CLEAN DEVELOPMENT MECHANISM
SMALL-SCALE PROGRAMME OF ACTIVITIES DESIGN DOCUMENT FORM
(CDM-SSC-PoA-DD) Version 01

CONTENTS

Annexes

NOTE:

(i) This form is for the submission of a CDM PoA whose CPAs apply a small-scale approved methodology.

(ii) At the time of requesting registration this form must be accompanied by a CDM-SSC-CPA-DD form that has been specified for the proposed PoA, as well as by one completed CDM-SSC-CPA-DD (using a real case).

SECTION A. General description of small-scale programme of activities (PoA)

A.1 Title of the small-scale programme of activities (PoA):

"Mini-Hydropower Generation Programme Utilizing Irrigation Canal in the Philippines"
Version 1
30 January 2009

A.2. Description of the small-scale programme of activities (PoA):

The "Mini-Hydropower Generation Programme Utilizing Irrigation Canal in the Philippines" (hereafter, the "Project") is to generate renewable energy by mini-hydropower generation facilities placed in existing irrigation canals. The assumed size of the hydropower generation facilities to be installed by the CPAs under this PoA is between 0.1~1.0MW and the maximum electricity generation volume is less than or equal to 15MW. At least 65 locations, generating approximately 40MW of electricity are identified in the Philippines as potential mini-hydropower generation sites that are yet to be developed.

1. General operating and implementing framework of PoA

The coordinating/managing entity of this Project is the National Electrification Administration (NEA), which is a government-owned entity promoting electrification throughout the Philippines. This Project is a voluntary project implemented by the NEA.

The owner of the irrigation system in which the mini-hydropower generation facilities are to be placed in this Project is the National Irrigation Administration (NIA). NIA will lease the irrigation system and collect water licence fees from the power producer. The power producer, the owner of the mini-hydropower generation facility within this Project, is the Regional Electric Cooperatives (REC) and the generated renewable electricity will be supplied to consumers through the REC. NEA, which is the coordinating/managing entity, will oversee the local RECs and manage the CDM project as the coordinator, as well as sell the CERs generated through this Project. Chugoku Electric Power Co., Inc. will support NEA's function as the coordinating/managing entity.

2. Policy/measure or stated goal of the PoA

The goals of the PoA are to reduce the dependence on fossil fuels as an energy source and to generate sustainable income for the NIA to enable and enhance the management and maintenance of their irrigation systems.

In the Philippines, where agriculture plays a dominant role in its economy, a total of approximately 23,000 km of irrigation canals stretch across the country supplying water to more than 3,000,000 ha of its agricultural lands. Most of the construction cost of this vast irrigation system has been funded by the country's national budget and official development aid (ODA) from foreign governments. Local farmers are required to pay only a minimal "irrigation fee" to utilize the irrigation system to supply water into their fields. However, with the government's current fragile financial circumstances, a development of an alternative and independent revenue generating system for the NIA, the owner of the irrigation systems, is vital for the sustainable management of the irrigation systems in the Philippines.

By promoting the implementation of environmentally friendly mini-hydropower generation projects that utilize unused heads of irrigation canals, greenhouse gas emissions will be avoided by replacing electricity generated from fossil fuel combustion with renewable energy for power supply to the grid.

Furthermore, the project activity will create a sustainable source of income for the National Irrigation Administration (NIA). By collecting fees from leasing the irrigation system to the hydro electricity developers, the NIA can allocate resources to manage and maintain the irrigation system.

3. Confirmation that the proposed PoA is a voluntary action by the coordinating/managing entity.

The implementation of mini-hydropower generation projects is a voluntary action that is not required by law in the Philippines. Within the "Mini-hydroelectric Power Incentive Act – Republic Act No. 7156", the Philippine Government has increased the incentives for implementing mini-hydropower generation projects. However neither the National Government nor the Provincial Governments mandate any quantitative targets for the installation of mini-hydropower generation facilities under this Act.

4. Contribution to Sustainable Development

The Project is designed to "co-benefit" both the global environmental aim to reduce greenhouse gas emissions, as well as the mitigation of local environmental problems including air pollution. Promoting the implementation of this Project will contribute to sustainable development in the Philippines by bringing about the following economic, social and environmental benefits:

Economic/Social Benefits

- Sustainable hydropower development: Because of the small-scale, simple hydropower system, the investment cost for the Project implementation is low. The NEA can utilize the revenues generated through electricity generation and CER sales to further develop hydro energy that meets the financial and social needs of the local communities. This will lead to the socioeconomic development of agricultural communities throughout the Philippines.
- Investments from foreign countries to the local economy: Investment from foreign countries such as Japan will be expected for the implementation of the Project.
- Creation of job opportunities: New jobs may be created by this Project in the fields of operation and maintenance of the power generation facilities.

Environmental Benefits

- Reduction of greenhouse gas emissions
- Generation of renewable energy without new development of natural landscapes: No new natural land needs to be developed because the mini-hydropower system will utilize the existing irrigation canals.
- Emissions Reduction of air pollutants (SOx, Nox): SOx, NOx emission will be reduced through replacing conventional grid electricity, most of which are generated through burning of fossil fuel, with hydro electricity.
- Reduction of improper waste accumulation in irrigation canals: Hydropower system will require periodic removal of waste to avoid waste materials from disrupting the turbine.

A.3. Coordinating/managing entity and participants of SSC-POA:

1. Coordinating or managing entity of the PoA as the entity which communicates with the Board

   The National Electrification Administration (NEA) of the Philippine's Central Government

2. Project participants being registered in relation to the PoA

Table 1. Project Participants

Name of Party Involved (*) ((host) indicates a host party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Government of the Philippines	NEA	No
Government of Japan	The Chugoku Electric Power Co.,Inc.	No

A.4. Technical description of the small-scale programme of activities:

A.4.1. Location of the programme of activities:

A.4.1.1. Host Party(ies):

Republic of the Philippines

A.4.1.2. Physical/ Geographical boundary:

The boundary of the PoA is defined within the Republic of the Philippines, which is an island country in Southeast Asia comprised of 7,190 islands including the islands of Luzon, the Visayas, and Mindanao. Its total land area is 299,404 km^2 with Metro Manila as its capital. 81 provinces and 61 chartered cities are grouped into 17 regions.

Figure 1. Location of Philippines

A.4.2. Description of a typical small-scale CDM programme activity (CPA):

A.4.2.1. Technology or measures to be employed by the SSC-CPA:

Technologies applied in the CPAs under this PoA includes:

- Power generation technology at unutilised canal drops in existing irrigation systems; and
- A system to feed generated electricity into the local grid via nearby substations.

As indicated in A.4.2.2, the maximum electricity generation volume is less than or equal to 15MW. The technology that is applied in this Project is the Submergible Turbine Generator.

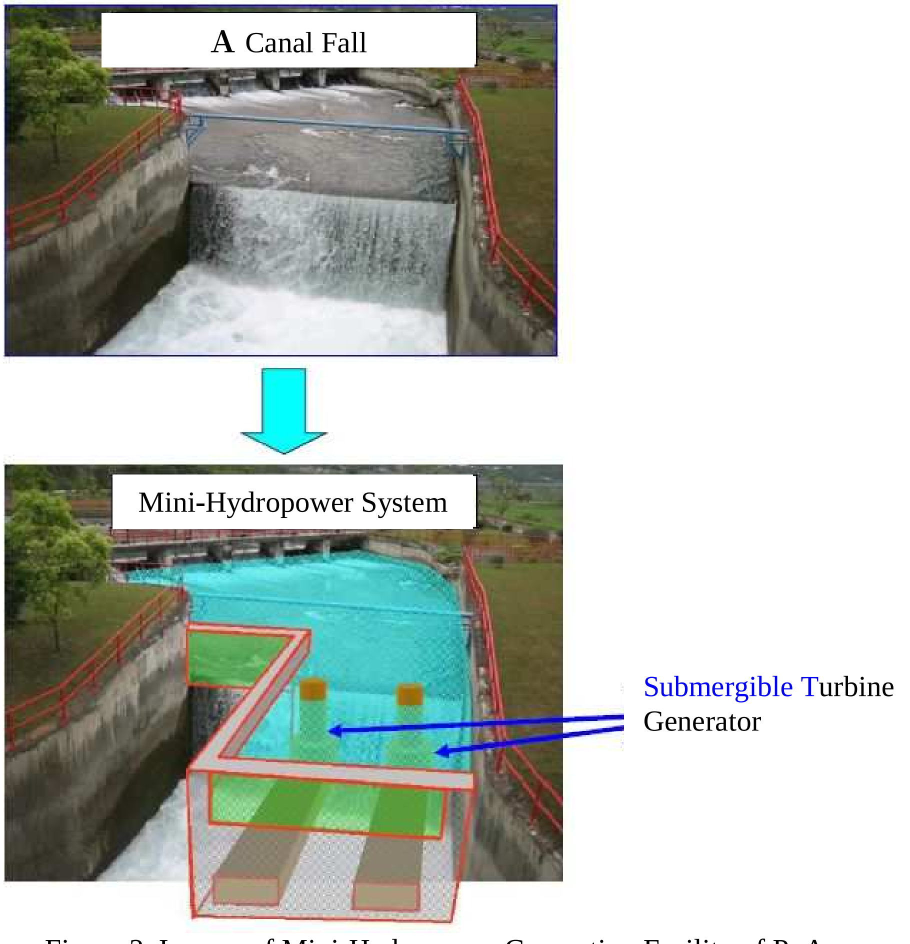

Figure 2. Images of Mini-Hydropower Generation Facility of PoA

The Submergible Turbine Generator shown in the Figure2 is the only technology applicable to the PoA. Below are the technological characteristics of the Submergible Turbine Generator.

(i) It does not require a building to situate the electricity generating facilities because it will be placed in water

(ii) Installation space is small and therefore its instalment does not require significant alteration of landscape

(iii) It can generate electricity from extra small canal drops (approx. 2.5m)

(iv) It does not cause noise pollution (noise level is very small) because it is operated within water

(v) It is resilient to flood because it is a submergible generator (an internationally unique technology)

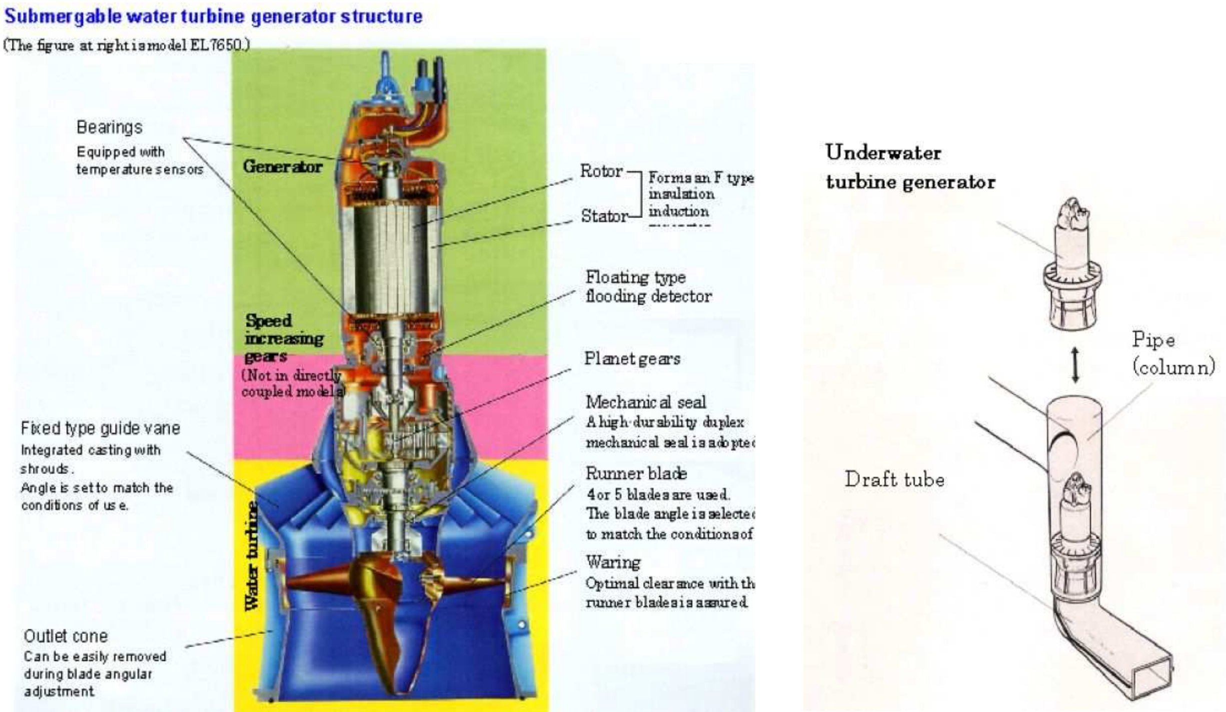

Figure3. Submergible Turbine Generator

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A.4.2.2. Eligibility criteria for inclusion of a SSC-CPA in the PoA:

The Project defines the following criteria for inclusion of a project activity as a CPA under the PoA.

- A mini-hydropower generation project that newly installs a mini-hydropower generation facility at irrigation canals that are owned by the NEA
- The technology to be applied must be the Submergible Turbine Generator
- Located within the Republic of the Philippines
- Maximum electricity generation volume less than or equal to 15MW
- A renewable energy facility that supplies electricity to, and/or displace electricity from, an electricity distribution system that is (or would have been) supplied by at least one fossil fuel fired generating unit.
- Monitors and collects appropriate data on the parameters listed in A.4.4.2

A.4.3. Description of how the anthropogenic emissions of GHG by sources are reduced by a SSC-CPA below those that would have occurred in the absence of the registered PoA (assessment and demonstration of additionality):

The proposed PoA is a voluntary coordinated action as explained in A.2 (section 3).

The Philippine Government promotes the Department of Energy (DOE)'s efforts to develop and implement renewable energy. The Government has set a target to increase renewable energy utilization volume to twice the utilization level in 2003 by 2013. Significant focus is placed on the promotion of hydropower through the establishment of Mini-hydroelectric Power Incentive Act.

- Mini-hydroelectric Power Incentive Act: Support the development and dissemination of renewable energy through legislation and tax systems
- Capacity Building to Remove Barriers to Renewable Energy Development in the Philippines (CBRED): Conduct capacity building for stakeholders involved in renewable energy development

As a result of the above renewable energy policies, there are many mini-hydropower generation plants in operation today. However, in terms of placing mini-hydropower generation facilities in existing irrigation canals, such efforts have been extremely rare due to the barriers, as indicated in E.5.1. Furthermore, the government legislations indicated above do not mandate hydropower generations to be implemented specifically within irrigation canals, therefore providing no legal incentives to overcome the economic and technological challenges of hydropower generation in irrigation canals. For these reasons, mini-hydropower generation in existing irrigation canals is unlikely to occur in the absence of the registered PoA.

A.4.4. Operational, management and monitoring plan for the programme of activities (PoA):

A.4.4.1. Operational and management plan:

The following operational and management arrangements will be implemented by the coordinating/managing entity for the implementation of the PoA:

(i) A record keeping system for each CPA under PoA

Regular monitoring and recording of specific parameters are carried out by individual CPAs. Data will be recorded digitally. The NEA is responsible for collecting, storing and analyzing data from all CPAs where they will closely monitor the progress of each CPAs as well as provide necessary assistance.

The following figure describes the general layout of the record keeping system.

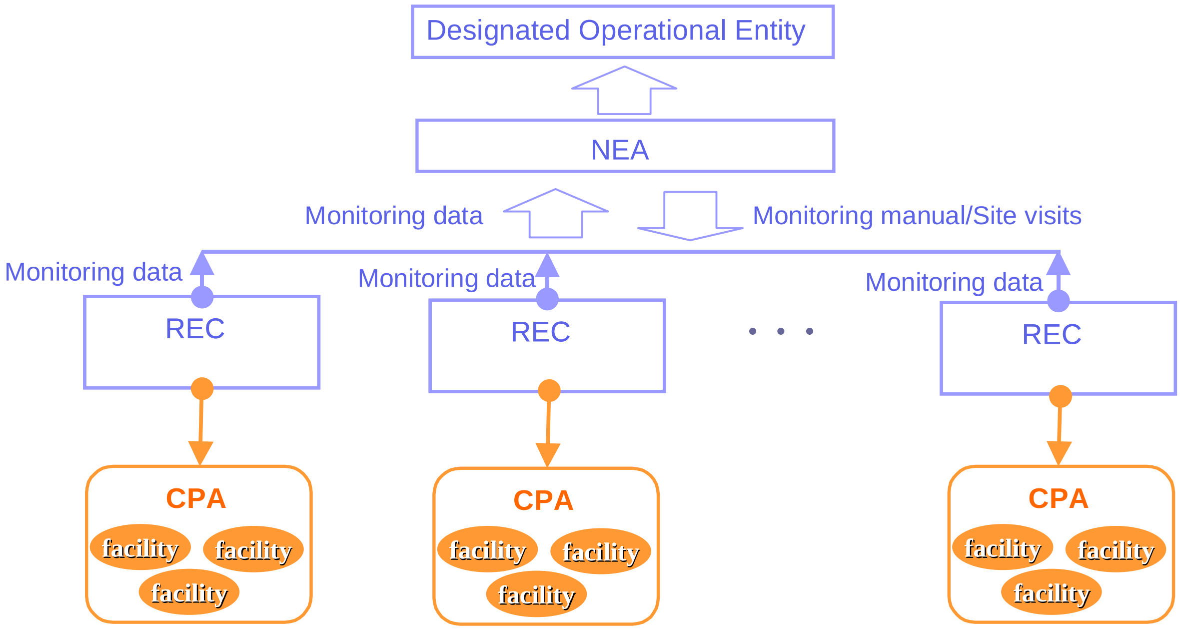

Figure4. Layout of Record Keeping System

(ii) A system/procedure to avoid double counting

An identification system is implemented where numbers will be assigned to a REC as an owner of a CPA based on the information of their geographic location. These CPA identification numbers are managed by the NEA who will be responsible for closely monitoring individual CPAs to prevent double counting.

(iii) Verification that SSC-CPA is not a debunlded component of another CPA

Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project activities defines that a registered SSC-CPA shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- With the same project participants;
- In the same project category and technology/measure;
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

If the CPA is managed by project participants that are only taking part in one CPA, it can be inferred that the CPA does not have the same project participants with any other CPAs (first criteria), thus verifying that the CPA is not a debulded component of another CPA.

If the CPA is managed by project participants that are taking part in more than one CPAs, the CPA will verify within their CDM-SSC-CPA-DD that one or more of the above criteria for debundling are not met.

Finally, if the CPA meets all four of the criteria for debunlding, it will indicate within their CDM-SSC-CPA-DD that the small-scale project activity "Renewable energy project activities with a maximum output capacity equivalent to up to 15 Megawatts (or an appropriate equivalent)" as stated in paragraph 6 (c) of the decision 17/CP.7. This is in concurrence with Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project activities, which states that, "if a proposed small-scale project activity is deemed to be a debundled component, but the total size of such an activity combined with the previous registered small-scale CDM project activity does not exceed the limits for small-scale CDM project activities as set in paragraph 6 (c) of the decision 17/CP.7, the project activity can qualify to use simplified modalities and procedures for small-scale CDM project activities."

(iv) Assurance that CPA operations/operators are being subscribed to the PoA
All CPA operations/operators will be assured to be subscribed to the PoA and the subscribed electric data will be managed by NEA.

A.4.4.2. Monitoring plan:

The following parameters are monitored to verify the amount of reductions of anthropogenic emissions of greenhouse gases due to CPAs under the PoA.

Table 2. Monitored Parameters

Monitoring Item	Unit	Monitoring Method	Monitoring Frequency	Monitoring Body
Electricity supplied to the grid by the project	MWh	To be measured by meter and will be cross checked by electricity bill	Hourly measured and monthly recording	CPA

The overview of the data recording system is described in A.4.4.1. The managing entity, in this case the NEA, will closely manage the collected data regarding the above parameters. In addition, the managing entity will assist the monitoring process at the CPA level by distributing monitoring manuals and necessary forms for data recording to CPAs, as well as making regular site visits to provide any necessary assistance and advice to the CPAs and solve any issues.

NEA will manage all the data in digital format, which will assure transparency through enabling easy access to the status of CPAs at anytime, as well as preventing double counting.

Further information on the monitoring items will be described in Section E.

A.4.5. Public funding of the programme of activities (PoA):

Public funding from each municipality is involved in this PoA and related CPAs. However, this PoA does not include any diversion of ODA funds.

SECTION B. Duration of the programme of activities (PoA)

B.1. Starting date of the programme of activities (PoA):

1st of January 2010

B.2. Length of the programme of activities (PoA):

28 years

SECTION C. Environmental Analysis

C.1. Please indicate the level at which environmental analysis as per requirements of the CDM modalities and procedures is undertaken. Justify the choice of level at which the environmental analysis is undertaken:

1. Environmental Analysis is done at PoA level ☐
2. Environmental Analysis is done at SSC-CPA level ☒

In the Philippines, requirements for environmental analysis, or the Environmental Impact Statement (EIS), are stated within the Department Administrative Order (DAO) 2003-30. Projects qualifying for certain criteria defined by the DAO 2003-30 are required to submit an Initial Environmental Examination (IEE) report or IEE checklist (checklist is prepared for certain types of projects for their simple procedures).

As indicated in C.3., CPAs under this PoA are not required to submit an IEE report. However, in order to fulfil the environmental analysis requirement of the Philippines, all CPAs must complete and submit a Project Description (PD) including an environmental managements plan (EMP). Therefore, for this PoA, an Environmental Analysis will be implemented at the CPA level.

C.2. Documentation on the analysis of the environmental impacts, including transboundary impacts:

The environmental impacts of the irrigation canals where the mini-hydropower generation facilities are to be located are expected to be very small because of the following reasons:

- CPAs under this PoA are not subject to the EIA under the regulations set forth by the Department of Environment and Natural Resources.
- The PoA installs hydropower in existing irrigation canals only. Therefore it does not cause any additional destruction of watersheds and other natural resources that have high ecosystem values and services.
- Through the removal of waste such as fallen leaves that accumulate in the canal system, there are positive environmental effects, while there are no known negative effects to the environment.

Furthermore, there are no transboundary environmental impacts predicted to be caused by the implementation of the hydropower facilities in the irrigation canals. Therefore, there are no transboundary impacts expected to be caused from this Project.

C.3. Please state whether in accordance with the host Party laws/regulations, an environmental impact assessment is required for a typical CPA, included in the programme of activities (PoA).:

According to Philippines Department Administrative Order (DAO) 2003-30, hydropower generation projects that impound water for electricity generation will be classified as Category A or Category B that are required to submit an EIS or Initial Environmental Examination (IEE) report which is equivalent to an Environmental Impact Assessment (EIA).

On the other hand, power generation plants less than 1MW and hydropower generation projects that apply run-of-river system will be classified as Category D, which is applicable to the CPAs under this PoA. As shown in the Table 3, Category D is considered as a project that will not result in significant environmental impacts and will not be required to submit an IEE report.

Table 3. Classification of The Environmental Impact Assessment of a Newly Developed Hydropower Generation Project

Criteria for Classification	Category	Description of the Category	Documents Required to be Submitted
Impounding >= 20 million cubic meters	Category A	Environmentally Critical Projects with significant potential to cause negative environmental impacts.	-(Programmatic)EIS*1
Impounding < 20 million cubic meters	Category B	Projects that are not environmentally critical in nature, but which may cause negative environmental impacts because they are located in environmentally critical areas	-IEE*2 or IEE Checklist*3 (if available)
Using run-of-river system **(Applicable to the CPAs under this PoA)**	Category D	Projects not falling under other categories OR unlikely to cause adverse environmental impacts	Project Description*4
Power generation plant less than 1MW capacity **(Applicable to the CPAs under this PoA)**			

*1: Environmental Impact Statement (EIS) - the document of studies on the environmental impacts of a project including the discussions on direct and indirect consequences upon human welfare and ecological and environmental integrity. The EIS may vary from project to project but shall contain in every case all relevant information and details about the proposed project or undertaking, including the appropriate mitigating and enhancement measures to address the identified environmental impacts. environmental impacts of co-located projects with proposals for expansions. The PEPRMP should also describe the effectiveness of current environmental mitigation measures and plans for performance improvement.
*2: Initial Environmental Examination (IEE) - the document required of proponents describing the environmental impact of, and mitigation and enhancement measures for, non critical projects or undertakings located in an environmental critical area.
*3: Initial Environmental Examination (IEE) Checklist - a short and simplified checklist version of an IEE prescribed by the DENR and required to be filled up by proponents for describing the project's environmental impact and corresponding mitigation and enhancement measures for non-critical projects located in an environmental critical area. The DENR prescribes appropriate corresponding IEE Checklists for different projects with minimal and manageable impacts.
*4: Project Description (PD) – document, which may also be a chapter in an EIS, that describes the nature, configuration, use of raw materials and natural resources, production system, waste or pollution generation and control and the activities of a proposed project. It includes a description of the use of human resources as well as activity timelines, during the pre-construction, construction, operation and abandonment phases.

For the projects under Category D, Project Description (PD) should be submitted. Within the PD, an EMP at the CPA level must be presented including items described in Table 4.

Table 4. Recommended Contents of Project Description

Chapter	Contents
I. Introduction	
II. Project Description	A. Project Rationale
	B. Proposed Project Location
	C. Description of Project Operations -Process Flow -Material and Energy Balance -Production capacity and descriptions of raw materials, by-products, products and waste materials
	D. Description of Project Phases -Pre-construction/Operational phase -Construction phase -Operational phase -Abandonment phase
	E. Project Capitalization and Manpower Requirement
III. Environmental Management Plan (EMP, Discussion of the residual management scheme among others)	A. Air
	B. Water
	C. Land
IV. Attachment	

SECTION D. Stakeholders' comments

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D.1. Please indicate the level at which local stakeholder comments are invited. Justify the choice:

1. Local stakeholder consultation is done at PoA level ☒
2. Local stakeholder consultation is done at SSC-CPA level ☒

Prior to the implementation of this Project, interviews were held for the purpose of explaining the objectives, processes, implications and benefits for sustainable development of the PoA to relevant stakeholders, including the representatives from the National Agencies, Financial Institution, environmental NGOs, etc. Further stakeholders' comments, especially at the CPA levels must be collected through interviews with local agencies and citizens who are specifically related to the CPAs.

D.2. Brief description how comments by local stakeholders have been invited and compiled:

Public comments were collected by individual interviews from the following organizations during the period between September 2008 and January 2009.

- National Agencies: NEA, NIA, DOE, DENR, National Power Corporation (NPC)
- Environmental NGO: International Council for Local Environmental Initiatives (ICLEI)
- Financial Institution: Development Bank of the Philippines

As described in D.1., comments from responsible persons of local agencies and citizens who are specifically related to the Project will be gathered at a later date through interviews at the CPA level.

D.3. Summary of the comments received:

Interviewees were generally very supportive towards the implementation of the PoA, viewing it as a positive opportunity for the Philippines to gain the technological and financial support from Japan in order to shift its energy supply to more renewable sources, as well as create opportunities to provide positive impacts to rural agricultural communities. Moreover, no direct objections to the implementation of the Project were expressed during or after the interviews and public comments.

D.4. Report on how due account was taken of any comments received:

All clarifications requested by local attending stakeholders were addressed during the discussion.

SECTION E. Application of a baseline and monitoring methodology

E.1. Title and reference of the approved SSC baseline and monitoring methodology applied to a SSC-CPA included in the PoA:

SSC AMS-I.D. "Grid connected renewable electricity generation (Version 13)" was applied to the baseline and monitoring methodologies in the PoA. Methodological Tool in Annex 12 of the EB 35 meeting Report: "Tool to calculate the emission factor for an electricity system (Version 01.1)" was also applied as references for SSC AMS-I.D (ver.13).

E.2. Justification of the choice of the methodology and why it is applicable to a SSC-CPA:

This PoA applies SSC AMS-I.D (ver.13). Justifications of the choice of SSC AMS-I.D (ver.13) are described in Table 5.

Table 5. Applicability Criteria and Justification

Applicability Criteria of SSC AMS-I.D (ver.13)	Justification of Applicability
1. This category comprises renewable energy generation units, such as photovoltaics, hydro, tidal/wave, wind, geothermal and renewable biomass, that supply electricity to and/or displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit.	All CPAs under the PoA comprises mini-hydropower generation facilities that supply electricity to the grid
2. If the unit added has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15MW for a small-scale CDM project activity applies only to the renewable component. If the unit added co-fires fossil fuel1, the capacity of the entire unit shall not exceed the limit of 15MW.	N/A
3. Combined heat and power (co-generation) systems are not eligible under this category.	None of the CPAs will employ co-generation systems
4. In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct2 from the existing units.	All CPAs under the PoA will apply the mini-hydropower generation facilities producing less than, or equal to, 15 MW of renewable energy
5. Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category. To qualify as a small-scale project, the total output of the modified or retrofitted unit shall not exceed the limit of 15 MW.	None of the CPAs under the PoA will retrofit or modify existing power generation facilities

E.3. Description of the sources and gases included in the SSC-CPA boundary

The boundary applies to each CPAs under the PoA and includes the physical and geographic location of each mini-hydropower generation facility. No greenhouse gas emissions are to be generated within the project boundary of the PoA because fossil fuel is not used for electricity generation or transportation.

E.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

The alternative baseline scenarios to a typical CPA under this PoA are identified as follows:

1) Alternative 1: The proposed project activity is not undertaken as a CDM project activity;
2) Alternative 2: An equivalent amount of annual electricity is generated by other renewable electricity sources(The proposed project activity will not be undertaken); and
3) Alternative3: An equivalent amount of annual electricity is generated by the existing power

distribution system (The proposed project activity will not be undertaken) .

Of the three alternative scenarios above, Alternative 1 and Alternative 2 are unlikely to be the baseline scenario because of the following reasons:

Alternative 1: There are barriers for its implementation as stated in E.5.
Alternative 2:The physical conditions at the Project site are not suitable for wave, tidal or geothermal power generation. Furthermore, solar, wind and biomass power generation are not financially feasible at the site. .

Therefore, the practical and feasible baseline scenario is Alternative 3, which is the generation of electricity from the existing power distribution system. At this scenario, electricity is supplied to the grid by existing power plants where much of their power is generated from burning of fossil fuel, causing greenhouse gas emissions into the atmosphere.

E.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the SSC-CPA being included as registered PoA (assessment and demonstration of additionality of SSC-CPA):

E.5.1. Assessment and demonstration of additionality for a typical SSC-CPA:

In the absence of the PoA, hydropower generation in irrigation canals will not be implemented, and electricity will be supplied to the grid from existing power plants where much of their power is generated from fossil fuel combustion. The existence of the following barriers prevents the implementation of a project activity (a typical CPA without CDM), thus greenhouse gasses will continue to be emitted into the atmosphere within the process of electricity generation.

Determination of additionality will be established in line with Attachment A of Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities. The project participants will provide an explanation to show that the project activity would not have occurred without the PoA, due to at least one of the following barriers: investment barrier, technology barrier, barrier due to prevailing practice and other barriers.

For a typical CPA under this PoA will be applicable to the following barriers:

(a) Technology barrier
The Submergible Turbine Generator applied in this CPA is a unique technology developed in Japan, where the generator can be installed within existing irrigation system and canals. To this day, there is no known case of the instalment of this technology in the Philippines. Therefore, manufacturing and maintenance capacity of this particular technology is limited, thus causing a technology barrier to the implementation of the CPA.

(b) Barrier due to prevailing practice
There are many existing hydropower plants in the Philippines. However, in terms of hydropower generation in existing irrigation systems, actualization of projects have been very rare. In addition, the technology to be applied to a typical CPA is the first of its kind technology in terms of hydropower

generation facility to be installed within water at an irrigation canal. Therefore there is a barrier due to prevailing practice.

(c) Other barriers: Access-to-finance barrier

Due to the small-scale nature of hydropower generation in irrigation canals, procurement of funds from financing banks without CDM is extremely challenging. The project activity cannot access appropriate capital without being implemented under the CDM scheme since implementation as the CDM project is the crucial factor for some financing banks to approve the loan.

Impact of CDM registration

CDM registration will enable CPAs to receive low-income loans from a financial institution. In addition, the approval and registration of the CDM project will alleviate the identified barriers through diversion of some risks in the project to the CDM partner. Moreover, additional revenue from CER sales, technology transfer and investment from countries such as Japan will allow the REC to finance and implement new hydropower projects.

E.5.2. Key criteria and data for assessing additionality of a SSC-CPA:

Below are the key criteria for assessing the additionality of the CPA when proposed to be included in the registered PoA.

- Technology barrier: The applied technology is the Submergible Turbine Generator, which is an advanced technology that has not been implemented in the Philippines and manufacturing and maintenance capacity of this particular technology is limited.
- Barrier to prevailing practice: The technology applied is the first of its kind technology in terms of hydropower generation facility to be installed within water at an irrigation canal in the Philippines.
- Other barrier: Access-to-finance barrier: A statement from the financing bank that the implementation as the CDM is critical in the approval of the loan.

CPA under PoA must meet at least one of the above criteria to meet the additionality requirement.

E.6. Estimation of Emission reductions of a CPA:

E.6.1. Explanation of methodological choices, provided in the approved baseline and monitoring methodology applied, selected for a typical SSC-CPA:

Baseline emissions and project emissions are calculated by the equations defined by SSC AMS-I.D. "Grid connected renewable electricity generation (Version 13)". The parameters used for calculation are locally obtained values and default values determined by IPCC Guidelines for National Greenhouse Gas Inventories (2006).

According to SSC AMS-I.D., the yearly emission factor of the grid should be calculated referring to Methodological Tool in Annex 12 of the EB 35 Meeting Report: "Tool to calculate the emission factor for an electricity system (Version 01.1)" (referring to equation (1) in E.6.2.).

E.6.2. Equations, including fixed parametric values, to be used for calculation of emission reductions of a SSC-CPA:

(i) Baseline Emissions

Based on SSC AMS-I.D., baseline emissions are obtained by the following steps:

Step 1. Emission Factor Calculation

Step 1-1. Select an Emission Factor Option

The baseline is the electricity generation (MWh) produced by the renewable generating unit multiplied by an emission factor (tCO2e/MWh) calculated in a transparent and conservative manner as:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the emission factor for an electricity system'.

OR

(b) The weighted average emissions (in kg CO2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

This PoA applied option (a) for calculation of the baseline emission factor.

Step 1-2. Determination of OM Emission Factor Calculation Method

The calculation of the operating margin emission factor (EF_{grid},OM,$_y$) is based on one of the following methods:

(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch data analysis OM, or
(d) Average OM.

The annual load duration curve and grid system dispatch data is necessary for Method (b) and (c) respectively; however, these datas are not open to public. Therefore, Methods (b) and (c) cannot be applied to this PoA.

Renewable energy (hydro, geothermal, wind, biomass, solar) and nuclear power are considered as sources of low-cost/must-run power generation. Therefore, Method (a) is obtained by the weighted average of the unit electricity generation volume of power plants excluding renewable energy and nuclear power plants. On the other hand, Method (d) is the average emission factor of all power plants connecting to the grid.

Method (a) can be used only if low-cost/must-run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production.

Based on "Tool to calculate the emission factor for an electricity system", this PoA will utilize Method (a) if the 5-year generation-weighted average data indicates that the percentage of electricity generated from low-cost/must-run power plants are less than/equal to 50% of the total electricity generated within the grid. If this percentage is above 50%, Method (d) will be applied.

Based on the above, with the currently available latest data, the OM calculation method to be applied to each grid system in the Philippines is determined as shown in the Table 6.

Table 6. OM Calculation Method to Be Applied to The Grid Systems in The Philippines

Grid	Proportion of Electricity Supply by Low-cost/Must-run Power Plants (2003-2007)	Option applied
Luzon	18.8% < 50%	Simple OM
Visayas	73.0% > 50%	Average OM
Luzon-Visayas	28.3% < 50%	Simple OM
Mindanao	66.7% > 50%	Average OM

Step 1-3. Calculate The OM Emission Factor According to The Selected Method.

Calculation of Simple OM [Method (a)]

The simple OM emission factor is calculated as the generation-weighted average CO2 emissions per unit net electricity generation (tCO2/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units.

$$EF_{grid,OMsimple,y} = \frac{\sum_i F_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{GEN_y}$$ ……Equation (1)

Where,

$EF_{grid,OMsimple,y}$: Simple operating margin CO2 emission factor in year y (tCO2/MWh)

$F_{i,y}$: Amount of fossil fuel type i consumed in the project electricity system in year y (mass or volume unit)

$NCV_{i,y}$: Net calorific value (energy content) of fossil fuel type i in year y (GJ / mass or volume unit)

$EF_{CO2,i,y}$: CO2 emission factor of fossil fuel type i in year y (tCO2/GJ)

GEN_y: Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost / must-run power plants / units, in year y (MWh)

i: All fossil fuel types combusted in power sources in the project electricity system in year y

y: Either the three most recent years for which data is available at the time of submission of the CDM-PDD to the Designated Operational Entity for validation (ex ante option)

For calculation, if only electricity generation and the fuel types used is available, the emission factor should be determined based on the CO2 emission factor of the fuel type used and the efficiency of the power unit.

In the Philippines, data on the fossil fuel consumption for power generation is not publicly available, and therefore, for this PoA, the heat energy content (Heat Rate) as an indication of the efficiency of each fuel type is used for the calculation of “$F_{i,a,y}$ multiplied by $NCV_{i,y}$ ” as shown in the Equation (2):

$$F_{i,y} \times NCV_{i,y} = GEN_{i,y} \times HeatRate_i \times CF \times 1000$$ ……Equation (2)

Where,

$F_{i,y}$:	Amount of fossil fuel type i consumed in the project electricity system in year y (mass or volume unit)
$NCV_{i,y}$:	Net calorific value (energy content) of fossil fuel type i in year y (GJ / mass or volume unit)
$GEN_{i,y}$:	The average power generation for the year y from fossil fuel type i (MWh).
Heat $Rate_i$:	The heat energy content of the fuel needed to produce one kilowatt hour of electricity (BTU/kWh)
CF:	Conversion factor from BTU into TJ(TJ/BTU)

Simple OM can be derived using either of the following two data vintages for years y:

1. A 3-year average, based on the most recent statistics available at the time of Project Design Document (PDD) submission or (ex ante);
2. The year in which project generation occurs, if the Simple OM emission factor is to be updated based on ex post monitoring.

For this PoA, ex ante approach (a 3-year average data) is applied.

$EF_{CO2,i,y}$ in the Equation (1) is obtained by the Equation (3) as follows:

$$EF_{CO2,i,y} = CC_i \times OXID_i \times 44/12$$ ……Equation (3)

Where,

$EF_{CO2,i,y}$:	CO2 emission factor of fuel type i (tCO2/GJ)
CC_i:	Carbon Contents of fuel type i (tC/TJ)
$OXID_i$:	Carbon oxidation factor of the fuel type i (%)

Calculation of Average OM [Method (d)]

The average OM emission factor ($EF_{grid,OM-ave,y}$) is calculated as the average emission rate of all power plants serving the grid, using the methodological guidance as described under Method (a) Equation(1) above for the simple OM, but including in all equations also low-cost/must-run power plants.

Step 1-4. Identify the Cohort of Power Units to Be Included in The Build Margin (BM) .

Sample Group of Power Units

The sample group of power units m used to calculate the build margin consists of either:

(a) The set of five power units that have been built most recently, or

(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

Project participants should use the set of power units that comprises the larger annual generation.

Capacity additions from retrofits of power plants should not be included in the calculation of the build margin emission factor.

Vintage of Data

In terms of vintage of data, project participants can choose between one of the following two options:

Option 1.

For the first crediting period, calculate the build margin emission factor ex-ante based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the Designated Operational Entity for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the Designated Operational Entity. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2.

For the first crediting period, the build margin emission factor shall be updated annually, ex-post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated ex-ante, as described in option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

For this PoA, Option 1 is applied.

Step 1-5. Calculate The Build Margin Emission Factor.

The build margin emissions factor is the generation-weighted average emission factor (tCO2/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m GEN_{m,y} \times EF_{EL,m,y}}{\sum_m GEN_{m,y}}$$ ……Equation (4)

Where,

$EF_{grid,BM,y}$: Build margin CO2 emission factor in year y (tCO2/MWh)
$GEN_{m,y}$: Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$: CO2 emission factor of power unit m in year y (tCO2/MWh)
m : Power units included in the build margin
y : Most recent historical year for which power generation data is available

The CO2 emission factor of each power unit m (EFEL,m,y) will be determined as per Step1-3. Method (a) for the simple OM using "y" for the most recent historical year for which power generation data is available, and using "m" for the power units included in the build margin.

Step 1-6. Calculate The Combined Margin (CM) Emissions Factor.

According to the above equations, the emission factor of the system power supply (combined margin, CM) is determined by the CO2 emission factor of system power supply (CEF_y). CEF is average of OM and BM described as follows:

$$CEF_y = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \qquad \text{……Equation (5)}$$

Where,

CEF_y: CO2 emission factor of system power supply ($tCO2_{eg}$ /MWh)
$EF_{grid,OM,y}$: Operating margin CO2 emission factor in year y ($tCO2_{eg}$ /MWh)
$EF_{grid,BM,y}$: Build margin CO2 emission factor in year y ($tCO2_{eg}$ /MWh)
w_{OM}: Weighting of operating margin emissions factor (%)
w_{BM}: Weighting of build margin emissions factor (%)

w_{OM} = 0.5 and w_{BM} = 0.5 for this crediting period.

According to the above equation, the latest emission factor of the system power supply (combined margin) for this PoA is determined as shown in the Table 7. CPAs under PoA can use these figures if new electricity generation statistic data is not available.

Table 7. Emission Factor of The System Power Supply (CEF_y)

	OM ($tCO2_{eg}$ /MWh)	BM ($tCO2_{eg}$ /MWh)	CM ($tCO2_{eg}$ /MWh)
Luzon	0.618	0.349	0.483
Visayas	0.205	0.696	0.451
Luson-Visayas	0.627	0.350	0.488
Mindanao	0.277	0.679	0.478

STEP 2. Calculation of Baseline Emissions

Baseline emissions is calculated by equation (6).

Renewable energy generation volume (MWh) for the baseline emissions calculations was derived utilizing data with high transparency. Baseline emissions from system power supply are determined as follows with CEF_y shown in the Table 7.

$$\underset{(tCO2_{eq}/y)}{BEy_{,grid}} = \underset{(MWh)}{EG_y} \times \underset{(tCO2_{eg}\ /MWh)}{CEF_y} \qquad \text{……Equation (6)}$$

$$\underset{(MWh)}{EG_y} = \underset{(MW)}{Electricity_y} \times \underset{(h/y)}{T_y} \qquad \text{……Equation (7)}$$

Where,
$BE_{y,grid}$: Annual baseline emissions from system power supply ($tCO2_{eq}$/year)

$Electricity_y$: Power generation capacity of installed plant (MW)
T_y: Operation hours of installed plant (h/y)
CEF_y: CO2 emission factor of system power supply ($tCO2_{eg}$ /MWh)

(ii) Project Emissions

This Project does not use fossil fuel within its entire activity. Therefore, Project Emission is zero.

(iii) Leakage Emissions

Emissions from leakage are calculated in the following cases:

- When power generation facilities are transferred from other activities or existing power generation facilities are transferred into other activities.
- Biomass resources are used for power generation in the project activity

This project activity does not apply to either of the above cases. Therefore, no leakage will be generated by the Project.

(iv) Emissions Reduction of Greenhouse Gas

GHG emissions reduction is calculated as indicated in equation (8).

$$\underset{(tCO2_{eq}/y)}{ER_y} = \underset{(tCO2_{eq}/y)}{BE_y} - \left(\underset{(tCO2_{eq}/y)}{PE_y} + \underset{(tCO2_{eq}/y)}{Leakage_y} \right) \quad \ldots\ldots \text{Equation(8)}$$

ERy: Emissions reduction in year "y" ($tCO2_{eq}/y$)
BEy: Baseline emissions in year "y" ($tCO2_{eq}/y$)
PE_y: Project emissions in year "y" ($tCO2_{eq}/y$)
$Leakage_y$: Emissions due to leakage in year y ($tCO2_{eq}/y$)

E.6.3. Data and parameters that are to be reported in CDM-SSC-CPA-DD form:

The detailed information on the data and parameters not requiring monitoring are described as follows. For data and parameters used for ex-ante calculation but need to be monitored after project implementation are shown in E.7.1.

Data / Parameter:	GEN_y
Data unit:	MWh
Description:	Net electricity generated and delivered to the grid by all power sources serving the system in year y (for calculation of Simple OM, low-cost / must-run power plants / units is not included in the figure)
Source of data used:	Department of Energy, the Philippines
Value applied:	See Annex 3 for details
Justification of the choice of data or description of	Official released statistic; publicly accessible and reliable data source

measurement methods and procedures actually applied:	
Any comment:	

Data / Parameter:	$GEN_{i,y}$
Data unit:	MWh
Description:	The average power generation for the year y from fossil fuel type i
Source of data used:	Department of Energy, the Philippines
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied:	Official released statistic; publicly accessible and reliable data source
Any comment:	

Data / Parameter:	$GEN_{m,y}$
Data unit:	MWh
Description:	Net quantity of electricity generated and delivered to the grid by power unit m in year y
Source of data used:	Department of Energy, the Philippines
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied:	The statistics data provided by the Department of Energy
Any comment:	

Data / Parameter:	$Heat\ Rate_i$
Data unit:	BTU/kwh
Description:	Heat energy content of the fuel needed to produce one kilowatt hour (kWh) of electricity. It is a measure of a plant's energy efficiency, expressed in British Thermal Units per kWh (BTU/kWh).
Source of data used:	Department of Energy, the Philippines
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied:	Official released statistic; publicly accessible and reliable data source
Any comment:	

Data / Parameter:	$EF_{CO2,I}$
Data unit:	tCO2/TJ
Description:	The carbon emission factor of fuel type I
Source of data used:	2006 IPCC Guideline for National Greenhouse Gas inventories, Table 1-4
Value applied:	See Annex3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied:	IPCC default values are adopted.
Any comment:	

Data / Parameter:	$CC_{,i}$
Data unit:	tC/TJ
Description:	Carbon contents of fuel type i
Source of data used:	2006 IPCC Guideline for National Greenhouse Gas inventories, Table 1-4
Value applied:	See Annex3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied:	IPCC default values are adopted.
Any comment:	

Data / Parameter:	$OXID_{,i}$
Data unit:	%
Description:	Carbon oxidation factor of fuel type i
Source of data used:	2006 IPCC Guideline for National Greenhouse Gas inventories, Table 1-4
Value applied:	See Annex3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied:	IPCC default values are adopted.
Any comment:	

Data / Parameter:	CF
Data unit:	TJ/BTU
Description:	Conversion factor from BTU into TJ
Source of data used:	-
Value applied:	1.055×10^{-9}
Justification of the choice of data or description of	Theoretical value

measurement methods and procedures actually applied:	
Any comment:	

Data / Parameter:	$Electricity_y$
Data unit:	MW
Description:	Power generation capacity of installed plant
Source of data used:	Based on each CPA's project plan
Value applied:	Depending on the plan of each CPA
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

Data / Parameter:	T_y
Data unit:	hours/year
Description:	Operation hours of installed plant
Source of data used:	Based on each CPA's project plan
Value applied:	Depending on the plan of each CPA
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

E.7. Application of the monitoring methodology and description of the monitoring plan:

E.7.1. Data and parameters to be monitored by each SSC-CPA:

Data / Parameter:	EG_y
Data unit:	MWh
Description:	Electricity supplied to the grid by the project in the year y
Source of data to be used:	Measurements undertaken by the facility operator of each CPA
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Depending on the scale of hydropower facility which varies for each CPA
Description of	- Date will be measured by electricity meter connected to the grid

measurement methods and procedures to be applied:	- Data will be measured each hourly and recorded monthly
QA/QC procedures to be applied:	Periodic international calibration will be implemented. Data collected through measuring device will be crosschecked with receipts indicating the electricity generation volume.
Any comment:	Data will be kept for two years after the last issuance of CERs for this activity.

E.7.2. Description of the monitoring plan for a SSC-CPA:

Monitoring and reporting framework is shown in Figure4. The operation and management of each power generation facilities are carried out by the power producers, which is the REC. Based on a project operation and monitoring manual, electricity data will be collected, managed, and monitored by the Regional Electric Cooperatives (RECs). NEA, which is the regulatory agency of the REC will undertake data checking, calculation of emission reduction, site visits and provision of advice to the REC. NEA will also be responsible for communication with Designated Operational Entity for verification procedures (Refer to Figure4. Layout of Record Keeping System)。

E.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

January 30th, 2009

Ryuichi Shinoda
Yoshinari Shimizu
The Chugoku Electric Power Co.,Inc.
4-33 Komachi,Naka-ku,Hiroshima-shi,Hiroshima
730-8701,Japan
Tel: +81-82-241-0211, Fax: +81-82-523-6185

Ai Kawamura
EX CORPORATION
2-17-22 Takata, Toshima-ku, Tokyo, JAPAN
Tel: +81-3-5956-7503, Fax: +81-3-5956-7523

Annex 1

CONTACT INFORMATION ON COORDINATING/MANAGING ENTITY and PARTICIPANTS IN THE PROGRAMME of ACTIVITIES

Organization:	The Chugoku Electric Power Co.,Inc.
Street/P.O.Box:	4-33
Building:	
City:	Komachi,Naka-ku, Hiroshima-shi
State/Region:	Hiroshima
Postfix/ZIP:	730-8701
Country:	Japan
Telephone:	+81-82-241-0211
FAX:	+81-82-523-6185
E-Mail:	
URL:	http://www.energia.co.jp/e/index.html
Represented by:	
Title:	
Salutation:	Mr.
Last Name:	Shinoda
Middle Name:	
First Name:	Ryuichi
Department:	
Mobile:	
Direct FAX:	+81 82 523 6369
Direct tel:	+81 82 523 6541
Personal E-Mail:	261367@pnet.energia.co.jp

Organization:	National Electrification Administration
Street/P.O.Box:	NIA Road, Government Center, Diliman
Building:	
City:	Quezon City
State/Region:	Metro Manila
Postfix/ZIP:	1101
Country:	Philippines
Telephone:	+632 929 19 09 loc.123
FAX:	+632 929 21 61
E-Mail:	
URL:	http://www.nea.gov.ph/
Represented by:	
Title:	Department Manager
Salutation:	Mr.
Last Name:	RODERICK
Middle Name:	
First Name:	PADUA
Department:	CORPLAN

Mobile:	
Direct FAX:	+632 929 21 61
Direct tel:	+632 929 19 09 loc.123
Personal E-Mail:	rod_padua@yahoo.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding is involved in this PoA and related CPAs.

Annex 3

BASELINE INFORMATION

Baseline information is described in Section E.

Table 8. Electricity Statistical Data of the Luzon Grid

	2003	2004	2005	2006	2007	Average of 2005-2007 (3years)	Proportion 2003-2007 (5years)
Coal	14,351,121	15,548,335	14,653,275	14,099,158	14,417,796	14,390,076	81.2%
Oil-Based	3,457,582	4,590,814	2,021,641	1,711,415	2,192,048	1,975,035	
Combined Cycle	438,755	738,437	90,608	238,870	652,834	327,437	
Diesel	2,178,922	2,688,194	1,910,774	1,315,067	1,348,033	1,524,625	
Gas Turbines	1,737	183	1,433	0		717	
Oil-Thermal	838,268	1,164,000	18,826	157,478	191,182	122,495	
Natural Gas	13,139,410	12,384,467	16,860,917	16,365,960	18,789,414	17,338,764	
Geothermal	2,600,465	3,033,417	2,742,203	3,519,417	3,600,503	3,287,374	18.8%
Hydro	3,847,774	4,296,879	4,331,224	5,492,271	4,562,309	4,795,268	
Other Renewble (Wind,Solar)			17,469	53,235	57,842	42,849	
Total (GEN_y)	37,396,452	39,853,912	40,626,729	41,241,456	43,619,913	41,829,366	100%

Source: Department of Energy, Philippines

Table 9. Electricity Statistical Data of the Visayas Grid

	2003	2004	2005	2006	2007	Average of 2005-2007 (3years)	Proportion 2003-2007 (5years)
Coal	587,626	646,077	603,903	718,663	848,428	723,665	
Oil-Based	1,860,563	1,997,708	1,799,876	1,281,766	1,477,089	1,519,577	
Combined Cycle							
Diesel	1,480,745	1,649,383	1,486,431	1,165,700	1,334,868	1,329,000	27.6%
Gas Turbines	40,236	82,094	23,862	193	9,045	11,033	
Oil-Thermal	339,582	266,231	289,582	115,873	133,176	179,544	
Natural Gas			0			0	
Geothermal	6,360,964	6,338,317	6,267,377	6,100,202	5,746,878	6,038,152	
Hydro	33,033	34,277	27,196	28,093	29,197	28,162	72.4%
Other Renewble (Wind,Solar)			0			0	
Total (GEN_y)	8,842,186	9,016,379	8,698,351	8,128,724	8,101,592	8,309,556	100%

Source: Department of Energy, Philippines

Table 10. Electricity Statistical Data of the Luzon-Visayas Grid

	2003	2004	2005	2006	2007	Average of 2005-2007 (3years)	Proportion 2003-2007 (5years)
Coal	14,938,747	16,194,412	15,257,178	14,817,821	15,266,224	15,113,741	
Oil-Based	5,318,145	6,588,522	3,821,517	2,993,181	3,669,137	3,494,612	
Combined Cycle	438,755	738,437	90,608	238,870	652,834	327,437	
Diesel	3,659,667	4,337,577	3,397,205	2,480,767	2,682,901	2,853,624	71.8%
Gas Turbines	41,973	82,277	25,295	193	9,045	11,511	
Oil-Thermal	1,177,850	1,430,231	308,408	273,351	324,358	302,039	
Natural Gas	13,139,410	12,384,467	16,860,917	16,365,960	18,789,414	17,338,764	
Geothermal	8,961,429	9,371,734	9,009,580	9,619,619	9,347,381	9,325,527	
Hydro	3,880,807	4,331,156	4,358,420	5,520,364	4,591,506	4,823,430	28.2%
Other Renewble (Wind,Solar)	0	0	17,469	53,235	57,842	42,849	
Total (GEN_y)	46,238,638	48,870,291	49,325,080	49,370,180	51,721,505	50,138,922	100%

Source: Department of Energy, Philippines

Table 11. Electricity Statistical Data of the Mindanao Grid

	2003	2004	2005	2006	2007	Average of 2005-2007 (3years)	Proportion 2003-2007 (5years)
Coal				476,245	1,570,872	1,023,559	
Oil-Based	1,713,693	1,915,799	2,319,927	1,671,619	1,478,868	1,823,471	
Combined Cycle							
Diesel	1,711,563	1,915,500	2,319,772	1,671,376	1,478,775	1,823,308	30.8%
Gas Turbines			0			0	
Oil-Thermal	2,129	299	155	242	93	163	
Natural Gas			0			0	
Geothermal	861,015	909,815	892,863	845,660	867,308	868,610	
Hydro	3,989,013	4,261,525	4,028,352	4,419,049	3,971,927	4,139,776	69.2%
Other Renewble (Wind,Solar)			1,517	1,376	1,309	1,401	
Total (GEN_y)	6,563,720	7,087,139	7,242,659	7,413,948	7,890,284	7,515,630	100%

Source: Department of Energy, Philippines

Table 12. OM Calculation Option to be applied to the CPAs under this PoA

Grid	Proportion of Electricity Supply by Low-cost/Must-run Power Plants (2003-2007)	Option applied
Luzon	18.8% < 50%	Simple OM
Visayas	73.0% > 50%	Average OM
Luzon-Visayas	28.3% < 50%	Simple OM
Mindanao	66.7% > 50%	Average OM

Source: Table 8-11

Table 13. Heat Rate

Type of Fuel	BTU/kWh
Combined Cycle	6,550
Diesel	8,900
Gas Turbine	14,400
Oil Thermal	8,600
Coal	8,900
Natural Gas	6,550

Source: Department of Energy, the Philippines

Table 14. Carbon Contents of Each Type of Fuel (CC_i)

Type of Fuel	CC_i(tC/TJ)
Gas/Diesel Oil	20.20
Residual Fuel Oil	21.10
Other Bituminous Coal	25.80
Natural Gas	15.30

Source: 2006 IPCC Guideline for National Greenhouse Gas inventories, Table 1-4

Table 15. Combustion Efficiency($OXID_i$)

Type of Fuel	Combustion Efficiency
For all type of fuel	1.00

Source: 2006 IPCC Guideline for National Greenhouse Gas inventories, Table 1-4

Table 16. OM Calculation Data (Simple OM, Luzon Grid)

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)
Item	Electricity Generation (2005-2007)	Heat Rate	Conversion Factor	Fuel Consumption Impact	Carbon Contents	Oxidation Factor	CO2 Emission Factor	Annual Carbon Dioxide Emission Impact	Simple OM CO2 Emission Factor
Abbreviation	GEN	Heat Rate	-	-	CC	OXID	EFCO2	-	$EF_{grid,OMsimple}$
Data Source	PDOE Powerstats	PDOE	CF	(A)x(B)x(C) x1000	IPCC	IPCC	(E)x(F)	(D)x(G)	(H)/(A)
Unit	MWh/yr	BTU/kwh	TJ/BTU	TJ/yr	tC/TJ	-	tCO2/TJ	tCO2/yr	tCO2/MWh
Coal	14,390,076	8,900	$1.055*10^{-9}$	135,116	25.8	1.00	94.6	12,781,938	
Oil based	1,975,035							0	
Combined Cycle	327,437	6,550	$1.055*10^{-9}$	2,263	20.2	1.00	74.1	167,664	
Diesel	1,524,625	8,900	$1.055*10^{-9}$	14,315	20.2	1.00	74.1	1,060,776	
Gas Turbine	717	14,400	$1.055*10^{-9}$	11	20.2	1.00	74.1	807	
Oil Thermal	122,495	8,600	$1.055*10^{-9}$	1,111	21.1	1.00	77.4	86,022	
Natural Gas	17,338,764	6,550	$1.055*10^{-9}$	119,815	15.3	1.00	56.1	6,721,632	
Total	33,704,114							20,818,839	0.618

Table 17. OM Calculation Data (Average OM, Visayas Grid)

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)
Item	Electricity Generation (2005-2007)	Heat Rate	Conversion Factor	Fuel Consumption Impact	Carbon Contents	Oxidation Factor	CO2 Emission Factor	Annual Carbon Dioxide Emission Impact	Average OM CO2 Emission Factor
Abbreviation	GEN	Heat Rate	-	-	CC	OXID	EFCO2	-	$EF_{grid,OM-ave,y}$
Data Source	PDOE Powerstats	PDOE	CF	(A)x(B)x(C) x1000	IPCC	IPCC	(E)x(F)	(D)x(G)	(H)/(A)
Unit	MWh/yr	BTU/kwh	TJ/BTU	TJ/yr	tC/TJ	-	tCO2/TJ	tCO2/yr	tCO2/MWh
Coal	723,664,667	8,900	$1.055*10^{-9}$	6,794,849	25.8	1.00	94.6	642,792,752	
Oil based	1,519,577,000							0	
Combined Cycle	0	6,550	$1.055*10^{-9}$	0	20.2	1.00	74.1	0	
Diesel	1,328,999,667	8,900	$1.055*10^{-9}$	12,478,642	20.2	1.00	74.1	924,667,400	
Gas Turbine	11,033,333	14,400	$1.055*10^{-9}$	167,618	20.2	1.00	74.1	12,420,523	
Oil Thermal	179,543,667	8,600	$1.055*10^{-9}$	1,629,000	21.1	1.00	77.4	126,084,576	
Natural Gas	0	6,550	$1.055*10^{-9}$	0	15.3	1.00	56.1	0	
Geothermal	6,038,152,333			0					
Hydro	28,162,000			0					
Other renewables	0			0					
Total	8,309,555,667							1,705,965,251	0.205

Table 18. OM Calculation Data (Simple OM, Luzon-Visayas Grid)

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)
Item	Electricity Generation (2005-2007)	Heat Rate	Conversion Factor	Fuel Consumption Impact	Carbon Contents	Oxidation Factor	CO2 Emission Factor	Annual Carbon Dioxide Emission Impact	Simple OM CO2 Emission Factor
Abbreviation	GEN	Heat Rate	-	-	CC	OXID	EFCO2	-	$EF_{grid,OMsimple}$
Data Source	PDOE Powerstats	PDOE	CF	(A)x(B)x(C) x1000	IPCC	IPCC	(E)x(F)	(D)x(G)	(H)/(A)
Unit	MWh/yr	BTU/kwh	TJ/BTU	TJ/yr	tC/TJ	-	tCO2/TJ	tCO2/yr	tCO2/MWh
Coal	15,113,741	8,900	$1.055*10^{-9}$	141,910	25.8	1.00	94.6	13,424,731	
Oil based	3,494,612							0	
Combined Cycle	327,437	6,550	$1.055*10^{-9}$	2,263	20.2	1.00	74.1	167,664	
Diesel	2,853,624	8,900	$1.055*10^{-9}$	26,794	20.2	1.00	74.1	1,985,443	
Gas Turbine	11,511	14,400	$1.055*10^{-9}$	175	20.2	1.00	74.1	12,958	
Oil Thermal	302,039	8,600	$1.055*10^{-9}$	2,740	21.1	1.00	77.4	212,107	
Natural Gas	17,338,764	6,550	$1.055*10^{-9}$	119,815	15.3	1.00	56.1	6,721,632	
Total	35,947,116							22,524,535	0.627

Table 19. OM Calculation Data (Average OM, Mindanao Grid)

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)
Item	Electricity Generation (2005-2007)	Heat Rate	Conversion Factor	Fuel Consumption Impact	Carbon Contents	Oxidation Factor	CO2 Emission Factor	Annual Carbon Dioxide Emission Impact	Average OM CO2 Emission Factor
Abbreviation	GEN	Heat Rate	-	-	CC	OXID	EFCO2	-	$EF_{grid,OM-ave,y}$
Data Source	PDOE Powerstats	PDOE	CF	(A)x(B)x(C) x1000	IPCC	IPCC	(E)x(F)	(D)x(G)	(H)/(A)
Unit	MWh/yr	BTU/kwh	TJ/BTU	TJ/yr	tC/TJ	-	tCO2/TJ	tCO2/yr	tCO2/MWh
Coal	1,023,559	8,900	$1.055*10^{-9}$	9,611	25.8	1.00	94.6	909,172	
Oil based	1,823,471							0	
Combined Cycle	0	6,550	$1.055*10^{-9}$	0	20.2	1.00	74.1	0	
Diesel	1,823,308	8,900	$1.055*10^{-9}$	17,120	20.2	1.00	74.1	1,268,588	
Gas Turbine	0	14,400	$1.055*10^{-9}$	0	20.2	1.00	74.1	0	
Oil Thermal	163	8,600	$1.055*10^{-9}$	1	21.1	1.00	77.4	115	
Natural Gas	0	6,550	$1.055*10^{-9}$	0	15.3	1.00	56.1	0	
Geothermal	868,610			0					
Hydro	4,139,776			0					
Other renewables	1,401			0					
Total	7,856,817							2,177,875	0.277

Table 20. Most Recently Built Power Plant Data Used for BM (Luzon Grid)

Plant Name	Rated Cap (MW)	Plant Type	Electricity Generation in 2007 (MWh)	Original Year Commissioned
Northwind Power	25	Wind	57,772	Jun 2005
San Roque HE	345	Hydro	728,751	May 2003
Casecnan HE	140	Hydro	441,557	Apr 2002
Sta Rita Nat Gas	1,060	Combine Cycle	7,337,257	Jun 2002
San Lorenzo Nat Gas	500	Combine Cycle	3,652,594	Sep 2002
Total			12,217,931	
Proportion within the grid:		*28%*		

Source: Data Provided by Department of Energy, Philippines

Table 21. Most Recently Built Power Plant Data Used for BM (Visayas Grid)

Plant Name	Rated Cap (MW)	Plant Type	Electricity Generation in 2007 (MWh)	Original Year Commissioned
Guimaras Power Project	3.4	Diesel	3,836	Apr 2005
20 MW Bunker (GBPC)	20	Diesel	41,873	Feb 2006
15 MW Bunker (GBPC)	15	Diesel	2470	Aug 2006
5 MW Bunker (GBPC)	5	Diesel	no operation	Sep 2006
Panay Power Corp	75	Diesel	345,411	1999
East Asia Utilities	50	Diesel	277,413	1998
Cebu Private Power Corp	70	Diesel	241,846	1997
Total			912,851	
Proportion within the grid:		*11%*		

Note: GBPC no 2006 submission

For Visayas grid, electricity generation data is only available for the six most recently build power plants, which does not reach 20% of the system generation.

Source: Data Provided by Department of Energy, Philippines

Table 22. Most Recently Built Power Plant Data Used for BM (Luzon-Visayas Grid)

Plant Name	Rated Cap (MW)	Plant Type	Electricity Generation in 2007 (MWh)	Original Year Commissioned
Guimaras Power Project	3.4	Diesel	3,836	Apr 2005
20 MW Bunker (GBPC)	20	Diesel	41,873	Feb 2006
15 MW Bunker (GBPC)	15	Diesel	2470	Aug 2006
5 MW Bunker (GBPC)	5	Diesel	no operation	Sep 2006
Northwind Power	25	Wind	57,772	Jun 2005
San Roque HE	345	Hydro	728,751	May 2003
Casecnan HE	140	Hydro	441,557	Apr 2002
Sta Rita Nat Gas	1,060	Combine Cycle	7,337,257	Jun 2002
San Lorenzo Nat Gas	500	Combine Cycle	3,652,594	Sep 2002
Total			12,266,111	
Proportion within the grid:		*24%*		

Note: GBPC no 2006 submission

Source: Data Provided by Department of Energy, Philippines

Table 23. Most Recently Built Power Plant Data Used for BM (Mindanao Grid)

Plant Name	Rated Cap (MW)	Plant Type	Electricity Generation in 2007 (MWh)	Original Year Commissioned
Mindanao Coal	210	Coal	1,570,872	Sep 16,2006 and Nov 15,2006
Solar	1	Solar	1,309	Oct 2004
Bubunawan		Hydro	22,215	Sep 2001
Mt Apo II	54	Geothermal	431,995	Jun 1999
Tolomo	4	Hydro	28,317	Oct 1998
Total			2,054,709	
Proportion within the grid:		*27%*		

Source: Data Provided by Department of Energy, Philippines

Table 24. BM Calculation Data (Luzon Grid)

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)
Item	Electricity Generation (2007)	Heat Rate	Conversion Factor	Fuel Consumption Impact	Carbon Contents	Oxidation Factor	CO2 Emission Factor of Power Unit	Annual Carbon Dioxide Emission Impact	BM CO2 Eemission Factor
Abbreviation	$GEN_{m,i}$	Heat Rate	-	-	CC	OXID	EF_{EL}	-	EF_{gridBM}
Data Source	PDOE Powerstats	PDOE	CF	(A)x(B)x(C) x1000	IPCC	IPCC	(E)x(F)	(D)x(G)	(H)/(A)
Unit	MWh/yr	BTU/kwh	TJ/BTU	TJ/yr	tC/TJ	-	tCO2/TJ	tCO2/yr	tCO2/MWh
Coal	0	8,900	$1.055*10^{-9}$	0	25.8	1.00	94.6	0	
Oil based								0	
Combined Cycle	0	6,550	$1.055*10^{-9}$	0	20.2	1.00	74.1	0	
Diesel	0	8,900	$1.055*10^{-9}$	0	20.2	1.00	74.1	0	
Gas Turbine	0	14,400	$1.055*10^{-9}$	0	20.2	1.00	74.1	0	
Oil Thermal	0	8,600	$1.055*10^{-9}$	0	21.1	1.00	77.4	0	
Natural Gas	10,989,850	6,550	$1.055*10^{-9}$	75,943	15.3	1.00	56.1	4,260,381	
Geothermal	0			0					
Hydro	1,170,308			0					
Other renewables	57,772			0					
Total	12,217,931							4,260,381	0.349

Table 25. BM Calculation Data (Visayas Grid)

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)
Item	Electricity Generation (2007)	Heat Rate	Conversion Factor	Fuel Consumption Impact	Carbon Contents	Oxidation Factor	CO2 Emission Factor of Power Unit	Annual Carbon Dioxide Emission Impact	BM CO2 Eemission Factor
Abbreviation	$GEN_{m,i}$	Heat Rate	-	-	CC	OXID	EF_{EL}	-	EF_{gridBM}
Data Source	PDOE Powerstats	PDOE	CF	(A)x(B)x(C) x1000	IPCC	IPCC	(E)x(F)	(D)x(G)	(H)/(A)
Unit	MWh/yr	BTU/kwh	TJ/BTU	TJ/yr	tC/TJ	-	tCO2/TJ	tCO2/yr	tCO2/MWh
Coal	0	8,900	$1.055*10^{-9}$	0	25.8	1.00	94.6	0	
Oil based								0	
Combined Cycle	0	6,550	$1.055*10^{-9}$	0	20.2	1.00	74.1	0	
Diesel	912,851	8,900	$1.055*10^{-9}$	8,571	20.2	1.00	74.1	635,127	
Gas Turbine	0	14,400	$1.055*10^{-9}$	0	20.2	1.00	74.1	0	
Oil Thermal	0	8,600	$1.055*10^{-9}$	0	21.1	1.00	77.4	0	
Natural Gas	0	6,550	$1.055*10^{-9}$	0	15.3	1.00	56.1	0	
Geothermal	0			0					
Hydro	0			0					
Other renewables	0			0					
Total	912,851							635,127	0.696

Table 26. BM Calculation Data (Luzon-Visayas Grid)

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)
Item	Electricity Generation (2007)	Heat Rate	Conversion Factor	Fuel Consumption Impact	Carbon Contents	Oxidation Factor	CO2 Emission Factor of Power Unit	Annual Carbon Dioxide Emission Impact	BM CO2 Eemission Factor
Abbreviation	$GEN_{m,i}$	Heat Rate	-	-	CC	OXID	EF_{EL}	-	EF_{gridBM}
Data Source	PDOE Powerstats	PDOE	CF	(A)x(B)x(C) x1000	IPCC	IPCC	(E)x(F)	(D)x(G)	(H)/(A)
Unit	MWh/yr	BTU/kwh	TJ/BTU	TJ/yr	tC/TJ	-	tCO2/TJ	tCO2/yr	tCO2/MWh
Coal	0	8,900	$1.055*10^{-9}$	0	25.8	1.00	94.6	0	
Oil based									
Combined Cycle	0	6,550	$1.055*10^{-9}$	0	20.2	1.00	74.1	0	
Diesel	48,180	8,900	$1.055*10^{-9}$	452	20.2	1.00	74.1	33,522	
Gas Turbine	0	14,400	$1.055*10^{-9}$	0	20.2	1.00	74.1	0	
Oil Thermal	0	8,600	$1.055*10^{-9}$	0	21.1	1.00	77.4	0	
Natural Gas	10,989,850	6,550	$1.055*10^{-9}$	75,943	15.3	1.00	56.1	4,260,381	
Geothermal	0			0					
Hydro	1,170,308			0					
Other renewables	57,772			0					
Total	12,266,111							4,293,902	0.350

Table 27. BM Calculation Data (Mindanao Grid)

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)
Item	Electricity Generation (2007)	Heat Rate	Conversion Factor	Fuel Consumption Impact	Carbon Contents	Oxidation Factor	CO2 Emission Factor of Power Unit	Annual Carbon Dioxide Emission Impact	BM CO2 Eemission Factor
Abbreviation	$GEN_{m,i}$	Heat Rate	-	-	CC	OXID	EF_{EL}	-	EF_{gridBM}
Data Source	PDOE Powerstats	PDOE	CF	(A)x(B)x(C) x1000	IPCC	IPCC	(E)x(F)	(D)x(G)	(H)/(A)
Unit	MWh/yr	BTU/kwh	TJ/BTU	TJ/yr	tC/TJ	-	tCO2/TJ	tCO2/yr	tCO2/MWh
Coal	1,570,872	8,900	$1.055*10^{-9}$	14,750	25.8	1.00	94.6	1,395,322	
Oil based								0	
Combined Cycle	0	6,550	$1.055*10^{-9}$	0	20.2	1.00	74.1	0	
Diesel	0	8,900	$1.055*10^{-9}$	0	20.2	1.00	74.1	0	
Gas Turbine	0	14,400	$1.055*10^{-9}$	0	20.2	1.00	74.1	0	
Oil Thermal	0	8,600	$1.055*10^{-9}$	0	21.1	1.00	77.4	0	
Natural Gas	0	6,550	$1.055*10^{-9}$	0	15.3	1.00	56.1	0	
Geothermal	431,995			0					
Hydro	50,532			0					
Other renewables	1,309			0					
Total	2,054,709							1,395,322	0.679

Annex 4

MONITORING INFORMATION

Refer to Section D. for the Monitoring Information

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