



NATURAL GAS BASED COMBINED CYCLE
POWER PROJECT AT VALANTHARAVAI
VILLAGE, RAMANATHAPURAM DISTRICT,
TAMIL NADU BY PENNA ELECTRICITY
LIMITED [FORMERLY ARKAY ENERGY
LIMITED]



Document Prepared By

LGAI Technological Center S.A. (Applus+ Certification)

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Summary:

LGAI Technological Center S.A. (Applus+ Certification) (Hereafter referred as Applus+ Certification) has been appointed by "PIONEER POWER LIMITED (Formally Penna Electricity Limited) to perform a verification of the project "Natural Gas based Combined Cycle Power Project at Valantharavai Village, Ramanathapuram District, Tamil Nadu by Penna Electricity Limited [Formerly Arkay Energy Limited]" for the period from 01-July-2012 to 30-June-2016 (inclusive both days). The main purpose of this verification activity is to have an independent third party for the assessment of the project design, monitoring report to ensure a thorough assessment of the proposed project activity against the applicable CDM and VCS requirements.

Project activity involved the Combined Cycle Power Project (CCPP) with installed capacity of about 58.15 MW. The plant consists of one gas turbine of 38.15 MW and one Heat Recovery Steam Generator Unit of 67 TPH rated capacity coupled to a Steam Turbine Generating Unit of 20 MW. Start date of the project activity is 01-July-2006 which is also commissioning date of project. The commissioning report for the project activity is checked by the assessment team and found correct.

The scope of the verification is the independent and objective review of the monitoring report (MR). The MR is reviewed against the relevant criteria (see above) and decisions by the CDM Executive Board and VCS executive board, including the approved baseline and monitoring methodology. The verification was based on the guidance given in the CDM Validation and Verification Standard for project activities, version 03.0, review against registered PD and Final Validation report, CDM Project Standard for project activities, version 03.0; CDM Project Cycle Procedure for project activities, version 03.0 and VCS program guideline v4.3 and standard version v4.4.

Monitoring report covers period from 01-July-2012 to 30-June-2016 (both days included). The total emission reductions achieved for the project activity during the monitoring period has been 508,306 tCO₂e. The crediting period for VCS began on 01-July-2006 and ended on 30-June-2016. An undertaking from the project participant confirms that project will not claim any other scheme benefits for the concerned monitoring period (Refer Section 3.1 of this FVR for further details).

A risk-based approach has been followed to perform this verification activity. In the course of verification, 06 Corrective Action requests (CAR), 01 Clarification Requests (CLs) and 00 Forward Action Requests (FARs) were raised and successfully closed. The review of the monitoring report and additional documents related to baseline and monitoring methodology; the subsequent background investigation, follow-up interviews and PP have provided DOE with sufficient evidence to verify the fulfilment of the stated criteria of VCS.

The assessment team has employed a risk-based approach to assess the completeness and accuracy of the claims and conservativeness of the assumptions in the MR. The main focus of the assessment team is to identify the significant risks for the project implementation and the generation of VERs. The verification is not meant to provide any consulting towards the project participants. However, stated requests for clarifications and/or corrective actions may have provided input for improvement of the monitoring report combined.

The only purpose of the verification is its usage during the issuance process as part of the VCS project cycle. Therefore, LGAI Technological Center S.A. (Applus+ Certification) can't be held liable by any party for decisions made or not made based on the verification opinion, which will go beyond that purpose.

The verification has been planned and organized to achieve a Reasonable Level of assurance as per the requirement of VCS. No sampling procedure applied for site visit or document verifications. The entire documents checked/power plant verification conducted to arrive at positive verification conclusions.

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1 INTRODUCTION

1.1 Objective

LGAI Technological Center S.A. (Applus+ Certification) (Hereafter referred as Applus+ Certification) has been appointed by “PIONEER POWER LIMITED (Formally Penna Electricity Limited)” to perform the 2nd periodic verification of the “Natural Gas based Combined Cycle Power Project at Valantharavai Village, Ramanathapuram District, Tamil Nadu by Penna Electricity Limited [Formerly Arkay Energy Limited]” under VCS standard v4.4 and guideline v4.3. The objective of this verification activity is to have an independent third party for the assessment of the project design, monitoring report and final validation report and to ensure a thorough assessment of the proposed project activity against the applicable CDM and VCS requirements. In particular;

- the project's baseline is assessed against “AM0029, Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas” Version 03”
- the project's monitoring plan is assessed against “AM0029, Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas” Version 03”
- the projects compliance with, the requirements of Article 12 of the Kyoto Protocol, the CDM Modalities and Procedures as agreed in the Marrakech Accords under decision 3/CMP.1, the annexes to this decision, subsequent decisions and guidance made by COP/MOP & CDM Executive Board and other relevant rules, including the Host Country legislation and sustainability criteria along with VCS guidelines v4.3 and standard version v4.4.
- CDM Validation and Verification Standard for project activities, version 03.0
- CDM Project Standard for project activities, version 03.0
- CDM Project Cycle Procedure for project activities, version 03.0
- VCS standard v4.4
- VCS program guideline v4.3

Verification is a requirement for all VCS projects and is seen as necessary to provide assurance to stakeholders of the quality of the project and its intended generation of verified emission reductions (VERs).

1.2 Scope and Criteria

The scope is defined as an independent and objective review of the Monitoring report (MR) prepared as per the registered PD and registered approved methodology “AM0029, Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas” Version 03”. The MR is reviewed against the criteria stated in Article 12 of the Kyoto Protocol, the CDM modalities and procedures as agreed in the Marrakech Accords and the relevant decisions by

the CDM Executive Board and VCS standard v4.4 and guideline version 4.3, including the approved baseline and monitoring methodology "AM0029, Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas" Version 03". The verification was based on the requirements in the CDM Validation and Verification Standard for project activities version 03.0; CDM project standard for project activities, version 03.0; CDM project cycle procedure for project activities, version 03.0 and VCS program guideline and standard version v4.4.

The verification is not meant to provide any consulting towards the project participants. However, stated requests for clarifications and/or corrective actions may have provided input for improvement of the Monitoring report. In line with Guidelines for Application of materiality in verifications, the verification team has conducted a complete verification of all the information presented in the monitoring report and data monitored as presented in the emission reduction calculation spread sheet. Its invoices follow the paper trail back to the raw data such as meter reading records and logbook data sheet. There are no material errors, overestimation of ER, omission or misstatement. No sampling is used as the verification team has reviewed all the documents like commissioning certificates, Logbook data sheet etc.

1.3 Level of Assurance

The verification has been planned and organized to achieve a Reasonable Level of assurance as per the requirement of VCS. No sampling procedure applied for document verifications. The entire documents checked to arrive at positive verification conclusions.

1.4 Summary Description of the Project

Project activity involved the Combined Cycle Power Project (CCPP) with installed capacity of about 58.15 MW comprises of one Gas Turbine Generating Unit of 38.15 MW rated capacity, one Heat Recovery Steam Generator Unit of 67 TPH rated capacity coupled to a Steam Turbine Generating Unit of 20 MW rated capacity along with all electrical systems, controls and Instrumentation, Civil, Structural and Architectural works. The rating of the power plant is 38.15 MW at PF: 0.8 in Open Cycle and about 58.15 MW at PF: 0.8 in Combined Cycle. Assessment team checked the commissioning Certificates and found that project activity was commissioned on 01-July-2006. The project is implemented as per the description in the registered VCS PD/CDM PDD. No event observed during the current monitoring period which can alter or deviate from the methodology requirement.

2 VERIFICATION PROCESS

2.1 Method and Criteria

Verification Process: The project assessment is based on the “Clean Development Mechanism Validation and Verification Standard” for project activities version 03.0 and “VCS standard v4.4 and program guideline version 4.3” and is conducted using standard auditing techniques to assess the correctness of the information provided by the project participants. Before the assessment begins, members of the team covering the technical scope(s), sectoral scope(s), and relevant host country experience for evaluating the VCS project activity are appointed.

Once the project is received by the assessment team, the members of the assessment team carried out:

1. A desk review of the Monitoring report against the registered PD and final validation report;
2. Follow-up interviews with project participant;
3. The resolution of outstanding issues and the issuance of the final verification report and opinion.

The prepared verification report and other supporting documents then undergo an internal quality control at the HQ (Accredited office) before being submitted to the VCS executive board.

In order to ensure transparency, assumptions must be clear and stated explicitly and background material must also be referenced. Applus+ Certification has developed a specific checklist customized for the project. The checklist demonstrates, in a transparent manner, the project criteria (requirements), discussion on each criterion by the assessment team, and the results from validating the identified criteria.

Appointment of the assessment team

According to the sectoral scope / technical area and experience in the sectoral or national business environment, Applus+ Certification has composed a project assessment team in accordance with the appointment rules in the internal Quality Management System of Applus+ Certification.

The composition of audit team shall be approved by the Applus+ Certification ensuring that the required skills are covered by the team.

The four qualification levels for team members that are assigned by formal appointment rules are as presented below:

- Lead Auditor (LA).
- Auditor (A) / Auditor in Training (AiT).
- Technical Expert (TE).
- Technical Reviewer (TR).

The sectoral scope / technical area knowledge linked to the applied methodology/ies shall be covered by the assessment team.

Name	Role	SS Coverage	TA Coverage	Financial aspect	Host country experience
Dr. Atul Takarkhede	LA/TE	YES	YES	NA	YES
Mr. Denny Xue	TR	YES	YES	NA	NA

The detail regarding the assessment team is provided below in this report as Appendix 3

Document review

The Monitoring report version 01 submitted by the PP was reviewed against the approved methodology, registered PD/PDD, final validation report and other relevant criteria to verify the correctness, credibility, and interpretation of the presented information. Furthermore, a cross-check between information provided and information from other sources has been done. A complete list of all documents and evidence material reviewed is included in this report below in Appendix 1.

Follow-up interviews

A site visit is conducted by Applus+ Certification. Audit team performed interviews, telephone conferences, and physical site inspection with project stakeholders to confirm selected information and to resolve issues identified in the document review. The detail is provided in this report.

Resolution of Clarification and Corrective Action Request

The objective of this phase of the Verification was to resolve the requests for corrective actions and clarification and any other outstanding issues which need to be clarified for Applus+ Certification positive conclusion on the Monitoring report. The Corrective Action Requests and Clarification Requests raised by Applus+ Certification were resolved during communications between the Client and Applus+ Certification to guarantee the transparency of the verification process, the concerns raised and responses given are summarized below in the Appendix 2.

The final MR submitted by PP serves as the basis for the final assessment presented. Additional changes to the project during the verification process are not considered to be significant with respect to the main CDM/VCS objectives. The two CDM/VCS main objectives are the reduction of anthropogenic GHG emissions and the contribution of sustainable development to the host country.

Internal quality control

As final step of a verification of the final documentation including the verification report and the checklist have to undergo an internal quality control by the technical review committee, i.e. each report has to be finally approved either by the head of the technical review committee or the

deputy. In case one of these two persons is part of the assessment team approval can only be given by the other one to avoid any conflict of Interest.

After confirmation of the PP the positive verification opinion and relevant documents are submitted to the VCS board through the VCS web-platform.

2.2 Document Review

The details of the document observed during the verification process are listed below in Appendix 1 of this report.

2.3 Interviews

No.	Interviewee			Date	Subject	Team member
	Last name	First name	Affiliation			
1.	Ramanand	-	DGM	09-November-2021 & 10-November-2021	Implementation of the project and monitoring. Baseline emission calculation, achieved emission reduction for the monitoring period, monitoring process followed onsite	Dr. Atul Takarkhede
2.	Ladukar	Anant	Consultant EKI Energy Services		Baseline emission calculation, achieved emission reduction for the monitoring period	

2.4 Site Inspections

Duration of on-site inspection: 09-November-2021 & 10-November-2021				
S.No.	Activity performed on-site	Site location	Date	Team member
1.	Assessment team checked the implementation of the project, Baseline emission, Emission reduction calculation, technical description of the project and Monitoring. Assessment team also checked that whether the monitoring plan as described in the VCS PD is actually practised onsite. Also assessment team checked any change in host country criteria which may affect the baseline of	Valantharavai Village, Ramanathapuram District, Tamil Nadu, India	09-November-2021 & 10-November-2021	Dr. Atul Takarkhede

Duration of on-site inspection: 09-November-2021 & 10-November-2021				
S.No.	Activity performed on-site	Site location	Date	Team member
	the project activity. Assessment team also had a discussion with Technical staff, monitoring team and checked grievance register placed onsite as per the continuous improvement measure of PP for the Local villagers.			

2.5 Resolution of Findings

The objective of this phase of the Verification was to resolve the requests for corrective actions and clarification and any other outstanding issues from validation which need to be clarified for Applus+ Certification's positive conclusion on the Monitoring report. The Corrective Action Requests and Clarification Requests raised by Applus+ Certification were resolved during communications between the Client and Applus+ Certification to guarantee the transparency of the verification process, the concerns raised and responses given are summarized below in the appendix 2.

The final MR submitted by PP serves as the basis for the final assessment presented. Additional changes to the project during the verification process are not considered to be significant with respect to the main CDM/VCS objectives. The two CDM/VCS main objectives are the reduction of anthropogenic GHG emissions and the contribution of sustainable development to the host country.

Areas of verification findings	No. of CL	No. of CAR	No. of FAR
Compliance of the monitoring report with the monitoring report form	01	00	00
Compliance of the project implementation and operation with the registered PDD	00	02	00
Post-registration changes	00	00	00
Compliance of the registered monitoring plan with the methodologies including applicable tools and standardized baselines	00	00	00
Compliance of monitoring activities with the registered monitoring plan	00	02	00
Compliance with the calibration frequency requirements for measuring instruments	00	01	00
Assessment of data and calculation of emission reductions or net removals	00	00	00
Assessment of reported sustainable development co-benefits	00	00	00
Local stakeholder consultation	00	01	00
Others (please specify)	00	00	00
Total	01	06	00

The list of findings and their resolution is presented in Appendix 2 of this report

2.5.1 Forward Action Requests

This is 2nd periodic verification of the project activity and no FAR was raised from validation and first verification which is ongoing.

2.6 Eligibility for Validation Activities

Where the validation/verification body has undertaken validation activities as part of the verification and does not hold accreditation for validation for the relevant sectoral scope, provide evidence that the eligibility requirements set out in the VCS Program Guide are met. Include the name and reference numbers of five registered projects the validation/verification body has validated under the VCS Program or an approved GHG program.

3 VALIDATION FINDINGS

3.1 Participation under Other GHG Programs

The project activity has not participated in any other GHG programs. PP has given declaration that the project activity will not claim emission reductions for the monitoring period claimed in VCS and avoid double counting of the emission reductions.

Verification team has also checked REC India registry and confirms that project activity is not availing any REC benefits¹.

¹ https://www.recregistryindia.nic.in/index.php/general/publics/registered_regens

3.2 Methodology Deviations

There is no methodology deviation in present verification and first verification is ongoing.

3.3 Project Description Deviations

There is no project description deviation in present verification and first verification is ongoing.

3.4 Grouped Project

This is not a grouped project.

4 VERIFICATION FINDINGS

4.1 Project Implementation Status

During the verification site visit it was concluded that the project is implemented as per the requirement of the registered VCD PD. During the current monitoring period, it was observed that no unforeseen incident/event evolved which can impact the operation of the project activity. The project undergone continuous operation and only scheduled maintenance is observed as per the manufactures specification which is acceptable to the assessment team.

Project location is confirmed by the assessment team during the site visit. Assessment team also checked with the GPS meter regarding the latitude and longitude of the project site and confirm that the details as mentioned in the registered PD are correct. The detail is as below:

Location	Latitude	Longitude
Valantharavai Village, Ramanathapuram District, Tamil Nadu, India	09° 19' 24" N	78° 54' 42" E

Assessment team also checked the technical details of the power plant installed onsite. Project activity involved the Combined Cycle Power Project (CCPP) with installed capacity of about 58.15 MW comprises of one Gas Turbine Generating Unit of 38.15 MW rated capacity, one Heat Recovery Steam Generator Unit of 67 TPH rated capacity coupled to a Steam Turbine Generating Unit of 20 MW rated capacity along with all electrical systems, controls and Instrumentation, Civil, Structural and Architectural works. The rating of the power plant is 38.15 MW at PF: 0.8 in Open Cycle and about 58.15 MW at PF: 0.8 in Combined Cycle. The electricity generated by project activity is being used to sell to grid.

Assessment team checked the commissioning certificate and confirmed that Project Activity was commissioned on 01-July-2006 is correct.

The assessment team confirmed that there is no proposed or actual change to the project design during this monitoring period. The project design as mentioned in the registered PD is implemented and thus the same is acceptable to the assessment team. All required monitoring equipment's and procedures as mentioned in the registered VCS PD are available and implemented in an appropriate manner.

The organisational role and responsibility as mentioned in the registered VCD PD is followed onsite. All the monitoring equipment was calibrated as per the specified interval in the registered VCS PD. All the emergency preparedness as mentioned in the registered PD is followed onsite and no discrepancies were found regarding the same.

The assessment team observed that the project is in line with the registered VCS PD, FVR and approved methodology and thus no clarification/deviation is sought. CL 01, CAR 01 and CAR 02 were raised during the verification process and closed successfully. Please refer Appendix 2 for the detail closure of the CAR.

Assessment team confirms following during the verification site visit:

1. Start date of the project is 01-July-2006 which is the date of commissioning of the Project.
2. Assessment team confirms that project has not received or sought any other form of environmental credit". An undertaking letter has been submitted by PP for double counting with any other GHG program. PP also has given a written declaration that project has not claimed other form of GHG credit for the concerned monitoring. Further, assessment team confirms that project activity provided contribution in sustainable development to the host country
3. Assessment team confirms that this is the 2nd monitoring under VCS and covers the activity from 01-July-2012 to 30-June-2016 (inclusive of both dates). Thus, VCS crediting period should be maximum of 10 years. The start date was crediting period was 01-July-2006 and end date was 30-June-2016. The first verification i.e. 01-July-2006 to 30-June-2012 is ongoing and yet to conclude.

The GHG credits from 01-July-2012 to 30-June-2016 to will be claimed under VCS only. At any point of time during the crediting period, the project proponent will abide by the "Double Counting".

4. Assessment team checked and found that the Project proponent of the project activity is same as per the registered PD. There is no change in details of the PP and the same is mentioned below:

Organization name	PIONEER POWER LIMITED ² (Formally Penna Electricity Limited)
Contact person	Mr. P Pratap Reddy

² PP have submitted Certificate of Incorporation from Registrar of Companies, Government of India for name change of the company from Penna Electricity Limited to PIONEER POWER LIMITED.

Title	Managing Director
Address	Plot No. 703, Sriniketan Colony, Road No.3, Banjara Hills, Hyderabad, Andhra Pradesh 500 034
Telephone	NA
Email	NA

5. Assessment team also checked the details of other entity and found that the detail as mentioned in the MR is correct.

Organization name	EKI Energy Services Limited
Role in the project	Project Consultant
Contact person	Anant Ladukar
Title	Senior Manager
Address	Office No 201, Plot No 48, Scheme 78, Part 2, Vijay Nagar, Indore- 452010, Madhya Pradesh, India
Telephone	9770900205
Email	anant@enkingint.org / registry@enkingint.org

6. The quantified emission reduction calculation for the monitoring period is correct and conservative. Assessment team also compared actual VER with the estimated VER and found that the actual VER (508,306 tCO₂e) is 40.57% higher than the estimated emission reduction 361,604 tCO₂e (90,3391 tCO₂e Annual) for 1461 days.

The comparison of estimated value and actual values is discussed below:

An increase in the actual emission reduction achieved during the current monitoring period as compared to registered CDM PDD due to the increase in the Build Margin emission factor for current monitoring period which is ex-post and PP don't have control over it.

Parameter	Net Export to grid		Gas Consumption		Ratio of Million kWh to Million SCM for Monitoring Period	Ratio of Million kWh to Million SCM as per registered PDD
Description	For Monitoring Period	Estimated as Per registered PDD	For Monitoring Period	Estimated as Per registered PDD		
Year	kWh	kWh	SCM	SCM	KWh/SCM ratio	KWh/SCM ratio
01-July-2012 to 31-December 2012	193,293,226	198,190,080	48,799,139	46,583,138	3.96	4.25
01-January-2013 to 31-December-2013	357,411,806	393,148,800	91,646,201	92,406,769	3.90	4.25

Parameter	Net Export to grid		Gas Consumption		Ratio of Million kWh to Million SCM for Monitoring Period	Ratio of Million kWh to Million SCM as per registered PDD
Description	For Monitoring Period	Estimated as Per registered PDD	For Monitoring Period	Estimated as Per registered PDD		
Year	kWh	kWh	SCM	SCM	KWh/SCM ratio	KWh/SCM ratio
01-January-2014 to 31-December-2014	388,137,935	393,148,800	99,340,860	92,406,769	3.91	4.25
01-January-2015 to 31-December-2015	199,903,161	393,148,800	51,633,302	92,406,769	3.87	4.25
01-January-2016 to 30 June-2016	159,961,871	198,190,080	41,242,600	46,076,800	3.88	4.30
Total	1,298,708,000	1,575,826,560	332,662,102	369,880,245	3.90	4.26
Average					3.90	4.26

The Ratio of Million KWh to Million SCM for Monitoring Period is 3.90 and Ratio of Million KWh to Million SCM for registered PDD estimation is 4.26. The ratio is calculated as “electricity generation/gas consumed”. Thus, the electricity generation and gas consumption ratio is within the range of estimation done in registered PDD.

Specific Gas Consumption (sm^3/kwhr) is optimum when the plant is operating at 100% load or Base load. If the machine is forced to run at lower loads due to any reasons then the specific gas consumption (sm^3/kwhr) is increases according to the load reduction. In other words, as inverse of the above, kwhr/sm^3 decreases according to the load reduction. In this monitoring period power plants the specific Gas Consumption was good due to better availability of gas & thus the plant is operated at 100% base load for that time period.

Form above table it has been also observed that there is no increase in the Net Export (electricity) to grid and as well as Gas Consumption during the current monitoring period as compared to the estimated in registered PDD.

There is an increase in the actual emission reduction achieved during the current monitoring period as compared to registered CDM PDD due to the increase in the Build Margin emission factor for current monitoring period (Please refer table below) against **713.3** tCO_2/GWh (registered VCS PD) which is ex-post and PP don't have control over it.

PP has adopted the conservative emission factor from respective year CEA database to calculate the emission reduction achieved from the respective year.

	Applied on year	2012	2013	2014	2015	2016		
	CEA Version	CEA Version 10	CEA Version 10	CEA Version 11	CEA Version 12	CEA Version 13	Unit	Remark
Option 1	The Build Margin	947.2	952.0	928.4	908.2	872.3	tCO_2/GWh	Determined Ex-post
Option 2	Combined Margin	954.1	969.3	961.3	946.2	922.4	tCO_2/GWh	Determined Ex-post
Option 3	Baseline Emission Factor of the	1,064.0	1,064.0	1,064.0	1,064.0	1,064.0	tCO_2/GWh	Determine at the time of registration

	Applied on year	2012	2013	2014	2015	2016		
	CEA Version	CEA Version 10	CEA Version 10	CEA Version 11	CEA Version 12	CEA Version 13	Unit	Remark
	Technology Identified							
Estimation of Baseline Emission Factor on conservative basis		947.2	952.0	928.4	908.2	872.3	tCO ₂ /GWh	Min of (BM, CM, EF _{BLCO₂y}) and lowest among the five year

Further, there is decrease in project emissions due to less gas consumption as compared with registered PDD i.e. 332,662,102 SCM for this monitoring period from 369,880,245 SCM as per registered PD.

Based on above justification, it is clear that emission reductions are increased purely due to a) change in grid emission factor for baseline emissions and being this parameter is ex-post, the values as per CEA database has been considered in line with methodology. b) Decrease in project emissions due to less gas consumption as compared with registered PDD.

Since project activity does not deviate in operational parameters and have almost same ratio of electricity to gas consumption, thus deviation is not applicable for this project activity. Also, the sensitivity parameters considered for additionality are fuel price, heat rate and PLF and all these parameters are within the range during current monitoring period, thus there is no any impact on additionality due to operational parameters. The higher emissions reductions are due to higher emission factor for baseline emissions and less gas consumption for project emission.

Assessment team also reviewed other similar projects UN1352 (61.64% higher ER³), UN4419 (325% higher ERs⁴) & VCS 68 (56.40% higher ERs⁵). Thus, the increase in actual emission reduction in the current monitoring period is justified and acceptable to verification team.

4.2 Safeguards

4.2.1 No Net Harm

No potential environment or socio-economic matter was found during the site visit. The project is fuel switch from high carbon intensive fuel to low carbon intensive and thus no negative impact observed onsite.

Project activity has obtained consent to operate from the State Pollution Control Board & complying pollution norms.

³ <https://cdm.unfccc.int/Projects/DB/BVQI1190262498.56/view>

⁴ <https://cdm.unfccc.int/Projects/DB/RWTUV1296210579.43/view>

⁵ <https://registry.terra.org/app/projectDetail/VCS/68>

Thus, there are no any significant impacts due to implementation of project activity on air, water, soil quality and ambience are envisaged due to the project activity.

4.2.2 Local Stakeholder Consultation

The local stake holder consultation was done during the registration of the project activity. There was no change in technical project description from the registered VCS PD. Assessment team confirmed the same during the verification site visit. Also, as best practice method PP also placed a grievance register onsite to record any grievance from the stakeholders as a part of continuous feedback from stakeholders. Assessment team checked the grievance register maintained onsite and no comments were observed for the project activity. Local people are happy as the project generated employment opportunities and thus the living standards in and around the vicinity of the project is increased and thus assessment team confirms that local stakeholders have no issue with this project activity after implementation and continuous operation. CAR 03 was raised and closed successfully.

4.3 AFOLU-Specific Safeguards

This section is not applicable as this project activity is a non-AFOLU project activity.

4.4 Accuracy of GHG Emission Reduction and Removal Calculations

Means of verification	The verification team assessed whether the data and calculations of GHG emission reductions achieved resulting from the VCS PD. The verification team has checked whether calculations of baseline GHG emissions, project GHG emissions and leakage GHG emissions have been carried out in accordance with the formulae and methods described in the monitoring plan of the VCS PD.
Findings	CAR 04 & CAR 05 were raised during the verification process and closed successfully. Please refer Appendix 2 of this report for the detail closure of the CAR.
Conclusion	The baseline Emissions for a given year is calculated in accordance with the approved methodology “AM0029, Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas” Version 03” as the project activity claims emission reductions from electricity generation only. Formula used: Baseline emission: $BE_y = EG_{PJ,y} * EF_{BL,CO_2,y}$ Where BE_y : Baseline emissions in year y. $EG_{PJ,y}$: Electricity generated in the project plant J in year y. $EF_{BL,CO_2,y}$: Baseline CO₂ emission factor in year y. Ex-ante Parameter: 1. $EF_{CO_2,NG,y}$ = Emission factor of Natural Gas As per the registered PD the parameter is fixed ex-ante & value is 54.3 tCO₂/GJ and found correct in the MR submitted.

	2. $OXID_{NG}$ = Oxidation factor of Natural gas As per the registered PD the parameter is fixed ex-ante & value is 1 and found correct in the MR submitted. 3. $EF_{NG, upstream, CH_4}$ = Emission factor for upstream fugitive methane emissions of natural gas from production, transportation and distribution As per the registered PD the parameter is fixed ex-ante & value is 160 tCH₄/PJ per annum and found correct in the MR submitted. Ex-post parameter: As per the registered VCS PD and requirement of the applied methodology following parameters have been monitored by PP: Annual quantity of Natural gas consumed in the project activity (FC_i)- Gas Authority of India Ltd (GAIL) supplies the natural gas to the Power Plant by a dedicated pipe line. GAIL has gas metering station at the gas supply terminal in the Power Plant to ensure proper monitoring and quantification of gas intake to the Plant. Quantity of gas consumption is measured with the help of Gas Flow meter continuously and daily readings are being recorded. The gas flow meter is calibrated at regular intervals as per GAIL standards. During this verification period plant has consumed 332,662,102 SCM of the natural gas. Values have been checked with the plant records by the Verification team and found consistent. NCV of NG ($NCV_{NG,y}$): The NCV of the natural gas is monitored by the gas supplier on monthly basis and values provided in the ER sheet & MR have been found correct. Total quantity of Electricity generated from the project activity during the year y (EG_{Gross}) - The parameter is monitored through the energy meters installed at Gas turbine & steam turbine. The readings are noted from the meter installed daily by the plant staff & recorded in the log books. The values are checked from the plant logbooks and values in the ER sheet found correct. During this monitoring period project activity have generated 1,367,117,000 KWh (1,367,117 MWh) gross electricity. Onsite electricity consumption of the project activity imported from the grid system during the year y (EG_{Import}) - The parameter is monitored through the energy meters installed at the project site. The readings are noted from the main meter installed at the plant sub-station in the presence of the state utility officials monthly. The values are checked from the monthly JMR and values in the ER sheet found correct. During this monitoring period project activity has imported 280,228,000 KWh (280,228 MWh) electricity from the grid. Same as also crosschecked with the invoices raised by PP towards state utility and found correct. Net quantity of electricity generated (exported) to the grid by the project activity ($EG_{PJ,y}$)- The parameter is monitored through the energy meters installed at the project site. The readings are noted from the main meter installed at the plant sub-station in the presence of the state utility officials monthly. The values are checked from the monthly JMR and values in the ER sheet found correct. During this monitoring period project activity have supplied 1,298,708,000 KWh (1,298,708 MWh) electricity to the grid. Same as also crosschecked with the invoices raised by PP towards state utility and found correct.
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Emission factor of the plants included in the build margin ($EF_{BL,CO_2,y}$): Values of the build margin emission factors have been taken from the CEA database version available for the respective year. Values are found correct with CEA database as mentioned in the revised MR. Values of the parameter found consistent in the MR and ER sheet.

The values of the parameter is taken ex-post for each year from the CEA database available for particular year (Ex. For year 2012 version 09 of CEA database applicable) inline with the methodology requirement and thus approach & lower values found correct and being more conservative, hence the same has been used to calculate the baseline emissions for respective year in monitoring period.

Values applied are as follows:

Applied on year	2012	2013	2014	2015	2016
CEA Version	CEA Version 10	CEA Version 10	CEA Version 11	CEA Version 12	CEA Version 13
$EF_{BL,CO_2,y}$ on conservative basis (tCO_2/GWh)	947.2	952.0	928.4	908.2	872.3

Emission factor for upstream fugitive methane emissions of natural gas from production, transportation and distribution ($EF_{BL, upstream, CH_4}$): $EF_{BL, upstream, CH_4}$ is calculated for power plants included in the Build Margin of Southern Regional grid, inline with the baseline emission factor selection. Values are found correct with CEA database as mentioned in the revised MR. Values of the parameter found consistent in the MR and ER sheet.

Baseline Emissions Calculation

Baseline emission:

$$BE_y = EG_{PJ,y} * EF_{BL,CO_2,y}$$

Where

BE_y : Baseline emissions in year y.

$EG_{PJ,y}$: Electricity generated in the project plant J in year y.

$EF_{BL,CO_2,y}$: Baseline CO_2 emission factor in year y.

The values of the parameter is taken ex-post for each year from the CEA database available for respective year inline with the methodology requirement and same are used to calculate the baseline emissions for each vintage in monitoring period.

Thus,

Year	Net Export to grid [Export to	Emission Factor of Grid	Baseline Emissions (tCO_2)
------	----------------------------------	-------------------------	--------------------------------

		Grid - Import from Grid] - (GWh)	(tCO ₂ /GW h)	
	01-July-2012 to 31-December 2012	193.29	947.2	183,087
	01-January-2013 to 31-December- 2013	357.41	952.0	340,256
	01-January-2014 to 31-December- 2014	388.14	928.4	360,347
	01-January-2015 to 31-December- 2015	199.90	908.2	181,552
	01-January-2016 to 30 June-2016	159.96	872.3	139,534
	Total	1298.71		1,204,776
Project Emission:				

The project activity is on-site combustion of natural gas to generate electricity and no start up fuels is required. The CO₂ emissions from electricity generation (PE_y) are calculated as follows:

$$PE_y = \sum FC_{f,y} * COEF_{f,y}$$

Where:

FC_{f,y} = Is the total volume of natural gas or other fuel 'f' combusted in the project plant or other Start up fuel (m³ or similar) in year(s) y.

COEF_{f,y} = Is the CO₂ emission coefficient (tCO₂/m³ or Similar) in year(s) for each fuel and is obtained as

$$COEF_{f,y} = \sum NCV_y * EF_{CO_2,f,y} * OXID_f$$

Where:

NCV_y : Is the net calorific value (energy content) Per volume unit of natural gas in Year 'y' (GJ/m³) as determined from the fuel supplier, Wherever possible, otherwise from local or national data;

EF_{CO₂,f,y} : Is the CO₂ emission factor per unit of energy of natural gas in year y (tCO₂/GJ) as determined from the fuel supplier, wherever Possible, otherwise from local or national data;

OXID_f : is the oxidation factor of natural gas

Thus,

Year	Gas Consumption	Avg. Net Calorific value of gas	Emission factor of Gas (IPCC)	Oxidation Factor of Gas	COEF of Gas	Project Emissions
	SCM	kcal/SCM	tCO ₂ /GJ		tCO ₂ /m ³	tCO ₂
01-July-2012 to 31-December 2012	48,799,139	8790.17	0.0543	1	0.0019981	97,506

	01-January-2013 to 31-December-2013	91,646,201	8791.47	0.0543	1	0.0019983	183,137
	01-January-2014 to 31-December-2014	99,340,860	8783.40	0.0543	1	0.0019965	198,335
	01-January-2015 to 31-December-2015	51,633,302	8789.70	0.0543	1	0.0019979	103,159
	01-January-2016 to 30 June-2016	41,242,600	8790.12	0.0543	1	0.0019980	82,403
	Total	332,662,102					664,540
Leakage Emission: The leakage for the current monitoring period is calculated as below:							
Year	Net Export to grid	Fugitive Emission Factor in Baseline	Fugitive Emission in Baseline	Net Leakage Attributable to the project activity			
				Fugitive Emissions for NG - Fugitive Emission in Baseline			
	GWh	tCO ₂ /GWh	tCO ₂	tCO ₂			
01-July-2012 to 31-December 2012	193.29	13.72	2,651.98	4,531			
01-January-2013 to 31-December-2013	357.41	13.00	4,646.35	8,845			

	01-January-2014 to 31-December-2014	388.14	13.05	5,065.20	9,545
	01-January-2015 to 31-December-2015	199.90	13.14	2,626.73	4,973
	01-January-2016 to 30 June-2016	159.96	12.72	2,034.71	4,036
				Total	31,930
Therefore, emission reductions by the project activity is, $ER_y = BE_y - PE_y - LE_y$ $= 1,204,776 - 664,540 - 31,930$ $= 508,306 \text{ tCO}_2\text{e (Rundown value)}$ Total emission reductions by the project activity during the monitoring period are 508,306 tCO₂e. VVB confirms that GHG emission reductions and removals have been quantified correctly in accordance with the project description and applied methodology.					

4.5 Quality of Evidence to Determine GHG Emission Reductions and Removals

Means of verification	The verification team checked the Calibration details of the monitoring meters with the calibration certificates.
Findings	CAR 06 was raised during the verification process. The description of the CAR and its closure is described below in Appendix 2 of this report
Conclusion	The metering facilities are installed within the plant premises for the monitoring of gross electricity generation, electricity exported, electricity imported & NG consumption. Verification team checked the calibration certificates of the energy meters & are calibrated as per calibration frequency mentioned in the VCS PD i.e. annually. Thus, no delayed calibration observed for the 01-July-2012 to 30-June-2016. Further, Verification team checked the calibration certificates of the gas flow meters & found that same are not calibrated as per calibration frequency mentioned in the VCS PD. Thus, delayed calibration observed for NG flow meter for 15-Jan to 15-Mar-2013, 15-Jan to 15-May-2014 & 15-Mar to 15-May-2015. PP has applied maximum permissible error of 0.075% (Error added) for this period as observed error was found within permissible limits. Thus, error of 0.075% added for the natural gas project emission calculations as observed error found within permissible limit, which is the line of requirement of paragraph 366 of CDM Validation and Verification Standard for project activities version 03.0. Assessment team has checked the calibration

	certificates of all meters and confirms that meters are calibrated by NABL accredited laboratories. Details of the monitoring meters for the electricity & gas consumption with assessment are provided in the Appendix 5 below in this verification report. Verification team confirms the sufficiency of quantity and appropriate quality of the evidences used to determine the GHG reductions and removals.”
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4.6 Non-Permanence Risk Analysis

No.	Risk that could lead to material errors, omissions or misstatements	Assessment of the risk		Response to the risk in the verification plan and/or sampling plan
		Risk level	Justification	
NA	NA	NA	NA	NA

5 VERIFICATION CONCLUSION

Applus+ Certification has been engaged by PIONEER POWER LIMITED (Formally Penna Electricity Limited) to perform the 2nd periodical verification of the “Natural Gas based Combined Cycle Power Project at Valantharavai Village, Ramanathapuram District, Tamil Nadu by Penna Electricity Limited [Formerly Arkay Energy Limited]”.

The management of PIONEER POWER LIMITED (Formally Penna Electricity Limited) is responsible for the preparation of the GHG emissions data and the reported GHG emissions reductions on the basis set out within the project’s Monitoring Plan in the registered VCS PD and the applied methodology Against “AM0029, Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas” Version 03”.

Our verification approach was based on the requirements as defined under the Kyoto Protocol, Marrakesh accord, as well as those defined by the CDM Executive Board. Our approach is risk-based, drawing on an understanding of the risks associated with reporting GHG emissions data and the controls in place to mitigate these. Further, the verification has been planned and organized to achieve a Reasonable Level of assurance as per the requirement of VCS. No sampling procedure applied for site visit or document verifications. The entire documents checked/Power plant verification conducted to arrive at positive verification conclusions. The verification team can confirm that:

- the project is operated as planned and described in the project document;
- the monitoring plan is as per the applied methodology;
- the monitoring process in Monitoring Report is as per the PD

- the development and maintenance of records and reporting procedures are in accordance with the monitoring plan;
- the installed equipment being essential for generating emission reduction runs reliably and is calibrated appropriately;
- the monitoring system is in place and generates GHG emission reductions data;
- the GHG emission reductions are calculated without material misstatements.
- A Reasonable Level of assurance was achieved as planned during verification process.

Verification period: 01-July-2012 to 30-June-2016 (inclusive of both days)

Verified GHG emission reductions and removals in the above verification period:

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
01-July-2012 to 31-December 2012	183,087	97,506	4,531	81,050
01-January-2013 to 31-December-2013	340,256	183,137	8,845	148,274
01-January-2014 to 31-December-2014	360,347	198,335	9,545	152,467
01-January-2015 to 31-December-2015	181,552	103,159	4,973	73,420
01-January-2016 to 30 June-2016	139,534	82,403	4,036	53,095
<i>Total</i>	1,204,776	664,540	31,930	508,306

APPENDIX 1: DOCUMENTS REVIEWED OR REFERENCED (VERIFICATION)

No.	Author	Title	References to the document	Provider
1.	NA	Commissioning certificates of the gas turbine/steam turbine	Commissioning certificate	Project participant
2.	NA	Contract of the project participant with the DOE	Contract document signed between PP and DOE	Project participant
3.	NA	Calibration Certificates for energy meters and gas flow meters	Calibration Certificates	Project participant
4.	NA	Registered PD https://registry.terra.org/app/projectDetail/VCS/508	Version 04, 17-November-2009	Project participant
5.	NA	Validation report https://registry.terra.org/app/projectDetail/VCS/508	Report No. 53602008-08/310 DATE: 18-November-2011	Project participant
6.	NA	MR version 01 MR version 02 MR version 03 MR version 04 MR version 05	Dated 08-October-2021 Dated 10-December-2021 18-January-2023 01-March-2023 04-May-2023	PP
7.	NA	Emission reduction sheet version 01 Emission reduction sheet version 02 Emission reduction sheet version 03 Emission reduction sheet version 04 Emission reduction sheet version 05	Dated 08-October-2021 Dated 10-December-2021 Dated 18-January-2023 01-March-2023 04-May-2023	Project participant
8.	NA	No Double Counting declaration	-	Project participant
9.	NA	NG consumption records	-	Project participant
10.	NA	Monthly JMR reports for electricity export & import	-	Project participant
11.	NA	Tools/ guidelines used in the project activity - Tool to determine the remaining lifetime of the project activity in line with Annex 15 EB 50 - Glossary of CDM terms version 07 - VCS verification report template version 4.1	UNFCCC CDM/VCS web site	UNFCCC
12.	NA	Log Sheets for diesel consumption	-	PP
13.	NA	Plant logbook data	NA	PP
14.	NA	Break down details of the complete monitoring period	Log sheet	PP
15.	NA	Technical Specification of Turbines	NA	PP
16.	NA	NG Purchase Records	-	PP

No.	Author	Title	References to the document	Provider
17.	NA	Certificate of Incorporation from Registrar of Companies, Government of India for name change	Dated 22-September-2010	PP
18.	NA	Consent to Operate from Tamilnadu Pollution Control Board	10-September-2021	PP

APPENDIX 2: CORRECTIVE ACTION REQUESTS, CLARIFICATION REQUESTS AND FORWARD ACTION REQUESTS (CAR/CL/FAR)

CL ID	01	Section no.	4.1	Date: 03-December-2021
Description of CAR				
The start date of the crediting period & start date for this monitoring are not matching as earlier issuance history not available on the VCS project webpage. Clarification requested.				
Project participant response				Date: 10-December-2021
Verification for period 01-July-2006 to 30-June-2012 are under progress by TUV SUD & till date ongoing. Once completed documents will be submitted to VERRA.				
Documentation provided by project participant				
NA				
DOE assessment				Date: 10-January-2022
Details of the first verification period now included in the section 1.6 of the MR and found correct inline with the technical proposal submitted for first verification period of the project activity. CL thus closed.				

CAR ID	01	Section no.	4.1	Date: 03-December-2021
Description of CAR				
Issuance history of the emission reductions achieved are found missing in the MR. Corrective actions sought. Further, PP requested to submit declaration regarding avoidance of double counting of emission reductions in the other GHG trading programmes including REC mechanism of India.				
Project participant response				Date: 10-December-2021
Verification for period 01-July-2006 to 30-June-2012 are under progress by TUV SUD. The same has been updated in section 1.6 of MR.				
Declaration regarding avoidance of double counting of emission reductions in the other GHG trading programmes including REC mechanism of India has been submitted.				
Documentation provided by project participant				
Revised MR Declaration for double counting				
DOE assessment				Date: 10-January-2022
PP have included details of ongoing verifications as yet no VCUs issued for the project activity & found correct. Further, PP have submitted declaration regarding no double counting of the emission reductions achieved from the project activity. CAR thus closed.				

CAR ID	02	Section no.	4.1	Date: 03-December-2021
Description of CAR				
During the review of documents submitted by PP, assessment team found that the following documents are missing;				
1. Commissioning Certificate of power plant				
2. Consent to Operate				
3. PPA				
PP is requested to submit above documents for verification.				
Project participant response				Date: 10-December-2021
Following documents has been submitted to assessment team for verification				
1. Commissioning Certificate of power plant				
2. Consent to Operate				
3. PPA				
Documentation provided by project participant				
1. Commissioning Certificate of power plant				
2. Consent to Operate				
3. PPA				
DOE assessment				Date: 10-January-2022
PP has submitted supporting documents requested & information in the MR found correct. CAR thus closed.				

CAR ID	03	Section no.	4.2.2	Date: 03-December-2021
Description of CAR				
Section 2.2 of the MR is not completed inline with the guidelines to complete MR. PP is requested to provide supporting documents of ongoing communication with local stakeholders as per requirement of Para 3.16.3 and 3.16.4 of the VCS standard V.4.0.				
Project participant response				Date: 10-December-2021
Section 2.2 of the MR has been made inline with the guidelines to complete MR.				
Supporting documents of ongoing communication with local stakeholders has been submitted				
Documentation provided by project participant				
Revised MR				
Documents of ongoing communication with local stakeholders				
DOE assessment				Date: 10-January-2022
Section 2.2 of the MR have been revised now and grievance records submitted. Information in the MR is found consistent inline with records submitted. CAR thus closed.				

CAR ID	04	Section no.	4.4	Date: 03-December-2021
Description of CAR				
Single emission factor have been used for the calculations of the baseline/project emissions. PP requested to review & correct the baseline emission factors inline with CEA CO ₂ emission database released periodically by CEA, Govt. of India. Corrective action sought.				
Project participant response				Date: 10-December-2021
CEA CO ₂ emission database released periodically by CEA, Govt. of India has been applied on respective year. Please refer ER sheet.				
Documentation provided by project participant				
Revised MR				
Revised ER sheet				
DOE assessment				Date: 10-January-2022
PP have revised emission factors for the latest CEA database available for the respective year & found correct. Thus, emission factors for each year calculated separately & found correct. CAR thus closed.				

CAR ID	05	Section no.	4.4	Date: 03-December-2021
Description of CAR				
PP requested to review all the ex-ante & ex-post parameters inline with the registered VCS PD. Further, PP requested to submit supporting evidence of all monitoring parameters and crosschecking of the same.				

Comparison of actual emission reductions and estimated found missing in Section 5.4 of MR. Corrective action is sought.	
Project participant response	Date: 10-December-2021
All the ex-ante & ex-post parameters has been review and made inline with the registered VCS PD and updated in section 4.1 and section 4.2 of MR respectively. Supporting documents of all monitoring parameter has been submitted Comparison of actual emission reductions and estimated has been updated in Section 5.4 of MR	
Documentation provided by project participant	
Revised MR JMR Invoice Gas consumption data Breakdown Report	
DOE assessment	Date: 10-January-2022
PP have revised ex-ante & ex-post parameters inline with the registered VCS PD & submitted supporting documents for the same. Values of the parameters monitored are found correct mentioned in the ER sheet & MR inline with the supporting documents. Further, detailed justification for the higher emission reductions achieved is also mentioned in the revised MR & found correct. CAR thus closed.	

CAR ID	06	Section no.	4.5	Date: 03-December-2021
Description of CAR				
Detailed complete information of metering equipment like serial number, make, calibration date and validity of calibration and calibration frequency is missing in MR. PP is requested to submit supporting documents of electricity meters and calibration certificate for monitoring period under verification. Kindly submit.				
Project participant response				Date: 10-December-2021
Detailed complete information of metering equipment like serial number, make, calibration date and validity of calibration and calibration frequency has been updated in MR. Calibration certificate of energy meter and gas flow meter for monitoring period has been submitted.				
Documentation provided by project participant				
Calibration certificate Revised MR				
DOE assessment				Date: 10-January-2022
PP have revised MR for the monitoring meter details & calibration and found correct with the supporting documents/calibration certificates provided. CAR thus closed.				

APPENDIX 3: COMPETENCE OF TEAM MEMBERS AND TECHNICAL REVIEWERS

Verification team member

No.	Role	Signature	Last name	First name	Affiliation	Involvement in
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					(e.g. name of central or other office of DOE or outsourced entity)	Desk review	On-site inspection	Interview(s)	Verification findings
1.	Lead Auditor/Technical Expert	OR	Takarkhede	Dr. Atul	TQC-Outsourced entity	Yes	Yes	Yes	Yes

Technical reviewer and approver of the verification and certification report

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 (TR)	EI	Xue	Denny	Applus+ Certification
2.	Approver	IR	Calle de Miguel	Agustín	Applus+ Certification

Short CVs of the Team:

1. **Dr. Atul Takarkhede** is Ph.D. (Environmental Sciences) from Institute of Science, RTM Nagpur University, Nagpur, and he has already published different technical papers related to environmental sciences. He counts with more than 11 years of experience in field of Environmental Auditing, consulting and accreditation. He is an expert in ISO 9001-14001, CO2/GHG Reporting, Carbon Foot Print, Energy, Water and Waste Management reporting for organizations' environmental performance. His professional portfolio is mainly related with carrying out EIA, conducting QA/QC of EIA Reports; conducting environmental/water audits; NABET requirements appliance, functional area expert in Water Pollution & Solid & Hazardous Waste management among others. Furthermore, he counts with solid experience on CDM-VCS-GS consultancy and auditing. Currently he is associated with True Quality Certifications Private Limited and empanelled with Applus+ Certification to carry out GHG audits in the aforementioned schemes.

2. **Mr. Denny Xue** (Master's Degree in Environmental Engineering, Bachelor's Degree in Thermal Engineering) is an Auditor appointed by Applus+ LGAI for the GHG project assessment, auditing and technical review. He has more than 6 years of work experience in CDM/GS4GG/VCS project assessment and technical review with Applus+. Before he joined Applus+ LGAI, he has been working for Shanghai Chuanji Investment and Management which is a CDM consultancy company as a project manager for CDM project development. Mr. Denny Xue is based in Shanghai, China. Mr. Denny Xue may participate in the project's technical review team .

APPENDIX 4: ABBREVIATIONS

Abbreviations	Full texts
BM	Build Margin
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CER	Certified Emission Reduction(s)
CEA	Central Electricity Authority
CL	Clarification request
CM	Combined Margin
CMS	Central Monitoring system
CO ₂	Carbon dioxide
CO ₂ e	Carbon dioxide equivalent
DNA	Designated National Authority
DOE	Designated Operational Entity
DR	Document Review
EF	Emission Factor
EIA	Environmental Impact Assessment
ER	Emission Reductions
FAR	Forward Action Request
GHG	Greenhouse gas(es)
GWP	Global Warming potential
PP	Project Participant

APPENDIX 5: CALIBRATION DETAILS

Energy Meter Calibration

Feeder	GTG	STG	Valuthur Feeder	Kavanoor Feeder	Calibration Compliance
Meter Details	Main meter	Main meter	Main meter	Main meter	
Make	Secure Meters	Secure Meters	Secure Meters	Secure Meters	
Model	E3M021	E3M021	E3M021	E3M021	
Accuracy Class	0.2s	0.2s	0.2s	0.2s	
Calibration Frequency	Annually	Annually	Annually	Annually	
Serial Number	ABB00271	ABB00273	ABB00268	ABB00278	
Date of Calibration	28-March-2012				No delayed calibration
	28-March-2013				
	25-March-2014				
	24-March-2015				
	22-March-2016				
Meter Details	Check meter	Check meter	Check meter	Check meter	
Make	Secure Meters	Secure Meters	Secure Meters	Secure Meters	
Model	E3M021	E3M021	E3M021	E3M021	
Accuracy Class	0.2s	0.2s	0.2s	0.2s	
Calibration Frequency	Annually	Annually	Annually	Annually	
Serial Number	ABB00272	ABB00274	ABB00276	ABB00277	
Date of Calibration	21-March-2012				
	21-March-2013				
	19-March-2014				
	18-March-2015				
	17-March-2016				

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Gas Flow Meter Calibration

AS NEW WATER CALIBRATION				
Parameter	DPT	PT	TT/TE	Calibration Compliance
Model	SISD2G3	-	PT-100	
Serial No.	2468817	-	-	
Accuracy Class	± 0.075%	± 0.075%	± 1.0%	
Frequency	Once in a Year			
Date of Calibration	14-Feb-2011			Delayed calibration: 25-Feb-2013, 26-Feb-2014 to 02-April-2014, 03-April-2015 to 20-April-2015. Thus, error applied for 15-Jan to 15-Mar-2013, 15-Jan to 15-May-2014 & 15-Mar to 15-May-2015
	25-Feb-2012			
	26-Feb-2013			
	03-April-2014			
	21-April-2015			
	13-April-2016			