Energy Utilization
Management Bureau

Quality Aspects of PV Program in the Philippines

Presented to:
ICRA/IEA Task 9 Regional Workshop
Lane-Xang, Hotel Vientiane, Lao PDR
April 7-9, 2005

Is there a standard Practice in the Philippines?

- Trainings
- Quality of Installations
- Services Provided

Local and Foreign Funded Projects

PROJECT	COVERAGE	TARGETS	FUNDING
DOE's Barangay Electrification Project	*Nationwide*	*163 barangays per day for 2004 by RE systems 41,995 target barangays in 2006 (92%)*	*GOP*
Capacity Building to Remove Barriers to Renewable Energy Development in the Philippines (CBRED)	*Nationwide*	*Capacitate renewable energy stakeholders to remove barriers (29.6 MMT CO2 emission reduction)*	*UNDP/GEF*
Solar Power Technology Support (SPOTS) Project	*Nationwide*	*Installation of solar energy systems in about 80 Agrarian Reform Communities*	*Spanish Mix Credit Facility/GOP*
Environmental Improvement for Economic Sustainability (EIES)	*Regions 1 - 6 and CAR and 6*	*Installation of 15,000 solar PV systems*	*Netherlands Ministry of Foreign Affairs*

PROJECT	COVERAGE	TARGETS	FUNDING
JICA Individual Expert Program for: Sustainable Improvement on RE Dev't in Village Electrification	*Nationwide*	*Capacity Building on DOE, ANEC and other stakeholders*	*JICA*
ADB TA 4174 – Rehabilitation of RE Projects for Rural Electrification and Livelihood Development	*Nationwide*	*Background study on the issues regarding successes and failures of RE project* *Rehab of at least two RE system*	*ADB Grant*
JFPR 9042 – PHI RE and Livelihood Development for the Poor in Negros Occidental	*Eight off-grid areas in Negros Occidental*	*Poverty reduction through provision of sustainable RE system*	*ADB*
Solar Electrification Project	*Pangan-an Island Cebu*	*Installation of a 28 kWp centralized PV plant that for 200 households*	*Belgian Government*

PROJECT	COVERAGE	TARGETS	FUNDING
Alliance for Mindanao Off-grid RE (AMORE) Project	*Nationwide*	*Energization of 160 barangays in the Muslim provinces through the use of PV system*	*USAID/GOP*
Photovoltaic Rural Electrification Service (PRES) Project	*4 Provinces (Davao, Masbate, Palawan and North Cotabato)*	*Installation of 7,750 PV systems in barangays for water pumping lighting and other uses*	*French Protocol/GOP*
Municipal Solar Infrastructure Project (MSIP)	*7 provinces in Visayas and Mindanao*	*Provision of 1,053 PV systems to power schools, health clinics, barangay hall in 359 barangays*	*AUSAid*
WB Rural Power Project – Solar Credit Line Facility	*Nationwide*	*10,000 SHSs installed (initial phase)*	*WB-GEF/GOP*

Three Project Cases

- 1MW Cagayan de Oro Project (Sharp)
- 20 kW New Ibajay, El Nido Palawan (BP Solar)
- 45 kW Pangan-an Island, Cebu City

Case 1. Cagayan de Oro Solar Power Plant

Courtesy from JICA

Cagayan de Oro Solar Power Plant

Type of the system	:	Grid connected PV system
PV array capacity	:	1082kW (Manufactured by SHARP, 167W modules 6480 pcs, 720 modules / 9 group,
Module type	:	ND-Q7E6Z, Pmax=167.0W,Voc=29.2V, Isc=8.14A, Vpm=23.53V, Ipm=7.10A,)
Inverter	:	Manufactured by SANSHA, Rated output=110kW, 9 sets
Type	:	PV-110K220T, Vin=225V～450VDC, Iin=392Adc, Vout= 220Vac, 3 ϕ , 60Hz, 289A, 110kW
Transf. grid connection	:	Manufactured by ABB Ltd. Vietnam, Capacity = 1200kVA, 60Hz, 3 phase, 220V/13300V (with 14400V tap) 3149.2A/50.2A
PV array configuration	:	tilt angle= 10 degree facing to south

Courtesy from JICA

1. Good Quality, Good Installation

Condition of System Operation

- *The system was designed and installed appropriately.*
- *Installed components are reliable.*
- *The layout of the PV array is very beautiful.*
- *According to CEPALCO, there was a trouble in the junction box and has been improved properly.*
- *The condition of the system operation is monitored continuously with a data monitoring system. The monitoring data showed an ideal operation index, when we visited the site.*

Problems found

- *No technical problem was found in the system. Dust, however, accumulates on the array surface coming from the unpaved road beside the power plant.*

Items to be solved in future

- *A grid connected PV system cannot operate independently. So, PV system and a grid affect each other. PV system requires a sufficient capacity of the grid and a better electric quality of the grid. The grid that connected with a PV system should have a stabilized voltage and frequency, low distorted voltage waveform. A PV system connected with a grid should have a protection function when the grid fails.*
- *In order to prevent some system trouble including the grid, some regulation and/or guideline for grid connected technology may be required in future.*

Courtesy from JICA

Case 2. New Ibajay, El Nido Palawan

Solar Power Plant (during construction)

Courtesy from JICA

New Ibajay, El Nido Palawan

Location	:	New Ibajay, El Nido
Type of the system	:	Centralized PV system with diesel generation backup
Area of the PV station	:	1000 m2 (25m * 40m)
PV array	:	20 kW (Manufactured by BP Solar, 125W module, 160 pcs. 10s *16p)
DG set for back up	:	25kW, DG will operate automatically when PV power is not enough.
Inverter	:	20kVA with battery charging function, Input voltage = 120V (120V – 165V), Output voltage = 220V, 60Hz
Storage battery	:	Manufactured by Classic, Type = OpzS Solar 1990, Cell = 2V / 1990Ah (C120), 1550Ah (C24), Number of cells = 60 pcs. Connection = 60s * 1p, Total capacity = 180 kWh (approximate)

Courtesy from JICA

2. Good Quality, Poor Installation

Condition of System Operation

- ***The system is under construction as of 5 March, 2005 by local technicians. 50 households are connected to the system, 68 households will join later. Other households are not sure for connection. Total number of households is 200.***

- ***Forty kilowatt hour (40kWh) electric power can be expected from the 20kW PV system without backup. The available power per household a day will be approximately 340Wh, if 118 households, which are already registered, are connected. If the power demand increase more, backup operation with DG will be required every day.***

Problems found

- ***This system has a lot of problem due to poor system design.***
  - ***Poor system design. (Available supply power estimation, system balance between main system (PV) and the backup system(DG) etc.).***
  - ***Poor site layout design***
  - ***Unsuitable design for battery room. (Storage battery generates combustible gas that is hydrogen . Battery room should always keep good ventilation)***

Courtesy from JICA

Case 3. Pangan-an, Island Solar Power Plant

Courtesy from JICA

3. Poor Quality, Not so Good Installation

Outline of the system:

PV array	:	45kW (90W 504 modules, 9s * 56p)
Storage battery	:	424.8kWh (2V/1800Ah cell, 59s*2p)
Household connected	:	300
Recent situation of households	:	Less than 150

Problems found:

Poor quality of the PV modules: Some module surface change to abnormal color
Some module consist of tow types of PV cells, that is single crystal ell and poly-crystal one. The seal of module seems to be insufficient.
Some cells of the modules have been damaged (cells were blown out).

Use of certified modules is strongly recommended.

Maintenance works of the storage batteries were not suitable. Water level adjustment is essential. Cleaning of the battery surface is also important. Grounding wire is on the ground. It will not effective.

System design seems no problem.

Courtesy from JICA

El Nido, New Ibajay Solar Power Plant

Reliable PV module, Poor system design
(Miss calculation in the power estimation)

20kW system / 80kWh/day ??

Welding of Array Support
<Imperfect joint >

Distorted & Curved PV array
<Poor installation >

Courtesy from JICA

Array Support

Cagayan de Oro

<Recommended>

El Nido

<Not recommended>

Courtesy from JICA

Layout of the Solar Power Plant, El Nido Site

<Power house locates unsuitable position>

Battery Room

<Insufficient ventilation>

Courtesy from JICA

Pangan an, Island Power Plant

Training on Battery Maintenance

Corroded Terminal

Training for PV Array Inspection

<At Pangan an site>

Courtesy from JICA

Some Maintenance Problems

Dusty module

Dusty PV array

Courtesy from JICA

Storage Battery

Deposit in the bottom of battery

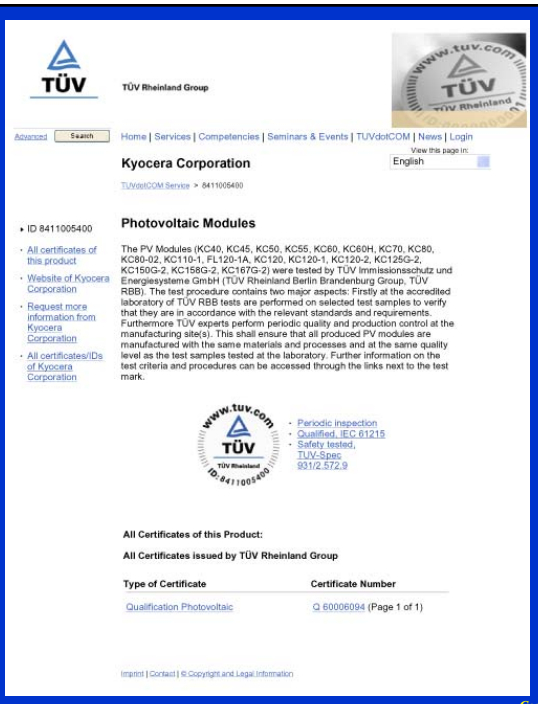
<Marshall Islands site>

Eroded Terminal

Well Maintained

Courtesy from JICA

Certification of PV Module



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Kyocera Corporation

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ID 84110054O0

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Photovoltaic Modules

The PV Modules (KC40, KC45, KC50, KC55, KC60, KC60H, KC70, KC80, KC80-02, KC110-1, FL120-1A, KC120, KC120-1, KC120-2, KC125G-2, KC150G-2, KC158G-2, KC167G-2) were tested by TÜV Immissionsschutz und Energiesysteme GmbH (TÜV Rheinland Berlin Brandenburg Group, TÜV RBB). The test procedure contains two major aspects: Firstly at the accredited laboratory of TÜV RBB tests are performed on selected test samples to verify that they are in accordance with the relevant standards and requirements. Furthermore TÜV experts perform periodic quality and production control at the manufacturing site(s). This shall ensure that all produced PV modules are manufactured with the same materials and processes and at the same quality level as the test samples tested at the laboratory. Further information on the test criteria and procedures can be accessed through the links next to the test mark.

- Periodic inspection
- Qualified, IEC 61215
- Safety tested, TUV-Spec 931/2.572.9

All Certificates of this Product:

All Certificates issued by TÜV Rheinland Group

Type of Certificate	Certificate Number
Qualification Photovoltaic	Q 60006094 (Page 1 of 1)

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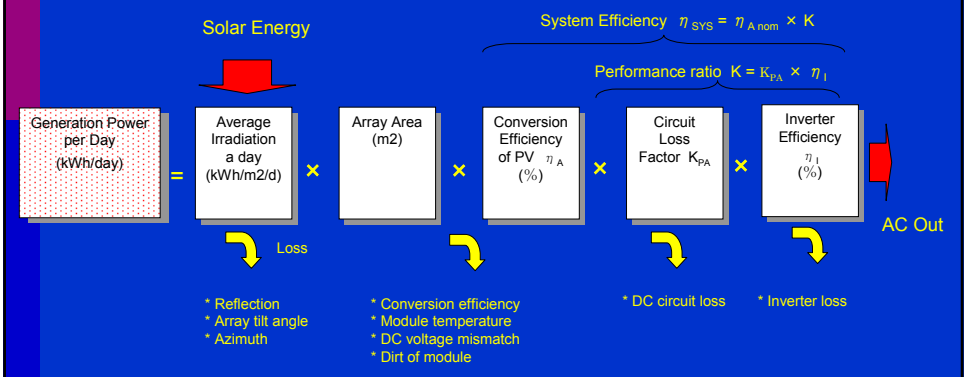
Courtesy from JICA

Lessons Learned:

- **Your guess is good as mine!**

Thank you!!!

Power Generation of Grid Connected PV System



< Power Estimation >

$$Ep = Ps \cdot \frac{HA}{Gs} \cdot K$$

K : Performance ratio (0.7 – 0.8)
Ep: Generated AC power a day (kWh/day)
Ps: Rated output power of PV array (kW)
H_A: Irradiation on the array surface (kWh/day)
Gs : Irradiance at standard condition 1 (kWh/m2)

Courtesy from JICA