-3-S	Pnom	27.00 kW ac
Batterie d'onduleurs	Nombre d'unités	3.0	Pnom total	**81.0 kW ac**
Besoins de l'utilisateur	Charge illimitée (réseau)			

Diagramme des pertes sur l'année entière

Figure 13

Note de calcule assurant l'autonomie de 2j

En prenant une profondeur de décharge de 65%. On obtient une capacité du parc d'accumulateur :

$$C_{Parc} = \frac{E\ (consomation\ journalière) \times N\ (Nombre\ de\ jours\ d'autonomie)}{DoD\ (Profondeur\ de\ décharge) \times V\ (Tension\ d'entrée\ du\ chargeur)}$$

$$C_{Parc} = \frac{460\,000\,Wh \times 2\ j}{0.65 \times 48\ V} = 29\,487\ Ah\ C48h$$

- Selon le catalogue d'Exide on constate que l'élément **OPzS Solar 2500** est conforme aux exigences techniques, avec une **capacité nominale de 2500 Ah (C120 à 25°C) entre 2000 Ah et 3000 Ah (C120 à 25°C).**

Donc le nombre de batteries de 48V constitués de 24 éléments de 2V **OPzS Solar 2500** est égale à :

$$N_{Bat} = \frac{C_{Parc}}{2215\ Ah\ C48h} = 14\ batteries$$

- Ce bloc de batteries suffit largement pour satisfaire le besoin en électricité en cas d'absence d'ensoleillement pendant deux jours entiers.

Figure 14

d) Costs :

After sizing the project it is necessary to deal with the financial part through the costing

Designation		Unité	Quantité	FOURNITURE										
				P A Complet Unitaire	P A Unitaire	Accessoire	Remise	Devise	Parité	DD	TRS+TST	Pourcentage	CA Unitaire	CA Total
Coût Wc			**31,52**	**34,67**	Marge	1,10	$=	10	€=	11		100%		3 536 354,62
Site Lamhiriz												**100%**		**3 536 354,62**
Prix 1-1 : Installation du chantier												9%		331 000,00
Prix du Personnel		U	1	200 000,00	200 000,00	-	1,00	MAD	1	0%	0%	6%	200 000,00	200 000,00
transport		U	1	50 000,00	50 000,00	-	1,00	MAD	1	0%	0%	1%	50 000,00	50 000,00
Ingénieurie		U	102 000	0,50	0,50	-	1,00	MAD	1	0%	0%	1%	0,50	51 000,00
Base de vie "Aménagement"		U	1	30 000,00	30 000,00	-	1,00	MAD	1	0%	0%	1%	30 000,00	30 000,00
Prix 1-2 : Fourniture et pose de la structure												7%		244 200,00
Structure		Wc	102 000	1,00	1,00	-	1,10	MAD	1	0%	0%	3%	1,10	112 200,00
Mur de cloture		ML	250	300,00	300,00	-	1,10	MAD	1	0%	0%	2%	330,00	82 500,00
Terrassement,décapage, nivèlement et compactage		M2	1500	30,00	30,00	-	1,10	MAD	1	0%	0%	1%	33,00	49 500,00
Prix 1-3 : Fourniture et pose des panneaux PV												14%		504 900,00
Cubenergy		Wc	102 000	4,50	4,50	-	1,10	MAD	1	0%	0%	14%	4,95	504 900,00
Prix 1-4 : Fourniture et pose des onduleurs injection												6%		196 306,83
Fronius Symo 20		U	5	2 455,00	2 455,00	-	1,10	€	11	0%	3%	4%	30 596,67	152 983,33
Climatiseurs		U	0	6 000,00	6 000,00	-	1,10	MAD	1	0%	0%	0%	6 600,00	-
DC	Câble DC 6 mm² PV-BJ	ML	3000	0,69	0,69	-	1,10	$	10	25%	0%	1%	9,49	28 462,50
	Chemin de câble	ML	320	40,00	40,00	-	1,10	MAD	1	0%	0%	0%	44,00	14 080,00
	Connecteur MC4 male	U	40	0,71	0,70	0,01	1,10	$	10	25%	0%	0%	9,76	390,50
	Connecteur MC4 femelle	U	40	0,71	0,70	0,01	1,10	$	10	25%	0%	0%	9,76	390,50
Prix 1-5 : Fourniture et pose des onduleurs-chargeurs												5%		160 065,42
Victron 30 Kva		U	2	6 265,00	6 265,00	-	1,10	€	11	3%	3%	5%	80 032,71	160 065,42
Climatiseurs		U	0	6 000,00	6 000,00	-	1,10	MAD	1	0%	0%	0%	6 600,00	-
Prix 1-6 : Fourniture et pose des accumulateur et régulateur de contrôle de charge												41%		1 461 690,97
Accumulateurs		U	10	12 682,65	12 682,65	-	1,00	€	11	0%	0%	39%	139 509,10	1 395 090,97
Structure Accumulateurs		U	10	6 660,00	6 660,00	-	1,00	MAD	1	0%	0%	2%	6 660,00	66 600,00

Table 2

e) Equipement :

In this part as we have seen in the bibliography we will look at the different technical data sheets of the elements seen in the first part (solar panels and inverters) and in addition we will be interested in batteries because the project has a storage part

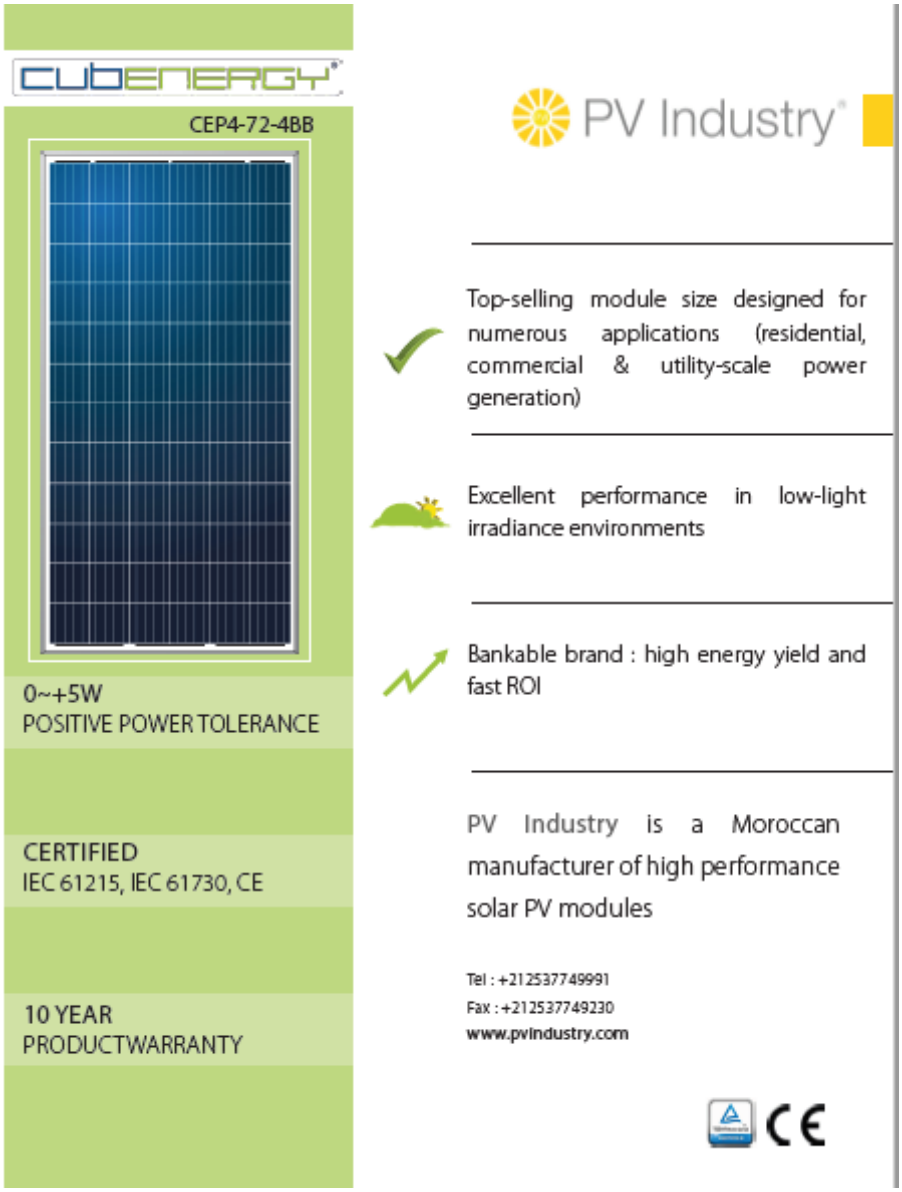


Figure 15

CONSTRUCTION PARAMETERS

Cell	72 multicrystalline silicon 156x156mm (6inch)
Front cover	High transmission, low iron, 3.2 mm thickness, fully tempered glass sheet
Frame	Anodized aluminum alloy
Junction box	IP65, 3 bypass diodes
Cable	1x4mm², 1000mm
Plug connector	MC4 compatible, IP67
Packaging configuration	22 per pallet

ELECTRICAL PARAMETERS

Standard Test Conditions (STC)

Module Class							
P_{max} (W)	300	305	310	315	320	325	330
Classification tolerances (W)	o/+5W	o/+5W	o/+5W	o/+5W	o/+5W	o/+5W	o/+5W
Rendement (%)	16.47	16.74	17.02	17.29	17.57	17.84	18.11
V_{mpp} (V)	36.30	36.61	36.82	36.98	37.08	37.19	37.25
I_{mpp} (A)	8.26	8.33	8.42	8.52	8.63	8.74	8.86
V_{oc} (V)	44.82	44.91	45.05	45.29	45.53	45.72	45.94
I_{sc} (A)	8.88	8.99	9.10	9.11	9.22	9.31	9.41

STC :Irradiance 1000W/m², Cell Temperature 25°C, AM 1.5g

Nominal Operating Cell Temperature (NOCT)

P_{max} (W)	216.2	219.8	223.1	226.4	230.0	233.4	237.5
V_{mpp} (V)	33.00	33.10	33.20	33.30	33.47	33.58	33.64
I_{mpp} (A)	6.55	6.64	6.72	6.80	6.87	6.95	7.06
V_{oc} (V)	40.90	41.00	41.10	41.20	41.30	41.40	41.50
I_{sc} (A)	7.18	7.27	7.35	7.44	7.53	7.62	7.73

NOCT :Irradiance 800W/m², Ambient Temperature 20°C, A.M. 1.5g, Wind Speed 1m/s

TEMPERATURE CORRECTION COEFFICIENTS

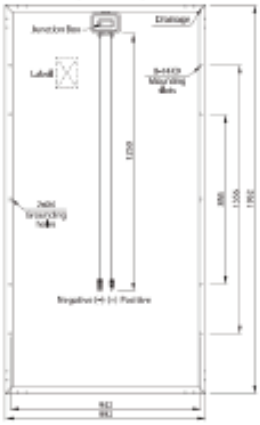
Nominal Operating Cell Temperature (NOCT)	46.0 °C +/- 2°C
Current correction coefficient	(0.04) %/ °C
Voltage correction coefficient	-(0.33) %/ °C
Power correction coefficient	-(0.44) %/ °C

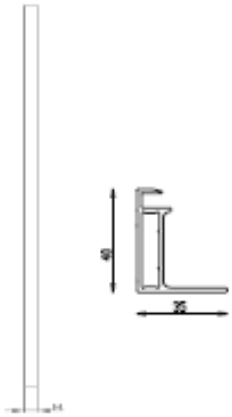
OPERATING CONDITIONS

Maximum system voltage	1000V DC Class II
Maximum series fuse rating	16A
Limiting reverse current	13.5A
Operating temperature	-40 to +85 °C
NOCT	46.0 °C +/ - 2°C

*PV industry reserves the right to alter the specifications without prior notice

ENGINEERING DRAWINGS





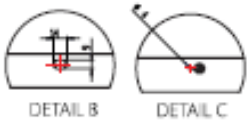


Figure 16

/ Perfect Welding / Solar Energy / Perfect Charging

Fronius
SHIFTING THE LIMITS

FRONIUS ECO

/ The compact project inverter for maximum yields.

/ SnapINverter Technology | / Integrated data communication | / Smart Grid Ready | / Dynamic Peak Manager | / Zero feed-in

/ The three-phase Fronius Eco in power categories 25.0 and 27.0 kW perfectly meets all the requirements of large-scale installations. Thanks to its light weight and SnapINverter mounting system, this transformerless device can be installed quickly and easily either indoors or outdoors. This inverter range is setting new standards with its IP 66 protection class. Furthermore, thanks to its integrated double fuse holders and optional overvoltage protection, string collection boxes are no longer necessary.

TECHNICAL DATA FRONIUS ECO

INPUT DATA	FRONIUS ECO 25.0-3-S	FRONIUS ECO 27.0-3-S
Max. input current ($I_{dc\,max}$)	44.2 A	47.7 A
Max. array short circuit current	71.6 A	
Min. input voltage ($U_{dc\,min}$)	580 V	
Feed-in start voltage ($U_{dc\,start}$)	650 V	
Nominal input voltage ($U_{dc,r}$)	580 V	
Max. input voltage ($U_{dc\,max}$)	1,000 V	
MPP voltage range ($U_{MPP\,min}$ – $U_{MPP\,max}$)	580 - 850 V	
Number of MPP trackers	1	
Number of DC connections	6	
Max. PV generator output ($P_{dc\,max}$)	37.8 kW_{peak}	

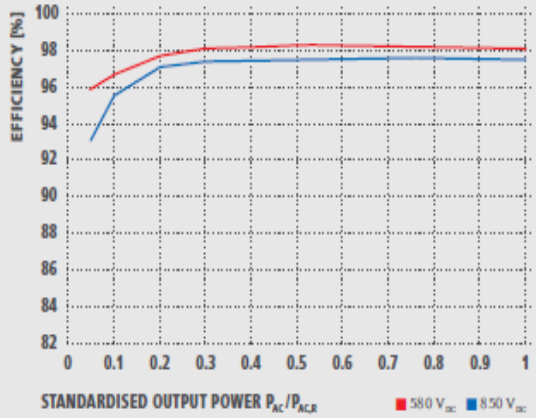
OUTPUT DATA	FRONIUS ECO 25.0-3-S	FRONIUS ECO 27.0-3-S
AC nominal output ($P_{ac,r}$)	25,000 W	27,000 W
Max. output power	25,000 VA	27,000 VA
AC output current ($I_{ac\,nom}$)	37.9 A / 36.2 A	40.9 A / 39.1 A
Grid connection (voltage range)	3~NPE 380 V / 220 V or 3~NPE 400 V / 230 V (+20 % / -30 %)	
Frequency (frequency range)	50 Hz / 60 Hz (45 - 65 Hz)	
Total harmonic distortion	< 2.0 %	
Power factor (cos φac,r)	0 - 1 ind. / cap.	

GENERAL DATA	FRONIUS ECO 25.0-3-S	FRONIUS ECO 27.0-3-S
Dimensions (height x width x depth)	725 x 510 x 225 mm	
Weight	35.7 kg	
Degree of protection	IP 66	
Protection class	I	
Overvoltage category (DC / AC) *	1 + 2 / 3	
Night-time consumption	< 1 W	
Inverter concept	Transformerless	
Cooling	Regulated air cooling	
Installation	Indoor and outdoor installation	
Ambient temperature range	-25 - +60 °C	
Permitted humidity	0 to 100 %	
Max. altitude	2,000 m	
DC connection technology	6x DC+ and 6x DC- screw terminals 2.5 - 16 mm²	
AC connection technology	5-pole AC screw terminals 2.5 - 16 mm²	
Certificates and compliance with standards	ÖVE / ÖNORM E 8001-4-712, DIN V VDE 0126-1-1/A1, VDE AR N 4105, IEC 62109-1/-2, IEC 62116, IEC 61727, AS 3100, AS 4777-2, AS 4777-3, CER 06-190, G59/3, UNE 206007-1, SI 4777, CEI 0-16, CEI 0-21	

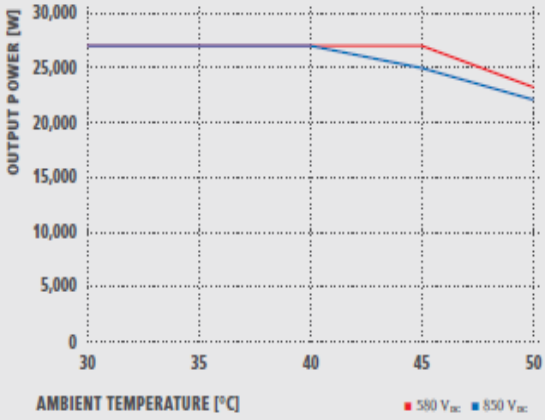
*According to IEC 62109-1. DIN rail for optional type 1 + 2 and type 2 overvoltage protection available.
Further information regarding the availability of the inverters in your country can be found at www.fronius.com.

Figure 17

FRONIUS ECO 27.0.3-S EFFICIENCY CURVE



FRONIUS ECO 27.0.3-S TEMPERATURE DERATING



TECHNICAL DATA FRONIUS ECO

EFFICIENCY	FRONIUS ECO 25.0-3-S	FRONIUS ECO 27.0-3-S
Max. efficiency	98.2 %	98.3 %
European efficiency (ηEU)	98.0 %	98.0 %
η at 5 % Pac,r [1]	95.1 / 91.5 %	95.9 / 93.1 %
η at 10 % Pac,r [1]	97.0 / 95.2 %	96.8 / 95.7 %
η at 20 % Pac,r [1]	97.8 / 96.9 %	97.7 / 97.1 %
η at 25 % Pac,r [1]	98.0 / 97.0 %	98.1 / 97.3 %
η at 30 % Pac,r [1]	98.1 / 97.2 %	98.1 / 97.4 %
η at 50 % Pac,r [1]	98.2 / 97.5 %	98.3 / 97.5 %
η at 75 % Pac,r [1]	98.2 / 97.5 %	98.2 / 97.6 %
η at 100 % Pac,r [1]	98.2 / 97.5 %	98.1 / 97.5 %
MPP adaptation efficiency	> 99.9 %	

PROTECTION DEVICES	FRONIUS ECO 25.0-3-S	FRONIUS ECO 27.0-3-S
DC insulation measurement	Yes	
Overload behavior	Operating point shift, power limitation	
DC disconnector	Yes	
Integrated string fuse holders [2]	Yes	
Reverse polarity protection	Yes	

INTERFACES	FRONIUS ECO 25.0-3-S	FRONIUS ECO 27.0-3-S
WLAN / Ethernet LAN	Fronius Solar.web, Modbus TCP SunSpec, Fronius Solar API (JSON)	
6 inputs and 4 digital inputs/outputs	Interface to ripple control receiver	
USB (A socket) [3]	Datalogging, inverter update via USB flash drive	
2x RS422 (RJ45 socket) [3]	Fronius Solar Net	
Signalling output [3]	Energy management (floating relay output)	
Datalogger and Webserver	Included	

Figure 18

victron energy

Convertisseur/chargeur Quattro

3 kVA - 15 kVA Compatible avec les batteries au lithium-ion

www.victronenergy.com

Quattro
48/5000/70-100/100

Quattro
24/3000/70-50/50

Deux entrées CA avec un commutateur de transfert intégré
Le Quattro peut être connecté à deux sources CA indépendantes : par exemple le réseau public et un générateur, ou bien deux générateurs. Le Quattro se connectera automatiquement à la source active.

Deux sorties CA
La sortie principale a une fonction d'alimentation ininterrompue. En cas de défaillance du réseau ou de déconnexion de la puissance de quai ou du générateur, le Quattro prend la suite de l'alimentation des charges connectées. Ce transfert est si rapide (moins de 20 millisecondes) que le fonctionnement d'ordinateurs ou d'autres équipements électroniques sensibles raccordés ne seront pas perturbés.
La deuxième sortie n'est sous tension que lorsqu'un courant CA est disponible sur l'une des entrées du Quattro. Des charges qui ne déchargeraient pas la batterie – par exemple un chauffe-eau – peuvent être connectées à cette sortie.

Puissance virtuellement illimitée grâce au fonctionnement en parallèle
Jusqu'à 6 Quattro peuvent fonctionner en parallèle. Par exemple, six unités 48/10000/140 fourniront une puissance de 54 kW / 60 kVA en sortie et 840 A de capacité de charge.

Configuration triphasée
Trois unités peuvent être configurées pour une sortie triphasée. Mais ce n'est pas tout : jusqu'à 6 séries de trois unités peuvent être raccordées en parallèle pour fournir une puissance de 162 kW / 180 kVA et plus de 2500 A de capacité de charge.

PowerControl – S'adapter aux limites d'un générateur, de l'alimentation de quai ou du secteur
Le Quattro comporte un chargeur de batteries très puissant. Il va donc tirer une grande quantité de courant depuis le générateur ou depuis le secteur (16 A par Quattro de 5 kVA à 230 VAC). Une limite de courant peut être configurée sur chaque entrée CA. Le Quattro prend alors en compte la demande de puissance d'autres charges CA en sortie et n'utilisera l'excédent que pour la charge, évitant ainsi toute surcharge du secteur ou du générateur.

PowerAssist – Davantage de puissance du quai ou du générateur
Cette fonction donne une dimension supplémentaire au principe du PowerControl en permettant au Quattro de compléter la capacité de la source alternative. En cas d'une demande de forte puissance de pointe, souvent requise pour une courte durée, le Quattro fournit à travers les batteries la puissance permettant de compenser le manque d'alimentation provenant du secteur ou du générateur. Et lorsque la demande diminuera, l'excédent de puissance sera utilisé pour recharger les batteries.

Énergie solaire. Énergie CA disponible même en cas de défaillance du réseau
Le Quattro peut être utilisé aussi bien hors réseau que connecté à un réseau PV ou à d'autres systèmes d'énergie alternative.
Un logiciel de détection de perte de secteur est disponible.

Configuration du système
- Dans le cas des applications autonomes, il est possible de modifier des paramètres en quelques minutes à l'aide de la procédure de configuration par des interrupteurs DIP.
- Des applications en configuration parallèle ou triphasée peuvent être configurées avec les logiciels VEBus Quick Configure et VEBus System Configurator.
- Les applications d'autocommutation, de réseau interactif et hors-réseau impliquant des convertisseurs rattachés au réseau et/ou des chargeurs solaires MPPT peuvent être configurées avec des assistants (logiciel spécifique pour des applications spécifiques).

Suivi et contrôle sur site
Plusieurs options sont disponibles : contrôleur de batterie, un tableau de commande MultiControl, tableau de commande VE.Net Blue Power, tableau de commande Color Control, Smartphone ou tablette (Bluetooth Smart), ordinateur de bureau ou portable (USB ou RS232).

Suivi et contrôle à distance
Victron Ethernet Remote, Victron Global Remote et le tableau de commande Color Control.
Les données peuvent être conservées et affichées sur notre site Web gratuit VRM (Victron Remote Management).

Configuration à distance
Si des systèmes disposant d'un tableau de commande Color Control sont connectés par Ethernet, il est possible d'y accéder et de modifier leur configuration.

Tableau de commande Color Control, montrant une application PV

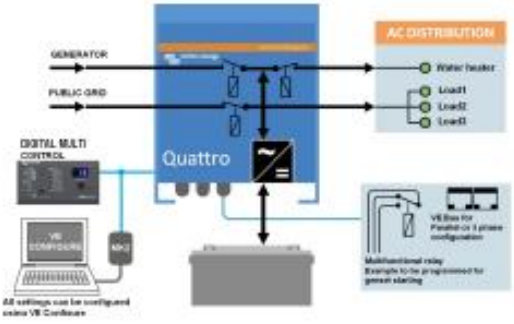


Figure 19

Quattro	12/3000/120-50/50 24/3000/70-50/50	12/5000/220-100/100 24/5000/120-100/100 48/5000/70-100/100	24/8000/200-100/100 48/8000/110-100/100	48/10000/140-100/100	48/15000/200-100/100
PowerControl / PowerAssist	Oui				
Commutateur de transfert intégré	Oui				
2 entrées CA	Plage de tension d'alimentation : 187-265 VCA Fréquence d'entrée : 45 – 65 Hz Facteur de puissance : 1				
Courant commutateur de transfert maximal (A)	2 x 50	2 x 100	2 x 100	2 x 100	2 x 100
CONVERTISSEUR					
Plage de tension d'entrée (V CC)	9,5 – 17 V 19 – 33 V 38 – 66 V				
Sortie (1)	Tension de sortie : 230 VCA ±2 % Fréquence : 50 Hz ±0,1 %				
Puissance de sortie cont. à 25°C (VA) (3)	3000	5000	8000	10000	15000
Puissance de sortie en continue à 25°C (W)	2400	4000	6500	8000	12000
Puissance de sortie en continue à 40°C (W)	2200	3700	5500	6500	10000
Puissance de sortie en continue à 65°C (W)	1700	3000	3600	4500	7000
Puissance de crête (W)	6000	10000	16000	20000	25000
Efficacité maximale (%)	93 / 94	94 / 94 / 95	94 / 96	96	96
Consommation à vide (W)	20 / 20	30 / 30 / 35	45 / 50	55	80
Consommation à vide en mode AES (W)	15 / 15	20 / 25 / 30	30 / 30	35	50
Consommation à vide en mode recherche (W)	8 / 10	10 / 10 / 15	10 / 20	20	30
CHARGEUR					
Tension de charge « absorption » (VCC)	14,4 / 28,8	14,4 / 28,8 / 57,6	28,8 / 57,6	57,6	57,6
Tension de charge « Float » (VCC)	13,8 / 27,6	13,8 / 27,6 / 55,2	27,6 / 55,2	55,2	55,2
Mode stockage (VCC)	13,2 / 26,4	13,2 / 26,4 / 52,8	26,4 / 52,8	52,8	52,8
Courant de charge de batterie de service (A) (4)	120 / 70	220 / 120 / 70	200 / 110	140	200
Courant de charge de batterie de démarrage (A)	4 (modèles 12 V et 24 V uniquement)				
Sonde de température de batterie	Oui				
GÉNÉRAL					
Sortie Auxiliaire (A) (5)	25	50	50	50	50
Relais programmable (6)	3x	3x	3x	3x	3x
Protection (2)	a - g				
Port de communication VE.Bus	Pour un fonctionnement en parallèle ou triphasé, suivi à distance et intégration du système				
Port de communication universel	2x	2x	2x	2x	2x
On/off à distance	Oui				
Caractéristiques communes	Température de fonctionnement : -40 à +65 °C Humidité (sans condensation) : 95 % maxi.				
BOÎTIER					
Caractéristiques communes	Matériel et Couleur en aluminium (bleu RAL 5012) Degré de protection : IP 21				
Raccordement batterie	4 boulons M8 (2 connexions positives et 2 négatives)				
Connexion CA 230 V	Visser les bornes 13 mm² (6 AWG)	Boulons M6	Boulons M6	Boulons M6	Boulons M6
Poids (kg)	19	34 / 30 / 30	45 / 41	45	72
Dimensions (H x L x P en mm)	362 x 258 x 218	470 x 350 x 280 444 x 328 x 240 444 x 328 x 240	470 x 350 x 280	470 x 350 x 280	572 x 488 x 344
NORMES					
Sécurité	EN-IEC 60335-1, EN-IEC 60335-2-29, EN-IEC 62109-1				
Émission, Immunité	EN 55014-1, EN 55014-2, EN-IEC 61000-3-2, EN-IEC 61000-3-3, EN-IEC 61000-6-3, EN-IEC 61000-6-2, EN-IEC 61000-6-1				
Véhicules, services après-vente	Modèles de 12 V et 24 V : 2004/104/EC				
Systèmes contre l'îlotage	Voir notre site Web				

Figure 20


Industrial Batteries / Network Power
Classic Solar
»Powerful energy storage for renewable energy systems«
Classic

Figure 21

Energy storage solutions for critical systems that require uninterrupted power supply. GNB® Industrial Power offers powerful batteries for your individual needs. The below table is only indicative and depends on customers' specific applications. For more information please ask a GNB sales representative.

Applications	Battery ranges																		
	Sonnenschein							Marathon		Sprinter			Absolyte	Powerfit	Classic				
	A400/ A600	A400 FT	A500	A700	SOLAR	RAIL	Power Cycle	M-FT	M/L/ XL	S	P/XP	XP-FT	GP/GX	S300	GRoE	OCSM	OPzS	Energy Bloc/OGi	Solar	rail
Telecom	●	●	●	●			●	●	●	●		●	●			●	●	●		
UPS		●	●	●			●	●	●	●	●	●	●			●		●		
Emergency lighting	●		●						●		●	●		●			●	●		
Security	●		●	●							●	●		●		●	●			
Utility	●	●		●			●	●	●	●			●		●	●	●	●		
Railways	●	●	●	●		●	●	●	●	●			●			●		●		●
Photovoltaic					●		●						●						●	
Universal	●	●	●	●			●	●	●	●	●	●	●	●		●	●	●		

The GNB Network Power brand overview

Figure 22

Your benefits:

> **Optimised design for renewable energy applications** – highest cycling ability and long life

> **Special alloy and large electrolyte reserve** – very long topping up intervals

> **Low maintenance** – saving costs

> **Completely recyclable** – low CO_2 footprint

Specifications:

> Nominal capacity (C_{120} at 25 °C): 82.7 - 4600 Ah
> Very thick tubular positive plates for the most demanding applications
> Up to 2800 cycles at 60 % depth of discharge (C_{10}) with IU charging profile at 20 °C. For enhanced performance and for systems ≥ 48 V we recommend IUI charging to reach 3000 cycles and more.
> Designed in accordance with IEC 61427 and IEC 60896-11
> Screw connectors for a better contact and reliability
> Also available in dry-charged version with separate electrolyte
> High quality transparent or translucent containers for easy maintenance

Figure 23

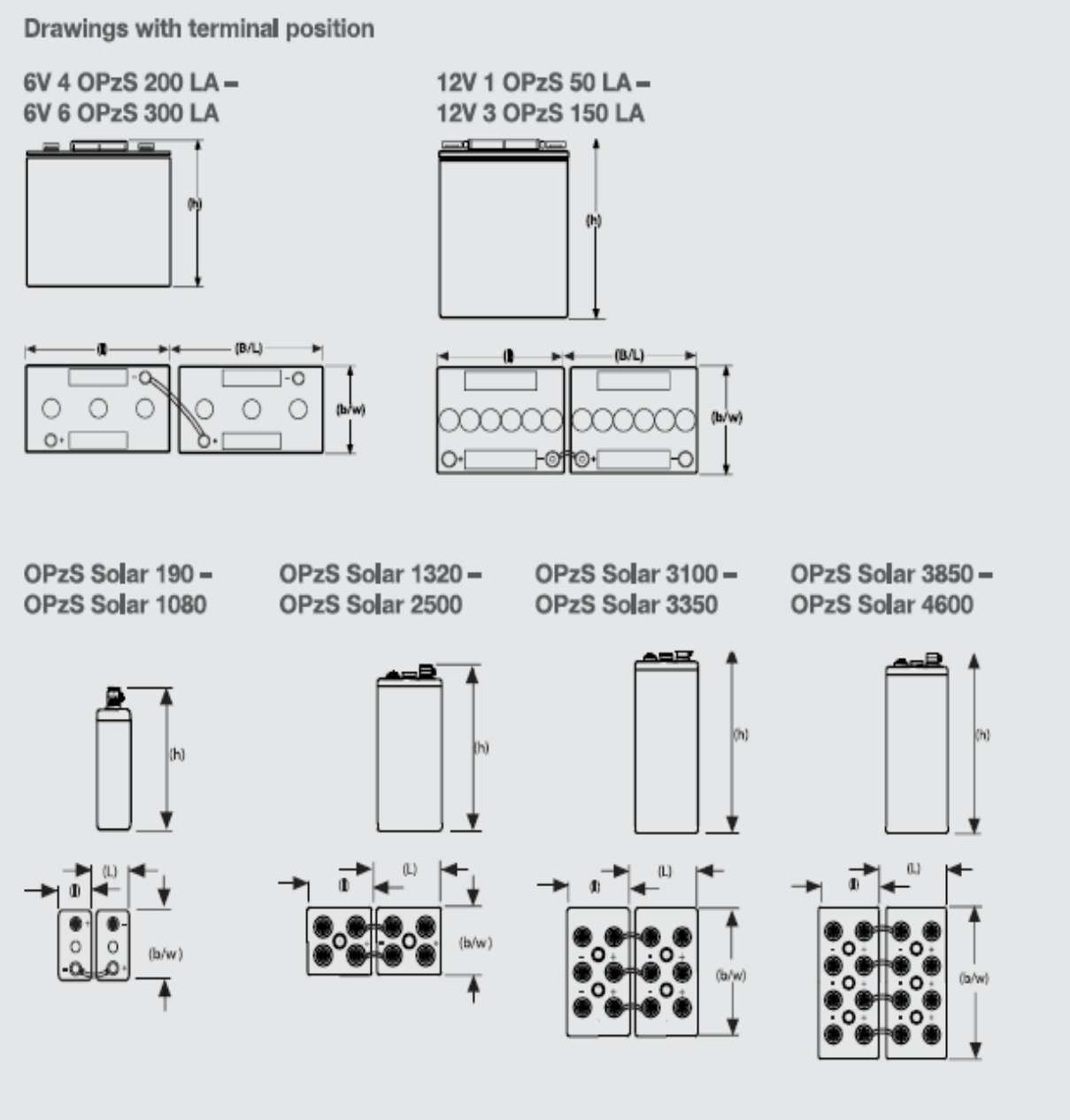

Drawings with terminal position
6V 4 OPzS 200 LA –
6V 6 OPzS 300 LA
12V 1 OPzS 50 LA –
12V 3 OPzS 150 LA
(h)
(B/L)
(b/w)
OPzS Solar 190 –
OPzS Solar 1080
OPzS Solar 1320 –
OPzS Solar 2500
OPzS Solar 3100 –
OPzS Solar 3350
OPzS Solar 3850 –
OPzS Solar 4600
(L)

Figure 24

CONCLUSION

To conclude, during this thesis presentation we've seen different aspect of the photovoltaic panels, from it's own representation to Project one's. We saw the use of solar panels on the scale of a business, how they are used, their benefit as well as their abilities to convert solar energy into electricity but also their service to the Environment where electricity is created naturally. Moreover , we were able to observe the different site as well as the interior of a company but also their response to the calls for tenders , their organization and progress, how they operate.

In addition, the different components of the solar panels have been observed, but above all, we have seen the electrical conductors that helped the transport of solar energy in order to convert it into electricity. All this has enabled us to develop a strategy that has helped us respond to certain challenges such as:

How the solar panel works, how to use them, what they were made of and how to facilitate conduction.
In addition, we were able to see their appearance in a company such as Jet Energy, how they can benefit of it and respond to the call for tenders.

Finally as we all know, renewable energies are the future of our society. In a few decades their use will be indispensable as we can see on the car scale where electric cars are more and more on the Market. All this is to say that we must preserve our environment and reduce the important mole of pollution that invades our planet, all these new renewable energies As well as the solar panel is a step towards a new more enriched and cleaner world but also a natural world.

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