Global Environment Facility

Inter-American Development Bank

EMERGENCY PROGRAM FOR SOLAR POWER GENERATION FOR HAITI

HA-X1018 and HA-X1019

Terminal Evaluation

April 2014

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Acronyms

A	Ampere
AC	Alternate Current
CDS	Centre de Santé (Health Center)
DC	Direct Current
DIS	Dispensary
EDH	Électricité d'Haïti
GEF	Global Environment Facility
GoH	Government of Haiti
HOS	Hospital
IA	Implementing Agency
IDB	Inter-American Development Bank
LED	Light-Emitting Diode
KW	Kilo Watt
NGOs	Non-Governmental Organizations
PAP	Port-au-Prince
PV	Photovoltaic
SECCI	Sustainable Energy and Climate Change Initiative
SELF	Solar Electric Light Fund
TOR	Terms Of Reference
UNEP	United Nations Environment Program
V	Volt
W	Watt
WB	World Bank
Wp	Watts Peak

Executive Summary

The Project: In a post-catastrophe Haiti, the Global Environment Facility (GEF) and the Inter-American Development Bank (IDB) decide to finance the access to electric power for health centers and refugee camps.

The Emergency Program for Solar Power Generation for Haiti (projects HA-X1018 and HA-X1019) (see Annex 1), were implemented by IDB and GEF, where the Solar Electric Light Fund (SELF) was the contractor to develop the project under the direct selection of the consulting firm IT Power. The general objective was to provide solar power and solar refrigerators. The specific objective of this project was to design, purchase, install, operate and maintain solar PV systems and solar powered refrigerators to provide electricity and appropriate conditions for vaccine conservation for emergency centers and key establishments during disaster management and reconstruction.

The Emergency Program for Solar Power Generation for Haiti was financed with the Sustainable Energy and Climate Change Initiative (SECCI) of the IDB (HA-X1019) and the GEF (HA-X1018), which was aimed to support Haiti's local authorities in the provision of sustainable and clean energy at this time of crisis, through the use photovoltaic (PV) panels and solar refrigerators for vaccine and medicine conservation. This project will contribute to promote solar PV as a sustainable and autonomous form of alternative renewable energy, in times when diesel fuel is difficult to obtain, transport, and purchase in Haiti.

This project was part of a larger program where the GEF, the World Bank (WB) and the IDB have contributed US$ 3 million (each institution contributing US$ 1 million) for solar equipment. The IDB executed US$ 1.5 million[1] to purchase, install and operate PV systems, while the WB will execute the rest of funds to purchase and distribute solar lanterns.

Through the IDB retainer (ATN/OC-11183-RG), awarded to the consulting firm IT Power through an international tendering process, was used for the selection of an

[1] The US$ 1.5 million comes from the co-financing US$ 1.0 million IDB-SECCI funds plus the US$ 0.5 million GEF resources.

Implementing Agency (IA) that would manage and procure the PV systems on behalf of the IDB. The non-profit charity organization called SELF was selected by IT Power as the IA between a group (short list of 6 firms and Non-Governmental Organizations (NGOs)) of highly reputable organizations with vast experience in managing solar systems in developing countries, particularly in Haiti.

The Evaluation: This report is the Terminal Evaluation for projects HA-X1018 and HA-X1019, providing an in-depth analysis of the project motivation, implementation, outputs, outcomes and lessons learned. This evaluation was performed according to the respective Terms Of Reference (TOR)(see Annex 2), while HA-X1018 was financed by GEF; HA-X1019 is a similar program funded by the WB and it has been executed together with HA-X1018.

The methodology used complies with GEF's guidelines for terminal evaluations, and it included the study of available documentation, interviewing with the IDB officers, IA officers and beneficiaries, a field trip to Haiti and a visual and technical inspection of some of the installations.

The interviews with the beneficiaries, the installations inspections, the conversations with IDB and SELF officers and ancillary research provided with a sizeable amount of data to reach and evaluation on project results, risks, catalytic role and lessons learned.

General Background

Within the context of the 2010 magnitude 7.0 earthquake that hit Haiti, the GEF and the IDB identified the lack of electric power as one serious issue affecting Haitians before and after the earthquake. The national electricity company, Électricité d'Haïti (EDH), had limited resources to continue providing power to key facilities as schools, hospitals, health centers and refugee camps. At this time a 2-year delay to resume power was though, but as today, many of these facilities continue without grid-provided power or with a limited access to electricity.

Project Background

The original project included 2 Components: Component 1 (US$ 1.5 million) was developed for the provision of street lights for two refugee camps in the Port-au-Prince (PAP) area (first outcome) and provision of self-sustained Photovoltaic systems and solar refrigerators for twelve health centers in the south of the country (second outcome). Component 2 (US$ 1.5 million) was the provision of hand-cranked lanterns to illuminate the most sensitive areas.[2]

In detail, the first outcome of Component 1 was to provide 100 self-sustained solar streetlights in two refugee camps in the PAP area, both Camp Caradeux and Camp Sean Penn were chosen for this. The second outcome was to provide and install off-grid PV systems in twelve health centers in the southern region of Haiti. The beneficiary cities are: Chantal, Saint Jean, Tiburon, Chardonnieres, Les Anglais, Port-à-Piment, Damassin, Coteaux, Roche-à-Bateaux, Cote de Fer, Randel and Ile-à-Vache.

Project Modifications

- As specified in the original project, five sites were pre-selected by the GoH which was working together with the Implementing Agency to define the precise location for the installation of solar power systems. For the selections of such sites, a joint effort among the Government of Haiti (GoH), the IDB via SELF as the IA, the United Nations Environment Program (UNEP) and Columbia

[2] This component it was out of the scope of this report since it was executed by the World Bank.

University (CU); the last two entities are part of an integrated project for the south coastal Haiti called CSI (acronym is French for Initiative for the South Coast - Côte Sud Initiative).

- The original project specified the installation of solar refrigerators in all twelve health centers. At the time of the execution of the project, both the IA and the IDB acknowledged of the existence of the "Direction du Programme Elargi de Vaccination" (Enhanced Vaccination Program Direction) of the GoH. This program provided health centers in Haiti with hybrid propane/electric refrigerators and solar refrigerators. Therefore, in order to use the limited fund in an effective manner, no refrigerators were purchased, as the refrigerators systems could always be connected to the PV systems directly. Therefore priority was given to provide more power with solar PVs for all medical purposes.
- The project team also expanded the scope of the project from Solar PV generator for power generation (the case of the health clinics) to Solar PV generators for public illumination, to illuminate the refugee camps in Port au Prince, as a way to reduce crime and violence by night.

Project Costs

Project costs for the solar streetlights and PV systems for the health centers were as described in Table 1:

Table 1: Project Costs. All values in US dollars.

	Item	US$	Comments
1	**Equipment**	**$882,700**	
1.1	PV equipment for 12 Health Centers	$378,250	Modules, batteries, inverters, controllers, cables, monitoring system and other related equipment
1.2	Solar street lights	$299,000	100 streetlights for transition camps
1.3	Battery Replacement for 12 Health Centers	$105,400	Battery Replacements for all sites
1.4	Locally purchased materials	$100,050	cement, gravel, poles, beams, pumps, pipes, storage tanks, module support structure, etc.
2	**Shipping**	**$50,000**	
2.1	Shipping	$50,000	Shipping within and from US to Haiti
3	**Training**	**$33,100**	
3.1	SELF training costs	$21,900	Project Manager and Instructor - development and presentation of training
3.2	On site training costs	$11,200	Materials, venue costs, translation, communications, etc.
4	**Installation**	**$205,300**	
4.1	SELF professional services for installation	$42,101.5	Site preparation, technical installation, oversight and inspection: Project Director, Project Manager, Technician
4.2	2. Design, procurement, oversight and other costs	$14,248.5	Lamps Installation

4.3	Locally hired professionals for installation	$35,650	Logistical support, technicians, installers for pumps, structures, etc, electricians, manual labor for construction
4.4	Transport of Equipment and Crews	$50,650	Transport of equipment from Port au Prince, transport of equipment, crews
4.5	Warehousing and Security of Equipment	$19,550	Warehousing and security in Port au Prince and at sites
4.6	Lodging and Food for crews	$37,950	Lodging and food for crews
4.7	Site Construction	$5,150	On-site construction for housing and securing equipment
5	**Other SELF Costs**	**$87,400**	
5.1	SELF project development costs	$63,500	Development and design of program, design of systems, procurement of equipment: Executive Director, Project Director, Project Manager, Director of Finance
5.2	Travel Costs	$19,900	Travel costs for SELF personnel for assessment, installation, training, and inspection
5.3	Office Supplies, Communications, etc.	$4,000	Office supplies, communications cost, etc.
6	**Post Installation**	**$91,500**	
6.1	SELF professional services	$31,100	2 site visits per year for 2 years, remote monitoring and project reporting: Project Manager, Project Director, Executive Director, Finance Director
6.2	Local Technicians	$24,700	Site visits, trouble shooting, support for operators/maintenance staff for 2 years
6.3	Tech/Operator at each site	$10,400	Provide for one Operator on site at each of 12 sites for 2 years
6.4	Hardware, spare parts and transport	$25,300	Misc parts and hardware needed for repairs; transport for Project Manager and Local Technician to do site visits and trouble shooting
	Total Cost of Project	**$1,350,000**	

Project Sites and Capacities

Solar Streetlights for Camps

This component of the project encompassed the installation of 100 solar streetlamps. Camp Caradeux received 63 lamps and Camp Sean Penn 37. As Camp Sean Penn was disassembled, those lights are being moved to the neighborhoods where the inhabitants of that camp moved.

Solar Power for Health Centers

The total PV generation power of the 12 centers is: 38,705Wp.

The total AC power available for the 12 centers is: 34,200W.

Table 2 shows the list of beneficiary health centers and the capacity installed:

Table 2: Beneficiary Health Centers.

#	Place	Population [(2)]	Type	Panel (Wp)	Batteries (No)(Ah)(V)	Inverter Capacity
1	Chantal	31030	DIS	4230	(24)(1050)(48)	3000 W
2	Saint-Jean	23251	CDS	2070	(16)(800)(48)	3000 W
3	Tiburon	21170	DIS	2070	(16)(800)(48)	3000 W
4	Chardonnières	22953	DIP	940	(4)(400)(24)	600 W
5	Les Anglais	27182	CDS	2820	(24)(1050)(48)	3000 W
6	Port-a-Piment	17207	HOP	11730	(24)(2430)(48)	6000 W
7	Damassin	4300	DIS	940	(8)(800)(24)	600 W
8	Coteaux	19372	CDS	2760	(16)(1050)(48)	3000 W
9	Roche a Bateau	16727	DIS	2070	(8)(800)(48)	3000 W
10	Cote-de-Fer	44595	CDS	2820	(24)(1050)(48)	3000 W
11	Randel [(1)]		CDS	2115	(16)(800)(48)	3000 W
12	Ile-a-Vache	14004	CDS	4140	(24)(1050)(48)	3000 W

Methodology

This evaluation was done according to the GEF's guidelines for terminal evaluations[3]. Three different activities serial in time where performed: a) Documentation Research; b) Field visit to sites and interviews to stakeholders; c) Refinement of data, re-study of documents, final consultation to stakeholders.

a. Documentation research.

It included the analysis of the original project TOR, the 2012 Project Implementation Report, SELF's Final Report, Specialist Kenol Thys's report, among others. The relevant information was systematized and incorporated to the results and analysis included in this report.

b. Field visit and interviews to stakeholders.

A field visit to the installations in Haiti took place from 02/10/2014 to 02/17/2014. During the visit, meetings were held with IDB's Energy Specialist, Kenol Thys, and the IA (SELF) Haiti Manager, Jean-Baptiste Certain. After those initial meetings, a visit strategy was planned and executed.

[3] Global Environment Facility Evaluation Office - Guidelines for GEF Agencies in Conducting Terminal Evaluations - Evaluation Document No. 3 – 2008.

A visit to Camp Caradeux in PAP took place. A visual inspection of the solar street lamps was performed as well as an interview with the community leaders. Camp Sean Penn was dismantled, so no visit was possible. However, information was provided by the Energy Specialist, Kenol Thys, who visited the camp in several occasions as well as SELF's Manager based in Haiti. They were able to confirm the successful installation and operation of the street lamps at this camp. Once the Sean Penn's camp was dismantled, the streetlights were dismantled as well and reinstallation in other locations.

Out of the twelve health centers that benefited from the project, four were visited due to distance and accessibility characteristics, comprehensive information on the rest of the sites was provided by Mr. Thys from IDB and Mr. Baptiste from SELF. The four sites, very representative of all installations, were: Chantal, Coteaux, Roche-à-Bateux and Port-à-Piment.

c. Study of field data and final consultation.

The large amount of data and interviews obtained during the visit to the sites in Haiti was contrasted to the original documentation and to information about the general status of Haiti when it comes to power generation and health infrastructure. This analysis served to assess the compliance to the purpose and reach of the implemented project. Finally, further consultation was made with the IA's manager and the IDB energy officer in Haiti, to enhance the completeness of this evaluation.

Evaluation Results

Solar Streetlamps: Installation Aspects.

The observed solar streetlights are at Camp Caradeux in the PAP area.

These streetlights systems were manufactured in Italy by the specification of the IA and assembled by GreenEnergy; a Haitian company specialized in solar power.

The self-contained streetlamps are equipped with a 65W solar panel a suitable lead-acid gel battery and a 2000 lumen LED light. They are assembled with reinforced steel framing and security screws, to avoid vandalism. The mounting poles are about 15 feet tall.

Field Visit to Refugee Camp

Camp Caradeux is located in the Tabarre area of PAP, about 30.000 people live in the camp that is administered by community leaders.

Precarious wooden houses and tents constitute the camp. There is no tap water, no sewers and dirt roads. The observed population is young and was prone to attacks during the nighttime.

Image 1: Camp Caradeux Location in PAP area. 18.5606° N, 72.2640° W

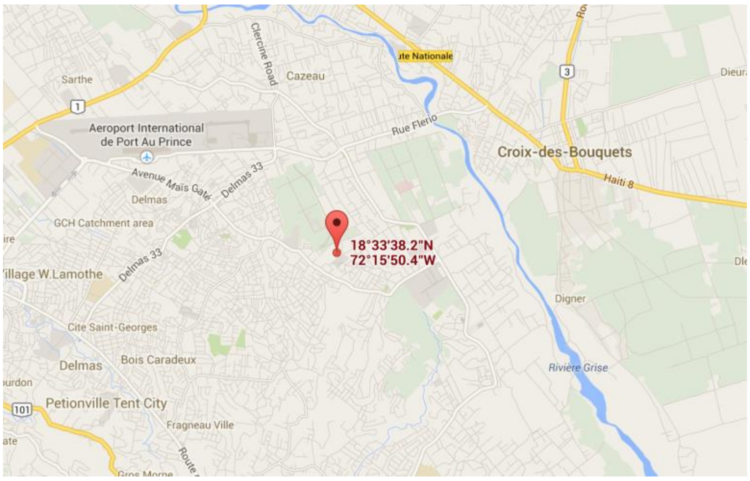


Image 2: Haiti Refugee Camp by night.

Image 3: Mr. Blot and Mr. Leroywood with Camp Caradeux streetlights.

Image 4: Blowout of streetlight in Camp Caradeux.

During the visit Mr. Blot and Mr. Leroywood, two community leaders, hosted the consultant. These leaders provided data about the condition of streetlights and general information about the camp.

The information provided is summarized in Table 3:

Table 3: Camp Caradeux Information.

Number of Streetlights	73 total; 68 provided by HA-X1018 and 5 by GoH.
Area of coverage	60% of the camp has night lighting.
Number of failures	5 lamps are not working. (not possible to discern from HA-X1018 or from GoH lamps)
Previous Situation	Very dangerous at night. Rapes and assaults were usual before the installation of the solar lamps
Present Situation	Safer at night.
Concerns	The servicing of the lamps was done by SELF under the supervision of the IDB. However, community leaders feel that they

	do not have contact point to demand servicing of the lamps. They are considering hiring a technician themselves. In spite of the robustness of the technology chosen, a maintenance plan is recommended for the next years to service these lamps properly in the future. The training of the local technician (hopefully from the same community) could be an excellent proposal for the sustainability of this project.

Solar Power Generation for Health Centers: Installation Aspects.

During the visit to Haiti, four health centers were visited. These centers and their facilities were accessible to the consultant, and it is a good case of all twelve centers where the PV systems were installed.

The consultant performed visual inspections, took photographs, performed interviews with beneficiaries and had technical discussions with the IA manager.

All the installations have many characteristics in common, including the equipment manufacturers, installation aspects and quality. These are reviewed in the following section.

Solar Panels

All solar panels were installed using aluminum frames for the panels and steel frames for the support. The rooftop installations are firmly attached to the concrete roofs (these type of roofs are standard in Haiti) via pass-thru iron bars and concrete blocks, achieving the desired strength to stand category-4 hurricanes as stated in the Project design.

The solar panels themselves are made by REC Solar ASA, a top-rated Norwegian company. In particular REC Peak 235PE where used in installations, each of these multi-crystalline panels provide 235W of power at a 14.2% of efficiency. Data sheets for the panels are included on Annex 3.

Inverters, Charge controllers and power electronics.

All inverters, charge controllers and electronics were installed indoors or in a brick and mortar shelter. All electronics are made by Outback Power, a premium manufacturer of electronics for renewable energy. The 3KW systems utilize the Outback FLEXpowerOne, a self-contained solution for solar power systems and the 6KW system uses FLEXpowerTWO. The systems include an inverter/charger, a charge controller, DC and AC connection boxes, surge protectors, a terminal computer and a communications hub. Datasheets for the FLEXpower systems can be found on Annex 4. Although an online data logging system was proposed, all data is stored on SD cards and uploaded monthly by technicians because the Outback Power data communications component was not developed; also, there is a manual logging on paper.

Battery Banks

The battery banks comprise 24 lead-acid flooded batteries for a 48V voltage. All the observed battery systems are indoor and resting on concrete floors, to minimize fire hazards. Particular attention has been given on the location of the Port-à-Piment battery bank, since at 300lbs each the system weights 7,200lbs (over 3 metric tons), this system has been placed downstairs to not stress the structure of the building.

Systems Security

All surveyed systems have an external low battery alarm that activates when the batteries are discharged enough so the system will shut down. This alarm system clearly indicates that more power than the stored in the batteries is being used.

Burglar alarms equip outdoor portions of the systems that are installed in places where there is risk of burglary. Particularly, the Port-à-Piment system is equipped with a system that protects the solar panels with a loud siren and powerful lights.

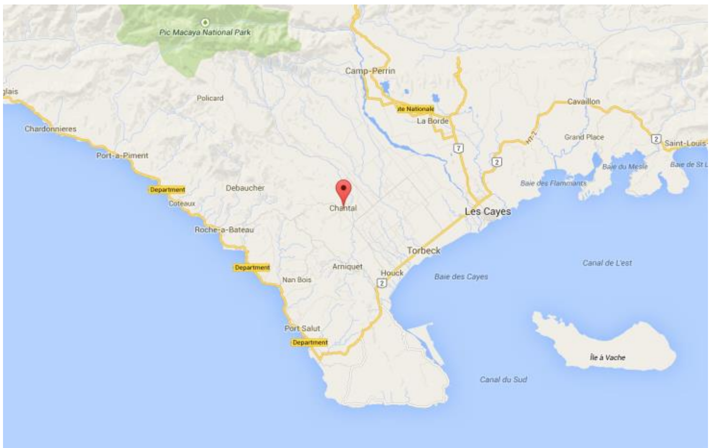
Field Visits to Health Centers

Chantal:

The city of Chantal is a rural city surrounded by rice fields, located 16 Km west from southern Haiti's main city of Les Cayes. The road to Chantal includes crossing a river with no bridge, which might be impossible to do during some days of the wet season. With a population of about 30,000 the city has a health dispensary run by nuns.

The health dispensary has a building surface of about 350 m^2, including waiting areas, offices, laboratory and maternity areas. Sister Mona, who was interviewed during the visit, runs the dispensary.

Image 5:Chantal location in southern Haiti.



Solar power infrastructure

Table 4: Chantal. PV

Equipment.Solar Panels	Batteries	Inverter / Charger	System installation details
REC PEAK Solar Panels in 3 groups. 4,140W of power. Top of pole mounting with concrete basement. Category 4 hurricane-proof.	24 Flooded lead-acid batteries, forming a 48V array with a 1,050Ah capacity.	Outback Power Systems inverter and charger. Outback Power Systems control unit/data logger. 110V 60Hz Power rating: 3KW.	Batteries and electronics installed in brick and mortar shelter. UL standard electric piping. Low battery external alarm present.

Image 6: Solar panel array in Chantal.

Image 7: Inverter, charger and electronics in Chantal.

Image 8: AC breakbox in Chantal.

Image 9: Battery bank in Chantal.

The Chantal installation exhibits a high quality level. All installations are made according the guidelines found in the TOR of HA-X1018 and HA-X1019, and complying with IEC and UL standards. DC power runs are kept to a minimum distance; breakers and fuses are installed and well signaled.

Chantal dispensary equipment

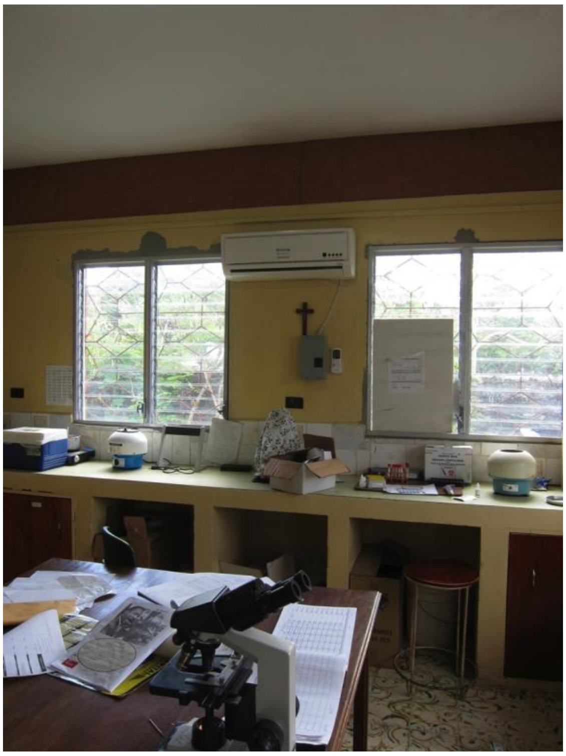
The power provided by the solar system powers all electrical equipment at the dispensary with the exception of AC units and refrigerators. AC units run off EDH power (when available), and refrigerators are hybrid propane/electricity, running mainly on gas.

The dispensary has been retrofitted with energy-efficient lighting and fans.

The lists of medical equipment running on solar power are:

- Laboratory: microscopes, centrifuges, autoclaves, stirrers, etc.
- Computer system: central patient database computer and workstations.
- Otoscopes, electrocardiogram machine, etc.

Image 10: Laboratory equipment running in Chantal.



Chantal interview with beneficiaries

A 30-minute interview with Sister Mona was carried out; a catholic nun who runs the dispensary. Specific questions about the number of patients, pathologies, benefits from power and unexpected implications of having permanent electric power were posed. The results are shown in Table 5:

Table 5: Chantal Interview Data.

Daily patients	30 – Consultation. 50 – 100 - Vaccination. 10 - HIV
Pathologies	Parasites, Typhus, Malaria, HIV, TB, Food Poisoning.
Previous situation	No night service. Laboratory had to run on diesel generator (only a day per week). No power for computers.
Unexpected outcomes	With permanent power they built an electronic database to better track and treat complex diseases as TB.

At the time of the visit, the Chantal health dispensary was fully operational with some 30 patients in the waiting room, and many others receiving care.

Maintenance

System maintenance is performed by a local technician who does battery electrolyte control, battery contact cleaning, and paper data logging.

One technician trained and paid by the IA, does a monthly visit checking the system and downloading the system performance data from an SD card to a shared folder online. Later this data is analyzed by the IA professionals at PAP.

Solar Refrigerator

The Chantal health dispensary has an electric/propane hybrid refrigerator provided by the GoH. In this case the refrigerator is not connected to the solar power system due to the fact that it is a 220V device, where the system provides 110V.

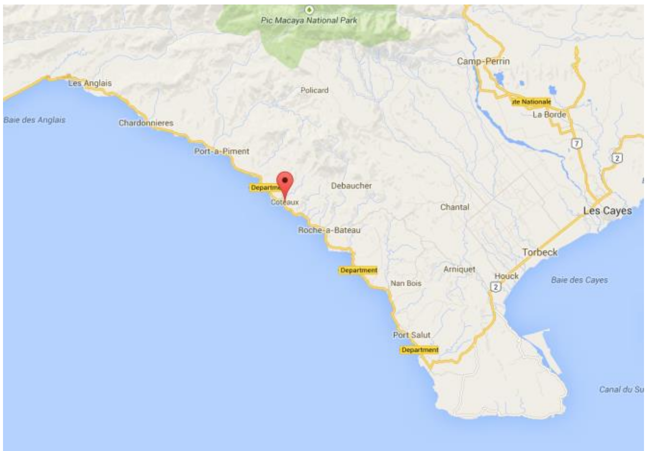
No solar refrigerator is in place.

Coteaux:

The city of Coteaux is a coastal city, located 31 km west from southern Haiti's main city of Le Cayes. The road to Coteaux is a paved and in general good condition. With a population of about 20,000 the city has a health facility.

The health center has a building surface of about 450 square meters, including waiting areas, offices, laboratory and maternity areas. No responsible officer could be found at the time of the visit.

Image 11: Coteaux location in southern Haiti.



Solar power infrastructure

Table 6: Coteaux PV Equipment.

Solar Panels	Batteries	Inverter / Charger	System installation details
REC PEAK Solar Panels in one group. 2,760W of power. Rooftop mounting with steel mounting. Category 4 hurricane-proof.	24 Flooded lead-acid batteries, forming a 48V array with a 1,050Ah capacity.	Outback Power Systems inverter and charger. Outback Power Systems control unit/data logger. 110V 60Hz Power rating: 3KW.	Batteries and electronics installed inside health center. UL standard electric piping. Low battery external alarm present.

Image 12: Solar panels. Coteaux.

Image 13: Inverter, charger, electronics. Coteaux.

Image 14: DC junction box. Coteaux.

Image 15: Battery bank. Coteaux.

The Coteaux installation exhibits a high quality level. All installations are made according the guidelines found in the TOR of HA-X1018 and HA-X1019, and complying with IEC and UL standards. DC power runs are kept to a minimum distance; breakers and fuses are installed and well signaled. The rooftop solar panels are well anchored and safe from vandalism.

Coteaux Health Center equipment

The power provided by the solar system powers all electrical equipment at the health center with the exception of AC units and refrigerators. The city has an independent electrical micro-grid that works for short lapses of time when some local authorities can provided diesel for the Generator.

Due to the lack of responsible officers at the time of the visit, no further information is available.

Coteaux interview with beneficiaries

There was no interview. However this center exhibits a low-level of activity. The IA final report says that 5 to 10 patients are treated daily.

Maintenance

System maintenance is performed by a local technician who does battery electrolyte control, battery contact cleaning, and paper data logging.

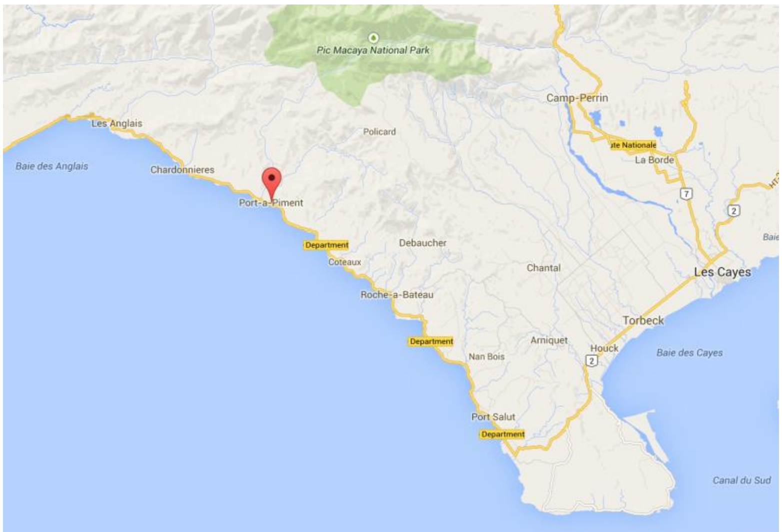
An area technician trained and paid by the IA, does a monthly visit checking the system and downloading the system performance data from an SD card to a shared folder online. Later the IA professionals at PAP analyze this data.

Port-à-Piment

The city of Port-à-Piment is a coastal city, located 40 km west from southern Haiti's main city of Les Cayes. The road to Port-à-Piment is paved and in a good condition, ambulances can get easily into town. With a population of about 18,000 the city has a GoH-run hospital.

The hospital has a building surface of about 1000 m^2, including waiting areas, offices, laboratory and maternity areas. A GoH officer, who was not present at the time of the visit, runs the hospital. The administrative person present let us interview two doctors, who provided useful information.

Image 16: Port-à-Piment location in Southern Haiti.



Solar power infrastructure

The Port-à-Piment installation exhibits a high quality level. All installations are made according the guidelines found in the TOR of HA-X1018 and HA-X1019, and complying with IEC and UL standards. DC power runs are kept to a minimum distance; breakers and fuses are installed and well signaled.

Table 7: Port-a-Piment PV Equipment

.Solar Panels	Batteries	Inverter / Charger	System installation details
REC PEAK Solar Panels. 11,730W of power. Rooftop mounting. Steel frame structures. Category 4 hurricane-proof. Active burglar alarm installed.	24 Flooded lead-acid batteries, forming a 48V array with a 2,430Ah capacity.	Outback Power Systems inverter and charger. Outback Power Systems control unit/data logger. 110V 60Hz Power rating: 6KW.	Batteries and electronics installed inside the hospital building. UL standard electric piping. Low battery external alarm present.

Image 17: Solar panels. Port-à-Piment.

Image 18: Burglar alarm to protect solar panels. Port-à-Piment.

Image 19: DC combiner box. Port-à-Piment.

Image 20: Twin inverters providing 6KW. Port-à-Piment.

Image 21: Battery Bank. Port-à-Piment.

Port-à-Piment hospital equipment

The power provided by the solar system powers all electrical equipment at the hospital with the exception of AC units which run off a very unreliable electrical micro-grid (when available), and refrigerators are hybrid propane/electricity, running mainly on gas.

The hospital has been retrofitted with energy-efficient lighting and fans.

The list of medical equipment running on solar power:

- Laboratory: microscopes, centrifuges, autoclaves, stirrers, etc.
- Personal computers.
- Electrocardiogram machine, otoscopes, autoclave, etc.

Port-à-Piment interview with beneficiaries

A 40-minute interview with Dr. Argant and Dr. Charles was carried-out. Specific questions about the number of patients, pathologies, benefits from power and unexpected implications of having permanent electric power were posed. The results are shown as follows:

Table 8: Port-à-Piment Interview Data.

Daily patients	30 – Consultation. 4 emergencies per hour, peak.
Pathologies	Typhus, Malaria, HIV, TB, Urinary Infections.
Previous situation	No night service. Laboratory had to run on diesel generator (only a few times a week). No power for cellphones.
Unexpected outcomes	With permanent power they can charge cellphones and operate the otoscope. That was not possible before the solar power.

At the time of the visit, the Port-à-Piment Hospital was operational with about 5 patients in the waiting room, and many others receiving care.

Image 22: Laboratory equipment. Port-à-Piment.

System maintenance is performed by a local technician who does battery electrolyte control, battery contact cleaning, and paper data logging.

One technician trained and paid by the IA, does a monthly visit checking the system and downloading the system performance data from an SD card to a shared folder online. Later this data is analyzed by the IA professionals at PAP.

Solar Refrigerator

The Port-à-Piment hospital has electric/propane hybrid refrigerator provided by the GoH. In this case the refrigerator is connected to the solar power system.

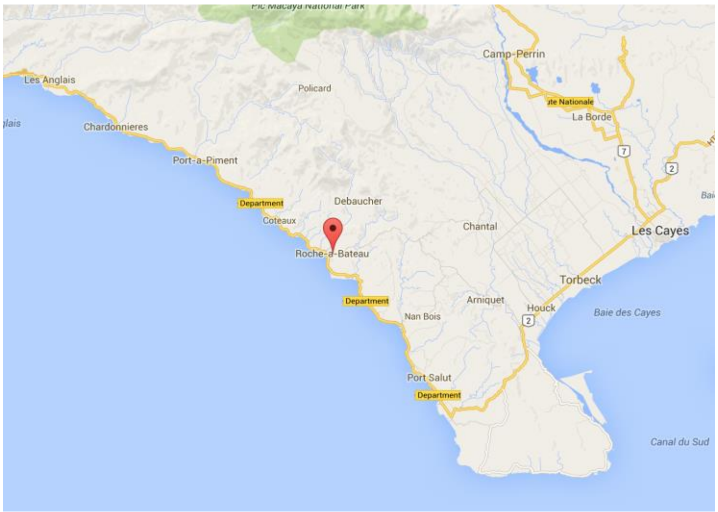
No solar refrigerator is in place.

Roche-à-Bateau

The city of Roche-à-Bateau is a coastal city, located 24 km west from southern Haiti’s main city of Les Cayes. The road to Roche-à-Bateau is a paved and in a general good condition. With a population of about 17,500 the city has a health dispensary.

The health dispensary has a building surface of about 200 m^2, including waiting areas and offices areas. The dispensary runs by Nuns with Sister Clany-Hyppolite as the head.

Image 23: Roche-à-Bateau location in Southern Haiti.



Solar power infrastructure

Table 9: Roche-a-Bateau PV Equipment.

Solar Panels	Batteries	Inverter / Charger	System installation details
REC PEAK Solar Panels in one group. 2,070W of power. Rooftop mounting with steel mounting. Category 4 hurricane-proof.	24 Flooded lead-acid batteries, forming a 48V array with a 800Ah capacity.	Outback Power Systems inverter and charger. Outback Power Systems control unit/data logger. 110V 60Hz Power rating: 3KW.	Batteries and electronics installed inside health center. UL standard electric piping. Low battery external alarm present.

Image 24: Dispensary. Solar panels on top of flat concrete roof. Roche-à-Bateau

Image 25: Inverter, charger, and electronics. Roche-à-Bateau.

The Roche-à-Bateau installation exhibits a high quality level. All installations are made according the guidelines found in the TOR of HA-X1018 and HA-X1019, and complying with IEC and UL standards. DC power runs are kept to a minimum distance; breakers and fuses are installed and well signaled. The rooftop solar panels are well anchored and safe from vandalism.

Roche-à-Bateau dispensary equipment

The power provided by the solar system powers all electrical equipment at the dispensary with the exception of refrigerators. The city has an independent electrical micro-grid that works for short period of time.

Roche-à-Bateau interview with beneficiaries

A 20-minute interview with Sister Clany-Hypolitte was carried-out. Specific questions about the number of patients, pathologies, benefits from power and unexpected implications of having permanent electric power were posed. The results are shown in Table 10:

Table 10: Roche-à-Bateau Interview Data.

Daily patients	50 – Consultation/Vaccination.
Pathologies	Malaria, TB, Fever, Anemia, Flu. Emergencies.
Previous situation	No night service. No night emergencies.
Unexpected outcomes	People from the town of Roche-à-Bateau uses the dispensary's energy to charge their cellphone and keep in contact in case of medical emergency.

Maintenance

System maintenance is performed by a local technician who does battery electrolyte control, battery contact cleaning, and paper data logging.

One technician, trained and paid by the IA, does a monthly visit checking the system and downloading the system performance data from an SD card to a shared folder online. Later the IA professionals at PAP analyze this data.

Solar Refrigerator

The Roche-à-Bateau dispensary has a propane refrigerator.

No solar refrigerator is in place.

Project Relevance

The general aim of the project was to provide electrical power to health centers and lighting for areas that were affected by the 2010 earthquake that hit Haiti. As shown, the problem with electrical power in Haiti is endemic and its reliance in imported oil for generation it only makes it worse.

This consultant surveyed the availability of power in the locations where the health centers were equipped with solar power. Table 11 shows the availability of power:

Table 11: Southern Haiti Electricity Landscape.

	EDH	Micro-Grid (local generator)	No power
Chantal	X		
Saint Jean du Sud	X		
Tiburon		X – dysfunctional	
Chardonnières			X
Les Anglais		X – dysfunctional, under repair	
Port-à-Piment		X – under repair & expansion	
Damassin		X – under repair & expansion	
Coteaux		X – under repair & expansion	
Roche-à-Bateaux		X – under repair & expansion	
Cote de Fer	X		
Randel			X
Ile-à-Vache			X

It is shown that the electricity where is supplied by EDH is poor because the service is supplied few hours per day during few days of the week.

As reported, the quality and quantity of services provided by the health centers has been greatly improved by the installation of the solar power systems. There have been also some outcomes, like the capability of tracking patient's pathologies using a computer database that exceed the basic utilization of electrical power in health environments and shows how beneficiaries profit the systems beyond the reach of the original project.

The precarious humanitarian situation at Camp Caradeux and the lack of any infrastructure, non-the less electrical, made the installation of solar streetlights a changing lifestyle event that improved many young Haitians to a safety and tranquility environment. However, the camp dwellers still lack any other basic services, like power for cooking or charging cellphones.

The arguments exposed show that this project is highly relevant to provide a power electricity solution to health centers that have a lack of electricity and relevant to solve a safety problem that occurs in the refugee camps in PAP.

This project is evaluated with **Highly Satisfactory (HS)** relevance.

Project Effectiveness

The lighting project for Camp Caradeux and Camp Sean Penn in PAP, provided with essential safety in the camps at nighttime. The Camp Caradeux illumination covered 60% of the camp with a total of 73 solar streetlights installed and Camp Sean Penn was initially provided with 37 streetlights, however the last was disassembled and those lights were moved to the neighborhoods where the inhabitants of this camp moved. With the installation of this equipment, more safety and tranquility quality of life was provided to the population of both Camps given the fact that this project was an emergency response to the PAP earthquake. Achieved the aim of this part of the project, it can be rated as **Satisfactory (S)** in its effectiveness.

The solar power provision of health centers is a complex part of Component 1 of this project and demonstrated to have been executed with technical excellence. All twelve centers have been working with 24/7 electric power (except for a battery failure in Ile-à-Vache) since the installation, more than a year ago.

The usage of the electrical power varies from beneficiary to beneficiary, some being somewhat underused and others, like the Chantal dispensary, being exploited to its maximum capacity. Particularly for the Chantal system, an expansion is in need, since there is new medical equipment that can't be used since there is no spare power left in the system.

On the other hand, a reliable program to maintain and replace the 5-year-lifetime batteries is needed. Until now the IA is in charge of the battery maintenance, but this year marks the handover to the GoH and this process should be monitored closely. The solar power system is as good as the health of the battery bank.

Considering all pros and cons, the results of the implementation of the project are **Highly Satisfactory (HS).**

Project Efficiency

The total allocation of Component 1 of the project was $1,350,000, with $500,000 provided by GEF and the rest by IDB.

Solar Streetlights

Due to the custom design, it is difficult to evaluate the efficiency in the use of funds for the solar streetlights for refugee camps. The price of US$2,990 is on the upper range of the market, but as surveyed by this consultant, the quality and durability of the installed lamps is above average. This part of the project is qualified as **Satisfactory (S)** in the efficiency of the funds used for it.

Solar Power for Health Centers

For the total power of 38,705W installed in all twelve Health Centers, US$378,250 was paid. From this amount and installed capacity, the cost of this system is US$9.77 per W, which it is reasonable considering that top-notch components from manufacturers like Outback and REC were used. As reviewed when visiting the installations, the quality of them is impeccable and no failures on the systems were reported after a year of usage. Due to these factors the efficiency on this part of the project is **Highly Satisfactory (HS).**

Project Risks

Financial Risks

The long-term usage of the PV systems for Health Centers requires maintenance. Technicians operations and a 5-year battery change is mandatory, but the project only included a 2-years period of maintenance by SELF technicians and one time battery replacement, this assures battery provision for 10 years or until year 2021 change. Considering a total cost of US$105.400 for battery replacement in all health centers, it is important to assure that the GoH or some other entity should be responsible for this financing. Assuming the current costs, expenditure of technicians for all health centers are US$24,500 per year.

As described by Mr. Thys, the GoH relies heavily on foreign institutions to finance all type of infrastructure, so it is likely they will do this for the project. It would be advisable for the health centers to generate a financial mechanism to provide technical service after the 2-years period is finalized.

It is **Moderately Likely (ML)** that the project risks running out of funds in a country like Haiti.

Socio-political Risks

The 2 outcomes of Component 1 of the project have strong social implications.

The streetlight installation in the refugee camps show a clear improvement of safety during nights and as well as a solid compromise of the community with these benefits. As examined, most streetlights in Camp Caradeux are still functioning and free of damage from vandalism.

The PV systems provided to the health centers made a change on the way of health services (for better) in some of the centers as well as the social benefit in some others as the cellphone charging in Roche-á-Bateau. All health centers benefited with this program have surely saved lives because the 24/7 availability of electrical power.

It is notice that there is **Likely (L)** no socio-political risks related to the implementation of the project.

Institutional Framework and Governance Risks

This project provided light and power to communities and health centers in need. Although the GoH participated in the selection of the sites, this work was mainly handled by IDB, GEF and the IA. No further interaction with the GoH is needed but the one for the aspects mentioned in the Financial Risk section.

There is **Likely (L)** no risk in the institutional and governance aspects of the project.

Environmental Risk

Haiti is a country with decimated natural resources. Only 3% of the country preserves natural forests, there is lack of potable water and there are widespread diseases related to the lack of sanitation.

The PV systems installed by this project, rely heavily on batteries to provide continuous power. Both the streetlights and the PV systems for the health center have lead-acid batteries on them.

The lifetime of these batteries is around 5 years, and a system like the one in Port-à-Piment has 7,200lbs of batteries, of which about 4,800lbs are pure lead. For the 20-year lifespan of the system there will be 19,200lbs (about 9 metric tons) of lead waste.

According to the IDB's Energy Specialist in Haiti, the country has a network of informal lead recyclers. No batteries are ever spotted in dumpsters, since the metallic lead is too valuable. From that, informal recycling is dangerous and polluting, agencies should consider budget to recycle the batteries in a safe manner.

Also, at 43.7kW (including PV systems plus street lighting) of installed power the reduction of CO_2 emissions has been calculated showing total greenhouse gases (GHG) emission avoided of 3,111 tonnes CO_2-eq. Here, an emission factor of 0.87 kg of CO_2/kWh was considered taking into account the total amount of electricity produced in the country and the quantity of different fossil fuel combusted within dedicated electricity plant sourced from the IEA (2011)[4]. Table 12 shows direct and indirect emission of the project.

Table 12: Direct and Indirect Emissions of the Project (tonnes CO_2-e).

Direct emissions reductions	3,111
Direct post-project GHG emissions reductions	29,802
Indirect (bottom-up) emissions reductions	397,367
Indirect (top-down) emissions reductions	17,517

The average useful investment lifetime of the project is of 10 years. Replication factor of the project was assumed as 12 due to the number of facilities where PV systems were installed.

Tracking tool of the Project is reported in Annex 6.

This project has a **Moderately Unlikely (MU)** chance to not distress the Haitian environment.

[4] IEA (2011a). Statistics by country/region for coal and peat, oil, and natural gas (data for 2008). http://www.iea.org/stats/index.asp
IEA (2011b). Statistics by country/region for electricity/heat (data for 2008).
http://www.iea.org/stats/prodresult.asp?PRODUCT=Electricity/Heat

Catalytic Role

This report describes how some of the health centers, like the one in Chantal, made a surprising good use of the 24/7 availability of electrical power. Also the community leaders serving Camp Caradeux are taking care of their streetlights. These two examples should be taken as successful cases for other Haitians to see how external assistance is leveraged with local efforts in a synergistic fashion.

More health centers will surely take the Chantal health dispensary as an example, and more community leaders will see how Camp Caradeux streetlights are not being vandalized.

Recommendations

As recommendation, the issue of safe battery recycling is the most evident. Throughout this document the necessity to avoid lead contamination was exposed. It is also known that informal battery recycling is dangerous and polluting. To enhance this project, and future ones, a recycling program must be included. One possible solution might be to include recycling services with the purchase of the battery banks, relying on the battery provider to properly handle the procedure.

Lessons Learned

- Solar streetlights are a normal feature of the urban Haiti landscape in 2014. What is also normal that those streetlights are normally vandalized, and the solar panels and batteries stolen. In the case of Camp Caradeux, 0 (zero) lamps were vandalized. The rugged, anti-vandalism equipment utilized and the control and containment performed by the self-administrated community, demonstrated to be very helpful to protect the premises.
- Not all health centers exhibit the same level of dynamism when it comes to the use of electrical energy. Some centers rapidly used all the capacity installed for new and better services, where others simply kept doing business-as-usual. In the future an adaptation period would be a great addition. During this period, the usage and innovation could be measured, an in that way a better balancing on the use of the funds could be done.

- This project included an extensive work with the community. Beneficiaries participated in trainings and information sessions that highlighted all the important aspects about capacities, limitations and maintenance of the installed equipment. The response to this community work can be appreciated in exceptional usage and maintenance of the systems. This kind of action is fundamental in projects where distributed technical infrastructure is deployed, and should be replicated in future endeavors of this kind.

Annex 1: HA-X1018 AND HA-X1019 Project TOR

TERMS OF REFERENCE
EMERGENCY PROGRAM FOR SOLAR POWER GENERATION FOR HAITI
HA-X1018 and HA-X1019

1. BACKGROUND.

The Emergency Program for Solar Power Generation for Haiti to be financed with the Sustainable Energy and Climate Change Initiative of the Inter-American Development Bank (IDB) and the Global Environment Facility (GEF), will support Haiti's local authorities in the provision of sustainable and clean energy at this time of crisis, through the use photovoltaic (PV) panels and solar refrigerators for vaccine and medicine conservation. This project will contribute to promote solar PV as a sustainable and autonomous form of alternative renewable energy, in times when diesel fuel is difficult to obtain, transport, and purchase in Haiti.

This project is part of a larger program where the GEF, World Bank (WB) and the IDB have contributed US$ 3 million (each institution contributing US$ 1 million) for solar equipment. The IDB will execute US$ 1.5 million to purchase, install and operate PV systems and solar refrigerators, while the WB will execute the rest of funds to purchase and distribute solar lanterns.

The IDB retainer (ATN/OC-11183-RG), awarded to the consulting firm IT Power through an international tendering process, was used for the selection of an implementing agency that would manage and procure the PV and solar refrigerators systems on behalf of the IDB. The non-profit charity organization called Solar Electric Light Fund (SELF) was selected by IT Power as the implementing agency between a group (short list of 6 firms and NGOs) of highly reputable organizations with vast experience in managing solar systems in developing countries, particularly in Haiti.

Given the fact that this program is an emergency response program for Haiti, the IDB and GEF have agreed to facilitate the procurement of PV and solar refrigerator systems through direct procurement. Therefore once the contract (including these TORs) between IDB and SELF is signed, SELF will be able to purchase the solar equipment directly, as well as install and operate the systems, according to the terms and conditions mentioned here below.

2. OBJECTIVES OF THE PROJECT

The general objective of this project is to support the country's emergency responses to the Port au Prince earthquake of January 12, 2010 by providing autonomous energy using solar PV applications and solar refrigerators.

The specific objective of this project is to design, purchase, install, operate and maintain solar PV systems and solar powered refrigerators to provide electricity and appropriate conditions for vaccine conservation for emergency centers and key establishments during disaster management and reconstruction. Additionally, were required, the PV systems will include water pumping and water purification capabilities.

3. ROLE OF THE IMPLEMENTING AGENCY (IA)

The main tasks of the Implementing Agency will be:

a. Design the PV systems. The IA shall design the configuration of the PV generation system, tentatively of 10-KW/system for each site.

b. Procurement of hardware. The IA will be in charge of the procurement of the systems, which includes transportation, payment of duties and taxes (if applicable) and storage. Annex A includes information about PV and solar refrigerators suppliers that could facilitate the IA in their procurement process.

c. Installation, maintenance and training of local technicians. After the systems have been designed and the procurement completed, the IA will install, operate and maintain the system for one (1) year as well as train local personnel and technicians that will continue to maintain and operate the systems, in behalf of the GoH, after the first year of operation.

4. THE SELECTED SITES

The GoH has pre-selected five sites and is working to select other highly sensitive locations. The five sites pre-selected are schools, clinics and community centers being constructed under the supervision of the Government of Haiti as humanitarian assistance projects. Three of these sites are located in the Gonaives Region, two are in the Grande Anse (Western Region) and the sixth site will be a refugee camp for displaced persons. The location of the latter has not yet been defined. The IA and the GoH will have to define the precise location of this sixth site. This site will use a similar configuration as those of the other selected sites.

There is no electricity available at the selected sites, thus the GoH requested IDB to utilize the grant funds under this program to provide power for these locations.

The three of the projects sites located in the Gonaives Region were visited and described as follows:

1. Mandrin. The Mandarin site will consist of a community center, a small school, and a clinic and community building. At present there are no structures on the site, however the international community assistance is planning and constructing the buildings. The PV systems will be integrated in the design of the buildings and the electricity consumption will be adapted to the availability of power from the PV system.

2. Hatte. Hatte is a small village not far from the coast. The village school was destroyed in one of the 2008 hurricanes. The rubble and debris was just cleared just before the earthquake. There will be a new school in this site which will use one of the PV systems of this project. The area is prone to flooding, therefore the school project will utilize the existing building foundation to provide flood security.

3. Desdunes. Desdunes is another small village not far from the coast and close to Hatte. There is an existing school in this site, however the plan is to add additional classroom buildings. Since the earthquake the school is overcrowded, therefore the need for more classrooms is urgent and so is the need for electricity to power the building. There is also a need for a clinic, community house, water well and its storage tank. The design of the project will also analyze the power requirements of the other buildings and well.

The remaining two selected sites are located in the Western extreme of the country.

The Implementing Agency will liaise with the GoH to identify all the remaining sites during the first 2 weeks of the implementation of the project.

5. TERMS OF EXECUTION

Timeframe: The overall term of execution is 14 months, effective from the date of signing the contract. Extensions, if deemed necessary, can only be granted through mutual agreement between the parties and the consent of the GoH.

Branding Display: All labelling related to the equipment’s brand name, model or other, shall be discreet and unobtrusive. Nevertheless, the labelling should provide indication that the systems were installed by the Government of Haiti, with funds provided by IDB and the GEF. The location of the display, which will consist of a metal plaque, for the PVs and solar refrigerators, will show the name of the sponsors and of the projects (IDB, GEF and SELF). For offices and control rooms funded under this project, these should be labelled with a sign showing the name of the sponsors and of the project (IDB, GEF and SELF).

Guarantees: The supplied equipment shall be tested, certified and commissioned in perfect operating condition and shall be warranted against any defects liability (parts and labour) for a minimum period of 12 months from the date of commissioning. This warranty covers all manufacturer / workmanship defects only.

Furthermore, all main components shall also have an individual warranty for defects in materials and workmanship and an operation and performance guarantee backed by the manufacturer. For the main components, the minimum acceptable manufacturers' guarantee period, from the date of purchase, against material and manufacturing faults are: PV modules – minimum 36 months and 20 year performance guarantee; Inverters and electronic converters – minimum 24 months.

The IA shall be liable for operational and maintenance problems for one year following acceptance of the commissioning reports. The IA shall take all reasonable provisions to prevent theft of the systems, including using theft-resistant hardware and solar module racks, security doors and locks, alarms on the control and battery guards, and security guards during installation and for 1 year after – providing the community center does not already have guards on duty.

Norms and Regulations: The IA must fullfil laws, regulatory and technical documentation, national by-laws and decrees, in effect in Haiti. All work must be accomplished using methodology internationally accepted for solar photovoltaic technology installations of the type being installed under this project. By signing the contract, the IA accepts responsibility for the design, supply and installation(s) of the complete solar system(s). If, by any chance, a new regulation is enacted during the contract period in relation with work being undertaken, the IA should inform the IDB and GoH in order to agree upon any possible changes.

Quality and origin of the material: All equipment, components, and various accessories used for the installation must be new and of high quality manufacture. Any types of equipment, components and materials can be proposed by the IA, as long as they fulfil the technical requirements laid out in this document and also comply with the applicable rules of origin.

Costs associated with shipping all equipment to a safe storage in Haiti should be included in the procurement costs. Shipping costs shall include all handling, packing, marking, loading, freight, insurance, duties and taxes, unloading, local transport, unpacking and checking costs in connection with the supplies shipped to Haiti. The shipping from storage facility (possibly in Port of Prince) to the project sites will be covered by IA.

6. TECHNICAL SPECIFICATIONS

General specifications.

The equipment furnished must meet or exceed all requirements herein. Also, the equipment shall conform to the accepted industry standards and relevant international quality standards. Nevertheless, the technical specifications presented herein are not to be interpreted as necessarily defining a particular manufacturer's product, model or features.

It should be noted that the equipment offered should be suitable for operation at 110V, 60 Hz, 1-Phase AC electric service.

All equipment shall be fully operational in the following conditions:
• Relative humidity up to 95%
• Ambient temperature from 20°C to 45°C
• Environment with high presence of dust, insects, salinity, etc.

External equipment shall additionally withstand the following conditions:
• High ultra violet radiation
• Wind speeds up to 110 miles per hour

The ability of the equipment of the same basic design and size to operate correctly in the indicated environmental and climatic conditions shall be demonstrated by appropriate documentation as supplied in manufacturers product specification sheets.

System design.

The IA will design the system systems for each site. Full technical specifications and generic drawings of the proposed physical design shall be provided showing the construction and assembly of the mounting structures and the details of the mounting of the modules and their attachment onto the supporting structure. These must specifically include physical size, and details of materials used in construction.

The IA shall provide engineering calculations confirming that the design will meet the requirements of each site.

The IA shall provide “as-built” drawings upon completion of system construction which accurately reflect actual system construction.

Mechanical design and exposure to environmental conditions.

Support structures and module mounting arrangements should comply with all applicable building codes, regulations and standards. Particular attention should be given to wind loads on PV systems. Wind loading capability shall be 110 miles per hour. All structures shall be made of corrosion resistant materials e.g. aluminium, galvanized steel, treated wood structures, etc. The same applies to all bolts, nuts and fasteners.

Provisions shall be made in order not to create electrochemical corrosion between the structures and the building on the one hand, and the structures and photovoltaic modules on the other. The negative conductor should be connected to the earth electrode as this arrangement will reduce electro-chemical degradation of the electrode and other metallic parts.

PV system wiring and associated components are exposed to UV, wind, water and other environmental conditions. Wiring and components should be fit for this purpose and built in such a way as to minimize exposure to detrimental environmental affects.

Particular attention is drawn to the need for prevention of water accumulation in cable/module support systems.

Safety issues.

Protection against electric shock in the Direct Current (DC) side shall be achieved either by remaining under extra-low voltage levels (<120V) in the whole line, or by keeping low voltage levels (<600V) and protect the lines by metallic conduit (US NEC code reference) together with components and systems classified as Class III or better and galvanic isolation or equivalent of the inverter. However, the voltage on the DC side will be determined by the number of PV modules to be connected in series in each string, which will have to comply with the inverter DC voltage input range. Hence, applicants for the provision of inverters and PV modules shall be required to state in their proposals the DC voltage levels at which their proposed equipment will operate.

Maximum photovoltaic system voltage shall be established following NEC section 690.7.

Each disconnect and over-current device and the insulation of the wiring must have a voltage rating exceeding the system voltage rating.

Energized parts in photovoltaic source circuits and photovoltaic output circuits over 150 volts to ground shall not be accessible to other than qualified persons while energized.

For the AC side, protection by double or reinforced insulation between any live conductor and any earthed or exposed conductive part is required.

Protection against over current.

Protection against over current in strings: Fault currents due to short circuits in modules, in junction boxes or in module wiring or earth faults in wiring can result in over current in a PV generator if there are multiple parallel adjacent strings.

For this reason over current protection in each string is required.

The PV source circuits shall have over-current devices rated at least 125 percent of the parallel module short-circuit current. The PV-output circuit over-current devices shall be rated at least 125 percent of the short-circuit PV currents.

Either fuses or circuit breakers are acceptable for over-current devices provided they are rated for their intended uses.

Protection against effects of lightning and over-voltage.

The installation of a PV system on a building has a negligible effect on the probability of direct lightning strikes; therefore it does not necessarily imply that a lightning protection system should be installed if none is already present.

Damage caused by over-voltage is ultimately due to the failure of insulation between live parts or between live parts and earth. The intention of over-voltage protection is to equalize all exposed metallic sections of an installation to a common potential during the event of an over-voltage. Grounding is therefore required as an important over- voltage protection measure and shall be done in accordance with recognized standards or acceptable state of the art.

To avoid the formation of wiring loops between earthed conductors and DC cabling, grounding conductors should run parallel and as close as possible to the d.c. cabling. It is also recommended to branch the bonding conductor to run parallel with all the d.c. cabling branches.

Metal conduit will add inductance to the array-to-building conductors and slow down any induced surges as well as provide some electromagnetic shielding.

System components

NOTE- The components that will be provided by the IA under a procurement process for acquisition are marked as “to be provided by IA via procurement” in the specifications below. The components not marked will be supplied by the IA during the installation.

PV modules – to be provided by IA via procurement

PV modules supplied under this contract shall be either crystalline or thin film silicon PV modules that comply with the norm IEC 61215 edition 2 and shall be qualified to and be classified by Class according to IEC 61730-1 and IEC61730-2.

The module’s junction boxes with the positive and negative terminals shall incorporate bypass diodes that have the function of preventing any possibility of the electrical circuit inside the module being broken due to the partial shading of a cell.

The photovoltaic modules shall be warranted to provide their rated output at standard conditions within ±15% for a minimum of 20 years under the harsh tropical, coastal conditions at the sites.

PV system junction/combiner boxes - to be provided by IA via procurement.

PV system combiner and fuse boxes are exposed to the environment, shall be readily available, shall be at least IP 65 and shall be UV resistant. The terminals must be clearly marked with + and – for the corresponding connections.

Batteries

All systems shall be equipped with flooded batteries. Each system shall include adequately sized battery banks to provide no less than three days autonomy if there is a back-up generator installed (existing diesel generator not financed by this project) onsite or two days autonomy if there is not.

Inverter - to be provided by IA via procurement

The inverter system must be capable of providing continuous power at the level required by each installation under the full range of environmental conditions of temperature and humidity found at the sites.

The inverter system shall be capable of synchronization with an external power supply (generator or utility grid) for battery charging through the inverter.

The UL 1741, Standard for Inverters, Converters and Controllers for use in Independent Power Systems should be the test procedure to certify that equipment to meet IEEE 929-2000.

Inverters.

The inverter system should have an operating efficiency of at least 80% at 10% of specified power and greater than 90% at 70% of specified power.

Total harmonic distortion (THD) shall be less than 5%.

Switching devices

All switching devices, shall comply with the following requirements:
- Have a voltage rating equal to or greater than 1.2 x VOC pvg.
- Not have exposed live metal parts in connected or disconnected state; - interrupt all poles.

Cables

NOTE: This clause needs to be checked against local building codes and practice

The distance between the PV system and the inverter should be as short as possible (typically < 50m . However, if because of particular conditions, longer distances are required, the cable sizes for the PV system cable shall be determined with regard to both the minimum current capacity and the maximum voltage drop requirements. The larger cable size obtained from these two criteria shall be applied.

Cables used within the PV system shall have a voltage rating of at least 1.2 x VOC-pvg; have a temperature rating higher than 40 °C above ambient temperature; be UV- resistant, or the cables be installed in UV-resistant conduit; water resistant and it is recommended that they be flexible (multithreaded) to allow for thermal/wind movement of arrays/modules.

Where cable ties are used as a primary means of support they must have a lifetime greater than or equal to the life of the system. (No plastic cable ties exposed to UV shall be used).

Fuses

Fuses used in PV systems shall be rated for d.c. use, have a voltage rating equal or greater than 1,2xVOCpvg, be rated to interrupt fault currents from the PV system.

Disconnecting means

Disconnecting means shall be provided in PV systems to isolate the PV system from the inverter.
Disconnection means of the inverter output shall be provided. No external PV plant disconnection is required.

Support Structure

The PV modules and the supporting structure must be made with marine grade aluminium, anodized aluminium or stainless steel with appropriate seals to prevent water and corrosion damage to the active components of the panel. The module support structures may also be made of galvanized steel.

The support frames shall be anchored to the roof or grounds of the selected sites with great attention not to damage to the water proofing of the building. Due to expected high wind loads, and subsequent potential for damage from flying debris, all PV modules must be securely installed to the roof as dictated by site conditions.

Data Acquisition System

Each installed PV system shall be outfitted to include a data acquisition system (DAS). The DAS may be a stand alone data-logger, or the DAS function may be included as part of the inverter functions. The system shall monitor and report the minimum number of data channels required for determining system performance. If connectivity (band width) is available (GSM, GPRS, CDMA, or wi-Max), the IA will collect the data via remote electronic access. Otherwise, the IA will collect the data, manually, using a PC.

Installation requirements

PV System structure mounting
Fastening of the structure to roofs should take into consideration existing waterproofing and thermal protection and shall not result in compromise of existing protection.

Material compatibility and the use of dissimilar metals shall be considered. PV modules and mounting hardware (bolts, screws, washers, etc) shall be well protected from corrosion. Steel-mounting hardware in contact with aluminium hardware is an example of metal combinations that have a high potential for corrosion.

Dissimilar metals can be separated by washers made of fluorocarbon polymer, phenolic, or neoprene rubber.

Placing the inverter

The inverter shall be placed as near the PV system as reasonably possible. If the inverter has a display panel it shall face in the adequate direction and height for easy inspection by the owner. The top of the inverter shall be placed at a height no greater than 6 feet above grade and no lower than 4 feet above grade.

Verification and Performance Tests

After completing the installation, verification and performance tests shall be performed by the IA and witnessed by a member of the Government of Haiti and/or the IDB. Before interconnection a complete system inspection shall be performed by the IA designated staff.

The main aspects to be tested are: Generator subsystem – testing of performance and inspection of compliance with standards. Inverter subsystem – testing of functionality and inspection of compliance with standards. Data logging equipment- testing the data acquisition performance and export for analysis.

The IA shall instantly fix any malfunctioning part or system resulting from the test and repeat the test until the system passes the required test.

A system acceptance and hand-over report shall be generated by IA and presented for to Government of Haiti and IDB for signature.

At intervals of six months and one year of operation, the system performance will be assessed by IA using the technical data downloaded from the data logger, the meter readings as well as user questionnaires. A performance report shall be issued to IDB for each of these periods for acceptance.

Documentation and Training

In addition to system supply, installation and commissioning, the IA will develop and execute a full training program, complete with pre-and post-tests, for local technicians and engineers who will be in charge of system operation & maintenance (O&M). This program shall assure that local staff will have capability of operating the maintaining the systems after program completion (one year after the start up).

The IA will also provide operation and maintenance manuals for all installed systems.

7. REPORTS, PRODUCTS ANDPAYMENT

The IA shall prepare the following reports (including an executive summary):

Inception Report: The report will include a detailed work plan (including methodology to be used, interviews, development of activities, etc.), schedule of activities of the team and schedule for all milestones. The Inception Report will be delivered within three weeks after signing the contract and will include the training program plan.

Design and Procurement Report. A document with full technical specifications and generic drawings of the proposed physical design shall be provided showing the construction and assembly of the mounting structures and the details of the mountingof the modules and their attachment onto the supporting structure. These must specifically include physical size, and details of materials used in construction. It should also include the engineering calculations confirming that the design will meet the requirements of each site. The report will also include all cost associated with the procurement of equipment, including shipping, storage, installation, including the shipping cost from storage facility to the respective site. The IA should also provide details of financial disbursement are Costs associated with supplying all equipment to a warehouse.

Report showing successful PV Systems Installed. Each system will be commissioned via a verification test will be performed and approved by the IDB. This report will include copies of as-built drawings.

Guidelines for operation and maintenance. This document will be delivered after the installation.

Report from Training Course. This document will be delivered after the completion of preliminary course training. It shall detail the nature of all training conducted, participants, and follow up plan.

Midterm report (6 months report after system acceptance). Using the technical data downloaded from the data logger, the meter readings as well as user questionnaires, a report will be submitted after 6 months of operation.

Final report. Using the technical data downloaded from the data logger, the meter readings as well as user questionnaires, a report will be submitted after a year of operation. This report should explain how the project is successfully transferred to the GoH, once the IA has concluded its contract with the IDB.

8. DISBURSEMENTS

The contract will cover all honoraries, management cost of the project, travel costs, per diem, lodging of IA's personnel as well as all costs described in these TORS for the successful installation and operation of the solar PV, refrigerator, and water pumping systems. The disbursement schedule is the following:

- 20% after signature of the Contract and approval of the Inception Report ;
- 35% after approval of the design and procurement report, including the identification of the supplier of both PV systems and solar refrigerators.
- 15% upon present bill of lading (shipping documents of the entire purchase)
- 15% upon clearing of Haitian Customs of the entire purchase
- 10% after approval of report and inspection of commissioning of the PV systems installed and operative.
- 2% after approval of Midterm report (6 month after installation), including operation and maintenance guidelines, training course and teaching material.
- 3% after approval Final report (including the successfully transfer of all project procured systems to the GoH).

9. COORDINATION

The IA will report directly to the IDB Project Manager. The IA will coordinate actions with the GoH and project coordinator hired under this program to liaise between the GoH and IA.

The activities will be developed in close coordination with the Energy Division of the Infrastructure and Environment Department (INE/ENE) of the IDB and the IDB country office in Haiti (CHA). INE/ENE will have the technical responsibility of this project as well as the approval of reports and the products prepared by the IA.

In representation of the IDB, the technical coordination for this assignment rests with Mr. Christiaan Gischler, Energy Specialist based in Washington DC (phone: (202) 623- 3411; e-mail: christiaang@iadb.org) and Mr. Lumas Kendrick based in Port au Prince (phone (509) 2812-5026; e-mail lumask@iadb.org).

Annex 2: Terminal Evaluation TOR

HAITI

EMERGENCY PROGRAM FOR SOLAR POWER GENERATION FOR HAITI

HA-X1018 and HA-X1019

TERMS OF REFERENCE

FINAL EVALUATION

I. Background

1.1 The Emergency Program for Solar Power Generation for Haiti was financed with the Sustainable Energy and Climate Change Initiative of the Inter-American Development Bank (IDB) and the Global Environment Facility (GEF), and supported Haiti's local authorities in the provision of sustainable and clean energy at a time of crisis, through the use photovoltaic (PV) panels and solar refrigerators for vaccine and medicine conservation. This project contributed to promote solar PV as a sustainable and autonomous form of alternative renewable energy, in times when diesel fuel was difficult to obtain, transport, and purchase in Haiti.

1.2 The IDB awarded the consulting firm IT Power through an international tendering process, and it was used for the selection of an implementing agency that managed and procure the PV and solar refrigerators systems on behalf of the IDB. The non-profit charity organization called Solar Electric Light Fund (SELF) was selected by IT Power as the implementing agency between a group (short list of 6 firms and NGOs) of highly reputable organizations with vast experience in managing solar systems in developing countries, particularly in Haiti.

1.3 IDB is a GEF Agency and is required to prepare, in English, a terminal (final) evaluation report at project completion for all GEF projects.

2.1 Prepare the Final Evaluation Report of the GEF project following the GEF guidelines.

3.1 The final evaluation aims to promote accountability for the achievement of GEF objectives through the assessment of results, effectiveness, processes, and performance of the partners involved in GEF activities.

3.2 The terminal or final evaluation must provide a comprehensive and systematic account of the performance of a completed project by assessing its project design, process of implementation, achievements vis-à-vis project objectives endorsed by the GEF including any agreed changes in the objectives during project implementation, and any other results.

3.3 Terminal evaluations have four complementary purposes:

3.3.1 To promote accountability and transparency, and to assess and disclose levels of project accomplishment;

3.3.2 To synthesize lessons that may help improve the selection, design, and implementation of future GEF activities;

3.3.3 To provide feedback on issues that are recurrent c. across the portfolio and need attention, and on improvements regarding previously identified issues;

3.3.4 To contribute to the GEF Evaluation Office databases for aggregation, analysis, and reporting on the effectiveness of GEF operations in achieving global environmental benefits and on the quality of M&E across the GEF system;

3.3.5 Terminal evaluations should not be used as an appraisal, preparation, or justification for a follow-up phase of the evaluated project.

3.3.6 The consultant should take into i. account the views of all relevant stakeholders.

3.4 The consultant should become familiar with the project document and will use the information generated by the project including, but not limited to, baseline data and information generated by the project M&E system. Evaluator should also seek the necessary contextual information to assess the significance and relevance of results.

3.5 The terminal evaluation report will provide information on when the evaluation took place, places visited, who was involved, the key questions, and the methodology.

3.6 The GEF three criteria will be used in terminal evaluations in assessing level of achievement of project outcomes and objectives:

a. **Relevance.** Were the project's outcomes consistent with the focal areas/operational program strategies and country priorities?
b. **Effectiveness.** Are the actual project outcomes commensurate with the original or modified project objectives? If the original or modified expected results are merely outputs/inputs, the evaluators should assess if there were any real outcomes of the project and, if there were, determine whether these are commensurate with realistic expectations from such projects.
c. **Efficiency.** Was the project cost effective? Was the project the least cost option?
Was project implementation delayed, and, if it was, did that affect cost effectiveness?
Wherever possible, the evaluator should also compare the costs incurred and the time taken to achieve outcomes with that for similar projects.

4.1 Deliverable No. 1: The Consultant shall prepare and submit to Team Leaders an interim report of the Final Evaluation.

4.2 Deliverable No. 2: Final Revised Report of Final Evaluation. The revised version should include the comments provided by the team leaders to the deliverable No. 1.

4.3 Deliverable No. 3. Power Point presentation of the Final Evaluation Report.

5.1 20% upon signature of contract;

5.2 40% upon approval of deliverable No. 1;

5.3 40% upon approval of deliverable No. 2 and 3.

6.1 Department/Division: INE/ENE

6.2 Team Leader / Coordinator: Team: the consultant will report directly to IDB. The activities will be developed in close coordination with the Energy Division of the Infrastructure and Environment Department (INE/ENE) of the IDB and the IDB country office in Haiti (CHA). INE/ENE will have the technical responsibility of this project as well as the approval of reports and the products prepared by the consultant.

6.3 In representation of the IDB, the technical coordination for this assignment rests with Mr. Christiaan Gischler, Energy Specialist based in Washington DC (phone: (202) 623-3411; e-mail: christiaang@iadb.org) and Mr. Kenol Thys based in Port-au-Prince (phone (509) 2812-5044; e-mail pthys@iadb.org).

6.4 General Considerations for Deliverables and Documents: the selected Consultant to perform the Task ("Contractor") shall undertake a quality control review process, including a technical and editorial review, of all deliverables and documents submitted to ensure readability, accuracy, and consistency. The Contractor shall prepare the Final Report in English.

7.1 Consultancy Category & Modality: **¡Error! No se encuentra CampoCombinación en el registro inicial u origen de datos.** & Lump Sum.

7.2 Contract Duration: February 1 to March 31, 2014.

7.3 Place(s) of work: The work will be carried out in Haiti and at the Consultants office. The contract will include one trip of 7 days of duration.

7.4 The Bank will provide the consultant the following documents:

a. Approved GEF project;
b. Mid Term Evaluation GEF document;
c. Project Implementation Report (PIR);
d. SELF final evaluation report;
e. Guidelines for GEF Agencies in Conducting Terminal Evaluations. GEF Evaluation Document No. 3 2008.

7.5 The consultant should provide an independent, unbiased, and free of conflicts of interest evaluation.

7.6 The final or terminal evaluation report will be published and make public and will be circulated among the GEF country focal points and relevant government counterparts.

8.1 Academic Degree/level and years of professional experience: At least 5 years of experience with strong evaluation experience, requisite expertise in the subject matter of the project, and experience in economic and social development issues. The evaluator should be knowledgeable about GEF operational programs and strategies and about relevant GEF policies such as those on project life cycle, M&E, incremental costs, and fiduciary standards.

8.2 Language: Fluency in English, French and Spanish.

8.3 Areas of expertise: Experience processing of raw survey data into usable information, preparation of final reports and high level presentations.

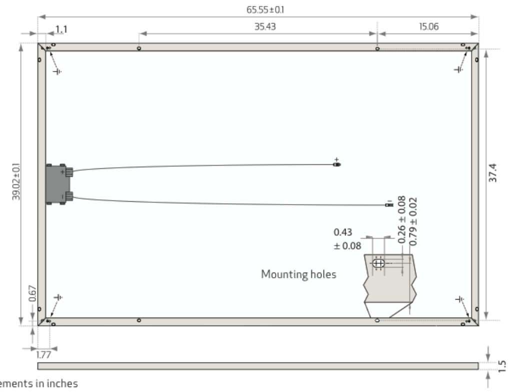
8.4 Skills: The selected Consultant to perform the Task ("Contractor") shall undertake a quality control review process, including a technical and editorial review, of all deliverables and documents submitted to ensure readability, accuracy, and consistency. The Contractor shall prepare the Final Report in English and Spanish.

Payment and Conditions of Employment: If the work will be carried out at Bank headquarters in Washington D.C. Remuneration will be determined in accordance with Bank regulations and criteria. The Bank will additionally contribute toward travel and moving expenses, if applicable. If a candidate is not a citizen or resident of the United States, the Bank will apply for a G-IV visa from the consulate of the United States in the candidate's country of origin. If a candidate cannot obtain a visa to work at the IDB the contractual offer will be rescinded.

Consanguinity: Individuals with relatives working for the IDB within, and including the fourth degree of consanguinity and the second degree of affinity are not eligible for employment as staff, consultants, or contractors through firms or agencies. Candidates must be citizens of a member country of the Inter-American Development Bank

Annex 3: Solar Panels Specs Sheet

REC PEAK ENERGY BLK SERIES



All measurements in inches

16.1%	EFFICIENCY
10	YEAR PRODUCT WARRANTY
25	YEAR LINEAR POWER OUTPUT WARRANTY
DUTY★FREE	US IMPORT DUTY FREE

ELECTRICAL DATA @ STC	REC240PE BLK	REC245PE BLK	REC250PE BLK	REC255PE BLK	REC260PE BLK	REC265PE BLK
Nominal Power - P_{MPP} (Wp)	240	245	250	255	260	265
Watt Class Sorting - (W)	0/+5	0/+5	0/+5	0/+5	0/+5	0/+5
Nominal Power Voltage - V_{MPP} (V)	29.7	30.1	30.2	30.5	30.7	30.9
Nominal Power Current - I_{MPP} (A)	8.17	8.23	8.30	8.42	8.50	8.58
Open Circuit Voltage - V_{OC} (V)	36.8	37.1	37.4	37.6	37.8	38.1
Short Circuit Current - I_{SC} (A)	8.75	8.80	8.86	8.95	9.01	9.08
Panel Efficiency (%)	14.5	14.8	15.1	15.5	15.8	16.1

Analysed data demonstrates that 99.7% of panels produced have current and voltage tolerance of ±3% from nominal values.
Values at standard test conditions STC (airmass AM 1.5, irradiance 1000 W/m², cell temperature 25°C).
At low irradiance of 200 W/m² (AM 1.5 and cell temperature 25°C) at least 97% of the STC panel efficiency will be achieved.

ELECTRICAL DATA @ NOCT	REC240PE BLK	REC245PE BLK	REC250PE BLK	REC255PE BLK	REC260PE BLK	REC265PE BLK
Nominal Power - P_{MPP} (Wp)	183	187	189	193	197	202
Nominal Power Voltage - V_{MPP} (V)	27.7	28.1	28.3	28.5	29.0	29.4
Nominal Power Current - I_{MPP} (A)	6.58	6.64	6.68	6.77	6.81	6.90
Open Circuit Voltage - V_{OC} (V)	34.4	34.7	35.0	35.3	35.7	36.0
Short Circuit Current - I_{SC} (A)	7.03	7.08	7.12	7.21	7.24	7.30

Nominal operating cell temperature NOCT (800 W/m², AM 1.5, windspeed 1 m/s, ambient temperature 20°C).

TEMPERATURE RATINGS	
Nominal Operating Cell Temperature (NOCT)	45.7°C (±2°C)
Temperature Coefficient of P_{MPP}	-0.40 %/°C
Temperature Coefficient of V_{OC}	-0.27 %/°C
Temperature Coefficient of I_{SC}	0.024 %/°C

GENERAL DATA	
Cell Type:	60 REC PE multi-crystalline 3 strings of 20 cells with bypass diodes
Glass:	1/8" mm solar glass with anti-reflection surface treatment
Back Sheet:	Double layer highly resistant polyester
Frame:	Anodized aluminum (black)
Junction Box:	IP67 rated 4 mm² solar cable, 35" + 47"
Connectors:	Multi-Contact MC4 (4 mm²)
Origin:	Made in Singapore

MAXIMUM RATINGS	
Operational Temperature:	-40 ... +85°C
Maximum System Voltage:	600 V
Design Load:	75.2 lbs/ft² (3600 Pa)* 33.4 lbs/ft² (1600 Pa)* *Refer to installation manual
Max Series Fuse Rating:	15 A
Max Reverse Current:	15 A

CERTIFICATION

UL 1703, IEC 62716 (ammonia resistance) & IEC 61701 (salt mist corrosion - severity level 6).

WARRANTY

10 year product warranty.
25 year linear power output warranty
(max. degression in performance of 0.7% p.a.).

MECHANICAL DATA	
Dimensions:	$65\ ^{1/2}$ x 39 x $1\ ^{1/2}$ in
Area:	17.76 ft²
Weight:	39.6 lbs

Note! All given specifications are provisional data only and subject to change without notice at any time.

Ref: NE-05-05-04-R 12.13

REC is a leading global provider of solar energy solutions. With more than 15 years of experience, we offer sustainable, high performing products, services and investments for the solar industry. Together with our partners, we create value by providing solutions that better meet the world's growing energy needs. Founded in Norway, REC is listed on the Oslo Stock Exchange (ticker: RECSOL) and headquartered in Singapore. Our 1,500 employees worldwide generated revenues of NOK 4.1 billion in 2012.

REC
www.recgroup.com

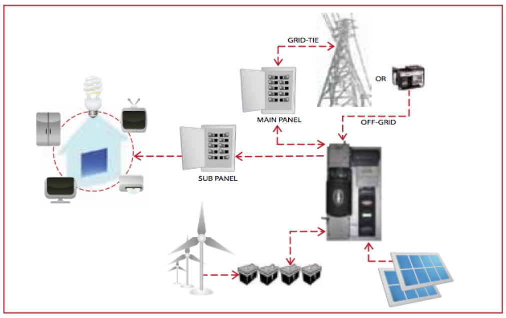
Annex 4: Inverter Specs Sheet

FLEXpower ONE Specifications

Pre-wired Systems*
System includes: FM-80 Charge Controller, MATE3 Programmer, FLEXnet DC, FW-SP-ACA, GDFI, HUB10 Communications

For 120 VAC/60 Hz Applications	*Description*	*Inverter(s)*	*FW-X240*	*BYPASS*	*Outlet*	*Inverter OCPD*	*PV OCPD*	*RTS*
FP1 VFX3524	VFX3524 3.5kW FLEXpower ONE	VFX3524	–	120 VAC Bypass	NEMA 5-15	250 A	80 A	Y
FP1 VFX3648	VFX3648 3.6kW FLEXpower ONE	VFX3648	–	120 VAC Bypass	NEMA 5-15	175 A	80 A	Y
FP1 GVFX3524	GVFX3524 3.5kW FLEXpower ONE	GVFX3524	–	120 VAC Bypass	NEMA 5-15	250 A	80 A	Y
FP1 GVFX3648	GVFX3648 3.6kW FLEXpower ONE	GVFX3648	–	120 VAC Bypass	NEMA 5-15	175 A	80 A	Y
FP1 GTFX3048	GTFX3048 3kW FLEXpower ONE	GTFX3048	–	120 VAC Bypass	NEMA 5-15	175 A	80 A	Y
FP1 FX3048T	FX3048T 3kW FLEXpower ONE	FX3048T	–	120 VAC Bypass	NEMA 5-15	175 A	80 A	Y
FP1 FX2524T	FX2524T 2.5kW FLEXpower ONE	FX2524T	–	120 VAC Bypass	NEMA 5-15	175 A	80 A	Y
FP1 GTFX2524-HI	GTFX2524-HI 2.5kW FLEXpower ONE for Hawaii	GTFX2524-HI	–	120 VAC Bypass	NEMA 5-15	175 A	80 A	Y
FP1 GTFX3048-HI	GTFX3048-HI 3kW FLEXpower ONE for Hawaii	GTFX3048-HI	–	120 VAC Bypass	NEMA 5-15	175 A	80 A	Y
For 230 VAC/50 Hz Applications								
FP1 VFX3024E	VFX3024E 3kW FLEXpower ONE	VFX3024E	–	230 VAC Bypass	CEE 7	250 A	80 A	Y
FP1 VFX3048E	VFX3048E 3kW FLEXpower ONE	VFX3048E	–	230 VAC Bypass	CEE 7	175 A	80 A	Y
FP1 GVFX3024E	GVFX3024E 3kW FLEXpower ONE	GVFX3024E	–	230 VAC Bypass	CEE 7	250 A	80 A	Y
FP1 GVFX3048E	GVFX3048E 3kW FLEXpower ONE	GVFX3048E	–	230 VAC Bypass	CEE 7	175 A	80 A	Y

* Individual FLEXpower ONE components carry all necessary ETL Certifications. * Additonal configurations available.



Easily Mounts On To Bracket

The FLEXpower ONE system was designed with ease of installation in mind. The hanging bracket can be quickly installed allowing the entire system to be hung with minimal effort.

Available From:

OutBack POWER
member of The alpha Group™

Corporate Office:
17825 59th Ave. NE, Suite B
Arlington, WA 98223 USA
Phone: +1 360 435 6030

European Office:
Hansastrasse 8
D-91126
Schwabach, Germany

Asia Office:
Suite 1903, Tower 1, China Hong Kong City
33 Canton Road, Kowloon
Hong Kong

Latin American Office:
15105 Cedar Bluff Pl.
Wellington, FL 33414 USA
Phone: +1 561 792 9651

Annex 5: List of People and Institutions Visited.

Date	Location	Name	Institution	Position
02/12/2014	PAP	Pierre Kenol Thys	IDB – COF Haiti	Energy Specialist
02/12/2014	Camp Caradeux	Mr. Blot Mr. Leroywood	Camp Caradeux Community	Community Leaders
02/13/2014	Port Salut	Jean Baptiste Certain	SELF	Country Manager
02/13/2014	Chantal	Sister Mona	Chantal health Dispensary	Director
02/14/2014	Port-a-Piment	Dr. Argant Dr. Charles	Port-a-Piment Hospital	Physicians
02/14/2014	Roche-a-Bateau	Sister Clany-Hypolitte	Roche-a-Bateau Health Dispensary	Director

Annex 6: Tracking tool of the project at Terminal Report.

Tracking Tool for Climate Change Mitigation Projects
(For Terminal Evaluation)

Special Notes: reporting on lifetime emissions avoided

Lifetime direct GHG emissions avoided: Lifetime direct GHG emissions avoided are the emissions reductions attributable to the investments made **during the project's supervised implementation period**, totaled over the respective lifetime of the investments.
Lifetime direct post-project emissions avoided: Lifetime direct post-project emissions avoided are the emissions reductions attributable to the investments made outside the project's supervised implementation period, but supported by financial facilities put in place by the GEF project, totaled over the respective lifetime of the investments. These financial facilities will still be operational after the project ends, such as partial credit guarantee facilities, risk mitigation facilities, or revolving funds.
Lifetime indirect GHG emissions avoided (top-down and bottom-up): indirect emissions reductions are those attributable to the long-term outcomes of the GEF activities that remove barriers, such as capacity building, innovation, catalytic action for replication.
Please refer to the Manual for Calculating GHG Benefits of GEF Projects.

Manual for Energy Efficiency and Renewable Energy Projects
Manual for Transportation Projects

For LULUCF projects, the definitions of "lifetime direct and indirect" apply. Lifetime length is defined to be 20 years, unless a different number of years is deemed appropriate. For emission or removal factors (tonnes of CO2eq per hectare per year), use IPCC defaults or country specific factors.

General Data	Results at Terminal Evaluation	Notes
Project Title	EMERGENCY PROGRAM FOR SOLAR POWER GENERATION IN HAITI	
GEF ID	4219	
Agency Project ID	HA-X1018	
Country	HAITI	
Region	LCR	
GEF Agency	Inter-American Development Bank	
Date of Council/CEO Approval	January 28, 2010	Month DD, YYYY (e.g., May 12, 2010)
GEF Grant (US$)	1,000,000	
Date of submission of the tracking tool	December 15, 2015	Month DD, YYYY (e.g., May 12, 2010)
Is the project consistent with the priorities identified in National Communications, Technology Needs Assessment, or other Enabling Activities under the UNFCCC?		Yes = 1, No = 0
Is the project linked to carbon finance?		Yes = 1, No = 0
Cumulative cofinancing realized (US$)		
Cumulative additional resources mobilized (US$)		additional resources means beyond the cofinancing committed at CEO endorsement

Objective 1: Transfer of Innovative Technologies		
Please specify the type of enabling environment created for technology transfer through this project		
National innovation and technology transfer policy	0	Yes = 1, No = 0
Innovation and technology centre and network	0	Yes = 1, No = 0
Applied R&D support	0	Yes = 1, No = 0
South-South technology cooperation	0	Yes = 1, No = 0
North-South technology cooperation	0	Yes = 1, No = 0
Intellectual property rights (IPR)	0	Yes = 1, No = 0
Information dissemination		Yes = 1, No = 0
Institutional and technical capacity building		Yes = 1, No = 0
Other (please specify)		
Number of innovative technologies demonstrated or deployed		
Please specify three key technologies for demonstration or deployment		
Area of technology 1	Renewable_Energy	
Type of technology 1		specify type of technology
Area of technology 2		
Type of technology 2		specify type of technology
Area of technology 3		
Type of technology 3		specify type of technology
Status of technology demonstration/deployment	0	0: no suitable technologies are in place 1: technologies have been identified and assessed 2: technologies have been demonstrated on a pilot basis 3: technologies have been deployed 4: technologies have been diffused widely with investments 5: technologies have reached market potential
Lifetime direct GHG emissions avoided		tonnes CO2eq (see Special Notes above)
Lifetime direct post-project GHG emissions avoided		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (bottom-up)		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (top-down)		tonnes CO2eq (see Special Notes above)

Objective 2: Energy Efficiency		
Please specify if the project targets any of the following areas		
Lighting	0	Yes = 1, No = 0
Appliances (white goods)	0	Yes = 1, No = 0
Equipment	0	Yes = 1, No = 0
Cook stoves	0	Yes = 1, No = 0
Existing building	0	Yes = 1, No = 0
New building	0	Yes = 1, No = 0
Industrial processes	0	Yes = 1, No = 0
Synergy with phase-out of ozone depleting substances	0	Yes = 1, No = 0
Other (please specify)		
Policy and regulatory framework	0	0: not an objective/component 1: no policy/regulation/strategy in place 2: policy/regulation/strategy discussed and proposed 3: policy/regulation/strategy proposed but not adopted 4: policy/regulation/strategy adopted but not enforced 5: policy/regulation/strategy enforced
Establishment of financial facilities (e.g., credit lines, risk guarantees, revolving funds)	0	0: not an objective/component 1: no facility in place 2: facilities discussed and proposed 3: facilities proposed but not operationalized/funded 4: facilities operationalized/funded but have no demand 5: facilities operationalized/funded and have sufficient demand
Capacity building	0	0: not an objective/component 1: no capacity built 2: information disseminated/awareness raised 3: training delivered 4: institutional/human capacity strengthened 5: institutional/human capacity utilized and sustained
Lifetime energy saved		MJ (Million Joule, IEA unit converter: http://www.iea.org/stats/unit.asp) Fuel savings should be converted to energy savings by using the net calorific value of the specific fuel. End-use electricity savings should be converted to energy savings by using the conversion factor for the specific supply and distribution system. These energy savings are then totaled over the respective lifetime of the investments.
Lifetime direct GHG emissions avoided		tonnes CO2eq (see Special Notes above)
Lifetime direct post-project GHG emissions avoided		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (bottom-up)		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (top-down)		tonnes CO2eq (see Special Notes above)

Objective 3: Renewable Energy		
Please specify if the project includes any of the following areas		
Heat/thermal energy production	0	Yes = 1, No = 0
On-grid electricity production	0	Yes = 1, No = 0
Off-grid electricity production	1	Yes = 1, No = 0
Policy and regulatory framework	0	0: not an objective/component 1: no policy/regulation/strategy in place 2: policy/regulation/strategy discussed and proposed 3: policy/regulation/strategy proposed but not adopted 4: policy/regulation/strategy adopted but not enforced 5: policy/regulation/strategy enforced
Establishment of financial facilities (e.g., credit lines, risk guarantees, revolving funds)	0	0: not an objective/component 1: no facility in place 2: facilities discussed and proposed 3: facilities proposed but not operationalized/funded 4: facilities operationalized/funded but have no demand 5: facilities operationalized/funded and have sufficient demand
Capacity building	0	0: not an objective/component 1: no capacity built 2: information disseminated/awareness raised 3: training delivered 4: institutional/human capacity strengthened 5: institutional/human capacity utilized and sustained
Installed capacity per technology directly resulting from the project		
Wind		MW
Biomass		MW el (for electricity production)
Biomass		MW th (for thermal energy production)
Geothermal		MW el (for electricity production)
Geothermal		MW th (for thermal energy production)
Hydro		MW
Photovoltaic (solar lighting included)	0.430	MW
Solar thermal heat (heating, water, cooling, process)		MW th (for thermal energy production, 1m² = 0.7kW)
Solar thermal power		MW el (for electricity production)
Marine power (wave, tidal, marine current, osmotic, ocean thermal)		MW
Lifetime energy production per technology directly resulting from the project (IEA unit converter: http://www.iea.org/stats/unit.asp)		
Wind		MWh
Biomass		MWh el (for electricity production)
Biomass		MWh th (for thermal energy production)
Geothermal		MWh el (for electricity production)
Geothermal		MWh th (for thermal energy production)
Hydro		MWh
Photovoltaic (solar lighting included)	380.600	MWh
Solar thermal heat (heating, water, cooling, process)		MWh th (for thermal energy production)
Solar thermal power		MWh el (for electricity production)
Marine energy (wave, tidal, marine current, osmotic, ocean thermal)		MWh
Lifetime direct GHG emissions avoided	3,111	tonnes CO2eq (see Special Notes above)
Lifetime direct post-project GHG emissions avoided	29,802	tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (bottom-up)	397,367	tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (top-down)	17,517	tonnes CO2eq (see Special Notes above)

Objective 4: Transport and Urban Systems		
Please specify if the project targets any of the following areas		
Bus rapid transit		Yes = 1, No = 0
Other mass transit (e.g., light rail, heavy rail, water or other mass transit; excluding regular bus or minibus)		Yes = 1, No = 0
Logistics management		Yes = 1, No = 0
Transport efficiency (e.g., vehicle, fuel, network efficiency)		Yes = 1, No = 0
Non-motorized transport (NMT)		Yes = 1, No = 0
Travel demand management		Yes = 1, No = 0
Comprehensive transport initiatives (Involving the coordination of multiple strategies from different transportation sub-sectors)		Yes = 1, No = 0
Sustainable urban initiatives		Yes = 1, No = 0
Policy and regulatory framework		0: not an objective/component 1: no policy/regulation/strategy in place 2: policy/regulation/strategy discussed and proposed 3: policy/regulation/strategy proposed but not adopted 4: policy/regulation/strategy adopted but not enforced 5: policy/regulation/strategy enforced
Establishment of financial facilities (e.g., credit lines, risk guarantees, revolving funds)		0: not an objective/component 1: no facility in place 2: facilities discussed and proposed 3: facilities proposed but not operationalized/funded 4: facilities operationalized/funded but have no demand 5: facilities operationalized/funded and have sufficient demand
Capacity building		0: not an objective/component 1: no capacity built 2: information disseminated/awareness raised 3: training delivered 4: institutional/human capacity strengthened 5: institutional/human capacity utilized and sustained
Length of public rapid transit (PRT)		km
Length of non-motorized transport (NMT)		km
Number of lower GHG emission vehicles		
Number of people benefiting from the improved transport and urban systems		
Lifetime direct GHG emissions avoided		tonnes CO2eq (see Special Notes above)
Lifetime direct post-project GHG emissions avoided		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (bottom-up)		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emissions avoided (top-down)		tonnes CO2eq (see Special Notes above)

Objective 5: LULUCF		
Area of activity directly resulting from the project		
Conservation and enhancement of carbon in forests, including agroforestry		ha
Conservation and enhancement of carbon in nonforest lands, including peat land		ha
Avoided deforestation and forest degradation		ha
Afforestation/reforestation		ha
Good management practices developed and adopted		0: not an objective/component 1: no action 2: developing prescriptions for sustainable management 3: development of national standards for certification 4: some of area in project certified 5: over 80% of area in project certified
Carbon stock monitoring system established		0: not an objective/component 1: no action 2: mapping of forests and other land areas 3: compilation and analysis of carbon stock information 4: implementation of science based inventory/monitoring system 5: monitoring information database publicly available
Lifetime direct GHG emission avoided		tonnes CO2eq (see Special Notes above)
Lifetime indirect GHG emission avoided		tonnes CO2eq (see Special Notes above)
Lifetime direct carbon sequestration		tonnes CO2eq (see Special Notes above)
Lifetime indirect carbon sequestration		tonnes CO2eq (see Special Notes above)

Objective 6: Enabling Activities		
Please specify the number of Enabling Activities for the project (for a multiple country project, please put the number of countries/assessments)		
National Communication		
Technology Needs Assessment		
Nationally Appropriate Mitigation Actions		
Other		
Does the project include Measurement, Reporting and Verification (MRV) activities?	0	Yes = 1, No = 0