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:

Title: Rice husk based Power project in Nakhonratchasima, Thailand
Version: 9.0
Date: 31/01/2013

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

The Rice husk based Power project in Nakhonratchasima, Thailand (hereafter referred to as the "Project") developed by TRC Clean Energy Co., Ltd. (hereafter referred to as the "Project Participant") is a grid connected renewable energy project in Nakhonratchasima province in Thailand (hereafter referred to as the "Host Country"). It involves the biomass base power generation which is connected to the national Electricity grid to supply renewable electricity.

Purpose of the proposed project activity:

The purpose of the Project is to utilize renewable biomass residue for power generation. The project is a green field project as it is a new power plant constructed on the site where there was no renewable energy power plant operating prior to the implementation of the project activity. The Project would use rice husk available in the region to generate power. Renewable biomass, which will be used for power generation, is greenhouse gases (GHGs) neutral thus it would effectively reduce the GHG emissions that would have otherwise been emitted by the fossil fuel dominated Thai National Grid.

The project activity includes a high pressure boiler and a condensing turbine of 9.9 MW rated capacity. In the proposed project activity biomass i.e. rice husk and woodchip will be combusted in boiler to produce steam at high pressure, which will be fed to turbine generator. The installed capacity of power generation of the project activity is 9.9 MW, of which 7.5MW[1] will be exported to the Thai National grid under Very Small Power Producer (VSPP)[2] program. The remaining electricity generated (2.4 MW) will be used to meet the auxiliary power requirement of the plant about (0.9 MW) and to supply to the nearest rice mill about (1.5 MW) which is not owned by the project participant with a dedicated transmission line. The rice mill have different owner and is connected to the grid with a line separate from the transmission line of the power plant for its electricity requirements. The proposed project activity only demonstrate the GHG reduction by the amount of electricity supplied to the Thai National Grid under VSPP scheme, which would otherwise be produced by grid connected power plants.

[1] Power Purchase Agreement (PPA) with Provincial Electricity Authority (PEA)

[2] *As Per Energy Planning and "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 10 MW of its electrical power output to the designated distribution utility, such as Metropolitan Electricity Authority (MEA) and/or Provincial Electricity Authority (PEA).*

Ref: http://www.eppo.go.th/power/vspp-eng/Regulations%20-VSPP%20Renew-10%20MW-eng.pdf

Sustainable Development by the project activity

The project activity will contribute towards the host country's sustainable development in the following manner:

Social well-being

- The project activity will provide business opportunity for biomass suppliers, contractors, local people etc.
- The project activity will result in lower GHG emissions to the surrounding environment and thus, improve the working conditions inside the plant premises as well as improving the local environment for people living in close proximity.

Economic well-being

- The commercial values to the biomass will improve the economic standards of the farmers. This might lead to setting up of small industries, shops, hotels thereby providing business opportunities for local stakeholders, manufacturers and contractors. The project activity will thus indirectly contribute to the creation of local infrastructure facilities and also some basic civic amenities.
- The project activity will help in conservation of fast depleting natural resources like coal and natural gas, thereby contributing to the economic well being of country as a whole.

Environmental well-being

- Renewable biomass is used as a fuel in the project activity. Uses of renewable fuels will reduce the GHG emission to the environment as compared to non-renewable fuels which have positive emissions to the atmosphere.
- The project activity will also reduce the pollution associated with the extraction and transport of the fossil fuel.

Technological well being:

- The project activity is expected to increase awareness and interest among the industry players to make investments in similar areas.
- The project activity is also expected to encourage technology providers in putting more R&D efforts towards new and renewable technology development.

The project will also contribute towards the objective to increase the share of alternative energy to 20.3 per cent of total energy consumption by 2022[3] in line with the Renewal Energy Development Plan (2008 - 2022), Ministry of Energy, Thailand. Thus a biomass based power plant, helps the country meet its sustainable development targets.

A.3. Project participants:

[3] *Thailand Renewable Energy Policies and Wind Development Potentials, DEDE, Thailand's Ministry of Energy, page 1of Ref: http://www.dede.go.th/dede/images/stories/english/information/ThaiRenewableEnPolicies.pdf*

Name of Party involved (*) ((host) indicates a host involved)	Private and/or public entity(ies) Project Participants(*) (as applicable)	Party involved wishes to be considered as project participant (Yes/No)
Thailand (Host Party)	**TRC Clean Energy Co., Ltd.** (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.

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.:

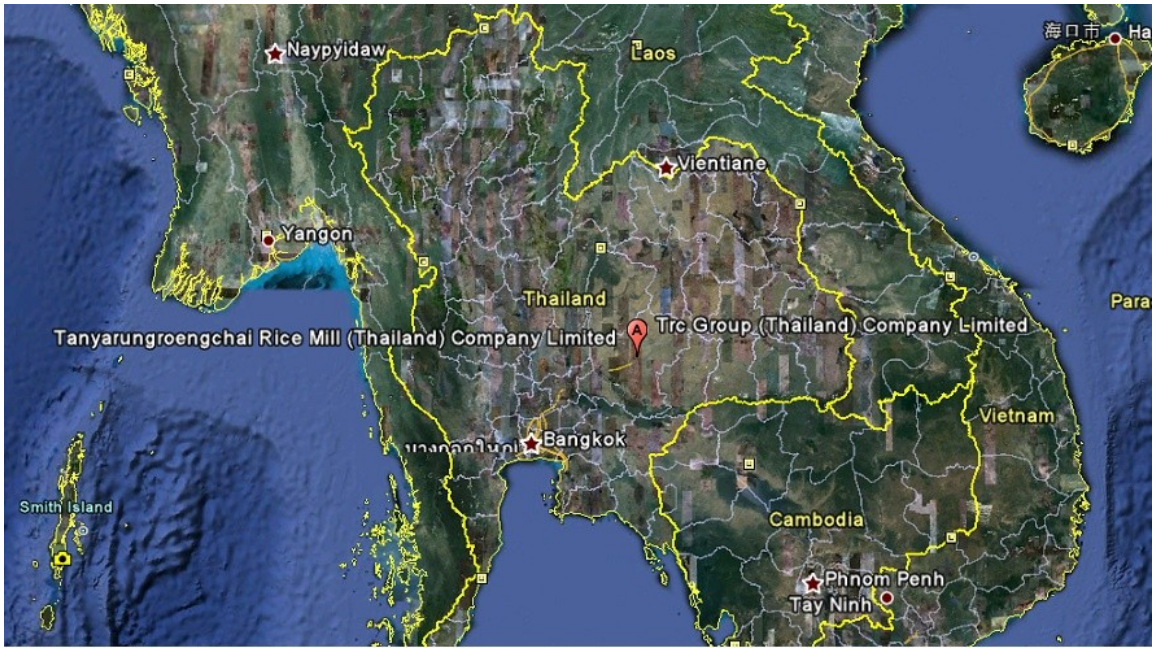
Nakhon Ratchasima

A.4.1.3. City/Town/Community etc:

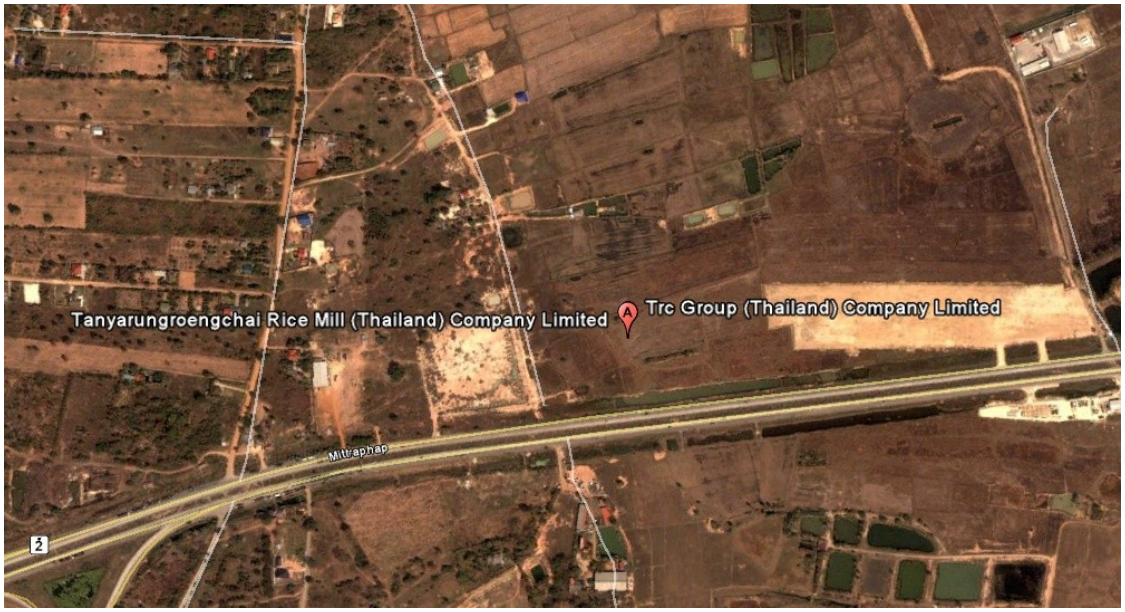
Ban Pho Village
Mueang District

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

The project activity is located in Mueang district, Nakhonratchasima province. The nearest International Airport is at Don Mueang International Airport, Bangkok, 245 km from project site. The project site is located at 15° 03’ 18.39” N Latitude and 102° 08’ 25.44” E Longitude. The physical location is depicted in the following Google maps:


Naypyidaw
Laos
Vientiane
Yangon
Thailand
Tanyarungroengchai Rice Mill (Thailand) Company Limited
Trc Group (Thailand) Company Limited
Vietnam
Bangkok
Smith Island
Cambodia
Phnom Penh
Tay Ninh


Tanyarungroengchai Rice Mill (Thailand) Company Limited
Trc Group (Thailand) Company Limited
Nakhon Ratchasima
Buriram
Saraburi



Physical Address:
TRC Clean Energy Co., Ltd.
386 Moo 8, Mitraphap Road
Ban Pho, Mueang,
Nakhonratchasima 30310,
Thailand

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

Project Type: I (Renewable energy projects)
Project Category: I.D. (Grid connected renewable electricity generation, version 17, EB 61)
Sectoral Scope: I

Technology measures:
The basic technology is Rankine cycle where direct combustion of biomass materials takes place through the biomass-fired Moving Step Grate boiler to generate high-pressure and high-temperature steam, which drives a turbine generator set. Other equipments include fuel conveyors, ash handling system, water cooling system and compressed air plant, etc. The technical specifications of the biomass power plant have been mentioned in the table below.

Table A.1: Technical Details

Boiler	
Manufacturer	Bangkok Industrial Boiler Co. Ltd.
Design pressure	78 barg (7.8 MPa)[4]
Maximum Operating pressure	67 barg (6.7 MPa)
Working Temperature	485 ^{0}C
Capacity	45 TPH (Tons per Hour)

[4] 1 bar = 0.1 Mega Pascal (Pressure Units)

Fuel	rice husk (100%) and woodchip (as secondary fuel option)
Efficiency	85[5]%
Steam Turbine Generator	
Type	Condensing Steam Turbine
Manufacturer	Shinko
Steam Inlet	43.5 TPH
Operating pressure	65 barg ± 2 (6.5 MPa ± 2)
Steam temperature	480± 10^0C
Generator type	Air-cool type Synchronous AC Generator
Alternator speed	1,500 RPM
Gross power generation	9.9 MW

The project is connected to the Thai national Grid to export and import electricity. In case when there is no electricity generation the small amount of electricity requirement would be fulfilled by importing electricity from the Grid. In the rare case of emergency when there would not be Grid i.e. transmission line breakdown, the project participant would have a Diesel Generator set as a backup option. The power plant would also be supplying electricity to the rice mill. The rice mill is importing and continues to import the electricity from Thai National grid.

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

Estimated amount of emission reductions over the chosen period, i.e. 10 years are given below.

Years	Estimation of annual emission reductions in tonnes of CO_2e
2013-14	30547
2014-15	30547
2015-16	30547
2016-17	30547
2017-18	30547
2018-19	30547
2019-20	30547
2020-21	30547
2021-22	30547
2022-23	30547
Total estimated reductions (tonnes of CO_2e)	305470
Total no. of crediting years	10 years
Annual average of the estimated reductions over the crediting period (tCO_{2e})	30547

[5] As per boiler technical document however was not available at the time of decision making. However to address this change efficiency of boiler is also considered under sensitivity analysis.

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

No Public funding (ODA and/ or Annex I countries) is used for the project activity.

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

As per Para 2 of Annex 13 of EB 54- GUIDELINES ON ASSESSMENT OF DEBUNDLING FOR SSC PROJECT ACTIVITIES version 3.1.
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 an application to register another small-scale CDM project activity:
(a) With the same project participants;
(b) In the same project category and technology/measure; and
(c) Registered within the previous 2 years; and
(d) Whose project boundary is within 1 km of the project boundary of the proposed small- scale activity at the closest point
There is no registered small-scale CDM project activity by the same project participant whose project boundary is within 1 km of the proposed small- scale activity at the closest point or request for registration for another small-scale project activity by the same project participant:

- In the same project category and technology/measure; and
- Registered within the previous 2 years; and

It, therefore, satisfies all conditions listed in "*Annex 13 of EB 54*" for the small scale CDM project activities for guidance on how to determine whether the proposed project activity is not a de-bundled component of a larger project activity".
Hence, the project is not a de-bundled component of a larger project activity.

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:

Following approved small scale methodology and tools are applied.

Methodology No.	Title	Reference
AMS-I.D.	***"Grid connected renewable electricity generation"***	Version 17, (EB 61)

Tool	Reference
"Tool to calculate the emission factor for an electricity system"	Version 02.2.1, EB 63
"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"	Version 02 EB 41, Annex 11

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

Applicability of AMS-I.D:

The project activity is in line with the methodology AMS-I.D., version 17; specific features of project and applicability of methodology AMS-I.D. are discussed below:

Applicability	Project Status
This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass: *(a) Supplying electricity to a national or a regional grid; or* *(b) Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.*	Proposed project comprises the renewable energy generation units from renewable biomass i.e. rice husk (100%) and woodchip (as the secondary fuel option) of 9.9 MW. The project activity supply electricity of 7.5MW to the Thai National Grid as under the Power Purchase Agreement with the Provincial Electricity Authority. The remaining electricity would be supplied to the nearby rice mill.
Illustration of respective situations under which each of the methodology (i.e. AMS-I.D, AMS-I.F and AMS-I.A) applies is included in Table 2.	From the Table 2 in the AMS-I.D., The project activity claims CER for project type 1 in the table "*Project supplies electricity to a national/regional grid*" for supplying electricity of 7.5 MW to the Thai National Grid under AMS I.D .
This methodology is applicable to project activities that (a) install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant); (b) involve a capacity addition; (c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an) existing plant(s).	The power generation unit of the project activity is installed as a green field project. The project activity is applicable to criterion *(a) install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant);*.
Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: • *The project activity is implemented in an existing reservoir with no change in the volume of reservoir;* • *The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the Project Emissions section, is greater than 4 W/m^2;* • *The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 W/m^2.*	Proposed project is not a hydro power plant. Hence, this applicability criterion is not applicable to the project activity.
If the new unit has both renewable and non-renewable components (e.g., a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies	The project is an installation of biomass based power plant which will generate renewable power. So the proposed project does not

only to the renewable component. If the new unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.	include non renewable components. The installed capacity of the biomass based power plant is 9.9 MW which is less than the threshold limit of 15 MW.
Combined heat and power (co-generation) systems are not eligible under this category.	Proposed project only comprises the generation of power with all the energy produced in the plant. Hence the project does not include combined heat and power generation system and this applicability criterion is not applicable.
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 distinct from the existing units.	The installed capacity of the new biomass based power plant is 9.9 MW which is less than the threshold limit of 15 MW. The biomass power plant is a Greenfield plan and doesn't involve any existing units.
In the case of retrofit or replacement, to qualify as a small-scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15 MW.	Proposed project is not a retrofit or replacement of existing power plant.

Conclusion:

The project is a renewable energy based power generation which will export generated power to the Thailand National Grid. Based on the above analysis, the project activity meets all the relevant applicability criteria of AMS-I.D., Version 17.

B.3. Description of the project boundary:

As per paragraph 9 of methodology AMS-I.D., version 17;

"*The physical, geographical site of the renewable energy generation delineates the project boundary*"
For the proposed project activity the project boundary includes biomass storage, boiler, steam turbine and all other auxiliaries. The following figure shows the project boundary:

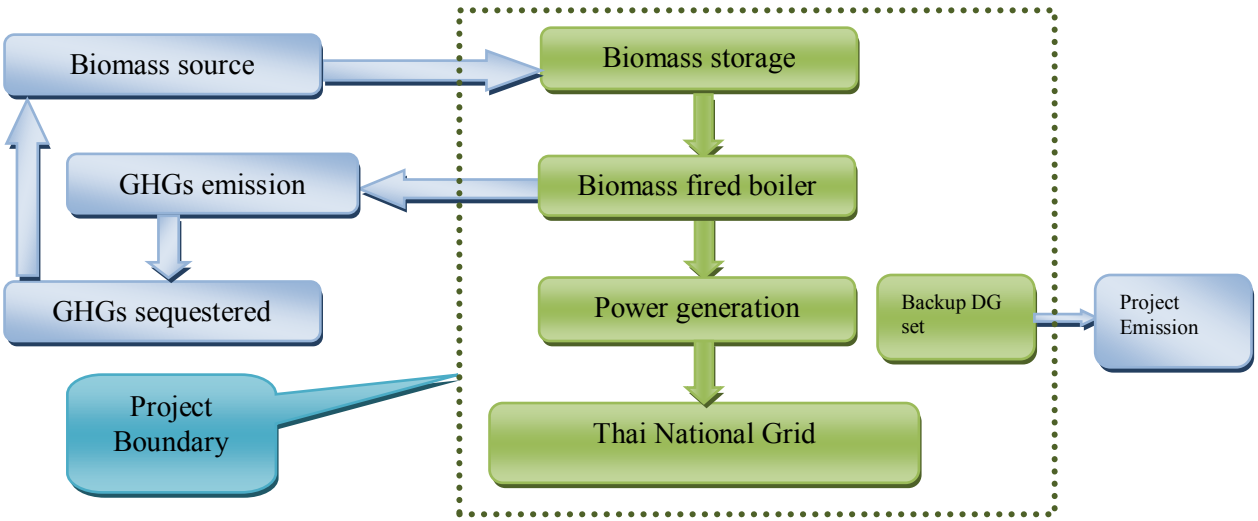


Figure: Project boundary

B.4. Description of baseline and its development:

Description of baseline situation:
The proposed project aims to utilize rice husk as primary fuel option (100%) and wood chip (as secondary fuel option) for power generation. The generated electricity will be exported to the Thai National grid.

According to AMS-I.D/ version 17, *"The baseline scenario is that the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources into the grid.""*

As per AMS I.D., version.17, "
The baseline emissions are the product of electrical energy baseline y BL EG ,expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor:"

$BE_y = EG_{BL,y} * EF_{CO2,grid,y}$

Where:

BE_y = Baseline Emissions in year y (t CO_2)

$EG_{BL,y}$ = Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y (MWh)

$EF_{CO2,grid,y}$ = CO_2 emission factor of the grid in year y (t CO_2/MWh)

The emission factor for the project activity is calculated ex-ante according to AMS I.D., version17.

The Emission Factor can be calculated in a transparent and conservative manner as follows

(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 t CO_2e/MWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Calculations shall be based on data from an official source (where available) and made publicly available.

Option (a), is applied for emission factor calculation. All data used to calculate the Combined Margin (CM), operating margin (OM) and Build Margin (BM) is made publically available by Thailand Greenhouse Gas management Organisation, TGO (Public Organisation).

The calculation, in accordance with *"Tool to calculate the emission factor for an electricity system"* version 02.2.1/ EB 63 is provided in Section B.6.1 of this document.

Emission Factor*	Value	Units
Operating Margin	0.6147	tCO_2/MWh
Built Margin	0.5477	tCO_2/MWh
Combined Margin	0.5812	tCO_2/MWh

(*)"*Summary Report: The Study of emission factor for an electricity system in Thailand 2009*" Thailand Greenhouse Gas management Organisation (Public Organisation)
http://www.tgo.or.th/english/download/publication/GEF/2009/GEFReport_EN.pdf

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:

The purpose of project activity is to install renewable biomass based power plant. The power generated will be exported to the Thai National Grid. The project activity will displace equivalent amount of electricity generated by grid connected power plants that are mainly dominated by fossil fuel power plants. Hence, project activity will avoid Greenhouse Gases (GHG) emissions to the atmosphere which would have otherwise been occurred by grid connected fossil fuel power plant.

A project activity is considered additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered project activity. In line with the *Guidelines on the demonstration of additionality of small-scale project activities, version 9.0*[6], project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

a) Investment barriers: a financially more viable alternative to the project activity would have led to higher emissions;

b) Technological barriers: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;

c) Barrier due to prevailing practice: Barrier due to prevailing practice: prevailing practice or existing regulatory or policy requirements would have led to the implementation of a technology with higher emissions;

d) Other barriers: without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher.

The additionality of the project has been demonstrated using the below mentioned barrier:

a) Investment Barrier

Investment barrier

Implementation of Project activity faces significant investment barriers. Hence, Project Participant did investment barrier analysis to check the feasibility of the project. The investment barrier has been

[6] Annex 27 of EB 68

demonstrated in line with the guidelines defined in *the Guidelines on the Assessment of Investment Analysis, version 05*[7]. To conduct the investment analysis, following steps are applied;

Selection of investment analysis method:

As per Guidance on the Assessment of Investment Analysis, a benchmark approach is suited to circumstances where the baseline doesn't require investment or is outside the direct control of the project participant, i.e. cases where the choice of the participant is to invest or not to invest. In the absence of the project activity, equivalent amount of energy would have been generated by grid electricity system through existing power plants which are connected to the grid and by new capacity addition (which are mostly thermal), i.e., *status quo*. Therefore, selection of benchmark analysis is in conformity with the above mentioned guidance.

In order to analyse the financial viability of the project activity, the financial indicator that has been used is the pre-tax Project IRR of the project activity. The pre-tax project IRR is one of the most commonly used tools to assess the feasibility and viability of the projects. As the project is funded by both debt and equity, project IRR is considered an appropriate financial indicator for demonstrating the additionality of the project.

The financial indicator is compared to the benchmark value and if this is found to be less than the benchmark, then the project activity can be termed as financially unattractive and hence additional.

Selection of appropriate benchmark:

According to Guidelines on the Assessment of Investment Analysis *"Benchmarks supplied by relevant national authorities are also appropriate if the DOE can validate that they are applicable to the project activity and the type of IRR calculation presented."* The benchmark available or the benchmark value calculated based on the available information at the time of decision making is used for demonstrating the additionality of the project. Following are relevant sources provided required rate of return for biomass power projects in Thailand;

1. National Energy Policy Office (NEPO) of Thailand:
   National Energy Policy Office (NEPO) of Thailand conducted study entitled "*Biomass-based Power Generation and Cogeneration within Small Rural Industries of Thailand*"[8] in the year 2001. The time period (during 2001) can be defined as the starting period for the upbringing of the biomass sector as major renewable sector for generating energy in Thailand. The above study was undertaken by National Energy Policy Office of Thailand with a technical expert in power plant. The objective of the study was to promote the development of cost effective biomass based power generation in Thailand. The study comprises biomass use and resource assessment, feasibility study of biomass power generation and promotion and implementation of the biomass projects. This study defines the acceptable project IRR as 23% for biomass based power plant.
   This study defines the acceptable project IRR as 23% for biomass based power plant.

2. The Pre tax WACC (Weighted Average Cost of Capital) Benchmark was been estimated for the project activity to compare it with the pre tax project IRR estimation based on the project

[7] EB 62 Annex 5

[8] *Biomass-based Power Generation and Cogeneration within Small Rural Industries of Thailand, National Energy Policy Office (NEPO) of Thailand, available at* http://www.nrbp.org/papers/037.pdf

cashflow. The project investment decision was taken on 16 July 2007 as shown in the chronology table prior to which the investment analysis was conducted. As per Annex 5 of EB 62 due to the impact of loan interest on income tax calculations it is recommended that when a project IRR is calculated to demonstrate additionality a pre-tax benchmark be applied. Since the project is funded with equity as well as debt so WACC is an appropriate benchmark indicator for the project. Hence the WACC value is derived from the input parameters valid and available at time of investment decision.

Post Tax WACC[9] is calculated as below:

$$WACC = \frac{E}{V} * Re + \frac{D}{V} * Rd * (1 - Tc)$$

Where
E/V= Equity Ratio
D/V= Debt Ratio
Re = Return on Equity
Rd = cost of Debt (Interest Rate)
Tc = Tax Rate is considered to be ZERO in Pre tax calculation

The pre tax WACC is calculated based on the data and information available in public domain at the time of Investment Decision was made for the project as shown in the table below:

Parameter	Value	Source
Expected Market Return	15.00%	www.set.or.th/static/mktstat/Table_Index.xls?001 The project lifetime is 25 years and hence the historic SET (Stock Exchange of Thailand) data is considered for 25 years from 1981to 2006.
Bond Rate (Risk free rate)	5.77%	http://www.thaibma.or.th/PriceYield.html The Government bond rates available in year 2006 prior to the year of the investment decision year 2007. To access: Step 1: In the above link please select Price & Yield tab> Yield Curve>Government Step 2: To access the historical data on Government Bond yield for year 2006, please select 2006 in the drop down list for yield interpolation and click Go. Download the sheet which having information of Government bond yield of different maturity. The bond rates with the maturity of 16 years were chosen as it is the most comparable data available to be used for benchmarking the project investment of 25 years. The latest available bond rate is considered from year 2006 (the year prior to the date of decision

[9] http://www.investopedia.com/terms/w/wacc.asp

		making).
Beta	1.60	www.stern.nyu.edu/~adamodar/pc/archives/emergcompfirm09.xls The BETA is referred from the New York Stern University database for the Electric generation Companies in Thailand which are listed at stock exchange of Thailand. The average of the BETA values of Electric Generating companies (0.87) represents the BETA for the Electric Generation sector. Further the average BETA values is re levered to the project capital structure of D/E ratio of 50/50 and effective tax rate of 17.40% which is average of (0% tax rate for 8 years and 15% tax rate for five years and 30% for 12 years). Project BETA = Average Electric generation Sector Beta*(1+(1- effective Tax rate)*Debt/Equity)
Return On Equity based on Capital Asset Pricing Model (CAPM)	21.2%	http://www.investopedia.com/terms/c/capm.asp CAPM Model ROE= Risk Free Rate + Project BETA*(Expected market return - Risk Free Rate)
Debt	50%	Feasibility Study report by Technical Consultant. The Debt Equity Ratio and the interest rate are based on the Feasibility Study Report by Technical Consultant in June 2007. Further the interest rate is also confirmed from Bank Of Thailand From the link below. Source: http://www.bot.or.th/english/statistics/financialmarkets/interestrate/_layouts/application/interest_rate/IN_Rate.aspx To Access: In the above link please check the button for Loan rates and put the date 29 June 2007 (prior to the date of decision making) and click go.
Equity	50%	
Interest rate	7.38%	
Tax rate	17.40%	Calculated based on the average of 0% Tax for 1-8 years 15% Tax from 8-13 years and 30% tax from 14-25 years (See page 11 of this link http://www.dede.go.th/dede/images/stories/english/information/6_5_53Bussiness.pdf) However for Pre Tax calculation WACC calculation Tax is considered to be zero
WACC (Pre Tax project IRR benchmark for the project)	**14.30%**	Calculated with pre-tax WACC Formula

The pre tax WACC value of 14.30% is considered as the benchmark for the project.

Calculation and comparison with financial indicators (pre-tax Project IRR):

Following tables include the data used for Project IRR calculation.

Technical details

Description	Value	Unit	Reference
Installed capacity	9.9	MW	Feasibility Report by Third party Technical Consultant (Excellent Energy International) in June 2007
Operating hours	8760	Hr	Total number of hours in a year
Operational days	365	day	Total number of days in a year
PLF (Plant Load factor)	80%	%	Feasibility Report by Third party Technical Consultant (Excellent Energy International) in June 2007
Efficiency of biomass boiler	80%[10]	%	Feasibility Report by Third party Technical Consultant (Excellent Energy International) in June 2007
Plant Life time	25	year	Feasibility Report by Third party Technical Consultant (Excellent Energy International) in June 2007
Auxiliary consumption	0.891	MW	Feasibility Report by Third party Technical Consultant (Excellent Energy International) in June 2007 (Calculated at Auxiliary Consumption as 9% of total Electricity Generated
Total Electricity Generation capacity (excluding Auxiliary consumption)	9.0	MW	Calculated
To Grid	7.5	MW	Feasibility Report by Third party Technical Consultant (Excellent Energy International) in June 2007
To Rice mill	1.5	MW	Feasibility Report by Third party Technical Consultant (Excellent Energy International) in June 2007

Electricity generation

Net Amount of Electricity Export to grid	52560	MWh	Calculated
Sale of Power to rice mill	10575	MWh	Calculated
Auxiliary consumption	6244	MWh	Calculated
Total electricity	69379	MWh	Calculated

[10] The Boiler efficiency considered for financial analysis is referred from feasibility report which was available at the time of decision making. The value is different from the Boiler efficiency value in other section in PDD.

Reference 1: As per the report "Potential alternatives of heat and power technology application using rice straw in Thailand" on Page number 129 the efficiency of the Industrial boiler with rice straw as FEEDSTOCK is 75%. Source: http://www.thaiscience.info/Article%20for%20ThaiScience/Article/3/Ts-3%20potential%20alternatives%20of%20heat%20and%20power%20technology%20application%20using%20rice%20straw%20in%20thailand.pdf

Reference 2: As per a report on Energy Technology Systems Analysis Program (ETSAP) by International Energy Agency on Industrial Combustion Boilers on page 1, the Boiler efficiency with Biomass is 70%. Source: http://www.iea-etsap.org/web/e-techds/pdf/i01-ind_boilers-gs-ad-gct1.pdf . Thailand is a Partner country in Energy Technology Systems Analysis Program (ETSAP) by International Energy Agency. 80% Efficiency in the project is a conservative estimate.

Electricity price

Description	Value	Unit	Remarks
VSPP electricity rate	2.43[11]	THB/KWh	http://www.eppo.go.th/power/data/STATUS_VSPP_Jun_2011.xls
Adder from biomass (for the period of 7 years only)	0.30	THB/KWh	Renewable Energy Policy: Recent Policies on SPP/VSPP dated 6 June 2007[12]
VSPP electricity rate with adder (for 7 Years)	2.73	THB/KWh	Calculated including Adder
PEA Charges (operation and maintenance of substation)	2%	% of the net units Exported	http://www.eppo.go.th/power/vspp-eng/Regulations%20-VSPP%20Renew-10%20MW-eng.pdf
Electricity price for supplying electricity to Rice mill	2.43	THB/KWh	Memorandum of Understanding between the Rice mill and the power plant dated 15 May 2007

Fuel[13]/Rice husk cost

Cost of rice husk	950	THB/ton	Feasibility Report by Third party Technical Consultant (Excellent Energy International) in June 2007
Total rice husk cost	76982181	THB/yr	Calculated

O&M cost

O&M rate (Plant building, Equipment and staff salary)	0.3	THB/KWh	Feasibility Report by Third party Technical Consultant (Excellent Energy International) in June 2007
Total O&M cost	20813760	THB/yr	Calculated

[11] The value referred here was taken from the PEA website http://www.pea.co.th/vspp/ .However the Weblink for the same is not available as the same gets changing . Hence the below mentioned link was reffered which also clearly mention that the tariff applicable in the year 2007 (Decision Making)In the link below go to the tab VSPP showing power purchase tariff for VSPP. On the mentioned tab see Total Whole sale tariff. The average of January-June in year 2007 is calculated and uses.

Source: http://www.eppo.go.th/power/data/STATUS_VSPP_Jun_2011.xls

[12] http://www.eppo.go.th/encon/SPP-VSPP-2007-06-06.pdf

[13] The project is envisaged to use only rice husk as 100% fuel. However woodchip is also mentioned in the PDD as the backup fuel. The IRR analysis with wood chip as 100% fuel is also done and the results are submitted to the DOE.

Miscellaneous cost

Annual M&V O&M Cost (metering equipment maintenance and calibration and stationery for documentation)	600000	THB/yr	Feasibility Report by Technical Consultant Excellent Energy International) in June 2007
Insurance	1236280	THB/yr	Calculated
Total Misc. cost	1836280	THB/yr	Calculated

Major overhaul cost

Portion of major overhaul cost to equipment cost	10%	%	Feasibility Report by Technical Consultant Excellent Energy International) in June 2007
Portion of equipment cost to total investment cost	74%	%	Calculated
Period of major overhaul	4	years	Feasibility Report by Technical Consultant
Major overhaul cost for 4 years period (material and spare parts replacements in equipment)	45694100	THB/yr	start at the 5th year (calculated)

Project cost at the time of Investment Decision			
SN.	**Particulrar**	**THB**	**Source**
1	Boiler	300000000	Feasibility Report by Third party Technical Consultant (Excellent Energy International) in June 2007
2	STG	92000000	Feasibility Report by Third party Technical Consultant (Excellent Energy International) in June 2007
3	Other Equipments (Storage and Conveyor)	64941000	Feasibility Report by Third party Technical Consultant (Excellent Energy International) in June 2007
	Total Equipment cost	**456941000**	
4	Non equipment cost includes O&M mobilization, Company incorporation fee, admin and accounting initially, Project Technical Consultancy fee, Construction and risk insurance	55000000	Feasibility Report by Third party Technical Consultant (Excellent Energy International) in June 2007
5	Civil and Building	100000000	Feasibility Report by Technical Consultant Excellent Energy International) in June 2007
6	Land	5000000	Feasibility Report by Technical Consultant Excellent Energy International) in June 2007

	Total Project cost	**616941000**	

The estimated Pre tax project IRR based on above mentioned assumptions is provided in Table below.

Table B.5.2: Project IRR

Project IRR	**Value**
Pre tax Project IRR (without CDM revenue)	5.54%

The estimated project IRR without the CER revenues is 5.54%, lower than the benchmark of 14.30%. It can be concluded that the proposed project activity is financially unattractive. However, additional revenue from CERs sale would improve the project's return and thus helps the project to overcome investment barriers.
The project is envisaged to use only rice husk as 100% fuel. However woodchip is also mentioned as the backup fuel and the IRR analysis with wood chip as 100% fuel is also done which comes to be very less in comparison to the IRR analysis with Rice husk.

Further the input parameters for calculating IRR with rice husk as the fuel are test for sensitivity analysis.

Sensitivity Analysis:
According to the Guidelines on the assessment of the investment analysis; *"Only variables, including investment cost, that constitute more than 20% of either total project cost or total project revenues should be subjected to reasonable variation (all parameters varied need not necessarily be subjected to both negative and positive variations of the same magnitude)"*

Therefore, following key parameters are selected as sensitive parameters to check financial attractiveness of proposed project activity under variations.

i. Project cost
ii. Fuel price (biomass)
iii. Operational and Maintenance cost
iv. Electricity tariff
v. Plant Load Factor
vi. Calorific value
vii. Boiler Efficiency

As per paragraph 21 of Annex 5 of EB 62, estimated IRR for a range of +10% or -10% variations in identified parameters are summarised in table below. For all cases, the estimated IRR is below identified benchmark.
Following is the analysis showing the amount of variation in the parameters to reach the benchmark and discuss the likability of the parameter to show this variation to reach the benchmark of 14.30%

Sensitivity	Project IRR changes with	
	(+)10%	(-)10%
Electricity Tariff	8.43%	2.09%

PLF	6.73%	4.29%
O&M Cost	4.86%	6.19%
Project Cost	4.58%	6.66%
Boiler Efficiency	6.93%	3.68%
Calorific value	6.93%	3.68%
Fuel Cost	3.84%	7.07%

Sensitivity on the parameters	Thresholds Limit	Project IRR	Benchmark
Electricity Tariff	34.39%	14.30%	14.30%
PLF	83.50%	14.30%	
O&M Cost	-165.45%	14.30%	
Project Cost	-49.37%	14.30%	
Boiler Efficiency	206.00%	14.30%	
Calorific value	206.00%	14.30%	
Fuel Cost	-67.40%	14.30%	

Electricity Tariff
The Electricity tariff needs to be increased by 34.39%% to reach to the level of the benchmark. The tariff used for analysis is also including the adder of 0.3 baht for the biomass project and as per the historical changes in tariff from year 2002 to 2006 as shown in the tab "Electricity tariff" is 5%. Hence a 34.39% increment in the tariff is unlikely to happen.

Plant Load Factor
The plant load factor (PLF) considered for the project is 80%. A further increase in the PLF by 83. 50% i.e. 80 %*(1+83.5%)> 100% PLF. This is not possible to be achieved for the biomass based power project. "Fuel Supply Strategies for large scale bio-energy projects in developing countries. Electricity generation from agricultural and forest residues in Northeastern Thailand." This analysis have considered 20 biomass based power plant in Thailand and from the Northeastern Region same as the location of the project activity. For each biomass power plants the PLF of 80% is considered for the analysis. See table 4 in the report. Hence an increment in PLF is unlikely to happen.

Operation and Maintenance Cost
A reduction beyond 100% in the operation and maintenance cost implies Zero Operation and Maintenance Cost which is very unlikely to be happening in the biomass project to reach the benchmark.

Project Cost
As demonstrated in the tab project cost in the IRR spreadsheet the actual project has already occurred which is equivalent to 80% of the total project cost and hence a decrease of 49.37 % is unlikely to happen to reach the benchmark.

Boiler Efficiency
As per the report "Potential alternatives of heat and power technology application using rice straw in Thailand" on Page number 129 the efficiency of the Industrial boiler with rice straw as FEEDSTOCK is

75%[14]. As per another report on Energy Technology Systems Analysis Program (ETSAP) by International Energy Agency on Industrial Combustion Boilers on page 1, the Boiler efficiency with Biomass is 70%[15]. Hence 80% Efficiency in the project is a conservative estimate. Further the increment in boiler efficiency is not practical to reach the Benchmark IRR.

Calorific value
An increment in the calorific value beyond 200% is not practical and unlikely to happen.

Fuel Cost
The fuel cost has been estimated by the technical consultant for the project. The same value can be crosschecked with the cost of biomass provided by Energy for Environment, Thailand[16]. Also the link confirms that the price is excluding the transportation and handling charges. Hence a further decrease in the cost of biomass by a value of 67.40% to reach the benchmark is unlikely to happen.

Conclusion:
It is evident from above assessment that the proposed project activity is not financially viable option. Hence, it can be concluded that the project activity is additional.

Demonstration of Prior CDM consideration:
The project has the start date (29 November 2007), prior to 2 August 2008 and hence is applicable under section III of Annex 13 of EB 62. As per para 6 a, the project has indicated the awareness of the CDM prior to the project activity start date and that the benefits of the CDM were a decisive factor in the decision to proceed with the project. Evidence to support this includes the minutes of the board resolution which demonstrates the decision of the board to take the project as CDM project. Further the project participant has indicated that continuing and real actions were taken to secure the CDM status for the project in parallel with the implementation of the project as shown in the chronological table below:

Table B.5.3: Chronology of events of project

Date	Evidence	Description
12/04/07	Company registration document	-
Jun-07	Report by technical consultant on the Project (IGA Report)	This report mentions about CDM eligibility of the project. This is evidence of PP's awareness about CDM.
16/07/07	Board Note on Management Decision	This note is evidence that CDM was a decisive factor in decision to proceed with

[14] http://www.thaiscience.info/Article%20for%20ThaiScience/Article/3/Ts-3%20potential%20alternatives%20of%20heat%20and%20power%20technology%20application%20using%20rice%20straw%20in%20thailand.pdf

[15] http://www.iea-etsap.org/web/e-techds/pdf/i01-ind_boilers-gs-ad-gct1.pdf

Thailand is a Partner country in Energy Technology Systems Analysis Program (ETSAP) by International Energy Agency.

[16] http://www.dede.go.th/dede/images/stories/english/information/6_5_53Bussiness.pdf

		the project.
29/11/07	Purchase Order for the Turbine	**This is the project start date**
01/09/08	Purchase Order for the Boiler	This is evidence of continuing action towards implementation of project.
04/09/08	Request for proposal submitted to CDM consultant Advance Energy Plus Co. Ltd.	This is evidence of negotiation with CDM consultant
10/09/08	Request for proposal submitted to CDM consultant Kyoto Energy	This is evidence of negotiation with CDM consultant
10/09/08	Request for proposal submitted to CDM consultant ERM	This is evidence of negotiation with CDM consultant
10/09/08	Acknowledgment from CDM Consultant ERM	This is evidence of negotiation with CDM consultant
16/09/08	Reply from CDM Consultant Kyoto Energy	This is evidence of negotiation with CDM consultant
03/10/08	Reply from CDM Consultant ERM	This is evidence of negotiation with CDM consultant
June-09	Communication with CDM consultant EVI	This is evidence of negotiation with CDM consultant
10/08/09	Proposal submitted by CDM Consultant EVI	This is evidence of negotiation with CDM consultant
05/11/09	Revised proposal submitted by CDM Consultant EVI	This is evidence of negotiation with CDM consultant
25/11/09	Intimation to Thailand DNA (Reference DNA acknowledgement)	Evidence of correspondence with DNA
All events from here above happened within 2 years of project start date		
15/12/09	Intimation to UNFCCC	Evidence of correspondence with UNFCCC
28/12/09	Thailand DNA acknowledgement of PP's intent and action towards securing status of CDM	Evidence of correspondence with DNA
18/01/10	Engagement of CDM consultant	This is contract for CDM PDD services
24/05/10 – 04/08/10	Communications between EVI and PP regarding PDD development	This is evidence of continuing action to secure CDM status by preparing draft PDD and other relevant documents.
17/09/10	Proposal invited from BVC for CDM validation (Reference is the proposal from BVC)	This is evidence of negotiation with DOE
23/11/10	Proposal invited from TUV Nord for CDM validation	This is evidence of negotiation with DOE
24/11/10	CDM validation proposal from TUV Nord	This is evidence of negotiation with DOE
24/11/10	CDM validation proposal from BVC	This is evidence of negotiation with DOE.

All events from here above happened within 3 years of project start date		
13/12/10	CDM Validation proposal from SGS	-
05/07/11	DOE engagement for CDM validation of project	-
09/07/11	Start date of Global stakeholder consultation on UNFCCC website	**Start of CDM validation of project**
18/10/11	Project commissioning date	This is after the engagement of DOE for the CDM validation.

The table shows parallel implementation of the project and CDM process with the respective dates.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Baseline emissions (BEy):

According to AMS-I.D., version 17,

"If the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline scenario is the electricity delivered to the grid by the project activity that otherwise would have been generated by the operation of grid-connected power plants and by the addition of new generation sources."

This project is a Greenfield project so we can calculate the baseline emissions of the 7.5MW that is sent to the grid, AMS-I.D., version 17,

"*The baseline emissions are the product of electrical energy baseline $EG_{BL,y}$ expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor.*

$$BE_y = EG_{BL,y} * EF_{CO_2,grid,y} \quad \text{---- (1)}$$

Where:

BE_y *Baseline Emissions in year y (tCO_2)*

$EG_{BL,y}$ *Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y (MWh)*

$EF_{CO2,grid,y}$ *CO_2 emission factor of the grid in year y (tCO_2/MWh)*

Calculation of $EF_{CO2,grid,y}$:

Emission factor ($EF_{CO2,Grid}$) is calculated following the AMS-I.D., version 17, Paragraph 12, "*option (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". Calculation is based on official data published by Thailand Greenhouse Gas management Organisation (Public Organisation) , which is Thai DNA[17].

The baseline emission factor (EF_y) as per the "***Tool to calculate the emission factor for an electricity system"* version 02.2.1** is calculated as a combined margin (CM), consisting of the combination of Operating Margin (OM) and Build Margin (BM) factors according to the following steps:

Step 1. Identify the relevant electricity system:

The tool defines that ***project electricity system*** as the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or the consumers where electricity is being saved) and that can be dispatched without significant transmission constraints.

A **connected electricity system**, e.g. national or international, is defined as an electricity system that is connected by transmission lines to the project electricity system. Power plants within the connected electricity system can be dispatched without significant transmission constraints but transmission to the project electricity system has significant transmission constraint.

Thailand National Grid is identified as the electricity system for estimation of baseline grid emission factor. Electric power transmitted by the national grid includes electricity generated annually by the Electricity Generating Authority of Thailand (EGAT), Independent Power Producers (IPPs), Small Power Producers (SPPs), Very Small Power Producers (VSPPs) and imported electricity from neighbouring countries.

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)

As per the tool project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

Option I: Only grid power plants are included in the calculation
Option II: Both grid power plants and off-grid power plants are included in the calculation

Option I: In Thailand, the generated electricity that is transferred to the national grid is the only available data. Thus, it is not possible to obtain off-grid electricity generation data[18]. Only grid power plants are included in the calculation is chosen which corresponds to the procedure contained in earlier versions of this tool to calculate the operating margin and build margin emission factor.

Step 3. Select an operating margin (OM) 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

[17] "*Summary Report: The Study of emission factor for an electricity system in Thailand 2009*" Thailand Greenhouse Gas management Organisation (Public Organisation) http://www.tgo.or.th/english/download/publication/GEF/2009/GEFReport_EN.pdf

[18] "*Summary Report: The Study of emission factor for an electricity system in Thailand 2009*" Thailand Greenhouse Gas management Organisation (Public Organisation) http://www.tgo.or.th/english/download/publication/GEF/2009/GEFReport_EN.pdf

(d) Average OM.

According to the tool *Simple OM (option a)* can only be used where Low-cost/must-run (LC/MR) resources comprise less than 50% of the total grid generation in

1) Average of the five most recent years, or
2) Based on long-term averages for hydroelectricity production.

Where, LC/MR resources are defined as power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of the grid. They typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation.

As per the published report by Thailand Greenhouse Gas Management Organization (TGO), the quantity of electricity generated by these power plants is not included in the calculation of the OM emission factor because it is less than 50% of total grid generation. The LC/MR resources are estimated based on the 5 years data (2005-2009) and found to comprise less than 50% as shown in table below[19].

	2009	2008	2007	2006	2005
Total	145,300.19	145,232.00	144,364.39	139,421.94	132,212.00
Non LC/MR	136,193.80	136,116.14	133,981.76	129,460.82	124,830.70
LC/MR	9,106.39	9,115.86	10,382.64	9,961.12	7,381.30
%of LCMR	6.27%	6.28%	7.19%	7.14%	5.58%

For the simple OM, the simple adjusted OM and the average OM, the emissions factor can be calculated using either of the two following data vintages:

Ex ante option: If the ex ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation.

Ex post option: If the ex post option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required calculating the emission factor for year y is usually only available later than six months after the end of year y, alternatively the emission factor of the previous year y-1 may be used. If the data is usually only available 18 months after the end of year y, the emission factor of the year preceding the previous year y-2 may be used. The same data vintage (y, y-1 or y-2) should be used throughout all crediting periods.

For Simple OM emission factor calculation Ex ante option is selected and 3- year generation weighted average is applied.

Step 4. Calculate the operating margin emission factor according to the selected method

Selected simple OM method (option A) in step 3 is applied in following sections to calculate the operating emission factor.

[19] See LC-MR under Annex 3 – Baseline Information for detail calculation

(a) Simple OM:

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units. Out of two options provided in tool, Option A is applied to calculate simple OM emission factor. The Operating margin emission factor can be calculated by using Simple OM Option B as the following equation:

$$EF_{grid,OMsimple,y} = \frac{\sum_i \left(FC_{i,y} \times NCV_{i,y} \times EF_{CO_2,i,y}\right)}{EG_y}$$

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

$FC_{i,y}$= 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)

EG_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 = The relevant year as per the data vintage chosen

The Average of CO_2 Emission tCO_2 of 2007-2009 divided by average of Grid Electricity of 2007-2009 gives simple Operating Margin (OM Emission factor)

Table B.6.1.i : Operating Margin

	2009	2008	2007	Summary
Grid Electricity[20] GWh)	136,193.80	136,116.14	133,981.76	406,291.70
CO_2 Emission [21] (tCO_2)	82,178,673	84,083,369	83,500,546	249,762,588.58
OM Emission Factor (tCO_2/MWh)	0.6034	0.6177	0.6232	0.6147

Step 5. Calculate the build margin (BM) emission factor

In terms of vintage of data, project participants have chosen *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*

[20] See Annexure 3 under OM 2009 in Quantity of electricity generated and delivered to the national grid (GWh) table

[21] See Annexure 3 under OM 2009 in CO2 emission from electricity generation in the years 2007 – 2009 table

The sample group of power units *m* used to calculate the build margin is determined as per the following procedure, consistent with the data vintage selected above:

a). The set of five power units has been identified, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5\text{-units}}$) and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-}units}$, in MWh)[22]

b). The annual electricity generation of the project electricity system is determined, excluding power units registered as CDM project activities (AEG_{total}, in MWh). The power units are identified, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and their annual electricity generation ($AEG_{SET\text{-}\geq 20\%}$, in MWh) is determined

c) From $SET_{5\text{-units}}$ and $SET_{\geq 20\%}$ the set of power units that comprises the larger annual electricity generation (SET_{sample}) is selected as 10,018,127,100 KWh;

The date when the power units in SET_{sample} started to supply electricity to the grid are identified and documented in Annex 3- Baseline Information in Table- Set of Most recent power Units with total generation and % of electricity generation from the total electricity generation in 2009.

The oldest unit in the SET was started in 1 February 2007 so none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago. Hence as per the Tool to calculate the emission factor for an electricity system, the SET_{sample} to calculate the build margin is used.

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

Where:
$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
m = Power units included in the build margin
y = Most recent historical year for which electricity generation data is available

Table B.6.1.ii: Build Margin

tCO_2 equivalent of Fuel consumptions of the most recently built power plants in 2009[23]	Electricity generation in KWh	Build margin
20,991,690	38,323,758,067	0.5477

Step 6. Calculate the combined margin (CM) emissions factor (EFgrid, CM, y)

[22] Please Annex 3- baseline Information in Table- Set of Most recent power Units with total generation and % of electricity generation from the total electricity generation in 2009

[23] Please see Table: Fuel consumptions of the most recently built power plants

The CM can be calculated as per the following:

$EF_{CM,y} = EF_{grid,OM,y} * W_{OM} + EF_{BM,y} * W_{BM}$

Where:

Parameter	Detail
$EF_{BM,y}$	Build Margin CO2 emission factor in the year y (tCO2/GWh)
$EF_{OM,y}$	Operating Margin CO2 emission factor in the year y (tCO2/GWh)
W_{OM}	Weighting of operating margin emission factor (%)
W_{BM}	Weighting of build margin emission factor (%)

According to the tool for combined margin emission factor: W_{OM} = 0.50 and W_{BM} = 0.50 should be applied. As noted above, the resulting Combined Margin is fixed ex ante for the duration of the crediting period:

Table.B.6.1.iii: Combined Margin Emission Factor

Parameter	Unit	Value
Operating Margin EF	tCO_2/MWh	0.6147
Build Margin EF	tCO_2/MWh	0.5477
Weight age for OM (W_{OM})	%	0.50
Weight age for BM (W_{BM})	%	0.50

In the project activity, **combined margin has been chosen as the baseline emission factor** for grid emission factor. The value chosen is taken from relevant official sources and is publicly available. The data and the calculation of the Combined margin Emission factor is also provided by Thai DNA [24](Thailand Greenhouse gas management Organization) and is provided under Annexure 3 Baseline Information.

Project emissions (PEy):

As part of the project activity a backup diesel generator, to meet the emergency requirements of power plant, will be installed. Emissions resulting from usage of diesel backup generator will be accounted as project emissions based on the following equation as provided in the ***"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" version 02.***

CO_2 emissions from fossil fuel combustion in process j are calculated based on the quantity of fuels combusted and the CO_2 emission coefficient of those fuels, as follows:

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y} \qquad \text{----(4)}$$

Where:

$PE_{FC,j,y}$ Are the CO_2 emissions from fossil fuel combustion in process j during the year y (tCO_2/yr);

[24] http://www.tgo.or.th/index.php?option=com_content&view=article&id=122:thailand-grid-emission-2009-report&catid=62:tgo-research&Itemid=29

The link above is in Thai. The English translation of the same was provided to DOE

$FC_{i,j,y}$ Is the quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr);

$COEF_{i,y}$ Is the CO_2 emission coefficient of fuel type i in year y (tCO_2/mass or volume unit)

i Are the fuel types combusted in process j during the year y

The CO_2 emission coefficient $COEF_{i,y}$ can be calculated using one of the following two Options, depending on the availability of data on the fossil fuel type i, as follows:

Option A
The CO_2 emission coefficient $COEF_{i,y}$ is calculated based on the chemical composition of the fossil fuel type i, using the following approach :

If $FC_{i,j,y}$ is measured in a mass unit: $COEF_{i,y} = W_{c,i,y} \times 44/12$
If $FC_{i,j,y}$ is measured in a volume unit: $COEF_{i,y} = W_{c,i,y} \times \rho_{i,y} \times 44/12$

Where:
$COEF_{i,y}$ Is the CO_2 emission coefficient of fuel type i (tCO_2/mass or volume unit);
$w_{C,i,y}$ Is the weighted average mass fraction of carbon in fuel type i in year y (tC/mass unit of the fuel);
$\rho_{i,y}$ Is the weighted average density of fuel type i in year y (mass unit/volume unit of the fuel)

i Are the fuel types combusted in process j during the year y

Option B
The CO_2 emission coefficient $COEF_{i,y}$ is calculated based on net calorific value and CO_2 emission factor of the fuel type i, as follows:

$$COEF_{i,y} = NCV_{i,y} \times EFco_{2,i,y}$$

Where:
$COEF_{i,y}$ = CO_2 emission coefficient of fuel type i in year y (tCO_2/mass or volume unit)

$NCV_{i,y}$ = weighted average net calorific value of the fuel type i in year y (GJ/mass or volume unit)

$EF_{CO2,i,y}$ = weighted average CO_2 emission factor of fuel type i in year y (tCO_2/GJ)

i = fuel types combusted in process j during the year y

The PP has selected the option B as COEF (CO_2 emission coefficient of fuel) testing facility for "Weighted average mass fraction of carbon in fuel type i in year y" under option A is not available to PP. Hence, the project emissions for the proposed project activity can be calculated as follows:

$$PE_{diesel,j,y} = FC_{i,j,y} \times NCV_{i,y} \times EFco_{2,i,y} \quad \textbf{-----(5)}$$

Where,
$FC_{i,j,y}$ = quantity of diesel used during the year

$NCV_{i,y}$ = weighted average net calorific value of fuel type i in year y

$EFco_{2,i,y}$ = weighted average CO_2 emission factor of fuel type i in year y

Leakage (LEy):

According to AMS-I.D./ version 17, if the energy generating equipment is transferred from another activity, leakage is to be considered.

According to the Attachment C to Appendix B of indicative simplified baseline and monitoring methodologies for selected small scale CDM project activity categories General guidance on leakage in biomass project activities[25], version 03 (EB47, Annex 28), there are three types of emission sources that are potentially significant (>10% of emission reductions) and attributable to the project activities:

A. Shifts of pre-project activities:
Decreases of carbon stocks, for example as a result of deforestation, outside the land area where the biomass is grown, due to shifts of pre-project activities

B. Emissions related to the production of the biomass:
Potentially significant emission sources from the production of renewable biomass can be emission from application of fertilizer and project emissions from clearance of lands.

C. Competing uses for the biomass:
The biomass may in the absence of the project activity be used elsewhere, for the same or a different purpose.

Out of these three categories only *Category C Competing uses for the biomass* is applicable to the project activity. According to paragraph 17 of General guidance on leakage in biomass project activities, version 03 (EB47, Annex 28); *"In some cases, the biomass used in the project activity could be used for other purposes in the absence of the project. For example, biomass residues from existing forests could have been used as fuel wood or agricultural biomass residues could have been used as fertilizers or for energy generation."*

Further as per paragraph 18 of General guidance on leakage in biomass project activities, version 03 (EB47, Annex 28);*"The project participant **shall evaluate ex ante if there is a surplus of the biomass** in the region of the project activity, which is not utilized. If it is demonstrated (e.g., using published literature, official reports, surveys etc.) at the beginning of each crediting period that the quantity of available biomass in the region (e.g., 50 km radius), is at least 25% larger than the quantity of biomass that is utilized including the project activity, then this source of leakage can be neglected otherwise this leakage shall be estimated and deducted from the emission reductions."*

Following the general guidelines, PP has evaluated ex-ante if there is surplus biomass available in the region of the project activity, which is not being utilized. A comprehensive biomass assessment[26] was conducted by a third party called Blue Sky Plus Co., Ltd. and it was concluded that the rice husk's availability was more than 25% larger than the quantity required for total consumption including the project activity. As per the biomass assessment study the amount of rice husk produced in the region

[25] http://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid04.pdf

[26] Report "Biomass Assessment Study for TRC Clean Energy Co., Ltd." by Blue Sky Plus Co., Ltd.

within 50 km radius near the project plant is 223,066 tons per year and the consumption including the project plant is 78,164 tons per year. Also the amount of woodchip produced in the region within 50 km radius near the project plant is 265,300 tons per year and the consumption including the project plant is 105,300 tons per year. Based on this the surplus availability of rice husk is 64% and woodchip is 60%.
The project is going to use rice husk as the biomass residue to generate electricity. Therefore, leakage due to competing uses of biomass is neglected. Also the biomass assessment has been done for other kind of biomass available in the region i.e. woodchip. Rice Husk is more available in the region and also less costly option than woodchip hence the project is envisaged to use 100% rice husk.

Emission reductions (ERy):

Following AMS-I.D./ version 17, emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad \text{----(8)}$$

Where,
ER_y = Emission reductions in year *y;* tCO_2e/y
BE_y = Baseline emissions in year *y;* tCO_2e/y
PE_y = Project emissions in year *y;* tCO_2e/y
LE_y = Leakage emissions in year *y;* tCO_2e/y

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

Data and parameters available at validation are listed as follows:

Data / Parameter:	$EF_{CO2,grid,y}$
Data unit:	tCO_2/MWh
Description:	Grid emission factor of Thai National Grid
Source of data used:	"The Study of emission factor for an electricity system in Thailand 2009" Thailand Greenhouse Gas Management Organization (TGO) (Public Organization) http://www.tgo.or.th/english/download/publication/GEF/2009/GEFReport_EN.pdf
Value applied:	0.5812
Justification of the choice of data or description of measurement methods and procedures actually applied :	Grid Emission Factor of Thai National Grid is calculated following "*Tool to calculate the emission factor for an electricity system" version 02.2.1*". All data used to calculate the emissions factor is publically provided by Thailand Greenhouse Gas Management Organization (TGO) (Public Organization)at following link http://www.tgo.or.th/english/download/publication/GEF/2009/GEFReport_EN.pdf
Any comment:	Ex ante fixed

Data / Parameter:	$EF_{grid,OM}$
Data unit:	tCO_2/MWh
Description:	Simple Operating Margin for Grid emission factor of Thai National Grid
Source of data used:	"The Study of emission factor for an electricity system in Thailand 2009" Thailand Greenhouse Gas Management Organization (TGO) (Public

	Organization) http://www.tgo.or.th/english/download/publication/GEF/2009/GEFReport_EN.pdf
Value applied:	0.6147
Justification of the choice of data or description of measurement methods and procedures actually applied :	Simple operating Margin (OM) of Thai National Grid is calculated following "*Tool to calculate the emission factor for an electricity system" version 02.2.1.* All data used to calculate the emissions factor is publically provided by Thailand Greenhouse Gas Management Organization (TGO) (Public Organization)at following link http://www.tgo.or.th/english/download/publication/GEF/2009/GEFReport_EN.pdf
Any comment:	Ex ante fixed

Data / Parameter:	$EF_{grid,BM}$
Data unit:	tCO_2/MWh
Description:	Build Margin for Grid emission factor of Thai National Grid
Source of data used:	"The Study of emission factor for an electricity system in Thailand 2009" Thailand Greenhouse Gas Management Organization (TGO) (Public Organization) http://www.tgo.or.th/english/download/publication/GEF/2009/GEFReport_EN.pdf
Value applied:	0.5477
Justification of the choice of data or description of measurement methods and procedures actually applied :	Build Margin (OM) of Thai National Grid is calculated following "*Tool to calculate the emission factor for an electricity system" version 02.2.1.* All data used to calculate the emissions factor is publically provided by Thailand Greenhouse Gas Management Organization (TGO) (Public Organization)at following link http://www.tgo.or.th/english/download/publication/GEF/2009/GEFReport_EN.pdf
Any comment:	Ex ante fixed

Data / Parameter:	Efficiency of Energy Generation in Boiler
Data unit:	%
Description:	The efficiency at which the boiler is generating steam.
Source of data used:	Performance guarantee by the Boiler manufacturer
Value applied:	85
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value is referred from EPC contract with the Boiler Technology provider as mentioned under the performance guarantee.

Any comment:	Ex ante fixed

B.6.3 Ex-ante calculation of emission reductions:

Ex- ante emissions are calculated as defined in section 6.1 as given below;

Baseline emissions (BE_y):

$$BE_y = EG_{BL,y} * EF_{CO2}$$

Where,

Parameter	Details	Value
BE_y	Baseline Emissions in year y (t CO_2)	30,547
$EG_{BL,y}$	Energy baseline in year y (MWh)	52,560
EF_{CO2}	CO_2 Emission Factor in year y (tCO_2e/kWh)	0.5812

Estimation of $EG_{BL,y}$:

$EG_{BL,y}$ is estimated as follows;

$EG_{BL,y}$ = Net electricity available for sale * Operational days * No. of hours *PLF

Values used to calculate $EG_{BL,y}$

Parameters	Units	Value
electricity generation capacity for Grid	MW	7.5
PLF	%	80%
electricity generated to export to Grid	MWh/annum	52,560

Project emissions (PE_y):

$$PE_y = 0$$

Leakage (LE_y):

$$LE_y = 0$$

Emission reduction (ER_y):

$$ER_y = BE_y - PE_y - LE_y$$

Where,

Parameter	Details	Value
ER_y	Emission reductions in year *y* (tCO_2)	30,547
BE_y	Baseline Emissions in year y (tCO_2)	30,547
PE_y	Project emissions in year *y* (tCO_2)	0
LE_y	Leakage emissions in year *y* (tCO_{2e})	0

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

Year	Estimation of project activity emissions (tCO_2 e)	Estimations of baseline emissions (tCO_2 e)	Estimation of leakage (tCO_2 e)	Estimation of overall emission reductions (tCO_2 e)
2013-14	0	30547	0	30547
2014-15	0	30547	0	30547
2015-16	0	30547	0	30547
2016-17	0	30547	0	30547
2017-18	0	30547	0	30547
2018-19	0	30547	0	30547
2019-20	0	30547	0	30547
2020-21	0	30547	0	30547
2021-22	0	30547	0	30547
2022-23	0	30547	0	30547
Total (tonnes of CO_2e)	**0**	**305470**	**0**	305470

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

B.7.1 Data and parameters monitored:

Data / Parameter:	$EG_{facility,y}$
Data unit:	MWh / year
Description:	Quantity of net electricity supplied to the Thailand National Grid in year y
Source of data to be used:	Onsite measurement
Value of data	52,560
Description of measurement methods and procedures to be applied:	Measurement Procedure: The electricity is continuously measured in two meters at the connection point to the grid onsite, installed by Provincial Electricity Authority (PEA). One meter measures the amount of "Electricity imported" from the grid and another meter measures the amount of "Electricity exported" to the grid. So the quantity of net electricity supplied to the Thailand National Grid is (Electricity Exported-Electricity Imported). . The measurement will be done in KWh and will be converted into MWh. Accuracy of the Measurement Method: The records of Electricity Imported and Electricity Exported are maintained in a log sheet on site. The net electricity exported to the grid will be crosschecked against the electricity receipts from PEA. The Net electricity import can be confirmed from the electricity bills from PEA. Responsibility: Log sheet would be maintained by the shift in charge and same would be crossed checked by the Plant manager Frequency: Data is to be monitored continuously, measured hourly and

	recorded and reported monthly.
QA/QC procedures to be applied:	Calibration frequency: The calibration of the meters would be as per PEA standards which is the National standards for Thailand or at least once in three years.
Any comment:	The Monitored data to be kept for a minimum of two years after the end of the crediting period.

Data / Parameter:	$Q_{y\ biomass}$
Data unit:	Tonnes/ annum
Description:	Quantity of biomass (i.e. Rice husk and Woodchip)
Source of data to be used:	Plant records
Value of data	(Rice husk = 81,034, Wood chip=0). The biomass going to be used in the project is Rice husk as 100% and woodchip as the backup fuel.
Description of measurement methods and procedures to be applied:	Measurement Procedure: PP has installed a conveyor belt system, which will supply the rice husk directly from the nearest Rice mill to the premises of project. The conveyor belt would be equipped with weighing scale to measure the amount of Biomass consumed in the boiler continuously. The project also installed a weighbridge to measure the amount of biomass coming inside the premises (the biomass which is not coming through conveyor belt). Also the biomass would be measure at the feeding point to the boiler. Accuracy of the Measurement Method: The amount and type of biomass used will be cross checked by invoices raised by the suppliers for the purchase quantities and stock changes. Also check the consistency of measurements ex post with annual data on energy generation, fossil fuels (if any) and biomass used and the efficiency of energy generation as determined ex ante Responsibility: Log sheet would be maintained by the shift in charge and same would be crossed checked by the Plant manager Frequency: Data is to be monitored continuously and recording would be based on estimate using annual energy /mass balance.
QA/QC procedures to be applied:	Cross-check the measurements with an annual energy balance that is based on purchased quantities (e.g. with sales/receipts). Calibration frequency: Weigh bridge will be calibrated as per the manufacturer's specification, at least once in three years.
Any comment:	The Monitored data to be kept for a minimum of two years after the end of the crediting period.

Data / Parameter:	Moisture content of Rice Husk
Data unit:	%
Description:	Moisture content of (ricehusk)
Source of data to be used:	Plant records.

Value of data	8.5%
Description of measurement methods and procedures to be applied:	Measurement Procedure: The moisture content will be measured by the moisture probe. The moisture content will be measured for the biomass before entering the boiler and average value for the year will be used for calculations. The reporting of moisture value be on monthly basis in ER sheet. Responsibility: Log sheet would be maintained by the shift in charge and same would be crossed checked by the Plant manager. Frequency: The moisture content will be measured and recorded on a daily basis. The average value for the year will be used for calculations.
QA/QC procedures to be applied:	The calibration of the measuring equipment would be as per manufacturer's recommendations, at least once in three years.
Any comment:	The Monitored data to be kept for a minimum of two years after the end of the crediting period.

Data / Parameter:	Moisture content of woodchip
Data unit:	%
Description:	Moisture content of woodchip
Source of data to be used:	Plant records.
Value of data	35%
Description of measurement methods and procedures to be applied:	Measurement Procedure: The moisture content will be measured by the moisture probe. The moisture content will be measured for the biomass before entering the boiler and average value for the year will be used for calculations. Responsibility: Log sheet would be maintained by the shift in charge and same would be crossed checked by the Plant manager. Frequency: The moisture content will be measured and recorded on a daily basis. The average value for the year will be used for calculations.
QA/QC procedures to be applied:	The calibration of the measuring equipments would be as per manufacturer's recommendations, at least once in three years.
Any comment:	The Monitored data to be kept for a minimum of two years after the end of the crediting period.

Data / Parameter:	$NCV_{y\ ricehusk}$
Data unit:	GJ/ton
Description:	net calorific value of Rice Husk
Source of data to be used:	Plant records.
Value of data	13.35
Description of measurement methods and procedures to be applied:	Measurement Procedure: The measurement will be done in laboratories on dry basis according to relevant national/international standards Accuracy of the Measurement Method: Samples will be collected from fuel

	storage of power plant, which would be tested at an external laboratory, in accordance with national/international standards. Responsibility: Log sheet would be maintained by the shift in charge and same would be crossed checked by the Plant manager. Frequency: Determine once in first year of the crediting period with quarterly measurements taking at least three samples for each measurement the average value will be used for the rest of the crediting period.
QA/QC procedures to be applied:	If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements.
Any comment:	The Monitored data to be kept for a minimum of two years after the end of the crediting period.

Data / Parameter:	$NCV_{y\ woodchip}$
Data unit:	GJ/ton
Description:	net calorific value of Woodchip
Source of data to be used:	Plant records.
Value of data	14.20
Description of measurement methods and procedures to be applied:	Measurement Procedure: The measurement will be done in laboratories on dry basis according to relevant national/international standards Accuracy of the Measurement Method: Samples will be collected from fuel storage of power plant, which would be tested at an external laboratory, in accordance with national/international standards. Responsibility: Log sheet would be maintained by the shift in charge and same would be crossed checked by the Plant manager. Frequency: Determine once in first year of the crediting period with quarterly measurements taking at least three samples for each measurement the average value will be used for the rest of the crediting period.
QA/QC procedures to be applied:	If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements.
Any comment:	The Monitored data to be kept for a minimum of two years after the end of the crediting period.

For the Project emissions:

Data / Parameter:	$EF_{CO2\ i,y}$
Data unit:	t CO_2/GJ
Description:	Weighted average CO_2 emission factor of Diesel oil in year y.
Source of data used:	Value from Fuel Supplier or Upper limit of IPCC value (at 95% confidence level)
Value applied:	74.8

Justification of the choice of data or description of measurement methods and procedures actually applied :	The option (d) of "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" version 02, EB 41 i.e IPCC default values for Emission factor as provided in tabel 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on Nation GHG Inventories, will be used since the fuel supplier does not provide the CO_2 emission factor on the invoices as required by the preferred option (a) of the tool IPCC upper limit values have been used for fuel oil because no country specific data is available. Any future revision of the IPCC guidelines would be taken into account. During verification if the value from the supplier is available in that case same will be used.
Any comment:	

Data / Parameter:	$FC_{i,j,y}$
Data unit:	Volume unit : m^3/yr
Description:	Quantity of Diesel oil used during the year y
Source of data to be used:	On-site measurements
Value of data	0 (assumed value for fossil fuel ex-ante calculation of emission reductions)
Description of measurement methods and procedures to be applied:	Measurement Procedure: The total number of operating hours of DG set and the corresponding quantity of diesel consumed for the purpose will be recorded, using ruler gauge, in the log book maintained at the DG set room. Accuracy of the Measurement Method: To confirm the accuracy on measurement of quantity of diesel consumed the same can be cross checked against the fuel purchase receipts. Responsibility: Log sheet would be maintained by the shift in charge and same would be crossed checked by the Plant manager Frequency: As and when consumed
QA/QC procedures to be applied:	The ruler gauge will undergo calibration/maintenance annually. The data recorded can be cross checked against the fuel purchase receipts.
Any comment:	The Monitored data to be kept for a minimum of two years after the end of the crediting period.

Data / Parameter:	**$NCV_{i,y}$**
Data unit:	GJ/ m^3
Description:	Weighted average net calorific value of fuel type *i* in year *y*
Source of data to be used:	The value would be measured as per the option (a) mentioned in the *"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"* version 02, EB 41 which is the preferred option of the tool. In case the information for option (a) is not available during monitoring period, then IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of chapter 1 of vol. 2 (energy) of the 2006 IPCC guidelines on National GHG inventories.

Value of data	-
Description of measurement methods and procedures to be applied:	Measurement Procedure: The measurement for Net Calorific Value of the auxiliary fuel type *i* would be obtained for each fuel delivery, from which weighted average annual values would be calculated. Responsibility: Log sheet would be maintained by the shift in charge and same would be crossed checked by the Plant manager Frequency: The NCV will be obtained for each fuel delivery, from which weighted average annual values will be calculated In case the same is not provided by the fuel supplier , upper limit of the IPCC will be used. Any future revision of the IPCC guidelines would be taken into account.
QA/QC procedures to be applied:	If this parameter are below the uncertainty range of the IPCC default values, additional information will be collected from the laboratory to justify the outcome or additional measurements would be conducted.
Any comment:	The Monitored data to be kept for a minimum of two years after the end of the crediting period.

B.7.2 Description of the monitoring plan:

PP will have procedures for monitoring and recording of data on operation & maintenance of the plant equipments. This monitoring plan is developed in accordance with the modalities and procedures for small-scale CDM project activities. The subsequent sections describes about the monitoring plan including CDM team, monitoring practices, quality assurance, quality control procedures, data storage and archiving.

Composition of CDM Team:

The Management team proposed for monitoring of emission reductions due to the project activity performs various functions such as measuring, recording, storage of measured data and reporting. The CDM Team comprises of following members.

- Plant Manager,
- Power plant In-Charge,
- Shift In-Charge

Responsibilities of CDM Team:

The plant manager is responsible for overall functioning and maintenance of the project activity. The Power Plant In-charge maintains all the data records and ensures the completeness and reliability of the data. The Shift In-charge maintains a day to day power generation and fuel consumption log. The monitoring reports (MR) are prepared monthly and annually, checked periodically by the Power Plant In-charge. Corrective action is taken immediately if any improper functioning or operation problem with the equipments is observed. A log will also be maintained for the biomass supply on the site, its storage and usage in the project activity.

Table B.7.1: Allocation of responsibility

S. No.	Task	Responsibility		
		Shift- In-charge	Plant In charge	Plant manager
1.	Day to day data collection and record keeping	Y		
2.	Reliability/ Verification of data collected		Y	
3.	Report generation monthly/daily	Y	Y	
4.	Checking data for its correctness and completeness			Y
5.	Maintenance of monitoring equipments		Y	
6.	Calibration of instruments:		Y	
7.	Internal audits of CDM project compliance			Y
8.	Emergency preparedness		Y	
9.	Training of CDM team personnel			Y

Monitoring plan:
The data collection on daily basis is done by shift In-Charge. Shift In-Charge is responsible for preventive maintenance, handling emergency situations and improvement measures under the overall responsibility of plant In-Charge. Plant In-Charge ensures monthly reading and meter testing on regular basis. A daily log is maintained by shift In-Charge about issues related to power generation (plant shutdown, grid failure etc). The reliability of the meters will be checked by testing the meters on yearly basis. Documents pertaining to testing of meters shall be maintained. The MR will also report the periodic calibration performed within the reporting period.

Monitoring equipments:
The electricity exported to the grid and the quantity of fuel procured will be monitored using energy meter and weigh bridge meter, respectively. Plant In-charge inspects and calibrate both the meters according to the as per the industrial standards prescribed by the meter supplier. The weigh bridge will be calibrated by the project proponent as per the industrial standards of Thailand.

Corrective actions:
The monitoring team will log all corrective actions and will report these in the monitoring report. In case corrective actions are considered necessary, these actions will be implemented.

Archiving of Data:
All data will be kept in both electronic and/ or paper. The archived data shall be kept for two years after the crediting period or issuance of CERs.

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 application of the baseline and monitoring methodology is 27 June 2011.
Person responsible for baseline determination: **TRC Clean Energy Co., Ltd. and their associates**

Responsible Person:

Mr. Decha Panyasawat

CDM – Executive Board

TRC Clean Energy Co., Ltd.
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E mail: dmd@trcce.com

Mr. Decha Panyasawat is project participant. The contact details are provided in Annex 1.

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:

29th November 2007

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

25 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:

NA

C.2.1.2. Length of the first crediting period:

NA

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

01/02/2013 or the date of registration whichever is later.

C.2.2.2. Length:

10 years

SECTION D. Environmental impacts

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

According to the Thai environmental regulations, power projects with a capacity less than 10 MW are not required to carry out an Environmental Impact Assessment (EIA) [27]. However, an Initial Environmental Evaluation (IEE) has been conducted, as required by the Thai DNA. The IEE report must be approved with due consideration to Thai sustainable development criteria for CDM. This process ensures that a project with a negative impact to the environment is considered in parallel with GHG reductions of the project.

The completed IEE report can be provided to the Designated Operation Entity (DOE) on request. The IEE report concluded that the project will create no negative impact on the local environment. In the event of a negative impact, mitigation measures need to be implemented.

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:

According to IEE report submitted to Thai DNA, PP has done an environmental evaluation as per Thai DNA's guidelines for Preparing an Initial Environmental Evaluation (IEE) Report of CDM Project in Thailand[28]. It was concluded that impact on noise, waste and air emission will be compliance with the relevant environmental law and regulation. Therefore, the project activity does not have significant adverse environmental impacts

SECTION E. Stakeholders' comments

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

The project participant conducted a Local stakeholder's consultation meeting with the local stakeholders like local people residing in village and around the vicinity of this project activity in order to understand and address the concerns of the local stakeholders and their opinion about the proposed project activity on 25th January 2011. The local stakeholders were invited of Ban Pho sub-district in Mueang district. The project participant also put advertisement in the local newspaper "Koraj Inside Weekly News Paper" on 7 January 2011 informing about the CDM Local Stakeholder consultation meeting. The local population and regulatory authorities participated in that meeting. An invitation was also published to inform local people regarding the project activity in the local newspaper.
The project participant explained briefly about the agenda of the meetings and introduced the global warming and the climate change. The CDM consultant also explained the role of Kyoto protocol and clean development mechanism in mitigating the impacts of climate change.

[27] http://www.onep.go.th/eia/index.php?option=com_content&view=article&id=67:2010-10-04-22-39-53&catid=4:2010-09-16-04-32-17&Itemid=10

[28] http://www.tgo.or.th/download/projapprv/Guideline_for_Preparing_IEE_report.pdf

After the brief introduction of climate change, Kyoto Protocol and CDM, project promoter explained the purpose of the stakeholder consultation meeting as to seek the concern, opinion and suggestion of the stakeholders.

Subsequently, project promoter invited the stakeholders to ask for their queries and suggestions. The questions and responses to their query are given in the next section.

E.2. Summary of the comments received:

People participated with great enthusiasm and raised a few questions, which were answered to in an appropriate manner by the project promoter. Summary of these comments is given as follows;

Queries and responses from the project promoter and the stakeholders:
Question: Is there any plan to reduce dust from the project?
Answer: The system is designed to prevent biomass and ashes from wind. There will be no biomass or ashes to pile outdoors and ash treatment system will be closed system.

Question: How would project developer inform local stakeholders when the project is facing with problem on environmental issues?
Answer: Project developer will cooperate with local governmental administration and make the list of village head or village representative to inform any progress. Meanwhile, the project would provide direct line number to gather any comments or suspicions from stakeholders.

Question: Does this project help reduce Global Warming?
Answer: Yes, this project will produce electricity using biomass instead of fossil fuel. Biomass is renewable source. GHGs produce in burning biomass to produce electricity will be recapture by the new biomass crop. Then, this project is helping reduce GHGs emission.

Question: How can we know that this project emission is in an acceptable range?
Answer: The emission is controlled under regulation standard. Third-party was hired to investigate the baseline emission of the project area on 13-18 July 2010. The information gather was sent to relevant governmental organization which can be verified.

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

There were no negative comments received from the local people near to the project activity. Hence no report is applicable.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	**TRC Clean Energy Co., Ltd.**
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Represented by:	
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding or direct funding from Annex-1 countries has been availed for this project activity.

Annex 3

BASELINE INFORMATION

Data and CM calculation provided by Thai DNA are as following[29]:

Net Calorific Value

Fuel	Carbon dioxide Emission ($kgCO_2/TJ$)		
	Average	Lower	Upper
Crude Oil	73,300	71,100	75,500
Orimulsion	77,000	69,300	85,400
Natural Gas Liquids	64,200	58,300	70,400
Gasoline			
Motor Gasoline	69,300	67,500	73,000
Aviation Gasoline	70,000	67,500	73,000
Jet Gasoline	70,000	67,500	73,000
Jet Kerosene	71,500	69,700	74,400
Other Kerosene	71,900	70,800	73,700
Shale Oil	73,300	67,800	79,200
Gas/Diesel Oil	74,100	72,600	74,800
Residual Fuel Oil	77,400	75,500	78,800
Liquefied Petroleum Gases	63,100	61,600	65,600
Ethane	61,600	56,500	68,600
Naphtha	73,300	69,300	76,300
Bitumen	80,700	73,000	89,900
Lubricants	73,300	71,900	75,200
Petroleum Coke	97,500	82,900	115,000
Refinery Feedstocks	73,300	68,900	76,600
Other Oil			
Refinery Gas 2	57,600	48,200	69,000
Paraffin Waxes	73,300	72,200	74,400
White Spirit and SBP	73,300	72,200	74,400
Other Petroleum Products	73,300	72,200	74,400
Anthracite	98,300	94,600	101,000
Coking Coal	94,600	87,300	101,000
Other Bituminous Coal	94,600	89,500	99,700
Sub-Bituminous Coal	96,100	92,800	100,000
Lignite	101,000	90,900	115,000
Oil Shale and Tar Sands	107,000	90,200	125,000
Brown Coal Briquettes	97,500	87,300	109,000
Patent Fuel	97,500	87,300	109,000

[29] http://www.tgo.or.th/index.php?option=com_content&view=article&id=122:thailand-grid-emission-2009-report&catid=62:tgo-research&Itemid=29

The link above is in Thai. The English translation of the same was provided to DOE

Coke			
Coke Oven Coke and Lignite Coke	107,000	95,700	119,000
Gas Coke	107,000	95,700	119,000
Coal Tar 3	80,700	68,200	95,300
Derived Gases			
Gas Works Gas 4	44,400	37,300	54,100
Coke Oven Gas 5	44,400	37,300	54,100
Blast Furnace Gas 6	260,000	219,000	308,000
Oxygen Steel Furnace Gas 7	182,000	145,000	202,000
Natural Gas	56,100	54,300	58,300
Municipal Wastes (non-biomass fraction)	91,700	73,300	121,000
Industrial Wastes	143,000	110,000	183,000
Waste Oil 8	73,300	72,200	74,400
Peat	106,000	100,000	108,000
Solid Biofuels			
Wood/Wood Waste 9	112,000	95,000	132,000
Sulphite lyes (black liquor) 10	95,300	80,700	110,000
Other Primary Solid Biomass 11	100,000	84,700	117,000
Charcoal 12	112,000	95,000	132,000
Liquid Biofuel			
Biogasoline 13	70,800	59,800	84,300
Biodiesels 14	70,800	59,800	84,300
Other Liquid Biofuels 15	79,600	67,100	95,300
Gas Biomass			
Landfill Gas 16	54,600	46,200	66,000
Sludge Gas 17	54,600	46,200	66,000
Other Biogas 18	54,600	46,200	66,000
Other nonfossil fuels			
Municipal Wastes (biomass fraction)	100,000	84,700	117,000

.

Type	**Unit**	**kcal/Unit**	**toe/10^6 Unit**	**MJ/Unit**	**10^3 Btu/Unit**
Crude Oil	liter	8,680.00	860.00	36.33	34.44
Condensate	liter	7,900.00	782.72	33.07	31.35
Natural Gas					
Wet	scf.	248.00	24.57	1.04	0.98
Dry	scf.	244.00	24.18	1.02	0.97
Petroleum Products					
LPG	kg	11,777.78	1,166.93	49.30	46.74
Gasoline	liter	7,520.00	745.07	31.48	29.84
Jet Fuel	liter	8,250.00	817.40	34.53	32.74
Kerosene	liter	8,250.00	817.40	34.53	32.74
Diesel	liter	8,700.00	861.98	36.42	34.52
Fuel Oil	liter	9,500.00	941.24	39.77	37.70
Bitumen	liter	9,840.00	974.93	41.19	39.05
Petroleum Coke	kg	8,400.00	832.26	35.16	33.33
Electricity	kWh	860.00	85.21	3.60	3.41
Coal Import	kg	6,300.00	624.19	26.37	25.00

Coke		kg	6,600.00	653.92	27.63	26.19
Antracite		kg	7,500.00	743.09	31.40	29.76
Ethane		kg	11,203.00	1,110.05	46.89	44.45
Propane			11,256.00	1,115.34	47.11	44.67
Lignite						
	Li	kg	4,400.00	435.94	18.42	17.46
	Krabi	kg	2,600.00	257.60	10.88	10.32
	Mae Moh	kg	2,500.00	247.70	10.47	9.92
	Chae Khon	kg	3,610.00	357.67	15.11	14.32
Fuel Wood		kg	3,820.00	378.48	15.99	15.16
Charcoal		kg	6,900.00	683.64	28.88	27.38
Paddy Husk		kg	3,440.00	340.83	14.40	13.65
Bagasse		kg	1,800.00	178.34	7.53	7.14
Garbage		kg	1,160.00	114.93	4.86	4.60
Saw Dust		kg	2,600.00	257.60	10.88	10.32
Agricultural Waste		kg	3,030.00	300.21	12.68	12.02
Biogas		cu.m.	5,000.00	495.39	20.93	19.84
Biodiesel		liter	8,123.00	804.85	34.00	32.23
Ethanal		liter		567.58		

LC-MR

	2009			
	EGAT	IPP	SPP	Total
Total	66,488.10	64,840.72	13,971.37	145,300.19
Non LC/MR	59,541.66	64,840.72	11,811.42	136,193.80
LC/MR	6,946.44	0.00	2,159.95	9,106.39
Heat Energy	23,463.69	12,388.03	2,225.63	38,077.35
Combine Heat Energy	33,164.46	52,452.69	8,752.19	94,369.35
Gas Turbine	309.63	0.00	833.60	1,143.23
Diesel	1.44	0.00	0.00	1.44
Hydro	6,941.74	0.00	23.97	6,965.71
Renewable	4.70	0.00	2,135.98	2,140.68
Import	2,602.43	0.00	0.00	2,602.43
%LC/MR	10.45	0.00	15.46	6.27

	2008			
	EGAT	IPP	SPP	Total
Total	63,719.02	67,420.14	14,092.83	145,232.00
Non LC/MR	56,791.19	67,420.14	11,904.81	136,116.14
LC/MR	6,927.83	0.00	2,188.03	9,115.86
Heat Energy	26,778.89	14,398.34	1,996.83	43,174.06
Combine Heat Energy	26,449.20	53,021.80	9,029.90	88,500.90
Gas Turbine	659.33	0.00	878.07	1,537.41
Diesel	2.30	0.00	0.00	2.30
Hydro	6,926.02	0.00	28.77	6,954.79

Renewable	1.81	0.00	2,159.26	2,161.07
Import	2,901.47	0.00	0.00	2,901.47
%LC/MR	10.87	0.00	15.53	6.28

	2007			
	EGAT	IPP	SPP	Total
Total	67,704.95	62,233.44	14,426.00	144,364.39
Non LC/MR	59,765.33	62,233.44	11,982.99	133,981.76
LC/MR	7,939.62	0.00	2,443.02	10,382.64
Heat Energy	30,265.00	17,453.59	2,168.76	49,887.35
Combine Heat Energy	24,124.09	44,779.85	8,935.60	77,839.54
Gas Turbine	884.20	0.00	878.63	1,762.83
Diesel	1.17	0.00	0.00	1.17
Hydro	7,937.20	0.00	21.70	7,958.90
Renewable	2.42	0.00	2,421.32	2,423.73
Import	4,490.87	0.00	0.00	4,490.87
%LC/MR	11.73	0.00	16.93	7.19

	2006			
	EGAT	IPP	SPP	Total
Total	70,409.11	55,360.65	13,652.19	139,421.94
Non LC/MR	62,480.23	55,360.65	11,619.95	129,460.82
LC/MR	7,928.88	0.00	2,032.23	9,961.12
Heat Energy	31,685.00	14,299.43	2,319.08	48,303.51
Combine Heat Energy	24,560.84	41,061.21	8,370.38	73,992.43
Gas Turbine	1,069.67	0.00	930.50	2,000.16
Diesel	1.20	0.00	0.00	1.20
Hydro	7,926.59	0.00	44.79	7,971.38
Renewable	2.29	0.00	1,987.44	1,989.74
Import	5,163.53	0.00	0.00	5,163.53
%LC/MR	11.26	0.00	14.89	7.14

	2005			
	EGAT	IPP	SPP	Total
Total	66,650.81	51,989.60	13,571.59	132,212.00
Non LC/MR	60,999.89	51,989.60	11,841.22	124,830.70
LC/MR	5,650.93	0.00	1,730.37	7,381.30
Heat Energy	31,959.86	9,196.93	2,268.70	43,425.49
Combine Heat Energy	23,366.77	42,792.66	8,747.76	74,907.19
Gas Turbine	1,295.10	0.00	824.76	2,119.86
Diesel	2.01	0.00	0.00	2.01
Hydro	5,648.72	0.00	17.43	5,666.15
Renewable	2.20	0.00	1,712.94	1,715.15
Import	4,376.14	0.00	0.00	4,376.14

%LC/MR	8.48	0.00	12.75	5.58

Build Margin 2009

Table- Set of Most recent power Units with total generation and % of electricity generation from the total electricity generation in 2009

Sl no.	Power Plant	Commercial Operation Date	KWh	% of Total Elec 2009	
	Set of Power Units		38,323,758,067	26.38	> 20% Total Elec 2009
1	Bangpakong Power Plant (Unit 05)	16-Sep-09	1,918,115,787		
2	South Bangkok Power Plant (Unit 03)	1-Mar-09	4,745,319,100		
3	Chana Power Plant (Unit 01)	15-Jul-08	4,150,262,280		
4	Ratchaburi Power Company Limited (RPCL) (Unit 1&2)	1-Jun-08	8,153,257,000		
5	Gulf Power Generation Co., Ltd. (Unit 1&2)	1-Mar-08	9,338,676,800		
6	BLCP Power Co., Ltd. (Unit 1&2)	1-Feb-07	10,018,127,100		

Table: Fuel consumptions of the most recently built power plants

2009 Emission		Volume	MJ/Unit	tCO2/TJ	kgCO2/Unit	tCO2
Total	Unit					20,991,690
Natural Gas	scf	223,467,679,056	1.02	54.30	0.0554	12,376,981
Lignite	tonnes	0	10,470.00	90.90	951.7230	0
Bituminous	tonnes	3,645,721	26,370.00	89.50	2,360.1150	8,604,321
Bunker	liter	0	39.77	75.50	3.0026	0
Diesel	liter	3,929,038	36.42	72.60	2.6441	10,389

BM 2009
tCO2/MWh
0.5477

Operating Margin 2009

CO_2 emission from electricity generation in the years 2007 - 2009

2009 Emission		EGAT	IPP	SPP	Volume	MJ/Unit	tCO2/TJ	kgCO2/Unit	tCO2
Total									82,178,673
Natural Gas	scf	369,146,214,392	459,228,417,361	140,550,086,056	968,924,717,809	1.02	54.30	0.0554	53,664,864
Lignite	tonnes	15,818,265	0	0	15,818,265	10,470.00	90.90	951.7230	15,054,607
Bituminous	tonnes	0	3,645,721	1,840,527	5,486,248	26,370.00	89.50	2,360.1150	12,948,176
Bunker	liter	111,039,065	38,180,874	8,797,506	158,017,445	39.77	75.50	3.0026	474,469
Diesel	liter	12,140,891		1,685,046	13,825,937	36.42	72.60	2.6441	36,557

2008 Emission		EGAT	IPP	SPP	Volume	MJ/Unit	tCO2/TJ	kgCO2/Unit	tCO2
Total									84,083,369
Natural Gas	scf	340,739,529,461	490,866,999,785	145,410,364,035	977,016,893,281	1.02	54.30	0.0554	54,113,058
Lignite	tonnes	16,407,465	0	0	16,407,465	10,470.00	90.90	951.7230	15,615,362
Bituminous	tonnes	0	3,711,791	1,866,776	5,578,567	26,370.00	89.50	2,360.1150	13,166,060
Bunker	liter	247,441,682	93,212,260	9,555,452	350,209,394	39.77	75.50	3.0026	1,051,551
Diesel	liter	6,792,039	43,698,832	1,451,087	51,941,958	36.42	72.60	2.6441	137,339

2007 Emission		EGAT	IPP	SPP	Volume	MJ/Unit	tCO2/TJ	kgCO2/Unit	tCO2
Total									83,500,546
Natural Gas	scf	342,335,310,261	454,590,745,280	145,512,075,117	942,438,130,658	1.02	54.30	0.0554	52,197,878
Lignite	tonnes	16,060,766	0	0	16,060,766	10,470.00	90.90	951.7230	15,285,400
Bituminous	tonnes	0	3,692,979	1,889,868	5,582,847	26,370.00	89.50	2,360.1150	13,176,161
Bunker	liter	785,979,152	144,198,973	6,042,880	936,221,005	39.77	75.50	3.0026	2,811,130
Diesel	liter	7,381,996	2,688,851	1,266,337	11,337,184	36.42	72.60	2.6441	29,977

Quantity of electricity generated and delivered to the national grid (GWh)

	2009				2008				2007			
	EGAT	IPP	SPP	Total	EGAT	IPP	SPP	Total	EGAT	IPP	SPP	Total
Total	66,488.10	64,840.72	13,971.37	145,300.19	63,719.02	67,420.14	14,092.83	145,232.00	67,704.95	62,233.44	14,426.00	144,364.39
Non LC/MR	59,541.66	64,840.72	11,811.42	136,193.80	56,791.19	67,420.14	11,904.81	136,116.14	59,765.33	62,233.44	11,982.99	133,981.76
LC/MR	6,946.44	0.00	2,159.95	9,106.39	6,927.83	0.00	2,188.03	9,115.86	7,939.62	0.00	2,443.02	10,382.64
Energy from heat	23,463.69	12,388.03	2,225.63	38,077.35	26,778.89	14,398.34	1,996.83	43,174.06	30,265.00	17,453.59	2,168.76	49,887.35
Energy from Combine heat	33,164.46	52,452.69	8,752.19	94,369.35	26,449.20	53,021.80	9,029.90	88,500.90	24,124.09	44,779.85	8,935.60	77,839.54
Energy from Gas turbine	309.63	0.00	833.60	1,143.23	659.33	0.00	878.07	1,537.41	884.20	0.00	878.63	1,762.83
Diesel	1.44	0.00	0.00	1.44	2.30	0.00	0.00	2.30	1.17	0.00	0.00	1.17
HYDRO	6,941.74	0.00	23.97	6,965.71	6,926.02	0.00	28.77	6,954.79	7,937.20	0.00	21.70	7,958.90
Renewable energy	4.70	0.00	2,135.98	2,140.68	1.81	0.00	2,159.26	2,161.07	2.42	0.00	2,421.32	2,423.73
Import	2,602.43	0.00	0.00	2,602.43	2,901.47	0.00	0.00	2,901.47	4,490.87	0.00	0.00	4,490.87

CM 2009

Ex Ante	tCO2	249,762,589
	GWh	406,291.70
OM	tCO2/MWh	0.6147
	weight	0.50
BM	tCO2/MWh	0.5477
	weitgh	0.50
CM 2009	tCO2/MWh	0.5812

Annex 4

MONITORING INFORMATION

Please refer section B.7 of the document.