Project design document form for small-scale CDM project activities

(Version 08.0)

Complete this form in accordance with the Attachment "Instructions for filling out the project design document form for small-scale CDM project activities" at the end of this form.

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	Pasak Jolasid Hydropower Project
Version number of the PDD	09
Completion date of the PDD	09/03/2017
Project participant(s)	Electricity Generating Authority of Thailand
Host Party	Thailand
Applied methodology(ies) and, where applicable, applied standardized baseline(s)	Project Type I: Renewable Energy Projects Project Category I.D: Grid Connected renewable energy generation. Version 17 with reference to EB 61
Sectoral scope(s) linked to the applied methodology(ies)	Sectoral Scope 01: Energy Industries (Renewable /non-renewable sources)
Estimated amount of annual average GHG emission reductions	18,392 tCO_2/year

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>> Pasak Jolasid Hydropower Project is a small-scale Greenfield run-of-river hydroelectric power plant with an installed capacity of 6.465 MW at Pasak Jolasid irrigation dam. As it is a Greenfield project, prior to implementation of the project activity there are no any hydro power projects at the project site. The project is implemented on the left bank of the existing Pasak Jolasid irrigation dam by using the by-pass water flow channel to generate the electricity. The by-pass water flow channel was specially constructed for the project activity. The Pasak Jolasid dam was constructed for the purpose of irrigation, flood control and water supply in Saraburi, Ayutthaya and Bangkok provinces. The Electricity Generating Authority of Thailand (herein after as EGAT) is developing this project with the aim of utilising the hydro resources in the province of Lopburi in Thailand.

The project aims to install a generator of 6.465 MW and a 6.7MW turbine to generate 6.465 MW[1] of electricity at 6.6kV which will be stepped up to export from the powerhouse to the existing Provincial Electricity Authority (PEA) transmission line. All the net generated electricity will be exported to the PEA. The purpose of the project activity is to generate electricity by using renewable hydro resources. Since the project activity generates electricity by using renewable hydro resources with the total capacity of 6.465 MW, the project activity is fall into type I (Renewable energy project) and small scale project (the installed capacity <15 MW).

The electricity generated from the project activity would reduce GHG emissions produced by the grid which is currently dominated by fossil fuel based power plants. Emission reduction from hydroelectric power projects arise as they replace grid electricity with a zero-emission source of electricity generation. Project activity will reduce greenhouse gas of about 18,392 tCO_2e annually throughout crediting period of 7 years or 128,744 tCO_2e for entire of crediting period of 7 years.

The project activity is not applied as a part or a CPA in any CDM PoAs.

The project activity will contribute to sustainable development within the following broad categories:

Socio-economic:

The proposed project activity contributes to poverty alleviation through income and employment generation for the local community by employing people at all levels from unskilled labour to skilled manpower throughout the construction and operation of the project activity. The project activity also helps diversify the sources of electricity generation, which is important for meeting growing energy demands and transition away from fossil fuel based electricity generation. Local investment environment will enhance due to the project as a result leading to an improved local economy. The project activity will lead to the development of basic amenities leading to an improvement of living standard of the community. The project activity will also improve the roads in the vicinity of project activity, which will benefit the communities in the area.

Furthermore the project provides community support and coordination such as donation and assistance to the local schools, eye care for the poor in the community, setting up reforestation programmes, organizing energy conservation programmes for children, child care support, etc.

The project will also contribute to the Thailand Community Development Fund. Revenues from the project will be paid into the Community Development Fund proportionate to the amount of electricity generated. These funds will be made available to representatives of local communities surrounding the power plant for use in community development projects.

Environment:

[1] General Guidelines for SSC CDM Methodologies (Version 21)

The Project will diversify the sources of electricity generation by displacing conventional fossil fuel-based[2] power generation with carbon-neutral hydro power generation, and hence GHGs emissions associated with the combustion of fossil fuels would be reduced.

Technology:

The turbine generator for the project activity will be manufactured and imported from China, therefore, positively contributing to technological development of Thailand through the transfer of technology. This would encourage other project promoters and pave way for the country to be technologically self reliant in future.

A.2. Location of project activity

A.2.1. Host Party

>> Thailand

A.2.2. Region/State/Province etc.

>> Lopburi Province

A.2.3. City/Town/Community etc.

>> Phatthananikhom District

A.2.4. Physical/Geographical location

>>

The project activity is located next to and on the south of Pasak Jolasid irrigation dam in Lopburi Province. Lopburi Province is located in central region of Thailand and far away from Bangkok (capital of Thailand) 160 km.

The geographical coordinates of the power plant site are:

Latitude: 14°51’09.26661’’N
Longitude: 101°04’45.38686’’E

[2] Refer to Appendix 4

Figure 1: Location Map of the project activity

A.3. Technologies and/or measures

>> The project activity is a hydro power plant which will generate electricity by harnessing the hydro resources of the Pasak Jolasid storage dam. The potential energy available in the water flow will be converted into mechanical energy using hydro turbines and then to electrical energy using alternators.

The installed total capacity of the generator is 6.465 MW which is less than the limit of 15 MW for renewable energy project activities to qualify under Type I project activities. As per the provisions of indicative simple baseline and monitoring methodologies for small scale CDM project activities, Type I.D. "comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal, and renewable biomass, that supply electricity to and/or displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit". With above considerations, the Type I.D. is the most appropriate category for the project activity.

The project involves the installation of 6.7 MW turbine to produce electricity at 6.6kV which will be stepped up to 22kV to export from the Pasak Jolasid Powerhouse to existing PEA transmission line. The powerhouse is situated at a distance of 1.5 km from the existing PEA transmission line. The project will install a S-type turbine with a design head of 13.5m and design discharge of 55m3/sec. The turbine generator shaft rotates at a speed of 187.5 rpm. Start up electricity for auxiliaries of turbine will be imported from PEA. The backup power supply in the event of power plant shut down (in case of emergency and Power plant maintenance) will be grid supply. All the electricity imported from the grid will be monitored.

The power plant is expected to run 365 days a year at a gross plant load factor (PLF) of 59.30% producing 33,584 MWh of electricity. 1.5% of the gross generation is used up as auxiliaries for station service which comes out to be 504 MWh. These auxiliaries are deducted from gross generation to arrive at a net electricity generation of 33,080 MWh. It is assumed that there will be no import of electricity from the grid except for start up of the power plant. However, all electricity import will be accounted in to calculate *the quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity ($EG_{BL,,y}$) .*

In order to calculate baseline emission, EGAT will monitor the electricity supplied to the grid ($EG_{export,y}$) and the electricity purchased from the grid ($EG_{import,y}$) for the project activity, and from these two data, the net grid-connected electricity generation($EG_{BL,y}$) will be calculated ($EG_{BL,y} = EG_{export,y} — EG_{import,y}$).

Turbine and generator installed in the project activity are new machines with average lifetime of 30 years

The main technical parameters are as below:

Table 1[3]

Turbine	UNIT I
Type	GZJG502-WZ-275
Rated Power	6.7 MW
Rated Head	13.5 m
Rated Flow	55 m^3/s
Rated Speed	187.5 r/min
Runaway Speed	534 r/min
Layout Type	Horizontal Axis (S- Type)

[3] Source: Contract between EGAT and ST Power Engineering Corp. Ltd.

Manufacturer	LingLing Heng Yuan Generating Equipment Co., Ltd.

Generator	UNIT I
Type	SFW6465-32/3450
Rated Capacity	7,606 kVA
Rated Power	6,465 kW
Rated Voltage	6,600V
Rated Current	665.34 A
Rated Frequency	50Hz
Manufacturer	LingLing Heng Yuan Generating Equipment Co., Ltd.

The monitoring equipments for the project activity are comprised of 2 electricity meters which are 1 main meter (for parameter $EG_{export,y}$ and $EG_{import,y}$) and 1 back up meter (for parameter $EG_{export,y}$ and $EG_{import,y}$) as indicated below;

Table 2

Monitoring equipment	Accuracy class	Location
1. Main electricity meter for parameter $EG_{export,y}$ and $EG_{import,y}$	0.2	The electricity meter is located in the control room
2. Back up electricity meter for parameter $EG_{export,y}$ and $EG_{import,y}$	0.2	The electricity meter is located in the control room

A.4. Parties and project participants

Party involved (host) indicates host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Thailand (Host)	Public Entity: Electricity Generating Authority of Thailand	No

A.5. Public funding of project activity

>> The project activity has received no public funding and there is no diversion of the Official Development Assistance (ODA) funds.

A.6. Debundling for project activity

>> Appendix C, paragraph 2 and 3 of the Simplified Modalities and Procedures for Small-Scale CDM project activities states:

"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:

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

The project proponent confirms that there are no other small-scale CDM projects with the same project participants that have been registered within 1 km of the project boundary of the proposed small-scale activity within the previous 2 years.

Furthermore, it is confirmed that the proposed project activity is not a debundled component of a large scale project activity.

SECTION B. Application of selected approved baseline and monitoring methodology and standardized baseline

B.1. Reference of methodology and standardized baseline

>> The approved baseline and monitoring methodology used for this project activity is AMS-I.D "Grid connected renewable electricity generation", version 17[4]

Methodology also refers to following tool:
Version 02.2.1 - Tool to calculate the emission factor for an electricity system (EB 63)[5];
Version 5 - Guidelines on the Assessment of Investment Analysis (EB 62)[6]

Reference: Guidelines on the Demonstration of Additionality of Small-scale project version 09.0 (EB 68, Annex 27)[7]

B.2. Project activity eligibility

>> Project type: Type I
Category: D
The proposed small scale project activity meets the eligibility criteria as proposed in approved baseline methodology AMS I D, Version 17. Applicability of the methodology is justified as below:

Table 3

	Applicability criteria	Justification
1	This category comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass that supply electricity to a national or a regional grid.	The project activity is the generation of hydro power that will be fed into the national grid.
2	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 proposed project activity consists of the installation of a new power plant at a site where there was no renewable energy power plant operating prior to its implementation and, therefore, it falls under item (a) and it is eligible to apply this methodology.
3	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 the reservoir; - The project activity is implemented in an existing reservoir, where the volume of reservoir is	The proposed project activity is implemented on an existing reservoir with no change in the volume of reservoir.

[4] http://cdm.unfccc.int/methodologies/SSCmethodologies/approved

[5] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.2.1.pdf

[6] https://cdm.unfccc.int/Reference/Guidclarif/reg/reg_guid03.pdf

[7] https://cdm.unfccc.int/Reference/Guidclarif/meth/methSSC_guid05.pdf

	increased and the power density of the project activity, as per definitions given in the Project Emissions section, is greater than 4 W/m2; - The project activity results in new reservoirs and the power density of the power plant is greater than 4W/m2.	
4	"In the case of biomass power plants, no other biomass types than renewable biomass are to be used in the project plant.	This project does not consist of biomass power plant. This is not applicable.
5	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 only to the renewable component. If the unit cofires fossil fue1, the capacity of the entire unit shall not exceed the limit of 15 MW	The project does not incorporate a mix of renewable and non-renewable components. The project involves the installation of a turbine of 6.7 MW and a generator of 6.465 MW thus remaining under the 15 MW limit required by the methodology.
6	"Combined heat and power (co-generation) systems are not eligible under this category.	The proposed project consists in new hydro power plant and, hence, it is not a combined heat and power (co-generation) system.
7	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 15MW and should be physically distinct from the existing units.	There was no power generation on site before the project activity hence this paragraph is not applicable.
8	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.	There is no existing power generation on the site of the project activity thus negating this condition.

Therefore, according to the criteria and conditions mentioned above, the project activity will remain under the limits and it qualifies as a small-scale project activity.

B.3. Project boundary

According to the baseline methodology

The project boundary encompasses the physical, geographical site of the renewable generation source

The project boundary includes the equipments installed for the operation of a new hydro power plant – the main elements of which are the turbine generator and the transformers.

In terms of gases, the project boundary is restricted to CO2. For the purpose of the project activity the relevant grid is defined by the power generating units serving the same grid as the project activity. The boundary for the calculation of the grid emission coefficient is the Thai national grid.

The below diagram clearly explains the project boundary of the project activity

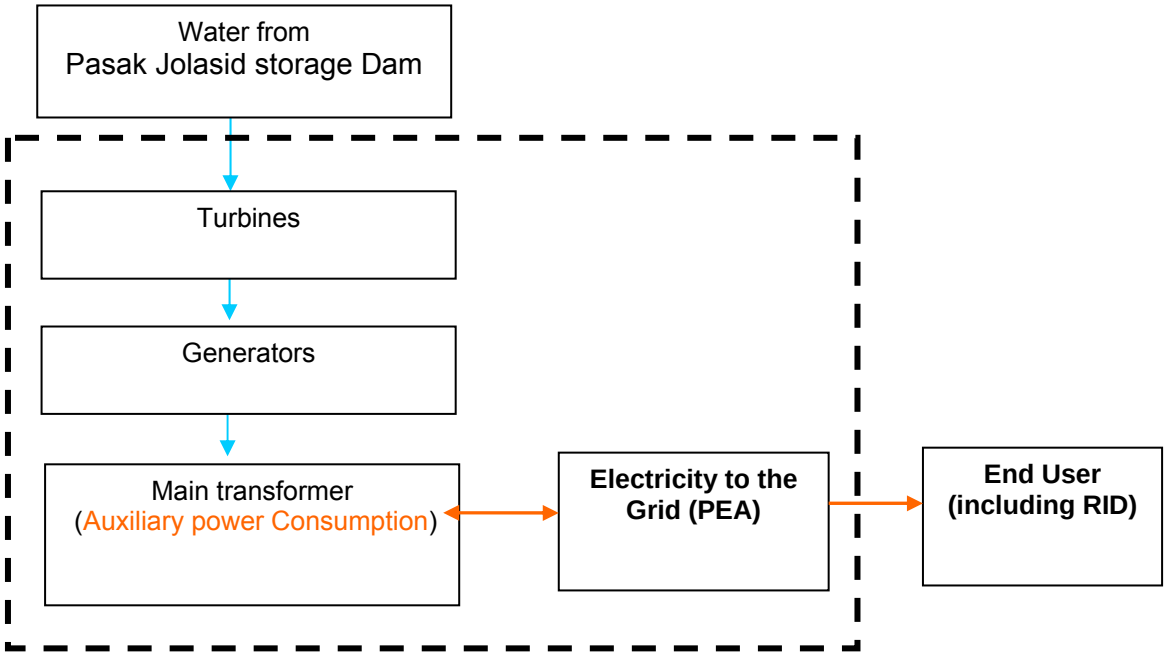


Figure 3 Project Boundary

B.4. Establishment and description of baseline scenario

>> As the project activity is the installation of renewable energy generation units and it is supplying electricity to Thai grid, according to Para 11 and 12 of approved methodology of AMS-I.D., Version 17, baseline scenario is *the electricity delivered to the Thai 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 into the grid.*

The baseline emissions are the product of electrical energy baseline $EG_{BL,y}$ expressed in MWh of electricity produced by the project activity multiplied by the grid emission factor.

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

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)
$EF_{CO2,grid,y}$	Thai grid CO_2 Emission Factor in year y, (tCO_2/MWh)

The Emission Factor is 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 kg CO2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

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

The project proponent has opted for approach 'a' i.e. combined margin emission factor and desired to keep the emission factor constant throughout the crediting period for the sake of adopting more simple approach for calculation of emission reductions.

The emission factor has been fixed ex-ante for the crediting period and has been calculated according to the Tools of CDM UNFCCC website.

Key Information and Data Used to Determine the Baseline Scenario[8]

	tCO_2/MWh
Simple OM, $EF_{OM, y}$	0.543
Build margin $EF_{BM, y}$	0.569
Combined margin, EF_y	**0.556**

B.5. Demonstration of additionality

>> In line with the *Guidelines on the Demonstration of Additionality of Small-scale project version 09.0 (EB 68, Annex 27)*, the Project is deemed to be additional if it faces at least one of the following barriers:
(a) Investment barriers
(b) Technological barriers
(c) Barrier due to prevailing practice
(d) Other barriers

The most important barrier to the incorporation of the Project Activity is the investment barrier.

Investment Barrier:

The main barrier to the project is the investment barrier. To analyze the feasibility of the project, the project proponent has conducted an Equity internal rate of return (IRR) analysis for the project activity. Since the project is 100% equity financed, PP has considered equity IRR as suitable financial indicator.

Suitability of benchmark:

Paragraph 12 of *"*Guidelines on the Assessment of Investment Analysis" (EB 62, Annex 5) states:
In cases where a benchmark approach is used the applied benchmark shall be appropriate to the type of IRR calculated. Local commercial lending rates or weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR. ***Required/expected returns on equity are appropriate benchmarks for an equity IRR.*** *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.*

Since both public and private companies can develop hydro power project in Thailand, benchmark shall be based on the parameters that are standard in the market. The equity IRR is selected as the financial indicator to demonstrate additionality of the project.

Benchmark:

The Cost of Equity has been calculated based on parameters which are standard in the market and which were available at the time of the board decision (10th Jan 2008). The average cost of equity financing is calculated from the formula from the Stock Exchange of Thailand (SET)[9] website.

Calculation details

[8] Detail calculation is in Appendix 4

[9] http://www.set.or.th/en/market/market_statistics.html

EGAT is a power generation company and hence will be categorized under Energy & Utilities sector of SET index. The general stock market sector Energy and Utilities includes 26 companies involved in a diverse range of activities which includes: operation of water pipeline systems, manufacturing of electrical equipment, aviation fuel services, manufacturer/distribution of petroleum based products and petroleum fuel refining/sales. For the purpose of calculating the benchmark, only companies involved in the production/sale of electricity have been included in the list of companies. Companies involved in manufacturing, petroleum fuel refining, water pipeline management, etc. are excluded because they do not face the same risk profile as the project activity.

Formula: ROE = Net profit after taxes year n ÷ [(Equity year n-1+Equityyear n)/2][10]

Table 4

Listed Electricity Generation Companies in Thailand[11]					
Symbol	**Company**	**ROE 2005**	**ROE 2006**	**ROE 2007**	**Average**
BANPU	Banpu Public Company Limited	24.73%	16.32%	21.87%	20.98%
EGCO	Electricity Generating Public Company Limited	13.83%	18.14%	21.89%	17.95%
GLOW	Glow Energy Public Company Limited	17.08%	21.76%	17.26%	18.70%
RATCH	Ratchaburi Electricity Generating Holding Public Co.	20.24%	18.45%	16.15%	18.28%
SCG	Sahacogen (Chonburi) Public Company Limited	18.81%	20.70%	16.59%	18.70%
SPCG	SPCG Public Company Limited	22.32%	26.43%	8.14%	18.96%
	3 YEARS AVERAGE:	19.50%	20.30%	16.99%	**18.93%**

The calculated ROE is 18.93% over the three years[12] prior to the decision to invest in the project (2005-2007). The benchmark obtained from the above calculation is consistent with paragraph 13 of the investment guideline.

"In the cases of projects which could be developed by an entity other than the project participant the benchmark should be based on publicly available data sources which can be clearly validated by the DOE. Such data sources may include local lending and borrowing rates, equity indices, or benchmarks determined by relevant national authorities."

In addition, the return on equity for EGAT's recent build power plants[13] is approximately 30%.

However, in the webhosted PDD, the benchmark was mentioned as 13.21% which is calculated based on data from third party consultant (Stern Stewart & Co.) and Thai Bond Market, thus to be conservative, this benchmark has been used for analysis.

The cost of equity (13.21%) has been determined based upon the Capital Asset Pricing Model (CAPM).

$$R_e = R_f + \beta_l (MRP)$$

Where:

[10] This formula is obtained from http://www.set.or.th/th/market/files/SET_Formula_Glossary.pdf (page 15)

[11] Source: http://www.set.or.th/en/company/companylist.html

[12] Annual Report of Glow Energy Public Company Limited and SPCG Public Company Limited are not publicly available for year 2003 and hence 5 yr average is not calculated.

[13] Songkla Combined Cycle power plant project and South Bangkok combined cycle power plant project

R_e	Expected return on equity
R_f	Risk free return on an investment
B_l	Equity Beta (levered)
MRP	Market Risk premium

Table 5

No.	Parameter	Symbol	Value	Source
1	Risk free return on investment	R_f	5.07%	Thai Government Bond yield (http://www.thaibma.or.th)
2	Market risk premium	MRP	8.00%	Report prepared by Stern Stewart & Co.
3	Equity Beta (unlevered)	B_u	0.50	Report prepared by Stern Stewart & Co.
4	Equity Beta (levered)	B_l	1	Calculated [14]
5	Debt Equity Ratio	D/E	1.48	Report prepared by Stern Stewart & Co.
6	Tax Rate	t	30%	Corporate tax rate in Thailand
7	Cost of Equity	R_e	13.21%	Calculated

Using the above values we arrive at a cost of equity of **13.21%** as a conservative and appropriate benchmark for the project activity.

The parameters of Investment Analysis have been produced in the table below:

Table 6

Parameter	Unit	Value	Source
Total Investment	THB 1000	336,810	FSR (excluding financing fee)
Construction Period	Yrs	3	FSR
Operation & maintenance cost	THB 1000/annum	5,392	EGAT estimate based on “Prasae hydro project Feasibility Study”
Escalation in O&M Cost	%	Nil	Conservative assumption
RID Payment	THB 1000/annum	13,064	MoU signed between Royal Irrigation Department (RID) and EGAT on 17-Apr-07.
Insurance	%	0.75% of Investment Cost	EGAT insurance cost for “Songkla Combined Cycle power plant project”
Interest on Working Capital	THB 1000/ annum	470	Assumption: Interest on 1 month of electricity sales
Working Capital Interest Rate	%	7.21%	Annual average Min. Lending Rate
Land Rent	THB 1000/annum	224	Letter from Office of Lopburi Area Treasury regarding Land rent before board decision date
Community development fund			NEPC Resolution Document
- Cost during Construction	THB/MW	50,000	NEPC Resolution Document
-Cost during Operation	THB/ MWh	20	NEPC Resolution Document
Equity	%	100	EGAT announcement and "Public debt management Plan for fiscal year 2008" dated 19-Oct-07 from EGAT.
Project Life Time	Yrs	30	EGAT contract with RID for water use

[14] Levered Beta is calculated from the formula: levered beta = Unlevered Beta * [1 + (1 - Tax Rate) * Debt / Equity]

Depreciation	Method	Straight line method	EGAT annual report
Salvage Value	THB 000	Nil	EGAT annual report
Tax	%	30	Thailand corporate tax rate
Tariff	THB/kWh	2.30	EGAT Time of Use (ToU) document
CER price	US$/CER	22.09	Calculated: Annual average issued CER price from GTZ monthly report
Exchange Rate	THB/US$	32.14	Calculated: Average annual exchange rate from www.oanda.com
Annual average CERs	tCO2/year	18,392	Calculated
Benchmark	%	13.21%	Calculation based on data from 3rd party Consultant "Stern Steward & Co., Ltd" and Thai Bond Market.

In the analysis of the revenues we have calculated the net export of electricity to the grid, based on which the project activity will be paid. Applying the applicable electricity tariff of THB 2.30 per kWh to the resultant exports provide the revenues for the project activity. This tariff is fixed for the life of the project. The electricity generation parameters are as follows:

Table 7

Electricity generation	
Capacity, MW	6.70[15]
PLF %	59.30%
Annual generation, MWh	34,804
Electricity to RID, MWh	250
Auxiliaries, %	1.50%
Exports, MWh	34,282

Adopting the above mentioned assumptions, the cash flow has been calculated for a period of 30 years. The ROE is calculated based on nominal values. The analysis arrives at **equity IRR of 10.12%** without considering the revenues from the CDM and the benchmark considered is 13.21%. It is therefore clearly demonstrated that the project activity is not a financially attractive course of action on a business-as-usual basis being below the expected equity return of 13.21%.

Plant load factor:

As per EB 48 annex 11, the plant load factor shall be defined ex-ante in the CDM-PDD according to one of the following three options:

(a) The plant load factor provided to banks and/or equity financiers while applying the project activity for project financing, or to the government while applying the project activity for implementation approval;
(b) The plant load factor determined by a third party contracted by the project participants (e.g. an engineering company);

PLF has been calculated by Civil & Hydro Engineering Division of EGAT based on the historical discharge data from Royal Irrigation Department and simulated by specific spreadsheet program. This PLF has been submitted to Cabinet (*government organization*) for *project implementation approval process.* The calculated PLF is 59.30%. Moreover, PLF has also been verified by an independent third party engineer (member of Council of Engineers, Thailand).

[15] Actual capacity of the generator is 6.465 MW. However, FSR was prepared based on the capacity of 6.70 MW and hence IRR has been calculated based on 6.70 MW to be conservative.

The PLF of 59.30%, however, is an upper end figure. It is quite challenging to run the plant at this load factor due to the limited water availability. This is because the Royal Irrigation Department (RID) has the sole ownership of the existing Pasak Jolasid dam on which the power plant is implemented. The dam was being built for irrigation and flood control purposes. Therefore, the RID controls the volume released to the power plant even though it is below the optimum capacity required to run the power plant. Hence the load factor of 59.30% is considered very optimistic.

Sensitivity analysis

The sensitivity analysis has been done in accordance with EB 62, Annex 5 '*Guidelines on the Assessment of Investment Analysis (version 05)'* paragraph 20 and 21. As per the tool the project's viability is evaluated through a change of ±10% in the parameters which have a major impact on the returns from the project:

1. Initial investment cost
2. Electricity tariff
3. Plant load factor
4. Recurring cost

1. The hydro project is expected to have investment cost over runs due to increase in the development period. Thus, in line with the tool ±10% changes have been given to the initial investment cost.

Initial Investment cost	**-10%**	**Base Case**	**+10%**
IRR Without CDM	11.25%	10.12%	9.14%

The IRR without CDM crosses the benchmark if the investment cost decreases by 24%. However, it should be noted that the Investment cost is unlikely to reduce by 24%.

2. The electricity tariff has also been given ±10% sensitivity since it has a major impact on the project returns.

Electricity tariff	**-10%**	**Base Case**	**+10%**
IRR Without CDM	8.68%	10.12%	11.48%

The electricity tariff of 2.30 THB/kWh considered in the financial analysis of the project activity has been taken from the most recent published TOU document of EGAT which was published on 1st Oct 2005 based on which PPA was signed on 22nd Dec 2005 to sell EGAT's electricity to PEA. With an increase in electricity tariff by 24% (2.85 THB/kWh) the project IRR becomes 13.28% and thus crosses the benchmark applied for the project activity. However, it is unlikely that tariff could increase by 24% as no fuel cost is involved for hydro power projects.

3. The output in a hydro project is mainly dependent on the flow and availability of water and hence the PLF. Since PLF has a significant effect on the financial returns of the project, these have been varied by ±10%.

PLF	**-10%**	**Base Case**	**+10%**
IRR Without CDM	8.68%	10.12%	11.47%

The IRR without CDM reaches the benchmark if the PLF increases by 24% i.e. PLF of 73.53%. However such a situation is not expected to occur as the PLF has already been calculated based on historical discharge data recorded by the Royal Irrigation Department and has also been certified by a third party chartered engineer.

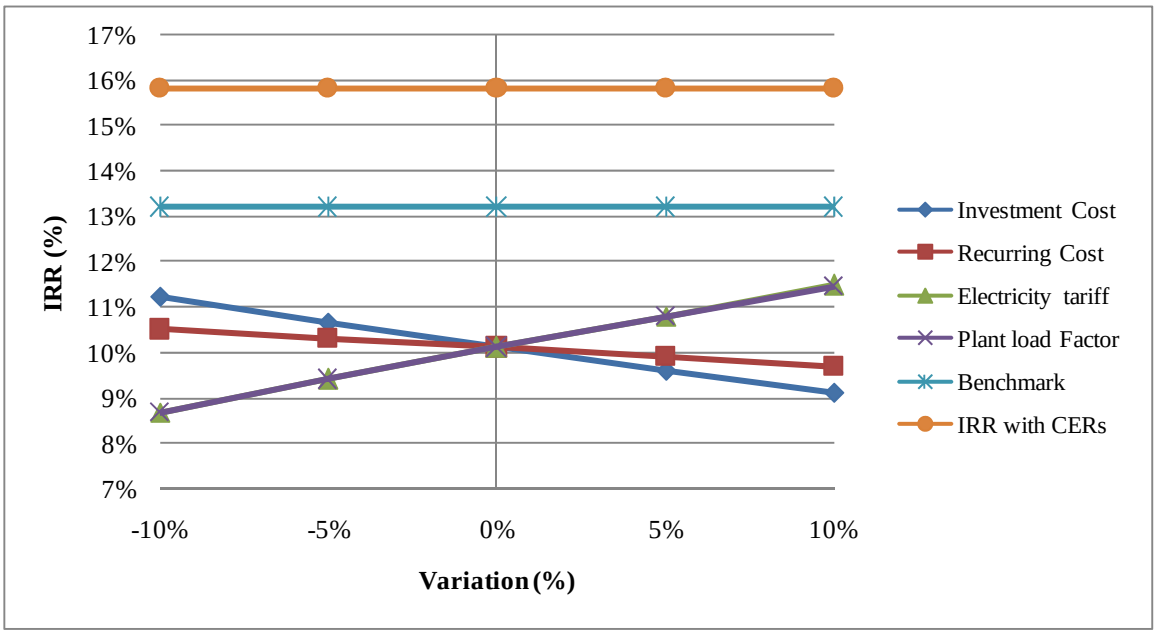
4. The Recurring costs include O&M cost, payment to RID for water usage, insurance, interest on working capital, land rent, community development fund. It has also been given a ±10% sensitivity since it has impact on the project returns.

Recurring Cost	-10%	Base Case	+10%
IRR Without CDM	10.52%	10.12%	9.71%

If the Recurring cost is reduced to nil, the IRR is 13.89% and crosses thebenchmark. This is a highly unrealistic situation since these operational expenses are required to be incurred to run a power plant.

The above results have been shown graphically below and it is evident that the project is not financially viable without the CDM revenues. The registration of the project activity as a CDM project and obtaining carbon finance helps mitigate these risks and CDM is thus a deciding factor in proceeding with the project.

Graph 1 Sensitivity



Power Generation Scenario in Thailand– Prevailing practice

It is important to highlight some salient features of electricity generation in the country. Thailand is one of the fastest developing economies in the region and rapid growth in the GDP has lead to increased power demand every year. The total national installed capacity in 2007 was 28,815MW, up by 5.5% from the previous year.[16]

Table 8

2007

	Installation		Generation	
Installed capacity	MW	%	GWh	%
Combined cycle	12,238	43.30%	69,648	49%

[16] http://www.dede.go.th/ (Electricity Power in Thailand 2007 Report)

Thermal power plant	9,297	32.90%	50,123	35%
Hydro	3,475	**12.30%**	8,114	**5.66%**
Cogeneration power plant	2,388	8.40%	14,545	10%
Gas turbine power plant	847	3.00%	901	1%
Diesel power plant	29	0.10%	30	0%
Gas Engine	8	0	14	0%
Others	3	0	3	0%

The above figures clearly demonstrate that the installed capacity of hydro power plants is merely 12%. The total electricity generated by the hydro power plants accounts only for the 5.7% of the national grid generation as opposed to approximately 49% and 35% by the combined cycle and thermal power plants respectively. It is evident that fossil fuel based power plants have a significant share in the country's power generation in comparison to hydro power plants that have a small share. Furthermore, the 15 year power development plan of Thailand states that natural gas, coal fired and nuclear power plants will constitute a majority of future generation capacity.[17]

The above statistics highlight the lack of initiatives and investments in the hydro power sector. It is therefore imperative to promote such projects with the help of benefits from the CDM.

What is more is that it has been several years since EGAT has built new hydro power plants, the last one of which was constructed in 1992. Difficulty in justifying investments in hydro power plants in the country has been one of the main reasons for EGAT not to venture into such projects.

Therefore, despite the prevailing practice EGAT has taken the initiative to set up the hydro power plants with the aim of generating clean energy which will help in the reduction of global GHG emissions. The power generated from these projects will help in meeting the ever increasing power demand of the country.

CDM Consideration

Since the start date of the project activity is after 2nd August 2008, the project proponents have notified the Designated National Authority (DNA) of Thailand within 6 months of the start date about their intention to seek CDM status as per '*guidelines on the demonstration and assessment of prior consideration of the CDM, Annex.46, EB 41'*.This guideline was the applicable guideline during the project start date (16/12/2008) as per which PP had to notify either the UNFCCC or the DNA. Hence, EGAT has informed the DNA on 27/11/2008. Supporting communication with Host country DNA has been provided to DoE for validation.

The start date of a project is defined in the CDM Glossary of terms as follows:
'*the start date shall be considered to be the date on which the project participant has committed to expenditures related to the implementation or related to the construction of the project activity. This, for example, can be the date on which contracts have been signed for equipment or construction/operation services required for the project activity.*'

The first contract associated with implementation/construction of the project was the EPC agreement (work order) signed on 16/12/2008 with ST Power Engineering Corp., Ltd. This is considered as the project start date. In relation to this start date, prior consideration of CDM is demonstrated as follows:

[17] http://uk.reuters.com/article/oilRpt/idUKBKK33166120070409 (accessed on 22/01/2013)

A detailed project timeline is provided below which demonstrates by means of reliable evidence, that continuing and real actions were taken to secure CDM status for the project in parallel with its implementation.

Table 9

Date	Key event	Evidence/Remarks
07-Nov-06	Creating CDM committee and members.	EGAT order No. 2549/95
17-Aug-07	Announcement of Guideline to develop CDM project to reduce GHG	Announcement Report Copy 18/2550
10-Jan-08	Board Meeting about developing the proposed project activity as pilot CDM project along with a solar project and four more hydro projects. (Board decision date)	Board Minutes of meeting Copy
03-Apr-08	Submission of the CDM consultation proposal from Agrinergy	The CDM consultation proposal submitted by Agrinergy.
May-Jul 08	Agreement discussed with CDM consultant	Emails/Letters exchanged
09-Sep-08	Agreement executed with a CDM consultant	The CDM consultation agreement with Agrinergy.
27-Nov-08	Prior CDM consideration Letter sent to TGO (Thai DNA) for hydro projects whose start date is after 2 Aug 2008	Letter of Intent (LoI) copy
11-Dec-08	TGO respond for LoI	TGO response copy
16-Dec-08	**(Official CDM Project Start date)**	
16-Dec-08	Start of procurement of equipments	EPC contract agreement with ST Power Engineering Corp., Ltd.
04-Feb-09	EGAT's hydro CDM project has been announced as the stakeholder notice	Naewna newspaper article
23-Mar-09	Meeting at OrBorTor Nong Bua in Lopburi Province with local representatives	Public Consultation Report
Aug-09	Completion of the Initial Environmental Evaluation (IEE) report	The IEE report.
Events related to validation		
31-Aug-09	Agreement with DOE (Tuv Nord)	Validation Agreement
12-Sep-09	PDD web hosted on UNFCCC	
19-23 Nov 09	Desk Review & Site Visit	
24-Mar-10	Host Country Approval	HCA letter from DNA (TGO)

B.6. Emission reductions

B.6.1. Explanation of methodological choices

>> Baseline Emissions (BE_y)

In line with paragraph 11 of the methodology, the baseline emissions have been calculated by the following formula:

$$BE_y = EG_{BL,y} * EF_{CO2,grid,y} \qquad \textit{Equation 1}$$

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)
$EF_{CO2,grid,y}$	Thai grid CO_2 Emission Factor in year y, (tCO_2/MWh)

Since the carbon dioxide emission factor determined in section B4 has been fixed ex-ante, this equation may be simplified to the following:

$$BE_y = EG_{BL,y} * 0.556 \qquad \textit{Equation 2}$$

Project emissions

Accordingly to the methodology AMS-I.D. version 17 para 20, *for most renewable energy activities, PE_y = 0. However, for the following categories of project activities, project emissions have to be considered following the procedure described in the most recent version of ACM0002.*

- *Emissions related to the operation of geothermal power plants (e.g. non-condensable gases, electricity/fossil fuel consumption)*
- *Emissions from water reservoirs of hydro power plants*

Following ACM0002 version 13.0.0, *Emissions from water reservoirs of hydro power plants ($PE_{HP,y}$)*
The project emissions from reservoirs of the hydro power plant are zero as the project activity does not result in new reservoir or in the increase in the capacity of the existing reservoir. Thus,

$$PE_{HP,y} = 0 \qquad \textit{Equation 3}$$

Leakage

The methodology in para 22 specifies

If the energy generating equipment is transferred from another activity, leakage is to be considered

No equipment transfer takes place thus no leakage is considered in the project activity.

Emission Reductions

$$ER_y = BE_y - PE_y - LE_y \qquad \textit{Equation 4}$$

Where:

ER_y	Emissions reductions in year y, (t CO_2/y)
BE_y	Baseline Emissions in year y, (t CO_2/y)

PE_y Project emissions in year y, (t CO_2/y)
LE_y Leakage emissions in year y, (t CO_2/y)

Since project emission and leakage values are zero, the above equation reduces to:

$$ER_y = BE_y \qquad \textit{Equation 5}$$

Substituting the value of BE_y from equation 2 emission reductions value becomes:

$$ER_y = EG_{BL,y} * 0.556 \qquad \textit{Equation 6}$$

B.6.2. Data and parameters fixed ex ante

Data / Parameter	$\mathbf{EF_{grid,OM}}$
Unit	tCO_2/MWh
Description	Simple Operating Margin
Source of data	All data used to calculate the emissions factor is publically available and detailed in Appendix 4. Data for electricity production and fuel use of power plant in the Thailand Grid is available from the Thailand Department of Alternative Energy Development and Efficiency (DEDE) for the years 2006, 2007 and 2008. Additional information for Small Power Producer (SPP) plants is available from the Thailand Energy Policy and Planning Office, Ministry of Energy.
Value(s) applied	0.543
Choice of data or Measurement methods and procedures	For full details of the choice of data and methods applied refer to Appendix 4
Purpose of data	Calculation of baseline emissions
Additional comment	This parameter has been fixed ex-ante for the crediting period

Data / Parameter	$\mathbf{EF_{grid,BM}}$
Unit	tCO_2/MWh
Description	Build Margin
Source of data	All data used to calculate the emissions factor is publically available and detailed in Appendix 4. Data for electricity production and fuel use of power plant in the Thailand Grid is available from the Thailand Department of Alternative Energy Development and Efficiency (DEDE) for the years 2006, 2007 and 2008. Additional information for Small Power Producer (SPP) plants is available from the Thailand Energy Policy and Planning Office, Ministry of Energy.
Value(s) applied	0.569
Choice of data or Measurement methods and procedures	For full details of the choice of data and methods applied refer to Appendix 4
Purpose of data	Calculation of baseline emissions
Additional comment	This parameter has been fixed ex-ante for the crediting period

Data / Parameter	$\mathbf{EF_{grid,CM}}$
Unit	tCO_2/MWh

Description	Carbon emissions factor for the Thailand grid
Source of data	All data used to calculate the emissions factor is publically available and detailed in Appendix 4. Data for electricity production and fuel use of power plant in the Thailand Grid is available from the Thailand Department of Alternative Energy Development and Efficiency (DEDE) for the years 2006,2007 and 2008. Additional information for Small Power Producer (SPP) plants is available from the Thailand Energy Policy and Planning Office, Ministry of Energy.
Value(s) applied	0.556
Choice of data or Measurement methods and procedures	For full details of the choice of data and methods applied refer to Appendix 4
Purpose of data	Calculation of baseline emissions
Additional comment	This parameter has been fixed ex-ante for the crediting period.

B.6.3. Ex ante calculation of emission reductions

>> As mentioned in section B.6.1, project emission (PE_y) and Leakage (LE_y) are zero.

Baseline Emissions

The hydro power plant is expected to operate for 365 days a year at a plant load factor of 59.30% generating *33,584 MWh* of power. Substituting the below values in equation 5 from section B.6.1, the emission reductions achievable by the project activity are *18,392 tCO_2/MWh*.

Table 10

S. No.	Parameter	Unit	Value
1	Plant capacity	MW	6.465
2	Operating days	Days	365
3	Operating hours	Hours	24
4	Plant Load Factor	%	59.30
5	Gross generation	MWh	33,584
6	Auxiliary consumption	%	1.5
7	Net generation available for export	MWh	33,080
8	Electricity Import	MWh	0
9	Grid emission factor	tCO_2/MWh	0.556
10	CER	tCO_2	18,392

$$ER_y = EG_{BL,y} * 0.556$$

$EG_{BL,y}$ is calculated as ($EG_{export,y}$ – $EG_{import,y}$).
The amount of the electricity delivered to the Grid from the proposed project activity ($EG_{export,y}$) is expected to be 33,080 MWh per year. The electricity imported ($EG_{import,y}$) from the Grid to the proposed project activity is expected to be 0.
Thus,

BE_y = $EG_{BL,y}$
= ($EG_{export,y}$ – $EG_{import,y}$)×$EF_{CO2,grid,y}$

ER_y = ($EG_{export,y}$ – $EG_{import,y}$) ×$EF_{CO2,grid,y}$
= (33,080 - 0)* 0.556
= 18,392 tCO_2e.

According to above description, the net grid-connected electricity is equal to deducting the power consumption and line loss from average annual electricity generation which is calculated under an ideal condition, but in fact, the net grid-connected electricity is affected by many factors, such as power dispatching, equipments maintenance, water flow etc., as a result, the actual net grid-connected electricity and emission reduction may be different with that estimated in the PDD.

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
01 Jul 2014-30 Jun 2015	18,392	0	-	18,392
01 Jul 2015-30 Jun 2016	18,392	0	-	18,392
01 Jul 2016-30 Jun 2017	18,392	0	-	18,392
01 Jul 2017-30 Jun 2018	18,392	0	-	18,392
01 Jul 2018-30 Jun 2019	18,392	0	-	18,392
01 Jul 2019-30 Jun 2020	18,392	0	-	18,392
01 Jul 2020-30 Jun 2021	18,392	0	-	18,392
Total	128,744	0	-	128,744
Total number of crediting years	7			
Annual average over the crediting period	18,392	0	-	18,392

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

In order to calculate emission of baseline, we need to monitor the electricity supplied to the grid ($EG_{export,y}$) and the electricity purchased from the grid ($EG_{import,y}$) for the project activity, and from these two data, the net grid-connected electricity generation($EG_{BL,y}$) will be calculated ($EG_{BL,y} = EG_{export,y} — EG_{import,y}$).

Data / Parameter	**$EG_{export,y}$**
Unit	MWh/yr
Description	Power supplied by the project activity to the grid in year y
Source of data	Measured value from electricity meter
Value(s) applied	33,080
Measurement methods and procedures	Measured continuously by using electricity meter (accuracy class 0.2). There is one main electricity meter and one back up electricity meter installed inside EGAT's control room. Consolidated reading is recorded in monthly basis.
Monitoring frequency	Measured continuously by using on-site electricity meter.

QA/QC procedures	The reading data from the electricity meter is recorded in the monthly report and it will be cross checked against the reading export meter report. The reading export meter report is an official document to confirm the quantity of power supplied as indicated in the PPA. In case of main meter failure, the data from back up meter will be applied in such period. The energy meter will be calibrated at least once in two year subject to national standards.
Purpose of data	Calculation of baseline emissions
Additional comment	All data will be kept for a minimum of 2 years following issuance of certified emission reductions or the end of the crediting period, whichever is later.

Data / Parameter	$\mathbf{EG_{import,y}}$
Unit	MWh/yr
Description	Power purchased by the project activity from the Grid in year y
Source of data	Measured value from electricity meter
Value(s) applied	According to the actual records
Measurement methods and procedures	Measured continuously by using electricity meter (accuracy class 0.2). There is one main electricity meter and one back up electricity meter installed inside EGAT's control room. Consolidated reading is recorded in monthly basis.
Monitoring frequency	Measured continuously by using on-site electricity meter.
QA/QC procedures	The reading data from the electricity meter is recorded in the monthly report and it will be cross checked against electricity invoice sent by PEA for electricity import. In case of main meter failure, the data from back up meter will be applied in such period. The energy meter will be calibrated at least once in two years subject to national standards
Purpose of data	Calculation of baseline emissions
Additional comment	All data will be kept for a minimum of 2 years following issuance of certified emission reductions or the end of the crediting period, whichever is later.

Data / Parameter	$\mathbf{EG_{BL,y}}$
Unit	MWh/yr
Description	Net electricity exported by the project activity in year y
Source of data	Energy meter readings from plant records
Value(s) applied	33,080
Measurement methods and procedures	$\mathbf{EG_{BL,y}}$ will be calculated by taking readings from the meter installed in the Control room. $EG_{BL,y,}$ is calculated as ($EG_{export,y} – EG_{import,y}$). $EG_{export,y}$ and $EG_{import,y}$ will be monitored continuously by the meter. This reading (export-import) will act as the basis for calculation of emission reductions.
Monitoring frequency	Continuously by the meter
QA/QC procedures	The meter will be calibrated as described in parameter $EG_{export,y}$ and $EG_{import,y}$
Purpose of data	Calculation of baseline emissions
Additional comment	All data will be kept for a minimum of 2 years following issuance of certified emission reductions or the end of the crediting period, whichever is later.

B.7.2. Sampling plan

>> All values of data and parameters to be monitored are not determined by sampling approach

B.7.3. Other elements of monitoring plan

>>

Section B.7.1 describes the data and parameters to be monitored. Monitoring shall consist of metering the export and import of electricity in the project activity. An internal audit will be carried out every year to ensure parameters are being monitored in accordance with the project PDD.

Monitoring Procedure

EGAT is well aware of the importance of having a good operational and management team in order to execute a well-defined monitoring plan for the project activity. So, it has an operational and management structure created exclusively for monitoring data. The responsibilities of data monitoring, archiving and analyzing will fall on different members of the monitoring team. This team will be composed of head office, power plant manager and shift supervisor. The shift supervisor will record the monitoring data. The power plant manager will cross-check the monitoring data and system to be properly functional and the head office will analyze the power plant performance through the monitoring data.

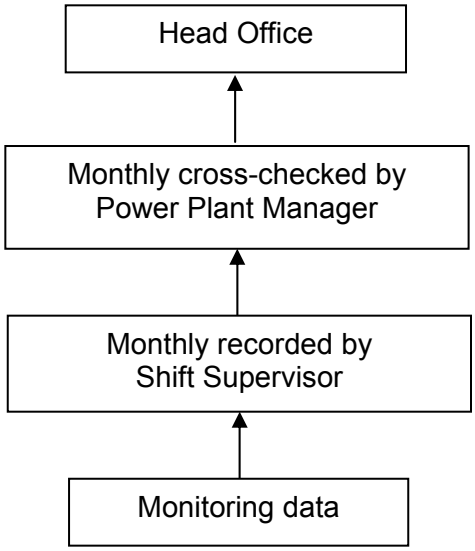


Figure 4 Data flow diagram

The suppliers of the equipments will train the staff in- charge during erection, to operate and maintain the equipments efficiently. Apart from this, the equipment supplier will provide complete manuals and documentation providing details for the maintenance schedule and the required activities associated with it.

The monitored data will be reported through EGAT to its head office on a monthly basis for the calculation and estimation of emission reductions. If the project is not performing as expected or if there are any negative impacts on the volume of emission reductions obtained, on the basis of the monthly data being monitored, a report will be sent to the project activity outlining where the project is deviating in its generation of emission reductions and the immediate measures which need to be undertaken to maintain the expected generation of emission reductions from the operation of this project.

At the end of each year of operation, a monitoring report will be prepared that will be submitted to a DOE for verification. All data will be kept for a minimum of 2 years following

issuance of certified emission reductions or the end of the crediting period, whichever is later, and the storage of this data will be the responsibility of the project developers.

B.8. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

>> 14/12/2009
Varsha Tripathi,
Agrinergy Pte Ltd.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>> 16/12/2008 (signing of the EPC contract)

C.1.2. Expected operational lifetime of project activity

>> 30 years and 0 month

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>> A seven year renewable crediting period has been chosen. This is the first crediting period.

C.2.2. Start date of crediting period

>> 01/07/2014

C.2.3. Length of crediting period

>> 7 years and 0 months.

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>> The implementation of the proposed hydro project has positive environmental impacts both globally and locally. In the global terms the positive impacts are outline as below:

1. A reduction in carbon dioxide emissions from the replacement of fossil fuels which would be generated under the baseline scenario.
2. A reduction in the emissions of other harmful gases (NO_x and SO_x) that arise from the combustion of coal in power generation.
3. No ash is generated in comparison to the baseline scenario.

The Local benefits to the environment as a result of the project activity can be summarised as follows:

Since hydro power generation is renewable and zero emission, no negative environmental impacts are expected with relation to the project activity in the local area surrounding the power plant.

The environmental impacts of the hydro project are minimal. Under MONRE rules an EIA is not required by the project activity. However, the Thailand DNA requires that an Initial Environmental Evaluation (IEE) be completed which includes an assessment of the project's environmental protection and improvement. The IEE has been completed and submitted to the Thai DNA.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>> For the project activity the local stakeholders have been conducted through consultation with the Director of Pasak Jolasid Dam on 06/05/2008. Thereafter, the Director of EGAT's hydropower projects and his team met Director of Irrigation Region 10, Lopburi to provide information on the CDM project. The meeting took place on 08/07/2008. Moreover a notice in a newspaper on 04/02/2009 has been published to highlight the CDM aspects of the project.

Furthermore, EGAT had a meeting with community leaders of Or Bor Tor Nong Bua, Lopburi Province to provide information on EGAT's hydropower projects. During the meet, the CDM aspect of the project was discussed. EGAT also mentioned that the construction of the Pasak Jolasid Hydropower Project would commence by 2009 end. The meeting was held at OrBorTor Nong Bua in Lopburi Province on 23/03/ 2009.

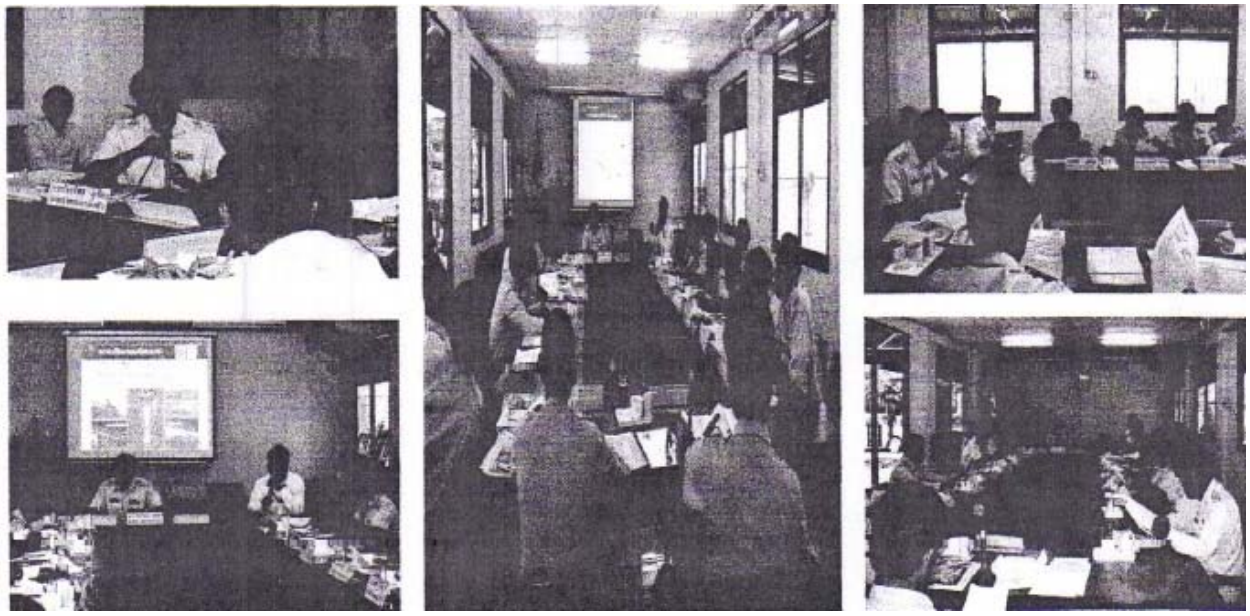


Figure 5 Stakeholder meeting 23 March 2009

E.2. Summary of comments received

>> No negative comments have been received in the meetings. The complete public consultation report has been provided to the DOE.

The stakeholders' comments and responses were measured through the questionnaire after the meeting had ended. The measurement has been completed statistically under satisfaction points method.

Using criteria index of agreement upon mentioned items in agenda:
4 = Excellent 3 = Good 2 = Fair 1 = To be improved

After the result had been calculated, the end result showed 80% satisfaction (3.20 of 4.0) which implies excellent, which means no negative comments had been mentioned.

Stakeholders' comments and suggestions

Comments
1) Suggest EGAT should be concerned to sustainably develop the project, suggest EGAT to cooperate with governor of local municipal on a campaign.
2) Suggest EGAT should make announcement through education centre within 1 km distance.
3) Suggest EGAT should form a committee in order to take care of any issue which might appear.
4) Suggest EGAT to develop the project activity's site to educational-tourism centre
5) Suggest EGAT should invite local people & students to observe and visit the project activity site.

Comments and suggestions have been brought to board meeting and relevant departments in order to find the most effective solution.

E.3. Report on consideration of comments received

>> There were no negative comments received in the stakeholder consultation and the local people welcomed the implementation of the project activity. Public consultation report has now been provided to the DOE.

SECTION F. Approval and authorization

>> The letter of approval from Thailand (Host country) for the project activity is available at the time of submitting the PDD to the validating DOE.

Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Electricity Generating Authority of Thailand
Street/P.O. Box	53 Moo 2, Charansanitwong Road
Building	
City	Bang Kruai, Nonthaburi
State/Region	
Postcode	11130
Country	Thailand
Telephone	+66-2-4361140
Fax	+66-2-4361190
E-mail	waraporn.k@egat.co.th
Website	
Contact person	Ms. Waraporn Kunawanakit
Title	
Salutation	Ms
Last name	Kunawanakit
Middle name	
First name	Waraporn
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Appendix 2. Affirmation regarding public funding

The proposed project do not available any public funding from Annex I countries.

Appendix 3. Applicability of methodology and standardized baseline

Referring to Section B.2 of PDD, the applicability criterions are met for the project activity.

List of support documents for project activity eligibility;
1. Energy control generation license issued by the Energy Regulatory Commission

This document is used to confirm the issues as listed below;

- The project activity can generate and export electricity to the grid (Applicability criteria 1)
- The project activity generates the electricity from hydro power (Applicability criteria 1, 4 and 6)
- The project activity is a Greenfield project (Applicability criteria 2, 7 and 8)
- The project activity is not involved to the volume of the reservoir (Applicability criteria 3)
- The project activity has one unit of turbine & generator at capacity of 6.7 MW and 6.465 MW respectively which is less than 15 MW (Applicability criteria 5)

Appendix 4. Further background information on ex ante calculation of emission reductions

Calculation of Thai Grid Emission Factor
As per the guidance given in the methodology, if the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline scenario is the following:

"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, as reflected in the combined margin (CM) calculations described in the *"Tool to calculate the emission factor for an electricity system".*

According to the methodology, the estimation is based on the calculation of - A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in "Tool to calculate the emission factor for an electricity system"[18].

In line with the tool, seven steps outlined for the determination of the emission factor has been followed.

STEP 1. Identify the relevant electricity systems.
STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional).
STEP 3. Select a method to determine the operating margin (OM).
STEP 4. Calculate the operating margin emission factor according to the selected method.
STEP 5. Calculate the build margin (BM) emission factor.
STEP 6. Calculate the combined margin (CM) emissions factor.

Step 1: Identify the relevant electric power system
For the purposes of defining the project electricity system, as the DNA has not published a delineation of the grid, Thailand national electricity grid is identified as the system boundary since there is only one grid electricity system in Thailand. For the purpose of determining the operating margin emission factor, the option of 0 tCO_2/MWh for net electricity imports from a connected electricity system will be chosen.

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional).
According to 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 is chosen to use in this calculation.

Step 3: Select a method to determine the operating margin (OM).
According to the *Tool to calculate the emission factor for an electricity system (version.02.2.1)*, the calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

(a) Simple OM, or

[18] EB 63, Annex 19, Tool to calculate the emission factor for an electricity system, Version 2.2.1

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

The determination of the operating margin emission factor ($EF_{grid,OM,y}$) is based on the Simple OM method (option a).

(a) The simple OM method is considered over other methods of calculating the operating margin because of dearth of relevant data as required by other methods.
(b) Simple adjusted OM: Because of commercialization of social development, grid data became more and more private of National power groups for business reason in Thailand. So the basic data of annual grid dispatch curve is hardly available neither regionally nor provincially, therefore option (b) cannot be used in this proposed project.
(c) Dispatch Data Analysis OM: Dispatch data analysis should be first methodological choice because it is the most conservative and accurate method to calculate Operation margin. However, in reality, it is very difficult to get concrete grid data of dispatch system. Therefore this option cannot be chosen.
(d) Average OM: The average emission rate method (d) can only be used where low-cost/ must run resources constitute more than 50% of total grid generation. Therefore option (d) is not selected.

The simple OM method (option a) can be applied as low-cost/must-run (LCMR) resources constitute less than 50% of total grid generation in; 1) average of five most recent years, or 2) based on long-term averages for hydroelectricity production. Table below presents the national grid generation by sources in Thailand for the 2004-2008 period (five most recent years for which data is available) and LCMR constitutes less than 50% of total grid generation:

Description	Year 2004	Year 2005	Year 2006	Year 2007	Year 2008
LCMR (GWh)	6,042	5,800	8,128	8,117	7,118
Total power generation (GWh)	112,213	118,495	125,011	128,819	132,781
% LCMR	5%	5%	7%	6%	5%
5-year average					**5.69%**

Low-cost/must-run resources represents only 5.69% of total grid emission in Thailand, hence the simple OM method can be applied.

We have chosen to apply the *ex-ante option*: 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, without requirement to monitor and recalculate the emission factor during the crediting period.

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

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. The two options for calculating the simple OM are assessed as follows:

Option A: Based on the net electricity generation and a CO2 emission factor of each power unit; or
Option B: Based on data on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

This option is used for the calculation of simple OM because the necessary data is available.

Using Option B, the simple OM is calculated as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i \left(FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}\right)}{EG_y}$$

Equation 7

Where:

$EF_{grid,OMsimple,y}$ Simple operating margin CO_2 emission factor in year *y* (tCO_2/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)

$EF_{CO2,i,y}$ CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/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 in Step 3

Classification	Fuel Type	Year 2006		Year 2007		Year 2008		Unit of Fuel Consumption
		Power Generation (GWh)	Fuel Consumption	Power Generation (GWh)	Fuel Consumption	Power Generation (GWh)	Fuel Consumption	
Non - LCMR	Natural Gas	86,339	764,215	88,166	783,137	94,549	812,620	MMscf
	Fuel Oil	8,350	2,030	3,646	936	1,454	350	million litres
	Diesel Oil	143	41	174	23	180	44	million litres
	Lignite	22,051	15,816	28,716	15,811	29,480	16,408	1000 tons
	Imported Coal		-		3,839		4,057	1000 tons
SPP and VSPP	Natural Gas	13,731	92,888	14,559	94,725	14,646	94,707	MMscf
	Fuel Oil		8.17		6.98		7.55	million litres
	Diesel Oil		0.44		1.25		1.45	million litres
	Lignite		9		893		-	1000 tons
	Imported Coal		1,341		6		970	1000 tons
Import	Hydro	5,152	-	4,488	-	2,784	-	-
LCMR	Hydro	8,125	-	8,114	-	7,113	-	-
	Renewable Energy	3	-	3	-	5	-	-
Total Non - LCMR + Import (including		135,766		139,749		143,093		

SPP & VSPP)							
Total Power Generation	143,894		147,866		150,211		

Type of Fuel	Unit of Fuel	NCV (TJ/unit)	EF_{CO2} (tCO_2/TJ)	Source
Natural Gas	MMscf	1.02	54.30	Net calorific value (NCV) and CO_2 emission factor ($EFCO_2$) of each fossil fuel type has been obtained from "Electric Power in Thailand 2008" (source: DEDE, page 42) and IPCC 2006 Guideline (Volume 2: Energy, Table 1.4), respectively
Fuel Oil	milliion litres	39.77	75.50	
Diesel Oil	milliion litres	36.42	72.60	
Lignite	1000 tons	10.47	90.90	
Imported Coal	1000 tons	26.37	89.50	

Total CO_2 emissions from fossil fuel consumption in yearly power generation are calculated in below table:

Type of Fuel	Unit of Fuel	Fuel Consumption (TJ)			CO_2 Emissions (tCO_2)		
		Year 2006	Year 2007	Year 2008	Year 2006	Year 2007	Year 2008
Natural Gas	MMscf	874,245	895,419	925,474	47,471,507	48,621,265	50,253,213
Fuel Oil	million liters	81,058	37,502	14,220	6,119,881	2,831,410	1,073,586
Diesel Oil	million liters	1,509	883	1,655	109,561	64,114	120,171
Lignite	1000 tons	165,688	174,891	171,792	15,061,016	15,897,581	15,615,871
Imported Coal	1000 tons	35,362	101,393	132,562	3,164,914	9,074,642	11,864,298

Simple operating margin CO_2 emission factor will be calculated as per equation (6)

Description	Year 2006	Year 2007	Year 2008	Unit
Total CO_2 emissions	71,926,879	76,489,012	78,927,140	tCO_2
Total Non - LCMR + Import	135,766,000	139,749,000	143,093,000	MWh
Simple OM emission factor	0.530	0.547	0.552	tCO_2/MWh
3-year average simple OM emission factor			**0.543**	**tCO_2/MWh**

Hence, **$EF_{grid,OM,y}$ = 0.543 tCO_2/MWh**

Step 5: Calculate the build margin (BM) emission factor.
In term of vintage of data, project participants can choose between one of the following two options:

Option 1: For the first crediting period, calculate the build margin emission factor ex ante based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of crediting period to the DOE. For the

third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2: For the first crediting period, the build margin emission factor shall be updated annually, ex post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emission factor shall be calculated ex ante, as described in Option 1 above. For the third crediting period the build margin emission factor calculated for the second crediting period should be used.

The Option 1 will be chosen for calculation of the build margin (BM) emission factor.

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

(a) Identify the set of five power units, 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);

(b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise of 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 determine their annual electricity generation ($AEG_{SET\geq 20\%}$ in MWh);

(c) From $SET_{5\text{-}units}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample});

Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin. Ignore steps (d), (e) and (f).

Otherwise:

(d) Exclude from SET_{sample} the power units which started to supply electricity to the grid more than 10 years ago. Include in that set the power units registered as CDM project activity, starting with power units that started to supply electricity to the grid most recently, until the electricity generation of the new set comprises of 20% the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) to the extent is possible. Determine for the resulting set ($SET_{sample\text{-}CDM}$) the annual electricity generation ($AEG_{SET\text{-}sample\text{-}CDM}$, in MWh);

If the annual electricity generation of that set is comprised at least 20% of the annual electricity generation of the project electricity system (i.e. $AEG_{SET\text{-}sample\text{-}CDM} \geq 0.2 \text{ X } AEG_{total}$), then use the sample group $SET_{sample\text{-}CDM}$ to calculate the build margin. Ignore steps (e) and (f).

Otherwise:

(e) Included in the sample group $SET_{sample\text{-}CDM}$ the power units that started to supply the electricity to the grid more than 10 years ago until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation);

(f) The sample of power units m used to calculate the build margin is the resulting set ($SET_{sample\text{-}CDM\text{->}10\ yrs}$)

Sub-step to identify sample group of power units *m*.

(a) The set of five power units, excluding power units registered as CDM project activity that started to supply electricity to the grid most recently

Plant Name	Commissioning Date	Fuel Type	Installed Capacity in 2008 (MW)	Generation in 2008 (MWh)[19]
Chana Power, unit 3	15/07/2008	Natural gas	250	
Chana Power, unit 2			230	3,754,000
Chana Power, unit 1			230	
Ratchburi power, Unit 2	1/6/2008	Natural gas	700	
Ratchburi power, Unit 1	1/3/2008		700	5,812,000
Total Generation of most recently power units				9,566,000

For the set of 5 most recently built power units ($SET_{5\text{-units}}$), the annual electricity generation ($AEG_{SET5\text{-units}}$) is 9,566,000 MWh.

(b) The set of power capacity additions that comprise 20% of the system generation, excluding power units registered as CDM project activity, in MWh that have been built most recently

Name of power plant	Plant type	Date of commissioning	Installed capacity in 2008 (MW)	Generation in 2008[20] (MWh)
1 Chana power, unit 3	Natural gas	15/07/2008	250	
2 Chana power, unit 2			230	
3 Chana power, unit 1			230	3,754,000
4 Ratchaburi power, unit2	Natural gas	1/6/2008	700	5,812,000
5 Ratchaburi power, unit1		1/3/2008	700	
6 Gulf Power Generation Co., Ltd.	Natural gas	1/3/2008	1,468	9,195,000
7 BLCP Co., Ltd. unit2	Coal	14/11/2006	673.3	
8 BLCP Co., Ltd. unit1		13/8/2006	673.3	10,801,000
Total Generation of SET>20% ($AEG_{SET>20\%}$)				**29,562,000**
Total generation in 2008 (AEG_{total})				**150,211,000**
Total % grid contribution				**20%**

(c) From sub-step (a) and (b) above, it can be concluded that $AEG_{SET>20\%}$ is larger than $AEG_{SET5\text{-units}}$. So the power units in (b) is set of sample (SET_{sample}). In addition, none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years. Sub-step (d), (e), and (f) are ignored.

The ex-ante option (Option 1) is chosen in this calculation: BM is calculated according to the most recent data available on units already built for sample group m at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emission factor during the crediting period.

The following equation is applied to determine the build margin emissions factor.

$$EF_{grid,BM,y} = \frac{\sum_{i,m} EG_{m,y} \times EF_{EF,m,y}}{\sum_{m} EG_{m,y}} \qquad \textit{Equation 8}$$

[19] Table 8, Existing national grid power plant in 2008, electric power in Thailand 2008, DEDE

[20] Table 8, Existing national grid power plant in 2008, electric power in Thailand 2008, DEDE

Where:

$EF_{grid,BM,y}$ Build margin CO2 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 power generation data is available.

According to the most recent available data on generation and efficiency of the cohort of power units released by the DEDE:

Name of power plant	Plant type	Commissioning Date	Capacity (MW)	Generation (MWh)	Efficiency (Btu/kWh)[21]	Effective CO2 emission Factor (tCO2/M Wh)	CO2 emission (tCO2)
1 Chana power, unit 3	Natural gas	15/07/2008	250	3,754,000	7,082	0.403	1,511,140
2 Chana power, unit 2			230				
3 Chana power, unit 1			230				
4 Ratchaburi power, unit2	Natural gas	1/6/2008	700	5,812,000	7,051	0.403	2,339,570
5 Ratchaburi power, unit1		1/3/2008	700				
6 Gulf Power Generation Co., Ltd.	Natural gas	1/3/2008	1,468	9,195,000	6,950	0.403	3,701,368
7 BLCP Co., Ltd. unit2	Coal	14/11/2006	673.3	10,801,000	9,100	0.859	9,280,170
8 BLCP Co., Ltd. unit1		13/8/2006	673.3				
	Total			29,562,000			16,832,248
EFgrid,BM,2008 (tCO2/MWh)							**0.569**

The CO_2 emission factor of each power unit m ($EF_{EL,m,y}$) is determined as per the guidance in step 4(a) for the simple OM, which using option A1 based on available data (data on fuel consumption and electricity generation from EGAT and Department of Alternative Energy Development and Efficiency (DEDE)

Hence, **$EF_{grid,BM,y}$ = 0.569 tCO_2/MWh**

Step 6: Calculate the combined margin emissions factor.

The calculation of the combined margin emission factor ($EF_{grid,CM,y}$) is is based on one of the following methods:

(a) Weighted average CM; or

(b) Simplified CM

The method (a) is chosen and the following equation is applied for the build margin emission factor calculation.

$$EF_{grid,CM,y} = EF_{grid,OM,y} * w_{OM} + EF_{grid,BM,y} * w_{BM} \qquad \textit{Equation: 9}$$

[21] Table 18, Electric generation efficiency by types of power plants in 2008, electric power in Thailand 2008

Where:

$EF_{grid,OM,y}$	Operating margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM}	Weighting of operating margin emissions factor (%)
w_{BM}	Weighting of build margin emissions factor (%)

Using default values set in the *Tool to calculate the emission factor for an electricity system Version 02.2.1,*

$W_{OM} = W_{BM} = 50\%$

Calculation of the combined margin

	tCO_2/MWh
Simple OM, $EF_{OM, y}$	0.543
Build margin $EF_{BM, y}$	0.569
Combined margin, EF_y	**0.556**

To conclude, the baseline emission factor is obtained from 50% weighted average of the operating margin (OM) and build margin (BM) emission factors. In calculating the OM emission factor, the Simple OM method is selected due to limited information available at the time. The OM emission factor is the generation weighted average emissions per electricity unit (tCO_2/MWh) of all generating sources serving the system, not including low-cost/must run power plants, on an average 3 most recent years where the data is accessible. The BM emission factor is calculated as the generation-weighted average emission factor (tCO_2/MWh) of a sample of power plants which comprise 20% of the system generation (in MWh) and that have been built most recently till 2008.

The result show that 3-year average OM emission factor of the years 2006 to 2008 is 0.543 and the BM emission factor of 2008 equals to 0.569. Therefore the baseline emission factor of the country's electricity system, on 50% weighted average of both emission factors, is 0.556tCO_2/MWh.

Appendix 5. Further background information on monitoring plan

Referring to section B.7 for details

Appendix 6. Summary of post registration changes

Summary of post registration changes is provided as following;

1. Description of "Purpose and general description of project activity" (section A.1)
   The description of the purpose and general description of project activity has been revised to reflect the "Instructions for filling out the project design document form for small-scale CDM project activities" of Project design document form for small-scale CDM project activities Version 08.0

2. Description of "Physical/Geographical location" (section A.2.4)
   The description of the physical/Geographical location has been revised to reflect the "Instructions for filling out the project design document form for small-scale CDM project activities" of Project design document form for small-scale CDM project activities Version 08.0

3. Runaway Speed of Turbine

Turbine	Specification in registered PDD	Post registration change
Runaway Speed	536 r/min	534 r/min
Manufacturer	-	LingLing Heng Yuan Generating Equipment Co., Ltd.

   Reason for the above change;
   The Runaway Speed has been revised to reflect the actual Runaway Speed. This change of project design does not require prior approval by the Board as it does not adversely impact to a) The applicability and application of the applied methodology and, where applicable, the applied standardized baseline under which the project activity has been registered, b) The additionality of the project activity, c) The scale of the project activity as indicated in Appendix 1 (6) of CDM project standard version 09.0. This change was occurred after completion of the project construction (02/07/2014) or after the registration date (01/02/2013).

4. Rated Capacity and Rated Current of Generator

Generator	Specification in registered PDD	Post registration change
Rated Capacity	7,265.9 kVA	7,606 kVA
Rated Current	799 A	665.34 A
Manufacturer	-	LingLing Heng Yuan Generating Equipment Co., Ltd.

   Reason for the above change;
   The Rated Capacity and Rated Current of the generator have been revised to reflect the actual specification. These changes do not increase the installed capacity of the project activity or amount of generated electricity due to both of them are depended on the Rated Power. Therefore these changes of project design do not require prior approval by the Board as it does not adversely impact to a) The applicability and application of the applied methodology and, where applicable, the applied standardized baseline under which the project activity has been registered, b) The additionality of the project activity, c) The scale of the project activity as indicated in Appendix 1 (6) of CDM project standard version 09.0. These changes were occurred after completion of the project construction (02/07/2014) or after the registration date (01/02/2013).

5. Technologies and/or Measures (Section A.3)
   This section has been revised to reflect the "Instructions for filling out the project design document form for small-scale CDM project activities" of Project design document form for small-scale CDM project activities Version 08.0

6. Reference of methodology and standardized baseline (Section B.1)
   The reference of the approved methodology AMS-I.D version 17, Tool to calculate the emission factor for an electricity system version 02.2.1 and Guidelines on the Demonstration of Additionality of Small-scale project version 09.0 to the UNFCCC CDM website have been added as per the "Instructions for filling out the project design document form for small-scale CDM project activities" of Project design document form for small-scale CDM project activities Version 06.0. Therefore this change was occurred during verification period.

7. Summary of ex ante estimates of emission reductions (Section B.6.4)
   This section has been to reflect the new start date of crediting period. The start date of crediting period was changed from the date in registered PDD "01/01/2014" to the new date "01/07/2014". This change was notified via email to UNFCCC on 23/11/2015, later the UNFCCC confirmed the receipt on 26/11/2015

8. Parameter $\mathbf{EG_{export,y}}$ in section B.7.1

Data	Registered monitoring plan	Permanent changed from registered monitoring plan
Source of data	Energy meter reading from plant records	Measured data from electricity meter
Measurement methods and procedures	There will be one meter for the generator (Type code: ZMD 402 CT44 - LANDIS + GYR) with Automated meter reading installed inside EGAT's control room. The meter is two-way meter through which export and import data will be continuously monitored. These data will be printed and recorded on a monthly basis. Additionally, one back up meter will also be installed for the generator. Moreover, a logbook will be maintained on site to record hourly readings from the energy meter. The readings will be taken by the shift supervisor. This hourly data will be signed off at the end of every shift by the engineer in charge of the shift and again at the end of each day by the power plant manager.	Measured continuously by using electricity meter (accuracy class 0.2). There is one main electricity meter and one back up electricity meter installed inside EGAT's control room. Consolidated reading is recorded in monthly basis.
QA/QC procedures	Data measured by meters and recorded in logbook will be cross checked by electricity sales receipt. This will act as a check against the electricity export-import meter readings. The energy meter will be calibrated at least once in two year subject to national standards.	The reading data from the electricity meter is recorded in the monthly report and it will be cross checked against the reading export meter report. The reading export meter report is an official document to confirm the quantity of power supplied as indicated in the PPA. In case of main meter failure, the data from back up meter will be applied in such period. The energy meter will be calibrated at least once in two year subject to national

		standards.

Reasons for the above changes are listed below;

1. Both EGAT and PEA are state-owned organizations, therefore the quantity of power supplied from EGAT to PEA is summarized and charged to PEA in overall of all power plants. Therefore the receipts/invoices for individual power plant are not available. Only one individual official document that refers to confirm the quantity of power supplied is the reading export meter report as indicated in the PPA. The reading export meter report is verified by off-taker party (PEA officer). The verified data shall be countersigned by PEA and EGAT officers.
2. The reading data is recorded in monthly basis which is read from continuous monitoring (energy meter) which is complied to the applied methodology AMS-I.D version 17.
3. In case the energy meter is malfunction/failure and need to be replaced, the same type or brand of the energy meter may not be available at that time. Therefore the type and model of energy meter have been removed for flexibility.

These changes were occurred after the project started exporting the electricity to the grid (02/07/2014) or after the registration date (01/02/2013).

9. Parameter $\mathbf{EG_{import,y}}$ in section B.7.1

Data	Registered monitoring plan	Permanent changed from registered monitoring plan
Source of data	Energy meter reading from plant records	Measured data from electricity meter
Measurement methods and procedures	There will be one meter for the generator (Type code: ZMD 402 CT44 - LANDIS + GYR) with Automated meter reading installed inside EGAT's control room. The meter is two-way meter through which export and import data will be continuously monitored. These data will be printed and recorded on a monthly basis. Additionally, one back up meter will also be installed for the generator. Moreover, a logbook will be maintained on site to record hourly readings from the energy meter. The readings will be taken by the shift supervisor. This hourly data will be signed off at the end of every shift by the engineer in charge of the shift and again at the end of each day by the power plant manager.	Measured continuously by using electricity meter (accuracy class 0.2). There is one main electricity meter and one back up electricity meter installed inside EGAT's control room. Consolidated reading is recorded in monthly basis
QA/QC procedures	Data measured by meters and recorded in logbook will be cross checked against electricity invoice sent by PEA for electricity import. The energy meter will be calibrated at least once in two years subject to national standards.	The reading data from the electricity meter is recorded in the monthly report and it will be cross checked against electricity invoice sent by PEA for electricity import. In case of main meter failure, the data from back up meter will be applied in such period. The energy meter will be calibrated at least once in two years subject to national standards.

Reasons for the above changes are listed below;

1. The reading data is recorded in monthly basis which is read from continuous monitoring (energy meter) which is complied to the applied methodology AMS-I.D version 17.
2. In case the energy meter is malfunction/failure and need to be replaced, the same type or brand of the energy meter may not be available at that time. Therefore the type and model of energy meter have been removed for flexibility.

These changes were occurred after the project started exporting the electricity to the grid (02/07/2014) or after the registration date (01/02/2013).

10. Parameter $EG_{BL,y}$ in section B.7.1

Data	As per registered PDD	Post registration change
Measurement methods and procedures	**$EG_{BL,y}$** will be calculated by taking readings from both meter installed in the Control room. $EG_{BL,y,}$ is calculated as ($EG_{export,y}$ – $EG_{import,y}$). $EG_{export,y}$ and $EG_{import,y}$ will be monitored continuously by the meter. This reading (export-import) will act as the basis for calculation of emission reductions.	**$EG_{BL,y}$** will be calculated by taking readings from the meter installed in the Control room. $EG_{BL,y,}$ is calculated as ($EG_{export,y}$ – $EG_{import,y}$). $EG_{export,y}$ and $EG_{import,y}$ will be monitored continuously by the meter. This reading (export-import) will act as the basis for calculation of emission reductions.
QA/QC procedures to be applied	This can be cross checked against the electricity invoices. The energy meter will be calibrated at least once in two years subject to national standards	The meter will be calibrated as described in parameter $EG_{export,y}$ and $EG_{import,y}$

Reason for the above changes
1. The electricity meter installed is a two-way reading meter, therefore the calculation of emission reductions is read from one meter.
2.The value of $EG_{BL,y}$, could not be cross checked against the electricity invoices because there are no any invoices for the quantity of net electricity supplied to the grid ($EG_{BL,y}$) for cross-checking. Therefore this change was occurred during verification period.

11. Monitoring Procedure in section B.7.3

Data	Registered monitoring plan	Permanent changed from registered monitoring plan
Monitoring Procedure (B.7.3)	There will be three 8 hour shifts and the readings from energy meters will be taken on an hourly basis by the shift supervisor and recorded in logbooks. This hourly data will be signed off at the end of every shift by the engineer in charge of the shift and again at the end of each day by the power plant manager. The power plant manager will analyze the data every month and report to the head office. The data will be archived electronically every month and invoices of electricity sales will be maintained.	EGAT is well aware of the importance of having a good operational and management team in order to execute a well-defined monitoring plan for the project activity. So, it has an operational and management structure created exclusively for monitoring data. The responsibilities of data monitoring, archiving and analyzing will fall on different members of the monitoring team. This team will be composed of head office, power plant manager and shift supervisor. The shift supervisor will record the monitoring data. The power plant manager will cross-check the monitoring data and system to be properly functional and the head office will analyze the power plant performance through the

		monitoring data.

Reason for the above change;
The monitoring procedure has been changed to reflect the practical present monitoring procedure. These changes were occurred after the project started exporting the electricity to the grid (02/07/2014) or after the registration date (01/02/2013).

12. Change of start date of crediting period (Section C.2.2 and Section B.6.4).

The start date of crediting period has been changed from the date in registered PDD "01/01/2014" to the new date "01/07/2014". This change was notified via email to UNFCCC on 23/11/2015, later the UNFCCC confirmed the receipt on 26/11/2015

Section C.2.2 and Section B.6.4 have been updated as per mentioned above.

	As per the registered PDD	As per this revised PDD
Start date of crediting period	01/01/2014	01/07/2014

Reason for the above change;
Due to the start date of crediting period as per registered PDD is 01/01/2014, but the project activity started to operate or export electricity to the grid on 02/07/2014, therefore change of crediting period to the project activity is requested by postponing the start date by 6 months as per para 279 (b) of Project Standard version 09.0. This change was occurred after the project started exporting the electricity to the grid (02/07/2014) or after the registration date (01/02/2013).

13. Expected operational lifetime of the project activity (Section C.1.2) and Type of crediting period (Section C.2.1)

Expected operational lifetime of the project activity (Section C.1.2) and Type of crediting period (Section C.2.1) have been revised as per the "Instructions for filling out the project design document form for small-scale CDM project activities" of Project design document form for small-scale CDM project activities Version 08.0. Therefore this change was occurred during verification period.

14. Approval and authorization (Section F)

This section has been revised as the letter of approval from Thailand (Host country) for the project activity is available at the time of submitting the PDD to the validating DOE. Therefore this change was occurred during verification period.

15. Contact information of project participants and responsible persons/ entities (Appendix 1)

The contact information of project participants and responsible persons/ entities has been revised as per the latest Modalities of Communication (MoC) available on UNFCCC CDM website. This change was occurred after the project started exporting the electricity to the grid (02/07/2014) or after the registration date (01/02/2013).

16. Applicability of methodology and standardized baseline (Appendix 3)

List of document support to the applicability criterions in Section B.2 has been added as per the "Instructions for filling out the project design document form for small-scale CDM project activities" of Project design document form for small-scale CDM project activities Version 08.0. Therefore this change was occurred during verification period.

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Document information

Version	*Date*	*Description*
08.0	22 July 2016	EB 90, Annex 2 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the "Standard: Applicability of sectoral scopes" (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revisions to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Editorial improvement.
05.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the project design document form for small-scale CDM project activities (these instructions supersede the "Guidelines for completing the project design document form for small-scale CDM project activities" (Version 01.1)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Error! Reference source not found.; • Change the reference number from *F-CDM-SSC-PDD* to *CDM-SSC-PDD-FORM*; • Editorial improvement.
04.1	11 April 2012	Editorial revision to change history box by adding EB meeting and annex numbers in the Date column.
04.0	13 March 2012	EB 66, Annex 9 Revision required to ensure consistency with the "Guidelines for completing the project design document form for small-scale CDM project activities"
03.0	15 December 2006	EB 28, Annex 34 • 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.
02.0	08 July 2005	EB 20, Annex 14 • 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>.

Version	*Date*	*Description*
01.0	21 January 2003	EB 07, Annex 05 Initial adoption.

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