CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

Power Prospect 9.9MW Rice Husk Power Plant (the "Project" or "project activity")
Document Version Number 02
23/10/2007

A.2. Description of the small-scale project activity:

The purpose of the project activity is to set up a biomass-based power generation plant that displaces the greenhouse gas (GHG) emission-intensive fossil fuel-based power generation in Thailand. The Project is designed to use rice husk, an abundant waste product of the rice milling process, as fuel to feed an advanced biomass-fired generation system with gross capacity of 9.9MW (8.9MW net) for green power generation.

In accordance with the project plans, the majority of the electricity generated will be sold to the Provincial Electricity Authority (PEA) under a firm power purchase contract in the Very Small Power Producer Program[1], while the remaining will be provided for the project plant's in-house (parasitic) consumption as well as to fuel the neighboring Nakorn Luang Rice Mill (NLRM) and Prospack Industry Company Limited (PICL), both affiliated companies. To ensure the consistency of energy supply to the PEA, the Power Prospect Company Limited (PPCL) plans to source the biomass waste from neighboring rice mills through fuel purchase agreements. PPCL plans to procure 60% of the rice husk from the neighboring NLRM and 40% of the rice husk from other mills nearby.

With combustion of an estimated 77,438 tonnes of biomass waste annually, the project activity will produce approximately 70,246 MWh of electricity to be supplied to the PEA. The expected amount of GHGs emission reductions is approximately 33,788 tonnes of CO_2 equivalent per annum.

Contribution to Sustainable Development

The Project will contribute to sustainable development to the host country in several areas:-

(1) Contribution to environmental development

The Project will diversify the sources of electricity generation by displacing conventional fossil fuel-based power generation with carbon-neutral biomass power generation, and hence GHGs emissions associated with the combustion of fossil fuels would be reduced.

[1] A Very Small Power Producer (VSPP) can be any private entity, government or state-owned enterprise that generates electricity either (a) from non-conventional sources such as wind, solar and mini-hydro energy or fuels such as waste, residues or biomass, or (b) from conventional sources provided they also produce steam through cogeneration. As per the VSPP program, the VSPP is limited to sell no more than 10MW of its electrical power output to the designated distribution utility, such as Metropolitan Electricity Authority (MEA) and/or Provincial Electricity Authority (PEA).

The Project, by (i) utilizing biomass in a more efficient manner and (ii) avoiding dumping of biomass, will also contribute to an important step forward in terms of effective and environmental management of agricultural waste.

(2) Contribution to economic development

The benefits due to the implementation of the Project will extend to economic sustainability, as the use of sustainable and indigenous biomass resource will reduce expensive fossil fuel imports and negative impact on the foreign exchange. Besides, it will also eliminate the risks of fluctuating oil prices, which will enable more economic and reliable energy production. Furthermore, the project activity also caters to the growing power demand that is forecast for Thailand.

(3) Contribution to social development

In terms of social contributions, the project activity will create employment opportunities to the local population for various activities involved in plant construction, operation and maintenance of power plant, transportation of biomass wastes, etc.

In addition, the local population will also benefit directly from the Project which produces reliable renewable energy.

(4) Conformation to the governmental policy and strategy of Thailand

The Project conforms to the governmental policy of Thailand and contributes to its national sustainable development using agro-residues as fuels for renewable energy generation. To promote the generation of green power, the Thai Government has stipulated a policy, called Very Small Power Producer Program, to encourage small power producer which generates power with renewable resources to sell part or all of its output to PEA. The Project is in the line with the Thai governmental policy.

A.3. 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)
Thailand (host)	**Power Prospect Company Limited (PPCL)** (Private entity)	No
Japan	**Clean Energy Finance Committee, Mitsubishi UFJ Securities Co., Ltd. (MUS)** (Private entity)	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

CDM – Executive Board

See contact information at Annex-1 of this PDD

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party(ies):

Thailand

A.4.1.2. Region/State/Province etc.:

Ayutthaya province

A.4.1.3. City/Town/Community etc:

Tha Ruea district

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

Ayutthaya, situated in the central part of Thailand, is approximately 75 kilometres on route A31, 72 kilometres by rail and 137 kilometres by boat away from the capital, Bangkok. It covers a total area of 2,557 square kilometres (or 1,597,900 rai). Ayutthaya is located in the flat river plain of the Chao Phraya River valley. The presence of the Lop Buri and Pa Sak River make the province a major rice farming area. Ayutthaya's boundary reaches Angthong and Lopburi to the north, Nakhon Prathom Nonthaburi and Pathumthani to the south, Saraburi to the east and Suphanburi to the west. The proposed project activity lies in the Tha Ruea district of Ayutthaya province, situated on the geographical coordinates at 100°42' east and 14°32' north.

The majority of Ayutthaya's landscape is a flood plain which consists of many rice fields without mountains and forests. It is an island city surrounded by four rivers: the Chao Phraya, the Pa Sak, the Lopburi and the Noi which are altogether 200 kilometres long. These four rivers are linked by about 860 small and big canals. The climate is hot and humid and influenced by 2 types of monsoons - Northeast monsoon in the cold season and Southwest monsoon in the rainy season.

Ayutthaya covers the area of 1,597,900 rai, of which 1,092,641 rai are used for agriculture: 451,001 rai (41.28%) belonging to the farmers while 594,725 rai (54.43%) belonging to non–farmers. Among the total agriculture land of 1,092,641 rai, 986,235 (90.26%) rai are rice fields.

Figure 1. The location map of Ayutthaya.

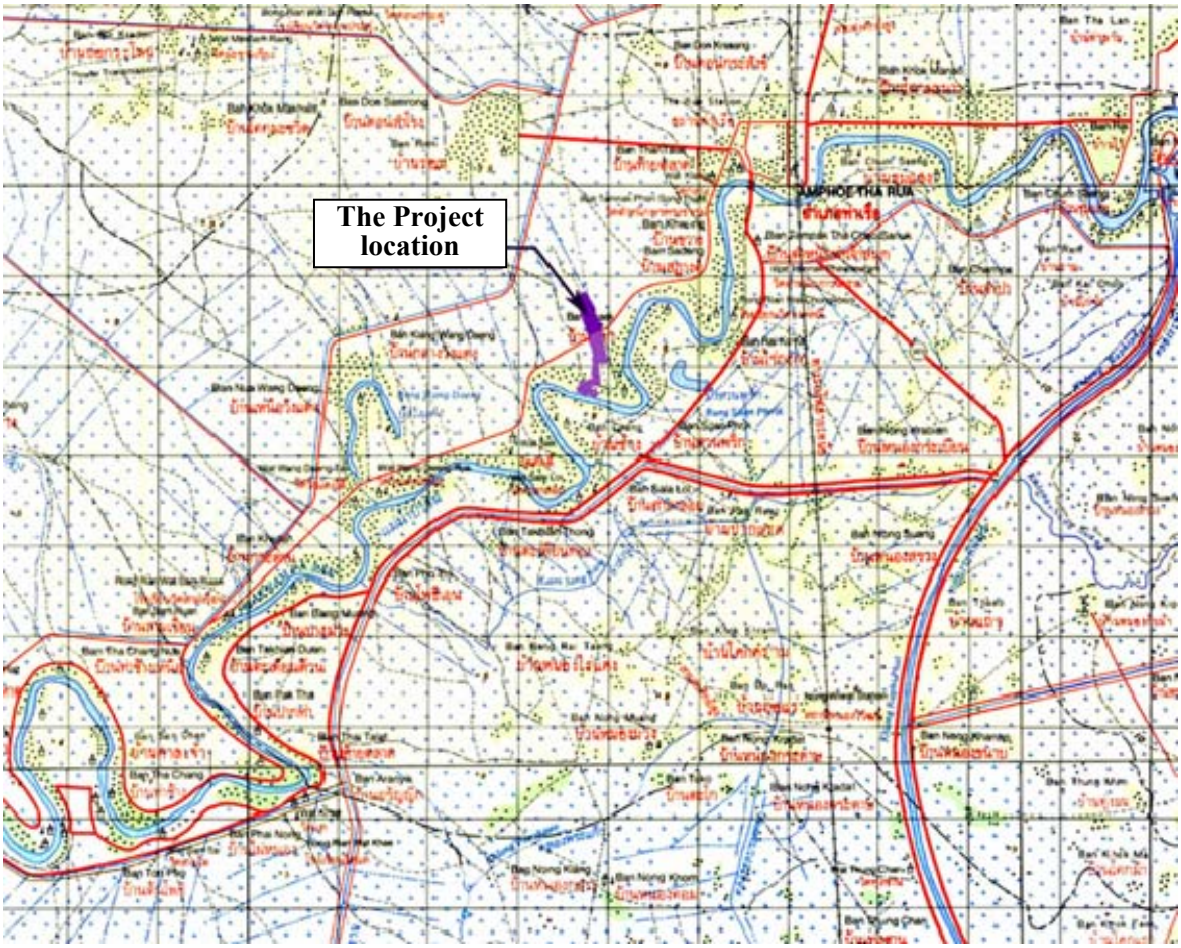

Figure 2. The location map of the project activity.

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

(1) Types and categories of the small-scale project activity

In accordance with Appendix B of the simplified modalities and procedures for small-scale CDM project activities ("SSC M&P"), the proposed Project falls under the following type and category:-

AMS-I.D.
Type I : Renewable energy projects
Category D : Grid connected renewable electricity generation
Reference : Version 12, Scope 1, approved on EB 33 (25-27 July 2007)

The proposed project activity is a biomass-based power generation project that displaces electricity from the grid. The total generated electricity from the Project does not exceed the capacity threshold limit of 15MW.

(2) Technology of the small-scale project activity

The boiler technology proposed in this Project is a water tube multi-fuelled boiler, which is capable of being fuelled with waste biomass, such as rice husk, and common fossil fuels. The combustion grate is completely integrated with the water tube boiler, which is considered as one of the best available technologies in the industry. It possesses various special features as follows:-

- High quality technology requiring minimum maintenance;
- Capable of long operation hours, normally more than 8,000 hours per year;
- Special design allowing dust removal by hammering, eliminating the risk of erosion by soot blowers;
- Low flue gas velocity, avoiding rapid wearing of the boiler and prolonging the lifetime of the plant;
- High efficiency;
- Low operation and maintenance costs; and
- Easy operation and maintenance.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

The total estimated amount of emission reductions over the chosen crediting period of 7 years is 236,516 tonnes of CO_2 equivalent (33,788 tonnes of CO_2 equivalent annually).

Years	**Annual estimation of emission reductions in tonnes of CO_2e**
Year 1	33,788
Year 2	33,788
Year 3	33,428
Year 4	33,788
Year 5	33,788
Year 6	33,788
Year 7	33,788
Total estimated reductions (tonnes of CO_2e)	**236,516**
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**33,788**

A.4.4. Public funding of the small-scale project activity:

The Project will not receive any public funding from Parties included in Annex I countries.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

As defined in paragraph 2 of Appendix C of the SSC M&P, a proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or a request for registration by another small-scale project activity:

- By 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.

The proposed project activity is not a debundled component of any larger project activity as there is no other small-scale project activity that fulfills the abovementioned criteria.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

The approved baseline and monitoring methodology applied to the project activity is:-

AMS-I.D.
Type I : Renewable energy projects
Category D : Grid connected renewable electricity generation
Reference : Version 12, Scope 1, approved on EB 33 (25-27 July 2007)

B.2 Justification of the choice of the project category:

The project activity can be categorized under the sectoral scope 1 "Energy industries (renewable - / non-renewable sources)".

In accordance with Appendix B of the SSC M&P, the proposed Project is qualified as a small-scale project activity and is in line with the applicability requirements stipulated in AMS-I.D., as summarized in the following table.

Table 1. Applicability conditions for AMS-I.D.

	Applicability condition	Project case
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.	The Project uses rice husk, an abundant waste product of the rice milling process, as the biomass fuel for carbon-neutral electricity generation. The majority of the electricity generated will be exported to the grid under the VSPP program, displacing fossil fuel-based electricity generation.
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 fuel, the capacity of the entire unit shall not exceed the limit of 15MW.	The installed gross capacity of the unit added is 9.9MW, which is below the threshold limit of 15MW.
3	Combined heat and power (co-generation) systems are not eligible under this category.	Not applicable. The Project does not involve co-generation.
4	In the case of project activities that involve the	Not applicable. The Project does not add to an

	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 distinct from the existing units.	existing renewable power generation facility.
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.	Not applicable. The Project does not involve retrofitting or modifying an existing facility for renewable energy generation.

B.3. Description of the project boundary:

Figure 3 shows the flowchart of the Project and its boundary. The project boundary is identified based on the definition stated in AMS-I.D. that "*The project boundary encompasses the physical, geographical site of the renewable generation source.*"

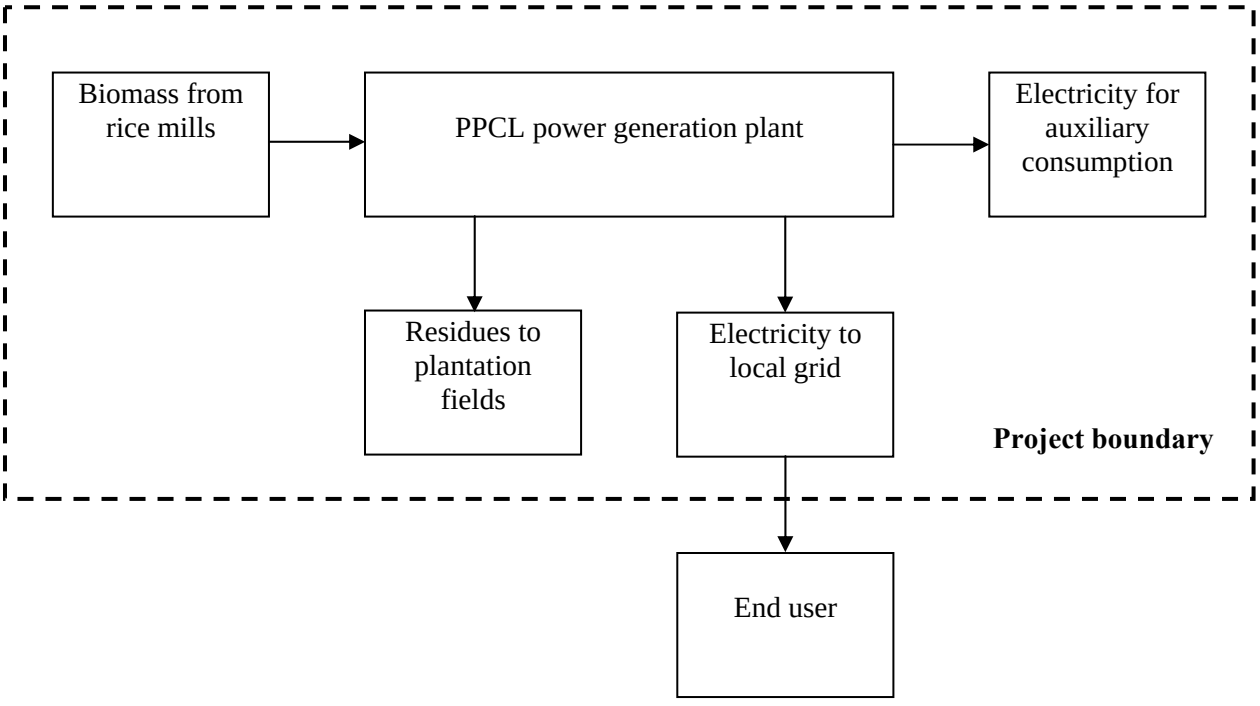

Figure 3. The project boundary.

B.4. Description of baseline and its development:

As per the indicative simplified baseline and monitoring methodology for AMS-I.D. delineated in Appendix B of the SSC M&P, the following baseline calculation method is chosen.

Among two options for estimation of baseline emissions, option (a) of item 9 for AMS-I.D. is selected. The baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (in kg CO_2equ/kWh) calculated in a transparent and conservative manner as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM).

Baseline emission for grid electricity (tCO_2/year)	=	**Net quantity of electricity generation by the Project (MWh/year)**	x	**CO_2 emission factor for displaced electricity (tCO_2/MWh)**

Table 2 summarizes the key information and data used to determine the baseline emission of grid electricity.

Table 2. Input values for the baseline emission calculation of grid electricity.

Emission factor	**Data**	**Unit**	**Source**
Operating margin (OM)[a]	0.595	tCO_2/MWh	Refer to Section B.6.3
Build margin (BM)	0.367	tCO_2/MWh	Refer to Section B.6.3
Combined margin (CM)	0.481	tCO_2/MWh	Calculated

[a] This is a 3-year average emission factor.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

Referring to Attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities, a small-scale project activity's additionality can be determined by showing that the project activity would not have occurred under business-as-usual due to at least one of the following barriers:

(1) Investment barrier
(2) Technological barrier
(3) Barrier due to prevailing practice
(4) Other barriers

The Project suffers from a number of these barriers, as delineated below.

(1) Investment barrier

With respect to the investment barrier, the construction of a grid-connected biomass power plant faces investment obstacles over a conventional fossil-fuel power plant. This is mainly due to the higher capital costs related to a biomass power plant. Though the operation and maintenance costs for the biomass power plant are comparatively low due to the lower fuel costs, improving their attractiveness in long term, this is still insufficient to increase project returns to an attractive level, particularly in view of the higher risk attached to biomass power projects. In consideration

of the importance placed on short-term cost minimization in developing economies, this project activity does not represent an attractive course of action.

In the case of no direct subsidies or promotional support for the implementation of the grid-connected biomass power plant, the assistance of CDM is extremely important. Based on the total investment cost of 665 Million baht, electricity tariff of 2.48 baht/kWh and operation and maintenance costs of 30.8 Million baht per year, the resultant IRR in the absence of the CDM is 10.8%. The additional revenue from the sale of CERs will increase the Project's return to a more acceptable level, enabling its implementation. Without this extra source of income, the high capital costs and relatively low return combined with the real and perceived risks involved make the Project unattractive to investors.

(2) Technological barrier

The technological barrier caused to this project activity is mainly attributed to the unique characteristics of the rice husk. The rice husk is very different from other types of biomass, such as wood, in terms of various aspects, which include:-

(a) High ash content

The ash content of rice husk is approximately 10 to 25 times higher than that of wood. High ash content makes the complete burnout of the ashes more difficult, in turn the residence time of the fuel on the grate has to be increased in order to guarantee the complete burnout of the bottom ashes. Taking this into account, an extra burnout section must be installed at the end of the grate.

In addition, high ash content also increases the fouling of the boiler. For the Project, in order to make a continuous operation possible, the convection bundles of the boiler will be equipped with appropriate continuous rapping system.

(b) Abrasive ashes

Due to the high silica (SiO_2) content of rice husk, ashes from the husk burning process are very abrasive. To prevent the boiler wearing by erosion, the velocity of the flue gases in the convection part of the boiler needs to be controlled and limited. The flue gas speed shall be designed between 5 to 6 meters per second. This measure makes the convection part of the boiler bigger compared to that of the classic wood waste boiler with flue gas velocity of 12 meters per second. It is obvious that with this specific requirement, a large boiler is needed hence resulting in a higher initial investment.

(3) Barrier due to prevailing practice

According to Thailand Power Development Plan (PDP) for 2004, the total energy generation for the year of 2003 is 116,743GWh[2], of which over 90% of the electricity is supplied from fossil fuel-based power generation plants. There is less than 1% of the electricity generated from renewable biomass. Although the Thai Government has stipulated a Small Power Producer

[2] Please refer to Table 4 at the Section of B.6.3 for details.

Program and promotes renewable energy projects, the generation of carbon-neutral energy from biomass is still not a prevailing practice as of today.

Owing to the presence of the combined investment barrier and other barriers that would have prevented the occurrence of the project activity, it is concluded that the Project is additional, and therefore is eligible as a CDM project activity.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

(A) BASELINE EMISSIONS

The methodological choices for baseline emissions are detailed in Section B.4.

(B) PROJECT EMISSIONS

The project activity that involves electricity generation from a renewable energy source (renewable biomass) is considered as carbon-neutral and therefore it will have zero project emissions.

(C) LEAKAGE

In line with AMS-I.D., leakage is not considered in this Project since there is no transfer of energy generating equipment from another activity, nor transfer of existing energy equipment to another activity.

Also, this Project does not result in increased fossil fuel consumption due to the diversion of rice husk from other uses to the project plant, as there is surplus rice husk available in the region that would be dumped and/or disposed through field burning in the absence of the project activity. It is noted that, the proposed power plant is located in Ayutthaya Province, Central Plain region of Thailand. This region is regarded as the second greatest agricultural region in Thailand comparing to other surrounding regions as shown in the table below.

Table 3. Rice production in Thailand for 2003[3].

Region	Production of major rice (t)	Production of second rice (t)	Total production of rice (t)	Production of rice husk (t)[4]
Northern	5,505,390	2,248,317	7,753,707	1,783,353
North – Eastern	9,553,721	449,366	10,003,087	2,300,710
Central Plain	5,067,501	3,659,856	8,727,357	2,007,292
Southern	782,751	68,075	850,836	195,692

Two million tonnes of rice husk are produced annually in the Central Plain region, 255,760 tonnes of which are yielded from Ayutthaya and Sara Buri provinces[5]. Uses of rice husk include (a) heat generation

[3] Agricultural Statistics of Thailand Crop 2003/2004, Office of Agricultural Economics. Latest data available for 2003. Website: http://www.oae.go.th/statistic/yearbook/2003/indexe.html.

[4] Based on estimated 0.23 tonnes rice husk for every tonne of rice.

for rice mill's own milling and parboiling, (b) use in chicken farms, brick plants and cement plants and (c) grid electricity generation. These are estimated at (a) 19.8% (50,640 t)[6], (b) 6% (15,346 t)[7] and (c) 0% respectively. The Project itself requires approximately 77,438 tonnes of rice husk. Thus, the quantity of available rice husk in the region is approximately 78.3% larger than the quantity of rice husk that is used for all purposes including the project activity. This is higher than the 25% threshold given in the Attachment C of Appendix B of the SCC M&P.

$$\text{Percent of rice husk in surplus (\%)} = \frac{(\text{Amount of available rice husk in the region (tonne/yr)} - \text{Amount of rice husk that is utilized (tonne/yr)})}{\text{Amount of rice husk that is utilized (tonne/yr)}} \times 100\%$$

$$= (255{,}760 - 143{,}424) / 143{,}424 \times 100\%$$

$$= 78.3\%$$

In addition, while the Project will source 60% of its rice husk from NLRM, 80% of which is currently used by NLRM to satisfy its own energy requirements, NLRM will be provided with steam generated by the Project, and no diversion to fossil fuels will occur.

To sum up, leakage is not considered in this Project.

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	**EF_y**
Data unit:	tCO_2/MWh
Description:	CO_2 Combined Margin emission factor of the grid
Source of data used:	Electricity Generating Authority of Thailand (EGAT), The Ministry of Energy's Energy Policy and Planning Office (EPPO)
Value applied:	0.481 tCO_2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data choice and calculation method as per ACM0002.
Any comment:	Not applicable.

Data / Parameter:	**$EF_{OM,y}$**
Data unit:	tCO_2/MWh

[5] According to Agricultural Statistic of Thailand Crop 2003/2004, the total rice production in Ayutthaya and Sara Buri provinces for 2003 is approximately 836,000 and 276,000 tonnes per year respectively. As partial of the rice husk will be supplied by the rice mills located in Sara Buri province, the leakage analysis covers both Ayutthaya and Sara Buri provinces.

[6] Based on interviews conducted in conjunction with a regular scale CDM project – A.T. Biopower Rice Husk Power Project in Pichit, Thailand.

[7] Based on anecdotal evidence.

Description:	CO_2 Operating Margin emission factor of the grid
Source of data used:	EGAT, EPPO
Value applied:	0.595 tCO_2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data choice and calculation method as per ACM0002.
Any comment:	Not applicable.

Data / Parameter:	$\mathbf{EF_{BM,y}}$
Data unit:	tCO_2/MWh
Description:	CO_2 Build Margin emission factor of the grid
Source of data used:	EPPO, The Department of Alternative Energy Development and Efficiency (DEDE)
Value applied:	0.367 tCO_2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data choice and calculation method as per ACM0002.
Any comment:	Not applicable.

Data / Parameter:	$\mathbf{F_{i,y}}$
Data unit:	Mass or volume
Description:	Amount of each fossil fuel consumed by each power source/plant
Source of data used:	EGAT, EPPO, DEDE
Value applied:	Refer to Tables 4 and 6
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data choice and calculation method as per ACM0002.
Any comment:	Not applicable.

Data / Parameter:	$\mathbf{COEF_{i,}}$
Data unit:	tCO_2/mass or $kgCO_2$/volume
Description:	CO_2 emission coefficient of each fuel type and each power source/plant
Source of data used:	IPCC default values
Value applied:	Refer to Table 5
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data choice and calculation method as per ACM0002.
Any comment:	Not applicable.

Data / Parameter:	$\mathbf{GEN_{j/m,y}}$
Data unit:	MWh/yr
Description:	Electricity generation of each power source/plant j or m
Source of data used:	EGAT, EPPO, DEDE

Value applied:	Refer to Tables 4 and 6
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data choice and calculation method as per ACM0002.
Any comment:	Not applicable.

Data / Parameter:	**Power source (OM)**
Data unit:	-
Description:	Identification of power source/plant for the OM
Source of data used:	EGAT, EPPO
Value applied:	Refer to Table 4
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data choice and calculation method as per ACM0002.
Any comment:	Identification of power sources (j or m) to calculate Operating Margin emission factors.

Data / Parameter:	**Plant name (BM)**
Data unit:	-
Description:	Identification of power source/plant for the BM
Source of data used:	EPPO, DEDE
Value applied:	Refer to Table 6
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data choice and calculation method as per ACM0002.
Any comment:	Identification of plants (j or m) to calculate Build Margin emission factors.

Data / Parameter:	**$GEN_{i/m,y\ IMPORTS}$**
Data unit:	MWh
Description:	Electricity imports to the project electricity system
Source of data used:	EGAT, EPPO
Value applied:	Refer to Table 4
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data choice and calculation method as per ACM0002.
Any comment:	Not applicable

Data / Parameter:	**$COEF_{i,j,y\ IMPORTS}$**
Data unit:	tCO_2/mass or volume unit
Description:	CO_2 emission coefficient of fuels used in connected electricity system (if imports occur)
Source of data used:	IPCC default values
Value applied:	Refer to Table 5

Justification of the choice of data or description of measurement methods and procedures actually applied :	Data choice and calculation method as per ACM0002.
Any comment:	Not applicable

B.6.3 Ex-ante calculation of emission reductions:

(A) BASELINE EMISSIONS

The emissions associated with electricity generation from plants connected to the grid are calculated as:

Baseline emission for grid electricity (tCO_2/year) = **Net quantity of electricity generation by the Project (MWh/year)** x **CO_2 emission factor for displaced electricity (tCO_2/MWh)**

Step 1: Determination of grid CO_2 emission factor

For the Project, the grid CO_2 emission factor is to be calculated as the combined margin (CM) using the method provided in the baseline methodology ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources".

Under ACM0002, the baseline emission factor is calculated as the CM, consisting of the combination of the operating margin (OM) and build margin (BM) emission factors, as detailed below.

Step 1.1: Calculation of the operating margin emission factor (EF_{OM})

The baseline methodology offers four options for the calculation of the OM: (a) Simple OM, (b) Simple adjusted OM, (c) Dispatch Data Analysis OM or (d) Average OM. Calculation using the Dispatch Data Analysis OM method, while being the first methodological choice, is not feasible as no dispatch data is publicly available for the Thai grid. Since EGAT's low-cost / must-run resources have constituted less than 50% of the total grid generation in the past 5 years, option (a), the Simple OM method, was chosen.

The Simple OM emission factor is calculated as the generation-weighted average emissions per electricity unit of all generating sources serving the system, not including low-operating cost and must-run power plants:-

$$\text{Simple OM emission factor } (tCO_2/MWh) = \frac{\Sigma \left[\text{Amount of fuel } i \text{ consumed by relevant power sources } j \text{ (unit fuel/yr)} \times \text{CO}_2 \text{ emission factor for fuel } i \text{ } (tCO_2/\text{unit fuel})\right]}{\Sigma \left[\text{Electricity delivered to the grid by power source } j \text{ (MWh)}\right]}$$

where

CO_2 emission factor for fuel *i* (tCO_2/unit fuel)	=	**Net calorific value of fuel *i* (TJ/unit fuel)**	x	**CO_2 emission factor of the fuel i (tCO_2/TJ)**	x	**Oxidation factor of the fuel *i***

The above calculations were conducted for all fuel types using the fuel consumption data from EGAT's Power Development Plan as shown in the Table 4. An illustration of the calculation is given using EGAT data for lignite in 2003 and IPCC emission factor values.

Table 4. EGAT's grid generation and fuel consumption data for 2001-2003[8]

Type of fuel	**Unit[9]**	**2001**	**2002**	**2003**
Hydroelectric	GWh (low-cost/must-run)	6,311	6,481	7,741
	GWh (Imported from Laos)	2,885	2,807	2,438
Natural Gas	GWh	70,280	76,689	83,500
	MMSCFD[a]	1,681	1,632	1,895
Heavy Oil	GWh	3,146	2,062	2,150
	Mlitres[b]	783	521	533
Diesel Oil	GWh	155	258	45
	Mlitres	46	67	12
Lignite	GWh	17,307	16,890	17,134
	Mtons[c]	15.24	15.2	16.22
Imported Coal	GWh	2,475	2,541	2,526
	Mtons	0.99	1.054	1.084
Renewable Energy	GWh (low-cost/must-run)	597	648	1,103
EGAT-TNB	GWh (Imported from Malaysia)	9	13	105
Total	GWh	**103,165**	**108,389**	**116,743**

[a] MMSCFD = million standard cube feet per day (10^6 ft^3/day).
[b] Mlitres = million liters.
[c] Mtons = million tons.

Table 5. Input values for the calculation of grid CO_2 emission factor.

Type of fuel	**Net calorific value* (TJ/Gg)**	**CO_2 emission factor* ($kgCO_2$/TJ)**	**Oxidation factor* (fraction)**
Hydroelectric	-	-	-
Natural Gas	48.00	56,100	1
Heavy Oil	40.40	77,400	1

[8] Thailand Power Development Plan 2004, EGAT. The most recent available grid data (actual) is for 2003.

[9] In converting volume-based fuel consumption to mass-based, the following densities were used:-

- Natural gas = 0.774 kg/m^3
- Heavy oil = 0.97 kg/L
- Diesel oil = 0.85 kg/L

Diesel Oil	43.00	74,100	1
Lignite	11.90	101,000	1
Imported Coal	26.70	98,300	1
Renewable Energy	-	-	-
EGAT-TNB	-	-	-

* IPCC 2006 Guidelines for National Greenhouse Gas Inventories.

Firstly, the CO_2 emission factor is calculated:-

CO_2 emission factor for lignite	=	Net calorific value of lignite (TJ/Gg)	x	CO_2 emission factor of lignite ($kgCO_2/TJ$)	x	Oxidation factor of lignite
	=	11.90	x	101,000	x	1
	=	1,201,900	$kgCO_2/Gg$			

Multiplying this with the fuel consumption of lignite:-

CO_2 emissions from lignite	=	Amount of lignite consumed by grid plants (Gg/yr)	x	CO_2 emission factor for lignite ($kgCO_2/Gg$)	x	Conversion factor (kg/t)
	=	16,220	x	1,201,900	x	1,000
	=	19,494,818	tCO_2/yr			

The total grid emissions for 2003 calculated in the same way was 64,653,234 tCO_2. According to EGAT, the total electricity generated by the grid in 2003, including imports and excluding low-cost/must-run resources, was 107,898,000 MWh. Then, the Simple OM emission factor for 2003 is:-

$$\text{Simple OM emission factor} = \frac{64,653,234}{107,898,000}$$

$$= 0.599\ tCO_2/MWh$$

The 3-year average Simple OM emission factor is summarised below.

Year	Simple OM emission factor (tCO_2/MWh)
2001	0.617
2002	0.571
2003	0.599
Average	**0.595**

Since there was sufficient grid data to compute a 3-year average, the Simple OM emission factor is set *ex ante* as 0.595 tCO_2/MWh.

Step 1.2: Calculation of the build margin emission factor (EF_{BM})

The build margin is calculated as the generation-weighted average emission factor of a sample of power plants. The sample group consists of either:-

(a) the five power plants that have been built most recently, or

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

From these two options, the sample group that comprises the larger annual generation is to be chosen. In the case of the Thai grid, option (b) represents a larger amount of generation.

EGAT does not make publicly available generation data on individual plants. Therefore, data from the Department of Alternative Energy Development and Efficiency (DEDE) was used. The following table details the grid data for the recent power plant capacity additions that comprise 20% for the system generation.

Table 6. Generation and fuel consumption data for recently built plants[10]

Plant name	Commissioning date	Fuel type	Capacity (MW)	Generation (GWh)	Efficiency (Btu/kWh)	Fuel consumption (TJ)	CO_2 emission (tCO_2)
Krabi	14-Aug-03	Heavy oil	340.0	1,145	8,917	10,772	883,715
EPEC	25-Mar-03	Natural gas	350.0	2,627	7,003	19,409	1,088,829
Glow	31-Jan-03	Natural gas	713.0	4,646	6,900	33,821	1,897,333
SPP* (collective)	13-Dec-02 to 31-Dec-05	Renewable	216.6	5,309	-	0	0
SPP (collective)	13-Dec-02 to 31-Dec-05	Natural gas	62.2	402	-	3,503	196,531
Ratchaburi	18-Apr-02, 1-Nov-02	Natural gas	2,175.0	14,796	7,540	117,698	6,602,843
Total	-	-	-	28,925 [11]	-	185,202	10,619,251

* Small power producer.

Repeating the calculations as described in Step 1.1 for the six identified plants, the resultant BM emission factor was 0.367 tCO_2/MWh.

For the data vintage, option 1, the *ex ante* calculation was chosen.

Step 1.3: Calculation of the baseline emission factor

[10] Department of Alternative Energy Development and Efficiency, www.dede.go.th/dede/ (last accessed October 2007), Energy Policy and Planning Office, www.eppo.go.th/ (last accessed October 2007).

[11] The total generation was 116,743 GWh for 2003, the latest year for which data is publicly available. 20% of 116,743 GWh is 23,349 GWh.

The CM emission factor is the weighted average of the OM and BM emission factors, where the default weightings are 50% each. As the emission factors were calculated as 0.595 tCO_2/MWh and 0.367 tCO_2/MWh, for the OM and BM respectively, the resultant combined margin CO_2 emission factor is 0.481 tCO_2/MWh.

Step 2: Determination of net quantity of electricity generation (EG_y)

With reference to the project plans, the maximum gross capacity of the power plant is 9.9 MW and the net electricity output to the EGAT grid[12] is 8.91 MW. With the minimum annual operating hours of 7,884 hours, the electricity generated by the Project is calculated as follows:-

Net quantity of electricity generation by the Project (MWh/yr)	=	Net capacity of the power plant (MW)	x	Annual operating hours (h/yr)
	=	8.91	x	7,884
	=	70,246	MWh/yr	

Applying the combined margin CO_2 emission factor of 0.481 tCO_2/MWh, the baseline emission for grid electricity is:-

Baseline emission for grid electricity (tCO_2/yr)	=	Net quantity of electricity generation by the Project (MWh/yr)	x	Combined margin CO_2 emission factor (tCO_2/MWh)
	=	70,246	x	0.481
	=	33,788	tCO_2/yr	

(B) PROJECT EMISSIONS

As per Section B.6.1, electricity generation from a renewable energy source is considered as carbon-neutral and therefore,

$$\text{Project emission}_y = 0\ tCO_2e/yr$$

(C) LEAKAGE

In line with AMS-I.D., leakage is not considered in this Project since there is no transfer of energy generating equipment from another activity, nor transfer of existing energy equipment to another activity. Therefore,

[12] The actual amount of electricity generated by the Project will be monitored after project implementation. The monitored amount of electricity will be used in the calculation of Certified Emission Reductions (CERs).

$Leakage_y = 0\ tCO_2e/yr$

B.6.4 Summary of the ex-ante estimation of emission reductions:

The *ex-ante* estimation of baseline emissions, project emissions, leakage and emission reductions in the first crediting period are expressed in the following table.

Table 7. Estimation of the emission reductions of the Project.

Year	Estimation of baseline emissions	Estimation of project activity emissions	Estimation of leakage	Estimation of overall emission reductions
	[tCO_2e]	[tCO_2e]	[tCO_2e]	[tCO_2e]
	(A)	(B)	(C)	(D)=(A)-(B)-(C)
1	33,788	0	0	33,788
2	33,788	0	0	33,788
3	33,788	0	0	33,788
4	33,788	0	0	33,788
5	33,788	0	0	33,788
6	33,788	0	0	33,788
7	33,788	0	0	33,788
Total	236,516	0	0	**236,516**
Average	33,788	0	0	**33,788**

B.7 Application of a monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	**EG_y**
Data unit:	MWh
Description:	Net quantity of electricity generated and delivered to the grid
Source of data to be used:	PPCL
Value of data	70,246
Description of measurement methods and procedures to be applied:	This parameter will be measured by electricity meters (main meter and backup meter). Data is to be aggregated monthly and yearly and will be archived electronically. The archived data will be kept during the crediting period and two years after the end of the crediting period.
QA/QC procedures to be applied:	The electricity meters will be calibrated in accordance with the strict standards set by EGAT. The consistency of the data will be verified through the actual sale records between EGAT and PPCL.
Any comment:	Not applicable.

Data / Parameter:	**Q_y**
Data unit:	tonnes
Description:	Quantity of waste combusted in the year y
Source of data to be used:	PPCL

Value of data	77,438
Description of measurement methods and procedures to be applied:	This parameter will be monitored by measuring equipments/weighting scales. Data is to be aggregated monthly and yearly and will be archived electronically. The archived data will be kept during the crediting period and two years after the end of the crediting period.
QA/QC procedures to be applied:	Maintenance and calibration of the equipments will be carried out according to the national or international approved standards and procedures. The consistency of the data will be verified through the actual sale records between PPCL and rice mill suppliers.
Any comment:	Not applicable.

B.7.2 Description of the monitoring plan:

PPCL understands that having a good operational and management team to execute a well-defined monitoring plan is extremely important for the project activity. From this perspective, PPCL has identified a tentative operational and management structure that will be implemented to relevant parameters. The responsibility of data monitoring, archiving and analyzing will fall on different members of the monitoring team. This team will be composed of a general manager, a site manager as well as a group of engineers, operators, technicians and administrative staffs as shown in the chart below.

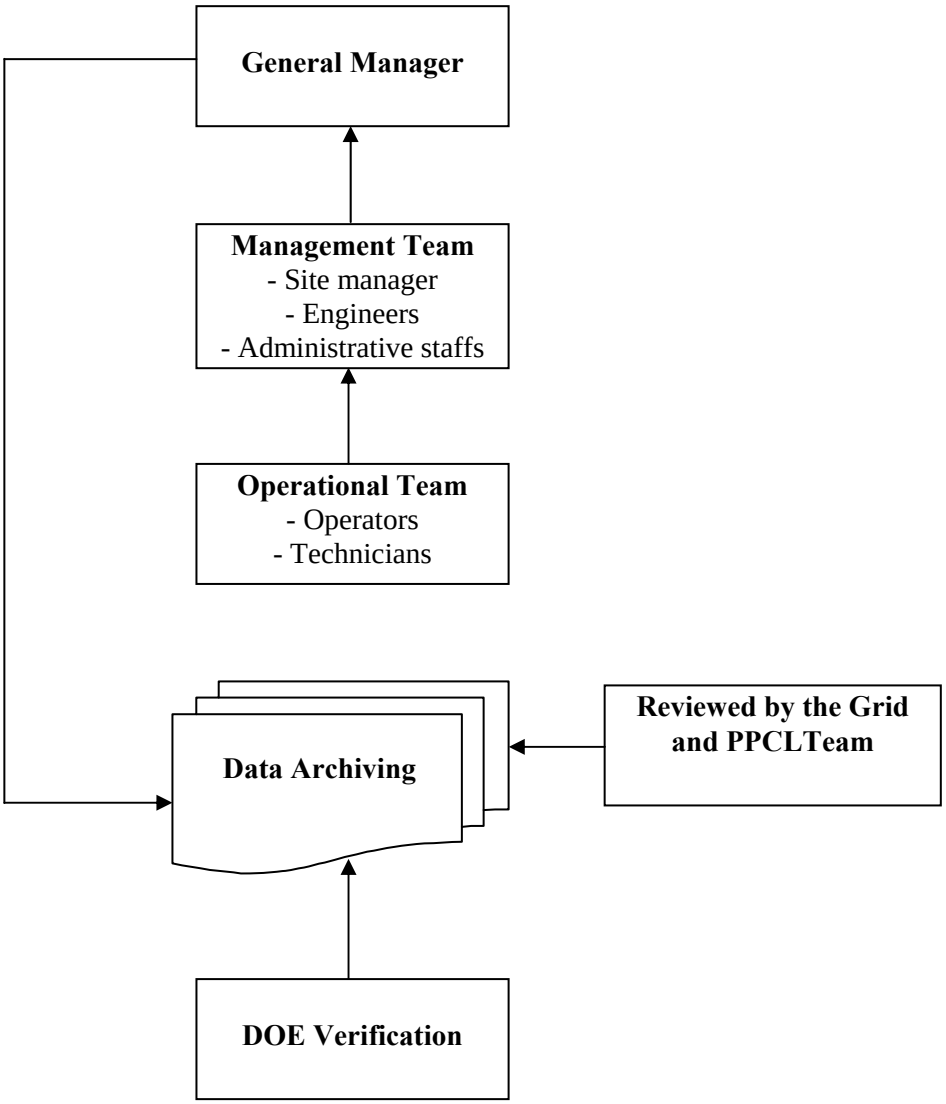

Figure 4. Planned operational and management structure for monitoring.

Under the supervision of the management team, data monitoring and archiving will be conducted by operators and technicians. All data will be recorded with reference to the data archiving procedures and stored electronically in a systematic and transparent manner. The management team will review the data archived and submit a complete set of documentation, which indicates the calculation procedure as well as the *ex-post* emission reduction estimate to the general manger for internal verification regularly. This documentation will also be verified externally by an independent Designated Operational Entity (DOE) on an annual basis.

The overall performance of the Project will be ensured by appointing consultants and/or technical support team to carry out the system analysis, equipment calibration and overall maintenance on a regular basis

throughout the crediting period. The analysis and calibration will be carried out in accordance with national standards or international standards where relevant.

Internal staff training before project implementation and also on-the-job training will be provided. These training will be tailored to ensure that the data monitoring and archiving tasks will be undertaken properly and according to the procedures and requirements as set in the Project's monitoring plan.

By the time of the Project commissioning, a specific monitoring plan tailored to the advanced multi-fuelled boiler and its associated technology as well as a well-defined guideline for the corrective actions and procedures to non-conformities will be developed and put in place.

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

Date of completion of the baseline study and monitoring methodology

23/10/2007

Entities determining the baseline and monitoring methodology

Clean Energy Finance Committee, Mitsubishi UFJ Securities Co., Ltd.
Address: 26th Floor, Marunouchi Building, 2-4-1 Marunouchi, Chiyoda-Ku, Tokyo 100-6317, Japan
Tel: (81 3) 6213-6331
Fax: (81 3) 6213-6175
E-mail: hatano-junji@sc.mufg.jp, cotytsui@cefconsulting.com

Mitsubishi UFJ Securities is the CDM advisor to the Project and is also a project participant. The contact details of the above entity determining the baseline is listed in Annex I.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

01/06/2007

C.1.2. Expected operational lifetime of the project activity:

At least 21 years.

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

C.2.1.2. Length of the first crediting period:

7 years.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable.

C.2.2.2. Length:

Not applicable.

SECTION D. Environmental impacts

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

In accordance with the Thai environmental regulations, the Project with the power plant under 10MW$_e$ capacity is not required to carry out an Environmental Impact Assessment. It is worth noting that the Project will be fully compliant with the relevant environmental laws and regulations as below.

Air quality standards

Emission standard from a new biomass fired power plant in all sizes[13]	
Pollutants	**Legal limit**
Sulfur dioxide (SO_2)	< 60 ppm
Oxides of Nitrogen (NO_2)	< 200 ppm
Particulate matter	< 120 mg/Nm^3

Noise standards

Ambient noise standards[14]	
Noise	**Legal limit**
Sound level from fluctuating noise	< 115 dB(A)
A-weighted equivalent continuous sound level from steady noise	< 70 dB(A)

[13] Information is sourced from the Notification of the Ministry of Industry B.E.2547 (2004), issued under Factory Act B.E.2535 (1992), dated September 28, B.E.2547 (2004). It was published in the Royal Government Gazette, Vol.121, Part 113D, dated October 7, B.E.2547 (2004)..

[14] Information is sourced from Pollution Control Department of Ministry of Natural Resources and Environment, Thailand (http://www.pcd.go.th/info_serv/en_reg_std_airsnd04.html).

Additionally, an environmental management system will be implemented in the several ways:-

(1) Air pollution management

- Rice husks will be transported from rice mill to power plant by covered conveyer;
- Trees will be planted within the project boundary to avoid spreading of air-borne particulates (from rice husk); and
- Particulates will be controlled by Cyclone System, Bag House System and/or Electrostatic Precipitator.

(2) Water resources management

- Water will be sourced from the Pa-sak River which suffers no water shortage problem all year round.

(3) Waste management

- Ashes from husk combustion will be either used for soil quality development or sold to concrete industries, brick refractory manufactures and/or steel industries;
- Wastewater generated from the cooling system will be treated before discharging to the rice field nearby; and
- Miscellaneous waste materials will be managed according to the regulations.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

Project participants expect no significant negative environmental impacts from the Project. In consistent with the host country DNA regulation, which stipulates that at least an IEE is conducted for all CDM projects regardless of the severity of the environmental impact, IEE has been conducted by Consultants of Technology Co. Ltd. in 2005.

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

A local stakeholder consultant meeting was held at the Community Hall of Amphur Tha Rue, Ayutthaya, Thailand on June 17, 2005. To encourage active participation, invitation letters were sent to the potential stakeholders identified and flyers were handed out to the local community members. A total of 183 persons attended the meeting. The breakdown of the participants is as follows.

Organization / Participants	Number of participants
Tambon Administrative Organization	7
Head of Tambon	38
Local villagers	138
Total	**183**

The stakeholder consultation meeting included a session of project activity description, a brief explanation on how this Project will mitigate climate change and contribute to social, economic and environmental development of host country, an overview of benefits to local community, followed by a question and answer session.

Apart from stakeholder consultation meeting, stakeholder comments of this Project were sought in the following ways:-

- A questionnaire survey to all potential stakeholders and local community;
- Direct consultation from government organizations and the community leaders;
- Focus group meetings; and
- Brochure advertisement.

E.2. Summary of the comments received:

To date no formal comments have been received from stakeholders. However, during the meeting, local stakeholders raised various questions pertaining to the Project and requested for further explanation on both the negative and positive concerns. These concerns have been specified in the following areas:-

- Impact on the local environment
  - air quality
  - water quality
  - noise levels
- Potential benefits to the local community
  - employment opportunities
  - clean energy supply
- Potential adverse effects on the local population
  - local's health and safety problems

All questions were duly answered and no subsequent negative comments were raised. At the end of the session, most of the participants expressed their satisfaction on employment opportunities, clean energy supply, climate change mitigation and also national sustainable development, which will be achieved through implementation of this Clean Development Mechanism Project.

E.3. Report on how due account was taken of any comments received:

As delineated in Section G.2., there were no negative comments on the Project, thus no further action was taken.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Power Prospect Company Limited
Street/P.O.Box:	Sukhumvit Rd., Bangjak, Phrakhanong
Building:	4 Soi Sukhumvit 81 (Siripot)
City:	Bangkok
State/Region:	
Postfix/ZIP:	10260
Country:	Thailand
Telephone:	
FAX:	
E-Mail:	
URL:	
Represented by:	
Title:	Managing Director, Power Prospect Company Limited
Salutation:	Mr.
Last Name:	Liangsiri
Middle Name:	
First Name:	Pongsak
Department:	
Mobile:	
Direct FAX:	+662 730-0598
Direct tel:	+662 730-0595-7
Personal E-Mail:	pliangsiri@hotmail.com

Organization:	Mitsubishi UFJ Securities Co., Ltd. (CDM Advisor)
Street/P.O.Box:	2-4-1 Marunouchi, Chiyoda-ku
Building:	Marunouchi Building, 26th Floor
City:	Tokyo
State/Region:	
Postfix/ZIP:	100-6317
Country:	Japan
Telephone:	+81 3 6213 6331
FAX:	+81 3 6213 6175
E-Mail:	hatano-junji@sc.mufg.jp
URL:	http://www.sc.mufg.jp/english/e_cefc/
Represented by:	
Title:	Chairman, Clean Energy Finance Committee
Salutation:	Mr.
Last Name:	Hatano
Middle Name:	
First Name:	Junji
Department:	Clean Energy Finance Committee
Mobile:	
Direct FAX:	+81 3 6213 6175
Direct tel:	+81 3 6213 6331
Personal E-Mail:	hatano-junji@sc.mufg.jp

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The Project does not involve public funding from Annex 1 countries.

Annex 3

BASELINE INFORMATION

Please refer to Sections B.4. and B.6.3. for details.

Annex 4

MONITORING INFORMATION

Please refer to Sections B.7. and B.8. for details.

- - - - -