JCM/BOCM Feasibility Study
"Solar-Diesel Hybrid Power Generation to Stabilize Photovoltaic Power Generation"

By Hitachi Zosen Corporation

URL: http://gec.jp/main.nsf/en/Activities-Climate_Change_Mitigation-FS2012jcmfs04

1. Description of Project/Activity

This project envisages electricity supply through the introduction of a MW class hybrid power generation system (see Figure 1) that combines PV and diesel engine power generation on the Indonesian Island of Nias, located approximately 140km off shore of North West Sumatra. (see Figure 2)

Introduction of the hybrid system will enable a reduction in fossil fuel consumption by offsetting it with PV power generation. Accordingly, through reduced fossil fuel consumption and increased efficiency in diesel engine operation, this project will result in a corresponding reduction in the amount of CO_2 emissions. The hybrid system, through highly advanced integrated controls, stabilizes output fluctuations in PV power generation and also incorporates a low-load type diesel engine.

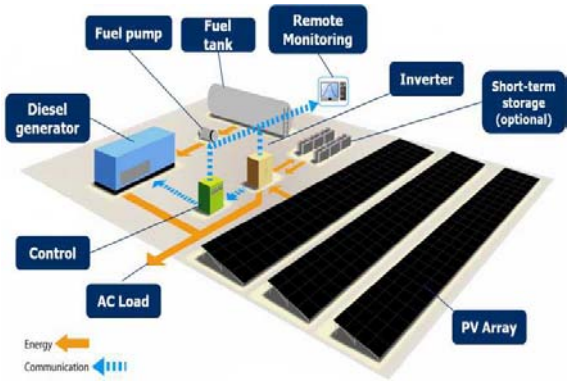

Figure 1. Hybrid Power generation system

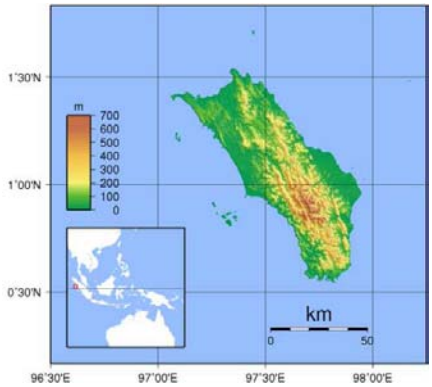

Figure 2. Nias Island topographical map

2. Results of the study

(1) Eligibility Criteria for MRV Methodology Application

Case 1 Provide base-load electricity by operating software to compensate for the fluctuation of PV power output and to stabilize the total power output of the hybrid system.

Case 2 Apply low-load type diesel power generator and CIS type PV panel.

Case 3 Keep the usage of battery for stabilizing the power output supplementary, or no usage at all.

(2) Reference Scenario and Project/Activity Boundary

It is planned to connect the hybrid system to the small grid (Island grid) on Nias Island. Currently only diesel engines are operating. Although there are plans to introduce a coal-fired plant, coal-gasification plant and the replacement of diesel engines in the near future, they are not yet fixed.

(3) Calculation Method Options

The method of setting a grid's CO_2 emission factor to calculate a reference emission factor (EF) varies according to the size of the grid. Here, the following two calculation methods have been selected:

1) Grid size
2) Use of default values

Using default values leads to a conservative estimate of CO_2 reduction as a trade-off between simplicity and the amount of carbon credit. The default values have been decided for a modern diesel engine of the relevant capacity operating at optimal load, therefore it can be said to be conservative to use them.

(4) Default Value(s) Set in MRV Methodology

The default emission factor values for a large-scale grid that are regularly calculated and published by the Ministry of Energy and Mineral Resources and the National Council on Climate Change are applied. Having been supplied by the Indonesian Government for use in CDM, these values are considered appropriate for use in JCM/BOCM.

Further, the default values for the CO_2 emission factor of a small-scale grid power generation plant are calculated solely on the consumption of liquid fossil fuels. Under this scenario, and based upon a continuous 24hr/per day power supply, a mini-grid emission factor of 0.8 t-CO_2/MWh is deemed appropriate.

(5) Monitoring Methods

Monitoring Items are shown in Table 1.

Table 1: Monitoring Items

Parameter	Description	Measurement Method (e.g.)
$EGP_{J,y}$	Yearly quantity of net electricity generation by the hybrid system (kWh)	Daily power supply monitoring.
$EGD_{J,y}$	Yearly quantity of net electricity generation by the PV power generation system (kWh)	Daily power supply monitoring.
FCD_y	Quantity of fossil fuel consumed by the diesel engine (ton)	Daily fuel flow quantity monitoring.
EF	Emission factor of fossil fuel used for the diesel engine ($kgCO_2$/TJ)	Use of default values.
NCV	Net calorific value of fossil fuel used for the diesel engine (TJ/kg)	Use of default values.

(6) Quantification of GHG Emissions and its Reductions

With a 4MW hybrid power generation plant, assuming a capacity utilization for the PV power generation system on Nias island of 15.39% and an EF of 0.7 tCO_2/MWh (in accordance with calculations provided by Wärtsilä), a reduction in GHG emissions of 7,243 tCO_2/year is forecast.

(7) Verification of GHG Emission Reductions

Based upon the MRV methodology as outlined herein, an on-site investigation has confirmed that the required third party verifications will be able to be performed. As implementing bodies, in addition to the Indonesian DOE, it is assumed that approximately 10 companies or other entities that perform ISO certification etc., will perform the verifications.

(8) Ensuring Environmental Integrity

It is necessary to take into consideration that the installation of PV panels and diesel engines, through acquisition of a large amount of land for private use, will have an impact on land development and will influence the use of bio-fuels (in particular palm oils) as fuels for the diesel engine used as a part of this system.

(9) Contribution to Sustainable Development in Host Country

Through expanding the electricity supply capacity on Nias Island, attracting factory rollouts by both Indonesian and foreign companies through improvements in electricity quality and also through the use of bio-fuels creating employment opportunities on local plantations, this project will indeed contribute to local development.

3. Toward Implementation/Future prospects and issues

- A government grant is necessary for the purpose of obtaining CO_2 reductions, because the initial cost of the hybrid system is high since it uses a diesel engine and a solar power system.
- To reduce the usage of fossil fuel, the Indonesian Government does not allow the installation of additional diesel engines, except to replace old engines in order to improve efficiency.
- Requiring too high a power quality level may cause an increase of initial cost due to the large amount of batteries needed. Hereafter, we need to discuss with PLN about quality requirements and operational guidelines.
- Most importantly, the people of Nias Island strongly support the installation of the hybrid system to improve their standard of living.