Project design document form for small-scale CDM project activities

(Version 05.0)

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	SPP3 Solar Power Project
Version number of the PDD	2.1
Completion date of the PDD	13/04/2015
Project participant(s)	SPP Three Co., Ltd. Carbon Partners Asiatica (Hong Kong) Co., Ltd. Asian Development Bank, as trustee of the Future Carbon Fund Swedish Energy Agency
Host Party	Thailand
Sectoral scope and selected methodology(ies), and where applicable, selected standardized baseline(s)	Sectoral Scope:1 Energy Industries (renewable -/non-renewable sources) Selected methodology: AMS-I.D. version 17
Estimated amount of annual average GHG emission reductions	8,891 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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SPP3 Solar Power Project developed by SPP Three Co., Ltd. (hereinafter referred to as "SPP Three"). SPP Three is a project company established for the installation and operation of a Greenfield grid-connected solar photovoltaic (PV) power plant in Srisaket province of Thailand. The proposed CDM project activity hereinafter is referred to as "the Project" or "project activity".

The purpose of this project activity is to utilize the sunlight as renewable energy resource for carbon-neutral electricity generation. The project activity is to install the polycrystalline PV panels at the project plant with a total installed capacity of approximately 9.628MW–DC Gross. The net quantity of electricity generation rated at approximately 8MW-AC will be sold to the Provincial Electricity Authority (PEA). The generated electricity will be exported to PEA at 22 kV via the PEA transmission lines in the district of Benchalak of Srisaket Province, Thailand. The electricity is to be sold under a Power Purchase Agreement (PPA) in the Very Small Power Producer (VSPP) Program.[1]

Another purpose of the project activity is to reduce greenhouse gases (GHGs). In the absence of the project activity, the same amount of electricity would have been generated from other power plants using fossil fuel. By displacing this electricity with the carbon-neutral electricity generated from the project activity will reduce carbon dioxide (CO_2) emissions which would otherwise be released to the atmosphere by fossil fuel-fired units.

The Project was commissioned on 21st February 2012. Upon full operation, the Project is expected to displace a net annual average (over the first crediting period) of 16,010 MWh of electricity from the grid, which corresponds to 8,891 tonnes of CO_2 equivalent GHGs emission reduction per year. The total GHG emission reduction for the chosen crediting period (7 years) is 62,239 tonnes of CO_2 equivalent.

Contribution to Sustainable Development

Consistent with the sustainable development criteria set by Thailand Greenhouse Gas Management Organisation (TGO), the proposed project activity will contribute to the sustainable development in the following ways:

1) **Natural resources and environment**

   The project activity will produce carbon-neutral electricity by utilising an environmentally-friendly technology and replacing the electricity generated by carbon intensive fossil fuels, resulting in the reduction of GHG emissions. It also improves local air environment quality by reducing other air pollutants including SOx, NOx and other particulates from the combustion of fossil fuels.

   The Project also conforms to the governmental policy of Thailand and will contribute to its national sustainable development using solar resource for renewable energy generation. Thailand has been seeking to develop new sources of power supply outside of its conventional (fossil fuel-based) power plants. The VSPP program was introduced by the government to promote the generation of renewable power from very small power producer. The Project is compliant with the Thai government policy and participates in the VSPP Program.

2) **Economic development**

[1] Data are sourced from the following link: http://www.eppo.go.th/power/vspp/vspp-briefing.html

The Project utilises sustainable and renewable solar resource and will reduce expensive fossil fuel imports and negative impact on the foreign exchange. In addition, it will eliminate the risks of fluctuating coal and/oil prices. Furthermore, the project activity will cater to the growing power demand that has been forecasted in Thailand. In the long term, the Project will help to promote solar industry within the host country.

3) **Social development**

The Project will offer job opportunities and will generate various short-term and long-term employment opportunities during the design and construction through to the operation and maintenance of the new power plant.

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

4) **Technology Development/Technology Transfer**

The project will adopt an innovative PV module and inverter manufactured by Hanwha SolarOne and Power-one respectively. Hanwha SolarOne is a subsidiary company of Hanwha Group where the Corporate Headquarters in situated in Korea, while Power-one is a company based in USA. The project will involve technology transfer from overseas countries to the host country. Training related to the operating and maintenance procedures for the operators was provided by technology providers to ensure proper operating and maintenance during project commissioning.

A.2. Location of project activity

A.2.1. Host Party

>>
Thailand

A.2.2. Region/State/Province etc.

>>
Srisaket Province

A.2.3. City/Town/Community etc.

>>
Benchalak District

A.2.4. Physical/Geographical location

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The total size area for this project is approximately 0.339 sq. km.[2] The geographical coordinates at the corner of the project as per Figure 1 are the following:
Point 1: 14.7879 N, 104.8165 E,
Point 4: 14.7839 N, 104.8150 E,
Point 7: 14.7936 N, 104.8078 E,
Point 8 : 14.7941 N, 104.8092 E, and
Central point : 14.7890 N, 104.8137 E

[2] Information is obtained from land purchase agreement.

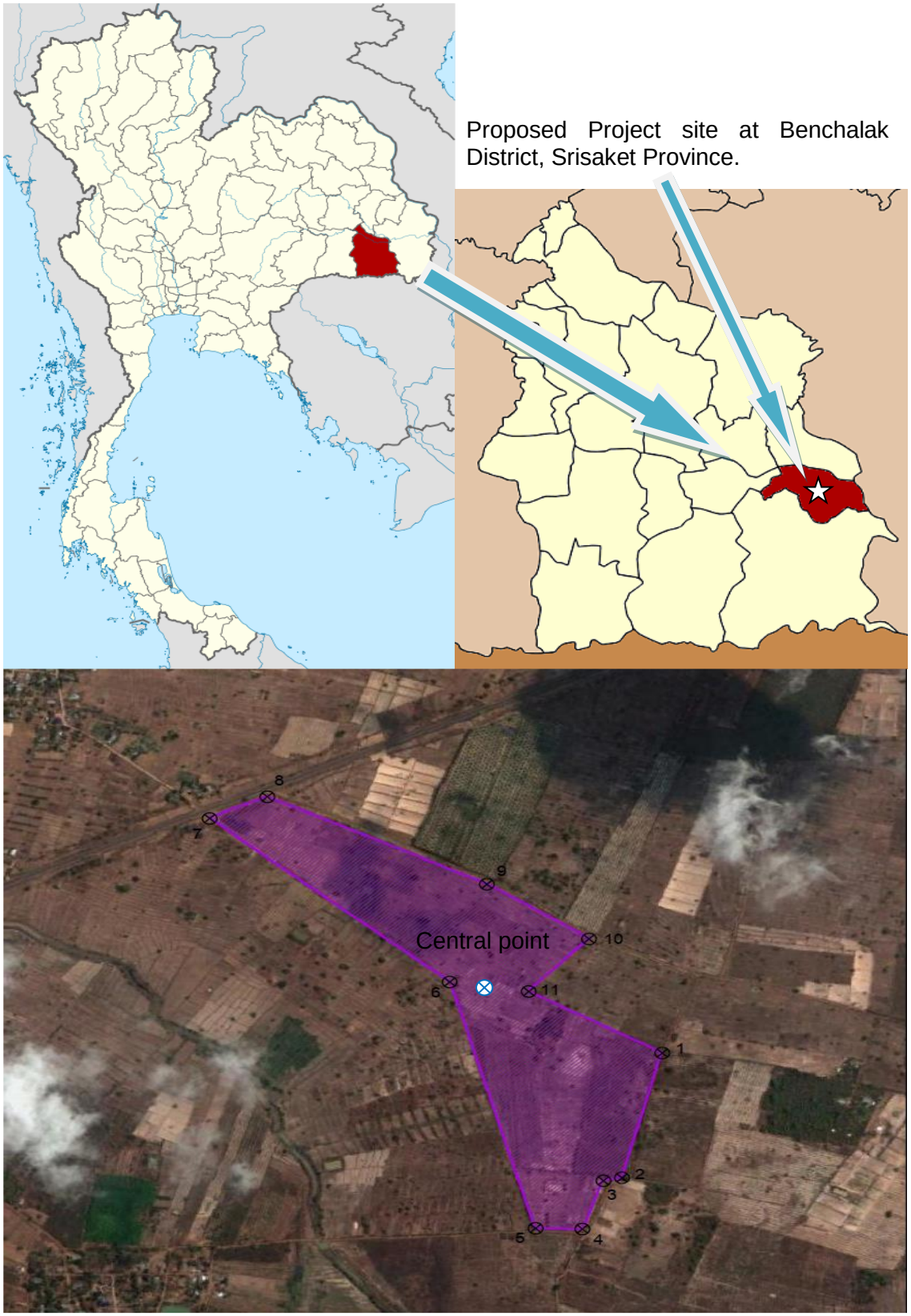

Figure 1: The location map of the project activity

A.3. Technologies and/or measures

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The photovoltaic technology which was employed by the proposed project activity is a method for generating electrical power by using solar cells to convert energy from the sunlight into electricity.

The Project involves using 33,600 polycrystalline PV modules for converting sunlight into electrical power. The modules are attached to frame, made with aluminium alloy. The direct current (DC) generated from the PV arrays will be converted into alternating current (AC) by 500 KW inverters. The generated electrical AC power will be passed through the 0.32kV/22kV step-up transformers (1,250kVA) and then exported via a 22kV grid line to PEA's substation.

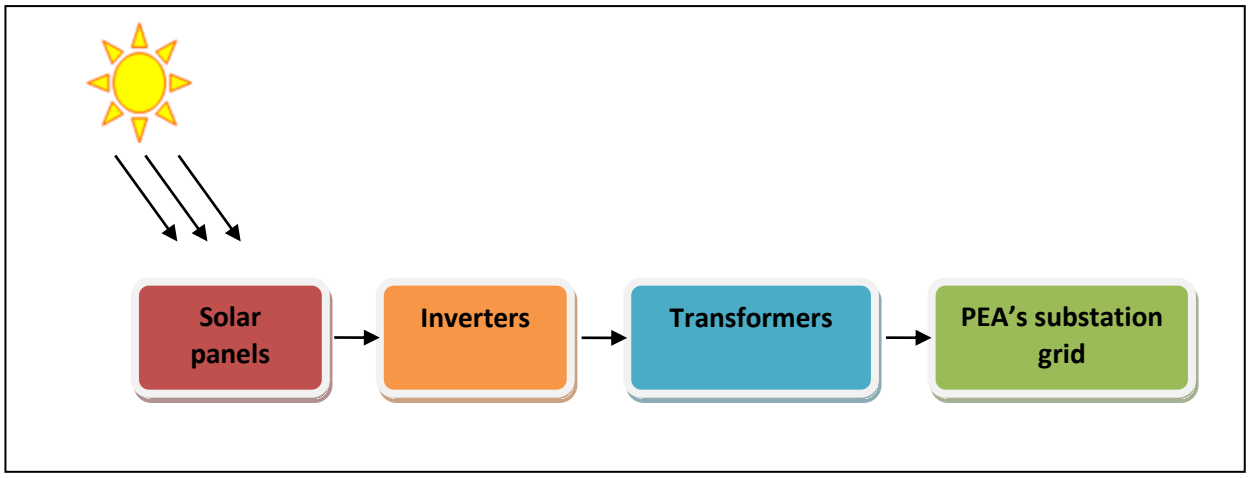

Figure 2: A simplified flow diagram of the project

Table 1: Technical specifications of the main production equipment used at the project[3]

Item	PV Module
Model	SF260
Cell type	Polycrystalline
Rated output	5 different power rating: 275 Wp, 280 Wp, 285 Wp, 290 Wp, and 295 Wp
Number of panels	275 Wp - 1,320 units 280 Wp - 3,520 units 285 Wp - 14,520 units 290 Wp - 11,880 units 295 Wp - 2,360 units Total modules – 33,600 units[4]

Item	Solar Inverter
Model	Aurora PVI-500.0 – TL
Rated output power	500 kW
Units	16

Item	Transformer
Manufacturer	Ekarat Engineering
Type	Oil immersed (Hermetically sealed)
Rated capacity	1,250 kVA
Standard	IEC 60076
Units	8

[3] In accordance with the specifications provided to the DOE during the site visit.

[4] See Appendix 3 for summary of PV modules arrangement

In addition to the above equipments, the power plant has installed a supervisory control and data acquisition (SCADA) system to control and monitor the output of the rows of panels.

In order to determine the net electricity supplied by the Project, the quantities of electricity exported to and imported from the grid are measured using electricity meters. As per Figure 3, a main electricity meter **[M01]** is installed at the project site to monitor the electricity exported to the grid ($EG_{export,y}$) via the 22kV transmission line continuously. Another main electricity meter **[M02]** is installed to monitor the auxiliary power, used at the site, which is imported from the grid ($EC_{import,y}$) when power plant is not operating. Both export electricity meter and import electricity meter are bi-directional meters. Each meter records both export and import readings at the same time. In the case of inaccuracy or malfunction of one of the main electricity meters, the reading from the other meter can be used as a backup.

The overall project lifetime is expected to be 25 years, taking into account the expected life time of the major equipment which is the solar modules.[5]

Plant load factor

In accordance with Para 3 of the EB48 Annex 11, "Guidelines for the reporting and validation of plant load factors", the plant load factor shall be defined ex-ante in the CDM-PDD. The plant load factor for this Project was determined from the yield estimated by the third party lenders engineer. On the basis of data provided, the load factor of the plant is 18.33%[6].

Technology Transfer

The project adopted an innovative PV module and inverter manufactured by Hanwha SolarOne and Power-one respectively. Hanwha SolarOne is a subsidiary company of Hanwha Group where the Corporate Headquarters in situated in Korea, while Power-one is a company based in USA. The project will involve technology transfer from overseas countries to the host country. Training related to the operating and maintenance procedures for operators was provided by technology providers to ensure proper operating and maintenance during project commissioning.

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)	SPP Three Co., Ltd. (Private)	No
Netherlands	Carbon Partners Asiatica (Hong Kong) Co., Ltd. (Private)	No
Sweden	Asian Development Bank, as trustee of the Future Carbon Fund	No
Sweden	Swedish Energy Agency	No

A.5. Public funding of project activity

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

[5] This is based on third party due diligence report and manufacturer's specification.

[6] The 25 years average of the net annualized electricity output based on third party is equivalent to 15,458 MWh/year. The plant load factor can be calculated as the 25 years average of the net annualized electricity output (MWh/year) divided by the product of the total installed capacity (MWp) and the number of operating hours in one year [15,458 MWh/year / (9.628MWp x 8,760 hr/year)] x 100 = 18.33%.

A.6. Debundling for project activity

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As defined in Appendix C of the SSC M&P and *"Guidelines on assessment of debundling for SSC project activities (Version 03)"*, *"a proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:*

(a) With the same project participants;

(b) In the same project category and technology/measure; and

(c) Registered within the previous 2 years; and

(d) Whose project boundary is within 1 km of the project boundary of the proposed small- scale activity at the closest point."

The proposed project activity is not a debundled component of any large project activity as there is neither a registered small-scale CDM project activity nor an application to register another small-scale CDM project activity with the same project participant as the proposed small-scale CDM project activity.

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

B.1. Reference of methodology and standardized baseline

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

- AMS-I.D. *"Grid connected renewable electricity generation (Version 17.0)"*

Tools referenced in AMS-I.D. include:

- *"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (Version 02.0)"*
- *"Tool to calculate the emission factor for an electricity system (Version 02.2.1)"*

B.2. Project activity eligibility

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AMS-I.D. is applicable to grid-connected renewable electricity generation project activities, including solar power project, with the installed capacity under the eligibility limit of 15MWp. The proposed project activity fulfils all applicability criteria stipulated in the methodology as summarized below.

Table 2: The applicability conditions of AMS-I.D.

	Condition	Project case[7]
1	*"This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass:* *(a) Supplying electricity to a national or a regional grid; or* *(b) Supplying electricity to an identified consumer*	**Applicable to (a)** The proposed project activity involves the installation and operation of a solar PV power plant that supplies electricity to a national grid (PEA). (refer to

[7] Please refer to Appendix 3 for a list of supporting documents

	facility via national/regional grid through a contractual arrangement such as wheeling."	Document no. 1&3 in Appendix 3)
2	*"Illustration of respective situations under which each of the methodology (i.e. AMS-I.D, AMS-I.F and AMS-I.A) applies is included in Table 2 (of AMS-I.D.)."*	**Applicable** As per Table 2 of AMS-I.D., project supplies electricity to a national grid belongs to *"Project type I"*. Thus, AMS-I.D. is applicable to the Project. (refer to Document no. 2 in Appendix 3)
3	*"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)."*	**Applicable to (a)** The proposed project activity is to 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). (refer to Documents no. 3 and no. 4 in Appendix 3)
4	*"Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology:* ▪ *The project activity is implemented in an existing reservoir with no change in the volume of reservoir;* ▪ *The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the project emissions section, is greater than 4 W/m^2;* ▪ *The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the project emissions section, is greater than 4 W/m^2."*	**Not applicable** The proposed project activity is a solar power plant and not a hydro power plant. (refer to Document no. 1-5 in Appendix 3)
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 new unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW."*	**Not applicable** The proposed project activity neither involves non-renewable component nor co-fires fossil fuel. It only has renewable component with the total installed capacity (maximum output capacity) of approximately 9.628MWp, which is under the eligibility limit of 15MWp. (refer to Document no. 1-5 in Appendix 3)
6	*"Combined heat and power (co-generation) systems are not eligible under this category."*	**Not applicable** The proposed project activity is a solar power plant, which does not involve any combined heat and power (co-generation) system. (refer to Document no. 1-5 in Appendix 3)
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 15 MW and should be physically distinct from the existing units."*	**Not applicable** The proposed project activity is to install a new photovoltaic power plant and there were no existing power generation units before the installation of the project activity. (refer to Document no. 1-5 in

		Appendix 3)
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."*	**Not applicable** The proposed project activity is to install a new photovoltaic power plant and does not involve retrofit or replacement of any renewable energy generation unit. (refer to Document no. 1-5 in Appendix 3)

The maximum output capacity of the project activity is approximately 9.628MWp, which is under the eligibility limit of 15MWp for project type I. The maximum output capacity was estimated based on the total product of rated output per panel and number of panel used at the project[8]. So, it can be concluded that project activity qualifies as Type I during every year of the crediting period in accordance with applicable provisions for project activity eligibility in the Project standard.

B.3. Project boundary

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As per paragraph 9 of the methodology, the project boundary can be identified as follows:

- *"The spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to."*

The electricity generated by the proposed project plant will be exported to PEA. This will replace the electricity produced by fossil fuel-fired power generating units connected to the grid. Therefore, the project boundary includes the project site and all the power plants that are physically connected to the electrical systems of PEA. The project boundary can be illustrated in the diagram below.

[8] Refer to Document no.5 in Appendix 3.

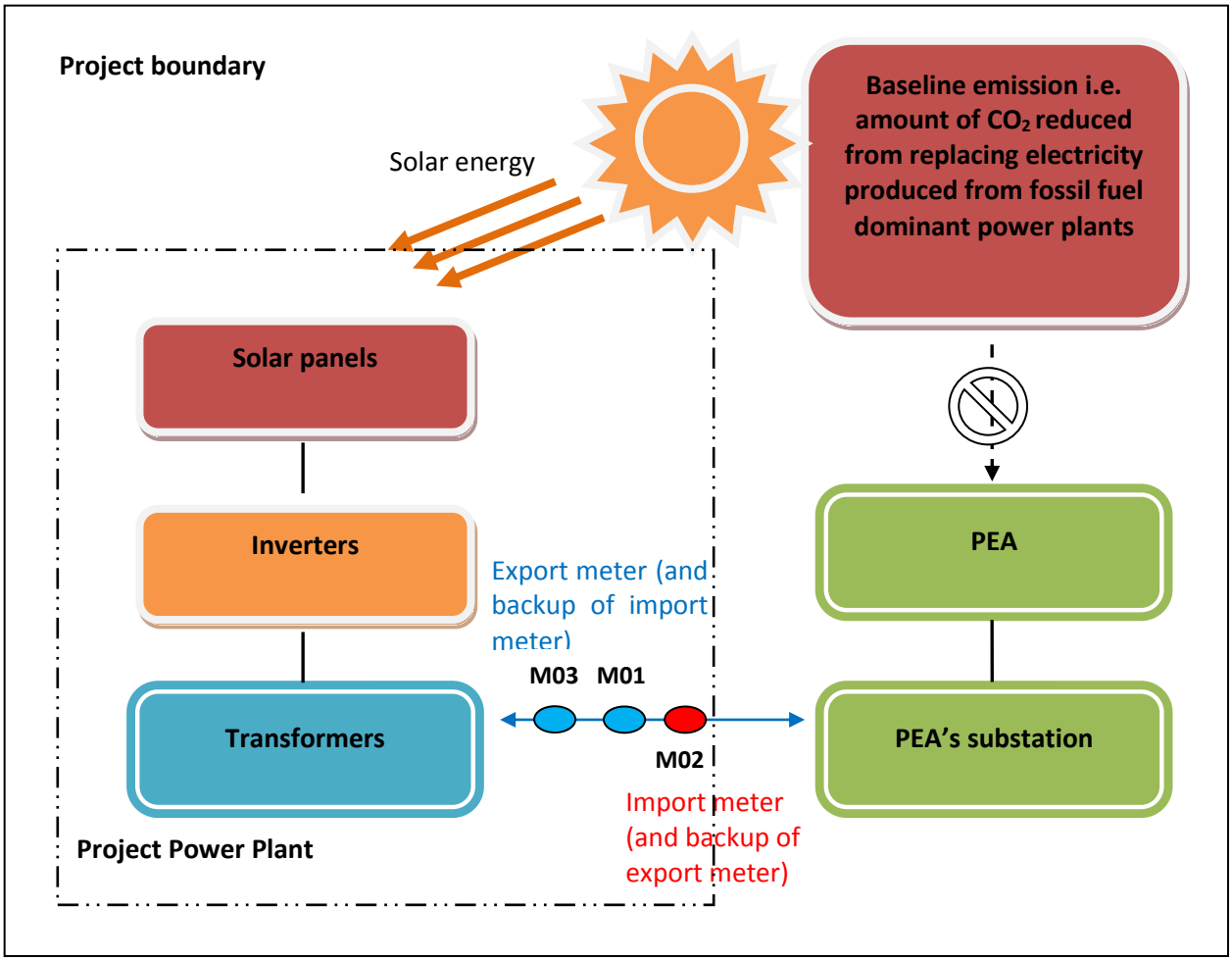

Figure 3: Flow diagram of the project boundary[9]

The emission sources included in the project boundary are as follows:

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	Thai National Grid	CO_2	Included	As per AMS-I.D, only CO_2 emissions from the net electricity generation supplied to the Thai national grid should be accounted for.
		CH_4	Excluded	According to AMS-I.D.
		N_2O	Excluded	According to AMS-I.D.
Project scenario	SPP3 Solar Power Project	CO_2	Excluded	According to AMS-I.D.
		CH_4	Excluded	According to AMS-I.D.
		N_2O	Excluded	According to AMS-I.D.

B.4. Establishment and description of baseline scenario

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Paragraph 10 of the methodology states - "*The baseline scenario is that the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources into the grid.*"

[9] As previously described in section A.3, it is note that both meters (Export meter [M01] and Import meter [M02]) shown in the Figure 3 are bi-directional meters. This means that each meter can measure and record both import and export electricity at the same time. Hence they are used as backup meters for one another.

In the absence of the project activity, the same amount of electricity would have been generated by the operation of grid-connected power plants in the Thai National grid and by the addition of new generation sources. Hence, emission from the equivalent amount of electricity generated by Thailand's grid has been taken as the baseline in accordance with paragraph 10 of the methodology and baseline emissions have been calculated.

The baseline emissions will be calculated as per paragraph 11 of the methodology which states – *"the baseline emission are the product of electrical energy baseline $EG_{BL,y}$ expressed in MWh of electricity produced by the renewable generating unit, multiplied by the grid emission factor."*

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

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

As per paragraph 12 of the methodology – *"The emission factor can be calculated in a transparent and conservative manner as follows:*

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

OR

(b) The weighted average emissions (in tCO_2/MWh) 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."

Between Options (a) and (b), Option (a) is selected for the proposed Project. Details of the grid emission factor calculation are provided in Section B.6.1. and Appendix 4.

National Policies and Circumstances

In Thailand, the prevailing practice for electricity generation as of today is to use fossil fuels. According to the "Electricity Statistic Annual Report 2010" by EGAT, the electricity generation of national grid in 2010 was 160,190.96GWh, of which approximately 91% of the electricity was supplied from fossil fuel-based generation systems and less than 5% of the electricity was generated by renewable fuel-based generation systems using renewable fuels, such as solar, biomass residues, biogas, residual gas from production processes, etc., as indicated in the table below.

Table 3: Quantity of electricity generated and transmitted to the national grid in 2010[a)]

Generation system	Grid generation	
	(GWh)	(%)
Thermal	44,860.34	28.0
Combined-cycle	99,362.04	62.0
Gas turbine	1,099.97	0.7
Diesel engine	3.98	0.0
Hydropower	5,348.84	3.3

Renewable energy[b)]	2,238.40	1.4
Electricity import	7,277.39	4.5
Total	**160,190.96**	**100.0**

[a)] "Electricity Statistic Annual Report 2010", by EGAT.

[b)] This includes electricity generation from renewable fuels, such as solar, biomass residues, biogas, residual gas from production processes, etc.

To promote the use of the renewable fuels and the generation of green power, the Thai Government has introduced two national policies, namely Small Power Producer (SPP) and VSPP Programs, to encourage a small power producer and a very small power producer which generate power with renewable fuels to sell part or all of its power output to EGAT and PEA respectively. Through participating these programs, the qualified power producer is eligible to acquire incentives (i.e. called "Adder") for each kWh of electricity generation and export. The proposed project activity is compliant with the Thai national policy and participates in the VSPP Program, and therefore is eligible to acquire 8Baht/kWh of Adder.

B.5. Demonstration of additionality

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According to the Glossary of CDM terms, the start date is *"in the context of a CDM project activity or CPA, the earliest date at which either the implementation or construction or real action of a CDM project activity or CPA begins"*. Based on this definition, the earliest date of the CDM project activity was the date when the acquisition of the land was completed, which is 14th January 2011.

As the project start date is prior to the date of publication of the PDD for the global stakeholder consultation and was after 02 August 2008, in accordance with Para 27 of project standard which says "*For a proposed CDM project activity with a start date on or after 02 August 2008, project participants shall inform the host Party's designated national authority (DNA) and the secretariat of their intention to seek CDM status in accordance with the Project cycle procedure.*" the only action required is for notifications to be sent to the UNFCCC and the Host Party DNA (Thailand Greenhouse Gas Management Organisation - TGO). For this project, the notifications were sent to the UNFCCC and TGO on dated 24th June 2011 and 21st June 2011, respectively [10] well within the 6 months of the project activity start date. Thus, it is clear that the Project meets the criteria stipulated in paragraph 27 of project standard and a conclusion can be reached that the project proponents have seriously considered CDM for the proposed project activity and that the benefits of CDM were decisive for the implementation of the Project. Summary of the project chronology is shown in Table 4 below:

Table 4: Chronology of the project

No	Key event	Date	Supporting Evidence
1	SPP Three Co., Ltd. signed PPA with PEA	30/04/2010	Power Purchase Agreement
2	Land acquisition by SPP Three Co., Ltd **(Project start date)**	14/01/2011	Land purchase agreement
3	Start of Construction	08/04/2011	Confirmation letter from EPC contractor
4	Placing first purchase order of the equipment	27/04/2011	Purchase order

[10]The notification was sent for the project with different project title (Solar PV Power Generation at Sri Sa Ket) and by different entity (SunEdison Energy (Thailand) Co., Ltd.). The notification has been validated by the DOE and confirmed that it is of the same project (SPP3 Solar Power Project) and developed by the same project participant (SPP Three Co., Ltd.).

5	SunEdison Energy (Thailand) Co., Ltd. [11] submitted the **Prior consideration notification to TGO** under the project titled "Solar PV Power Generation at Sri Sa Ket"	21/06/2011	Prior Consideration form dated 21/06/2011 [12] and acknowledgement by TGO
6	SunEdison Energy (Thailand) Co., Ltd.[11] submitted the **Prior consideration notification to UNFCCC** under the project titled "Solar PV Power Generation at Sri Sa Ket"	24/06/2011	Prior Consideration form dated 21/06/2011 and UNFCCC website[13]
7	SPP Three Co., Ltd. signed EPC contract with SunEdison Energy Engineering Co., Ltd.	23/09/2011	EPC contract
8	SPP Three Co., Ltd. signed O&M contract with SunEdison Operations and Maintenance Co., Ltd.	23/09/2011	O&M contract
9	Financial closure	26/09/2011	Facility Agreement with bank
10	Commercial operation	21/02/2012	PEA meter reading report
11	SPP Three Co., Ltd. signed CDM Consultant service with Carbon Partners Asiatica Co., Ltd.	04/07/2012	Agreement for consulting services
12	SPP Three Co., Ltd. sent the notification to TGO for the project title change to "SPP3 Solar Power Project"[14]	04/07/2012	Prior Consideration form dated 04/07/2012
13	SPP Three Co., Ltd. sent the notification to UNFCCC for the project title change to "SPP3 Solar Power Project"[14]	05/07/2012	Prior Consideration form dated 04/07/2012
14	The UNFCCC secretariat sent acknowledgement on notification of project title and project entity changes	05/07/2012	Email from UNFCCC secretariat
15	TGO sent acknowledgement on notification of project title and project entity changes	25/07/2012	Acknowledgement letter by TGO
16	Publication of the PDD for the global stakeholder consultation	25/08/2012 – 23/09/2012	UNFCCC website

According to EB 68 Annex 27, "Guidelines on the demonstration of additionality of small-scale project activities" version 09.0, project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

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

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

[11] SunEdison Energy (Thailand) Co., Ltd. was representative of project participant (SPP Three Co., Ltd.).

[12]The records of notification receipt from UNFCCC and TGO have been provided to DOE for validation.

[13] http://cdm.unfccc.int/Projects/PriorCDM/notifications/index_html,"Solar PV Power Generation at Sri Sa Ket"

[14]For transparency, SPP Three Co., Ltd. submitted the form and notified to both TGO and UNFCCC regarding the changes in project title and project entity for the same project which notification was submitted by SunEdison Energy (Thailand) Co., Ltd.

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

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

However, in paragraph 2 of the Guidelines, it provides a positive list of technologies and project activity types that are defined as automatically additional, without further documentation of barriers for project sizes up to and including the small-scale CDM thresholds (e.g. installed capacity up to 15 MWp). The positive list for the grid-connected renewable electricity generation technologies, which is the Project's type, as per paragraph 2(a) of the guidelines comprises of:

i. Solar technologies (photovoltaic and solar thermal electricity generation);

ii. Off-shore wind technologies;

iii. Marine technologies (wave, tidal);

iv. Building-integrated wind turbines or household rooftop wind turbines of a size up to 100 kW.

As the proposed project involves implementing a solar photovoltaic technology and its installed capacity is less than 15 MWp, the project is automatically defined as additional, without further documentation of barriers. As the result, the explanation to demonstrate the above barriers is deemed unnecessary.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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1. BASELINE EMISSIONS

The baseline emissions associated with electricity generation from power plants connected to the grid are calculated by the equation below:

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

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)*

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

(a) Determination of net quantity of electricity supplied to the grid ($EG_{BL,y}$)

Considering that the proposed project activity is a Greenfield renewable energy power plant where no renewable power plant was operated prior to the project implementation, then:

$$EG_{BL,y} = EG_{facility,y}$$

where:

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

$EG_{facility,y}$ = *Quantity of net electricity supplied by the project activity to the grid in year y (MWh)*

$$EG_{facility,y} = EG_{export,y} - EC_{import,y}$$

where:
$EG_{export,y}$ = *Quantity of electricity exported to the grid in year y (MWh)*
$EC_{import,y}$ = *Quantity of electricity imported from the grid in year y (MWh)*

(b) Determination of CO_2 emission factor of the grid ($EF_{CO2,grid,y}$)

As mentioned in Section B.4. above, Option (a) is selected for the proposed project activity, thus:

$$EF_{CO2,grid,y} = EF_{grid,CM,y}$$

where:
$EF_{CO2,grid,y}$ = *CO_2 emission factor of the grid in year y (tCO_2/MWh)*
$EF_{grid,CM,y}$ = *Combined margin CO_2 emission factor in year y (tCO_2/MWh)*

The $EF_{grid,CM,y}$ is calculated according to the steps stipulated in *"Tool to calculate the emission factor for an electricity system (version 02.2.1)"*, as delineated in Appendix 4. A summary of baseline emission factors of Thailand's national electricity system in 2010 is shown in the table below:

Table 5: Baseline emission factors of Thailand's national electricity system in 2010

Emission factor	Data	Unit	Data source
Operating margin (OM)	0.5994	tCO_2/MWh	*"The study of emission factor for electricity generation of Thailand in year 2010"* published by TGO on December 30, 2011
Build margin (BM)	0.4231	tCO_2/MWh	
Combined margin (CM)	0.5554	tCO_2/MWh	

2. PROJECT EMISSIONS

Paragraph 20 of methodology states – "*For most renewable energy project activities, PE= 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."* These two categories are:

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

No project emissions will be produced from the proposed project activity since it is a solar power plant and falls into neither of the categories.

Paragraph 21 of the methodology also states – *"CO_2 emissions from on-site consumption of fossil fuels due to the project activity shall be calculated using the latest version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"*. Since there is no fossil fuel consumption due to the project activity, there is no CO_2 emission. Hence,

$$PE_{FF,y} = 0\ tCO_2e$$

3. LEAKAGE

As per AMS-I.D., leakage is to be considered only if the energy generating equipment is transferred from another project activity. Taking into consideration that there is no energy generating equipment is transferred from another project activity, no leakage emissions are considered. Hence,

$$LE_y = 0\ tCO_2e$$

4. EMISSION REDUCTIONS

In accordance to AMS-I.D. version 17.0, emissions reduction (ER_y) can be calculated as follows:

$$ER_y = BE_y – PE_y - LE_y$$

where:

ER_y = *Emission reductions in year y (tCO_2e/y)*
BE_y = *Baseline emissions in year y (tCO_2e/y)*
PE_y = *Project emissions in year y (tCO_2e/y)*
LE_y = *Leakage emissions in year y (tCO_2e/y)*

For the proposed project, since there is no leakage emission and the project emission is equal to zero therefore $ER_y = BE_y$.

B.6.2. Data and parameters fixed ex ante

(Copy this table for each piece of data and parameter.)

Data / Parameter	$FC_{i,y}$
Unit	Mass or volume unit
Description	Amount of fossil fuel type *i* consumed in the project electricity system in year *y*
Source of data	*"Electricity Statistic Annual Report 2008-2010"* by EGAT
Value(s) applied	Refer to Table A5 of Appendix 4
Choice of data or Measurement methods and procedures	Data choice and calculation method as per the methodological tool *"Tool to calculate the emission factor for an electricity system (Version 0.2.2.1)"*.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$NCV_{i,y}$
Unit	GJ/Mass or volume unit
Description	Net calorific value (energy content) of fossil fuel type *i* in year *y*
Source of data	*"Electric Power in Thailand 2010"*, published by the Department of Alternative Energy Development and Efficiency, Ministry of Energy
Value(s) applied	Refer to Table A2 of Appendix 4
Choice of data or Measurement methods and procedures	Data choice as per the methodological tool *"Tool to calculate the emission factor for an electricity system (Version 02.2.1)"*.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EF_{CO2,i,y}$
Unit	tCO_2/GJ
Description	CO_2 emission factor of fossil fuel type *i* in year *y*
Source of data	IPCC default values at the lower limit as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the *"2006 IPCC Guidelines on National GHG Inventories"*
Value(s) applied	Refer to Table A2 of Appendix 4
Choice of data or Measurement methods and procedures	Data choice as per the methodological tool *"Tool to calculate the emission factor for an electricity system (Version 02.2.1)"*.

Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	EG_y
Unit	MWh
Description	Net quantity of 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*
Source of data	*"Electricity Statistic Annual Report 2008-2010"* by EGAT
Value(s) applied	Refer to Table A4 of Appendix 4
Choice of data or Measurement methods and procedures	Data choice as per the methodological tool *"Tool to calculate the emission factor for an electricity system (Version 02.2.1)"*.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$FC_{i,m,y}$
Unit	Mass or volume unit
Description	Amount of fossil fuel type *i* consumed by power plant/unit *m* in year *y*
Source of data	*"Electricity Statistic Annual Report 2010"* by EGAT
Value(s) applied	Refer to Table A9 of Appendix 4
Choice of data or Measurement methods and procedures	Data choice and calculation method as per the methodological tool *"Tool to calculate the emission factor for an electricity system (Version 02.2.1)"*.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EG_{m,y}$
Unit	MWh/yr
Description	Net quantity of electricity delivered to the grid by power plant/unit *m* serving the system, not including low-cost/must run units, in year *y*
Source of data	*"Electricity Statistic Annual Report 2010"* by EGAT
Value(s) applied	Refer to Table A9 of Appendix 4
Choice of data or Measurement methods and procedures	Data choice as per the methodological tool *"Tool to calculate the emission factor for an electricity system (Version 02.2.1)"*.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EG_{CO2,grid,y}$
Unit	tCO_2/MWh
Description	CO_2 emission factor of the grid
Source of data	Calculated
Value(s) applied	0.5554
Choice of data or Measurement methods and procedures	The $EF_{CO2,grid,y}$ is calculated according to the steps stipulated in *"Tool to calculate the emission factor for an electricity system (Version 02.2.1)"*, as delineated in Appendix 4.
Purpose of data	Calculation of baseline emissions
Additional comment	-

B.6.3. Ex ante calculation of emission reductions

>>

1. BASELINE EMISSIONS

The baseline emissions associated with electricity generation from power plants connected to the grid are calculated by the equation below:

$$BE_y = EG_{facility,y} \times EF_{grid,CM,y}$$

$$EG_{facility,y} = EG_{export,y} - EC_{import,y}$$

Baseline emissions were then calculated using a combined margin grid emissions factor of 0.5554 tCO_2/MWh. As example, the baseline emission (in year 1) can be calculated using equation above as below.

$$EG_{facility,y} = 16{,}405 \text{ MWh/yr} - 151 \text{ MWh/yr} = 16{,}254 \text{ MWh/yr}$$

$$BEy = 16{,}254 \text{ MWh/yr} \times 0.5554 \text{ tCO}_2\text{/MWh} = 9{,}027 \text{ tCO}_2\text{e/yr}$$

Year	$EG_{export,y}$	$EC_{import,y}$	$EG_{facility,y}$	$EF_{grid,CM,y}$	BEy
	(MWh/yr)	(MWh/yr)	(MWh/yr)	(tCO_2/MWh)	(tCO_2e/yr)
01/01/2013 – 31/12/2013	16,405	151	16,254	0.5554	9,027
01/01/2014 – 31/12/2014	16,323	151	16,172	0.5554	8,981
01/01/2015 – 31/12/2015	16,242	151	16,091	0.5554	8,936
01/01/2016 – 31/12/2016	16,160	151	16,009	0.5554	8,891
01/01/2017 – 31/12/2017	16,080	151	15,929	0.5554	8,846
01/01/2018 – 31/12/2018	15,999	151	15,848	0.5554	8,801
01/01/2019 – 31/12/2019	15,919	151	15,768	0.5554	8,757

2. PROJECT EMISSIONS

As explained in Section B.6.1., no project emissions are involved in this Project. Hence,

$$PE_{FF,y} = 0 \text{ tCO}_2e$$

3. LEAKAGE

As explained in Section B.6.1., no leakage emissions are considered in this Project. Hence,

$$LE_y = 0 \text{ tCO}_2e$$

4. EMISSION REDUCTIONS

The emission reduction is calculated using the following equation:

$$ER_y = BE_y – PE_y - LE_y$$

As mentioned above, since there are no project emission and leakage emission, the emission reduction will be equal to baseline emission.

$$ER_y = BE_y$$

Therefore the emission reduction ER_y is equal to BE_y as table above.

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)
01/01/2013 – 31/12/2013	9,027	0	0	9,027
01/01/2014 – 31/12/2014	8,981	0	0	8,981
01/01/2015 – 31/12/2015	8,936	0	0	8,936
01/01/2016 – 31/12/2016	8,891	0	0	8,891
01/01/2017 – 31/12/2017	8,846	0	0	8,846
01/01/2018 – 31/12/2018	8,801	0	0	8,801
01/01/2019 – 31/12/2019	8,757	0	0	8,757
Total	62,239	0	0	62,239
Total number of crediting years	7			
Annual average over the crediting period	8,891	0	0	8,891

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

(Copy this table for each piece of data and parameter.)

Data / Parameter	$EG_{facility,y}$
Unit	MWh/y
Description	Quantity of net electricity supplied by the project activity to the grid in year y
Source of data	Measured data by electricity meters
Value(s) applied	

Year	1	2	3	4	5	6	7
Value	16,254	16,172	16,091	16,009	15,929	15,848	15,768

Measurement methods and procedures	This parameter shall be measured using electricity meter(s), with accuracy class of 0.5S, owned by government institution (PEA meter). The parameter is the difference between the measured electricity exported to the grid and the measured electricity imported from the grid by the project activity. This is in line with AMS-I.D which states that *"The net electricity export/supplied to a grid is the difference between the measured quantities of the grid electricity export and the import"* as formula below: $EG_{facility,y} = EG_{export,y} - EC_{import,y}$ Where $EG_{facility,y}$= Quantity of net electricity supplied by the project activity to the grid $EG_{export,y}$ = Quantity of electricity exported to the grid in year y (MWh) $EC_{import,y}$ = Quantity of electricity imported from the grid in year y (MWh)
Monitoring frequency	Continuous monitoring, hourly measurement and at least monthly recording. Readings are to be recorded in the form of meter reading reports from PEA, aggregated yearly and shall be archived. Readings are taken jointly by representative from SPP Three and PEA staff personnel.
QA/QC procedures	Measured data will be cross checked with sale/purchase records (invoices/receipts).
Purpose of data	Calculation of baseline emissions
Additional comment	The archived data shall be kept during the crediting period and two years after the end of the crediting period.

Data / Parameter	$EG_{export,y}$
Unit	MWh/y
Description	Quantity of electricity exported to the grid in year y
Source of data	On-site measurement
Value(s) applied	

Year	1	2	3	4	5	6	7
Value	16,405	16,323	16,242	16,160	16,080	15,999	15,919

Measurement methods and procedures	This parameter shall be measured using electricity meter(s), with accuracy class of 0.5S, owned by government institution (PEA meter).
Monitoring frequency	Continuous monitoring, hourly measurement and at least monthly recording. Readings are to be recorded in the form of meter reading reports from PEA, aggregated yearly and shall be archived. Readings are taken jointly by representative from SPP Three and PEA staff personnel.
QA/QC procedures	The electricity meter is under control of PEA and is maintained and calibrated in accordance with the PEA procedures but at least once in 3 years. The measurement results will be cross-checked with the sales and/or purchase invoices between SPP Three and PEA to ensure consistency.
Purpose of data	Calculation of baseline emissions
Additional comment	The archived data shall be kept during the crediting period and two years after the end of the crediting period.

Data / Parameter	$EC_{import,y}$
Unit	MWh/y
Description	Quantity of electricity imported from the grid in year y
Source of data	On-site measurement
Value(s) applied	151

Measurement methods and procedures	This parameter shall be measured using electricity meter(s), with accuracy class of 0.5S, owned by government institution (PEA meter).
Monitoring frequency	Continuous monitoring, hourly measurement and at least monthly recording. Readings are to be recorded in the form of meter reading reports from PEA, aggregated yearly and shall be archived. Readings are taken jointly by representative from SPP Three and PEA staff personnel.
QA/QC procedures	The electricity meter is under control of PEA and is maintained and calibrated in accordance with the PEA procedures but at least once in 3 years. The measurement results will be cross-checked with the sales and/or purchase invoices between SPP Three and PEA to ensure consistency.
Purpose of data	Calculation of baseline emissions
Additional comment	The archived data shall be kept during the crediting period and two years after the end of the crediting period.

B.7.2. Sampling plan

>>

Sampling plan is not required for the monitoring parameters.

B.7.3. Other elements of monitoring plan

>>

1. Operational and management structure

To ensure the smooth monitoring process, it is important to have a good monitoring team to execute a well-defined monitoring plan for the project activity. From this perspective, SPP Three established the operational and management structure as shown in Figure 4. The responsibility of data collecting, archiving, analyzing and reviewing is shared between different members of the CDM monitoring team. This team is composed of a General Manager, a CDM Manager, and a group of Operators and Technicians, as shown in the diagram below.

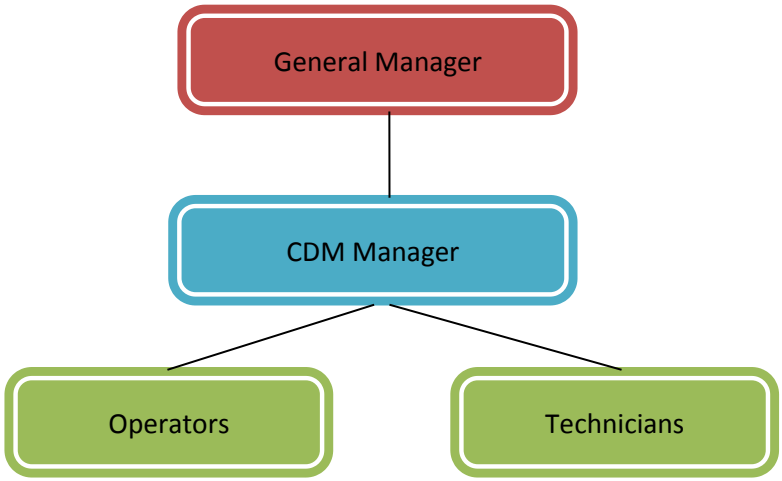

Figure 4: The CDM monitoring team

The roles and responsibilities of each team member are as follows:

A. General Manager

He/she is responsible for overall supervision of the whole project plant, including the CDM monitoring and verification activities as well as internal review of the monitoring records and the CDM monitoring reports.

B. CDM Manager

He/she is responsible to:

- Supervise the operators and technicians
- Review the monitoring data and monthly records
- Liaise with the CDM Advisor and the Verification DOE
- Track the CDM development of the Project
- Check the monitored data on-site and collect measured data regularly
- Archive collected data electronically and prepare the monitoring records monthly
- Cross-check the monitoring records with the sales and/or purchases invoices, if available
- Collect and archive the instrument calibration reports
- Report to the General Manager regularly
- Provide CDM training and CDM monitoring training

C. Operators

They are responsible to:

- Monitor the operation of monitoring instruments and meters
- Record the monitored data
- Report to the CDM Manager when the abnormal operation observes

D. Technicians

They are responsible for:

- Facilities, instruments and meters maintenance
- Ensuring smooth operation of each instrument and meter

Relevant team members will be given trainings on the measurement methods to be applied for each parameter, as well as data monitoring and recording requirements. During the crediting period, on-the-job training will also be provided whenever necessary.

2. Monitoring instrument

The parameters that are used to calculate emission reduction include the net electricity supplied by the project activity to the grid ($EG_{facility,y}$) and the carbon dioxide emission factor of the grid ($EF_{CO2,grid,y}$). The $EF_{CO2,grid,y}$, which is set ex-ante, will be updated upon renewal of crediting period, whereas $EG_{facility,y}$ will be monitored throughout the crediting period.

The net electricity supplied by the project activity to the grid ($EG_{facility,y}$) is monitored as the difference between the quantity of electricity exported to the grid ($EG_{export,y}$) and the quantity of electricity imported from the grid ($EC_{import,y}$) due to the on-site auxiliary consumption by the project activity (when plant is not operated).

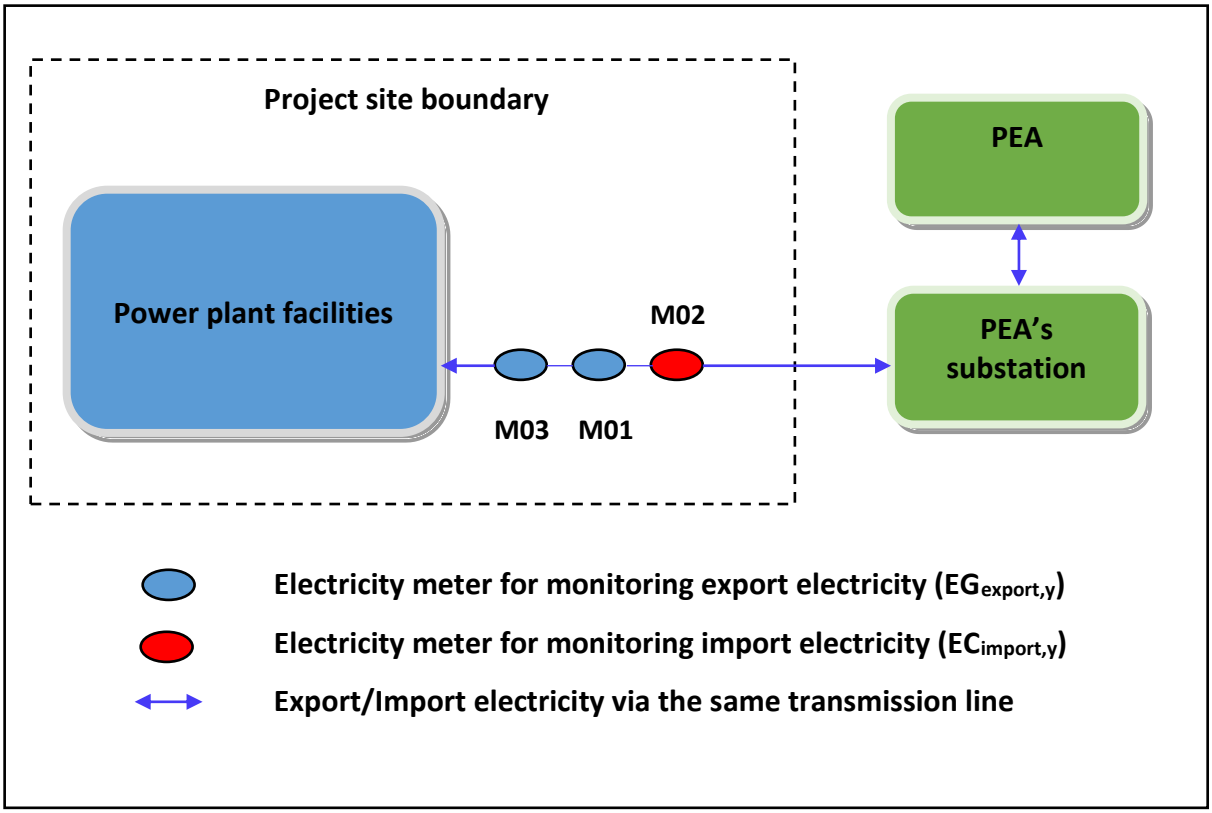

Figure 5: A simplified monitoring plan of the Project

As per detailed explanation in section A.3 and as per Figure 5 above, a main electricity meter **[M01]** (in addition to an electricity meter **[M03]** for the sake of SPP Three's internal reference only) was installed at the project site to monitor the quantity of electricity exported to the grid ($EG_{export,y}$). Another main electricity meter **[M02]** was installed at the project site for the monitoring of the quantity of electricity imported from the grid ($EC_{import,y}$), when plant is not operated. In an emergency event when the reading from one of the main electricity meters is inaccurate or malfunctioning, the reading from the other meter can be used as a backup[15]. Specifications of both export and import electricity meters are in accordance with PEA, with an accuracy class of 0.5S.

To meet the standard of quality assurance and quality control (QA/QC), all the meters at the power plant will be regularly checked and calibrated according to the PEA procedures or manufacturer specifications where appropriate. The calibration records will be maintained on site for verification.

3. Data monitoring and management system

The parameters stipulated in Section B.7.1 shall be monitored as per the set monitoring frequency in the monitoring plan and logged at a predetermined time either manually and/or electronically by the Operators. The CDM Manager will review the monitored data and archive the collected data electronically monthly, unless otherwise stated in Section B.7.1. The archived results will then be analyzed and cross-checked against the sales and/or purchases invoices, if available, by the CDM Manager. As part of the internal quality control and assurance process, the monthly records will be submitted to the General Manager for internal review.

For the sake of verification, a CDM Monitoring Report, which contains estimated delivered emission reductions, status of plant operation and maintenance, instrument calibration certificates,

[15] Both export electricity meter **[M01]** and import electricity meter **[M02]** are bi-directional meters. Each meter monitors and records both export and import readings at the same time.

etc., will be prepared by CDM Advisor. This essential report will then be reviewed by the General Manager before submitting to a DOE for emission reduction verification.

In compliance with the methodology, all data collected as part of monitoring shall be archived electronically and be kept at least 2 years after the end of the crediting period or the last issuance of CERs for the project activity, whichever occurs later. 100% of the data should be monitored if not indicated otherwise in Section B.7.1. All meters shall be calibrated regularly as per PEA procedures, but at least once in 3 years.

Furthermore, there will be CDM training and CDM monitoring training for the team members. The training will be done at least once every two years.

B.7.4. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

>>

Date of completion of study on application of the selected methodology was on 25/10/2012.

The selected methodology was applied by:

Carbon Partners Asiatica (HK) Co., Ltd.
Suite 1402, World Commerce Centre,
11 Canton Road, Tsim Sha Tsui,
Kowloon, Hong Kong
(Tel: +852-31010131 / Fax: +852-36221360)
www.cp-asiatica.com

CDM Advisor
Ms. Kyoko Tochikawa (kyoko.tochikawa@cp-asiatica.com)
Ms. Coty Tsui (coty.tsui@cp-asiatica.com)

Carbon Partners Asiatica is the CDM advisor and a project participant to the Project.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>

The start date of the project activity is 14/01/2011. This is the date when the land was purchased.

C.1.2. Expected operational lifetime of project activity

>>

25 Years 00 Months.

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>

Renewable crediting period.
The project is currently in its first crediting period.

C.2.2. Start date of crediting period

>>
01/01/2013.

C.2.3. Length of crediting period

>>
7 Years and 00 Months

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
With reference to the National Environmental Quality Act of Thailand, a solar power plant is not categorised as one of the project activities that is required to submit an Environmental Impact Assessment (EIA) report to the Office of National Resources and Environmental Policy and Planning (ONEP) for national approval[16].

However, in compliance with the host country DNA (TGO) regulation, an Initial Environmental Evaluation (IEE) Report shall be conducted for the proposed project. The IEE was prepared by an IEE consultant.

The IEE report has been prepared to initially assess potential impacts for the Project's entire life cycle on the local environmental quality and communities. The assessment provides a set of impact mitigation measures as well as monitoring measure for the Project to pursue in order to ensure minimized adverse impacts on the environment and communities nearby.

The IEE assesses all environmental aspects of the Project from construction phase through to operation phase. The overall results of the IEE were favourable and it is demonstrated that no negative impacts were identified. For the sake of avoidance or mitigation of any potential impacts on our environment, a series of environmental impact prevention and mitigation measures are suggested to be implemented during each period.

Table 6: Summary of potential pollution source

Potential pollution source	Environmental impact prevention and mitigation measures	
	Construction period	Operation period
Air pollution	- The impact was caused by the site preparation, the site levelling of the project site or transportation. Especially during the construction of the concrete poles. Most of the dusts were heavy and fell close to its origin. The dusts were mostly larger than 10 microns did not fall far from the project site. - Measures adopted to minimize dust generation include (a) frequently sprayed the dusty areas by water, (b) constructed the fence with at least two meters height around the project to control the dust from spreading and (c) limited	- No air pollution source is expected.

[16] Data are sourced from the following link: http://www.onep.go.th/eia

	the speed and number of vehicles within project site	
Light pollution	- The impact of the light and its reflection were based on the movement of the sun from east to west. - On temporary basis, cover site perimeter with cloth or plastic sheet to prevent the reflection during the installation of the solar cells.	- The impact of the light and its reflection will be based on the movement of the sun from east to west. - After the operation, trees will be planted to help prevent the reflection to the nearby area.
Noise pollution	- Noise and vibration were generated during construction by heavy construction machinery. - Though these impacts were short-term, mitigation measures were taken to protect the labours and nearby residents. These involved (a) avoidance of construction activities between 5:00pm and 8:00am, and (b) provision of protection equipments, such as ear-muffs, masks and helmets, to the workers.	- No noise pollution source is expected from the power production process.
Solid waste	- 0.8 kg/person/day of solid waste was estimated to be generated by labours. All solid wastes were temporarily stored in the rubbish bags or containers at the site and were collected and treated by a licensed company.	- The waste will be produced from the office and the employees. The project has the system to manage and recycles the waste by dividing the garbage bin within the project area. - All of the wastes above are to be collected and treated by municipality and by the licensed company.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>

The local stakeholder consultation took place on the 20th January 2010, at conference room at Ta Klao Sub-district Administrative Organization, Ta Klo Sub-district, Benchalak District, Srisaket Province. Invitation letters were sent out to the villagers at Moo 2 and Moo 3 of Ta Klo Sub-district who are living within 1 km radius of the project area, and other stakeholders including community leaders and representative of local administrative organizations. The head of Moo 2 and Moo3 were responsible for gathering other villagers to attend the meeting. There were 94 people attended the meeting.

The objective of the meeting was to disclose the project information to the group, as well as exchange opinions between both parties toward the Project, both positive and negative potential impacts. The project information was presented to the audience in a clear and transparent manner. During the meeting, the stakeholders were given opportunities to ask questions and share their opinions about the Project.

Figure 6: Pictures taken during the stakeholder meeting

E.2. Summary of comments received

>>

During the meeting, the questions were invited from the participants. The questions were raised by the local villagers from Moo 3. The discussions were based on both the negative and positive concerns of the local villagers. The questions and responses are summarized below.

Question 1: Will there be a lot of reflections from the panels? Can this cause irritation to the nearby settlement or people driving by?

Response 1: The Project owner has considered the possibility and will make sure that during the construction of the power plant, the perimeter of the project site is covered with plastic sheet or cloth to prevent reflection during the construction. During the operation, trees will be grown to absorb some of the reflection from the panels.

Question 2: What kind of technology is being used for the Project? Where does the technology come from?

Response 2: The technology that is being used for the Project is polycrystalline solar panels from Hanwha SolarOne. The panels are manufactured from China but the Hanwha SolarOne is part of a well-known Korean Corporation.

Question 3: Will the light be turned on during the night? Could this be disturbing the rice grown in the nearby field?

Response 3: During the night time, the plant is not in operation and therefore there is no need to turn on all the light. There will be minimal lighting coming from the power plant and this will not affect the rice field in anyway.

Question 4: How could the community benefit from the Project?

Response 4: Aside from providing a clean energy to the local community, the Project is expected to provide job opportunities for the local people, during both construction and operation of the project. The Project will also follow the rules and regulations to ensure that no negative impact will be caused by the project.

All questions were duly answered and no subsequent concerns or comments were raised. In addition, no formal comments have been received from the stakeholders. At the end of the meeting, most of the participants expressed their satisfaction on the project.

E.3. Report on consideration of comments received

>>
There were no negative comments received from the local stakeholders, thus no further action was taken.

SECTION F. Approval and authorization

>>
The Letters of Approval (LoAs) are not available at the time of submitting the PDD to the validating DOE. However, currently, LOAs have been received and forwarded 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	SPP Three Co., Ltd.
Street/P.O. Box	222 Moo 5, Vibhavadi Rangsit Road
Building	EGCO Tower
City	Bangkok
State/Region	Tungsonghong, Laksi
Postcode	10210
Country	Thailand
Telephone	+66-2-998-5999
Fax	+66-2-955-0931
E-mail	yuthapong.cho@egco.com
Website	
Contact person	Yuthapong Chokjarernwanit
Title	General Manager – Power Plant Business 1
Salutation	Mr.
Last name	Chokjarernwanit
Middle name	-
First name	Yuthapong
Department	-
Mobile	+66-83-116-0149
Direct fax	+66-2-955-0931
Direct tel.	+66-2-998-5410
Personal e-mail	yuthapong.cho@egco.com

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	Carbon Partners Asiatica (Hong Kong) Co., Ltd.
Street/P.O. Box	11 Canton Road
Building	Suite 1402 World Commerce Centre
City	Tsim Sha Tsui
State/Region	Kowloon
Postcode	-
Country	Hong Kong
Telephone	+852-3101- 0131
Fax	+852-3622-1360
E-mail	kyoko.tochikawa@cp-asiatica.com
Website	www.cp-asiatica.com
Contact person	Kyoko Tochikawa
Title	Managing Director
Salutation	Ms.
Last name	Tochikawa
Middle name	-
First name	Kyoko
Department	-
Mobile	-
Direct fax	-
Direct tel.	+852-3101-0131
Personal e-mail	kyoko.tochikawa@cp-asiatica.com

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	Asian Development Bank, as trustee of the Future Carbon Fund
Street/P.O. Box	6 ADB Avenue
Building	-
City	Mandaluyong City
State/Region	Metro Manila
Postcode	1550
Country	Philippines
Telephone	+63 2 632 4444
Fax	+63 2 636 4444
E-mail	futurecarbonfund@adb.org
Website	-
Contact person	Ma. Carmela D. Locsin
Title	-
Salutation	Ms.
Last name	Locsin
Middle name	-
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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
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Appendix 2. Affirmation regarding public funding

There is no public funding involve in the project activity.

Appendix 3. Applicability of methodology and standardized baseline

Supporting documents for the applicability conditions of AMS-I.D.

1. Operation license (Ror Ngor 4) for SPP Three's solar power plant
2. Power Purchase Agreement (PPA) with PEA
3. Signed EPC contract with SunEdison Engineering Co.,Ltd.
4. Land purchase agreement
5. The maximum output capacity of the project activity is 9.628MWp. This is based on site survey summary of PV modules arrangement for the project as below.

Summary of PV Modules Arrangement for the Project (based on confirmation from Toyo-Thai report)

Area No.	Inverter		PV Module	
	Tag No.	250kW Block No.	Pnom (W)	Q'ty
Area-01	INV-1A	01	285	960
		02	285	1160
	INV-1B	01	285	960
		02	285	1160
Area-02	INV-2A	01	285	960
		02	285	1160
	INV-2B	01	285	960
		02	285	1160
Area-03	INV-3A	01	285	960
		02	285	1160
	INV-3B	01	285	960
		02	285	1160
Area-04	INV-4A	01	295	960
		02	285 295	900 220
	INV-4B	01	295	960
		02	285 295	900 220
Area-05	INV-5A	01	290	960
		02	290	1120
	INV-5B	01	290	960
		02	290	1120

Area-06	INV-6A	01	290	960
		02	290	1120
	INV-6B	01	290	960
		02	290	1120
Area-07	INV-7A	01	290	960
		02	280 290	880 240
	INV-7B	01	290	960
		02	280 290	880 240
Area-08	INV-8A	01	275 280	880 80
		02	275 280	440 760
	INV-8B	01	290	960
		02	280 290	920 200
Total				**33,600**

All of the documents have been provided to DOE during validation.

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

Calculation of the baseline emission factor ($EF_{grid,CM,y}$)

The CO_2 emissions factor for the grid system is sourced from "*The study of emission factor for electricity generation of Thailand in year 2010"*[17] (hereinafter referred to as the "Study"), published by Thailand Greenhouse Gas Management Organization (TGO) on 30 December 2011. TGO is a public organization under the Ministry of Natural Resources and Environment (MNRE) and is being the Designated National Authority for CDM (DNA-CDM) in Thailand. According to this documentation, this grid emission factor was determined based on the data given in the "*Electricity Statistic Annual Report 2008 – 2010"* and along with the procedure stipulated in latest methodological tool "*Tool to calculate the emission factor for an electricity system (version 02.2.1)"* (hereinafter referred to as the "EF Tool")

This methodological EF Tool determines the CO_2 emission factor for the displacement of electricity generated by power plants in an electricity system, by calculating the operating margin (OM), the build margin (BM) as well as the combined margin (CM), as follows:

Step 1: Identify the relevant electricity systems

Consistent with the requirements stipulated in the EF Tool, the delineations of the project electricity system and connected electricity systems that were published by the host country DNA, TGO, are applied. Following the Thai DNA delineation, the relevant electric power system of the project activity is Thailand's national grid. It is because the electricity transmission system of Thailand is considered as a single system since the transmission lines are networked throughout the country and owned by the Electricity Generating Authority of Thailand (EGAT). EGAT is the authority that regulates electricity generation and main transmission system, meanwhile Metropolitan Electricity Authority (MEA) is responsible for electricity distribution system in Bangkok and vicinity area, and Provincial Electricity Authority (PEA) is responsible for electricity distribution system in the rest of country.

The quantity of electricity generated and transmitted to the national grid can be obtained from the Electricity Statistic Annual Report 2008 – 2010 provided by EGAT. Data are categorized by electricity generation system, group of power producer (EGAT, Independent Power Producers (IPPs), Small Power Producers (SPPs) and type of power plant (LC/MR and Non LC/MR).

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

Project participant chosen Option I as provided in Step 2 of the EF Tool, where, only grid power plants are included in the calculation. It is because in Thailand the electricity data that generate and transmit to the national grid are available, while, the off-grid electricity data are not available.

Step 3: Select a method to determine the operating margin (OM)

The EF Tool offers four methods for the calculation of operating margin emission factor ($EF_{grid,OM,y}$), which include:
(a) Simple OM;
(b) Simple adjusted OM;
(c) Dispatch data analysis OM; or

[17] Data source:
http://www.tgo.or.th/english/index.php?option=com_content&view=article&id=178:thailand-grid-emission-2010-report&catid=50:tgos-research-projects&Itemid=40

(d) Average OM.

Out of the four methods, the simple OM method (Option a) is used, as low-cost/must-run (LC/MR) resources of the national grid was determined to be 6.32% of the total grid generation in average of the five most recent years, which constitute less than threshold limit of 50%, as shown in Table A1 below.

Table A1: The ratio of the low cost / must run (LC/MR) in the last 5 years (2006-2010)

	Electricity Generation (GWh)				
Generation Type	**EGAT**	**IPP**	**SPP**	**Total**	**Percentage**
2010					
Total	78,517.70	67,775.98	13,897.27	160,190.96	-
- Non LC/MR	73,185.41	67,775.98	11,642.33	152,603.73	-
- LC/MR[18]	5,332.30	0.00	2,254.94	7,587.23	**4.74%**
2009					
Total	66,488.10	64,840.72	13,971.37	145,300.19	-
- Non LC/MR	59,541.66	64,840.72	11,811.42	136,193.80	-
- LC/MR	6,946.44	0.00	2,159.95	9,106.39	**6.27%**
2008					
Total	63,719.02	67,420.14	14,092.83	145,232.00	-
- Non LC/MR	56,791.19	67,420.14	11,904.81	136,116.14	-
- LC/MR	6,927.83	0	2,188.03	9,115.86	**6.28%**
2007					
Total	67,704.95	62,233.44	14,426.00	144,364.39	**-**
- Non LC/MR	59,765.33	62,233.44	11,982.99	133,981.76	**-**
- LC/MR	7,939.62	0	2,443.02	10,382.64	**7.19%**
2006					
Total	70,409.11	55,360.65	13,652.19	139,421.94	**-**
- Non LC/MR	62,480.23	55,360.65	11,619.95	129,460.82	**-**
- LC/MR	7,928.88	0	2,032.23	9,961.12	**7.14%**
Average 5 year of LC/MR					**6.32%**

Between the *Ex-ante* and *Ex-post* options of the data vintages, the *Ex-ante* option of a 3-year generation –weighted average is chosen for the project activity. The simple OM emission factor is calculated 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 LC/MR power plants/units. Option B, which is based 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, provided in Step 4 of the EF Tool was chosen with the following reasons:

(a) The necessary data for Option A is not available (Net electricity generation and a CO_2 emission factor of each power plant unit);
(b) Only nuclear and renewable power generation are considered as LC/MR power sources and quantity of electricity supplied to the grid by these sources is known; and
(c) Off-grid power plants are not included in the calculation, as per reason provided in Step 2 that off-grid data in Thailand is not available.

[18] LC/MR power plants include hydropower and renewable energy (including biomass, solar and geothermal power)

Therefore, the simple OM emission factor ($EF_{grid,OMsimple,y}$) is calculated based on the net electricity supplied to the grid by all power plants serving the system, excluding LC/MR power plants/units and including electricity imports, and based on the fuel type(s) and total fuel consumption of the project electricity system, as follow:

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

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 LC/MR 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

The values of CO_2 emission from combustion of fossil fuel (per unit of fossil fuel) are shown in Table A2. Net Calorific Value (NCV) is obtained from data provided by the Department of Alternative Energy Department and Efficiency (DEDE), Ministry of Energy. The CO_2 Emission Factor of fossil fuel follows IPCC default values as specified in the *"2006 IPCC Guidelines for National Greenhouse Gas Inventories"*.

Table A2: Net Calorific Values ($NCV_{i,y}$) and CO_2 emission per unit of each type of fossil fuel

Fuel type[19]	Unit	Net Calorific Value[20]	CO_2 Emission Factor[21]	CO_2 Emission
		(MJ/Unit)	(tCO_2/TJ)	($kgCO_2$/Unit)
Natural Gas	scf.	1.02	54.30	0.055
Lignite	ton	10,470.00	90.90	951.723
Bituminous	ton	26,370.00	89.50	2,360.115
Bunker	liter	39.77	75.50	3.003
Diesel	liter	36.42	72.60	2.644

Table A3: Comparison of the name of fuel type sourced from different reports

The Study[22]	DEDE[23] (Thailand)	IPCC[24]
Natural Gas	Natural Gas (Dry)	Natural Gas
Lignite	Lignite (Mae Moh)	Lignite
Bituminous	Coal Import	Other Bituminous Coal
Bunker	Fuel Oil	Residual Fuel Oil
Diesel	Diesel	Diesel Oil

[19] See Table A3: Comparison of the name of fuel type sourced from different report

[20] Electric Power in Thailand 2010/Department of Alternative Energy Development and Efficiency, Ministry of Energy

[21] IPCC default values at the lower limit as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guideline for National Greenhouse Gas Inventories

[22] The Study of emission factor for an electricity system in Thailand 2010

[23] Electric Power in Thailand 2010/ Department of Alternative Energy and Efficiency, Ministry of Energy

[24] 2006 IPCC Guideline for National Greenhouse Gas Inventories

The quantity of electricity generated and delivered to the national grid can be obtained from the *"Electricity Statistic Annual Report 2008 – 2010"*, as shown in Table A4. Data are categorized by electricity generation system, group of power procedure (EGAT, IPPs, SPPs) and type of power plant and quantity of electricity generated by non LC/MR power plants. Quantity and type of fossil fuel consumed in electricity generation are also obtained from the "Electricity Statistic Annaul Report 2008 – 2010", as shown in Table A5.

Table A4: Quantity of electricity generated and delivered to the national grid[25] (excluding LC/MR power plants/units), EG_y

Generation System	Electricity Generated and Delivered to the Grid (EG_y, GWh)			
	EGAT	IPP	SPP	Total
(2010)				
Total non LC/MR	**73,185.41**	**67,775.98**	**11,642.33**	**152,603.73**
Thermal	27,289.03	15,408.42	2,162.89	44,860.34
Combined-Cycle	38,338.71	52,367.56	8,655.76	99,362.04
Gas Turbine	276.3	-	823.67	1,099.97
Diesel Engine	3.98	-	-	3.98
Electricity Import	7,277.39	-	-	7,277.39
(2009)				
Total non LC/MR	**59,541.66**	**64,840.72**	**11,811.42**	**136,193.80**
Thermal	23,463.69	12,388.03	2,225.63	38,077.35
Combined-Cycle	33,164.46	52,452.69	8,752.19	94,369.35
Gas Turbine	309.63	-	833.60	1,143.23
Diesel Engine	1.44	-	-	1.44
Electricity Import	2,602.43	-	-	2,602.43
(2008)				
Total non LC/MR	**56,791.19**	**67,420.14**	**11,904.81**	**136,116.14**
Thermal	26,778.89	14,398.34	1,996.83	43,174.06
Combined-Cycle	26,449.20	53,021.80	9,029.90	88,500.90
Gas Turbine	659.33	-	878.07	1,537.41
Diesel Engine	2.30	-	-	2.30
Electricity Import	2,901.47	-	-	2,901.47

Table A5: Amount of fossil fuel consumed by power plants[26] (excluding LC/MR power plants/units), $FC_{i,y}$

Fuel Type	Unit	Fuel Consumption			
		EGAT	IPP	SPP	Total
(2010)					
Natural Gas	scf.	430,662,249,446	491,131,955,423	151,290,468,150	1,073,084,673,019
Lignite	ton	16,043,174	-	-	16,043,174
Bituminous	ton	-	3,646,898	1,855,262	5,502,160
Bunker	liter	140,084,467	87,347,782	5,797,497	233,229,746
Diesel	liter	11,865,427	10,853,795	1,307,336	24,026,558
(2009)					
Natural Gas	scf.	369,146,214,392	459,228,417,361	140,550,086,056	968,924,717,809

[25] Electricity Statistic Annual Report 2008 – 2010/ Electricity Generating Authority of Thailand (EGAT)

[26] Electricity Statistic Annual Report 2008 – 2010/ Electricity Generating Authority of Thailand (EGAT)

Lignite	ton	15,818,265	-	-	15,818,265
Bituminous	ton	-	3,645,721	1,840,527	5,486,248
Bunker	liter	111,039,065	38,180,874	8,797,506	158,017,445
Diesel	liter	12,140,891	-	1,685,046	13,825,937
(2008)					
Natural Gas	scf.	340,739,529,461	490,866,999,785	145,410,364,035	977,016,893,281
Lignite	ton	16,407,465	-	-	16,407,465
Bituminous	ton	-	3,711,791	1,866,776	5,578,567
Bunker	liter	247,441,682	93,212,260	9,555,452	350,209,394
Diesel	liter	6,792,039	43,698,832	1,451,087	51,941,958

Table A6 summarizes the calculated CO_2 emissions from electricity generation in the years 2008 – 2010 categorized by fuel types. The total emissions during the 3-year period were 254,714,130 tCO2. The results in Table A6 show that the 3-year weighted average simple OM emission factor is 0.5994 tCO2/MWh.

Table A6: Determination of the simple OM emission factor, $EF_{grid,OMsimple,y}$

Fuel type	Fuel Consumption ($FC_{i,y}$)		NCV of fossil fuels, $NCV_{i,y}$ (MJ/Unit)	CO_2 Emission Factor of Fossil Fuel, $EF_{CO2i,y}$ (tCO_2/TJ)	Electricity Generated and Delivered to Grid, EG_y (MWh)	CO_2 Emissions (tCO_2)	OM Emission Factor (tCO_2/MWh)
	Unit	Volume/mass					
(2010)							
Total					**152,603,730**	**88,452,088**	
Natural Gas	scf.	1,073,084,673,019	1.02	54.3		59,433,868	
Lignite	ton	16,043,174	10,470	90.9		15,268,658	**0.5796**
Bituminous	ton	5,502,160	26,370	89.5	152,603,730	12,985,730	
Bunker	liter	233,229,746	39.8	75.5		700,304	
Diesel	liter	24,026,558	36.4	72.6		63,528	
(2009)							
Total					**136,193,800**	**82,178,673**	
Natural Gas	scf.	968,924,717,809	1.02	54.3		53,664,864	
Lignite	ton	15,818,265	10,470	90.9		15,054,607	**0.6034**
Bituminous	ton	5,486,248	26,370	89.5	136,193,800	12,948,176	
Bunker	liter	158,017,445	39.8	75.5		474,469	
Diesel	liter	13,825,937	36.4	72.6		36,557	
(2008)							
Total					**136,116,140**	**84,083,369**	
Natural Gas	scf.	977,016,893,281	1.02	54.3		54,113,058	
Lignite	ton	16,407,465	10,470	90.9		15,615,362	**0.6177**
Bituminous	ton	5,578,567	26,370	89.5	136,116,140	13,166,060	
Bunker	liter	350,209,394	39.8	75.5		1,051,551	
Diesel	liter	51,941,958	36.4	72.6		137,339	
Average simple OM Emission Factor, $EF_{grid,OMsimple,y}$, during 2008 - 2010							**0.5994**

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

The build margin is calculated as the generation-weighted average emission factor of a sample group of power plants. The sample group of power units m used to calculate the build margin

should be determined as per the following procedure, consistent with the data vintage selected above:

(a) Identify Tthe set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently (SET5-units) and determine their annual electricity generation (AEGSET-5-units, in MWh) that have been built most recently; or

(b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEGtotal, in MWh). Identify Tthe set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEGtotal (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) (SET≥20%) and determine their annual electricity generation (AEGSET-≥20%, in MWh).

From these two options, the sample group that comprises the larger annual generation is to be chosen. In the case of the Thailand's national grid, the annual electricity generation estimated under Option (a) equals to 10,815,570 MWh (AEGSET-5-units), whereas that under Option (b) equals to 32,934,250MWh (AEGSET-≥20%), which is equivalent to 20.56% of the total national grid generation in 2010 (AEGtotal = 160,190,960 MWh). Therefore, Option (b) is chosen.

Table A7: Annual electricity generation of the set of five power units in Option (a)

Power Unit	Commissioning Date	Grid Generation (MWh)[27]
1. North Bangkok Power Plant (Unit 01)	19-Nov-10	1,584,220
2. Bangpakong Power Plant (Unit 05)	16-Sep-09	4,643,220
3. Phu Kieaw Bio Power Project 2	15-Sep-09	79,460
4. Dan Chang Bio Power Project 2	15-Sep-09	76,750
5. South Bangkok Power Plant (Unit 03)	1-Mar-09	4,431,920
Total annual electricity generation from 5 power units that started to supply electricity to the grid most recently (AEGSET-5-units)	-	**10,815,570**

Table A8: Annual electricity generation of the set of power units in Option (b)

Power Unit	Grid Generation (MWh)[28]	Accumulated MWh	Accumulated % as of total grid generation in 2010
1. North Bangkok Power Plant (Unit 01)	1,584,220	1,584,220	0.99%
2. Bangpakong Power Plant (Unit 05)	4,643,220	6,227,440	3.89%
3. Phu Kieaw Bio Power Project 2	79,460	6,306,900	3.94%
4. Dan Chang Bio Power Project 2	76,750	6,383,650	3.99%
5. South Bangkok Power Plant (Unit 03)	4,431,920	10,815,570	6.75%
6. Chana Power Plant (Unit 01)	5,090,020	15,905,590	9.93%
7. Ratchaburi Power Company Limited (RPCL) (Unit 1&2)	7,124,720	23,030,310	14.38%
8. Gulf Power Generation Co., Ltd. (Unit 1&2)	9,903,930	**32,934,250**	**20.56%**[29]

Between the Ex-ante and Ex-post options of the data vintages, the Ex-ante option is chosen for the project activity. For the first crediting period, the BM emission factor is calculated ex-ante based on the most recent information available on units already built for sample group m at the time of CDM-

[27] Electricity Statistic Annual Report 2010/Electricity Generating Authority of Thailand

[28] Electricity Statistic Annual Report 2010/ Electricity Generating Authority of Thailand

[29] As per Step 5 of the EF Tool, "if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation", therefore, electricity generation from Gulf Power Generation Co., Ltd (Unit 1&2) was included in the calculation.

PDD submission to the DOE for validation. For the second crediting period, the BM emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the BM emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

The build margin emission factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units *m* during the most recent year y for which electricity generation data is available. As represented in above, eight power plants listed in Table A8 comprise 20.56% of total national grid generation system in 2010, which has the larger generation than the group of power plants listed in Table A7. Therefore, the group of power plants in Option (b) of Step 5 is chosen and used for build margin emission factor calculation, shown below:

$$EF_{grid,BM,y} = \frac{\sum_m (EG_{m,y} \times EF_{EL,m,y})}{\sum_m EG_{m,y}}$$

Where:

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

The CO_2 emission factor of each power unit m ($EF_{EL,m,y}$) is determined as per the guidance in Option A1 of Step 4 as provided in the EF Tool as follows:

$$EF_{EL,m,y} = \frac{\sum_i (FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y})}{EG_{m,y}}$$

Where:

$FC_{i,m,y}$	=	Amount of fossil fuel type *i* consumed by power unit *m* 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)
i	=	All fossil fuel types combusted in power unit *m* in year *y*

Thus, the build margin CO_2 emission factor ($EF_{grid,BM,y}$) is then calculated by the following equation:

$$EF_{grid,BM,y} = \frac{\sum_i (FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y})}{EG_{m,y}}$$

Table A9: Build margin emission factor ($EF_{grid,BM,y}$) in 2010

Fuel type	Fuel Consumption,[30] $FC_{i,m,y}$		NCV of fossil fuels, $NCV_{i,y}$ (MJ/Unit)	CO_2 Emission Factor of Fossil Fuel, $EF_{CO2i,y}$ (tCO_2/TJ)	Electricity Generated and Delivered to Grid, $EG_{m,y}$ (MWh)	CO_2 Emissions (tCO_2)
	Unit	Volume/ mass				
Natural Gas	scf.	251,512,881,819	1.02	54.3	32,934,250	13,930,292
Lignite	ton		10,470	90.9		0

[30] Fuel consumptions of the most recently built power plants as listed in Table 8 are sourced from Electricity Report 2009/ Electricity Generating Authority of Thailand.

		-				
Bituminous	ton	-	26,370	89.5		0
Bunker	liter	-	39.8	75.5		0
Diesel	liter	1,179,772	36.4	72.6		3,119
				Total	**32,934,250**	**13,933,412**
BM Emission Factor, $EF_{grid,BM,y}$ (tCO_2/MWh)					**0.4231**	

Based on the above calculation, the resultant build margin (BM) emission factor is 0.4231 tCO_2/MWh.

Step 6: Calculate the combined margin emission factor

The combined margin emission factor ($EF_{grid,CM,y}$) is calculated as follows:

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

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 emission factor (%)
W_{BM} = Weighting of build margin emission factor (%)

As per the EF Tool, the weightings of OM and BM emission factors for a solar power project are 0.75 and 0.25 respectively for the first crediting period and for subsequent crediting periods. Table A10: demonstrates that the resultant combined margin (CM) CO_2 emission factor of Thailand's national grid is 0.5554 tCO_2/MWh, for a solar power project.

Table A10: Baseline emission factor of Thailand's national grid in 2010

Parameters	Solar power project
OM emission factor, $EF_{grid,OM,y}$ (tCO_2/MWh)	0.5994
Weighting of OM, W_{OM} (tCO_2/MWh)	0.75
BM emission factor, $EF_{grid,BM,y}$ (tCO_2/MWh)	0.4231
Weighting of BM, W_{BM} (tCO_2/MWh)	0.25
CM emission factor, $EF_{grid,CM,y}$ (tCO_2/MWh)	**0.5554**

Estimation of the annual electricity generation for the project (by the third party lenders engineer)

Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
MWh	16,405	16,323	16,242	16,160	16,080	15,999	15,919	15,840	15,760	15,682	15,603	15,525	15,448
Year	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	
MWh	15,370	15,293	15,217	15,141	15,065	14,990	14,915	14,840	14,766	14,692	14,619	14,546	

Appendix 5. Further background information on monitoring plan

Please refer to Section B.7. for details.

Appendix 6. Summary of post registration changes

1. Corrections

1. Number and accuracy level of the electricity meters

To enhance the accuracy of project description, the number of electricity meters installed on the same electricity transmission line at the project plant has been clarified in Figure 5 above. In addition to the main bi-directional electricity meters **[M01]** and **[M02]** for monitoring power exported to and imported from the grid respectively as per the registered PDD, an electricity meter **[M03]** has been installed to monitor power exported to/imported from the grid for the sake of SPP Three's internal reference only.

A typographical error on the accuracy level of the main bi-directional electricity meter for monitoring power exported to the grid via 22kV transmission line (i.e. meter M01 as referred in Figure 5 above) has been corrected from 0.2S to 0.5S, as per PEA's meter calibration report[31]. Please note that this electricity meter is owned by and under the control of PEA.

A typographical error on the accuracy level of the main bi-directional electricity meter for monitoring power imported from the grid via 22kV transmission line (i.e. meter M02 as referred in Figure 5 above) has been corrected from 0.2S to 0.5S, as per PEA's meter calibration report[32]. Please note that this electricity meter is owned by and under the control of PEA.

2. Description of the parameters $EG_{facility,y}$, $EG_{export,y}$ and $EC_{import,y}$

The name of the below parameters have been corrected/described consistently throughout the revised PDD:

- $EG_{facility,y}$ – from "Quantity of net electricity supplied to the grid in year *y*" to "Quantity of net electricity supplied by the project activity to the grid in year *y*".
- $EG_{export,y}$ – from "Quantity of net electricity exported to the grid in year *y*" and "Electricity exported to the grid in year *y*" to "Quantity of electricity exported to the grid in year *y*".
- $EC_{import,y}$ – from "Quantity of electricity imported from the grid by the project activity in year *y*" and "Quantity of electricity imported from the grid (when the plant is not operated) in year *y*" to "Quantity of electricity imported from the grid in year *y*".

3. Details of project participants[33]

The details of project participants have been updated in Section A.4. and Appendix 1 of the revised PDD based on the approved Modalities of Communication Statement and its Annex 2, valid as of 20/02/2015 and 19/02/2015 respectively.

2. Changes to start date of crediting period

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[31] The meter was installed before the plant's commercial operation on 21/02/2012 and the project's validation site visit on 18/09/2012. This meter has been inspected and approved by PEA before the plant's commercial operation date.

[32] The meter was installed before the plant's commercial operation on 21/02/2012 and the project's validation site visit on 18/09/2012. This meter has been inspected and approved by PEA before the plant's commercial operation date.

[33] Technically speaking, this correction is not necessary to be made in the revised PDD. However, SPP Three takes this opportunity to correct this information for the sake of transparency.

An email notification on the change of the first crediting period from 15/12/2012-14/12/2019 (in the registered PDD (Version 1.3)) to 01/01/2013-31/12/2019 has been submitted to the secretariat and was accepted by the secretariat on 29/01/2015[34]. Thus, the first crediting period has been updated to 01/01/2013-31/12/2019 in the revised PDD.

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[34] As per the CDM project cycle procedure, since the change to start date of crediting period is within one year, the project participants are not required to request for approval by the Board of the change but notified the secretariat by email.

Document information

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

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