




**Validation report form for renewal of crediting period for
CDM project activities
(Version 03.0)**

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

BASIC INFORMATION

Title and UNFCCC reference number of the project activity	Wayang Windu Phase 2 Geothermal Power Project, UNFCCC ID: 3193
Number and duration of the next crediting period	CP No.: 2 nd 02 Dec 2017 – 01 Dec 2024
Version number of the validation report	01.6
Completion date of the validation report	12/02/2020
Version number of PDD to which this report applies	11.0
Project participants	Star Energy Geothermal (Wayang Windu) Ltd Sindicatum Carbon Capital Ltd
Host Party	Indonesia
Applied methodologies and standardized baselines	ACM0002 - Grid-connected electricity generation from renewable sources version 19.0
Mandatory sectoral scopes	Sectoral scope: 1- Energy industries (renewable/ non-renewable sources)
Conditional sectoral scopes, if applicable	NA
Estimated amount of annual average GHG emission reductions or GHG removals by sinks in the next crediting period	743,033 tCO ₂ e
Name and UNFCCC reference number of the DOE	EPIC Sustainability Services Private Limited (E-0062)
Name, position and signature of the approver of the validation report	 K. Suryanarayana Murthy, Managing Director

SECTION A. Executive summary

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Star Energy Geothermal (Wayang Windu) Ltd (hereinafter Project participant or PP) had engaged EPIC to perform validation of renewal of crediting period from 02 Dec 2017 – 01 Dec 2024 (Second crediting period) for the project activity titled “Wayang Windu Phase 2 Geothermal Power Project” (hereinafter called “the project”). The proposed project activity, Wayang Windu Phase 2 Geothermal Power Project, is the construction and operation of 117MW geothermal power station, which is an additional power unit to an existing grid-connected renewable power plant.

The purpose of the validation is to assess the validity of the original baseline and whether the emission reductions are in line with the valid version of the applicable methodology and, applicable standardized baseline if any. The validation consists of checking the project's baseline, the monitoring plan, and the project's compliance with relevant UNFCCC and host country criteria in order to confirm that the project design, baseline, monitoring plan and calculation of emission reductions as documented is sound and reasonable and meets the stated requirements and identified criteria.

This report summarizes the findings of the validation of the project, performed on the basis of UNFCCC criteria for CDM, as well as criteria given to provide for consistent project operations, monitoring and reporting. UNFCCC criteria refer to the Kyoto Protocol, the CDM rules and modalities as agreed in the Bonn Agreement, the Marrakech Accords and the CDM Executive Board's decisions. EPIC has employed a risk-based approach in the validation based on the recommendations in the Validation and Verification Standard for project activities version 2.0, EB101^{1/} (hereinafter referred to as VVS-PA), focusing on validity of applied methodology, baseline, monitoring plan and emission reduction calculations as documented in the updated PDD version 11.0^{2/}. The validation is not meant to provide any consulting towards the client. However, the stated requests for clarifications and/or corrective actions may provide input for improvement of the project design.

The renewable crediting period request of the project for the second crediting period (02 December 2017 – 01 December 2024), submitted previously, was rejected on 22nd July 2019. The reasons for rejection was, the calculation of the parameter $EF_{grid,OM}$ was not calculated in line with the “Tool to calculate the emission factor for an electricity system”, as the parameter was calculated based on 3-year simple average instead of the requirement of 3-year generation-weighted average. Now, the revalidation is performed and resubmission request is made addressing the reasons for rejection, including other regulatory requirement for renewable crediting period validation.

SECTION B. Validation team, technical reviewer and approver**B.1. Validation team member**

No.	Role	Type of resource	Last name	First name	Affiliation (e.g. name of central or other office of DOE or outsourced entity)	Involvement in			
						Desk/document review	On-site inspection	Interview(s)	Validation findings
1.	Team Leader	IR	Anbazhagan	Prabu Das	EPIC, Central office, Bangalore	√	√	√	√
2.	Technical Expert	ER	Dewi	Permatasari		√	√	√	√

B.2. Technical reviewer and approver of the validation report for RCP

No.	Role	Type of resource	Last name	First name	Affiliation (e.g. name of central or other office of DOE or outsourced entity)
1.	Technical reviewer	IR	Radhamadhavan	Vijayaraghavan	EPIC, Central office, Bangalore
2.	Technical Expert assisting TR	ER	Fitri	Oktaviani	
3.	Approver	IR	Murthy	K. Suryanarayana	

SECTION C. Means of validation**C.1. Desk/document review**

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As a first step, the validation team has reviewed the submitted PDD version 8.0^{/8/}, registered PDD version 3.0^{/5/}, monitoring plan^{/5/}, initial validation report^{/5/}, previous verification reports^{/20/} and additional background documents submitted by the project participants. Based on the review, the validation team has issued corrective action requests/ clarification requests. As a result of these findings, the PP has revised the PDD version 11.0^{/8/} (hereinafter referred to as updated PDD). The resolution of the findings by the validation is presented in Appendix 4 of this report.

C.2. On-site inspection

Duration of on-site inspection: 26/04/2018 to 27/04/2018*				
No.	Activity performed on-site	Site location	Date	Team member
1.	<ul style="list-style-type: none"> - Project history - Remaining lifetime of equipment - Baseline study assumptions - Validity of the original baseline or its update - National legislation / sectoral policies and its impact on the project - Crediting period of the project - Application of methodologies - Roles & responsibilities of the project participants, changes from initial registration stage, if any and its compliance with the latest version of MoC statement - Notification of the intention to request a renewal of the crediting period to UNFCCC secretariat using CDM-RENN-FORM as per para 263 and 266 of PCP version 1.0 - Analysis of post registration changes proposed along with RCP, if applicable - Monitoring and measurement equipment and system - Estimated GHG Emission reductions and its calculation for the renewed period - Ex-ante parameters and its assessment in accordance with "Methodological tool: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period". - Changes of monitoring parameters - Editorial issues of the revised PDD - FAR's (open issues), if any, from previous verification - Monitoring plan and its compliance with the applied valid version of the methodology 	Star Energy Geothermal (Wayang Windu) Ltd, Kecamatan Pangalengan, 40km south of Bandung, West Java, Indonesia	26/04/2018 to 27/04/2018	Mr A. Prabu das, Dr Madhukara Gowda, Ms Dewi Permatasari

* The on-site visit was carried out during the first submission request of the renewable crediting period validation, since the reasons for rejection was pertaining only to the calculation of the parameter $EF_{grid,OM}$, no re on-site visit was required to be performed as part of this validation. However, telephonic interview was done on 06/11/2019 to conform any change that has happened during the interim period to the project activity (see sec C.3 below).

C.3. Interviews

No.	Interviewee			Date	Subject	Team member
	Last name	First name	Affiliation			
1.	Hidayat	Ismail	Head of Power plant Operation - Star Energy	26/04/2018 to 27/04/2018 and 06/11/2019	<ul style="list-style-type: none"> -Validity of the original baseline or its update -National legislation / sectoral policies and its impact on the project 	Mr A. Prabu das, Dr Madhukara Gowda, Ms Dewi Permatasari
2.	Hariyanto	-	Operation and		<ul style="list-style-type: none"> - Monitoring plan -Changes of 	

			Production - Star Energy		monitoring parameters	
3.	Rachma	Ruri	Team Leader Business Services - Star Energy		-Monitoring and measurement equipment and system - Notification of the intention to request a renewal of the crediting period to UNFCCC secretariat using CDM-RENN-FORM as per para 263 and 266 of PCP version 1.0	
4.	Darwoto	Diko	CDM Consultant and PP – PT. Sindicatum Carbon Capital Indonesia		- Validity of the original baseline or its update -National legislation / sectoral policies and its impact on the project - Crediting period of the project - Application of methodologies - Monitoring plan - CER calculation	Mr A. Prabu das, Dr Madhukara Gowda, Ms Dewi Permatasari
5.	Putri N.F	Dea	Business Planner – Star Energy	06/11/2019	- Monitoring plan -Changes of monitoring parameters -Monitoring and measurement equipment and system - Design Changes to the project activity	Mr A. Prabu das, Dr Madhukara Gowda, Ms Dewi Permatasari
6.	Purwakusu mah	Anton	Team Leader Operations - Star Energy			
7.	Handoko	Dwi Sapto	Operations Support Assisstant - Star Energy			
8.	Kuntoaji	Mahendra	Group Leaders Operations support - Star Energy			

C.4. Sampling approach

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Not applicable

C.5. Clarification requests (CLs), corrective action requests (CARs) and forward action requests (FARs) raised

Area of validation findings	No. of CL	No. of CAR	No. of FAR
Compliance with PDD form	00	01	00
Application and selection of methodologies and standardized baselines	01	00	00
Validity of original baseline or its update	01	00	00
Estimated emission reductions or net anthropogenic removals	00	00	00
Validity of monitoring plan	01	00	00
Crediting period	00	00	00

Project participants	01	00	00
Post-registration changes	00	00	00
Others (please specify)	00	00	00
Total	04	01	00

SECTION D. Validation findings

D.1. Compliance with PDD form

Means of validation	As per the paragraph 403 of VVS 2.0/1/, the validation team has checked if PP used a later valid version of the PDD form for the updated PDD. The validation team is to determine whether information transferred to the later valid version of the PDD form is materially the same as that in the registered PDD. The validation team has determined whether PP has updated the PDD updating applicability section as per the latest version of the applied methodology, baseline section, calculation of emission reduction section, monitoring section and other relevant sections of the PDD in accordance with the requirements as per Project standard version 02.0, EB101 ^{/3/} (hereinafter referred to as Project Standard).
Findings	One CAR (CAR 01) is raised in this section
Conclusion	The project design document uses the latest version of the PDD template ^{/3/} version 11.0 (CDM-PDD-FORM) which is currently valid and applicable, and hence acceptable. All relevant sections of the PDD are revised as per paragraph 279 of the Project Standard (Version 02.0, EB101) and the instructions provided in the PDD template. The validation team conforms that the information transferred to the later valid version of the PDD form is materially the same as that in the registered PDD

D.2. Application and selection of methodologies and standardized baselines

Means of validation	As per paragraph 404 b) of VVS 2.0, the validation team has checked whether PP have used the valid version of the approved methodology ^{/4/} (ACM0002 version 19.0) ^{/7/} (hereinafter referred to as applied meth) applied in the original PDD and have demonstrated the project to be in line with the applicable conditions specified therein.
Findings	One CL (CL02) is raised in this section
Conclusion	The submitted PDD applies the valid version of the methodology, "Grid-connected electricity generation from renewable sources" ACM0002 version 19.0 ^{/6/} . the request for registration is permitted until 24 th July 2020 as reviewed from the methodology webpage https://cdm.unfccc.int/methodologies/DB/XP2LKUSA61DKUQC0PIWPGWDN8ED5PG The validation team has concluded that PP has used the valid version of the applied methodology and the project to be in line with the applicable conditions specified therein. Refer Appendix 5 of this report for more details.

D.3. Validity of original baseline or its update

Means of validation	The validation has checked whether the following steps stipulated in the methodological tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period", version 03.0.1, were applied by the project activity:- Step 1: Assess the validity of the current baseline for the next crediting period Step 2: Update the current baseline and the data and parameters
Findings	One CL (CL03) is raised in this section
Conclusion	<u>Step 1: Assess the validity of the current baseline for the next crediting period</u> As demonstrated in the registered PDD and assessed in the validation report, the project activity is the installation of an additional power unit at an existing grid-connected geothermal power plant, it is considered as the capacity addition to an existing grid-connected renewable power plant/unit, and the baseline scenario in line with baseline methodology procedure of ACM0002 ver 19.0 ^{/6/} , would be the

existing facility that would continue to supply electricity to the grid at historical levels, until the time at which the generation facility would likely be replaced or retrofitted (DATE_{BaselineRetrofit}), and electricity delivered to the grid by the added capacity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the “Tool to calculate the emission factor for an electricity system”. From that point of time onwards, the baseline scenario is assumed to correspond to the project activity, and no emission reductions are assumed to occur.

As per the methodology ACM0002 Version 19.0^{/6/}, the baseline for the project activity remains the same as that in the registered PDD as “Electricity delivered to the grid by the project activity (added capacity) would have otherwise been generated by the operation of grid-connected power plant and by the addition of new generation sources connected to the Jamali Grid, as reflected in the combined margin (CM) calculations described in the “Tool to calculate the emission factor for an electricity system” Version 07.0^{/21/}.

The validity of the current baseline is assessed using the following sub-steps:

Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/sectoral policies

Although national policies favour the development of renewable energy, electricity generated by fossil fuel based power plants dominated the electricity supply. There has been no significant change in the relevant national and/or sectoral policies since the date of registered PDD till now. Hence, it was concluded that the current baseline was complied with all relevant national and sectoral policies.

Step 1.2: Assess the impact of circumstances

The project technical characteristics remain the same. Renewable power generated by the project activity will be exporting to the Jamali (national) Grid. After years of development, current conditions like build margin and operating margin of the Jamali (National) Grid power generation are not the same as that was determined at the validation of the project activity. Therefore, baseline emissions need to be updated for the subsequent crediting period.

Step 1.3: Assess whether the continuation of the use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested.

The sub-step is applicable to the project activity, as the baseline scenario of the project activity was the continuation of the current equipment without any additional investment. In the registered PDD and the validation report, the technical lifetime of the existing facility (Wayang Windu Phase 1), has been assessed and reported as 30 years and since Wayang Windu unit 1 started operation in June 2000, the DATE_{BaselineRetrofit} is taken as 01 June 2030. Hence, it is concluded that the remaining technical lifetime of the equipment that would have continued to be used in the absence of the project activity exceeds the crediting period (second C.P 02 December 2017 – 01 December 2024) for which renewal is requested.

Step 1.4: Assessment of the validity of the data and parameters

The emission factors have been updated by the project participants for the second crediting period of the project activity accordingly.

Step 2. Update the current baseline and the data and parameters

Step 2.1: Update the current baseline

As per the requirement of the sub-step, the update for baseline emissions of the second crediting period is based on ACM0002 Version 19.0^{/6/}, which is the valid

approved version of the methodology applicable to the project activity at the time of request for renewal of the crediting period (the request for registration is permitted until 24th July 2020).

Step 2.2: Update the data and parameters

The emission factors for the project activity have been updated and determined ex-ante as a combined margin consisting of combination of the operating margin and build margin for the second crediting period by the project participants as per the "Tool to calculate the emission factor for an electricity system", version 07.0^{/21/}.

EPIC was able to confirm that values applied in the calculation of the updated emission factors were in line with the "Department of Energy and Mineral Resources of Indonesia - Directorate General of Electricity and Energy Utilization" which is endorsed by the DNA of Indonesia^{/17/}.

The updated PDD version 11.0 date 11/02/2020 was submitted for crediting period renewal of the project activity. The data used in the EF calculation has been verified to be in accordance with data endorsed by DNA of Indonesia for the years 2015, 2016 and 2017, and was aggregated and calculated with reference to the "Tool to calculate the emission factor for an electricity system"^{/21/}. The EF data used for the host country (Indonesia) is the latest data available at the time of the validation of the second C.P.

Parameter	Previous value (as in registered PDD)	Updated value (for the second C.P)	Reference
EF _{grid,CM,y}	0.891 (ton CO ₂ /MWh)	0.945 (ton CO ₂ /MWh)	Department of Energy and Mineral Resources of Indonesia - Directorate General of Electricity and Energy Utilization ^{/17/}
GWP _{CH₄}	21 tCO ₂ e/tCH ₄	25 tCO ₂ e/tCH ₄	IPCC data

These changes have been appropriately considered in the updated PDD.

Conclusion:

The original baseline scenario of the project as per the registered PDD is still valid for the 2nd crediting period. Most of the data and parameters determined ex-ante are still valid except for the emission factor, global warming potential of methane which are re-determined in the emission calculation.

D.4. Estimated emission reductions or net anthropogenic removals

Means of validation	As per the Paragraph 412 a) iv of VVS 2.0 ^{/17/} , the validation team has assessed the approach of PP in calculating the estimated GHG emission reductions comply with the applied methodology and other requirements of Project Standard, Version 02.0, EB101 ^{/3/} .
Findings	One CL (CL04) is raised in this section
Conclusion	<p>The calculation of ERs is done as per the applied methodology (ACM0002 version 19.0)^{/6/}. The calculation in the Excel spreadsheet and the corresponding calculation tables in the PDD have been checked and no mistakes have been identified. The estimation of emission reductions for the 2nd crediting period is deemed plausible and conservative.</p> <p>All changes due to the upgraded methodology and the re-assessment of the baseline have been considered appropriately. The calculation in the Excel spreadsheet and the corresponding calculation tables in the updated PDD have been checked and no mistakes have been identified. The estimation of emission reductions for the 2nd crediting period is deemed plausible and conservative.</p>

For the calculation:

EG_{historical} considers values from June 2000 (Existing facility - Wayang Windu Phase 1 start of operation) to Feb 2009 (Project activity - Wayang Windu Phase 2 operation started in March 2009) of Unit I = 912,476 MWh, it is reviewed to be as per para 5b(i) of the methodology ACM0002, ver 19.0^{/6/}

EG_{facility} – for Unit II (project activity) the values applicable for the entire first crediting period are considered i.e (Dec 2010 to Dec 2017)

EF_{grid,CM,y} –

As per applied methodology ACM0002 version 19^{/6/}, the spatial extent of the project boundary includes the project power plant and all power plants connected physically to the grid. JAMALI (Jawa-Madura-Bali) grid applies for the project activity. The grid emission factor is calculated as per Methodological tool “Tool to calculate the emission factor for an electricity system”, version 07.0^{/21/} and the steps 1 to 6 followed in the calculation as in B.6.1 of the PDD and ER spreadsheet are reviewed to be correct inline with the requirement.

The calculation considers the years 2015, 2016 and 2017 for the OM and the year 2017 for the BM.

Years	EF _{grid avgOM} (tCO ₂ /MWh)	Power Generation – EG _m , (MWh)
EF _{grid OM,2015}	0.860	162,722,468.61
EF _{grid OM,2016}	0.821	172,825,586.98
EF _{grid OM,2017}	0.802	178,220,872.26
Total		513,768,927.85
EF _{grid WeightedAverageOM,2015,2016,2017}		$= \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}}$ $= [(0.860 * 162,722,468.61) + (0.821 * 172,825,586.98) + (0.802 * 178,220,872.26)] / 513,768,927.85$ $= \mathbf{0.8268 \text{ tCO}_2/\text{MWh}}$

The weighted average OM for the year 2015, 2016 and 2017 are 0.860, 0.821 and 0.802, which is weighted averaged to 0.8268 (rounded off value is 0.827) tCO₂/MWh for the three years, and the build margin (BM) for the year 2017 is 0.985 tCO₂/MWh. The input values are sourced from “Department of Energy and Mineral Resources of Indonesia - Directorate General of Electricity and Energy Utilization”, vide letter dated 21st November 2019^{/17/}. Though the EF_{grid,AverageOM} value of 0.827 is directly provided by the Department of Energy and Mineral Resources of Indonesia^{/17/}, it is not used by the project activity as such, as it is calculated as three year simple average whereas the requirement as per Electricity Tool^{/21/} is to calculate based on three year weighted average.

So applying the ratios of 0.25 for the W_{OM} and 0.75 for the W_{BM} in the calculation (this ratio is as per Electricity Tool for the second crediting period) the EF_{grid,CM,y}

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

EF _{grid CM}	=	EF _{grid AverageOM,2015,2016,2017}	x	25%	+	EF _{grid,BM,2017}	x	75%
	=	0.827	x	25%	+	0.985	x	75%
EF _{grid CM}	=	0.945 tCO ₂ /MWh						

Baseline emissions:-

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

Where:

BE_y = Baseline emissions in year y (t CO₂/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 CO₂ emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (t CO₂/MWh)

$EG_{PJ,y}$ is calculated as follows:

$$EG_{PJ,y} = EG_{facility,y} - (EG_{historical} + \sigma_{historical}); \text{until } DATE_{BaselineRetrofit}$$

and

$$EG_{PJ,y} = 0; \text{on/after } DATE_{BaselineRetrofit}$$

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 plants/units to the grid in year y (MWh/yr)

$EG_{historical}$ = Annual average historical net electricity generation delivered to the grid by the existing renewable energy power plants/units that was operated at the project site prior to the implementation of the project activity (MWh/yr)

$\sigma_{historical}$ = Standard deviation of the annual average historical net electricity generation delivered to the grid by the existing renewable energy power plants/units that was operated at the project site prior to the implementation of the project activity (MWh/yr)

$DATE_{BaselineRe}$ = Point in time when the existing equipment would need to be replaced in the absence of the project activity (date). This only applies to retrofit or replacement projects

In case $EG_{facility,y} < (EG_{historical} + \sigma_{historical})$ in a year y then:

$$EG_{PJ,y} = 0$$

The average of historical electricity delivered by additional power unit facility (Wayang Windu Phase 2(Unit 2)) to the grid, spanning all data from the most recent available month December 2010 to December 2017:

$$EG_{unit2, y} = 872,838 \text{ MWh/ yr}$$

The $EG_{historical}$ is the historical electricity delivered by existing facility i.e. Wayang Windu Phase I to the grid from the start of its operation in June 2000 to the period when Wayang Windu Phase 2 (Project activity) was commissioned in February 2009. This is as per option B of para 52, ACM0002 version 19.

$$EG_{historical} = 912,476 \text{ MWh}$$

$$\sigma_{historical} = 5,952 \text{ MWh}$$

$$EG_{historical} + \sigma_{historical} = (912,476 + 5,952) \\ = 918,427 \text{ MWh}$$

$$EG_{PJ,y} = ((872,838 + 912,476) - 918,427) \\ = 866,886 \text{ MWh/yr}$$

$$BE_y = 866,886 \text{ (MWh)} \times 0.945 \text{ (tCO}_2\text{/MWh)} \\ = 819,638 \text{ tCO}_2$$

Project emissions:-

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$$

Where:

- PE_y = Project emissions in year y (t CO₂e/yr)
- $PE_{FF,y}$ = Project emissions from fossil fuel consumption in year y (t CO₂/yr)
- $PE_{GP,y}$ = Project emissions from the operation of dry, flash steam or binary geothermal power plants in year y (t CO₂e/yr)
- $PE_{HP,y}$ = Project emissions from water reservoirs of hydro power plants in year y (t CO₂e/yr)

$PE_{GP,y}$ is calculated as follows:

$$PE_{GP,y} = PE_{dry \text{ or } flash \text{ steam},y} + PE_{binary,y}$$

Where:

- $PE_{GP,y}$ = Project emissions from the operation of dry steam, flash steam and/or binary geothermal power plants in year y (t CO₂e/yr)
- $PE_{dry \text{ or } flash \text{ steam},y}$ = Project emissions from the operation of dry steam or flash steam geothermal power plants due to release of non-condensable gases in year y (t CO₂e/yr)
- $PE_{binary,y}$ = Project emissions from the operation of binary geothermal power plants due to physical leakage of non-condensable gases and working fluid in year y (t CO₂e/yr)

Only $PE_{dry \text{ or } flash \text{ steam}}$ is applicable to the project activity, hence the formula is

Project emissions from dry or flash steam geothermal power plants:

$$PE_{dry \text{ or } flash \text{ steam},y} \\ = (w_{steam,CO_2,y} + w_{steam,CH_4,y} \times GWP_{CH_4}) \times M_{steam,y}$$

Where:

$w_{steam,CO_2,y}$ = Average mass fraction of CO₂ in the produced steam in year y (t CO₂/t steam)

$w_{steam,CH_4,y}$ = Average mass fraction of CH₄ in the produced steam in year y (t CH₄/t steam)

GWP_{CH_4} = Global warming potential of CH₄ valid for the relevant commitment period (t CO₂e/t CH₄)

$M_{steam,y}$ = Quantity of steam produced in year y (t steam/yr)

$$= (0.0097 + 1.65 \cdot 10^{-5} \cdot 25) \cdot 7,591,442.27$$

$$= 76,590 \text{ tCO}_2/\text{yr}$$

Project emission from combustion of fossil fuel related to the operation of geothermal power plant is calculated as:

$$PE_{FF,y} = PE_{FC,j,y}$$

Where:

$PE_{FF,y}$ = project emissions from combustion of fossil fuels related to the operation of the geothermal power plant in year y (/yr)

$PE_{FC,j,y}$ = CO₂ emissions from fossil fuel combustion in process j during the year y (tCO₂/yr).

This parameter is calculated by the “tool to calculate project or leakage CO₂ emissions from fossil fuel combustion version 03”

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y}$$

Where:

$FC_{diesel,j,y}$ = quantity of diesel combusted in emergency genset and fire pump during the historical year of Wayang Windu 1 operation (ton)

$COEF_{i,y}$ = CO₂ emission coefficient of diesel fuel (tCO₂/ton)

$COEF_{i,y}$ is calculated based on net calorific value and CO₂ emission factor of diesel fuel, as follows:

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO_2,i,y}$$

Where:

$NCV_{diesel,y}$ = Weighted average net calorific value of diesel fuel (IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories) (GJ/ton)

$EF_{CO_2,diesel,y}$ = Weighted average CO₂ emission factor of diesel fuel historical (IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories) (tCO₂/GJ)

$$COEF_{i,y} = 42.73 \cdot 0.0748$$

$$= 3.196204 \text{ (tCO}_2/\text{ton)}$$

$$PE_{FC,j,y} = (5.073 \cdot 0.87) \cdot 3.196204$$

$$= 15 \text{ (tCO}_2/\text{yr)}$$

$$PE_y = PES_y + PEFF_y$$

	$= 76,590.0 + 15.0$ $= 76,605.0 \text{ (tCO}_2\text{/yr)}$ <p>Emission reductions (ER_y)</p> <p>Emission reductions are calculated as follows:</p> $ER_y = BE_y - PE_y$ <p>Where:</p> $ER_y = \text{Emission reductions in year } y \text{ (t CO}_2\text{e/yr)}$ $BE_y = \text{Baseline emissions in year } y \text{ (t CO}_2\text{/yr)}$ $PE_y = \text{Project emissions in year } y \text{ (t CO}_2\text{e/yr)}$ $ER_y = 819,638 - 76,605$ $= 743,033 \text{ tCO}_2\text{/yr}$ <p>The validation has concluded that the estimation of emission reductions for the applicable crediting period of the registered CDM project activity is in compliance with the applicable requirements of the “CDM project standard for project activities”, and the applied methodology ACM0002, ver 19.0^{6/}.</p>
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D.5. Validity of monitoring plan

Means of validation	As per the Paragraph 412 a) clause iii of VVS 2.0, the validation team has assessed whether the approach and validity of the monitoring plan indicated in the updated PDD comply with the requirements of the applied methodology and other requirements of Project Standard, Version 02.0, EB101 ^{3/} .
Findings	One CL (CL04) is raised in this section
Conclusion	<p>The monitoring plan containing the parameters to be monitored is reviewed for their completeness against the new version of the applied methodology ACM0002, ver 19.0. Sec B.7.1 of the revised PDD contains the ex-post parameters, this section is reviewed to be complete as per CDM-PDD-FORM completion guidelines. Sources of the data, measurement methods and procedures, monitoring frequency, QA/QC procedures, monitoring equipments and calibration etc described in the PDD are as per the actual practice followed by the project activity. The validation team has also reviewed the previous monitoring reports and issuance reports^{20/} for the data monitoring followed by the project activity and accepts that the information provided in the updated PDD is in compliance with monitoring requirement. Further, in sec B.7.3 of the updated PDD, the roles and responsibilities, CDM organisation structure, institutional arrangement for data collection and archiving is also updated. The PP has submitted the revised CDM Monitoring Manual^{22/}, version 3.0 which describes the monitoring procedures and is reviewed to be updated for the ACM0002, ver 19.0 requirements.</p> <p>The validation has concluded that the monitoring plan of the updated PDD (version 11.0) is in line with the requirements of the applied methodology and implemented monitoring plan and as per the requirements in para 79 to 82 of the “CDM project standard for project activities, version 2.0. For details, refer section D.4 and Appendix 6 of this report.</p>

D.6. Crediting period

Means of validation	As per the Paragraph 412 a) clause V of VVS 2.0, the validation team has assessed whether the next crediting period of the registered CDM project activity commences on the day immediately after the expiration of the current crediting period and in accordance with paragraph 278 of Project Cycle Procedure, version 2.0, EB101 ^{1/} (hereinafter referred to as PCP). The validation team has also checked whether the submission of request for renewal of crediting period is no earlier than 270 days prior to, but no later than one year after, the expiry of the
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	crediting period.
Findings	No findings are raised in this section
Conclusion	The validation team has reviewed the notification email ^{/10/} sent by PP to the CDM registry on 30 th May 2017, which falls within the required time limit (first C.P ends on 01 Dec 2017). The valid version of PCP during the period of notification by PP was version 1.0, and the intimation is reviewed to be meeting the requirement of para 266 of PCP-PA, ver 1.0 valid at that point of time. However, with the entry into force of PCP-PA version 2.0 from 01 Jan 2019, the requirement of notification by PP is removed. As per para 278 of PCP-PA, ver 2.0, the submission request of RCP is to be within one year of expiry of the crediting period, since the first C.P ended on 01 Dec 2017 itself, the RCP is overdue for renewal, but the RCP submission request qualifies as per para 28 of EB 105 meeting report ^{/19/} , which says <i>"The Board considered its decision in paragraph 32(a)(iv) of the 100th meeting report: "the grace period for the submission of renewal request for the existing registered project activities whose crediting period has expired but has not been renewed (i.e. overdue for renewal) is to be by 31 December 2019". The Board agreed to extend the deadline for overdue cases for submission of renewal requests from 31 December 2019 to 30 September 2020. The Board requested the secretariat to continue its efforts to communicate the Board's decision to the project participants of the project activities that are overdue for renewal"</i> . Hence, the validation team has concluded that the submission of RCP request is eligible as it is before the deadline and that the next renewable credit period can start immediately after the expiry of the current crediting period.

D.7. Project participants

Means of validation	As per paragraph 412 (a) clause vi of VVS 2.0, the validation team has checked whether the names of the PP in the updated PDD are consistent with that in the registered PDD/ project webpage
Findings	One CL (CL01) is raised in this section
Conclusion	Contact person name of project participants 1) Sindicatum Carbon Capital Limited and 2) Star Energy Geothermal (Wayang Windu) Limited indicated in the updated PDD is inline with the MoC information available in the project UNFCCC webpage. The validation team, after reviewing the updated PDD and project UNFCCC webpage ^{/5/} , has concluded that the names are correctly specified in the updated PDD.

D.8. Post-registration changes

Type of post-registration changes (PRCs)	Confirmation (Y/N)	Validation report for PRCs	
		Version	Completion date
Temporary deviations from the registered monitoring plan, applied methodologies, standardized baselines or other methodological regulatory documents ¹	N	NA	NA
Corrections	N	NA	NA
Change to the start date of the crediting period	N	NA	NA
Inclusion of a monitoring plan	N	NA	NA
Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents	N	NA	NA
Changes to the project design	N	NA	NA
Changes specific to afforestation and reforestation project activities	N	NA	NA

SECTION E. Internal quality control

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¹ Other standards, methodologies, methodological tools and guidelines (to be) applied in accordance with the applied (selected) methodologies are collectively referred to as the other (applied) methodological regulatory documents).

After the completion of assessment by the validation team all the relevant documentation is submitted to a qualified, Independent Technical reviewer as part of EPIC' internal quality control system. A Technical reviewer team is appointed to review the draft final validation report (Draft FVR). The comments made by the Technical reviewer team are taken into consideration and incorporated in the final FVR. The technical reviewer team assesses whether all the reporting requirements have been fulfilled and whether all the issues raised were closed satisfactorily by the validation team with justification. The technical review process can also raise issues in this regard which is resolved further by the validation team to the satisfaction of the technical reviewer. The technical reviewer team either accepts or rejects the report made by the validation team. The final report (after resolutions of all findings) is then submitted to the Head-operations for review and approval.

SECTION F. Validation opinion

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EPIC performed the validation of the renewal of crediting period of the CDM project "Wayang Windu Phase 2 Geothermal Power Project" in Indonesia (UNFCCC registration Ref. No. 3193). The validation was performed on the basis of the specific criteria as per VVS, PS and PCP and other relevant requirements.

The validation team has concluded that updated PDD uses the valid version of the PDD template and all the necessary instructions are followed in preparing the PDD. The names of the PP are consistent with that specified in the UNFCCC project webpage. The project activity confirms with all the applicable conditions of the valid version of the applied methodology. The baseline and monitoring methodology are applied in accordance with the applicable requirements of PS. The baseline, the estimated GHG emission reductions and the monitoring plan in the updated PDD comply with the applicable requirements in the PS. The next crediting period can commence on the day immediately after the expiration of the current crediting period.

In summary, it is opinion of EPIC that the project meets all relevant UNFCCC requirements for the CDM and is eligible for renewal of crediting period from 02 Dec 2017 to 01 Dec 2024.

Project title:	Wayang Windu Phase 2 Geothermal Power Project
UNFCCC ref no:	3193
Crediting period requested for renewal:	02 December 2017 – 01 December 2024 (second crediting period)
Updated PDD	Version 11.0, dated 11 th Feb 2020
Sector and applied methodology	Sector 1: Energy industries (renewable - / non-renewable sources) ACM0002 - Grid-connected electricity generation from renewable sources - Version 19.0
Estimated CER	743,033 tCO ₂ e/year

Appendix 1. Abbreviations

Abbreviations	Full texts
BM	Build Margin
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CER	Certified Emission Reductions
CL	Clarification Request
CM	Combined Margin
CO ₂	Carbon Dioxide
CO ₂ e	Carbon Dioxide Equivalent
DNA	Designate National Authority
DOE	Designated Operational Entity
EF	Emission Factor
ESSPL	EPIC Sustainability Services Private Limited
EG	Electricity grid
FAR	Forward Action Request
GHG	Greenhouse gases
IPCC	Intergovernmental Panel on Climate Change
LoA	Letter of Approval
MoV	Means of Verification
OM	Operating Margin
PCP	Project Cycle Procedure
PDD	Project Design Document
PLF	Plant Load Factor
PP	Project Participant
PS	Project Standard
QA/QC	Quality Assurance/Quality Control
RCP	Renewal of Crediting Period
UNFCCC	United Nations Framework Convention on Climate Change
VVS	Validation and Verification Standard

Appendix 2. Competence of team members and technical reviewers

The following validation team has been assigned to carry out the validation of the project.

Name	Mr. A. Prabu Das	Ms. Dewi Permatasari	Mr. Radhamadhavan Vijayaraghavan	Ms. Fitri Oktaviani
Role	Lead Auditor	Technical Expert	Technical Reviewer	Technical Expert assisting TR
Competence in relevant sectors	Sector 1 and Sector 13 including TA 1.1. and TA 13.1	Sector 1 including TA 1.1	Sector 1 and Sector 13	Sector 1 including TA 1.1
Responsibility	Document review, DVR preparation, DVR resolution, FVR preparation	Document review, DVR preparation, DVR resolution	Technical review	Technical review

Mr. A Prabu Das, holds a M. Tech Degree in Energy Conservation and Management and B. Tech Degree in Petro-chemical Technology. He is a certified Energy Auditor by Bureau of Energy Efficiency (BEE), Government of India. He has around 13 years of work experience in Design of biomass Power plants, preparing Techno Economic Feasibility Reports (TEFR), carrying out energy audits, of which last eight years have been in CDM consultancy and validation services. He has undergone extensive training on CDM validation and verification and is a qualified lead auditor for Sectoral Scope 1 and 13 in accordance with procedures of EPIC Sustainability Services Pvt. Ltd. He is also an ISO 26000 lead auditor certified by Professional Evaluation and Certification Board (PECB).

Ms. Dewi Permatasari, holds a Master of Engineering Degree in Mining and Petroleum Engineering and Bachelor of Engg Degree in Environmental Engineering. She worked as Environmental Advisor and also involved in carrying out Environmental impact assessment for numerous projects (Geothermal) in Indonesia. She has around 8 years of work experience in Environmental related services including CDM. She is a qualified Technical Expert under CDM validation and verification services for Sectoral Scope 1 in accordance with procedures of EPIC Sustainability Services Pvt. Ltd.

Mr. R Vijayaraghavan, holds BE in Mechanical Engineering, M. Tech in Energy Conservation and Management and MBA in Technology Management. He is certified as Energy Auditor by Bureau of Energy Efficiency (BEE), Government of India. He has 15 years of working experience in energy sector including 9 years as validator. He has successfully completed around hundred CDM, VCS/GS projects. He has been qualified as Technical Reviewer for Sectoral Scope 1 and 13.

Ms. Fitri Oktaviani, holds a Master of Engineering Degree in Geothermal Engineering and Bachelor of Engg Degree in Electrical Engineering. She worked as professional engineer and also involved in carrying out feasibility studies for geothermal in Indonesia. She has around 7 years of work experience in renewable energy especially in geothermal economic and management, oilfield data management. She is a qualified Technical Expert under CDM validation and verification services for Sectoral Scope 1 in accordance with procedures of EPIC Sustainability Services Pvt. Ltd.

Appendix 3. Documents reviewed or referenced

No	Author	Title	References to the document	Provider
1	UNFCCC	CDM Validation and Verification Standard for project activities, Version 02.0, EB101	1	Publicly available
2	UNFCCC	CDM Project Cycle Procedure for project activities, Version 01.0, EB93 CDM Project Cycle Procedure for project activities, Version 02.0, EB101	2	Publicly available
3	UNFCCC	CDM Project Standard for project activities, Version 02.0, EB101	3	Publicly available
4	UNFCCC	Glossary – CDM terms, Version 10.0 https://cdm.unfccc.int/Reference/Guidclarif/glos_CDM.pdf	4	Publicly available
5	UNFCCC	Registered PDD, Corresponding previous validation report http://cdm.unfccc.int/Projects/DB/TUEV-SUED1260194062.48/view	5	Publicly available
6	UNFCCC	Large-scale Methodology for Grid connected renewable electricity generation, ACM0002 (Version 19.0) http://cdm.unfccc.int/methodologies/DB/VJI9AX539D9MLOP_XN2AY9UR1N4IYGD	6	Publicly available
7	UNFCCC	Project Design Document form for CDM project activities, version 11.0 https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20170628103246832/PDD-Form05.pdf	7	Publicly available
8	PP	Initial PDD Version 8.0 and Final PDD version 11.0	8	PP
9	PP	ER sheet version 4.0 and version 6.0	9	PP
10	UNFCCC	Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period, (Version 03.0.1)	10	Publicly available
11	Ministry of Energy and Mineral Resources	Low Cost Must Run (LCMR) data	11	PP
12	PP	Intention of RCP Notification using CDM-RENN-FORM by PP to UNFCCC	12	PP
13	UNFCCC	Confirmation of receipt of CDM-RENN-FORM from PP by UNFCCC via e-mail	13	UNFCCC
14	Govt of Indonesia	Presidential Regulation No. 61/2011 on National Action Plan in reducing the GHG Emission, Presidential Regulation No. 62/2014 on the Ratification of the Statute of the International Renewable Energy Agency	14	PP
15	Ministry of Energy and Mineral Resources	Ministry of Energy and Mineral Resources Regulation No. 50/2017 on the use of Renewable Energy for Electricity Supply	15	PP
16		Ministry of Energy and Mineral resources Regulation No. 17/2014 on the Purchase of Electricity from Geothermal by PLN	16	PP
17		Department of Energy and Mineral Resources of Indonesia - Directorate General of Electricity and Energy Utilization, vide letter dated 21 st November 2019 for the EF values	17	PP
18	General Director of Electricity and Energy	Plant operation test certificate for Unit –I (Phase I)	18	PP

	Development			
19	UNFCCC	CDM-EB 105 Meeting report https://cdm.unfccc.int/filestorage/I/Y/Q/IYQR9ABW62KMF3SD4O70HNXJ5GPCVL/eb105_meeting_report.pdf?t=b1F8cTJhYnZmfDD5oB4D70klAmQwbv3Tfs0j	19	Publicly available
20	PP/DoE	Previous monitoring reports and corresponding verification reports https://cdm.unfccc.int/Projects/DB/TUEV-SUED1260194062.48/iProcess/RWTUV1518161086.69/view	20	PP
21	UNFCCC	Tool to calculate the emission factor for an electricity system, Version 07.0	21	Publicly available
22	PP	CDM Monitoring Manual, version 3.0	22	PP

Appendix 4. Clarification requests, corrective action requests and forward action requests

Table 1. CL from this validation

CL ID	01	Section no.	D.7	Date: 05/11/2019
Description of CL				
Contact details of Appendix 1 of PP is not as per MoC information in the UNFCCC project webpage http://cdm.unfccc.int/Projects/DB/TUEV-SUED1260194062.48/view				
Project participant response				Date: 11/11/2019
PP Response 01				
The names of the person (PP) in Appendix 1 of PDD has been revised as per the latest MoC statement				
Documentation provided by project participant				
PDD ver 9.0				
DOE assessment				Date: 14/11/2019
DOE Assessment 01				
Information in Appendix 1 of the revised PDD is verified to be as per MoC information in the project UNFCCC webpage, thus accepted.				
CL 01 Closed				

CL ID	02	Section no.	D.2	Date: 05/11/2019
Description of CL				
The version of the "Tools to calculate the emission factor for electricity system", is not uniform throughout the PDD.				
Project participant response				Date: 11/11/2019
PP Response 01				
The version number of the "Tool to calculate the emission factor for electricity system" has been revised to be consistent with the tools that has been used for the PDD, that is "Tool to calculate the emission factor for electricity system version 07.0"				
Documentation provided by project participant				
Revised PDD version 9				
DOE assessment				Date: 14/11/2019
DOE Assessment 01				
The version number of the "Tool to calculate the emission factor for electricity system" is made consistent across the PDD and the ER spreadsheet.				
CL 02 Closed				

CL ID	03	Section no.	D.3	Date: 05/11/2019
Description of CL				
It is observed that the value of $EF_{grid\ OM}$ is not directly sourced from the document provided by "Department of Energy and Mineral Resources of Indonesia - Directorate General of Electricity and Energy Utilization", but instead it is calculated – PP to clarify.				
Project participant response				Date: 05/12/2019
PP Response 01				
The value of $EF_{grid\ OM}$ provided by Department of Energy and Mineral Resources of Indonesia – Directorate General of Electricity and Energy Utilization was calculated based on 3-year simple average while the tool followed for this PDD required the $EF_{grid\ OM}$ to be calculated based on 3 year weighted average. Thus, the value based on 3 year weighted average is used.				
PP Response 02				
The latest data available for EF calculation is upto 2017, obtained from "Department of Energy and Mineral Resources of Indonesia - Directorate General of Electricity and Energy Utilization", dated 21 st Nov 2019 and all the calculations are updated as per the latest data.				
Documentation provided by project participant				
Ex-Ante calculation sheet version 6.0 and PDD version 10.0				
DOE assessment				Date: 06/12/2019

DOE Assessment 01
Though the $EF_{grid,OM}$ value of 0.827 is directly provided by the Department of Energy and Mineral Resources of Indonesia, it is not used by the project activity as such, as it is calculated as three year simple average whereas the requirement as per Electricity Tool is to calculate based on three year weighted average. The weighted average calculated value is 0.8268 which is used by the project activity and is accepted by the validation team. PP to conform whether the used values are the latest available data.
DOE Assessment 02
The submitted ER sheet is updated for the latest data available upto the year 2017, and the calculations for $EF_{grid,OM}$ and EF_{CM} are reviewed to be correct and accepted. Revised PDD version 10.0 also updated for the change.
CL 03 Closed

CL ID	04	Section no.	D.5	Date: 11/02/2020
Description of CL				
PP to clarify how the updated monitoring plan in the PDD is in compliance of the applied methodology ACM0002 ver 19 and as per paragraph 78 of PS for PAs (ver 2).				
Project participant response				Date: 11/02/2020
PP Response 01				
Sec B.7 of the PDD is updated				
Documentation provided by project participant				
PDD version 11.0 and CDM Monitoring Manual ver 3.0				
DOE assessment				Date: 12/02/2020
DOE Assessment 01				
The submitted revised PDD ver 11.0 is reviewed for the compliance against the valid version of the applied methodology ACM0002, ver 19.0. The monitoring parameters, sources of the data, measurement methods, QA/QC procedures, the operational and management structure for monitoring, provisions for data archiving, and responsibilities and institutional arrangement for data collection and archiving, the monitoring equipments and calibration etc are found to be updated in Sec B.7.1 and Sec B.7.3 of the revised PDD ver 11.0. The project activity follow CDM monitoring manual, ver 3.0, it is reviewed to be updated for the applied methodology ACM0002, ver 19.0, the manual contain the detailed procedure for data monitoring, QA/QC, calibration schedule, data archiving, data control etc. Thus, it is concluded by the validation team that the monitoring plan of the project activity is in compliance of the ACM0002 ver 19 and also as per paragraph 78 to 82 of PS for PAs (ver 2).				
CL 04 Closed				

Table 2. CAR from this validation

CAR ID	01	Section no.	D.1	Date: 05/11/2019
Description of CAR				
The CDM-PDD-FORM version 11.0 used is incomplete, as the “ document information ” is not included as part of the FORM template				
Project participant response				Date: 11/11/2019
PP Response 01				
The PDD has been revised to include all of the form template.				
Documentation provided by project participant				
Revised PDD version 9				
DOE assessment				Date: 14/11/2019
DOE Assessment 01				
The submitted revised PDD is as per the FORM template requirement and accepted.				
CAR 01 Closed				

Table 3. FAR from this validation

FAR ID	XX	Section no.	XX	Date: DD/MM/YYYY
Description of FAR				
XX				
Project participant response				Date: DD/MM/YYYY
XX				
Documentation provided by project participant				
XX				
DOE assessment				Date: DD/MM/YYYY

Appendix 5:

	Applicability Criteria for Applied Meth ACM0002, Ver 19.0	Justification
1	<p>The methodology is applicable to grid-connected renewable energy power generation project activities that:</p> <ul style="list-style-type: none"> (a) Install a Greenfield power plant; (b) Involve a capacity addition to (an) existing plant(s); (c) Involve a retrofit of (an) existing operation plant(s)/unit(s); (d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or (e) Involve a replacement of (an) existing plant(s)/unit(s). 	Applicable. The project is a grid – connected renewable energy power generation that involves a capacity addition to an existing plant by installing a new power plant near the existing power plant (category b).
2	<p>The project activity may include renewable energy power plant/unit of one of the following types: hydro power plant/unit with or without reservoir, wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit;</p>	Applicable. The project activity is a capacity addition to geothermal power plant
3	<p>In the case of capacity additions, retrofits, rehabilitations or replacements (except for wind, solar, wave or tidal power capacity addition projects the existing plant/unit started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion, retrofit, or rehabilitation of the plant/unit has been undertaken between the start of this minimum historical reference period and the implementation of the project activity</p>	Applicable. The existing geothermal plant (unit 1) started its commercial operation in June 2000 and the project activity commercial operation started in March 2009. Hence, the project activity started more than 5 years (minimum historical reference period) after the existing project was commercially operated, and no capacity expansion, retrofit or rehabilitation of the plant/ unit has been undertaken between the start of this minimum historical reference period and the implementation of the project activity.
4	<p>In case of hydro power plants, one of the following conditions shall apply:</p> <ol style="list-style-type: none"> 1. The project activity is implemented in existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or 2. The project activity is implemented in existing single or multiple reservoirs, where the volume of the reservoir(s) is increased and the power density calculated using equation (3), is greater than 4 W/m²; or 	Not applicable, since the project is not a hydro power plant

	<p>3. The project activity results in new single or multiple reservoirs and the power density, calculated using equation (3), is greater than 4 W/m^2; or</p> <p>4. The project activity is an integrated hydro power project involving multiple reservoirs, where the power density for any of the reservoirs, calculated using equation (3), is lower than or equal to 4 W/m^2, all of the following conditions shall apply:</p> <p>(i) The power density calculated using the total installed capacity of the integrated project, as per equation (4), is greater than 4 W/m^2;</p> <p>(ii) Water flow between reservoirs is not used by any other hydropower unit which is not a part of the project activity;</p> <p>(iii) Installed capacity of the power plant(s) with power density lower than or equal to 4 W/m^2 shall be:</p> <p>a. Lower than or equal to 15 MW; and</p> <p>b. Less than 10 per cent of the total installed capacity of integrated hydro power project.</p>	
5	<p>In the case of integrated hydro power projects, project proponent shall:</p> <p>Demonstrate that water flow from upstream power plants/units spill directly to the downstream reservoir and that collectively constitute to the generation capacity of the integrated hydro power project; or</p> <p>Provide an analysis of the water balance covering the water fed to power units, with all possible combinations of reservoirs and without the construction of reservoirs. The purpose of water balance is to demonstrate the requirement of specific combination of reservoirs constructed under CDM project activity for the optimization of power output. This demonstration has to be carried out in the specific scenario of water availability in different seasons to optimize the water flow at the inlet of power units. Therefore, this water balance will take into account seasonal flows from river, tributaries (if any), and rainfall for minimum five years prior to implementation of CDM project activity.</p>	Not applicable, since the project is not a hydro power plant
6	<p>The methodology is not applicable to:</p> <ul style="list-style-type: none"> Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site; 	Not applicable, since the project does not involve switching from fossil fuels to renewable energy sources at the site of the project activity and the project is not a

	<ul style="list-style-type: none"> ○ Biomass fired power plants/units. 	biomass fired power plant.
7	In the case of retrofits, rehabilitations, replacements, or capacity additions, this methodology is only applicable if the most plausible baseline scenario, as a result of the identification of baseline scenario, is “the continuation of the current situation, that is to use the power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance”.	Applicable. The project is a capacity addition and the identification of baseline scenario is the continuation of the current situation, that is to use the power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance.

Appendix 6:

Parameters	Justification by the verification team
Emission reductions (ER_y)	As per updated PDD, Emission reductions are calculated as follows. $ER_y = BE_y - PE_y - LE_y$ Where: BE_y – Baseline emissions PE_y – Project emissions LE_y – Leakage emissions
Baseline Emissions CO ₂ emission from electricity generation in fossil fuel fired power plants that is displaced due to the project activity	As per para 42 and equation 11 of applied methodology (ACM0002, Version 19) ^{6/} , baseline emission BE_y are calculated as follows: $BE_y = EG_{PJ,y} \times EF_{grid,CM,y}$ 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) $EF_{grid,CM,y}$: Combined margin CO ₂ emission factor for grid connected power generation in year y calculated using the latest version of the “Tool to calculate the emission factor for an electricity system” (t CO ₂ /MWh) considering the years 2015, 2016 and 2017 for the OM and 2017 for the BM, the CM is calculated by applying the ratios of 0.25 for OM and 0.75 for BM, which is as per the electricity tool valid for the second crediting period.
Parameter, $EG_{PJ,y}$ Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh) = MWh/year.	Following para. 46 - 53 of ACM0002 version 19.0 ^{6/} , if the project activity is the capacity addition to geothermal power plant greenfield power plant, then: $EG_{PJ,y} = EG_{facility,y} - (EG_{historical} + \sigma_{historical}); \text{until } DATE_{BaselineRetrofit}$ And $EG_{PJ,y} = 0; \text{on/after } DATE_{BaselineRetrofit}$ In case $EG_{facility,y} < (EG_{historical} + \sigma_{historical})$ in a year y then: $EG_{PJ,y} = 0$ The average of historical electricity delivered by additional power unit facility (Project activity - Wayang Windu Phase 2 (unit 2)) to the grid, spanning all data for the first crediting period 02 Dec 2010 to 01 December 2017 is considered: $EG_{unit2, y} = 872,838 \text{ MWh/yr}$ The average of historical electricity delivered by the existing facility (Wayang Windu Phase 1) to the grid, spanning all data from June 2000 (Existing facility - Wayang Windu Phase 1 start of operation) to Feb 2009 (Project activity - Wayang Windu Phase 2 operation started in March 2009) it is reviewed to be as per para 5b(i) of the methodology ACM0002, ver 19.0 ^{6/} : $EG_{historical} = 912,476 \text{ MWh}$ $\sigma_{historical}$ is calculated as 5,952 MWh $EG_{historical} + \sigma_{historical} = (912,476 + 5,952)$

	<p>= 918,427 MWh</p> $EG_{PJ,y} = ((872,838 + 912,476 - 918,427) = 866,886 \text{ MWh/yr})$ $BE_y = 866,886 \text{ MWh/yr} \times 0.945 \text{ tCO}_2/\text{MWh} = 819,638 \text{ tCO}_2/\text{yr}$ <p>Those parameters will be monitored during crediting period using bi-directional energy meter to measure the electricity supplied by the Grid to the geothermal plant and by the geothermal plant to the Grid</p> <p>Monitoring methods and QA/QC procedure: The procedure defined for the monitoring is as per the provisions of the applied monitoring methodology, ACM0002, ver 19.0 and the actual process followed is verified with site observations, document review and interaction with site operatives, the validation team gained conformance that the procedure followed will enable data monitoring. The project activity follow CDM monitoring manual, ver 3.0 which contain the detailed procedure for data monitoring, QA/QC, calibration schedule, data archiving, data control etc. Further, the procedure followed is also verified with the earlier issued verification reports for the conformance. Hence, accepted by the validation team.</p>
<p><u>Parameter, $EF_{grid,CM,y}$</u> CO₂ emission factor for grid connected power generation ($EF_{grid,CM,y}$) = 0.945 tCO₂e/MWh</p>	<p>For the ex-ante estimation:</p> <p>The emission factor ($EF_{grid,CM,y}$) is calculated by using the version of the "Tool to calculate the emission factor for an electricity system", version 7.0. It is determined ex-ante and consists of the weighted average factors of operating margin (EF_{OM}) and build margin (EF_{BM}).</p> <p>The data source and process of calculation OM and BM are based on the latest data at the time of finalisation of the FVR as part of validation. Those Grid calculation are published by Department of Energy and Mineral Resources of Indonesia - Directorate General of Electricity and Energy Utilization and endorsed by Indonesia DNA^{17/}.</p> <p>The data vintages and calculation have been checked and were assessed as correct.</p> <p><u>$EF_{grid,CM,y}$</u> – The calculation considers the years 2015, 2016 and 2017 for the OM and the year 2017 for the BM. The weighted average OM for the year 2015, 2016 and 2017 are 0.860, 0.821 and 0.802, which is weighted averaged to 0.8268 (rounded off value is 0.827) tCO₂/MWh for the three years, and the build margin (BM) for the year 2017 is 0.985 tCO₂/MWh. The values are sourced from "Department of Energy and Mineral Resources of Indonesia - Directorate General of Electricity and Energy Utilization", vide letter dated 21st November 2019^{17/}.</p> <p>So applying the ratios of 0.25 for the W_{OM} and 0.75 for the W_{BM} in the calculation (this ratio is as per Electricity Tool for the second crediting period) the $EF_{grid,CM,y} = 0.945 \text{ tCO}_2/\text{MWh}$</p> <p>During the crediting period: It is fixed for the entire duration of crediting period</p>
<p>Ex-ante calculation of baseline emissions as ACM0002^{16/} are calculated as follows. $BE_y = EG_{PJ,y} \times EF_{grid,CM,y} = 866,886 \times 0.945 = 819,638 \text{ tCO}_2$</p>	
<p><u>Project emissions (PE_y)</u></p>	<p>Following para. 34 of ACM0002 (version 19.0)^{16/}, For most renewable energy power generation project activities, $PE_y = 0$. However, some project activities may involve project emissions that can be significant. These emissions shall be accounted for as project emissions by using the following equation:</p>

	$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$ <p>Where: PE_y : Project emissions in year y (t CO₂e/yr) $PE_{FF,y}$: Project emissions from fossil fuel consumption in year y (t CO₂/yr) $PE_{GP,y}$: Project emissions from the operation of dry, flash steam or binary geothermal power plants in year y (t CO₂e/yr) $PE_{HP,y}$: Project emissions from water reservoirs of hydro power plants in year y (t CO₂e/yr)</p>
Parameter, $PE_{FF,y}$: Project emissions from fossil fuel consumption in year y	<p>Project emission from combustion of fossil fuel related to the operation of geothermal power plant is calculated as: Therefore $PE_{FF,y} = PE_{FC,j,y}$ Where: $PE_{FF,y}$ = Project emissions from combustion of fossil fuels related to the operation of the geothermal power plant in year y $PE_{FC,j,y}$ = CO₂ emissions from fossil fuel combustion in process j during the year y (tCO₂/yr). This parameter will be calculated by the “tool to calculate project or leakage CO₂ emissions from fossil fuel combustion version 03”</p> $PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y}$ <p>Where: $FC_{diesel,j,y}$ = quantity of diesel combusted in emergency genset and fire pump during the historical year of Wayang Windu 1 operation (ton) $COEF_{i,y}$ = CO₂ emission coefficient of diesel fuel (tCO₂/ton)</p> <p>$COEF_{i,y}$ is calculated based on net calorific value and CO₂ emission factor of diesel fuel, as follows:</p> $COEF_{i,y} = NCV_{i,y} \times EF_{CO_2,i,y}$ <p>Where: $NCV_{diesel,y}$ = weighted average net calorific value of diesel fuel (IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories) (GJ/ton) $EF_{CO_2,diesel,y}$ = weighted average CO₂ emission factor of diesel fuel historical (IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories) (tCO₂/GJ)</p> $COEF_{i,y} = 42.73 \times 0.0748$ $= 3.196204 \text{ (tCO}_2\text{/ton)}$ $PE_{FC,j,y} = (5.073 \times 0.87) \times 3.196204$ $= 15 \text{ (tCO}_2\text{/yr)}$
Parameter, $PE_{GP,y}$: Project emissions from the operation of dry, flash steam or binary geothermal power plants in year y (t CO ₂ e/yr)	<p>The proposed project activity is geothermal power plant, $PE_{GP,y} = PE_{dry \text{ or flash steam},y} + PE_{binary,y}$</p>

	$PE_{dry\ or\ flash\ steam,y}$ $= (w_{steam,CO2,y} + w_{steam,CH4,y} \times GWP_{CH4})$ $\times M_{steam,y}$ $= 76,590\ tCO_2$
$PE_{binary,y}$	Not applicable to the project activity
Parameter, $PE_{HP,y}$ Methane emissions from reservoirs	The proposed project activity is not hydropower power plant, $PE_{HP,y} = 0$.
Project emissions (PE_y) It is calculated as follows $PE_y = PE_{HP,y} + PE_{FF,y} + PE_{GP,y}$ $= 0 + 15\ tCO_2e + 76,590\ tCO_2e$ $= 76,605\ tCO_2e$	
<u>Leakage (LE_y) = 0 tCO₂e</u>	Following ACM0002 ^{6/} , no other 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. $LE_y = 0.$
<u>Emission reductions (ER_y) = 743,033 tCO₂e</u> (Rounded off)	As per the applied methodology, Emission reductions are calculated as follows. $ER_y = BE_y - PE_y - LE_y$ $= 8,19,638 - 76,605 - 0$ $= 743,033\ tCO_2/yr$

Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
03.0	31 May 2019	Revision to: <ul style="list-style-type: none"> • Ensure consistency with version 02.0 of the “CDM validation and verification standard for project activities” (CDM-EB93-A05-STAN) and version 02.0 of the “CDM project cycle procedure for project activities” (CDM-EB93-A06-PROC); • Make editorial improvements.
02.0	31 October 2017	Revision to align with the requirements of the “CDM validation and verification standard for project activities” (version 01.0).
01.0	23 March 2015	Initial publication.
Decision Class: Regulatory Document Type: Form Business Function: Renewal of crediting period Keywords: crediting period, project activities, validation report		