Project design document form
(Version 11.0)

Complete this form in accordance with the instructions attached at the end of this form.

BASIC INFORMATION	
Title of the project activity	Cam Lam VN Solar Power Plant
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	3.4
Completion date of the PDD	03/06/2021
Project participants	Hanwha Energy Corporation Cam Lam Solar Joint Stock Company
Host Party	Viet Nam
Applied methodologies and standardized baselines	ACM0002 Version 19.0 "Grid-connected electricity generation from renewable sources"
Sectoral scopes	Sectoral Scope 01 Energy industries (renewable/non-renewable sources)
Estimated amount of annual average GHG emission reductions	66,991 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The Cam Lam VN Solar Power Plant is necessary to supplement the power supply, as the demand for electricity will gradually increase due to continuous development country wise and at province level. The power will contribute to reduce environmental pollution by providing clean energy sources in line with the general sustainable development trend of the world. The project use ~~poly-~~ Mono-Si photovoltaic cells without any backup generators and will generate 100% clean energy to be fed into the national grid.

The 50 MW project is installation of a new power plant at the site and is not a capacity addition or retrofit or replacement of any other existing plant. So the current baseline scenario is the energy that is being fed into the national grid through other power plants, the details of which would be provided in the document later, and the project scenario is a clean Greenfield power plant that would generate energy and supply it to the national grid. This energy would help reduce the energy deficit of the country by supplying the electricity through the grid.

The project would be generating around 78,885 MWh of electricity on average for the first crediting period as per the data from the contractor and would thus be reducing 66,991 tonnes of CO_2 from the atmosphere annually, thus generating 66,991 CERs for the relevant crediting period. As the minimum power generation requirement that the power purchaser requested is 78,885MWh and the minimum power generation requirement can be achieved at a performance Ratio 79.84%, the average electricity generation from this project is capable to meet the requirement during the crediting period.

The most significant improvement the project would be making the generation of electricity itself that would reduce the load shedding and the energy crisis to some extent and provide electricity to the local population. The entire solar park in the long run would play a critical role in attempting to bridge the supply demand gap that the country is facing at the moment.

A.2. Location of project activity

Khanh Hoa is a coastal province in the south of Vietnam, some of its territory extend farthest to the South China Sea.

- Host Country: Viet Nam
- Region/State/Province etc.: Khanh Hoa Province

- Town/City/community etc.: Cam Nghia Ward, Cam Ranh City
    - Geographical coordinates: 11°59`29.6322" N, 109°5`8.31" E

The project area had been used for annual crops production but it does not bring high productivity and inefficient to develop agriculture and forestry. At the same time, this position is not in the planning of other projects and there are no inhabitants. Therefore, priority should be given to the development of solar power plants in these areas to maximize land use efficiency.

There are natural advantages along with easy grid connection, roads and status, and favorable land use planning are important factors for the project to be feasible and gain high efficiency.

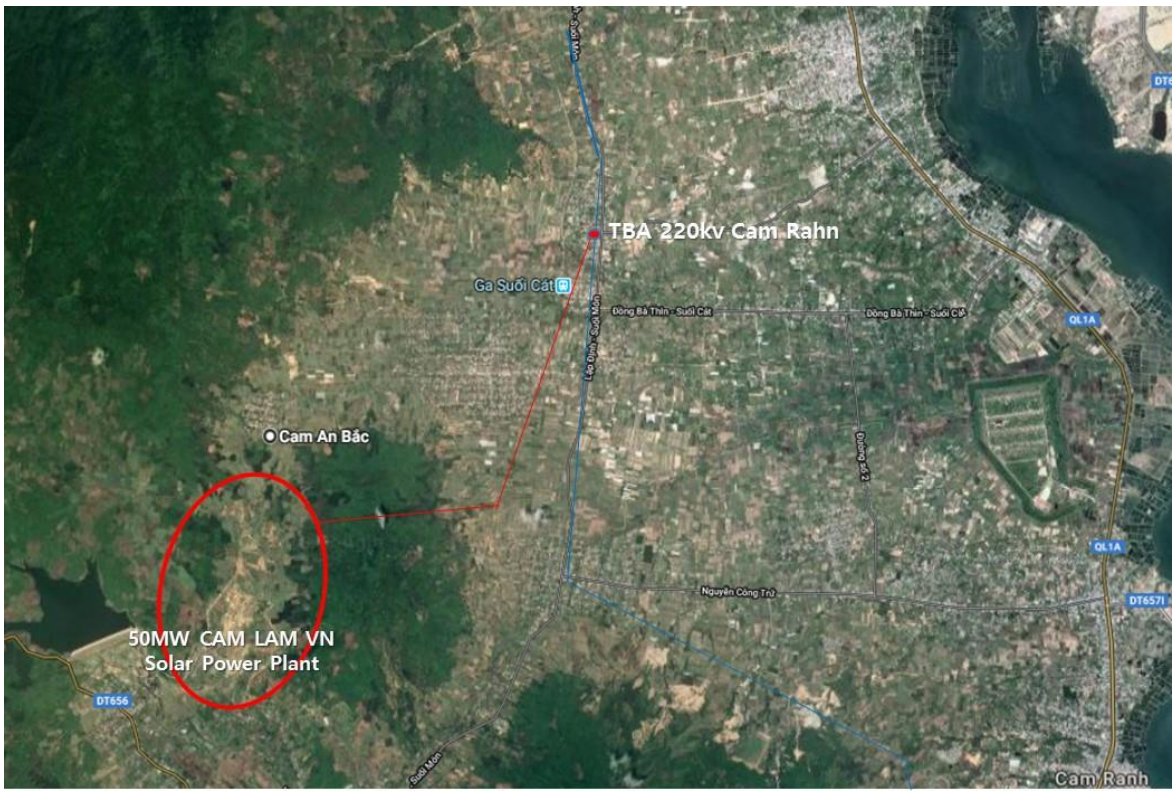


Figure 1 Location of Cam Lam VN Solar Power Project

A.3. Technologies/measures

Solar PV system use directly sunlight for electricity production tank to solar module systems. Solar modules are made of many different types of materials, manufactured by many processes and used widely for solar power projects in the world. Solar PV systems may only create electricity on day and power output will also vary according to different conditions of weather. However, Solar PV systems will produce max electricity on days hot days, where the needs for electricity is increasingly high.

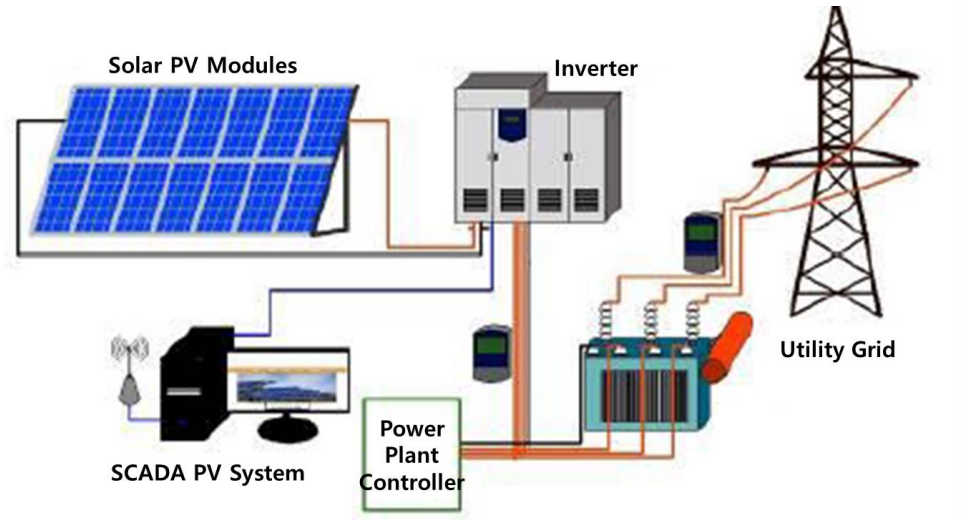


Figure 2 Typical grid-connected Solar Power Project

Solar PV modules will invert sunlight into DC current by photovoltaic effects. This energy will be converted into AC with the same frequency of the grid's current through frequency inverters. Multiple solar modules are connected, which can range from tens of watts (W) to tens of megawatts (MW). For solar panels manufactured for commercial purposes, the photovoltaic conversion efficiency of solar panels ranges from 14% to 20%. This technology mainly uses tow radiation components that are direct and diffused and suitable even in area with low direct radiation.

When designing the Cam Lam VN Solar Power Plant which has total capacity of 50 MW arranged with a layout area of about 60ha, the PP consider the following issues and select the main equipment.

Fixed flat PV module
PV modules will be fixed in a certain direction. This configuration will make the installation simple, and make installation and maintenance cost very low. The PV modules will be installed in a fixed direction so that PV modules receive solar radiation energy the most.

Solar panels
According to the operation license of the Cam Lam VN Solar Power Plant, PP uses a 144cell, Mono-Si with a capacity of 385Wp and 390Wp module.
According to Decision 11/QD-TTg of the Prime Minister on the mechanism for supporting the development of solar power, the efficiency of PV panels should be > 15%.

Inverter
With the development of inverter technology, for large-scale grid connected solar power plants, solutions using inverter power units with a capacity of, more than 500 KVA/inverter are suitable.

In the current phase, for large-scale grid connected solar power plants such as Cam Lam VN Solar Power Plant, the solution is to use central inverter units with a capacity of 1000KVA/inverter or more and use a suitable common configuration.

Summary of Equipment		
Installed capacity of the plant		50 MWp
Number of PV Modules	Sub-array #1 Q.PEAK DUO L-G5.3 390	76,160 PV Modules
		28 Modules in series
		2,720 strings in parallel
	Sub-array #2	51,744 PV Modules

	Q.PEAK DUO L-G5. 3 385	28 Modules in series
		1,848 strings in parallel
PV Module technology		Mono-Si, 144 cells
Array global power	Sub-array #1 Q.PEAK DUO L-G5. 3 390	Nominal(STC) 29,702 kWp
		At operating cond. 26,958 kWp (50℃)
	Sub-array #2 Q.PEAK DUO L-G5. 3 385	Nominal(STC) 19,921 kWp
		At operating cond. 18,072 kWp (50℃)
Tilt angle of PV modules		10°
Row to row		2 m
Total area		Module area 257,727 m^2
		Cell area 225,070 m^2
Number of inverter stations	Sub-array #1	18 cabinets typed 2500 kWac
Maximum capacity of AC power 50MW (10h - 12h)		45 MWac
Annual electricity output with a probability of 50%		**78,885 MWh/year (Expected)[1]**

Annual power output estimation is expressed with a range of values with certain reliability. P50 value is the estimation of the potential annual power output. The uncertainty of energy yield simulation software depends on each modelling stage and on the uncertainty in the input variables. Modelling software itself can introduce uncertainty of 2 percent to 3 percent. Uncertainty in other modelling inputs include estimates in downtime, estimates in soiling, uncertainty in the inter-annual variation in solar resource and errors due to module specification not accurately defiling the actual module characteristics.

Plant Monitoring

Large capacity inverter is built in communication modules and internal protocol processing. Input parameters (DC side) and output parameters(AC side) will measure and collect data such as current, voltage, power, frequency of solar module groups. Grid connection data, on-site status of the plant and real-time response data will be collected with 1 main meter with 0.2s class accuracy and 2 back-up meters with 0.5s class accuracy.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Viet Nam	Cam Lam Solar Joint Stock Company	No
Viet Nam	Hanwha Energy Corporation (Private entity)	No

A.5. Public funding of project activity

The project is not receiving any public funding from Annex-I countries.

A.6. History of project activity

We confirm that the proposed CDM project activity is neither registered as a CDM project activity nor included as a component project activity (CPA) in a registered CDM programme of activities

[1] Grid-Connected system :Simulation parameters and Result Report

(PoA). Also the proposed CDM project activity is not a project activity that has been deregistered.

A.7. Debundling

As this project is large-scale project activities, debundling assessment is not applicable.

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines

For this project activity applies the Approved consolidated baseline and monitoring methodology ACM 0002 "Grid-connected electricity generation from renewable sources" version 19.0, Sectoral Scope01.

This methodology also refers to the followings tools (available on the UNFCCC CDM website):

(a) "TOOL01: Tool for the demonstration and assessment of additionality";

(b) "TOOL02: Combined tool to identify the baseline scenario and demonstrate additionality";

(c) "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion";

(d) "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation";

(e) "TOOL07: Tool to calculate the emission factor for an electricity system";

(f) "TOOL10: Tool to determine the remaining lifetime of equipment";

(g) "TOOL11: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period".

The tools that accompany the methodology and are referred-to in the methodology, for the purpose of calculations, are as follows.

"TOOL07: Tool to calculate *the emission factor for an electricity system" (Versions 7.0)*

B.2. Applicability of methodologies and standardized baselines

Project participants choose Approved Consolidated Methodology ACM0002 version 19.0 to develop the project activity design document due to the fact that this methodology is applicable to grid-connected renewable power generation project activities that involve the installation of a new power plant. The project activity fulfils the applicability conditions of the methodology as follows:

Renewable Resources	Project scale	Grid Connected
Solar Photovoltaic	50MW	Connected to National Grid Install a Greenfield power plant

The 50MW solar PV project is a newly installed Greenfield power project, which is neither a retrofit nor a capacity addition and does not involve switching from fossil fuels to renewable energy sources.

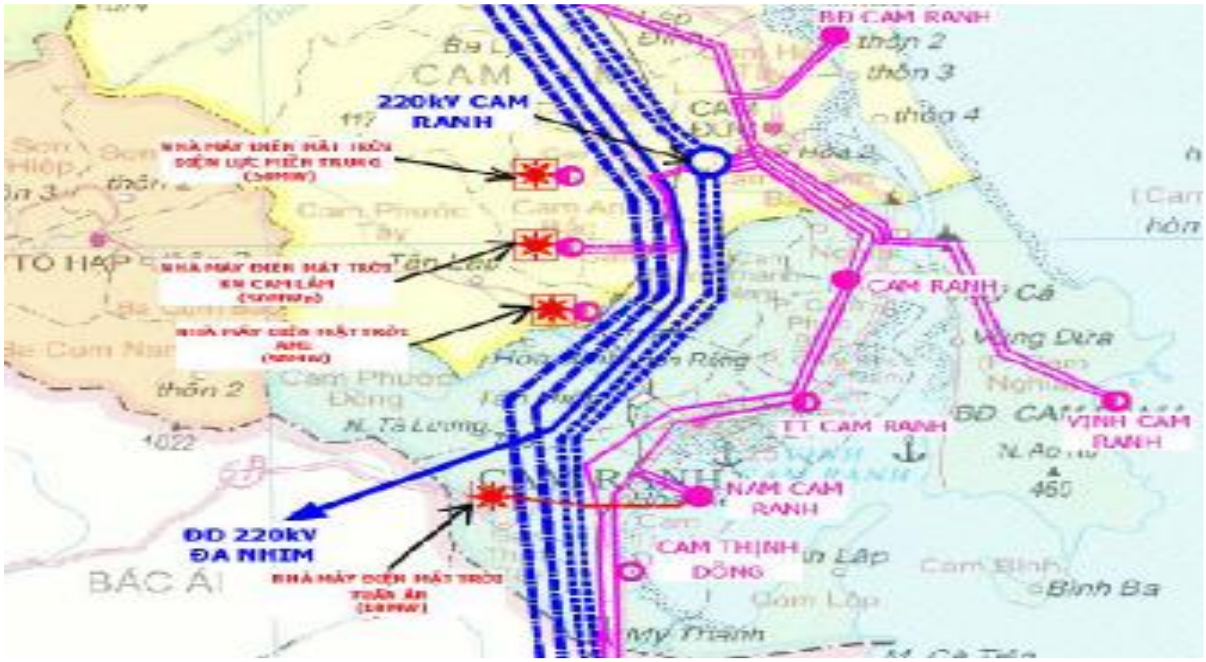


Figure 3 Connection Map of CAM LAM VN solar power plant to grid

With a total installed capacity of 50MWp and based on the plant's location, existing regional grid, and future grid development planning, the Cam Lam VN Solar Power Plant with capacity connected to the grid by 110kV voltage. Electricity generated by the project is connecting to 110kV busbar of 110kV substation to contect the plant with the national power system.

B.3. Project boundary, sources and greenhouse gases (GHGs)

According to ACM0002 version 19.0, the project boundary is "The spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system". In the project area, there are solar power plants approved and added to the power development plan of Khanh Hoa province.

The greenhouse gases and emission sources included in or excluded from the project boundary are shown in Table as follow;

Source		GHG	Included?	Justification/Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project activity	Any relevant emissions from the project activity	CO_2	No	Not applicable for solar PV project
		CH_4	No	Not applicable for solar PV project
		N_2O	No	Not applicable for solar PV project

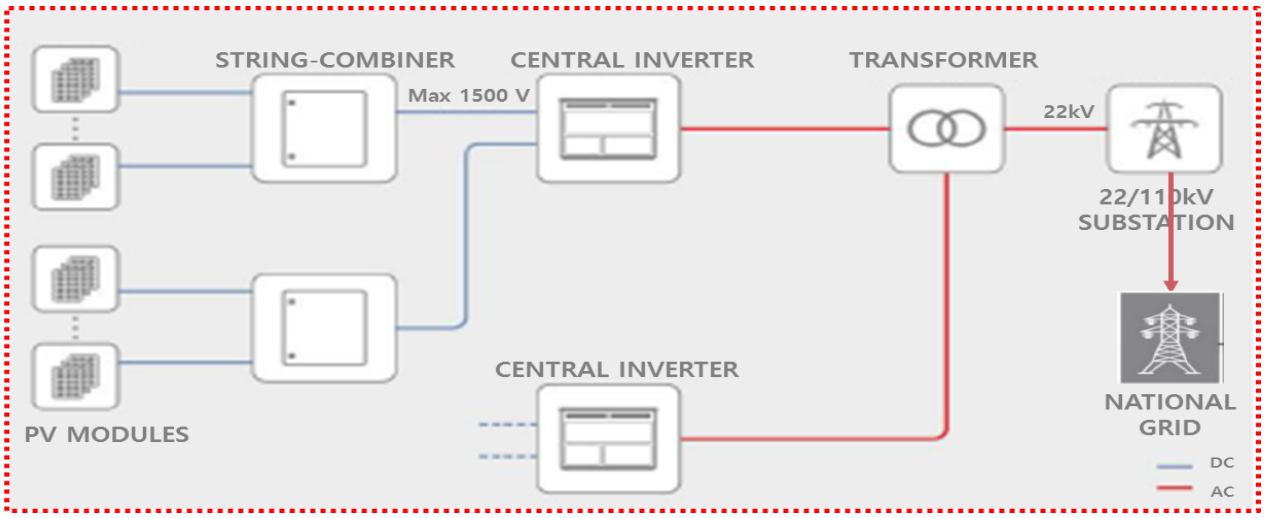


Figure 4 Project Boundary

The plant does not have any emission sources and GHGs within the project boundary that may need any monitoring. The plant boundary in the diagram is shown via a dotted line whereas, the project is connected to the national grid. The project boundary, thus, is depicted by solid line.

B.4. Establishment and description of baseline scenario

According to ACM0002 version 19.0, in case of the baseline scenario for the Greenfield power plant, the baseline scenario is electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in "TOOL07: Tool to calculate the emission factor for an electricity system". (Versions 7.0)

The Project activity is generation of electricity from renewable energy sources. The electricity generated from the solar PV plant has zero emissions; there is no material leakage and the electricity generated will be fed into the fossil intensive national grid through the interconnection facility at the site.

The grid in Viet Nam is partly composed of greenhouse gas intensive fossil fuel based power stations. The state-owned company Electricity of Viet Nam (EVN) dominates power production, transmission, and sales in Viet Nam. Vietnam has a large range of domestic primary energy sources such as crude oil, coal, natural gas and hydro power which have played an important role in ensuring energy security for economic development in the past two decades. With the increasing energy demand and recent fluctuations in energy import and export, Vietnam has become a net energy importer since 2015.

All power plants in Viet Nam are physically connected to the Viet Nam national electricity grid, which is operated and monopolized by the EVN. Thus, the baseline scenario of the proposed project is the delivery of equivalent amount of annual power output from the Viet Nam national grid to which the proposed project is also connected. The database for calculating the baseline is published by the DNA of Viet Nam.

One of the key assumptions made in determining the baseline is to treat the whole grid system as one entity. The grid system is not divided into provincial sub-groups (as in China for example). The only distinction made by the EVN as to categorize power stations are by power source (hydro power 37.6%, Coal fired power 34.3%, Gas fired 17.3%, Oil fired 3.3% others included diesel,

small hydro, renewables 5.8%, import 1.2%) and ownership (state, independent power producer, "build-operate-transfer").[2]

According to the official letter No.330 BDKH-GNPT published by DNA Vietnam on 29/03/2019, the operating margin emission factor $EF_{grid,OM,y}$ = 0.8336 tCO2/MWh; and the build margin emission factor $EF_{grid,BM,y}$ = 0.8961 tCO2/MWh which is not changed during monitoring period according to the TOOL 07 para 72&73, Option 1. And based on "Tool to calculate emission factor for an electricity system", the defaults weights value for solar power projects.

A conservative approach was taken by using the approved ACM0002 methodology, which states that the Project activity would replace the weighted average of the ratio of emissions in the system represented by:

(a) The Operating Margin (OM): the ratio of emissions from generation of all power generating projects in the defined system over the latest three year period excluding least cost/must run projects; and

(b) The Build Margin (BM): the generation-weighted average emission factor (tCO2/MWh) of all power units *m* during the most recent year *y* for which power generation data is available, calculated;

(C) The Combined Margin (CM): the default values established in the "Tool to calculate the emission factor for an electricity system" version 07 for the weighting of the OM (w_{OM} = 75%) and for the weighting of the BM (w_{BM} =25%)

Variables	Value	Source
Operating Margin Emission Factor	0.8336 tCO_2/MWh	Ministry of Natural Resources and Environment Vietnam (March 2019)
Build Margin Emission Factor	0.8961 tCO_2/MWh	
Combined Margin Emission Factor	0.8492 tCO_2/MWh (weighted average)	

The value are used in the calculation of the baseline emission factor respectively for Wind and solar power generation project activities, for the first crediting period and for subsequent crediting periods; The values for wOM + wBM applied by project participants should be fixed for a crediting period and may be revised at the renewal of the crediting period.

Accordingly, it is proposed to present in this PDD the measurement of emissions observed when comparing the "business as usual" case (without the project activity) with emissions under the project (the "project scenario" case). The baseline emission factor represents a conservative estimate of emissions per MWh of grid generation and the emissions "saved" per MWh of the project generation.

Vietnam's average electricity grid emission factor of 0.8492tCO2eq/MWh, as stipulated by the Government of Vietnam (Ministry of Natural Resources and Environment Vietnam) in March 2019 and the carbon dioxide intensity of the fuel source (other than electricity) used in the relevant industrial installations.

[2] Annual Report 2017 from EVN

B.5. Demonstration of additionality

Prior Consideration of the CDM
Cam Lam VN Solar Power Plant prior consideration was published on November 30th of 2018.[3]

Date	Milestone	Document
19 August 2018	Environmental protection plan Approval	Environment Protection Department
01 October 2018	Implementation of EPC contract	EPC Contract
27 November 2018	Approval of investment policy and application for investment certification	
30 November 2018	Prior Consideration Form submitted to the host country DNA and UNFCCC	Submission of Prior Consideration Form
21 June 2019	Power generation/multiplication capacity testing record between the National Load Dispatch Center	(VN)CV thoa thuan COD NM_Certification
27 June 2019	COD	(VN)CV thoa thuan COD NM_Certification

Additionality
According to simplified procedure to demonstrate additionality, presented in methodology ACM0002 version 19.0: The simplified procedure to demonstrate additionality is applicable to the following grid connected electricity generation technologies;

Positive list

(a) Solar photovoltaic technologies;
(b) Solar thermal electricity generation including concentrating Solar Power (CSP);
(c) Off-shore wind technologies;
(d) Marine wave technologies;
(e) Marine tidal technologies.

Cam Lam VN Solar Power Plant in Viet Nam uses photovoltaic technology to generate electricity and it connected to the Grand North Interconnected System; therefore, additionality of this project activity is demonstrated using the Simplified, presented in Section 5.3.1.of methodology ACM0002 v.19.0: A specific technology in the positive list is defined as automatically additional if at the time of PDD submission any of the following conditions is met:

According to simplified procedure to demonstrate additionality, presented in methodology ACM0002 version 19.0: A specific technology in the positive list is defined as automatically additional if at the time of PDD submission any of the following conditions is met:

[3] The prior consideration submitted as of two projects; 50MW CAM LAM Solar Power Project in Viet Nam.

(a) The percentage share of total installed capacity of the specific technology in the total installed grid connected power generation capacity in the host country is equal to or less than two per cent; or

(b) The total installed capacity of the technology in the host country is less than or equal to 50 MW

In Viet Nam, the total installed grid connected power generation capacity is 42,135[4] MW and the installed grid connected solar photovoltaic power plants are 106MW[5].
The percentage share of total installed capacity of the specific technology in the total installed grid connected power generation capacity in the host country is equal to about 0.25% (less than 2%).

The positive list of technologies indicated in paragraph 28 above is valid for two years from the date of entry into force of version 19.0 of ACM0002 on 31 August 2018. The Board may reassess the validity of these simplified procedures and extend or update them if needed. Any update of the simplified procedures does not affect the projects that request registration as a CDM project activity or a programme of activities by 30 August 2020 and apply the simplified procedures contained in version 19.0 of ACM0002.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows:

Equation (1)

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

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2/yr)
$EG_{PJ,y}$	=	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)
$EF_{grid,CM,y}$	=	Combined margin CO_2 emission factor for grid connected power generation in year *y* calculated using the latest version of "TOOL07: Tool to calculate the emission factor for an electricity system" (t CO_2/MWh)

If the project activity is the installation of a Greenfield power plant, then:

Equation (2)

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

[4] Installed capacity as 31st December 2016 from Vietnam Electricity Annual Report 2017

[5] Renewable Capacity Statistics 2019, International Renewable Energy Agency

Where:

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)

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

Leakage

No leakage emissions are considered. The emissions potentially arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, transport etc.) are neglected.

Emission Reductions

As per the methodology, "ACM0002 Version 19.0", emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$ Equation (3)

Where:

ER_y = Emission reductions in year *y* (t CO_2e/yr)

BE_y = Baseline emissions in year *y* (t CO_2/yr)

PE_y = Project emissions in year *y* (t CO_2e/yr)

B.6.2. Data and parameters fixed ex ante

Data/Parameter	$EF_{grid, OM,y}$
Data unit	tCO_2/MWh
Description	Operating Margin CO_2 emission factor in year y
Source of data	2017 Viet Nam Grid Emission Factor issued by Department of Climate Change, Ministry of Natural Resources and Environment
Value(s) applied	0.8336
Choice of data or measurement methods and procedures	Calculated as per "Tool to calculate the emission factor for an electricity system, version 07.0" as 3-year generation weighted average using data for the years 2015~2017. The data are obtained 2017 Viet Nam Grid Emission Factor issued by Department of Climate Change, Ministry of Natural Resources and Environment.
Purpose of data	For the calculation of baseline emission
Additional comment	

Data/Parameter	$EF_{grid, BM,y}$
Data unit	tCO_2/MWh
Description	Build Margin CO_2 emission factor in year y
Source of data	2017 Viet Nam Grid Emission Factor issued by Department of Climate Change, Ministry of Natural Resources and Environment
Value(s) applied	0.8961
Choice of data or measurement methods and procedures	Calculated as per "Tool to calculate the emission factor for an electricity system, version 07.0". The data are obtained 2017 Viet Nam Grid Emission Factor issued by Department of Climate Change, Ministry of Natural Resources and Environment.
Purpose of data	For the calculation of baseline emission
Additional comment	According to the Tool 07 para 72~73, Option 1 was chosen

Data/Parameter	$EF_{grid, CM,y}$
Data unit	tCO_2/MWh
Description	Combined Margin CO_2 emission factor in year y
Source of data	2017 Viet Nam Grid Emission Factor issued by Department of Climate Change, Ministry of Natural Resources and Environment
Value(s) applied	0.8492
Choice of data or measurement methods and procedures	Calculated as per "Tool to calculate the emission factor for an electricity system, version 07.0". The data are obtained 2017 Viet Nam Grid Emission Factor issued by Department of Climate Change, Ministry of Natural Resources and Environment.
Purpose of data	For the calculation of baseline emission
Additional comment	-

B.6.3. Ex ante calculation of emission reductions

Baseline Emissions

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

Where:

BE_y = Baseline emissions in year *y* (t CO_2/yr)

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)

$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year *y* calculated using the latest version of "TOOL07: Tool to calculate the emission factor for an electricity system" (t CO_2/MWh)

Total electricity generation = 78,885 MWh/yr

BE = 78,885 MWh × 0.8492 tCO_2/MWh
= 66,991 tCO_2

Project Emissions
The project emissions have been taken to be 0 as mentioned in section B.6.1.

$$PE_y = 0$$

Leakage
Leakage emissions are not considered and neglected as stated in section B.6.1.

Emission Reductions
As mentioned in section B.6.1, the emission reductions from a project can be calculated using the following formula:

$$ER_y = BE_y - PE_y$$

Where:

ER_y = Emission reductions in year *y* (t CO_2e/yr)

BE_y = Baseline emissions in year *y* (t CO_2/yr)

PE_y = Project emissions in year *y* (t CO_2e/yr)

Therefore, Emission reduction
$ER_y = BE_y – PE_y – LE_y$
$= 66{,}991\ tCO_2 – 0\ tCO_2 – 0\ tCO_2$
$= 66{,}991\ tCO_2$

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)
Year 1	66,991	0	0	66,991
Year 2	66,991	0	0	66,991
Year 3	66,991	0	0	66,991
Year 4	66,991	0	0	66,991
Year 5	66,991	0	0	66,991
Year 6	66,991	0	0	66,991
Year 7	66,991	0	0	66,991
Total	468,937	0	0	468,937
Total number of crediting	7 (Renewal)			
Annual average over the crediting period	66,991	0	0	66,991

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data/Parameter	$EG_{facility, y}$
Data unit	MWh/year
Description	Energy generated by the project activity and supplied to the national grid during the year (y), excluding imported electricity

<table>
<tr><td>Source of data</td><td>Standard metering measured by electricity meters (1 main meter and 2 back-up meters) of the net electricity supplied to the national grid

<table><tr><th>Meter</th><th>S/N</th><th>Calibration frequency (as per PPA)</th></tr><tr><td>Main</td><td>19030328</td><td>1 year</td></tr><tr><td>Back-up meter</td><td>19030582
19030585</td><td>1 year</td></tr></table></td></tr>
<tr><td>Value(s) applied</td><td>78,885</td></tr>
<tr><td>Measurement methods and procedures</td><td>Electricity generated would be measured and monitored by the electricity meters (1 main meter and 2 back-up meters) on a continuous basis and readings will be taken every month for billing to the power purchaser. The data would also be monitored using SCADA system, having a data storage that would keep track of the historical data. Archive of the data would be available for last 3 years.
However, the loss factor by the 12km transmission line to the measurement point was not considered on the SCADA system value.
The loss factor was calculated as k=0.99229 according to the metering agreement with EVNEPTC, and k=0.99229 is applied to monthly electricity sale INVOICE.
Therefore, when calculating the quantity of export electricity, the data is based on the INVOICE value to which 0.99229 is applied.</td></tr>
<tr><td>Monitoring frequency</td><td>Measuring Frequency: Continuous
Recording Frequency: Monthly</td></tr>
<tr><td>QA/QC procedures</td><td>All measurements should be conducted with calibrated measurement equipment according to the PPA.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of Certified Emission Reduction (CER) units</td></tr>
<tr><td>Additional comment</td><td>Settlement metering system shall be provided by operator in line with the PPA, Metering Agreement and latest version of the local regulations and laws (for example, the operational procedures from EVN).</td></tr>
</table>

B.7.2. Sampling plan

The data would not be collected through sampling. It would be available on ground and recorded as per the actual generation of electricity.

B.7.3. Other elements of monitoring plan

The power connection diagrams of the project is as under:

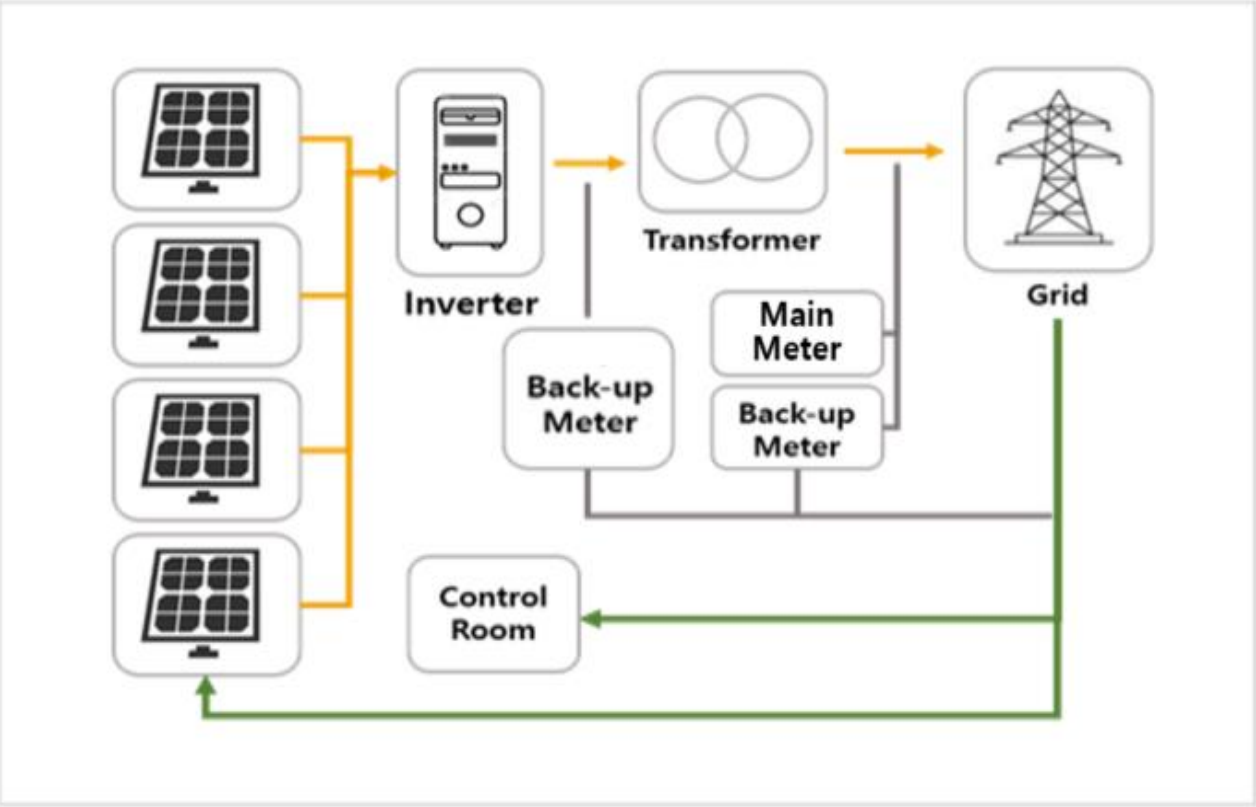


Figure 5 Monitoring diagram

One multi-function main meter is installed and sealed by the Power Purchaser, which gather the data for electricity generation and the reading from which is used to bill the purchaser for electricity. The main meter will also gather the data for electricity usage which is used for control room and operation of the plant. The main meter is between the transformer (T2) and the grid.
The company installed two back-up meters for its own reassurance of the meter readings of standard meters and to detect any potential fault between the grid. The details of meters are as follows:

Meter No.	**Parameter**	**Description**
Main	Metering Concept	Main meter for the billing
	Energy Meter Accuracy Class	0.2S
	The main metering location: at between the transformer (T2) and the grid	
Back up	Metering Concept	2 Back up meter for data management
	Energy Meter Accuracy Class	0.5S
	The backup metering locations: One at between the inverters and the transformer (T2), *and;* The other one at between the transformer (T2) and the grid	

All technical requirements conform to Circular No.42/2015/TT-BCT dated 1/12/2015 MOIT. All meters are to be tested and appraised by the testing organization certified by the relevant authorities. The owner of the project has to carry out the periodic inspection and appraisal of the metering through a certified organization approved by ENVEPTC according to the following schedule and the owner will incur all expenses for this periodic inspection and appraisal.

- once a year for the power meters
- once every 5 years for the current and voltage transformer
- after the appraisal, the equipment will be lead sealed-off

Meter Selection, Installation and Meter Quality Control
"A1700 Alpha" from ELSTER is used for both main and backup meter. In accordance with the brochure6 that the manufacturer provides, both total import and export kWh are measurable.

The measurement system is fully equipped with the functions according to Circular No.42/2015/TT-BCT of Ministry of Industry and Trade and relevant regulations and shall be compliant with the requirements of the PPA and Metering Agreement.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

1st October 2018: EPC Contract[7]

C.2. Expected operational lifetime of project activity

The expected operational lifetime is derived from the manufacturing information i.e. 25 years. The tool used to calculate the remaining lifetime of the project equipment is "Tool to Calculate the Remaining Lifetime of the Project, Version 1, EB 50 Report, Annex 15, Page 1." Using option (a) of the tool, 'Use manufacturer's information for the technical lifetime of equipment and compare to the date of first commissioning'.

As per the tool, this option can only be applied if Manufacturer's information for the technical lifetime of the equipment is available.
The project participants can demonstrate that the equipment has been operated and maintained according to the recommendations of the equipment supplier to ensure that the technical lifetime specified by the manufacturer is not reduced; and There are no periodic replacement schedules or scheduled replacement practices specific to the industrial facility, that require early replacement of equipment before the expiry of the technical lifetime.

The equipment has no design fault or defect and did not have any industrial accident due to which the equipment cannot operate at rated performance levels. Manufacturer's information on the following equipment is available in Power Purchase Agreement

Equipment	Manufacturer	Lifetime	Certificate Available
PV Modules	Hanwha Q Cells Korea (Q.PEAK DUO L G5.3)	25 years	Yes
Inverters	Inverter Station, 2.5MW inverter and MV (22kV), Aux. 15 kVA, Incl. PID, oil Tray Inverter: Sungrow, TR & RMU: ABB	25 years	Yes

Solar PV modules and inverters are the major equipment of the 50MWp plant and the manufacturers of both the equipment list the lifetime of the equipment to be of 25 years.

To ensure the safety of the plant in operation, maintenance must be carried out regularly according to the maintenance schedule prescribed by the manufacturer. In addition, instructions from the manufacturers of parts, machinery, equipment and the instructions in the operation and maintenance manual for the plant must be properly applied. The required maintenance content from the manufacturer should be complied fully and on schedule.

[6] Brochure_A1700CT

[7] EPC Contract(VN_en)

Maintenance must be performed by skilled technicians (knowledgeable about the plant and trained by the manufacturer). Upon completion of the maintenance work, maintenance personnel will issue a Certificate of Maintenance confirming the condition of the factory.

Maintenance work must be done properly and must be recorded. All accessories, mechanical equipment related to transmission as well as operation status must be checked by experts every 2 or 4 years.

Annual maintenance calendars must describe measures and/or limit values or calibration range of parameters. Annual maintenance Plan is performed every 6 months (except for the first time after 1 month operation), and include the following maintenance: General inspection: Visual inspection corrosion, faults, damage to structures and parts of the plant; check for leakage or penetration; strange noise test, lightning protection element, grounding wire, etc.

Given the above information and justification, the lifetime of the plant can be safely assumed to be 25 years.

C.3. Crediting period of project activity

C.3.1. Type of crediting period

Renewable crediting period, First period of crediting

C.3.2. Start date of crediting period

The start date of crediting period is 25/11/2019 or the CDM registration date whichever is later.

C.3.3. Duration of crediting period

7 years

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

Solar power plants that use renewable energy. It is safe, clean and environmentally friendly power plants. The operation of a solar power plant does not generate greenhouse gases, so it affects not only the regional climate but also the ecosystem of the earth. However, during the preparation and construction of the project, it also has some impact on the surrounding environment.

The project "Cam Lam VN solar power plant" is located in Cam An Bac commune, CAM LAM district, Khanh Hoa province. Considering the hydrographic climate, especially the region's radiation potential, the good regional environmental factors are well suited for photovoltaic development. At the same time, the nature of the terrain and geology of the area is relatively stable, mainly of sugarcane, acacia, banana, and cashew. There are no treasures, military zones or industrial projects, chemical works, cultural belief works in the project area so it is very convenient for the construction of the project. The project area is close to the inter-village road asphalted, which is very advantageous in transporting equipment to build the plant. The line is built mainly on sugarcane and cash crops of the people, mainly affecting the production activities of the people during the construction phase.

D.2. Environmental impact assessment

Evaluation of impacts of land acquisition

The objective of the project is to minimize the encroachment on residential land and historical and cultural relics such as communal houses, temples and shrines. The project survey area is mostly uncultivated land and a part of cash crops. During the implementation of the project, about 70ha of land is for the solar power plant.

The destruction of production forests, trees, and crops discourage people's income from agricultural production, affecting the quality of life of people, making it difficult for people to find a job appropriate to the level. As a result, these impacts will be mitigated by the attention of the community and authorities, which will provide adequate compensation for loss of land.

- Negative impact

Loss of all cultivated land has been recovered, loss of income due to cultivation, overcapacity, etc. However, impacts are only local with households losing their cultivated land. Owners will have policies to compensate land, crops in accordance with the regulations.

- Positive impact

When the project goes into operation, economic benefits to the project area in particular and CAM LAM district in general. The project does not have a major impact on ecosystems, biodiversity; environmental problems such as erosion, sliding, collapse, land subsidence; Climate Change; degradation of environmental components and other factors. The Cam Lam VN Solar Power Plant is necessary to supplement the power supply for the demand of load development continuously of the country in general and Khanh Hoa province, contributing to reduce environmental pollution, to develop clean energy sources in line with the general sustainable development trend of the world. Apart from the environmental attributes, this project will bring about local employment in construction, quality assurance and general management area and local economy vitalization will thus be expected. Moreover, if we take power demand forecast of Khanh Hoa Province into account, average commercial electricity growth rate of 10.9%/year is quite large, so the commissioning of solar power plants to operate in upcoming period seems reasonable.

Evaluation of impacts of site clearance

During preparation, site clearance, CTRs are mainly demolition materials, photoluminescence of plant biomass in the project area. The type of waste discharged from demolition, photoluminescence depends on the volume and characteristics of objects in the demolition area. In the plant construction area, there are only plant and vegetation. As a result, large amounts of solid wastes are the branches, leaves and vegetation. The amount of dust diffused due to the demolition process, clearance of the project is mostly deposited dust, the ability to spread not far. Moreover, this amount of dust can be controlled by humidification method during demolition works, land clearance. The concentration of pollutants in the exhaust gases and dust generated by vehicles transporting wastes during the preparation of construction sites are many times lower than the permissible standards, so the range and the degree of impact of the polluting sources on the waste transport route during the preparation phase is negligible.

Impacts on landscape architecture

The PV modules and the entire solar power plant are the typical projects of the clean energy sector in Vietnam, the project is designed with scientific space and layout. The solar project is a clean and environmentally friendly energy project that will create beautiful scenery and can promote the strengths of local sightseeing, learning, research and tourism.

Impacts due to dust generation, emission

In comparison of the use of solar energy to fossil-fuel power projects (such as thermal power plants, gas power plants, etc.), Cam Lam VN solar power plant project producing electricity from clean energy does not generate waste, dust, toxic gases, especially greenhouse gases that do not emit greenhouse gases. With this advantage, the projects of solar power in general, the project of Cam Lam VN solar power plant in particular is considered a form of "clean energy" or also known as "green energy", contributing to saving fossil fuel. With a capacity of 50MW, the Cam Lam VN Solar Power Plant project brings many benefits to localities in particular and to Khanh Hoa province in general.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

All agencies and households affected by the project to be fully informed of all information relating to benefits and compensation policies, includes: Standard, benefits, compensation method, place and time for compensation, as well as instructions on compensation and grievance procedures during project implementation.

After the prescribed time, the organization performing the tasks of compensation, site clearance, payment of compensation and support money to agencies and households according to the approved plan, agencies and persons having land to be recovered must hand over the land to the organization in charge of compensation and site clearance.

E.2. Summary of comments received

After obtaining the agreement of Khanh Hoa Provincial People's Committee, the compensation for ground clearance shall comply with the following specific steps:

- Establish Compensation Board under the direction of the local People's Committee
- Conducting boundary demarcation project area and drawing
- Inventory and identify the affected area
- Calculate the cost to make restitution of trees under inspected quantity
- Announcement of land acquisition decisions
- Implementation of clearance
- Monitoring activities are carried out during implementation of project.

E.3. Consideration of comments received

No.	Source of impact	Objects can be affected directly or indirectly	Impacts	Note
1	Acquisition of land for construction of the solar power plant	- Households whose land, plants and flowers on the land are recovered - Local government.	- Occupying land for the construction of power plant and foundations. Change of land use purpose: into specialized land (plant and pier foundation). - Affecting the activities of daily life, disrupting the life of the people who lost their cultivation.	The government and PP support the people who use the land to move. During the process of demolition, households were all satisfied with their compensation and moved.

2	Demolition and clearing of vegetation	The air environment of the project area.	- Waste and dust: + Due to the dismantling and clearing of vegetation + Due to the use of dismantlement and demolition facilities.	After the construction, the fence which can separate the site and road will be constructed and managed the site people.
		Soil and water environment	- Common solid wastes include: + Vegetation, shrubs. - Hazardous waste: Derived from the process of cleaning machines, equipment, ... Include: grease, grease clothing, grease box	
		- Direct workers; - People live in the surrounding area.	- Noise: + Arising from the operation of construction machinery at the site; + From demolition works	PP do restoration work after the construction
		- Direct workers;	- Occupation safety: Accidents caused by material breaking down into people, due to entangled in the power system,…	In terms of the managing and operating plant, the regional job creation effect can be founded
3	Transportation of construction waste	- The air environment around the project area	- waste gas and dust from: + Dropping dust during transportation; + The operation of the engines using the fuel of the means of transport.	PP do restoration work after the construction
		- People on the road in the project area.	- Noise: arising from the operation of the means of transport. - Traffic Safety: Increased traffic means will increase the risk of traffic accidents.	The around road improved caused this construction, the people who live there will be given better ease access to road.

- Environmental protection measures of the project: Minimize negative impacts on the environment, treatment and waste management facilities, environmental treatment measures for other factors other than waste;
- Measures to prevent and respond to environmental incidents;
- Environmental education and training program;
- Funds for implementing, implementing time and completing environmental protection works and measures;
- Executing agency and monitoring agency implement the environmental management program of the project.

Implementation of environmental management

- PP is responsible for implementation of environmental management and monitoring activities during the construction and operation phase.
- Contractor supervisor: Responsible for supervision of construction contractor during construction, including implementation of environmental management activities according to the content of EIA report approved by DoNRE.
- Construction contractor: apply measures to minimize and ensure safety for construction workers and local people during the construction of the project.
- Educate environmental awareness for the official & worker in the process of project development. Promote knowledge dissemination on the Law on Environmental Protection as well as specific requirements on environmental protection.
- Encourage officials and workers to participate in general environmental protection activities. At the same time, there are economic sanctions for individuals who waste, consume energy and raw materials of the project.

SECTION F. Approval and authorization

The host country Letter of Approval (LoA) has been issued on 28/10/2019 and the same has been provided to the DOE.

Appendix 1. Contact information of project participants

Organization name	Hanwha Energy Corporation
Country	Republic of Korea
Address	4th Floor, 411 Hannuri-daero, Sejong 20102, Republic of Korea
Telephone	+82-44-850-3594
Fax	
E-mail	gaeunchoi@hanwha.com
Website	http://hec.hanwha.co.kr/eng/enMain.do
Contact person	Ga Eun Choi

Appendix 2. Affirmation regarding public funding

The project does not receive any public funding from Annex I countries.

Appendix 3. Applicability of methodologies and standardized baselines

The applicability of the methodology has been discussed in section B.2.

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

All the information required for the calculation has been given section B.6., and an excel sheet would be provided, showing all the figures used for the calculations of emission reductions. No further information is required in this regard.

Appendix 5. Further background information on monitoring plan

The monitoring plan has been discussed in section B.7. No further information is available in this regard.

Appendix 6. Summary report of comments received from local stakeholders

Refer to Section E.

Appendix 7. Summary of post-registration changes

"Corrections" proposed in this version 3.3 of the PDD are as below:

Incorrect information on the registered PDD version 3.2 was found during the verification of the 1st monitoring period, 25/11/2019 - 31/05/2020, and request for corrections are submitted with the monitoring report as part of the request for issuance (post-registration change - issuance track) as applicable from the monitoring period.

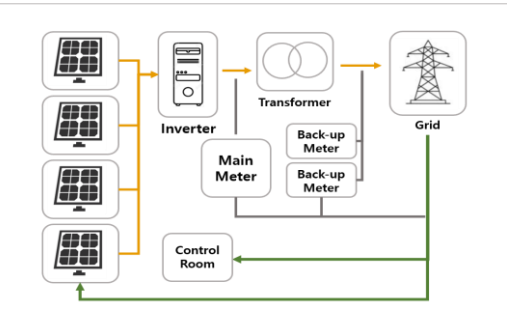
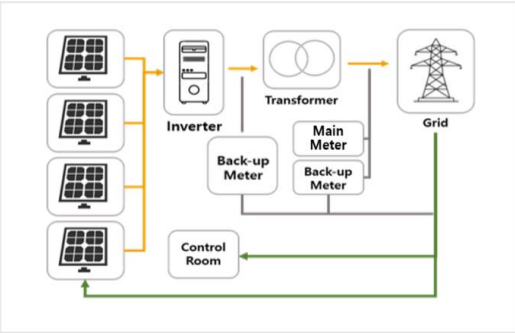
The reason of the change is the PDD was written based initial information of the technical information and location of meter before the construction. Actual installation was fixed during the process of construction.

The information regarding the corrections submitted is as below:

- Technical information of the equipment:

PDD Section	Registered PDD version 3.2	Changes (Revised PDD version 3.3)
A.3. (Table 'Summary of Equipment')	Sub-array #1 Q.PEAK DUO L-G5.2 390 Sub-array #2 Q.PEAK DUO L-G5.2 385	Sub-array #1 Q.PEAK DUO L-G5.3 390 Sub-array #2 Q.PEAK DUO L-G5.3 385
	PV Module technology: Si-Poly, 72 cells	PV Module technology: Mono-Si, 144 half cells
	Number of inverter stations: Sub-array #1: 10 cabinets typed 2500 kWac; Sub-array #2: 08 cabinets typed 2000 kWac	Number of inverter stations: 18 cabinets typed 2500 kWac

- The location of the meters:

PDD Section	Registered PDD version 3.2	Changes (Revised PDD version 3.3)
B.7.3. Other elements of monitoring plan		
	The main meter is between the inverter and the transformer. The details of the meters are as under:	The main meter is located between the transformer (T2) and the grid.
	The Main metering location: at the 110kV incoming of T1 Transformer	The Main metering location: at between the transformer (T2) and the grid.
	The backup metering location at two 110kV outgoing lines to 220kV Cam Ranh substation.	The backup metering locations: One at between the inverters and the transformer (T2), *and;* The other one at between the transformer (T2) and the grid

"Permanent changes to the registered monitoring plan" in this version 3.3 of the PDD is as below:

Incorrect information on the registered PDD version 3.2 was found during the verification of the 1st monitoring period, 25/11/2019 - 31/05/2020, and request for permanent change is submitted with the monitoring report as part of the request for issuance (post-registration change - issuance track) as applicable from the monitoring period.

The reason of the change is the PDD was written based initial information of the meter before the construction. Actual installation was fixed during the process of construction.

- The serial number of back up meter:

PDD Section	Registered PDD version 3.2			Changes (Revised PDD version 3.3)		
B.7.1 (Data and para to be monitored for $EG_{facilty,y}$)	Meter	SN	Calibration frequency (as per PPA)	Meter	SN	Calibration frequency (as per PPA)
	Back-up meter	1903581	1 year	Back-up meter	1903582	1 year

GPS coordination on the registered PDD version 3.3 is little different with real location of power plant. It was found during the verification of 2nd monitoring period 01/06/2020 - 31/12/2020, so request for corrections are being confirmed with 2nd monitoring report as part of the request for issuance. (post-registration change - issuance track)

The information regarding the corrections submitted is as below:

- Project participant

PDD Section	Registered PDD version 3.3	Changes (Revised PDD version 3.4)
A.2. Location of Project activity	11°42`50``N, 108°40`33``E	11°59`29.6322" N, 109°5`8.31" E

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Document information

Version	*Date*	*Description*
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Make editorial improvements.
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the "CDM project standard for project activities" and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the "CDM project standard for project activities" (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the "Project design document form for small-scale CDM project activities" (CDM-SSC-PDD-FORM); • Make editorial improvement.

Version	*Date*	*Description*
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • 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 Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

Decision Class: Regulatory
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