South Asia

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Gold Standard for Global Goals Verification Report

GOLD STANDARD VERIFICATION OF GS PROJECT NO.12112 "LIKI PINANGAWAN MUARALABOH GEOTHERMAL POWER PLANT"

Report No 1010142SK

8 May 2024

TÜV SÜD South Asia Pvt. Ltd.
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INDIA

South Asia

Title of the project activity	Liki Pinawangan Muara Laboh Geothermal Power Plant
GS Reference number of the project activity	GS-12112
Version number of the verification and certification report	3
Completion date of the verification and certification report	8 May 2024
Monitoring period number and duration of this monitoring period	2nd Monitoring from 01/11/2020 – 31/01/2023 (including both days) (1st monitoring period was under the CDM)
Version number of monitoring report to which this report applies	1.7
Crediting period of the project activity corresponding to this monitoring period	16/12/2019 -15/12/2024 (Renewable)
Project participant(s)	PT Supreme Energy Muara Laboh
Host Party	Indonesia
Sectoral scope(s)	1: Energy industries (renewable - / non-renewable sources)
Methodology (ies)	ACM0002 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", Version 12.2.0
Estimated amount of annual average certified SDG impact (as per approved PDD)	382,076 tCO_2e
Certified GHG emission reductions or net anthropogenic GHG removals for this monitoring period	1,144,912 tCO_2e
Name of VVB	TÜV SÜD South Asia Private Limited (TÜV SÜD)
Name, position and signature of the approver of the verification and certification report	 Deepankar Chowdhury, Head - Quality Assurance Certification Body, (Environment & Energy), TÜV SÜD South Asia Pvt Ltd

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1 METHODOLOGY

1.1 Objective

TÜV SÜD has been commissioned by the aforementioned client to perform an independent verification assessment.

The objective of the verification work is to comply with the requirements of Gold Standard for the Global Goals. According to this assessment TÜV SÜD shall:

- ensure that the project activity has been implemented and operated as per the registered PDD, and that all physical features (technology, project equipment, monitoring and metering equipment) of the project are in place,
- ensure that the published MR and other supporting documents provided are complete, verifiable and in accordance with applicable GS requirements,
- ensure that the actual monitoring systems and procedures comply with the monitoring systems and procedures described in the monitoring plan and the approved methodology,
- evaluate the data recorded and stored as per the applicable requirements.
- assessment of the sustainability monitoring parameters as per the GS requirements.

1.2 Scope

The scope of any assessment is defined by the underlying legislation, regulation and guidance given by relevant entities or authorities. In the case of GS project activities, the scope is set by:

- Gold Standard for the Global Goals.
- Baselines and monitoring methodologies (including GHG inventories)
- Environmental issues relevant to the applicable sectoral scope
- Applicable environmental and social impacts and aspects of GS project activity
- Current technical and operational knowledge of the specific sectoral scope and information on best practice
- Stakeholder consultation and feedback

The verification process is not meant to provide any form of consulting for the project participant (PP). However, stated requests for clarifications, corrective actions, and/or forward actions may provide input for improvement of the project design.

Once TÜV SÜD receives the MR, it is made available on the GS Registry through a dedicated interface on the Gold standard website. The Verification shall commence only after the project documents are listed on the registry.

1.3 Verification Process

The information provided by the project participants is assessed by applying the means of verification specified in the GS requirements available at the time of the verification starts, and applying standard auditing techniques..

Once TÜV SÜD receives the Monitoring Report and a confirmation from any PP to upload, the MR is made available on the GS Registry.

A competent assessment team is selected prior to the start of the verification. The team is selected to cover the technical area(s), sectoral scope(s) and relevant host country experience for evaluating the

GS project activity. Additionally, a competent Technical Reviewer or Technical Reviewer Team is appointed to conduct checks on quality and completeness.

The verification team performs first a desk review, followed by an on-site visit, (in the proposed verification , it is remote audit) which results in the formation of a draft report and a list of findings. The next step involves the evaluation of the findings through direct communication with the PPs and then finally the preparation of the verification report. This verification report and other supporting documents then undergo an internal quality control by the CB "Environment and energy" before submission to the GS.

1.4 Appointment of the Team

According to the technical scopes and experiences in the sectoral or national business environment, TÜV SÜD has composed an assessment team in accordance with the appointment rules of the TÜV SÜD Certification Body "Environment and Energy".

The composition of an assessment team has to be approved by the Certification Body (CB) to assure that the required skills are covered by the team. The CB of TÜV SÜD operates the following qualification levels for team members that are assigned by formal appointment rules:

- Assessment Team Leader (ATL);
- Verifier (V);
- Technical Experts (TE);
- Country expert (CE);
- Technical reviewer (TR).

It is required that the sectoral scope(s) and the technical area(s) (TA) linked to the methodology/ies and project has to be covered by the assessment team. Appointment certificates of the selected team members are attached to this report as Annex.

Verification team member

No.	Role	Type of resource	Last name	First name	Affiliation (e.g. name of central or other office of VVB or outsourced entity)	Involvement in			
						Desk review	On-site inspection	Interview(s)	Verification findings
1	Team Leader, Verifier, Technical Expert (old)	IR	Vyas	Arjun	TÜV SÜD South Asia Private Limited (TÜV SÜD)	√	√	√	√
2.	Team Leader, Verifier, Technical Expert (new)	IR	Kudtarkar	Shruti	TÜV SÜD South Asia Private Limited (TÜV SÜD)	√			√
3.	Host Country Expert	IR	Rangkuti	Arie Jufrizal	TÜV SÜD South Asia	√	√	√	√

					Private Limited (TÜV SÜD)				

Technical reviewer and approver of the verification and certification report

No.	Role	Type of re-source	Last name	First name	Affiliation (e.g. name of central or other office of VVB or outsourced entity)
1.	Technical reviewer	ER	K	Sudheendra	TÜV SÜD South Asia Private Limited (TÜV SÜD)
2.	Approver	IR	Chowdhury	Deepankar	TÜV SÜD South Asia Private Limited (TÜV SÜD)

1.5 Review of Documents

The GS- monitoring report, version 1.3 dated 12/09/2023 /01/, the emission reduction calculations provided in the form of a spreadsheet (MR v01.xlsx), version 3.0 of 06/09/2023 /02/, were assessed as part of the verification. In addition, the GS-PDD , version 1.0 of 27/03/2023 /03/ in particular the baseline estimations and the monitoring plan for the project were reviewed.

A complete list of all documents reviewed is available in the Information Reference List attached as Annex 2 to this report.

1.6 On-site Assessment and follow-up Interviews

Duration of on-site inspection: 18/07/2023				
No.	**Activity performed on-site**	**Site location**	**Date**	**Team member**
1.	Opening meeting Brief introduction about the plant (start-up / capacity) History and background of the project Project starting date and start of crediting period Technology employed Operational process Project activity in the registered PD Actual implementation and operation of the project activity Monitored data and parameters ER calculations Comparison between recorded data and calculation spreadsheets. Storage of data Calibration Maintenance procedure Quality Control procedures Quality Assurance procedures Mandatory clearances Assessment of sustainability monitoring parameters and document verification Interviews with local stakeholders Discussions on the observations noted down and closing meeting	At the project site	18/07/2023	Arjun Vyas, Arie Jufrizal Rangkuti

Interviews

No.	Interviewee			Date	Subject	Team member
	Last name	First name	Affiliation			
1.	Argo	Ismoyo	SEML, Employee	18/07/2023	History and background of the project. Project starting date and start of crediting period Technology employed Operational process Actual implementation and operation of the project activity. Monitored data and parameters Storage of data Calibration Maintenance procedure Quality Control procedures Quality Assurance procedures Mandatory clearances	Arjun Vyas, Arie Jufrizal Rangkuti
2.	T. N	Sakityo	Consultant	18/07/2023		
3.	Anggii	Rahmatul	SEML Employee	18/07/2023		
4.	D. Busta	Ryski	SEML Employee	18/07/2023	Project activity in the registered PDD ER calculations Comparison between recorded data and calculation spreadsheets.	
5.	Roza	M	SEML Employee	18/07/2023		
6.	Satria E.	Evans	SEML Employee			
7.	Dwisavira	Meidina	SEML Employee			
8.	Primanandra	Hans	SEML Employee			
9.	Joan	Bujang	SEML Employee			
10.	Floris	Erwin	SEML Employee			
11.	Lina	Tati	Local resident	11/09/2023	Stakeholders' consultation	
12.	-	Hermanto	Ex-village head Sapan Sari			
13.	Hidayat	Taufik	Contract Employee			
14.	-	Bambang	Contract Employee			
15.	-	Budiman	Village head-Pekonina			

1.7 Resolution of Clarification and Corrective and Forward Action Requests

The objective of this phase of the verification is to resolve the requests for corrective actions, clarifications, and any other outstanding issues which need to be clarified for TÜV SÜD`s conclusion on the achieved emission reductions. 03 CARs, 02 CLs and no FARs were raised during the course of verification. All the CARs and CLs raised by TÜV SÜD are resolved during communication between the client and TÜV SÜD. To guarantee the transparency of the verification process, the concerns raised and responses that have been given are documented in detail in the List of Findings that is attached as Annex 1 to this report.

1.8 Internal Quality Control

Internal quality control within the team is assured by means of a technical review process that takes place after the off-site assessment and after closure of findings. The internal quality control in the verification process is given by the final decision (Verification and Certification Conclusion) made by the CB “Environment and Energy”.

2 CARBON VERIFICATION AND REPORTING

In the following sections, the results of the verification are stated. The verification results relate to the project performance as documented and described in the final PD and final Monitoring Report. The verification findings for each verification subject are presented below.

2.1 FARs from Validation / Previous Verification

>> The proposed verification is the 1st Gold Standard verification of the 1st crediting period. There is five pending FAR from the design certification approval report /04/ to be addressed during this monitoring period.

Means of verification	Forward Action Request	VVB Assessment and opinion
	FAR # 1: At the time of verification, the VVB shall ensure that no double counting takes place as PD has already issued credits under the CDM between 16/12/2019 - 31/10/2020.	VVB team checked that the project is registered in CDM with Project ID 6307/14/. However, VVB team check and confirm that there are no current request for issuance acitve for the monitoring period 01/11/2020 to 31/01/2023. Hence, this FAR has been addressed and closed.
	FAR # 2: At the time of verification, the VVB shall interview local stakeholders and provide their comments in the FVR	VVB team checked the checked and confirm that all the grievances received during the current monitoring period are addressed and closed by the PP. Also, few stakeholders were interviewed by the VVB team. Details are mentioned in section 1.6 of this report. Hence, this FAR has been addressed and closed.

	FAR # 3: In-line with GS4GG Principles and Requirements, VVB and PP shall consider the rule below for future monitoring activities: 5.1.39: An annual update report shall be provided to GS, when successfully Transitioned to GS4GG, for each monitoring year by the end of next calendar year for which verification is not completed.	PP has provided reports for the year 2020, 2021 and 2022 to VVB team. PP will also submit the same to GS. Hence, this finding is closed for this monitoring period.
	FAR # 4: In-line with GS4GG Principles and Requirements, VVB and PP shall consider the following rule after Certification is achieved: 5.1.29: 1st verification shall be completed within two years after the certification is achieved.	VVB team verifies that GS Project Design Certification is 27/03/2023/04/ and currently, the project is under verification by VVB. Thus, it is within two years. Hence, the FAR is closed.
	FAR # 5: PD and VVB to consider the Rule Update – Applicability of Minimum Site Requirements by VVB to claim credits as the start date of the crediting period is before the project registration.	VVB Team checked and confirm that there are no gaps in the monitoring period. Also, VVB Team has done on site audit as mentioned in section 1.6 of this report. Hence, this FAR is addressed by VVB team and closed.
Findings	CAR#04 has been raised and closed in this section	
Conclusion	VVB Team confirms to close the FAR applicable to the current monitoring period. However, any FAR if applicable to the crediting period shall be addressed by the successive verification body.	

2.2 CLs, CARs and FARs raised

Areas of verification findings	No. of CL	No. of CAR	No. of FAR
Compliance of the monitoring report with the monitoring report form			
Compliance of the project implementation with the registered PDD	01		
Post-registration changes			
Compliance of the monitoring plan with the monitoring methodology including applicable tool and standardized baseline	01	02	
Compliance of monitoring activities with the registered monitoring plan		01	
Compliance with the calibration frequency requirements for measuring instruments		01	
Assessment of data and calculation of emission reductions or net removals	01		
Others (Assessment of SDG outcomes)			
Total	**03**	**04**	**00**

2.3 Project Implementation in accordance with the registered PD

The audit team has checked the project Implementation in accordance with the registered Project Design Document (PDD) according to the requirement of GS4GG Principles and Requirements v1.2 dated October 2019, applicable rule updates and clarifications.

Liki Pinawangan Muara Laboh Geothermal Power Plant is located in Pauh Duo Subdistrict, Solok Selatan Regency, West Sumatera Province, Republic of Indonesia. The GPS co-ordinates of the powerplant are as follows:

- Longitude: 1010 02' – 1010 08' East
- Latitude: 010 28' – 010 36' South

The same was crosschecked during the site visit and confirmed to be consistent.

The installed capacity and estimated annual gross power generation of Liki Pinawangan Muara Laboh Geothermal Power Plant is 88.81 MW and 1,598,751 MWh, respectively. The project installs green-field grid-connected geothermal power plant project. The electricity generated by the project activity is supplied to the Sumatera grid, which is one of regional grids in Indonesia.

The project was synchronized with the grid and started injecting the renewable power from 16/12/2019. The same was confirmed from the commissioning certificate dated 20/12/2019. /05/.

The verification team checked the technical specifications of steam turbine, generator, transformers and energy meters with the name plate specifications at the site and also the technical specifications sheets provided by the PP /06/.

All measuring devices have been found installed and operational /07/. The verification team has checked the electricity generation and net electricity export reports. There is no case or situation occurred during this monitoring period which has impacted the applicability of methodology. There was no diversion from the implementation details given in the registered PDD during this reported monitoring period.

The verification team has verified the implementation of the project activity as per GS4GG Principles and Requirements v1.2 dated October 2019, applicable rule updates and clarifications, ACM0002 v12.2/08/ and found to be correct. The project activity has been implemented and operated as stated in approved PDD which has been confirmed during the interviews.

2.4 Sampling Approach

>> N/A

2.5 Compliance of the Monitoring Report with the Monitoring Report Form

Means of verification	It was checked that the GS-MR used by PP is as per the requirements of GS-MR-template version 1.1 of 14/10/2020 /09/.
Findings	No CARs/CLs have been raised.
Conclusion	TUV SUD confirms that the monitoring report has been prepared as per the latest version of the MR available at GS website.

2.6 Post Registration Changes

>> N/A

2.7 Compliance of the Monitoring with the Monitoring Plan

The monitoring has been carried out in accordance with the monitoring plan contained in the registered PDD. All parameters were monitored and determined as per the Monitoring Plan. CAR#01 has been raised in this section.

Data and paarameters fixed ex-ante or at renewal of crediting period

Means of verification	Data and parameters fixed ex-ante as listed in the monitoring report have been crosschecked and reviewed as applicable against the registered PDD, monitoring plan as well as against the applied methodology and other relevant GS related documentation. The ex-ante and validated fixed value of GWP, CH4 (Global warming potential of methane valid for the relevant commitment period as per RULE UPDATE-2020-P&R v1.2-GWP values.), Density of Oil, $EF_{grid,OM,y}$ (Operating margin CO2 emission factor for grid connected power generation in year y), $EF_{grid,BM,y}$ (Build margin CO2 emission factor for grid connected power generation in year y) $EF_{grid,CM,y}$ i.e. Combined margin CO_2 emission factor for grid connected power generation is referred from the published document by Directorate General of Electricity and Energy Utilization, Indonesia. The same is as per the registered PDD and the validation report. Thus, accepted by the verification team.
Findings	No CARs/CLs have been raised
Conclusion	TUV SUD team confirms that the parameters listed above are fixed ex-ante and used for baseline, project emissions and leakage emissions calculation in accordance with the applied methodology and methodological tools. Furthermore, it is confirmed that PP has correctly applied the values that were traced to their respective sources and found correct.

Data and Parameters monitored

Means of verification

The monitoring parameters in the GHG emission reductions calculation have been monitored in accordance with the monitoring plan described in the PDD/01/. The monitoring mechanism, including the data collection and report, is effective and reliable. During the site visit, personnel involved at the appropriate level of operation of the project activity have been interviewed.

Verification team have assessed all relevant monitoring parameter as listed in section D.2 of the Monitoring Report/02/ as follows.

1) Appropriateness of the applied measurement/determination method
2) Correctness of the values applied for ER calculation
3) Accuracy and the applied QA/QC measures

Verification team have assessed whether relevant monitoring parameter and defined in the PDD and the applied methodology are correctly described in the monitoring report as bellows:

Data/Parameter	$EG_{facility,y}$
Description	Quantity of net electricity generation supplied by the project plant to the grid
Value	01/11/2020 - 31/12/2020 = 109,466.00 MWh 01/01/2021 - 31/12/2021 = 702,971.40 MWh 01/01/2022 - 31/12/2022 = 723,884.65 MWh 01/01/2023 - 31/01/2023 = 62,429.12 MWh **Total = 1,598,751 MWh**
Unit	MWh
Source	Energy Meters
Assessment	The energy meter monitors the bi-directional energy generated and consumed by the project activity. Serial numbers of the energy meters were verified during the site visit and found correct as below: **Line / Status / Serial Number** 1 / Main / MW 1810A247-02 1 / Check / MW 1807A670-02 2 / Main / MW 1810A249-02 2 / Check / MW 1807A671-02 The recorded data was cross checked with the help of PT PLN Joint meter reading reports for each month. The value is found correct.

Data/Parameter	$w_{steam,CO2,y}$
Description	Average mass fraction of carbon dioxide in the produced steam
Value	Period / CO_2 (tCO2/tsteam) Nov-20 / 0.0044 Feb-21 / 0.0041 May-21 / 0.0045 Aug-21 / 0.0037 Dec-21 / 0.0040 Mar-22 / 0.0036 May-22 / 0.0038 Aug-22 / 0.0037 Nov-22 / 0.0039
Unit	tCO_2/tsteam
Source	NCG lab test reports by PT ThermoChem/11/

Assessment	The sampling of NCG is taken at Production wells (ML-A1, ML-A2 and ML-A3) and at the separators (ML-HP A, ML-HP B, ML-LP) locations. The measurements are carried out using ASTM Standard Practice E1675 for Sampling 2-Phase Geothermal Fluid for Purposes of Chemical Analysis. The chemical analysis is performed by third party laboratory, PT ThermoChem Indonesia which is internationally recognised in chemical testing and consulting services for the Energy Industry. As per the methodology the measurement frequency is every three months. The values provided in the ER spread sheets were checked against the PT Thermochem Indonesia laboratory analysis reports and found to be consistent.

Data/Parameter	$w_{steam,CH4,y}$
Description	Average mass fraction of Methane in the produced steam
Value	

Period	CO_2 (tCO2/tsteam)
Nov-20	0.000134
Feb-21	0.000136
May-21	0.000150
Aug-21	0.039321
Dec-21	0.000115
Mar-22	0.000110
May-22	0.000118
Aug-22	0.000121
Nov-22	0.000117

Unit	$tCO_2/tsteam$
Source	NCG lab test reports by PT ThermoChem/11/
Assessment	The sampling of NCG is taken at Production wells (ML-A1, ML-A2 and ML-A3) and at the separators (ML-HP A, ML-HP B, ML-LP) locations. The measurements are carried out using ASTM Standard Practice E1675 for Sampling 2-Phase Geothermal Fluid for Purposes of Chemical Analysis. The chemical analysis is performed by third party laboratory, PT ThermoChem Indonesia which is internationally recognised in chemical testing and consulting services for the Energy Industry. As per the methodology the measurement frequency is every three months. The values provided in the ER spread sheets were checked against the PT Thermochem Indonesia laboratory analysis reports and found to be consistent.

Data/Parameter	$M_{steam,y}$
Description	Quantity of steam produced in year y
Value	01/11/2020 - 31/12/2020 = 715,242 t_{steam} 01/01/2021 - 31/12/2021 = 4,578,744 t_{steam} 01/01/2022 - 31/12/2022 = 4,766,022 t_{steam} 01/01/2023 - 31/01/2023 = 407,993 t_{steam} **Total = 1,01,12,962 t_{steam}**
Unit	t_{steam}/yr
Source	Main inlet steam flowmeter; plant monthly records

Assessment	Both flow meters are YOKOGAWA with accuracy level 0.5%. All meters are subject to be calibrated every 3 years. Flow Meter: Number HP Main Steam Flow: ML01LBA64CF001 LP Main Steam Flow: ML01LBA82CF001 Flow rate data is sent to the control room via DCS (Distributed Control System). Flow rate data is measured continuously in terms of kg/s and recorded in DCS. Daily and monthly reports are generated digitally kept at the control room. The audit team has checked the complete set of monthly data for the monitoring period from the spreadsheets and compared with the plant records and same is found to be consistent.

Data/Parameter	FC_y
Description	Quantity of diesel combusted in the process
Value	01/11/2020 - 31/12/2020 = 0.0411 m^3 01/01/2021 - 31/12/2021 = 16.3487 m^3 01/01/2022 - 31/12/2022 = 1.0958 m^3 01/01/2023 - 31/01/2023 = 0.0348 m^3 **Total = 17.51 m^3**
Unit	m^3/yr
Source	Fuel level meter
Assessment	Fuel consumption for emergency diesel generator (EDG) is monitored by level transmitter which is digital meter measuring in litres of diesel consumption. The record is kept in the DSC monthly log in digital form.

Data/Parameter	Number of jobs created locally
Description	Refers to the total number of jobs generated as a result of the project operation.
Value	Total: 386 **Breakdown by Location** Local: 275 Women: 111
Unit	Number
Source	Employee database
Assessment	The team checked the no. of jobs created by the project activity. Noted that the project created 386 jobs in the proposed monitoring period, with 351 men and 35 women. Out of 386, 69 (62 male, 7 female) and (20 Local, 49 Non local) are permanent employees through direct hire while 317 (289 male, 28 female) and (255 local, 62 Non local) employees are outsourced employees through contratual agreements. This has been verified by the verification team team through HR employement records /12/.

Data/Parameter	NCV_y
Description	Net calorific value of diesel in year y
Value	36.54
Unit	GJ/m^3
Source	Table 1.2, Chapter 1, Volume 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories

	Assessment: Checked IPCC Guidelines on National GHG Inventories/22/ and confirmed the NCV.

Data/Parameter	$EF_{CO2,y}$
Description	CO_2 emission factor of diesel
Value	0.0748
Unit	tCO_2/Gj
Source	Table 1.4, Chapter 1, Volume 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Assessment	Checked IPCC Guidelines on National GHG Inventories/23/ and confirmed the emission factor.

Data/Parameter	$EF_{CO2,y}$
Description	CO_2 emission factor of diesel
Value	0.0748
Unit	tCO_2/Gj
Source	Table 1.4, Chapter 1, Volume 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Assessment	Checked IPCC Guidelines on National GHG Inventories/23/ and confirmed the emission factor.

Findings	CAR#02 has been raised in this section.
Conclusion	TUV SUD confirms that the monitoring of this parameter has been carried out in accordance with the registered monitoring plan and all the monitoring activities comply with GS4GG rules.

Compliance with the calibration frequency requirements for measuring instruments

Means of verification

The audit team has checked the calibration certificates and records of the monitoring equipment as given below:

Parameter	Equipment	Serial No.	Make	Accuracy	Calibration date
$EG_{facility,y}$	Main	MW 1810A247 -02	Schneider Electric	0.1%	21/09/2020 14/10/2021 13/10/2022
	Check	MW 1807A670 -02	Schneider Electric	0.1%	21/09/2020 14/10/2021 13/10/2022
	Main	MW 1810A249 -02	Schneider Electric	0.1%	21/09/2020 14/10/2021 13/10/2022

		Check	MW 1807A671 -02	Schneider Electric	0.1%	21/09/2020 14/10/2021 13/10/2022
	$M_{Steam,y}$	HP Main Steam Flow	ML01LBA 64CF001	Yokogawa	1%	19/06/2018
		LP Main Steam Flow	ML01LBA 82CF001	Yokogawa	1%	19/06/2018
	FC_y	Diesel Consump-tion	NA	Oval Gear Digital Meter	0.5%	NA

As discussed in the above table, the verification team noted regular calibration is done. The calibration is performed in accordance with the monitoring plan by accredited entity /07/. However, there were gaps in the calibration since 18/06/2021 and 01/11/2020 in case of meters- ML01LBA64CF001, ML01LBA82CF001 and oval gear digital meter to measure $M_{Steam,y}$ and FC_y respectively, for which error factor has been applied as per meter specification in the ER calculation sheet.

Findings	CL01 has been raised and closed in this section.
Conclusion	TUV SUD confirms that the calibration certificates of all monitoring equipment, and calibration entity accreditation, have been verified against the document provided. If there is a delay in the calibration, the suitable correction factor has been applied to the parameter as per the GS VVB standard v1.0.

3 SUSTAINABILITY VERIFICATION

The monitoring has been carried out in accordance with the GS sustainability monitoring plan contained in the registered GS4GG PDD . During the verification, the team also checked the ongoing stakeholder communication. As per the interaction with the Plant manager has made available a greivance register at the project site /16/. During the site visit and interaction with the local stakeholders, it was also relaised that the stakeholders also have acess to phone and email of the plant manager. During the audit , it was checked that the complaints received are documented in the grievance book /16/. As per the book checked, six complaints were received and resolved. The verification team further had interviews with the local stakeholders, who confirmed that the they do not have any comments.

3.1 Assessment of Sustainability Parameters for the current Monitoring period relavant to Safe Guarding Principle

All the sustainability parameters were monitored and determined as per the Monitoring Plan.

Means of Verification	As per the project monitoring plan relevant to safeguarding principle on Community Health, Safety & Working Conditions needed the mitigation measures. The PP has conducted various trainings during the year 2021 and 2022 for the emplyees working with the project to create awareness. Also, the verification team has accessed the participation in the monthly and quarterly safety and environmental trainings through attendance list, copy of certificates and photographs of the event.
Findings	No findings were raised in this section.
Conclusion	TUV SUD confirms that monitoring of all the sustainable development monitoring parameters during this monitoring period is in line with registered GS passport and are consistent with remote audit observations

3.2 Assessment of Data and Calculation of Greenhouse Gas Emission Reductions

Calculation of baseline GHG emissions or baseline net GHG removals by sinks

Means of verification	The verification team checked the Emission Reduction calculation sheets /03/ and confirms that that equations used have been correctly applied and as per the selected methodology ACM0002, version 12.2 /08/. The same was also cross checked with the PDD and found to be in order. The baseline emissions are calculated as follows: $\mathbf{BE_y = EG_{PJ,y} \times EF_{grid,CM,y}}$ Where -$\mathbf{EF_{grid,CM,y}}$ is 0.743 in tCO_2/MWh (fixed ante according to the approved PDD). -$\mathbf{EG_{PJ,y}}$ is 1,598,751 Mwh (checked against the monthly electricity report) $\mathbf{BE_y=}$ 1,598,751 * 0.743 = 1,187,872 tCO_2
Findings	No finding is raised in this section
Conclusion	Calculations applied formulae and method for calculation of baseline emission are in accordance with the registered monitoring plan and are in line with the requirements of the applied methodology.

3.2.2 Calculation of project GHG emissions or actual net anthropogenic GHG removals by sinks

Means of verification	The project emissions are calculated as follows: $\mathbf{PE_y = PE_{FF,y} + PE_{GP,y}}$ **A.** $\mathbf{PE_{FF,y} = \sum FC_y * COEF_y}$ Option B of the tool 03 has been choosed to calculate the CO2 emission coefficient: $\mathbf{COEF_y = NCV_y * EF_{CO2,y}}$ $\mathbf{PE_{FF,y} =}$ 17.51 * 36.54 * 0.0748 **=** 47.803 t_{CO2} **B.** $\mathbf{PE_{GP,y} = (wsteam,CO2,y + wsteam,CH4,y * GWP_{CH4}) * Msteam,y}$ **=** (39,979.74 + 1,299.4 * 28) * 1,01,12,962 **=** 41,290.17 t_{CO2} $\mathbf{PE_y =}$ 41,338 $\mathbf{t_{CO2}}$
Findings	CAR#03 has been raised in this section.
Conclusion	The calculation of project emissions is correct. Further the information provided in the monitoring report has been cross-checked with other sources such as plant logbooks, inventories and purchase records to confirm the correctness and for plausibility check. The calculation of baseline GHG emissions have been carried out in accordance with the formulae and methods described in the registered monitoring plan. Any assumptions used in emission or removal calculations have been justified. Appropriate emission factor, IPCC default values, GWPs and other reference values have been correctly applied.

3.2.3 Calculation of leakage GHG emissions

Means of verification	No leakage emissions considered as per the methodology.
Findings	Not applicable.
Conclusion	Not applicable.

3.2.4 Summary calculation of GHG emission reductions or net anthropogenic GHG removals by sinks

Means of verification	No lack of evidence and missing data were detected during this monitoring period. All values as per the monitoring plan were crosschecked by the verification team against basic monitored data and the calculations were found to be correct. The verification team confirms that all assumptions, emission factors and default values have been correctly justified. All the emission factors, application of maximum permissible errors and default values are explicitly mentioned in the monitoring report. Hence the VVB confirms that the methods and formulae used to obtain the emissions are appropriate. No reporting risks have been identified for the data reported. Troubleshooting procedure, maintenance and calibration of monitoring equipment, monitoring measurements and reporting, record handling and maintenance, reviewing monitored data are available at the plant. All the monitored data are archived partially in electronic and paper form. The data will be kept for the whole crediting period and 2 years after the last crediting period thereby meeting the requirement of the monitoring plan. Verified emission reductions in this monitoring period: 1,144,912 (round down to nearest integer) tCO_2e.
Findings	No CARs/CLs have been raised.
Conclusion	The formulae and the methods referred in the MR and the emission reduction calculation spread sheet comply with the methods described in the registered PDD. No lack of evidence and missing data were detected during this monitoring period. All values as per the monitoring plan were crosschecked by the verification team against basic monitored data and the GHG emission calculation is found correct. TUV SUD confirms that all assumptions, emission factors and default values have been correctly justified. All the emission factors and default values are explicitly mentioned in the monitoring report.

3.2.5 Comparison of actual GHG emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Means of verification	The emission reductions from the project for the monitoring period as reported in the monitoring report is 1,144,912 tCO2e while the estimated emissions as per the registered PDD is 860,456 tCO2e. The actual emissions are 33.06% higher than the estimated emission reductions. The main reason of actual ERs being on higher end is mainly due to lower Non Combustion Gases (NCG) of CO_2 with actual NCG having an average of 0.4% compared to the figure estimated in PDD of 1.9%. Lower

	NCG has caused less project emissions. This parameter is not in control of PP. At the validation, PP has estimated NCG based on the assumptions available at the validation while in calculating achieved emission reductions, PP has monitored this parameter as per the monitoring plan. Hence, the difference in actual and estimated emission reductions is found justifiable.
Findings	No CARs/CLs have been raised
Conclusion	TUV SUD confirms that the emission reductions are real and measurable.

3.2.6 Remarks on increase from estimated value in registered PDD

Means of verification	The increase in the actual VERs are due to the reduction in the actual NCG which is 0.4% as compared to 1.9% estimated in the registered PDD. This led to to reduction in the project emissions, which is the main cause for the increased VERs.
Findings	CL#02 has been raised and closed in this section
Conclusion	TUV SUD confirms that the increase in the emission reductions are due to factor which is not in the hand of PP and accepts the explanation given by PP.

3.3 Assessment of mitigation measures resulting from the Safeguarding reporting

Means of verification	VVB team have assessed the biodiversity action plan and critical habitat assessment program including installed camera traps and endangered species monitoring implemented by PP in collaboration with Kerinci Seblat National Park (KSNP). VVB team has also checked half yearly reports/15-19/ which monitores and details the impact on the flaura, fauna and biodiversity (endangered species) due to operational activity of the geothermal plant. It is found during assessment that many vulernable, endangered, near threatened species are still found in the camera traps database records/20/. VVB team also confirms that there is a dedicated team appointed by the PP for the monitoring and reporting any incident which can disturb the habitat of the flaura and fauna in the vicinity of the project boundary. Also, PP has implemented biodiversity restoration plan for nearly 52.5 hectare of forest land near batigo – pauh duo district, solok selatan district in collaboration with Kerinci Seblat Nagari National park. VVB team has cross checked via joint report published/21/. Also, PP has taken some proactive measures to mitigate the negative impact on the biodiversity as below: To protect the flora and fauna, especially endangered species, SEML deployed several forestry signage that contain a list of protected species, and warnings. SEML monitors fauna species and reported every 6 months. SEML restores habitat around the project site by replanting and enriching flora species and monitoring growth rate. Monitoring and restoring habitat involving experts from Kerinci Seblat National Park, they involve in drafting programs and plans that will be implemented in the restoration area. Promotion to Mass Media of Ecosystem Recovery Activities in South Solok Regency.
Findings	No findings are raised in this section
Conclusion	TUV SUD confirms that there are no potential findings related to the negative impact on the Biodiversity (endangered species) principle 9 of the GS4GG.

4 VERIFICATION OPINION

TUV SUD South Asia has performed verification of the emission reductions reported for the project activity “Liki Pinawangan Muara Laboh Geothermal Power Plant”, GS Reference No. 12112 for the period 01/11/2020-31/01/2023, with regard to the relevant GS4GG requirments. The project participants are responsible for the collection of data in accordance with the monitoring plan and the reporting emission reductions from the project.

It is TUV SUD’s responsibility to express an independent verification opinion on the reported emission reductions from the project and VVBs not express any opinion on the selected baseline scenario or on the validated and registered PDD. From the documented evidences and corroborated by an off-site assessment TUV SUD can confirm that:

(i) the project has been implemented and operated as per the PDD;

(ii) the monitoring report and other supporting documents provided are complete and verifiable and in accordance with the relevant GS requirements and principles;

(iii) the monitoring is in place as per the applied baseline and monitoring methodology; (iv) the monitoring complies with the monitoring plan;

(iv) the monitoring plan in the PDD is as per the applied baseline and monitoring methodology.

Verified emission reductions in this monitoring period -01/11/2020-31/01/2023 (both days included) : 1,144,912 tCO_2e

Baseline:	1,187,872 tCO_2e
Project emissions:	42,946 tCO_2e
Leakage:	0 tCO_2e

South Asia

Annex 1

Clarification requests, corrective action requests and forward action requests

Table 1. Remaining FAR from validation and/or previous verifications

NA.

Table 2. CL from this verification

CL ID	01	**Section no.**	2.7	**Date:** 18/07/2023
Description of CL				
PP is requested to submit calibration certificate of Yokogawa flow meter serial number ML01LBA82CF001 for verification. Also, the date of calibration for Yokogawa flow meter serial number ML01LBA64CF001 is not matching with the date mentioned in MR.				
Project participant response				**Date:** 09/08/2023
- Kindly find in the attachment for the calibration certificate of flow meter serial number ML01LBA82CF001. - The MR has been updated accordingly. Kindly find in the attachment for MR ver 1.1				
Documentation provided by project participant				
- 01 Calibration certificate of flow meter serial number ML01LBA82CF001. - MR ver 1.1				
VVB assessment				**Date:** 29/08/2023
The calibration certificate is found correct and accpetable. The calibration date is not in line with the calibration certificate, but the PP has applied the correction factor and hence the finding is closed.				

CL ID	02	**Section no.**	3.2.6	**Date:** 18/07/2023
Description of CL				
The emission reduction is higher by 33% while the NCG is only lower by 1.6% than estimated in the PDD. PP to clarify other applicable reasons for the increase in the emission reduction value compared to the ex-ante. Also, PP needs to check whether this breach the additionality threshold value or not.				
Project participant response				**Date:** 09/08/2023
As explained in section E.6 of the MR, the higher emission reduction is due to a combination of lower Non Combustible Gas and higher plant load factor. The sensitive analysis of Gold Standard Certified PDD of section B.5 shows that project IRR was still below the benchmark even though the electricity generation increased.				
Documentation provided by project participant				
NA				
VVB assessment (Round 2)				**Date:** 29/08/2023
PP to clarify the reason for not including NCG in the senstivity analysis.				

Project participant response	**Date:** 06/09/2023
According to *'Assessment approach for reporting higher ex-post emission reductions' version 1.0 para 2.1.2,* only parameters with material impact and impact in project revenue were included in the sensitivity analysis for investment analysis. As NCG has no impact on project revenue therefore not included in the sensitivity analysis.	
VVB assessment (Round 2)	**Date:** 15/09/2023
The justification by the PP is accepted and the finding is closed.	

CL ID	03	**Section no.**	2.3	**Date:** 18/07/2023
Description of CL				
PP to clarify how 88.8 MW capacity is defined. Since the COD contains 85.33 MW, while the name-plate of the Geothermal steam turbine mentions 85,260 kW = 85.26 MW.				
Project participant response				**Date:** 09/08/2023
Kindly find in the attachment for the Turbine technical specification from the manufacturer.				
Documentation provided by project participant				
02 Turbine Data Sheet.				
VVB assessment				**Date:** 29/08/2023
The specified value is in line with the turbine data sheet of the manufacture. Hence this finding is closed.				

Table 3. CAR from this verification

CAR ID	01	**Section no.**	2.7	**Date:** 18/07/2023
Description of CAR				
Section B.2.3 of the MR version 1.0 contains information which is pre-design certification. Hence, can be removed.				
Project participant response				**Date:** 09/08/2023
The MR has been updated accordingly.				
Documentation provided by project participant				
MR ver 1.1				
VVB assessment				**Date:** 29/08/2023
The updated MR is now verified and found correct. The finding is closed.				

CAR ID	02	**Section no.**	2.7	**Date:** 18/07/2023
Description of CAR				

Parameter FCy table directly reports the project emissions whereas the parameter is measured in m3/yr. PP to revise the correct values for the parameter. Also, the measurement device installed at site is a digital meter which shows reading in unit litres of diesel consumed, but the MR still mentions some different procedure to calculate the fuel consumption.
Project participant response **Date:** 06/09/2023
MR has been updated accordingly. Please see MR v1.2 page 19.
Documentation provided by project participant
Revised MRv1.2
VVB assessment **Date:** 15/09/2023
The updated MR is now verified and found correct. The finding is closed.

CAR ID	03	**Section no.**	2.6	**Date:** 18/07/2023
Description of CAR				
The calculation of Project emission on page 25 of the MR needs to be consistent with the ER sheet.				
Project participant response				**Date:** 09/08/2023
The MR has been updated accordingly.				
Documentation provided by project participant				
MR ver 1.1				
VVB assessment				**Date:** 31/08/2023
The updated MR is now verified and found correct. The finding is closed.				

CAR ID	04	**Section no.**	2.1	**Date:** 06/09/2023
Description of CAR				
MR v1.2 submitted also does not contain information in section B.1.1 Forward Action Request, please refer to the GS MR template guide and submit the revised MR accordingly for the five FAR in the Final Design Review by Sustain Cert.				
Project participant response				**Date:** 12/09/2023
MR has been updated accordingly.				
Documentation provided by project participant				
Revised MR v1.3				
VVB assessment				**Date:** 15/09/2023
Revised MR is checked and found correct. Hence, the finding is closed.				

Table 4. FAR from this verification

NA

Annex 2: Information Reference List

No.	Author	Title	References to the document	Provider
1	PP	Monitoring report for the project "Liki Pinawangan Muara Laboh Geothermal Power Plant".	Version 1.3 dated 12/09/2023, Version 1.7 dated 16/04/2024	PP
2	PP	Emission Reduction spread sheet (MR v01.xlsx)	Version 1.0 dated 06/09/2023	PP
3	PP	Registered PDD for the project ""Liki Pinawangan Muara Laboh Geothermal Power Plant".	Version 1.0 dated 27/03/2023	Others
4	Sustain Cert	Design certification report	27/03/2023	PP
5	PT PLN	Commercial date of operation certificate	Dated 20/12/2019	PP
6	PP	Turbine data sheet (Controlled Docuement)	-	PP
7	PT PLN	Calibration certificate	Multiple dates	PP
8	CDM	Grid-connected electricity generation from renewable sources ACM0002 v12.2	EB 65, Annex 16 25 November 2011	PP
9	GS4GG	Monitoring report v1.1	Dated 14/10/2020	PP
10	PT PLN	Electricity generation invoices	Multiple dates	PP
11	Thermochem Indonesia	Chemical analysis report	For the period 2020-2022	PP
12	PT Supreme Energy Muara Laboh	Employment contracts	-	
13	PT Supreme Energy Muara Laboh	Grievance Register	-	PP
14	CDM Project Page	https://cdm.unfccc.int/Projects/DB/LRQA%20Ltd1338387972.21/view	Accessed on 15/09/2023	Others
15	PT Supreme Energy Muara Laboh	Economic and Social monitoring report from July - Dec 2020	Issued on 02 March 2021	PP
16	PT Supreme Energy Muara Laboh	Economic and Social monitoring report from Jan - July 2021	Issued on 31 July 2021	PP
17	PT Supreme Energy Muara Laboh	Economic and Social monitoring report from July -Dec 2021	Issued on 31 January 2022	PP
18	PT Supreme Energy Muara Laboh	Economic and Social monitoring report from Jan - Jun 2022	Issued on 31 July 2022	PP
19	PT Supreme Energy Muara Laboh	Economic and Social monitoring report from July - Dec 2022	Issued on 31 January 2023	PP
20	PT Supreme Energy Muara Laboh	Camera trap database records for year 2020, 2021, 2022 and 2023	-	PP

21	PT Supreme Energy Muara Laboh and Kerinci Seblat National Park	Expert recommendations Activity Implementation Report	October 2022	PP
22	IPCC	Table 1.2, Chapter 1, Volume 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories		Others
23	IPCC	Table 1.4, Chapter 1, Volume 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories		Others

Annex 3: Abbreviations

Abbreviations	Full texts
BE	Baseline Emissions
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CDM M&P	Modalities and Procedures CDM
CER(s)	Certified Emission Reduction(s)
CH4	Methane
CL	Clarification Request
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
DNA	Designated National Authority
VVB	Designated Operational Entity
EB	Executive Board
ER	Emission Reductions
EVN	Electricity Corporation of Indonesia
FAR	Forward Action Request
FSR	Feasibility Study Report
GHG(s)	Greenhouse gas(es)
GS4GG	Gold Standard for Global Goals
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
LoA	Letter of Approval
MoV	Means of Verification
MWh	Mega Watt Hour
MR	Monitoring Report
NGO	Non-governmental Organization
ODA	Official Development Assistance
PCP	Project Cycle Procedure
PDD	Project Design Document
PE	Project Emission

PP(s)	Project Participant(s)
PPA	Power Purchase Agreement
PS	Project Standard
QA/QC	Quality Assurance/ Quality Control
Ref.	Document Reference
SS(s)	Sectoral Scope(s)
TA(s)	Technical Area(s)
TÜV SÜD	TÜV SÜD South Asia Private Limited
UNFCCC	United Nations Framework Convention on Climate Change
VVS	CDM Validation and Verification Standard

Annex 4

ZERTIFIKAT ◆ CERTIFICATE ◆ 認証証書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

South Asia

CERTIFICATE OF APPOINTMENT

Ms. Shruti Kudtarkar fulfills the requirements of the Certification Body 'Environment and Energy' of TÜV SÜD South Asia Pvt Ltd to participate in audits.

Qualification applicable to					
Standard	CDM	GS	VCS	ISO-14064-1, 2	Other GCC, PAS 2060
	☒	☒	☒	☒	☒

Qualification as						
Status	Validator ☒	Verifier ☒	ATL ☒	Technical Reviewer ☒	Financial Expert ☒	Technical Expert ☒
TA (s)	CDM - 1.2, 13.1, 13.2 ISO 14064-1 – (1,11,13) ISO 14064-2 - (1,13)					

Country Expertise						
Region	1	2	3	4	5	6
Further countries	India, Malaysia, Sri Lanka, Indonesia, Paraguay, Myanmar					

Technical Area/ Scopes
CDM - 1.2_Renewable, 13.1_ Solid waste and wastewater, 13.2_Manure ISO 14064 –1 - Power Generation and Electric Power Transactions, Waste handling and disposal, General ISO 14064-2 - Energy industries (renewable/non-renewable sources), Waste handling and disposal

This appointment is valid until 25/10/2024 and is bound by internal requirements of the Certification Body 'Environment and Energy' of TÜV SÜD South Asia Pvt Ltd.
In case of loss of validity of this certificate as per result of an assessment according to internal procedures or due to any other reason, it will be properly communicated to you.
Your Certificate has the internal reference no. CB-IND-CCP-0022/003.

Date	Signature
01/11/2023	Deepankar Chowdhury

TÜV SÜD South Asia ● Solitaire, 4th Floor ● ITI Road, Aundh ● Pune – 411007 ● Tel.: +91 20 6684 1200 ● Fax: +91 20 6684 1261

ZERTIFIKAT ◆ CERTIFICATE ◆ 認証書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

South Asia

CERTIFICATE OF APPOINTMENT

Mr. Arjun Vyas, fulfills the requirements of the Certification Body 'Environment and Energy' of TÜV SÜD South Asia Pvt Ltd to participate in audits.

Qualification applicable to					
Standard	CDM	GS	VCS	ISO-14064-1, 2	Other GCC
	☒	☒	☒	☒	☒

Qualification as						
Status	Validator ☒	Verifier ☒	ATL ☒	Technical Reviewer ☐	Financial Expert ☐	Technical Expert ☒
TA (s)	1.2					

Country Expertise						
Region	1	2	3	4	5	Other
Further countries	India					

Technical Area/ Scopes
1.2_Renewables

This appointment is valid until 12.07.2024 and is bound by internal requirements of the Certification Body 'Environment and Energy' of TÜV SÜD South Asia Pvt Ltd.
In case of loss of validity of this certificate as per result of an assessment according to internal procedures or due to any other reason, it will be properly communicated to you.
Your Certificate has the internal reference no. CB-IND-CCP-0023/002.

Date	Signature
12/07/2023	Shruti Kudtarkar

IS-CMS-CB-POG-01/05, version 03

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South Asia

ZERTIFIKAT ◆ CERTIFICATE ◆ 認証証書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

South Asia

CERTIFICATE OF APPOINTMENT

Mr. Sudheendra, K fulfills the requirements of the Certification Body 'Environment and Energy' of TÜV SÜD South Asia Pvt Ltd to participate in audits.

Qualification applicable to					
Standard	CDM	GS	VCS	ISO-14064-1, 2	Other GCC
	☒	☒	☒	☒	☒

Qualification as						
Status	Validator ☐	Verifier ☐	ATL ☐	Technical Reviewer ☒	Financial Expert ☐	Technical Expert ☒
TA (s)	1.1, 1.2					

Country Expertise						
Region	1	2	3	4	5	Other
	☒	☐	☐	☐	☐	
Further countries						

Technical Area/ Scopes
1.1_Thermal energy generation, Energy Industries (Thermal)-GHG
1.2_Renewables
Power generation and Electrical power transactions (fossil fuel-thermal, renewable/nonrenewable-(GHG)
Energy distribution (GHG)

This appointment is valid until 31.07.2024 and is bound by internal requirements of the Certification Body 'Environment and Energy' of TÜV SÜD South Asia Pvt Ltd.
In case of loss of validity of this certificate as per result of an assessment according to internal procedures or due to any other reason, it will be properly communicated to you.
Your Certificate has the internal reference no. CB-IND-CCP-0104/004.

Date	Signature
01/08/2023	Shruti Kudtarkar

IS-CMS-CB-POG-01/05, version 03

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