
Verification and Certification Report

PT. Nubika Jaya


Nubika Jaya Biogas Extraction for Bio-Hydrogen Production (Ref. 2421)

Project No. JQA-C0237
(No. 1812000446)

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JAPAN QUALITY ASSURANCE ORGANIZATION

Verification and Certification Report		Project Title: Nubika Jaya Biogas Extraction for Bio-Hydrogen Production	
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Project No.: JQA-C0237 (No.1812000446)		Registration Date: 30/06/2009	Ref. 2421
Client: PT. Nubika Jaya		Project Participants: - PT. Nubika Jaya (Indonesia) - Mitsubishi UFJ Morgan Stanley Securities Co., Ltd. (Japan)	
Second Monitoring Period: 01/08/2010 - 31/07/2012			
Monitoring Report: - First version and date: Ver. 1.0, 09/10/2012 - Date of making publicly available on the UNFCCC website: 15/10/2012 - Revised version and date: ver. 3.0, 26/08/2013			
Verified Amount of Emission Reductions for the Monitoring Period: 27,012 tCO ₂ e			
<p>Summary:</p> <p>JQA performed the 2nd periodic verification of the emission reductions achieved by the registered CDM project activity "Nubika Jaya Biogas Extraction for Bio-Hydrogen Production" (Ref. 2421) under the contract with PT. Nubika Jaya. The 2nd periodic verification covers the monitoring period from 01/08/2010 to 31/07/2012 which is within the 1st renewable crediting period between 01/05/2010 and 30/04/2017 (seven years).</p> <p>As a result of the verification, JQA confirms that the project has been implemented and operated in accordance with the approved revised PDD. The GHGs emission reductions determined in revised Monitoring Report and revised ER calculation spreadsheet have been achieved in accordance with the monitoring plan of the approved revised PDD. Based on the results of the desk review of relevant documents and the on-site assessment, JQA confirms the following statement:</p> <p>Certified emission reductions verified in the 2nd monitoring period between 01/08/2010 and 31/07/2012 are 27,012 tCO₂e.</p>			
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Approved by Senior Executive <div style="text-align: center;">  Tadayuki Yano </div>			

Abbreviations

AD	Anaerobic Digestion
BE	Baseline Emissions
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CL	Clarification Request
CMP	Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol
COD	Chemical Oxygen Demand
COP/MOP	Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol
DOE	Designated Operational Entity
DR	Desk Review
EB	CDM Executive Board
EF	Emission Factor
ER	Emission Reductions
FAR	Forward Action Request
GHGs	Greenhouse Gases
ISO	International Organization for Standardization
JQA	Japan Quality Assurance Organization
BSN	National Standardization Agency of Indonesia (Badan Standardisasi Nasional)
LPG	Liquefied Petroleum Gas
MCS	Methane Capture System
MR	Monitoring Report
NCV	Net Calorific Value
NIST	National Institute of Standards and Technology of USA
OA	On-site Assessment
PSA	Pressure Swing Adsorption
PDD	Project Design Document
PE	Project Emissions
PHG	Permata Hijau Group
PP	Project Participant
QA/QC	Quality Assurance and Quality Control
SOP	Standard Operational Procedure
UKL/UPL	Environmental Mitigation and Monitoring Plan in Indonesia (Upaya Pengelolaan Lingkungan Hidup (UKL)/Upaya Pemantauan Lingkungan Hidup (UPL))
UNFCCC	United Nations Framework Convention on Climate Change
UO	Under Observation
VVS	Clean Development Mechanism Validation and Verification Standard

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Appendix C: Expertise and experience of Verification Team Members and Technical Reviewers

1. INTRODUCTION

Japan Quality Assurance Organization (hereinafter JQA) has performed the 2nd periodic verification of the registered CDM project “Nubika Jaya Biogas Extraction for Bio-Hydrogen Production” (hereinafter the CDM Project) under the contract with PT. Nubika Jaya, which is one of the subsidiary companies of Permata Hijau Group (hereinafter PHG). The CDM Project has been implemented by PT. Nubika Jaya (hereinafter Nubika) (Indonesia) and Mitsubishi UFJ Morgan Stanley Securities Co., Ltd. (Japan). Monitoring Report (ver. 1.0) (**Ref. 1**) prepared by Mitsubishi UFJ Morgan Stanley Securities Co., Ltd. was issued on 09/10/2012 and was made publicly available on 15/10/2012 on the UNFCCC website. Monitoring Report (ver.3.0) was issued on 26/08/2013.

This Verification and Certification Report describes the processes and findings in the verification of the CDM Project and states the GHG emission reductions achieved during the 2nd monitoring period between 01/08/2010 and 31/07/2012 within the 1st renewable crediting period between 01/05/2010 and 30/04/2017 (seven years).

1.1 Objective

Verification is the periodic independent review and *ex-post* determination by a DOE of the monitored reductions in anthropogenic emissions by sources of GHGs that have occurred as a result of a registered CDM Project activity during the verification period. Certification is the written assurance by a DOE that, during a specific time period, a project activity achieved the reductions in anthropogenic emissions by source of greenhouse gases as verified. (Para 61 of the Modalities and Procedures for a clean development mechanism as defined in Article 12 of the Kyoto Protocol (Decision 3/ CMP.1)),

According to the VVS (ver. 04.0), the verification process includes the activities aiming to:

- (a) Determine whether the project activity has been implemented and operated as per the registered PDD or any approved revised PDD, and that all physical features (technology, project equipments, and monitoring and metering equipment) of the project are in place;
- (b) Determine whether the monitoring report and other supporting documents provided are complete in accordance with latest applicable version of the completeness checklist for requests for issuance of CERs, verifiable, and in accordance with applicable CDM requirements;
- (c) Determine whether actual monitoring systems and procedures comply with the monitoring systems and procedures described in the monitoring plan or any revised approved monitoring plan, and the approved methodology including applicable tool(s),

- (d) Evaluate the data recorded and stored as per the monitoring methodology including applicable tool(s).

1.2 Scope

Monitoring Report (ver. 1.0, 09/10/2012, hereinafter the MR; ver. 3.0, 26/08/2013, hereinafter the revised MR) (**Ref. 1**) including the ER calculation spreadsheet (**Ref. 2**) which summarizes information regarding GHGs emission reductions achieved during the 2nd monitoring period were reviewed against:

- Decisions by UNFCCC
- Kyoto Protocol
- Decisions 3 and 4 / CMP 1
- Relevant decisions of COP/MOP and CDM-EB
- CDM Validation and Verification Standard (VVS) (ver. 04.0)
- CDM Project Standard (PS) (ver. 04.0)

The MR and the ER calculation spreadsheet are also assessed to confirm their conformity with the following documents:

- Project Design Document (PDD), ver. 3.4.2 (**Ref. 3**)
- Validation Report, ver. 1.2 (**Ref. 4**)
- Approved revised PDD, ver. 4.1.0 (**Ref. 5**)
- AMS-III.H. ver. 09 (Sectoral Scope 13)
- AMS-III.O. ver. 01 (Sectoral Scope 5)
- Tool to determine project emissions from flaring gases containing methane (EB28, Annex 13)
- Tool to calculate project and leakage CO₂ emission from fossil fuel combustion (EB 32, Annex 09)

1.3 Project description

The CDM Project produces hydrogen from biogas generated by the anaerobic digestion of wastewater from the Nubika palm oil mill which is located in Labuhan Batu, Kota Pinang, Sisumut, North Sumatera, Indonesia. Methane Capture System (MCS) with open flare and a hydrogen production plant with H₂S and moisture removal systems are installed for the CDM Project. The CDM Project is expected to reduce 44,181 tCO₂e per year by capturing biogas generated from wastewater and further by displacing the LPG with biogas as feedstock and fuel in the hydrogen production plant.

The CDM Project was registered by the CDM EB on 30/06/2009 (Ref. 2421). The PPs selected seven years crediting period (twice renewable). Due to the delay in the

procurement of monitoring equipment, the start date of the crediting period was changed from 30/06/2009 to 01/05/2010 by post-registration changes and was approved by the UNFCCC on 26/08/2010 (**Ref. 8**). Hence, the first crediting period of the CDM Project is from 01/05/2010 to 30/04/2017.

1.4 Verification team and technical reviewers

The verification team and technical reviewers were assigned on 19/09/2012 based on the latest JQA CDM Quality Manual at that time. The coverage of technical area by the team and technical reviewer granted by the criteria of the latest JQA CDM Quality Manual are shown in Table 1. Their certificates are attached to this report (Appendix B) and their expertise and experience are also attached to this report (Appendix C).

Table 1 Verification team members and Technical Reviewers

Name	Qualification ¹⁾	Task ²⁾	Coverage of Technical Area	Local Expertise	OA Participation
Tadashi Yoshida	TLA	TL	5.1/13.1	✓	✓
Akiko Furuya	A	TM	13.1	✓	
Lambok Hilarius Silalahi	PA	UO	-	✓	✓
Rohmadi Ridlo	PA	UO	-	✓	✓
Hiroshi Motokawa	-	TR	13.1		
Hiroshi Kuribayashi	-	TR	5.1		

1) TLA: Team Leader Assessor; A: Assessor; PA: Provisional Assessor

2) TL: Team Leader, TM: Team Member, UO: Assessor under observation ; TR: Technical Reviewer

The verification team and the technical reviewers cover the sectoral scopes 5 and 13 defined by the methodologies AMS-III.H / AMS-III.O and necessary technical areas 5.1 and 13.1.

The roles and responsibilities of the team leader are mainly to prepare the verification plan including the desk review and the on-site assessment, and to manage the verification activities of the team. The team leader is also responsible for the description of the verification and certification statements in the final Verification and Certification Report.

The roles and responsibilities of the team member are to perform the desk review and the on-site assessment including the investigation of background information and interviews with the PPs and relevant stakeholders, and also to indicate potential Corrective Action Requests (CARs), Clarification Requests (CLs) and/or Forward Action Requests (FARs).

CDM Provisional Assessor is a trainee and may serve as an assistant of the verification team, while he/she is not defined as team member under the Quality Manual of JQA.

The on-site assessment (OA) was implemented by the team members on 06-07/11/2012, and after the OA the CDM Verification Checklist indicating CARs, CLs and FARs was submitted to the PPs on 15/11/2012.

2. VERIFICATION PROCESS

2.1 Verification process

The verification process of JQA consists of the following steps:

- 1) Desk review of relevant documents including Monitoring Report provided from the PPs;
- 2) Materiality assessment and preparation of verification and sampling plan;
- 3) On-site assessment including site-tour, interview with the relevant personnel, cross-check of the data and the calculation for GHG emission reductions, and identification of the PPs' quality control and the quality assurance procedures;
- 4) Resolution of corrective action requests (CARs) and clarification requests (CLs); In case that forward action requests (FARs) are raised, the PPs are expected to address the issues for the next verification period;
- 5) Preparation of the draft Verification and Certification Report;
- 6) Internal quality control (Technical Review), and
- 7) Decision on the issuance of Verification and Certification Report

In order to ensure transparency, CDM Verification Checklist is prepared for the project according to VVS and decisions/guidelines issued by the CDM-EB. The applied Checklist is attached as Appendix A to this report. Issues or findings identified in the verification process are indicated under the titles "CAR", "CL" or "FAR" in the Checklist. CAR requires the PPs to take corrective action without fail, while CL indicates that the PPs are requested to make clarifications and/or amendments.

According to the VVS, the criteria for CAR, CL and FAR are as follows:

CAR (Corrective Action Request)

- a) Non-conformities with the monitoring plan or methodology are found in monitoring and reporting and has not been sufficiently documented by the PPs, or if the evidence provided to prove conformity is insufficient;
- b) Modifications to the implementation, operation and monitoring of the registered project activity has not been sufficiently documented by the PPs;
- c) Mistakes have been made in applying assumptions, data or calculations of emission reductions that will impact the quantity of emission reductions;
- d) Issues identified in a FAR during validation to be verified during verification or previous verification(s) have not been resolved by the PPs.

CL (Clarification Request)

- a) Information is insufficient or not clear enough to determine whether the applicable CDM requirements have been met.

FAR (Forward Action Request)

- a) The monitoring and reporting require attention and/or adjustment for the next verification period.

Finally, all issues are listed in Table 2 and Table 3 of the CDM Verification Checklist (Appendix A), and the solution of CARs and CLs raised during the 2nd verification through the PP's correspondences is summarized in Table 4 of the CDM Verification Checklist (Appendix A).

2.2 Desk review of relevant documents

In line with the VVS (ver. 04.0), the following documents were reviewed by comparing with the approved revised PDD (**Ref. 5**) and applied methodologies:

- Monitoring Report (ver. 1.0 and ver. 3.0) (**Ref. 1**)
- ER calculation spreadsheet (ver. 1.0 and ver. 3.0) (**Ref. 2**),

Five FARs were raised in the 1st verification. The documentary evidences necessary for the 2nd periodic verification were also provided in response to the JQA's request. The findings obtained through the desk review of these documents and the OA are listed in Table 2 and Table 3 of the CDM Verification Checklist (Appendix A).

2.3 Materiality and Sampling plan

In accordance with Para 16 of "Guideline on the application of materiality in verifications" (ver. 01.0), JQA considered materiality in planning of the verification based on the following steps:

- (a) Identify the materiality threshold according to Para 10 of the guideline that corresponds to the amount of emission reductions or removals the specific type of CDM project activity will achieve;
- (b) Understand the environment in which the project activity operates, the sources of project emissions within the project boundary and the leakage, the monitoring activities, the equipment used to monitor or measure activity data, the origin and application of data used to calculate or measure the emissions, data flow, the internal quality control system, and the overall organization with respect to monitoring and reporting;
- (c) Conduct a risk assessment to identify and assess the risks of individual or aggregated material errors, omissions or misstatements that may occur within the threshold based on elements in subparagraphs (a) and (b) above;
- (d) Design verification and sampling plans and audit procedures whose type, timing and extent are based on and are responsive to the assessed risks of material errors, omissions or misstatements.

The materiality threshold, risk assessment and the corresponding verification and sampling plans designed for the 2nd periodic verification is summarized in Section 3.6.1.

2.4 On-site assessment

In line with the VVS, the OA was performed to verify the monitoring data and project implementation in comparison with the approved revised PDD. During the OA, JQA received additional documentary evidences from the PPs. Through the OA, JQA examined documents, facilities and instruments to check whether the project activity had been implemented and operated as per the approved revised PDD and the revised monitoring plan and whether all physical features (technology, project equipment, and monitoring and metering equipment) of the project were in place. JQA also performed the data cross-check and the interview with the PPs to confirm monitoring activities, information flows and QA/QC procedures.

Tables 2 and 3 of the CDM Verification Checklist (Appendix A) indicating the findings obtained and CARs/CLs/FAR raised through the desk review of relevant documents and the OA were submitted to the PPs.

2.5 Resolution of CARs/CLs/FARs

The PPs responded to the CARs/CLs raised during the verification. JQA reviewed the revised MR and the revised ER calculation spreadsheet prepared after the OA and the relevant additional documentary evidences, and confirmed that all the CARs/CLs were resolved. Details of resolution process of CARs and CLs are shown in Table 4 of the CDM Verification Checklist (Appendix A).

2.6 Draft Verification and Certification Report

The Draft Verification and Certification Report was prepared based on the results of the desk review of the relevant documents, the on-site assessment and the clarification / resolution of CARs and CLs raised in the 2nd verification. To ensure transparency, the final conclusion was made by using CDM Verification Checklist (Appendix A) which contained the necessary requirements based on VVS (ver. 04.0) and decisions/guidelines issued by the CDM-EB.

2.7 Internal Quality Control and final approval

Draft Verification and Certification Report and CDM Verification Checklist were assessed by technical reviewers in line with the latest Procedure for Internal Quality Control of JQA. The appropriateness of the draft conclusions on the verification of the CDM Project and its procedures were reviewed from technical points of view. The technical reviewers inform the review results to the verification team. The verification team responds to the technical reviewers' comments and revises the Draft Verification and Certification Report, if necessary. The results of the review are informed to the Manager of CDM/JI Assessment Division.

The Manager of CDM/JI Assessment Division reports the review result to the Senior Executive of JQA. Finally, the Senior Executive approves the validity of emission reductions achieved by the approved revised CDM Project and issues the Verification and Certification Report.

3. RESULTS OF VERIFICATION

The findings including four CARs, eight CLs and one FAR raised in the 2nd verification and the resolution of these CARs/CLs are described in this Chapter.

3.1 PPs response to FARs raised in the 1st verification

The PPs response to five FARs raised in the 1st verification are as follows:

FAR 01: The daily data records and the interview with the PPs show that the biogas has never been used as feedstock for hydrogen production in the first monitoring period due to the deactivation of the Ni catalyst in the hydrogen production plant which was occurred during the commissioning test. The use of biogas as feedstock is to be confirmed in the next periodic verification as it is essential feature of the CDM Project.

Resolution: During the 2nd monitoring period, the PPs have continuously strived to reduce both H₂S and moisture contents in biogas. Eventually, the PPs succeeded in feeding biogas as the feedstock for hydrogen production in April 2012 and the plant has been fully operated since June 2012. Through the review of the relevant documents such as Hydrogen Plant Journal, etc., on-site observation and the interview with the PPs, JQA confirms that the hydrogen production plant using biogas as feedstock has been fully operated since June 2012, in compliance with the approved revised PDD.

FAR 02: Since PPs recognize the possible risk of data loss during the off-site calibration of some monitoring equipment (for 1-1.5 months), PPs are requested to establish an appropriate measure to avoid data loss for the next verification period.

Resolution: To reduce the risk of data loss during off-site calibration, the PPs have prepared spare flow meters (F-00 to F-06). When the monitoring equipments are due for calibration, they are switched to their spare flow meters while waiting for the calibration sent to accredited calibration entity. Through the review of calibration certificates, on-site inspection and the interview with the PPs, JQA confirms that the spare flow meters of F-00 to F-06 are prepared and used during the off-site calibration of the main flow meters.

FAR 03: Although PPs verbally explained their training activities during the 1st monitoring period, any documented procedures/ records could not be confirmed. Documented CDM training plan and its record format are to be prepared for the next verification period.

Resolution: The PPs have scheduled an annual training and information meeting to keep the staffs responsible for monitoring and reporting of the data up-to-date. During the 2nd monitoring period, the training was conducted on 23/08/2011 and 30-31/07/2012 under the cooperation of the CDM consultant. The minutes of the training and the list of attendee with their signatures were provided. Through the review of the minutes and materials used in the training and the interview with the PPs, JQA confirms that the training is appropriately implemented every year during the 2nd monitoring period in accordance with the approved revised monitoring plan.

FAR 04: Monitoring data of F-01 and F-03 shown in Biogas Journal are calculated as daily values. Original data (hourly readings) are recorded in other data sheet. As

many calculation errors are found between Biogas Journal and the original data sheet, the PPs are requested to improve the data sheet format for the next verification period.

Resolution: The PPs have improved the data sheet format of biogas journal such that the monitoring data of biogas flows are all done hourly. This action is taken to reduce the calculation errors when transferring the data from the journal into the computerized format. Through the review of the relevant data documents and the cross-check of the data in the sheet, JQA confirms that the data sheet format was appropriately improved.

FAR 05: The PPs are requested to take necessary actions to ensure the accurate monitoring of V_{AD} for the next monitoring period, such as adjustment/ replacement of meter F-01.

Resolution: To check the accuracy and reliability of V_{AD} monitoring data measured by the flow meter F-01, the existing flow meter was replaced with a new spare meter on 14/07/2011. Through the comparison of V_{AD} with V_{TR} ($= V_D + V_F$), it was found that the accuracy and reliability level of V_{AD} monitoring data since 14/07/2011 had not been improved by the replacement of the flow meter F-01.

Through further review of relevant monitoring data and manufacturer's specification of the flow meter F-01, and the interview with the PPs, JQA has confirmed that there was a large discrepancy between the actual flow rate of biogas collected from the anaerobic digester (AD) and optimal measurement range of the flow meter F-01 installed in the AD plant. The mismatched installation of the flow meter F-01 led to a reduction in the accuracy level of the V_{AD} monitoring data.

As the PPs failed to ensure the accurate monitoring of V_{AD} in the 2nd monitoring period, CAR 04 was newly raised to resolve this issue.

3.2 Compliance of the project implementation with the registered PDD

3.2.1 Implementation status of the CDM Project

Nubika is one of the subsidiary companies of Permata Hijau Group (PHG). The CDM Project implemented by Nubika is aiming to produce hydrogen by the steam reforming of the biogas which is generated by the anaerobic digestion of organic wastewater from Nubika's palm oil mill (**Ref. 9**). The Methane Capture System (MCS) with open flare and the hydrogen production plant with H_2S and moisture removal systems are installed and operated to implement the CDM Project (**Refs. 10-20**).

JQA confirms that the CDM Project consists of only one site and is not phased implementation. The start date of the CDM Project was 15/10/2006 when the contract of Anaerobic Digester (AD) was concluded (**Ref. 10**). The construction of MCS and biogas purification system to support hydrogen production was initiated in 2007 and these plants were commissioned on 06/02/2009. The MCS has been in operation since then.

The start date of the 1st crediting period was changed to 01/05/2010 by the post-registration changes, due to the delay in the delivery of monitoring equipment. The request for post-registration was approved by the UNFCCC on 26/08/2010 (**Ref. 8**).

The post-registration changes for the Corrections, Permanent changes from the registered monitoring plan or monitoring methodology and Changes to the project design of registered project activity were submitted in the 1st verification and approved by the CDM-EB on 19/07/2011.

The PP of Annex I country (Japan) has changed its name from “Mitsubishi UFJ Securities Co., Ltd.” to “Mitsubishi UFJ Morgan Stanley Securities Co., Ltd.” after the registration of the project activity. The change of the name was approved by the Japanese DNA on 30/07/2010 and then approval by UNFCCC.

Regarding the post-registration changes in B.2, CL 01, CL 03 and CL 04 were raised and resolved as follows:

CL 01: The description on the change to the start date of the 1st crediting period from 30/06/2009 to 01/05/2010 in A.1 and B.2.5 is not necessary because the change has already been approved by the EB on 26/08/2010 and confirmed on the UNFCCC website.

Resolution: The description is removed from A.1 and B.2.5 of the revised MR.

CL 03: The request for permanent change submitted in the 1st monitoring period was approved by the CDM-EB on 19/07/2011. As the issues contained in B.2.3 are limited to the permanent changes during the 2nd monitoring period, the above description is not necessary.

Resolution: The description is removed from B.2.3 of the revised MR.

CL 04: The changes to project design of registered project activity submitted in the 1st monitoring period were approved by the CDM-EB on 19/07/2011. As the issues contained in B.2.4 are limited to the project design changes during the 2nd monitoring period, the above description is not necessary.

Resolution: The description is removed from B.2.4 of the revised MR.

3.2.2 Actual operation

During the 2nd monitoring period from 01/08/2010 to 31/07/2012, Nubika still experienced many technical troubles in the project activity such as low and unstable generation of biogas in the MCS and low removal efficiency of H₂S in the purification system of biogas. As a result, the project facility was not running in full operation.

Through the review of monitoring records and the interview with the PPs, JQA confirms that the MCS and hydrogen production plant were not fully operated in the 2nd monitoring period.

In spite of the above difficulties, the biogas of 2,826,607 Nm³ in total was recovered by the anaerobic digestion of the wastewater (398,785 m³) from the palm oil mill during the 2nd monitoring period. The concentration of methane in the biogas was in a range of 59.9% - 71.2%. From the COD values of wastewater at the inlet and the outlet of the anaerobic digester, it is found that approximately 75% of the organic matter contained in the wastewater was decomposed by the Methane Capture System (MCS) to generate biogas, followed by the further decomposition in the lagoon. More than 99% of the

organic substances are treated by the combined system of the MCS and subsequent eight lagoons.

The extracted biogas from the MCS then goes through the biogas purification system for the removal of H₂S (approximately 3,000 ppm) and moisture contained in the biogas before it is supplied to hydrogen production plant, while the excess biogas is flared by using an open flare. The biogas has been used as fuel in the hydrogen production unit throughout the 2nd monitoring period and effectively displaced LPG as fuel. However, the use of the biogas as a feedstock for hydrogen production was commenced in April 2012, due to the technical problem in the biogas purification system. Before that, LPG had been used as a feedstock for hydrogen production.

Due to the high content of H₂S in the biogas generated by the anaerobic digestion of organic wastewater, the biogas had never been used as a feedstock for the hydrogen production during the 1st monitoring period because Ni catalyst used in the hydrogen production plant was rapidly deactivated by H₂S. To solve this technical problem, Nubika repeated testing of the H₂S wet removal system (manufactured by Tangshan IMA Technology Co., Ltd.) to reduce H₂S content in the biogas during the 2nd monitoring period (**Ref. 16**). As a result, the efficient removal of H₂S from 3,000 ppm to a negligible small level was achieved by the operation of the wet removal system at the elevated temperature up to 45°C. Eventually, Nubika succeeded to supply biogas as a feedstock for hydrogen production and the plant has been operated since April 2012. This success is the first case for the production of hydrogen from biogas at least in the area of south-east Asia.

Through the review of the monitoring data, on-site inspection and interview with the PPs, JQA confirms that the CDM Project, which is an integrated process of biogas generation by the anaerobic digestion of wastewater from the palm oil mill and the hydrogen production from the biogas by steam reforming, has been implemented and operated in accordance with the approved revised PDD.

In addition, through the observation and the interview with the PPs during the on-site assessment, it is confirmed that the palm waste (300 t/d of shell and fiber) is used as fuel for all captive power plants (New: 7.5 MW x 2 units; Old: 2.1 MW x 3 units and 2.95 MW x 1 unit) (**Ref. 21**) and the project site is not connected to the external grid. All the electricity consumed at the palm oil mill is supplied by these captive power plants (**Ref. 56**). In an emergency, three diesel generators (500 kW x 2 units and 300 kW x 1 unit) will be used. The data of electricity and diesel oil consumption during the 2nd monitoring period demonstrate that the GHG emissions resulted from the use of the fossil fuel-based electricity by the CDM Project were only 86 tCO₂e and this was less than 1% of the emissions reductions of 27,012 tCO₂e. Therefore, the project emissions from the operation of diesel generator deem to be negligible small (**Ref. 57**).

Prior to the start of the project activity, the wastewater generated from the Nubika palm oil mill was treated sequentially by the eight lagoons with a total holding capacity of 131,336 m³. The original lagoon system was built to meet the regulatory standards for wastewater discharged to environment, which mandated COD to be controlled below 350 mg/L (**Ref. 22**). JQA reviewed the COD analysis data of wastewater at the final discharge into river (**Ref. 51**) and confirms that the CDM Project has been operated in compliance with the regulatory standards during the 2nd monitoring period.

3.2.3 Installed equipment

The approved revised PDD (Ref. 5) states that the following equipment is installed by the CDM Project.

- Methane extraction facility (Methane Capture System)
- Biogas purification system to remove H₂S and moisture
- Hydrogen production system with PSA unit
- Open flaring system of excess biogas

Table 2 summarizes the specifications of the main equipments which are installed and operated for the CDM Project.

Table 2 Main specification of CDM Project equipments

Methane Capture System (MCS)	
Manufacturer	Aquarius System (Malaysia) Sdn Bhd.
Reactor	Anaerobic digestion
Treatment mode	Continuous flow-stirred tank reactor (CSTR)
Palm oil mill effluent	800 m ³ /day
Digester capacity	1 x 3,000 m ³ Floating roof tank and 3 x 3,700 m ³ Fixed roof tanks
Retention time	Less than 17.6 days
COD of wastewater	Inlet: 52,000 mg/L, Outlet: 8,000 – 12,000 mg/L
Biogas purification system No.1 (Dry process for LPG)	
Manufacturer	Hydro-Chem, a division of Linde BOC Process Plants LLC
Sulfur removal vessel	Adsorption with activated carbon at 60-120 °F Regeneration with steam at 325 °F
Biogas pressure	20 barG
Biogas purification system No.2 (Wet process for biogas)	
Manufacturer	Tangshan IMA Technology Co., Ltd.
Biogas flow rate	750 Nm ³ /hr
Pressure	0.8 bar
Temperature	35 – 50 °C (45°C)
Desulfurization	3,000 ppm → 0 ppm
De-moisture	7 % → 0.2 %
Air dryer machine system	
Manufacturer	Tangshan IMA Technology Co., Ltd.
Moisture outlet content	10 ppm
Working pressure	0.7 – 2.0 MPa
Allowable Input temp.	45 – 55 °C
Hydrogen production system	
Manufacturer	Hydro-Chem, a division of Linde BOC Process Plants LLC
Hydrogen output	750 Nm ³ /hr

Hydrogen purity	99.99 vol%
Impurities in hydrogen	CO 10 ppmv max, CO ₂ 10 ppmv max
Biogas feed composition	CH ₄ 65±5 mol%, CO ₂ 35±5 mol%, H ₂ S 0.3 mol% max
Biogas feed rate	Feedstock 510 Nm ³ /hr, Fuel 210 Nm ³ /hr
Steam reforming	Reaction temperature 843 °C, Catalyst Nickel
Shift conversion	Reaction temperature 343 °C, Catalyst Cr/Fe
Hydrogen purification	PSA with activated alumina/carbon/molecular sieve
Flaring system	
Manufacturer	Aquarius System (Malaysia) Sdn Bhd.
Type	Open

Through the review of purchase contracts (**Refs. 10, 12-15**), the on-site inspection and the interview with the PPs, JQA confirms that all the systems in Table 2 are actually installed and operated in accordance with the approved revised PDD.

3.3 Compliance of the monitoring plan with the monitoring Methodology

Through the request for changes from registered monitoring plan or applied methodology submitted in the 1st verification, the monitoring parameters $Q_{y,ww}$, $COD_{y,ww,untreated}$, $COD_{y,ww,treated_AD}$, $COD_{y,ww,treated}$, $COD_{y,ww,removed,i}$, $COD_{y,removed,j}$, $S_{y,final}$, End use of the final sludge, which are necessary to evaluate and/or calculate project emissions as per Para 34 of AMS-III.H (ver. 09), and FC_{Diesel} for emergency use of diesel generator were newly added to the registered monitoring plan. In addition, the analysis frequency of LPG molar composition was revised from “at least annually” to “every quarter” as per Para. 22(c) of AMS-III.O (ver. 01).

Through the desk review of the relevant documents, JQA confirms that the approved revised monitoring plan is fully consistent with the approved methodologies AMS-III.H (ver. 09) and AMS-III.O (ver. 01) applied to the CDM Project. Further revision of the monitoring plan is not required for the CDM Project.

3.4 Compliance of monitoring activities with the revised monitoring plan

3.4.1 Monitoring parameters and procedures

Twenty monitoring parameters are prescribed in the approved revised monitoring plan (**Ref. 5**). Among them, SFC_{LPG} (Specific fuel consumption of hydrogen production unit using LPG as fuel, kg-LPG/Nm³-H₂) is excluded because the hydrogen production plant never used LPG as fuel in the 2nd monitoring period. The value of SFC_{LPG} is provided by the manufacturer (**Ref. 12**) as per the Para. 15 of AMS-III.O, which is described in D.1 of the revised MR as a parameter determined *ex-ante*. $S_{y,final}$ (Amount of final sludge generated by the wastewater treatment) and “End use of the final sludge” (Details of

end-use/disposal of removed sludge) were also not measured during the 2nd monitoring period as sludge removal was not occurred in this monitoring period.

Among seventeen parameters remained, data of the following two parameters were sourced from the certificate of LPG quality issued by the LPG supplier (Laboratory PT Pertamina) (**Ref. 58**) which is accredited by National Standardization Agency of Indonesia (Badan Standardisasi Nasional; BSN):

- $m_1; m_2$: Molar composition of propane and butane in LPG used in hydrogen plant, %.
- EF_{LPG} : CO₂ emission factor from combustion of LPG, kg CO₂/kg LPG.

Among fifteen parameters remained, the following eight parameters were continuously measured by flow meters installed in the project site:

- $M_{LPG\ FEED}$: Amount of LPG used as reaction feedstock in mass unit, kg.
- $M_{LPG\ FUEL}$: Amount of LPG used as fuel to reformer in mass unit, kg.
- V_{AD} : Amount of biogas recovered from anaerobic digester, Nm³.
- V_D : Amount of biogas used for hydrogen production, Nm³.
- V_F : Amount of biogas flared, Nm³.
- $V_{H_2,T}$: Total volumetric amount of hydrogen produced, Nm³.
- $Q_{y,ww}$: Volume of wastewater treated, m³.
- FC_{Diesel} : Amount of diesel oil consumed by the project activity, liter.

These parameters are continuously measured by flow meters and logged manually on hourly or daily or monthly basis, in accordance with the approved revised monitoring plan (**Ref. 5**).

X_{CH_4} (Concentration of methane in the biogas on volumetric basis) was continuously measured by an infrared methane analyzer installed on-site and the readings were manually recorded on hourly basis. As the approved revised monitoring plan describes that it shall be measured by either (a) continuous gas sampling or (b) daily gas sampling to meet 95% confidence level, the option (a) was taken by the PPs in the monitoring activity (**Ref. 5**).

$FT_{20,y}$ (The number of hours in year y , of which the flame is detected for more than 20 minutes in an hour h) was continuously measured by a thermocouple and manually recorded on hourly basis. The number of hours in which the flame was detected for more than 20 minutes was automatically counted by a flame detection system in accordance with the approved revised monitoring plan. However, despite that $FT_{20,y}$ was measured as per the approved revised monitoring plan, the monitored data of $FT_{20,y}$ are not used for the calculation of emission reductions because the project emissions need not be deducted from baseline emissions as per Para. 34 of AMS-III.H. (Refer to Section 3.6.2-3).

The following three parameters were measured through sampling and analysis of the wastewater at the in-house laboratory in accordance with the approved revised monitoring plan (**Ref. 5**):

- $COD_{y,ww,untreated}$: Chemical oxygen demand of the wastewater entering the anaerobic digester system, tonnes/m³.

- $COD_{y,ww, treated_AD}$: Chemical oxygen demand of the treated wastewater out from the anaerobic digester system into the existing lagoon system, tonnes/m³.
- $COD_{y,ww,treated}$: Chemical oxygen demand of the final treated wastewater discharged into sea, river or lake, tonnes/m³.

Finally, the following two parameters were calculated from the above three COD analysis data:

- $COD_{y,removed,i}$: Chemical oxygen demand removed by the anaerobic wastewater treatment systems i in the baseline situation to which the sequential anaerobic treatment step is being introduced. For the project activity, treatment system i is the open lagoon system. This is determined by subtracting $COD_{y,ww, treated}$ from $COD_{y,ww,untreated}$, tonnes/m³.
- $COD_{y,removed,j}$: Chemical oxygen demand removed by the treatment system j of the project activity equipped with methane recovery. For the project activity, treatment system j is the anaerobic digester system. This is determined by subtracting $COD_{y,ww, treated_AD}$ from $COD_{y,ww,untreated}$, tonnes/m³) and recorded every month.

Through the review of monitored data provided by the PPs, JQA confirms that all monitoring parameters are appropriately measured and calculated in accordance with the approved revised monitoring plan.

3.4.2. Monitoring equipment

The following five kinds of monitoring / analysis equipment are used for the CDM Project.

- Flow meters for $Q_{y,ww}$, V_{AD} , V_D , V_F , $M_{LPG\ FEED}$, $M_{LPG\ FUEL}$, $V_{H2,T}$, and FC_{Diesel}
- Methane analyzer for X_{CH4}
- Thermocouple for $FT_{20,y}$
- Spectrophotometer for analysis of $COD_{y,ww,untreated}$, $COD_{y,ww,treated_AD}$ and $COD_{y,ww,treated}$
- Weighbridge for $S_{y,final}$

1) Flow meters

Eight flow meters are installed and operated at the biogas plant and hydrogen production plant. The parameters V_{AD} , V_F and V_D are measured by Vortex gas flow meters (**Ref. 23**) and M_{LPG_FEED} , M_{LPG_FUEL} and $V_{H2,T}$ are measured by differential pressure gas flow meters (**Ref. 24**). The parameter $Q_{y,ww}$ is measured by electromagnetic liquid flow meter (**Ref. 25**) and FC_{Diesel} is measured by mechanical flow meter (**Ref. 26**). Details of these flow meters are summarized in Table 3.

Table 3 Details of flow meters

Parameter	ID	Location	Manufacturer/ Model	Accuracy		Serial No.
				PDD	Spec	

$Q_{y,ww}$	F-00	Biogas Plant Site	Endress+Hauser PROMAG 10W	--	0.5%	M: 99005320000 S: EA166719000
V_{AD}	F-01	Biogas Plant Site	Endress+Hauser PROWIRL 72	Max 4%	< 1%	M: CC031202000 S: E7048E02000
V_F	F-02	Biogas Plant Site	Endress+Hauser PROWIRL 72	Max 4%	< 1%	M: A901BF02000 S: E102F702000
V_D	F-03	Biogas Plant Site	Endress+Hauser PROWIRL 72	Max 4%	< 1%	M: 99005120000 S: E102F802000
$M_{LPG\ FEED}$	F-04	Hydrogen Plant Site	Siemens SITRANS 7MF4433	Max 4%	< 0.55%	M: N1-X622-9087676 S: N1-B314-9024712
$M_{LPG\ FUEL}$	F-05	Hydrogen Plant Site	Siemens SITRANS 7MF4433	Max 4%	< 0.55%	M: IX-V009-9037948 S: IX-V009-9037944
$V_{H_2,T}$	F-06	Hydrogen Plant Site	Siemens SITRANS 7MF4433	Max 4%	< 0.55%	M: 1X-V009-9037945 S: N1-BN08-9078867
FC_{Diesel}	-	Fuel tank	GASBOY / 4860-9S	--	$\pm 0.5\%$	00560

M: Main flow meter; S: Spare flow meter

To reduce the risk of data loss during the off-site calibration of flow meters, the spare meters of the main meters F-00, F-01, F-02, F-03, F-04, F-05 and F-06 were prepared by the PPs during the 2nd monitoring period. These main and spare flow meters were alternately used for the continuous monitoring of flow data of the wastewater, biogas, LPG and hydrogen, respectively.

2) Methane analyzer

A methane analyzer is installed at the outlet of MCS and operated for the monitoring of X_{CH_4} (Concentration of methane in the biogas on volumetric basis). Details of the methane analyzer are summarized in Table 4 (Ref. 27).

Table 4 Details of methane analyzer

Parameter	ID	Location	Manufacturer/ Model	Accuracy		Serial No.
				PDD	Spec	
X_{CH_4}	X-01	Biogas Plant Site	Awite Bioenergie GmbH / AwifLEX	Max 5%	$\pm 2\%$	670_09

3) Thermocouple

The open flare is equipped with a thermocouple for the monitoring of $FT_{20,y}$ (Number of hours in the monitoring period, of which the flame is detected for more than 20 minutes in an hour). Details of the thermocouple are summarized in Table 5 (Ref. 29).

Table 5 Details of thermocouple

Parameter	ID	Location	Manufacturer	Accuracy		Serial No.
				PDD	Spec	
$FT_{20,y}$	FT-02	Biogas Plant Site	Endress+Hauser / TAF11	-	IEC 584 Class 2 $\pm 2.5^\circ\text{C}$ (-40 - 333 $^\circ\text{C}$) $\pm 0.0075 t $ (333 - 750 $^\circ\text{C}$)	CC0001141D5

4) Spectrophotometer

A spectrophotometer is used at the in-house laboratory for the analysis of $COD_{y,ww,untreated}$, $COD_{y,ww,treated_AD}$ and $COD_{y,ww,treated}$. COD analysis is conducted based on “Closed Reflux, Colorimetric Method” based on 5220D of “Standard Methods for the Examination of Water and Wastewater”, published by American Public Health Association (APHA), the American Water Works Association (AWWA) and the Water Environment Federation (WEF). Details of the spectrophotometer are summarized in Table 6 (Ref. 30).

Table 6 Details of spectrophotometer

Parameter	ID	Location	Manufacturer	Accuracy		Serial No.
				PDD	Spec	
$COD_{y,ww,untreated}$ $COD_{y,ww,treated_AD}$ $COD_{y,ww,treated}$	-	In-house laboratory	Thermo Electron Corporation / Genesys 10UV Scanning Spectrophotometer	-	0.5%	2M1L149001

5) Weighbridge

$S_{y,final}$ (Amount of final sludge generated by the wastewater treatment in the year “y”) was monitored in the 2nd monitoring period, but sludge removal operation was not occurred. The weighbridge will be used for the monitoring of $S_{y,final}$. Details of the weighbridge are summarized in Table 7 (Ref. 42).

Table 7 Details of weighbridge

Parameter	ID	Location	Manufacturer	Accuracy		Serial No.
				PDD	Spec	
$S_{y,final}$	-	Entrance of Palm Oil Mill	Weighing Engineering Sdn. Bhd. / WE 9000 N	-	Class III	000035N

Through the review of relevant documents including manufacturer’s specification and calibration records, the on-site inspection and the interview with the PPs, JQA confirms that all the monitoring equipment are installed in place and operated in accordance with the approved revised monitoring plan.

3.4.3 Management system and QA/QC

Nubika is certified according to ISO 9001 (Ref. 46). The CDM monitoring organization is shown in Figure 1. As Nubika is wholly owned by PHG, the director of PHG is responsible for the management of the CDM monitoring system.

The PHG Board of Director is responsible for the check and approval of Monitoring Report submitted by CDM Manager. The role and responsibility of each staff are as follows:

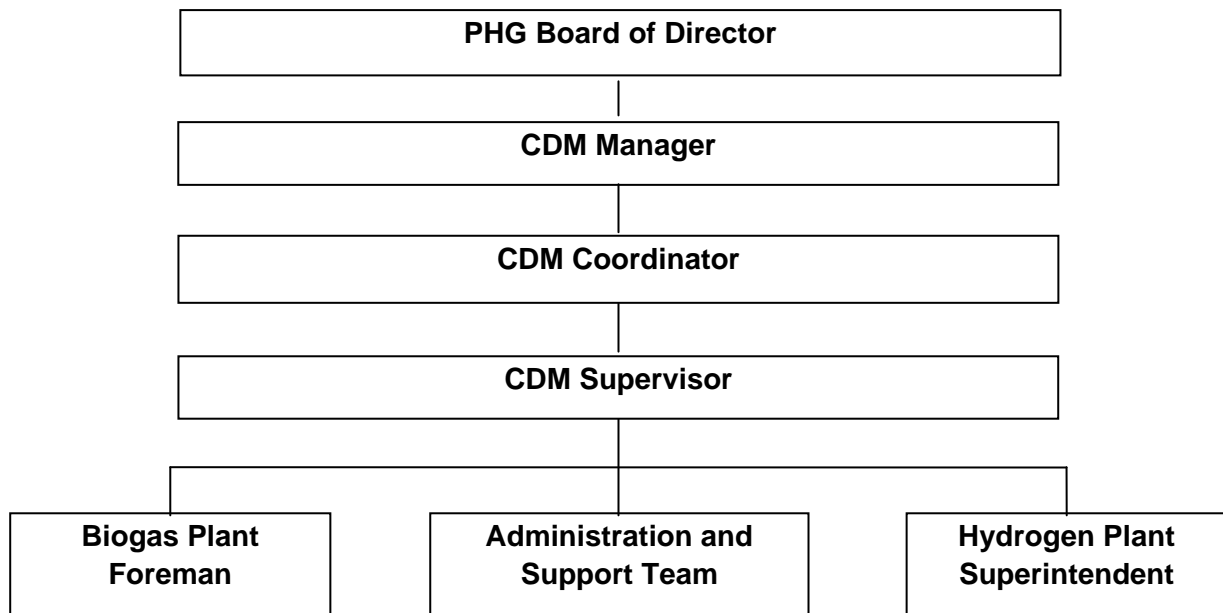


Figure 1 CDM monitoring organization

CDM Manager

- Coordinate data collection and instrument calibration by technical department;
- Consolidation of results from each department on monthly basis;
- Preparation of the draft Monitoring Report for the purpose of verification;
- Preparation of annual education and training program; and
- Revision of Standard Operational Procedure (SOP).

CDM Coordinator

- Supervision of Daily Report and Consolidated Monthly Report made by CDM Supervisor; and
- Submission of Biogas / Hydrogen Facility Daily Report to CDM Manager.

CDM Supervisor

- Preparation of Biogas / Hydrogen Facility Daily Report based on Biogas / Hydrogen Plant Site Monitoring Journal;
- Preparation of Consolidated Monthly Report; and
- Collection of relevant information / records such as invoice of LPG.

Biogas Plant Foreman / Hydrogen Plant Superintendent

- Supervision of operators who record data in Biogas / Hydrogen Plant Site Monitoring Journal;

Administrative and Support Team

- Collection of data and information which are periodically monitored or provided from a third party, such as LPG molar analysis, wastewater COD analysis, sludge removal amount, end use of final sludge and diesel oil consumption by power generators for emergency use.

The training of the CDM staffs was conducted on 23/08/2011 and 30-31/07/2012 with the support of the CDM consultant (**Ref. 59**). Through the review of the minutes and text used in the training and the interview with the PPs, JQA confirms that the training is appropriately implemented during the 2nd verification period in accordance with the approved revised monitoring plan.

Regarding the training activity, CL 02 was raised and resolved as follows:

CL 02: The response to FAR 03 raised in the 1st verification is not included in B.1 and Section C, while the training activity has been actually implemented in this monitoring period.

Resolution: The response to FAR 03 on the implementation of training activity was added in Section B.1 and Section C of the revised MR. The date and minutes of the CDM Staff training which were conducted on 23/08/2011 and 30-31/07/2012 were also added in B.1 and Section C of revised MR.

Through the review of the relevant documents including SOP (**Ref. 7**), the on-site assessment and the interview with the PPs, JQA confirms that the monitoring organization and role / responsibility of each staff are in accordance with those in the approved revised PDD.

3.5 Compliance with the calibration frequency requirements for measuring instruments

The information on the calibration of measuring instruments used in the monitoring activity is summarized in Table 8. The calibration of each measuring instrument was conducted by the following certified calibration entities: Directorate of Metrology, and Industry and Trade Service of North Sumatra Provincial Government is governmental agencies being directly responsible to meteorology. PT CALTESYS INDONESIA is a calibration entity accredited by National Standardization Agency of Indonesia (Badan Standardisasi Nasional; BSN) (**Ref. 43**). ENDRESS+HAUSER and Awite Bioenergie GmbH are certified to ISO/IEC 17025 and ISO 9001, respectively (**Refs. 44,45**).

Through the review of the calibration records (**Refs. 31-42**) and the interview with the PPs, the calibration standard, calibration date, validity period and calibration frequency of each measuring instrument were checked. The information is summarized in Table 8. As a result of cross-check, the delayed calibration for the flow meters F-04, F-05, F-06 and COD analyzer are identified.

Table 8 Details of Calibration

Parameter	ID	Calibration standard	Calibration date	Validity	Calibration frequency	Calibration entity
$Q_{y,ww}$	F-00	DIN 29104	M: 13/04/2010 S: 03/11/2011	12/04/2012 02/11/2013	Every 2 years as per the revised MP	ENDRESS + HAUSER
V_{AD}	F-01	DIN 11631	M: 10/12/2009 S: 14/07/2011	09/12/2011 13/07/2013		
V_F	F-02		M: 09/04/2010 14/10/2011 S: 07/01/2011	08/04/2011 13/10/2012 06/01/2013	Every year for main meter as per calibration certificate Every 2 years for spare meter as per the revised MP	Directorate of Metrology
V_D	F-03		M: 09/04/2010 14/10/2011 S: 07/01/2011	08/04/2011 13/10/2012 06/01/2013		
$M_{LPG\ FEED}$	F-04	EN 60770-1	M: 28/04/2010 07/02/2013 (Delayed) S: 04/04/2011	27/04/2011 06/02/2014 03/04/2012	Every year as per manufacturer's specification	PT. CALTESYS INDONESIA
$M_{LPG\ FUEL}$	F-05		M: 28/04/2010 S: 07/11/2011 (Delayed)	27/04/2011 06/11/2012		
$V_{H_2,T}$	F-06		M: 01/06/2010 S: 15/11/2011 (Delayed)	31/05/2011 14/11/2012		
FC_{Diesel}	-	Manufacturer's procedure (GASBOY)	20/12/2009 11/12/2011	19/12/2011 10/12/2013	Every 2 years as per calibration certificate	PT. Nubika Jaya
X_{CH_4}	X-01	Standard gas according to ISO6141	22/01/2010 21/01/2011 11/01/2012	21/01/2011 20/01/2012 10/01/2013	Every year as per manufacturer's specification	ENERBON (Partner of Awite Bioenergie GmbH)
$FT_{20,y}$	FT-02	IEC 584	23/12/2009 22/12/2010 19/12/2011	22/12/2010 21/12/2011 18/12/2012	Every year as per manufacturer's specification	ENDRESS + HAUSER PT. Nubika Jaya
$COD_{y,ww,untreated}$ $COD_{y,ww,treatedAD}$ $COD_{y,ww,treated}$	-	NIST SRM 930 and NIST SRM 1930 (photo-metric) and NIST SRM 2034	29/05/2008 19/12/2011 (Delayed)	28/05/2011 18/12/2014	At least once in three years as per General SSC Guideline	PT. CALTESYS INDONESIA
$S_{y,final}$	-	Legal Metrology Law No. 2, 1981	July 2010 July 2011	July 2011 July 2012	Every year as per calibration certificate	Industry and Trade Service, North Sumatra Provincial Government

M: Main flow meter; S: Spare flow meter

Regarding the calibration frequency and delayed calibration, CAR 01, CL 06, CL 07 and FAR 01 were raised and resolved as follows:

CAR 01: Delayed calibration of flow meters F-02, F-03, F-04, F-05, F-06 and FC_{Diesel}, and COD analyzer are identified. The values of the baseline and leakage emissions are not corrected in a conservative manner, taking into consideration the delayed calibration, during the period between the scheduled date and the actual date of calibration.

(a) The maximum permissible errors of these equipment are to be applied in the calculation of baseline and leakage emissions.

(b) The error identified in the delayed calibration test is to be applied if the error is beyond the maximum permissible error.

Resolution: It is confirmed through the on-site inspection, the calibration certificates and the interview with the PP that the main flow meters of F-02 and F-03 were switched to their spare meters during the off-site calibration of the main meters. Therefore, the monitoring with F-02 and F-03 covered the whole monitoring period.

As for the flow meters of F-04, F-05 and F-06, the measured values of the delayed calibration are corrected as follows:

- F-04: The values of $M_{LPG,FEED}$ measured from 04/04/2012 to 31/07/2012 are increased by applying a maximum uncertainty of 4% in the approved revised PDD. This parameter is used in the calculation of $m_{H_2,LPG}$ and increased values lead to a conservative calculation of $BE_{LPG,FEED}$.
- F-05: The value of $M_{LPG,FUEL}$ data is zero during the 2nd monitoring period. Therefore, the delayed calibration of F-05 from 28/04/2011 to 07/11/2011 does not affect the calculation of emission reductions.
- F-06: The values of $V_{H_2,T}$ measured from 01/06/2011 to 15/11/2011 are decreased by applying a maximum uncertainty of 4% in the approved revised PDD. This parameter is used in the calculation of $m_{H_2,T}$ and decreased values lead to a conservative calculation of $BE_{LPG,FEED}$.

As for the delayed calibration of Spectrophotometer, the measured values are corrected as follows:

- $COD_{y,ww,untreated}$: The measured data from 29/05/2011 to 18/12/2011 are decreased by applying a maximum permissible error of the instrument with 0.5%. The decreased values are conservatively used in the calculation of $COD_{y,removed,AD} = COD_{y,ww,untreated} - COD_{y,ww,treated_AD}$.
- $COD_{y,ww,treated_AD}$: The measured data from 29/05/2011 to 18/12/2011 are increased by applying a maximum permissible error of the instrument with 0.5%. The increased values are conservatively used in the calculation of $COD_{y,removed,AD} = COD_{y,ww,untreated} - COD_{y,ww,treated_AD}$.
- $COD_{y,ww,treated}$: The measured data from 29/05/2011 to 18/12/2011 are increased by applying a maximum permissible error of the instrument with 0.5%.

As explained in Section 3.6.2-3), however, these COD data are not used in the calculation of project emissions as a result of the demonstration as per Para. 34 of AMS-III.H (ver. 09).

CL 06:

- 1) The calibration frequency of F-01, F-02, F-03, F-04, F-05 and F-06 in the MR (every year) is not consistent with that in the revised PDD (every 2 years).
- 2) It is not clear whether the flow meters (F-01 (V_{AD}) and F-06 ($V_{H_2,T}$)) are replaced or not during this monitoring period. (Their serial number are changed from the information in the 1st MR) If replaced, the change is to be clearly described in B.1 and D.2 of the revised Monitoring Report.
- 3) Serial numbers of F-04 and F-05 in the MR are not consistent with those in their calibration records.
- 4) The calibration date and frequency of the flow meter F-00 are not consistent with those in the 1st MR.
- 5) The quarterly data of LPG composition (m_1 & m_2) and EF_{LPG} are not included using table.

Resolution:

- 1) The revision of calibration frequency for gas flow meters is confirmed in the revised MR as follows:
 - F-00 and F-01: every 2 years as per the approved revised monitoring plan,
 - F-02 and F-03: every year as per the calibration certificates,
 - F-04, F-05 and F-06: every year as per the manufacturer's specification.
- 2) It is confirmed through on-site inspection, calibration certificates and the interview with the PP that all gas flow meters (F-00, F-01, F-02, F-03, F-04, F-05 and F-06) are switched to spare flow meters during the 2nd monitoring period in order to avoid unavailability of monitoring data during off-site calibration. The alternative use of them is clearly described in Section B.1 of the revised MR.
- 3) It is confirmed through on-site inspection, calibration certificates and the interview with the PP that the serial numbers of all flow meters including the main and spare ones are correctly described in Sections B.1 and D.2 of the revised MR.
- 4) The calibration date and frequency of the flow meter F-00 (both main and spare flow meters) are appropriately corrected in Section D.2 of the revised MR.
- 5) The quarterly data of LPG composition (m_1 & m_2) and EF_{LPG} are described in Section D.2 of the revised MR using table.

CL 07: The calibration certificate of F-04 in 2012, FC_{Diesel} in 2011, $FT_{20,y}$ in 2011 and 2012 are not provided.

Resolution: The calibration certificates of FC_{Diesel} and $FT_{20,y}$ in 2011, and F-04 in 2013 are provided.

Regarding the calibration management system of measuring instruments, FAR 01 was raised as follows:

FAR 01: The PPs is required to establish the management system to ensure the calibration frequency of monitoring equipment without delay for the next monitoring period, such as making of the calibration schedule plan and the

clarification of role and responsibility of CDM staffs.

Through the review of the calibration records, the revised ER calculation spreadsheet and the interview with the PPs, JQA confirms that the main flow meters F-02 and F-03 were switched to their spare meters within the term of validity, and the data measured by the flow meters F-04, F-05 and F-06 and COD analyzer were conservatively corrected for the delayed calibration period.

3.6 Assessment of data and calculation of GHG emission reductions

3.6.1 Assessment of data

1) Recording and aggregation of monitoring data

JQA confirmed that the following nine recording forms were used by the PPs:

- Biogas Journal (“Journal Biogas”) (**Ref. 47**): paper-based handwritten records prepared by biogas plant operators based on the hourly readings of X-01 (X_{CH_4}), FT-02 ($FT_{20,y}$), F-00 ($Q_{y,ww}$), F-01 (V_{AD}), F-02 (V_F) and F-03 (V_D). Completed Biogas Plant Journals are checked and authorized by Biogas Plant Foreman and then submitted to CDM Supervisor every day.
- Biogas Facility Daily Report (“Laporan Fasilitas Biogas”) (**Ref. 48**): electronic (Excel) records prepared by CDM Supervisor based on Biogas Journal. The contents of Biogas Facility Daily Report and Biogas Journal are the same. Completed Biogas Facility Daily Reports are checked and authorized by CDM Supervisor and then submitted to CDM Coordinator.
- Wastewater and Biogas Analysis Record (“Analysis POME and Biogas”) (**Ref. 49**): paper-based records prepared by in-house laboratory based on the wastewater analysis of $COD_{y,ww,untreated}$, $COD_{y,ww,treated_AD}$ and $COD_{y,ww,treated}$.
- Hydrogen Plant Journal (“Journal Hydrogen Plant”) (**Ref. 52**): paper-based handwritten records prepared by hydrogen production plant operators based on the hourly readings of F-04 ($M_{LPG\ FEED}$), F-05 ($M_{LPG\ FUEL}$) and F-06 ($V_{H_2,T}$). Completed Hydrogen Plant Journals are checked and authorized by Hydrogen Production Plant Superintendent and then submitted to CDM Supervisor every day.
- Hydrogen Facility Daily Report (“Laporan Fasilitas Hydrochem”) (**Ref. 53**): electronic (Excel) records prepared by CDM supervisor based on Hydrogen Plant Journal. The contents of Hydrogen Facility Daily Report and Hydrogen Plant Journal are the same. Completed Hydrogen Facility Daily Reports are checked and authorized by CDM Supervisor and then submitted to CDM Coordinator.
- Consolidated Monthly Report (“Consolidated Emission Reductions”) (**Ref. 54**): electronic (Excel) records prepared by CDM supervisor based on Biogas / Hydrogen Facility Daily Report. It summarizes daily data of all monitoring parameters for a month. Completed Consolidated Monthly Reports are checked and authorized by CDM Coordinator and then submitted to CDM Manager.
- Monthly Power Station Data (**Ref. 55**): paper-based records summarizing monthly

quantity of diesel oil consumed in case of emergency of power generator (FC_{Diesel}).

- Monitoring Report (**Ref. 1**): a report prepared by CDM Manager for the purpose of DOE's verification/certification.
- ER calculation spreadsheet (**Ref. 2**): electronic (Excel) file contains the monitored data and the results of emission reduction calculation. Information presented in Section E of the MR is consistent with those in the spreadsheet.

As there was no trouble with the monitoring equipment, a complete set of data covering the whole monitoring period was available. JQA has cross-checked Biogas Journal (logbook data) (**Ref. 47**) with Biogas Facility Daily Report (**Ref. 48**) and Hydrogen Plant Journal (logbook data) (**Ref. 52**) with Hydrogen Facility Daily Report (**Ref. 53**), respectively, on-site.

2) Materiality and sampling plan

As mentioned in Section 2.3 of this report, JQA has conducted a verification using the concept of materiality in order to detect errors, omissions or misstatement in emission reductions claimed by the PPs in the MR (ver. 1.0) and the ER calculation spreadsheet. The materiality threshold, risk assessment and designed verification/ sampling plan for the 2nd periodic verification are summarized below.

(1) Materiality threshold

Since the project is a small scale CDM project activity achieving an annual emission reductions of 44,181 tCO₂e, a 5 per cent materiality threshold is applied to achieve reasonable level assurance as per Para 10 of "Guideline on the application of materiality in verifications" (ver. 01.0). The 5 per cent materiality threshold is equivalent to 1,368 tCO₂e (= 27,356 tCO₂e x 0.05) for the 2nd monitoring period.

2) Risk assessment and designed verification/sampling plan

According to the approved revised PDD, emission reductions (ER_T) are calculated by the following equation:

$$ER_{y,T} = BE_{y,T} - PE_{y,T} - L_{y,CH_4}$$

$$= (BE_{y,CH_4} + BE_{LPG\ FEED} + BE_{LPG,_FUEL}) - (PE_{MCS,y,power} + PE_{MCS,y,ww,treated} + PE_{MCS,y,s,final} + PE_{MCS,y,fugitive} + PE_{MCS,y,dissolved}) - (PE_{y,power} + PE_{y,fuel} + PE_{y,chem}) - L_{y,CH_4}$$

The MR (ver. 1.0) states that it is not necessary to deduct the project emissions from baseline emissions, as per Para 34 of AMS-III.H (ver. 09), during the 2nd monitoring period and thus the project emissions described in AMS-III.H (ver. 09) are regarded as zero. In addition, the project emissions described in AMS-III.O (ver. 01) are also zero because the CDM Project uses no electricity from external sources, no fossil fuels for steam generation and no chemicals or energy for the regeneration of adsorbent. Therefore, the emission reductions achieved by the project activity are calculated from the baseline emissions from methane recovery, the use of LPG as feedstock and fuel and L_{y,CH_4} (leakage emissions) as shown by the following equation:

$$ER_{y,T} = BE_{y,T} - PE_{y,T} - L_{y,CH_4}$$

$$\begin{aligned}
&= (BE_{y, CH_4} + BE_{LPG\ FEED} + BE_{LPG,_FUEL}) - L_{y, CH_4} \\
&= (27,350 + 280 + 143) - 417 \\
&= 27,356\ tCO_2e
\end{aligned}$$

From an initial review of data provided by the PPs, the first emission source (BE_{y, CH_4}) accounts for 99.9 % ($=27,350\ tCO_2e / 27,356\ tCO_2e \times 100$) of the total emission reductions and the second emission sources ($BE_{LPG\ FEED}$ and $BE_{LPG,_FUEL}$) are negligibly small. The impact of L_{y, CH_4} on the total emission reductions is a level of 1.5 % ($=417\ tCO_2e / 27,356\ tCO_2e \times 100$)

The calculation of BE_{y, CH_4} needs the monitoring data of $V_{D,y}$ (Volumetric amount of biogas used in hydrogen production), $V_{F,y}$ (Volumetric amount of biogas flared) and methane concentration of the biogas (X_{CH_4}). These data are read by biogas plant operators and manually recorded in Biogas Journal (logbook data) on an hourly basis and then aggregated to Biogas Facility Daily Report and Consolidated Monthly Report. L_{y, CH_4} is also calculated from the monitoring data of $V_{AD,y}$, $V_{D,y}$, $V_{F,y}$ and X_{CH_4} . Therefore, these data have a relatively high risk for errors, omissions or misstatements in the manual recording and aggregation of the data.

The verification plan is therefore designed to ensure that the majority of time to test and detect potential errors is spent on verifying the data of $V_{AD,y}$, $V_{D,y}$, $V_{F,y}$ and X_{CH_4} which have potential to impact directly on the determination of the emission reductions.

Table 9 summarizes the potential risks of errors, omissions and misstatements in the relevant data recording documents, the ER calculation spreadsheet and the MR in relation to the following types of risks:

- Inherent risk: risk associated with the complexity of the project and tasks being performed;
- Control risk: risk that the controls of the GHG project will not prevent or detect a material discrepancy;
- Detection risk: risk that the verifier will not detect any material discrepancy that has not been corrected by the controls of the GHG project.

The impact of each risk is evaluated as follows:

- The inherent risk for parameters measured by monitoring equipment such as flow meter and methane analyzer is considered low.
- The monitoring data of $V_{AD,y}$, $V_{D,y}$, $V_{F,y}$ and X_{CH_4} are manually recorded in Biogas Journal (logbook) and then aggregated to Biogas Facility Daily Report and Consolidated Monthly Report. Therefore, the control risk for these data is relatively high in the manual recording and aggregation of the data.
- From above analysis, the sampling plan described in Table 9 is made to ensure that detection risk is appropriately controlled.

As noted in Table 9, JQA decided to verify the daily data of $V_{AD,y}$, $V_{D,y}$, $V_{F,y}$ and X_{CH_4} in Biogas Facility Daily Report through cross-checking with the logbook hourly data of 240 days in Biogas Journal by random sampling. This verification plan surely contributes to improve accuracy and reliability of reported values in the MR and the ER calculation spreadsheet.

(3) Detected errors, omissions and misstatements and corresponding revision of verification/sampling plan

Following errors, omissions and misstatements are identified by the initial review of the ER calculation spreadsheet:

- Daily data of $V_{AD,y}$, $V_{D,y}$, $V_{F,y}$ and X_{CH_4} were cross-checked with their logbook hourly data of 240 days during the on-site assessment, but no errors were detected in the sample. Thus, JQA concludes that there is no risk of material errors in the daily data set and further sampling is not needed.
- In the calculation of the daily quantity of methane production in Consolidated Monthly Report, the systematic miscalculation was detected in which not the daily methane concentration but monthly averaged methane concentration was incorrectly applied. Thus, CAR 03 was raised.
- In the calculation of R_{CO_2/H_2} , $R_{H_2/LPG}$ and MW_{LPG} , the systematic miscalculation was detected in which the quarterly data of LPG composition are not appropriately applied. Thus, CAR 02 was raised.
- These errors, omissions and miscalculation gave increased emission reductions by 71 tCO_{2e}, which is within the threshold of 5 % applied.

In response to CAR 02 and CAR 03 issued by JQA, the revised ER calculation spreadsheet and the revised MR were provided by the PPs. As a result of the second review of the revised ER calculation spreadsheet and the revised MR, JQA has confirmed that the emission reductions in these documents are correctly and transparently calculated and there are no more errors, omissions and misstatements.

Regarding the calculation procedures using LPG composition and daily methane concentration in Consolidated Monthly Report, CAR 02 and CAR 03 were raised and resolved as follows:

CAR 02: The quarterly data of LPG composition are not appropriately applied in the calculation of R_{CO_2/H_2} , $R_{H_2/LPG}$ and MW_{LPG} in the MR and the ER calculation spreadsheet.

Resolution: The quarterly data of m_1 , m_2 issued by the supplier are correctly applied to the calculation of R_{CO_2/H_2} , $R_{H_2/LPG}$ and MW_{LPG} in the revised MR and the revised ER calculation spreadsheet.

CAR 03: 1) The daily quantity of methane production was calculated not using the daily methane concentration but using monthly averaged methane concentration.

2) The amounts of VD and VF since Sep 2011 in Table 1 of the MR and the ER calculation spreadsheet are not consistent with those in Biogas Journal (logbook data).

Resolution: 1) The daily quantity of methane production (BE_{CH_4}) is calculated using daily methane concentration (X_{CH_4}) and daily amount of biogas (V_{TR}). The monthly data of BE_{CH_4} in Table 1 of the revised MR and the revised ER calculation spreadsheet are correctly calculated.

2) It is confirmed that the data of V_D and V_F in Table 1 of the revised MR and the revised ER calculation spreadsheet are corrected and calculated appropriately.

Table 9 Risk assessment of parameters

Parameter measured	ID	Effect on ERs	Monitoring	Recording frequency	Data transfer to ER spreadsheet	Risk			Data checked	Sample size	Documentation checked	
						Inherent	Control	Detection				
Q _{y,ww}	F-00	Low	Continuously	Hourly	Manual	Low	High	Middle	Hourly data of 240 days	Middle	-Biogas Journal -Biogas Facility Daily Report	
V _{AD}	F-01	High										
V _D	F-03											
V _F	F-02											
M _{LPG, FEED}	F-04	Low									-Hydrogen Plant Journal -Hydrogen Facility Daily Report	
M _{LPG, FUEL}	F-05	No										
V _{H2,T}	F-06	Low										
X _{CH4}	X-01	High										-Biogas Journal -Biogas Facility Daily Report
FT _{20,y}	FT-02	No										
COD _{y,ww,untreated}	--	No	Monthly	Monthly	Manual	--	--	--	All data	--	-Wastewater and Biogas Analysis Record	
COD _{y,ww,treated_AD}												
COD _{y,ww,treated}												
m ₁ :m ₂	--	Middle	Quarterly	Quarterly	Manual	--	--	--	All data	--	-Certificate of LPG data	
FC _{Diesel}	--	Low	Monthly	Monthly	Manual	--	--	--	All data	--	-Record of oil consumption	
S _{y,final}	--	No	Time when sludge is removed	Irregularly	Manual	--	--	--	No	No	-Record of sludge removal	

3.6.2 Calculation of GHG emission reductions

1) Assumptions, default values and factors

The following eight default values and factors, which are determined *ex-ante* and not monitored, are described in D.1 of the MR:

- P_N : Reference pressure (P) at normal (N) condition as adopted by the volume measurement device; 100 kPa or 10^5 Pa
- T_N : Reference temperature (T) at normal (N) condition as adopted by the volume measurement device; 0°C or 273.15 K
- R: Ideal gas constant in SI Unit; $8.314 \text{ m}^3 \cdot \text{Pa} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$
- GWP_{CH_4} : Global warming potential of methane; 21 $\text{tCO}_2\text{e} / \text{tCH}_4$
- SFC_{LPG} : Specific fuel consumption of the hydrogen production unit using LPG as fuel; $0.1 \text{ kg LPG} / \text{Nm}^3 \text{ H}_2$
- MW_{CO_2} ; $\text{MW}_{\text{C}_3\text{H}_8}$; $\text{MW}_{\text{C}_4\text{H}_{10}}$; MW_{CH_4} : Molecular weight of CO_2 , C_3H_8 , C_4H_{10} and CH_4 respectively; 44 g/mol, 44 g/mol, 58 g/mol and 16 g/mol
- $\text{EF}_{\text{CO}_2, \text{Diesel}}$: CO_2 emission factor of diesel; $74.8 \text{ tCO}_2 / \text{TJ}$ (upper value)
- $\text{NCV}_{\text{Diesel}}$: Net calorific value of diesel; 43.3 TJ/Gg (upper value)

As described previously, the hydrogen production plant had never been operated using LPG as fuel in the 2nd monitoring period, therefore a default value which is determined by the manufacturer is used for SFC_{LPG} in D.1 of the MR in accordance with the Para. 15(c) of AMS- III.O.

The above default values and factors are correctly applied in the calculation of emission reductions. In addition, LPG density is used in Consolidated Monthly Report (**Ref. 54**) to convert Nm^3 into kg for calculation of emission reductions.

Regarding the description of “Purpose of data” in D.1, CL 05 was raised and resolved as follows:

CL 05: It is not clear why leakage is not included in the cell of "Purpose of data" in D.1. These parameters are used in the calculation of leakage.

Resolution: The description of “leakage” is appropriately added for all the relevant parameters in D.1 of the revised MR.

2) Baseline emissions

Baseline emissions ($\text{BE}_{y,T}$) are the sum of the baseline emissions from methane recovery by Methane Capture System ($\text{BE}_{y,\text{CH}_4}$) as per AMS-III.H, the baseline emissions from the use of LPG as feedstock in the hydrogen production plant ($\text{BE}_{y,\text{LPG FEED}}$) and the baseline emissions from the combustion of LPG as fuel in the hydrogen production plant ($\text{BE}_{y,\text{LPG,FUEL}}$) as per AMS-III.O, as shown by the following equation:

$$\text{BE}_{y,T} = \text{BE}_{y,\text{CH}_4} + \text{BE}_{y,\text{LPG FEED}} + \text{BE}_{y,\text{LPG FUEL}}$$

(1) Calculation of baseline emissions from methane recovery ($\text{BE}_{y,\text{CH}_4}$)

According to the approved revised PDD, the baseline emissions from methane recovery (BE_{CH_4}) are calculated by Eq. (3):

$$BE_{y,CH_4} = X_{CH_4} \times \frac{P_N \times V_{TR,y}}{R \times T_N} \times \frac{MW_{CH_4}}{X_1} \times GWP_{CH_4} \quad \text{.. Eq. (3) in the revised PDD}$$

Where:

- BE_{y,CH_4} : Baseline methane emission from methane recovery (tCO₂/yr)
 X_{CH_4} : Proportion of methane in biogas in volume/volume basis (Nm³/Nm³)
 P_N : Reference pressure at normal condition in Pascal (Pa)
 $V_{TR,y}$: Volumetric amount of biogas recovered (Nm³/yr)
 R : Ideal gas constant (m³.Pa/mol.K)
 T_N : Reference temperature at normal condition in Kelvin (K)
 MW_{CH_4} : Molecular weight of methane (gram/mol)
 X_1 : Conversion factor 10⁶ grams / tones (gram/ton)
 GWP_{CH_4} : Global warming potential of methane (tCO₂/tCH₄)

In this Project, the amount of methane recovered ($V_{TR,y}$) is calculated as the sum of all biogas delivered to the hydrogen plant ($V_{D,y}$) and the flare ($V_{F,y}$) in the project activity.

$$V_{TR,y} = V_{D,y} + V_{F,y} \quad \text{.....Eq. (4) in the revised PDD}$$

Where:

- $V_{TR,y}$: Total volumetric amount of biogas recovered from the project (Nm³/yr)
 $V_{D,y}$: Volumetric amount of biogas used in H₂ production (Nm³/yr)
 $V_{F,y}$: Volumetric amount of biogas flared (Nm³/yr)

The calculation of baseline emissions from methane recovery (BE_{CH_4}) is summarized in Table 10.

Table 10 Baseline emissions from methane recovery (BE_{CH_4})

Period	V_D (Nm ³)	V_F (Nm ³)	V_{TR} (Nm ³)	X_{CH_4} (%)	BE_{CH_4} (tCO ₂ e)
01/08 - 31/08/2010	63,892	40,764	104,656	71.06%	1,100
01/09 – 30/09/2010	34,355	20,809	55,164	68.94%	562
01/10 – 31/10/2010	104,704	12,525	117,229	68.84%	1,193
01/11 – 30/11/2010	54,400	12,192	66,592	69.88%	688
01/12 – 31/12/2010	95,324	2,722	98,046	69.22%	1,004
01/01 – 31/01/2011	64,364	8,930	73,294	66.55%	721
01/02 – 28/02/2011	46,579	16,390	62,969	71.71%	668
01/03 – 31/03/2011	117,394	22,082	139,475	70.79%	1,460
01/04 – 30/04/2011	20,200	20,759	40,958	70.29%	425
01/05 – 31/05/2011	6,289	35,805	42,093	67.76%	421
01/06 – 30/06/2011	98,873	4,045	102,918	64.74%	985
01/07 – 31/07/2011	88,338	47,683	136,020	59.94%	1,206
01/08 – 31/08/2011	49,953	30,288	80,242	60.23%	715
01/09 – 30/09/2011	51,226	89,955	141,181	61.91%	1,293
01/10 – 31/10/2011	83,667	114,614	198,281	60.21%	1,766

01/11 – 30/11/2011	44,311	110,545	154,856	60.05%	1,375
01/12 – 31/12/2011	53,099	126,973	180,073	59.87%	1,595
01/01 – 31/01/2012	69,647	117,613	187,260	63.05%	1,746
01/02 – 28/02/2012	77,732	88,274	166,006	67.25%	1,651
01/03– 31/03/2012	28,819	60,818	89,637	69.46%	921
01/04 – 30/04/2012	85,714	27,549	113,263	68.90%	1,154
01/05 – 31/05/2012	107,339	5,999	113,338	69.92%	1,172
01/06 – 30/06/2012	150,995	6,824	157,819	67.67%	1,579
01/07 – 31/07/2012	146,240	58,997	205,237	62.65%	1,902
	1,743,451	1,083,156	2,826,607	66.29%	27,302

JQA confirms that the monthly baseline emissions from methane recovery (BE_{CH_4}) in the revised MR and the revised ER calculation spreadsheet is the summation of the daily quantity of methane production which is calculated using daily methane concentration (X_{CH_4}) and daily amount of biogas (V_{TR}). The value of X_{CH_4} in Table 10 shows the monthly average concentration of methane in biogas for reference.

(2) Calculation of baseline emissions from use of LPG as feedstock ($BE_{LPG\ FEED}$)

According to the approved revised PDD, the baseline emissions from use of LPG as feedstock in the hydrogen production plant ($BE_{LPG\ FEED}$) are calculated by Eq. (5):

$$BE_{LPG\ FEED} = R_{CO_2/H_2} \times m_{H_2, BIO} \times MW_{CO_2} \times C_1 \quad \dots \text{Eq. (5) in the revised PDD}$$

Where:

$BE_{LPG, FEED}$: Baseline CO_2 emission from the reaction of LPG feedstock in the hydrogen production unit (tCO_2e)

R_{CO_2/H_2} : CO_2 generation potential ($kmol\ CO_2/kmol\ H_2$)

$m_{H_2, BIO}$: Molar quantity of hydrogen produced from biogas ($kmol\ H_2$)

MW_{CO_2} : Molecular weight of CO_2 , 44 ($kg\ CO_2/kmol\ CO_2$)

C_1 : Conversion factor 10^{-3} tonnes/kg, 0.001 ($tCO_2/kg\ CO_2$)

$$R_{CO_2/H_2} = (3m_1 + 4m_2) / (10m_1 + 13m_2) \quad \dots \text{Eq. (6) in the revised PDD}$$

Where:

R_{CO_2/H_2} : CO_2 generation potential from the reaction of LPG as feedstock (-)

m_1 : %mol of the propane in the LPG ($mol\ C_3H_8/mol\ LPG$)

m_2 : %mol of the butane in the LPG ($mol\ C_4H_{10}/mol\ LPG$)

$$m_{H_2, BIO} = m_{H_2, T} - m_{H_2, LPG} \quad \dots \text{Eq. (7) in the revised PDD}$$

Where:

$m_{H_2, BIO}$: Molar quantity of hydrogen produced from biogas ($kmolH_2$)

$m_{H_2, T}$: Total molar amount of hydrogen produced by hydrogen production unit as calculated using Equation 8 ($kmolH_2$)

$m_{H_2, LPG}$: Molar amount of hydrogen derived from LPG as calculated using equation 9 ($kmolH_2$)

$$m_{H2,T} = \frac{1 \times 10^5 \text{ Pa} \times V_{H2,T}}{8.314 \frac{\text{Pa} \cdot \text{m}^3}{\text{mol} \cdot \text{K}} \times 273.15 \text{ K} \times 1,000 \frac{\text{mol}}{\text{kmol}}} \quad \text{..... Eq. (8) in the revised PDD}$$

Where:

$m_{H2,T}$: Equivalent molar quantity of total hydrogen produced (kmolH₂)
 $V_{H2,T}$: Total volume of hydrogen produced in Normal volume (Nm³)

$$m_{H2, \text{LPG}} = R_{H2/\text{LPG}} \times M_{\text{LPG,FEED}} / \text{MW}_{\text{LPG}} \quad \text{..... Eq. (9) in the revised PDD}$$

Where:

$m_{H2, \text{LPG}}$: Molar amount of hydrogen derived from LPG (kmolH₂)
 $R_{H2/\text{LPG}}$: H₂ generation potential (mol H₂/mol LPG)
 $M_{\text{LPG_FEED}}$: Amount of LPG used as feedstock in mass unit based on monitoring (kg LPG)
 MW_{LPG} : Molecular weight of LPG (kg LPG/kmol LPG)

$$\text{MW}_{\text{LPG}} = m_1\% \times 44 + m_2\% \times 58 \quad \text{..... Eq. (10) in the revised PDD}$$

Where:

m_1 : %mol of the propane in the LPG (mol C₃H₈/mol LPG)
 m_2 : %mol of the butane in the LPG (mol C₄H₁₀/mol LPG)

$$R_{H2/\text{LPG}} = (10m_1 + 13m_2)/100 \quad \text{..... Eq. (11) in the revised PDD}$$

The calculation of baseline emissions from use of LPG as feedstock in the hydrogen production plant (BE_{LPG FEED}) is summarized in Table 11.

Table 11 includes the actual monitoring frequency and data of m_1 ; m_2 analyzed for LPG used in the 2nd monitoring period. The laboratory analysis of m_1 and m_2 was quarterly performed as per the Para. 22(c) of AMS-III.O. Based on the quarterly data of m_1 and m_2 , the values of $R_{H2/\text{LPG}}$, $R_{\text{CO2}/\text{H2}}$ and MW_{LPG} are correctly calculated in the revised ER calculation spreadsheet (**Ref. 2**) according to the approved revised PDD.

Furthermore, Table 11 shows that the value of $m_{H2, \text{BIO}}$ gives a negative value except for February 2011, June and July 2012, based on Eq. (7), because $m_{H2, \text{LPG}}$ is larger than $m_{H2, T}$. The revised PDD (ver. 4.1.0) states in page 7 that 245 kg/hr of LPG as a feedstock is consumed to produce hydrogen of 750 Nm³/hr in the design of hydrogen production plant. In this case, the amount of hydrogen ($m_{H2, \text{LPG}}$) produced by the chemical reaction of LPG can be calculated to be 55.2 kmol-H₂/hr, based on Eq. (9). The hydrogen of 750 Nm³/hr is equal to 33.0 kmol-H₂/hr, based on Eq. (8). Therefore, the ratio of actual/theoretical amount of hydrogen ($m_{H2, T}/m_{H2, \text{LPG}}$) is 0.60 (=33.0/55.2). One of the reason for the great difference between the actual/theoretical amount of hydrogen is that the chemical equilibrium is not taken into consideration in the calculation of $m_{H2, \text{LPG}}$. as per AMS-III.O. As a result, the value of $m_{H2, \text{BIO}}$ (= $m_{H2, T} - m_{H2, \text{LPG}}$) is conservatively calculated and the negative values of $m_{H2, \text{BIO}}$ in most months are justified. As negative value of $m_{H2, \text{BIO}}$ is theoretically impossible in the actual calculation, $m_{H2, \text{BIO}}$ is regarded as zero.

JQA confirms that the monthly baseline emissions from the use of LPG as feedstock in the hydrogen production plant ($BE_{LPG\ FEED}$) in the revised MR and the revised ER calculation spreadsheet are correctly calculated using the quarterly data of m_1 ; m_2 and the monitored data of $M_{LPG\ FEED}$ and $V_{H_2, T}$.

Table 11 Calculation of baseline emissions from use of LPG as feedstock in the hydrogen production plant (BE_{LPG FEED})

Period	m ₁ (mol%)	m ₂ (mol%)	V _{H₂,T} (Nm ³)	M _{LPG, FEED} (kg)	R _{H₂/LPG} (-)	R _{CO₂/H₂} (-)	MW _{LPG} (kg/kmol)	m _{H₂, T} (kmol H ₂)	m _{H₂, LPG} (kmol H ₂)	m _{H₂, Bio} (kmol H ₂)	BE _{LPG FEED} (tCO ₂ e)
01/08 - 31/08/2010	49.08	50.63	112,917	47,493	11.490	0.3044	50.96	4,972	10,708	0	0
01/09 – 30/09/2010	49.08	50.63	95,779	45,755	11.490	0.3044	50.96	4,218	10,316	0	0
01/10 – 31/10/2010	53.14	46.64	294,485	103,088	11.377	0.3041	50.43	12,967	23,256	0	0
01/11 – 30/11/2010	53.14	46.64	134,527	69,819	11.377	0.3041	50.43	5,924	15,751	0	0
01/12 – 31/12/2010	53.14	46.64	362,189	108,733	11.377	0.3041	50.43	15,949	24,529	0	0
01/01 – 31/01/2011	42.83	56.77	295,272	87,136	11.663	0.3049	51.77	13,002	19,630	0	0
01/02 – 28/02/2011	42.83	56.77	196,946	37,373	11.663	0.3049	51.77	8,672	8,419	253	3
01/03 – 31/03/2011	42.83	56.77	365,178	120,019	11.663	0.3049	51.77	16,080	27,038	0	0
01/04 – 30/04/2011	44.15	55.32	12,922	3,507	11.607	0.3048	51.51	569	790	0	0
01/05 – 31/05/2011	44.15	55.32	8,411	6,736	11.607	0.3048	51.51	370	1,518	0	0
01/06 – 30/06/2011	44.15	55.32	249,421	103,867	11.607	0.3048	51.51	10,983	23,403	0	0
01/07 – 31/07/2011	43.18	56.96	289,933	119,625	11.723	0.3049	52.04	12,767	26,949	0	0
01/08 – 31/08/2011	43.18	56.96	165,383	64,378	11.723	0.3049	52.04	7,282	14,503	0	0
01/09 – 30/09/2011	43.18	56.96	93,686	41,019	11.723	0.3049	52.04	4,125	9,241	0	0
01/10 – 31/10/2011	43.53	55.92	223,371	89,010	11.623	0.3048	51.59	9,836	20,054	0	0
01/11 – 30/11/2011	43.53	55.92	244,534	98,252	11.623	0.3048	51.59	10,768	22,136	0	0
01/12 – 31/12/2011	43.53	55.92	268,656	103,227	11.623	0.3048	51.59	11,830	23,257	0	0
01/01 – 31/01/2012	42.13	56.58	251,012	108,877	11.568	0.3049	51.35	11,053	24,527	0	0
01/02 – 28/02/2012	42.13	56.58	329,928	100,758	11.568	0.3049	51.35	14,528	22,698	0	0
01/03– 31/03/2012	42.13	56.58	122,760	44,636	11.568	0.3049	51.35	5,406	10,055	0	0
01/04 – 30/04/2012	38.88	60.82	201,871	45,586	11.795	0.3052	52.38	8,889	10,264	0	0
01/05 – 31/05/2012	38.88	60.82	197,742	70,509	11.795	0.3052	52.38	8,707	15,876	0	0

01/06 – 30/06/2012	38.88	60.82	196,758	0	11.795	0.3052	52.38	8,664	0	8,664	116
01/07 – 31/07/2012	38.88	60.82	248,626	0	11.795	0.3052	52.38	10,948	0	10,948	146
			4,962,308	1,619,404				218,511	364,919	19,865	265

(3) Calculation of baseline emissions from combustion of LPG as fuel (BE_{LPG_FUEL})

According to the approved revised PDD, the baseline emissions from combustion of LPG as fuel in the hydrogen production plant (BE_{LPG_FUEL}) are calculated by Eq. (12):

$$BE_{LPG_FUEL} = SFC_{LPG} \times V_{H_2,BIO} \times EF_{LPG} \times C_3 \quad \text{..... Eq. (12) in the revised PDD}$$

Where:

SFC_{LPG}: Specific fuel consumption of hydrogen production unit when run using LPG (kg LPG/Nm³ H₂)

V_{H₂,BIO}: Volume of hydrogen derived from biogas (Nm³H₂)

EF_{LPG}: Emission factor of LPG calculated based on its carbon content (kg CO₂/kg LPG)

C₃: Conversion factor, t/kg, 0.001 (t/1000 kg)

$$V_{H_2,BIO} = \frac{m_{H_2,BIO} \times 1,000 \frac{mol}{kmol} \times 8.314 \frac{Pa \cdot m^3}{mol \cdot K} \times 273.15 K}{1 \times 10^5 Pa}$$

..... Eq. (13) in the revised PDD

Where:

m_{H₂, BIO}: Molar quantity of hydrogen produced from biogas (kmol H₂)

The calculation of baseline emissions from combustion of LPG as fuel in the hydrogen production plant (BE_{LPG_FUEL}) is summarized in Table 12.

Table 12 Baseline emissions from combustion of LPG as fuel (BE_{LPG_FUEL})

Period	m ₁ (mol%)	m ₂ (mol%)	EF _{LPG} (kg CO ₂ /kg LPG)	LPG Density (kg/Nm ³)	SFC _{LPG} (kgLPG/Nm ³ H ₂)	V _{H₂, BIO} (Nm ³)	BE _{LPG, FUEL} (tCO ₂ e)
01/08 - 31/08/2010	49.08	50.63	3.0199	2.2440	0.10	0	0
01/09 – 30/09/2010	49.08	50.63	3.0199	2.2440	0.10	0	0
01/10 – 31/10/2010	53.14	46.64	3.0185	2.2208	0.10	0	0
01/11 – 30/11/2010	53.14	46.64	3.0185	2.2208	0.10	0	0
01/12 – 31/12/2010	53.14	46.64	3.0185	2.2208	0.10	0	0
01/01 – 31/01/2011	42.83	56.77	3.0219	2.2797	0.10	0	0
01/02 – 28/02/2011	42.83	56.77	3.0219	2.2797	0.10	5,745	1
01/03 – 31/03/2011	42.83	56.77	3.0219	2.2797	0.10	0	0
01/04 – 30/04/2011	44.15	55.32	3.0215	2.2683	0.10	0	0
01/05 – 31/05/2011	44.15	55.32	3.0215	2.2683	0.10	0	0
01/06 – 30/06/2011	44.15	55.32	3.0215	2.2683	0.10	0	0
01/07 – 31/07/2011	43.18	56.96	3.0219	2.2914	0.10	0	0
01/08 – 31/08/2011	43.18	56.96	3.0219	2.2914	0.10	0	0
01/09 – 30/09/2011	43.18	56.96	3.0219	2.2914	0.10	0	0
01/10 – 31/10/2011	43.53	55.92	3.0217	2.2716	0.10	0	0

01/11 – 30/11/2011	43.53	55.92	3.0217	2.2716	0.10	0	0
01/12 – 31/12/2011	43.53	55.92	3.0217	2.2716	0.10	0	0
01/01 – 31/01/2012	42.13	56.58	3.0220	2.2613	0.10	0	0
01/02 – 28/02/2012	42.13	56.58	3.0220	2.2613	0.10	0	0
01/03 – 31/03/2012	42.13	56.58	3.0220	2.2613	0.10	0	0
01/04 – 30/04/2012	38.88	60.82	3.0232	2.3066	0.10	0	0
01/05 – 31/05/2012	38.88	60.82	3.0232	2.3066	0.10	0	0
01/06 – 30/06/2012	38.88	60.82	3.0232	2.3066	0.10	196,758	59
01/07 – 31/07/2012	38.88	60.82	3.0232	2.3066	0.10	248,626	75
						451,128	135

The emission factor of LPG (EF_{LPG}) is calculated from the carbon content of LPG based on its quarterly data of m_1 and m_2 , i.e., $EF_{LPG} = C_{LPG} \times 44 \text{ kg CO}_2 / 12 \text{ kg C}$. The density of LPG, which is used for converting from volumetric unit to the mass unit of LPG, is also calculated based on its quarterly data of m_1 and m_2 . As stated in Section 3.6.2-1), the value of SFC_{LPG} is provided as a default value of $0.1 \text{ kgLPG/Nm}^3\text{H}_2$ by the manufacturer.

JQA confirms that the monthly baseline emissions from combustion of LPG as fuel in the hydrogen production plant ($BE_{LPG, FUEL}$) in the revised MR and the revised ER calculation spreadsheet are correctly calculated by using Eq. (12).

Total baseline emissions (BE_T) are calculated from the summation of BE_{CH_4} , $BE_{LPG FEED}$ and $BE_{LPG, FUEL}$, and summarized in Table 13.

Table 13 Calculation of total baseline emissions (BE_T)

Period	BE_{CH_4} (tCO ₂ e)	$BE_{LPG FEED}$ (tCO ₂ e)	$BE_{LPG, FUEL}$ (tCO ₂ e)	BE_T (tCO ₂ e)
01/08 - 31/08/2010	1,100	0	0	1,100
01/09 – 30/09/2010	562	0	0	562
01/10 – 31/10/2010	1,193	0	0	1,193
01/11 – 30/11/2010	688	0	0	688
01/12 – 31/12/2010	1,004	0	0	1,004
01/01 – 31/01/2011	721	0	0	721
01/02 – 28/02/2011	668	3	1	672
01/03 – 31/03/2011	1,460	0	0	1,460
01/04 – 30/04/2011	425	0	0	425
01/05 – 31/05/2011	421	0	0	421
01/06 – 30/06/2011	985	0	0	985
01/07 – 31/07/2011	1,206	0	0	1,206
01/08 – 31/08/2011	715	0	0	715
01/09 – 30/09/2011	1,293	0	0	1,293
01/10 – 31/10/2011	1,766	0	0	1,766
01/11 – 30/11/2011	1,375	0	0	1,375
01/12 – 31/12/2011	1,595	0	0	1,595
01/01 – 31/01/2012	1,746	0	0	1,746
01/02 – 28/02/2012	1,651	0	0	1,651

01/03– 31/03/2012	921	0	0	921
01/04 – 30/04/2012	1,154	0	0	1,154
01/05 – 31/05/2012	1,172	0	0	1,172
01/06 – 30/06/2012	1,579	116	59	1,754
01/07 – 31/07/2012	1,902	146	75	2,123
	27,302	265	135	27,702

JQA confirms that the total baseline emissions (BE_T) achieved in the 2nd monitoring period are appropriately and correctly calculated according to the revised monitoring plan and thus verifies that the value of BE_T is 27,702 tCO₂e.

3) Project emissions

According to AMS-III.H (Ver. 09), the project emissions in this project activity consist of:

- Emission from combustion of fossil fuel to generate power used to run the project equipment ($PE_{MCS,y,power}$);
- CH₄ emission from degradable organic matter in treated wastewater returned to anaerobic lagoon ($PE_{MCS,y,ww,treated}$);
- CH₄ emission from final sludge disposed ($PE_{MCS,y,s,final}$);
- Fugitive CH₄ emission from the inefficiency of the AD and flare system ($PE_{MCS,y,fugitive}$); and
- CH₄ emission from final treated waste water disposed to river system ($PE_{MCS,y,dissolved}$).

Therefore, the project emissions are calculated by the following equation:

$$PE_{MCS,y} = PE_{MCS,y,power} + PE_{MCS,y,ww,treated} + PE_{MCS,y,s,final} + PE_{MCS,y,fugitive} + PE_{MCS,y,dissolved}$$

However, Para 34 of AMS-III.H (Ver. 09) stipulates that “the project emissions and leakage will be deducted from the emission reductions calculated from the methane recovered and combusted, except where it can be demonstrated that the technology implemented does not increase the amount of methane produced per unit of COD removed (COD removed is the difference between the inflow COD ($COD_{y,ww,untreated}$) and outflow COD ($COD_{y,ww,treated}$)), compared with the technology used in the baseline”.

In order to demonstrate the requirement in Para 34 of AMS-III.H (Ver. 09), the actual amount of methane production per unit of COD removed from wastewater during the 2nd monitoring period is examined and compared with that for baseline anaerobic lagoon as shown in Table 14.

Table 14 Actual amount of methane production per unit of COD removed from wastewater in the 2nd monitoring period

Period	Wastewater treated (m ³)	COD Removed (t COD)	Biogas Generated (Nm ³)	CH ₄ Content (%)	CH ₄ generated		CH ₄ Generation rate (tCH ₄ / tCOD)
					(Nm ³)	(tCH ₄)	

01/08 - 31/08/2010	17,840	472	104,656	71.06	74,365	53.30	0.1130
01/09 – 30/09/2010	12,689	370	55,164	68.94	38,032	27.26	0.0737
01/10 – 31/10/2010	14,845	525	117,229	68.84	80,699	57.84	0.1102
01/11 – 30/11/2010	18,019	580	66,592	69.88	46,531	33.35	0.0575
01/12 – 31/12/2010	17,441	732	98,046	69.22	67,871	48.65	0.0665
01/01 – 31/01/2011	16,110	505	73,294	66.55	48,780	34.97	0.0692
01/02 – 28/02/2011	12,766	472	62,969	71.71	45,153	32.37	0.0685
01/03 – 31/03/2011	18,364	750	139,475	70.79	98,728	70.77	0.0943
01/04 – 30/04/2011	14,386	527	40,958	70.29	28,789	20.64	0.0392
01/05 – 31/05/2011	12,113	402	42,093	67.76	28,522	20.44	0.0508
01/06 – 30/06/2011	12,641	606	102,918	64.74	66,632	47.76	0.0788
01/07 – 31/07/2011	13,573	633	136,020	59.94	81,531	58.44	0.0924
01/08 – 31/08/2011	10,760	471	80,242	60.23	48,332	34.64	0.0736
01/09 – 30/09/2011	17,848	610	141,181	61.91	87,406	62.65	0.1026
01/10 – 31/10/2011	18,416	769	198,281	60.21	119,388	85.58	0.1112
01/11 – 30/11/2011	17,128	744	154,856	60.05	92,991	66.66	0.0896
01/12 – 31/12/2011	21,483	762	180,073	59.87	107,815	77.28	0.1014
01/01 – 31/01/2012	20,736	477	187,260	63.05	118,063	84.63	0.1773
01/02 – 28/02/2012	18,727	530	166,006	67.25	111,636	80.02	0.1510
01/03– 31/03/2012	14,012	440	89,637	69.46	62,257	44.63	0.1013
01/04 – 30/04/2012	15,526	707	113,263	68.90	78,040	55.94	0.0791
01/05 – 31/05/2012	20,767	754	113,338	69.92	79,248	56.80	0.0754
01/06 – 30/06/2012	20,895	694	157,819	67.67	106,788	76.55	0.1103
01/07 – 31/07/2012	21,701	821	205,237	62.65	128,578	92.16	0.1123
	398,785	14,353	2,826,607	66.29	1,873,666	1,343.04	0.0936

The result in Table 14 shows that the actual amount of methane production per unit of COD removed from wastewater is 0.0936 kg CH₄/kg COD in the 2nd monitoring period. This value is much lower than that of the baseline anaerobic lagoon (0.168 kg CH₄/kg COD) which is calculated from the IPCC default value of 0.21 kg CH₄/kg COD for methane producing capacity of the wastewater and methane correction factor (MCF) of 0.8 as an IPCC default value for anaerobic deep lagoon (depth more than 2 meters). Thus, JQA confirms that it is not necessary to deduct the project emissions from baseline emissions, as per Para 34 of AMS-III.H (ver. 09), and concludes that the project emissions described in AMS-III.H (ver. 09) are regarded as zero.

Regarding the actual amount of methane production per unit of COD removed from wastewater, CL 08 was raised and resolved as follows:

CL 08: The value of V_{AD} is used in the calculation of biogas generated in Table 5 of the MR and ER calculation spreadsheet, whereas the value of V_{TR} is used in the calculation of baseline emissions from methane recovery.

Resolution: It is confirmed that the V_{TR} data is used in Table 5 of the revised MR and revised ER calculation spreadsheet to calculate the actual methane generation rate from the wastewater.

Furthermore, according to AMS-III.O (ver. 01), the project emissions consist of:

- CO₂ emissions from fossil fuels and/or electricity used for operating the biogas purification system (PE_{y,power}),
- CO₂ emissions from fossil fuels used to generate steam for the purpose of regeneration of the biogas purification system (PE_{y,fuel}),
- GHG emissions from the use of additional chemicals or energy to regenerate the adsorbent for purpose of biogas purification (PE_{y,chem}).

However, these three emissions are excluded by the following reasons:

- PE_{y,power}: Nubika's palm oil mill generates its own electricity using biomass and does not use electricity from external sources (grid),
- PE_{y,fuel}: The project uses low pressure steam to regenerate carbon bed in the PSA. The project installed a waste heat recovery boiler to generate steam using excess heat from the reformer which is fuelled using biogas. The use of fossil fuel for this purpose is therefore unlikely.
- PE_{y,chem}: The project uses steam to regenerate the adsorbent (carbon). No chemical is used for the operation of this biogas purification system.

Thus, JQA confirms that the project emissions described in AMS-III.O (ver. 01) are also zero.

However, as mentioned earlier, JQA found on-site that three diesel generators (500 kW x 2 units and 300 kW x 1 unit) had been used during the 2nd monitoring period for emergency. In order to check whether GHG emissions from diesel oil consumption by the CDM Project in the 2nd monitoring period was less than 1% of overall emission reductions, the additional documents were requested by JQA. The records of monthly generation and consumption of electricity at the whole Nubika palm oil mill (**Ref. 56**) and the quantity data of diesel oil consumed for emergency generation (**Ref. 55**) during the 2nd monitoring period were provided.

Table 15 GHG emissions from diesel oil consumption by captive power units in the 2nd monitoring period

Period	Total diesel oil consumption (L)	Diesel oil consumption by Project *1 (L)	Diesel Oil Density *2 (kg/L)	Diesel Oil NCV *3 (TJ/Gg)	Diesel Oil EF *4 (tCO ₂ /TJ)	CO ₂ Project Emissions (tCO ₂)
01/08 - 31/08/2010	1,192	179	0.89	43.3	74.8	0.52
01/09 – 30/09/2010	29,362	4,404				12.70
01/10 – 31/10/2010	228	34				0.10
01/11 – 30/11/2010	7,895	1,184				3.41
01/12 – 31/12/2010	3,132	470				1.35
01/01 – 31/01/2011	1,950	293				0.84
01/02 – 28/02/2011	1,307	196				0.57
01/03 – 31/03/2011	26	4				0.01
01/04 – 30/04/2011	680	102				0.29

01/05 – 31/05/2011	2,372	356				1.03
01/06 – 30/06/2011	1,828	274				0.79
01/07 – 31/07/2011	14,223	2,133				6.15
01/08 – 31/08/2011	4,585	688				1.98
01/09 – 30/09/2011	14,426	2,164				6.24
01/10 – 31/10/2011	21,613	3,242				9.35
01/11 – 30/11/2011	16,374	2,456				7.08
01/12 – 31/12/2011	3,604	541				1.56
01/01 – 31/01/2012	1,150	172				0.50
01/02 – 28/02/2012	1,937	291				0.84
01/03 – 31/03/2012	1,653	248				0.71
01/04 – 30/04/2012	6,067	910				2.62
01/05 – 31/05/2012	8,568	1,285				3.70
01/06 – 30/06/2012	26,637	3,996				11.52
01/07 – 31/07/2012	27,968	4,195				12.09
Total	198,776	29,816				85.95
CO₂ Emissions due to consumption of diesel oil by captive Power Plant						86.00

- 1) Oil consumption by the biogas and hydrogen plants (15% of total diesel oil consumption at Nubika Jaya)
- 2) Maximum Value (Value from PERTAMINA is 0.87)
- 3) IPCC 2006 Vol. 2 Table 1.2; upper limit
- 4) IPCC 2006 Vol. 2 Table 1.4; higher value

JQA confirms that the PPs' calculation is conservative because the amount of diesel oil consumption in Table 15 is calculated from the ratio of electricity consumption by the operation of both the biogas plant and the hydrogen plant to the overall electricity consumption at Nubika palm oil mill, although $PE_{y,power}$ in AMS-III.O is defined as electricity consumption in the biogas purification system only. The calculated GHG emissions from the diesel oil generators, 86 tCO₂e in Table 15, are about 0.3% of total emission reductions of 26,876 tCO₂e and thus its impact is negligible.

In conclusion, JQA confirms that total project emissions from methane capture system as per AMS-III.H and from the hydrogen production plant as per AMS-III.O are negligibly small, i.e., $PE_T = 0$ tCO₂e.

4) Leakage emissions

AMS-III.H and AMS-III.O require that leakage effect is to be considered if the project technology is equipment transferred from another activity or the existing technology is transferred to another activity. According to the approved revised PDD, the project equipment in the CDM Project is newly installed and the anaerobic lagoons are not used by activities other than Nubika's activity. Thus, such leakage is not relevant. JQA confirmed through the review of equipment purchase contracts (**Refs. 10, 12-15**) and on-site observation that the project technology was newly purchased and the anaerobic lagoons were not used by other activities.

As for the leakage calculation in the CDM Project, Para 23(b) of AMS-III.O states that "the difference is considered as loss due to physical leakage and deducted from the emission reductions". In addition, the MR details the leakage calculation, i.e., the

leakage emissions from physical loss of biogas is calculated by maintaining methane balance between the source of methane generation (anaerobic digester) and the consumptions of biogas (flare and hydrogen unit). In this project, physical leakage in the pipeline among the monitoring points of V_{AD} , V_F and V_D is expressed as the difference between V_{AD} and V_{TR} ($=V_D+V_F$). Therefore, leakage emissions from physical loss of biogas are calculated by Eq. (26):

$$L_{y,CH_4} = X_{CH_4,y} \times \frac{P_N \times [V_{AD,y} - V_{TR,y}]}{R \times T_N} \times \frac{MW_{CH_4}}{X_1} \times GWP_{CH_4}$$

..... Eq. (26) in the revised PDD

Where:

- L_{y,CH_4} : Methane loss from physical installations (tCO₂e/yr)
 X_{CH_4} : Proportion of methane in biogas in volume/volume basis (Nm³/Nm³)
 P_N : Reference pressure at normal condition in Pascal (Pa)
 $V_{AD,y}$: Volumetric amount of biogas recovered at source (at outlet of Anaerobic Digester) prior to distribution to users (Nm³/yr)
 $V_{TR,y}$: Volumetric amount of biogas recovered (Nm³/yr)
 R : Ideal gas constant (m³·Pa/mol·K)
 T_N : Reference temperature at normal condition in Kelvin (K)
 MW_{CH_4} : Molecular weight of methane (gram/mol)
 X_1 : Conversion factor 10⁶gram/tones (gram/ton)
 GWP_{CH_4} : Global warming potential of methane (tCO₂/tCH₄)

The amount of leakage in the 2nd monitoring period is summarized in Table 16.

Table 16 Calculation of leakage

Period	V_{AD} (Nm ³)	V_{TR} (Nm ³)	X_{CH_4} (%)	L_{CH_4} (tCO ₂ e)
01/08 - 31/08/2010	48,244	104,656	71.06	0
01/09 – 30/09/2010	29,754	55,164	68.94	0
01/10 – 31/10/2010	129,263	117,229	68.84	123
01/11 – 30/11/2010	75,045	66,592	69.88	88
01/12 – 31/12/2010	102,303	98,046	69.22	44
01/01 – 31/01/2011	71,587	73,294	66.55	0
01/02 – 28/02/2011	27,348	62,969	71.71	0
01/03 – 31/03/2011	17,874	139,475	70.79	0
01/04 – 30/04/2011	11,190	40,958	70.29	0
01/05 – 31/05/2011	8,540	42,093	67.76	0
01/06 – 30/06/2011	48,728	102,918	64.74	0
01/07 – 31/07/2011	100,583	136,020	59.94	0
01/08 – 31/08/2011	67,453	80,242	60.23	0
01/09 – 30/09/2011	110,306	141,181	61.91	0
01/10 – 31/10/2011	165,874	198,281	60.21	0
01/11 – 30/11/2011	172,962	154,856	60.05	161

01/12 – 31/12/2011	179,562	180,073	59.87	0
01/01 – 31/01/2012	182,573	187,260	63.05	0
01/02 – 28/02/2012	165,062	166,006	67.25	0
01/03– 31/03/2012	57,196	89,637	69.46	0
01/04 – 30/04/2012	85,693	113,263	68.90	0
01/05 – 31/05/2012	77,052	113,338	69.92	0
01/06 – 30/06/2012	116,644	157,819	67.67	0
01/07 – 31/07/2012	167,495	205,237	62.65	0
Total	2,218,331	2,826,607	66.29	416

Theoretically, V_{AD} should be equal or larger than V_{TR} , but the monitored data of V_{AD} in Table 16 were smaller than those of V_{TR} in most months during the 2nd monitoring period. As stated in FAR 05 of Section 3.1, the PPs failed to ensure the accurate monitoring of V_{AD} in the 2nd monitoring period and therefore CAR 04 was raised in this verification.

In response to CAR 04, the PPs replaced the existing flow meter F-01 again with a new meter having an appropriate measurement range on 04/06/2013, taking into account the actual flow data of biogas monitored during the 2nd monitoring period. At the same time, the flow meters F-02 and F-03 were also replaced voluntarily with new meters having appropriate measurement range, respectively, to ensure further increase in the accuracy level of the monitoring parameters V_D and V_F . Through the review of relevant documents such as purchase order with meter's specification (**Ref. 60**) and calibration certificate for shipping (**Ref. 61**), JQA has confirmed that new flow meters F-01, F-02 and F-03 were delivered and installed on 04/06/2013, during a period of shutdown of the AD plant for regular maintenance.

In order to confirm the accuracy level of the improved monitoring system using the replaced flow meters F-01, F-02 and F-03, a two-week monitoring test was conducted in July 2013. The measurement of the biogas flow rate was conducted under the same operational conditions as before. The average value of V_{TR} per day during the 2nd monitoring period in Table 16 is $3,867 \text{ Nm}^3 (= 2,826,607 \text{ Nm}^3 / 731 \text{ days})$, whereas the daily value of V_{TR} during the two-week monitoring test in Table 17 is $4,633 \text{ Nm}^3 (= 64,860 \text{ Nm}^3 / 14 \text{ days})$ which is higher by about 20% than $3,867 \text{ Nm}^3$. However, taking into consideration the low operational rate of the plant due to many troubles and shutdown during the 2nd monitoring period, these values are reasonable. From these results, JQA concludes that the two-week monitoring test was appropriately conducted under the same operation conditions as the 2nd monitoring period.

The results in Table 17 demonstrate that the amount of V_{AD} measured by F-01 is very close to the sum of V_F and V_D measured by F-02 and F-03, and the difference between V_{AD} and V_{TR} was decreased to the accuracy level of 1-2 %. In conclusion, JQA has confirmed that the level of monitoring accuracy of the parameters V_{AD} , V_F and V_D is significantly improved by the replacement of these meters and thus CAR 04 is resolved.

Table 17 Results of monitoring test using newly replaced flow meters in July 2013

Monitoring period (days)	V _{AD} (Nm ³)	V _{TR} (Nm ³)	Difference (%)	X _{CH4} (%)	L _{CH4} (tCO ₂ e)
1	5,732	5,445	5.0	71.2	3.02
2	5,884	5,623	4.4	70.1	2.71
3	5,588	5,299	5.2	70.0	3.00
4	4,957	4,899	1.2	70.8	0.60
5	4,401	4,266	3.1	71.0	1.42
6	4,315	4,242	1.7	70.1	0.76
7	3,928	3,854	1.9	68.4	0.75
8	4,127	4,085	1.0	70.0	0.44
9	4,031	3,983	1.2	70.1	0.50
10	4,009	3,964	1.1	72.0	0.48
11	4,082	4,036	1.1	73.9	0.51
12	5,097	5,030	1.3	74.8	0.75
13	5,113	5,075	0.7	75.4	0.42
14	5,103	5,059	0.9	75.8	0.50
Total	66,368	64,860	2.3	71.7	15.84

Based on the result of the monitoring test above, more correct leakage emissions during the 2nd monitoring period are determined by applying the value of 15.84 tCO₂e for two weeks to the entire period of the 2nd monitoring period (2 years). Namely, as the result in Table 17 shows the leakage emissions of 15.84 tCO₂e against the V_{TR} of 64,860 Nm³, the leakage emissions during the 2nd monitoring period can be determined as follows:

$$\begin{aligned}
 L_{CH4} &= 15.84 \text{ tCO}_2\text{e} / 64,860 \text{ Nm}^3 \times 2,826,607 \text{ Nm}^3 \\
 &= 690 \text{ tCO}_2\text{e}
 \end{aligned}$$

JQA concludes that the leakage emissions during the 2nd monitoring period are 690 tCO₂e which is more reasonably and accurately determined compared to the previous monitoring result.

Regarding the monitoring accuracy of V_{AD}, CAR 04 was raised and resolved as follows:

CAR 04: The PPs are further requested to take necessary actions such as changes to the appropriate measurement range of flow meter to ensure the accurate monitoring of V_{AD}, taking into account the actual flow rate of biogas.

Resolution: The PPs replaced the existing flow meter F-01 with a new meter having an appropriate measurement range on 04/06/2013, taking into account the actual flow data of biogas monitored during the 2nd monitoring period. A two-week monitoring test using the replaced flow meter F-01 demonstrated that the accuracy level of the monitoring system was much improved and the difference between V_{AD} and V_{TR} was decreased to an accuracy level of 1-2 %. Thus, CAR 04 was closed.

5) Emission reductions

According to the approved revised PDD, emission reductions (ER_T) are calculated by Eq. (25):

$$ER_{y,T} = BE_{y,T} - PE_{y,T} - L_{y,CH_4}$$

$$= (BE_{y,CH_4} + BE_{LPG\ FEED} + BE_{LPG_FUEL}) - (PE_{MCS,y,power} + PE_{MCS,y,ww,treated} + PE_{MCS,y,s,final} + PE_{MCS,y,fugitive} + PE_{MCS,y,dissolved}) - (PE_{y,power} + PE_{y,fuel} + PE_{y,chem}) - L_{y,CH_4}$$

..... Eq. (25) in the revised PDD

Where:

$ER_{y,T}$:	Total emission reductions (tCO ₂ e/yr)
BE_{y,CH_4} :	Baseline methane emission from methane recovery (tCO ₂ e/yr)
$BE_{LPG\ FEED}$:	Baseline CO ₂ emission from the reaction of displaced LPG feedstock in the hydrogen production unit (tCO ₂ e)
BE_{LPG_FUEL} :	Baseline CO ₂ emission from avoidance of LPG as fuel to reformer burner (tCO ₂ e)
$PE_{MCS,y,power}$:	Emission from combustion of fossil fuel to generate power used to run the project equipment (tCO ₂ e/yr)
$PE_{MCS,y,ww,treated}$:	CH ₄ emission from degradable organic matter in treated waste water returned to anaerobic lagoon (tCO ₂ e/yr)
$PE_{MCS,y,s,final}$:	CH ₄ emission from final sludge disposed (tCO ₂ e)
$PE_{MCS,y,fugitive}$:	Fugitive CH ₄ emission from the inefficiency of the AD and flare system (tCO ₂ e/yr)
$PE_{MCS,y,dissolved}$:	CH ₄ emission from final treated waste water disposed to river system (tCO ₂ e/yr)
$PE_{y,power}$:	CO ₂ emission from power used to run biogas treatment system (tCO ₂ e/yr)
$PE_{y,fuel}$:	CO ₂ emission from fuel used to run biogas treatment system (tCO ₂ e/yr)
$PE_{y,chem}$:	Greenhouse gas emissions from the use of additional chemical in the biogas cleaning system (tCO ₂ e/yr)
L_{y,CH_4} :	Equivalent amount of methane loss from physical leakage of biogas (tCO ₂ e/yr)

Emission reductions are calculated by applying Equation 25 as follows:

$$ER_{y,T} = (27,302 + 265 + 135) - (0 + 0 + 0 + 0 + 0) - (0 + 0 + 0) - 690$$

$$= 27,012\ tCO_2e$$

The initial estimates of emission reductions in the MR (ver. 1.0), 27,356 tCO₂e, were revised to 27,012 tCO₂e as a result of resolution of CAR 02, CAR 03 and CAR 04.

3.6.3 Difference from estimated value in the PDD

The emission reductions achieved in the 2nd monitoring period from 01/08/2010 to 31/07/2012 are 27,012 tCO₂e, which corresponds to about 30.6 % of the estimated emission reductions of 88,362 tCO₂e in the approved revised PDD.

According to the revised MR (ver. 3.0), such a lower emission reductions were caused by the following reasons;

- a) The biogas plant was not fully operated in the first half of the 2nd monitoring period, due to the lower production rate of biogas in the Methane Capture System;
- b) The production of hydrogen from LPG as feedstock in the hydrogen production plant was delayed until April 2012 due to the technical difficulties which are relevant to the reduction of H₂S and moisture contents in the biogas to the required level. Thus, emission reductions by the use of biogas as feedstock for hydrogen production were only achieved from April 2012 onwards;
- c) Due to many technical troubles and shutdowns in the operation of downstream processes and oleochemical plant during the 2nd monitoring period, the project activity was not fully operated.

Regarding a), JQA reviewed the records of wastewater treated by Methane Capture System during the 2nd monitoring period. The actual amount of COD removed during the 2nd monitoring period is 14,353 tCOD (see Table 14), which is 60.5% of the estimated value (23,712 tCOD = 228,000 m³ x 2yr x 0.052 tonnes/m³) in the approved revised PDD. JQA confirms that such a lower-than-expected wastewater generation and COD content are likely to have contributed to lower methane recovery.

In addition, when compared to the methane producing capacity of the wastewater (0.168 kgCH₄/kgCOD as default value) in the baseline anaerobic lagoon, the methane generation rate calculated during the 2nd monitoring period was 0.0936 kgCH₄/kgCOD (see Table 14). Namely, methane generation rate in this project was as low as 55.7% of the default value.

Based on these consideration, JQA concludes that PPs' explanation a) is considered to be correct.

Regarding b), through the review of Hydrogen Plant Journal (**Ref. 52**) and Hydrogen Facility Daily Report (**Ref. 53**), JQA confirms that the use of biogas as feedstock for hydrogen production started from April 2012 onwards;

Regarding c), through the review of the operation record of the hydrogen production plant during the 2nd monitoring period (**Ref. 52**), JQA confirms that many troubles and shutdown of the downstream processes lowered the operation rate of hydrogen production plant which reduced the amount of BE_{LPG,FEED} and BE_{LPG,FUEL}.

3.7 Post registration changes

3.7.1 Temporary deviations from the registered monitoring plan and/or monitoring methodology

As described in Chapter 3, JQA confirms that there are no temporary deviations from the approved revised monitoring plan and/or monitoring methodology during this monitoring period.

3.7.2 Corrections

JQA confirms that there are no corrections to project information or parameters fixed at

validation made by the PPs during this monitoring period.

3.7.3 Changes to the start date of the crediting period

As described in Section 3.2.1, JQA confirms that there are no changes to the start date of the crediting period during this monitoring period.

3.7.4 Permanent changes from the registered monitoring plan or monitoring methodology

As described in Section 3.3, JQA confirms that there are no permanent changes from the approved revised monitoring plan or monitoring methodology.

3.7.5 Changes to the project design of a registered project activity

As described in Section 3.2, JQA confirms that there are no changes to the project design of a registered project activity.

3.7.6 Types of changes specific to afforestation or reforestation project activity

Not applicable.

4. ISSUES RAISED DURING VERIFICATION

JQA raised four CARs, eight CLs and one FAR during the 2nd verification process. The issues are listed below.

<CAR 01> Delayed calibration of F-02, F-03, F-04, F-05, F-06, COD analyzer and FC_{Diesel} are identified. The values of the baseline and leakage emissions are not corrected in a conservative manner, taking into consideration the delayed calibration, during the period between the scheduled date and the actual date of calibration.

(a) The maximum permissible errors of these equipment are to be applied in the calculation of baseline and leakage emissions.

(b) The error identified in the delayed calibration test is to be applied if the error is beyond the maximum permissible error.

<CAR 02> The quarterly data of LPG composition are not appropriately applied in the calculation of $R_{CO2/H2}$, $R_{H2/LPG}$ and MW_{LPG} in the MR and ER calculation spreadsheet.

<CAR 03> 1) The daily quantity of methane production was calculated not using the daily methane concentration but using monthly average methane concentration.

2) The amounts of V_D and V_F since Sep 2011 in Table 1 of the MR and the ER calculation spreadsheet are not consistent with those in Biogas Journal (logbook data).

<CAR 04> The PPs are further requested to take necessary actions such as changes to the appropriate measurement range of flow meter to ensure the accurate monitoring of V_{AD} , taking into account the actual flow rate of biogas.

<CL 01> The description on the change to the start date of the 1st crediting period from 30/06/2009 to 01/05/2010 in A.1 and B.2.5 is not necessary because the change has already been approved by the EB on 26/08/2010 and confirmed on the UNFCCC website.

<CL 02> The response to FAR 03 raised in the 1st verification is not included in B.1 and Section C, while the training activity has been actually implemented in this monitoring period.

<CL 03> The request for permanent change submitted in the 1st monitoring period was approved by the CDM-EB on 19/07/2011. As the issues contained in B.2.3 are limited to the permanent changes during the 2nd monitoring period, the above description is not necessary.

<CL 04> The changes to project design of registered project activity submitted in the 1st monitoring period were approved by the CDM-EB on 19/07/2011. As the issues contained in B.2.4 are limited to the project design changes during the 2nd monitoring period, the above description is not necessary.

<CL 05> It is not clear why leakage is not included in the cell of "Purpose of data" in D.1. These parameters are used in the calculation of leakage.

<CL 06> 1) The calibration frequency of F-01, F-02, F-03, F-04, F-05 and F-06 in the MR

(every year) is not consistent with that in the revised PDD (every 2 years).

2) It is not clear whether the flow meters (F-01 (V_{AD}) and F-06 ($V_{H_2,T}$)) are replaced or not during this monitoring period. (Their serial number are changed from the information in the 1st MR) If replaced, the change is to be clearly described in B.1 and D.2.

3) Serial numbers of F-04 and F-05 in the MR are not consistent with those in their calibration records.

4) The calibration date and frequency of the flow meter F-00 are not consistent with those in the 1st MR.

5) The quarterly data of LPG composition (m_1 & m_2) and EF_{LPG} are not included using table.

<CL 07> The calibration certificate of F-04 in 2012, FC_{Diesel} in 2011, $FT_{20,y}$ in 2011 and 2012 are not provided.

<CL 08> The value of V_{AD} is used in the calculation of biogas generated in Table 5 of the MR and calculation spreadsheet, whereas the value of V_{TR} is used in the calculation of baseline emissions from methane recovery.

<FAR 01> The PPs is required to establish the management system to ensure the calibration frequency of monitoring equipment without delay for the next monitoring period, such as making the calibration schedule plan and the clarification of role and responsibility of CDM staffs.

5. VERIFICATION AND CERTIFICATION STATEMENT

JQA has performed the 2nd periodic verification of the CDM Project “Nubika Jaya Biogas Extraction for Bio-Hydrogen Production” (Ref. 2421; registered on 30/06/2009) under the contract with PT. Nubika Jaya.

Verification is the periodic independent review and *ex-post* determination by the DOE of emission reductions from anthropogenic emissions sources of GHGs that have occurred as a result of the registered CDM project activity during the monitoring period. JQA has performed the verification of the registered CDM Project as per VVS to check whether the CDM Project is implemented and operated in accordance with the approved revised PDD, its revised monitoring plan, the applied monitoring methodologies/tools and decisions/rulings by Kyoto Protocol, UNFCCC, CMP and CDM EB. The verification process includes the desk review of the relevant documents, on-site assessment including data cross-check and site observation, preparation of Draft Verification Report, resolution of CARs and CLs, internal quality control and the final approval of Verification and Certification Report.

Through the resolution of four CARs and eight CLs, JQA has confirmed that the CDM project activity is implemented and operated in accordance with the approved revised PDD and the revised monitoring plan which complied with the monitoring methodologies AMS-III.H (Ver. 09) and AMS-III.O (Ver. 01). The GHG emission reductions stated in revised MR (ver. 3.0) and the revised ER calculation spreadsheet (ver. 3.0) are transparently and correctly calculated throughout the 2nd monitoring period from 01/08/2010 to 31/07/2012, which is within the 1st crediting period between 01/05/2010 and 30/04/2017.

As a result of verification, JQA has determined that the certified emission reductions achieved by the CDM Project “Nubika Jaya Biogas Extraction for Bio-Hydrogen Production” in the 2nd monitoring period between 01/08/2010 and 31/07/2012 are as follows and are free from material errors, omissions or misstatements with a reasonable level of assurance:

Baseline emissions	27,702 tCO ₂ e
Project emissions	0 tCO ₂ e
Leakage	690 tCO ₂ e
Emission reductions	27,012 tCO ₂ e

02/09/2013



Tadayuki Yano
Senior Executive
Japan Quality Assurance Organization (JQA)

6. REFERENCES

Category 1: To be submitted to CDM EB

1. Monitoring Report: ver. 1.0 dated 09/10/2012, ver. 3.0 dated 26/08/ 2013
2. ER Calculation spreadsheet: ver. 3.0 dated 26/08/ 2013

Category 2: Others

3. PDD, ver. 3.4.2, 15/05/2009
4. Validation Report, ver. 1.2, 26/06/2009.
5. Approved revised PDD, ver. 4.1.0, 31/05/2011
6. Verification report for the 1st monitoring period prepared by JQA, Report No: JQA-C0148, 10/02/2012
7. Standard Operation Procedure (SOP), Ver. 2.1.0 dated 12/10/2011)
8. Submission and approval letter of post-registration change (25/01/2010 and 26/08/ 2010).
9. Layout of Nubika palm oil mill site including lagoon, anaerobic digester, hydrogen production plant, captive power plant, etc.
10. Contract and specifications of anaerobic digestion facility issued by Aquarius Systems (Malaysia) Sdn Bhd on 15/10/2006.
11. Commissioning record of anaerobic digestion facility issued by Aquarius Systems (Malaysia) Sdn Bhd on 06/02/2009.
12. Contract and specifications of hydrogen production facility issued by Linde BOC Process Plants LLC on 11/10/2006.
13. Contract and specifications of flaring system.
14. Contract and specifications of monitoring equipment issued by Endress+Hauser
15. Contract and specification of new desulfurization and air dryer machine by Tangshan IMA Technology Co., Ltd. on 25/08/2009.
16. Testing history of new desulfurization and air dryer for Hydrochem system at PT. Nubika Jaya, dated 05/01/2011.
17. Commissioning record of monitoring equipment installed by Endress+Hauser between 13/04/2010 and 02/05/2010.
18. Approval for construction of the project facility (No. 503.648/16/PEM/2007) issued by Labuhan Batu District Government on 13/02/2007.
19. UKL/UPL approval (660/145/BPDL-LB/AP/2008) issued by Labuhan Batu District Environmental Control Agency on 10/06/2008.
20. Business license of PT. Nubika Jaya. (No. 02.12.1.01.06911) issued by Municipal Government Departments of Industry and Commerce on 22/09/2008 (Valid until 23/07/2011)

21. Specifications of existing and new biomass fired power plants including boiler and generator.
22. Government regulation on the wastewater release into river (No. 51/10/1995)
23. Technical information - Proline Prowirl 72F, 72W, 73F, 73W, Vortex flow management system issued by Endress+Hauser
24. SITRANS P measuring instruments for pressure, Transmitters for pressure, absolute pressure, differential pressure, flow and level, DS III series issued by Siemens on 2010
25. Electromagnetic flow measuring system, Proline promag 10 W Flow measurement in water or wastewater applications issued by Endress+Hauser
26. Specifications for Series 4860 Meter Register issued by GASBOY
27. USER'S MANUAL for SITRANS P, Series DSIII Transmitter for Pressure, Differential Pressure, Flanged Level, and Absolute Pressure Model 7MF4*33-... issued by Siemens in September 2004.
28. USER'S MANUAL - AWITE Process Analysis Systems, AwiFLEX and AwiECO Series 07 / Firmware 645, Part B: Operation of the Process Analysis System issued by AWITE Bioenergy GmbH on 14/04/2009
29. Technical information – Thermocouple (TC) Thermometer omnigrad S TAF 11, TAF 12x, TAF 16 issued by Endress+Hauser
30. Specifications for Thermo Scientific GENESYS 10S Series UV-Visible Spectrophotometers issued by Thermo Scientific
31. Calibration certificate for wastewater flow meter F-00 (Serial.No: 99005320000 and EA166719000) for $Q_{y,ww}$ issued by Endress + Hauser on 13/04/2010 and 3/11/2011.
32. Calibration certificate for biogas flow meter for F-01 (Serial.No: CC031202000 and E7048E02000) for V_{AD} issued by Endress + Hauser on 10/12/2009 and 14/07/2011.
33. Calibration certificate for biogas flow meter for F-02 (Serial.No: A901BF02000 and E102F702000) for V_F issued by Directory Metrology on 09/04/2010, 07/01/2011 and 14/10/2011.
34. Calibration certificate for biogas flow meter for F-03 (Serial.No: 99005120000 and E102F802000) for V_D issued by Directory Metrology on 09/04/2010, 07/01/2011 and 14/10/2011.
35. Calibration certificate for LPG flow meter F-04 (Serial.No: N1-X622-9087676 and N1-B314-9024712) for $M_{LPG\ FEED}$ issued by PT. Caltesys Indonesia on 28/04/2010, 04/04/2011 and 07/02/2013.
36. Calibration certificate for LPG flow meter F-05 (Serial.No: IX-V009-9037948 and IX-V009-9037944) for $M_{LPG, FUEL}$ issued by PT. Caltesys Indonesia on 28/04/2010 and 07/11/2011.

37. Calibration certificate for hydrogen flow meter F-06 (Serial.No: IX-V009-9037945 and N1-BN08-9078867) for $V_{H_2,T}$ issued by PT. Caltesys Indonesia on 01/06/2010 and 15/11/2011.
38. Calibration record for diesel oil meter for FC_{Diesel} implemented by Nubika on 20/12/2009 and 11/12/2011.
39. Calibration certificate for biogas methane analyzer X-01 for X_{CH_4} issued by Awite Bioenergie GmbH on 22/01/2010, 21/01/2011 and 11/01/2012..
40. Calibration certificate for flare flame detector FT-02 for $FT_{20,y}$ issued by Endress+Hauser on 23/12/2009, 22/12/2010 and 19/12/2011.
41. Calibration certificate for spectrophotometer for analysis of $COD_{y,ww,untreated}$, $COD_{y,ww,treatedAD}$ and $COD_{y,ww,treated}$ issued by Thermo Fischer Scientific on 29/05/2008 and 19/12/2011.
42. Calibration certificate for weighbridge for $S_{y,final}$ issued by Industry and Trade Service, North Sumatra Provincial Government on July 2010 and July 2011.
43. Certificate of calibration entity "PT. CALTESYS INDONESIA" (No. LK-053-IDN) issued by Indonesian National Accreditation Committee on 01/12/2011 (Valid until 30/11/2015).
44. Certificate of ISO/IEC 17025:2005 for ENDRESS+HAUSER (No. 1897.01) on 13/04/2010 (Valid until 30/04/2012).
45. Certificate of ISO 9001:2008 for Awite Bioenergie GmbH (No. 499817 QM08) on 22/06/2012 (Valid until 21/06/2015).
46. Certificate of ISO 9001:2008 for PT. Nubika Jaya (No. 01 100 086048) on 29/12/2011 (Valid until 01/12/2014).
47. Biogas Journal: paper-based hourly data for X-01 (X_{CH_4}), FT-02 ($FT_{20,y}$), F-00 ($Q_{y,ww}$), F-01 (V_{AD}), F-02 (V_F) and F-03 (V_D) during 01/05/2010 – 31/07/2010
48. Biogas Facility Daily Report: electronic records of hourly data for F-04 ($M_{LPG\ FEED}$), F-05 ($M_{LPG\ FUEL}$) and F-06 ($V_{H_2,T}$) during 01/05/2010 – 31/07/2010.
49. Wastewater and Biogas Analysis Record: paper-based handwritten records for $COD_{y,ww,untreated}$, $COD_{y,ww, treated_AD}$ and $COD_{y,ww,treated}$.
50. COD analysis data of wastewater at the inlet and outlet of the anaerobic digester analyzed by Nubika's in-house laboratory during the 2nd monitoring period.
51. COD analysis data of wastewater at final discharge into river system issued by Sucofindo.
52. Hydrogen Plant Journal: paper-based hourly data for F-04 ($M_{LPG\ FEED}$), F-05 ($M_{LPG\ FUEL}$) and F-06 ($V_{H_2,T}$) during the 2nd monitoring period.
53. Hydrogen Facility Daily Report: electronic records of hourly data for F-04 ($M_{LPG\ FEED}$), F-05 ($M_{LPG\ FUEL}$) and F-06 ($V_{H_2,T}$) during the 2nd monitoring period.
54. Consolidated Monthly Reports during the 2nd monitoring period.
55. Data of diesel oil consumed for the emergency use of generator.

56. Records of monthly electricity generation and consumption at the palm oil mill site during the 2nd monitoring period.
57. Record of sludge removal during the 2nd monitoring period (No sludge removal).
58. LPG composition data issued by Laboratory of Pertamina during the 2nd monitoring period.
59. Minutes of CDM staff training with a list of attendee conducted on 23/08/2011 and 30-31/07/2012.
60. Purchase order with meter's specification for the replaced flow meters F-01, 02 and 03.
61. Calibration certificates of replaced flow meters F-01, 02 and 03 for shipping.

7. LIST OF INTERVIEWED PERSONS / ATTENDEES

PT. Nubika Jaya (Project Company)

Mr. AsepTatang	General Affairs Manager
Mr. Erianto	Biogas plant Supervisor
Mr. Bahri Hasibuan	Hydrogen Plant Supervisor
Mr. Joko S. Pasaribu	Instrument
Mr. Feber Th. Saragih	Electronical

Permata Hijau Group

Mr. Jhonny Virgo	Director
Mr. Eric Luhur	Assistant Director
Mr. Dodik Suyanto	Manager – Technique and Production

Mitsubishi UFJ Morgan Stanley Securities Co., Ltd.

Mr. Ricky Tagar Risnauli	CDM Consultant
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Local Government

Mr. Bustami Ali	Head of local village
Mr. Hendar Harahap	Environmental Bureau of Labuanbatu Selatan District
Mr. Dodi Suwoto	Environmental Bureau of Labuanbatu Selatan District
Mr. Hasan Harahap	Environmental Bureau of Labuanbatu Selatan District
Mr. Tedi Supriatna	Environmental Bureau of North Sumatera Province

CDM VERIFICATION CHECKLIST

PT. Nubika Jaya

Nubika Jaya Biogas Extraction for Bio-Hydrogen Production

(Ref. 2421)

Project No. JQA-C0237

(No. 1812000446)

02 September 2013



Japan Quality Assurance Organization

Appendix A

Ref. No. Documents

- 1 Clean development mechanism validation and verification standard (ver. 04.0)
dated on 29 July 2013 (Annex 4, EB74)
- 2 Guidelines for completing the monitoring report form (ver. 03.2)
dated on 6 December 2012 (Annex 11, EB70)
- 3 Clean development mechanism project standard (ver. 04.0)
dated on 29 July 2013 (Annex 3, EB74)
- 4 Clean development mechanism project cycle procedure (ver. 04.0)
dated on 29 July 2013 (Annex 11, EB74)
- 5 AMS-III.H. : Methane Recovery in Wastewater Treatment (ver. 09),
dated on 14 March 2008 (Annex 10, EB38)
- 6 AMS-III.O. : Hydrogen production using methane extracted from biogas (ver. 01),
dated on 19 October 2008 (Annex 24, EB35)
- 7 Tool to determine project emissions from flaring gases containing methane,
dated on 15 December 2006 (Annex 13, EB28)
- 8 Tool to calculate project or leakage CO2 emissions from fossil fuel combustion (ver. 02),
dated on 02 August 2008 (Annex 11, EB41)

19 Others

Appendix A

Remarks:

- MoV : Means of Verification
- DR : Desk review refers to CARs/CLs/FARs found out through the desk review for the Monitoring Report/Version 1.0 (completed on 09/10/2012) and Monitoring Report/Version3.0 (completed on 26/08/2013) taking the background documents related to the requirements for verification into account.
- OA : On-site Assessment
- CAR : Corrective Action Request, raised if one of the following occurs:
- (a) Non-conformities with the monitoring plan or methodology are found in monitoring and reporting, or if the evidence provided to prove conformity is insufficient;
 - (b) Mistakes have been made in applying assumptions, data or calculations of emission reductions that will impair the estimate of emission reductions;
 - (c) Issues identified in a FAR during validation to be verified during verification have not been resolved by the project participants.
- CL : Clarification Request, raised if information is insufficient or not clear enough to determine whether the applicable CDM requirements have been met.
- FAR : Forward Action Request, raised during verification for actions if the monitoring and reporting require attention and/or adjustment for the next verification period.
- NA : Not Applicable to the project activity
- : Pending at the time of the checklist preparation
- /XX/ : Number of the documents referred to

Appendix A

Table 1 Comprehensive Verification requirements based on paragraph 62 of the CDM modalities and procedures

Para. 62	Requirement	Comments	Conc.
(a)	Was it determined whether the project documentation provided is in accordance with the requirements of the registered project design document and relevant provisions of decision 17/CP.7, the present annex and relevant decisions of the COP/MOP?	Yes, the project documentation is in accordance with the approved revised PDD and relevant decisions.	OK
(b)	Was on-site inspections conducted, as appropriate, that may comprise, inter alia, a review of performance records, interviews with project participants and local stakeholders, collection of measurements, observation of established practices and testing of the accuracy of monitoring equipment?	Yes, the on-site inspection was conducted on 06-07/11/2012.	OK
(c)	If appropriate, was additional data from other sources used?	No, additional data was not used.	NA
(d)	Were monitoring results reviewed? And was it verified that the monitoring methodologies for the estimation of reductions in anthropogenic emissions by sources have been applied correctly and their documentation is complete and transparent?	Yes, the monitoring results stated in Monitoring Report and ER calculation spreadsheet were reviewed, and it was verified that the methodologies (AMS-III.H/ver. 09 and AMS-III.O/ver. 01) have been correctly applied and the documentation was complete and transparent.	OK
(e)	Were appropriate changes to the monitoring methodology for any future crediting period recommended to the project participants , if necessary?	No, any change is not needed.	NA
(f)	Were the reductions in anthropogenic emissions by sources of greenhouse gases that would not have occurred in the absence of the CDM project activity determined, based on the data and information derived under subparagraph (a) above and obtained under subparagraph (b) and/or (c) above, as appropriate, using calculation procedures consistent with those contained in the registered project design document and in the monitoring plan?	Yes, through the review of project documents provided by PPs, the on-site inspection and the review of additional data from other sources, it was confirmed that the emission reductions achieved during 01/08/2010 - 31/07/2012 by the project activity were correctly determined using calculation procedures consistent with those contained in the approved revised PDD and the revised monitoring plan.	OK

Appendix A

Para. 62	Requirement	Comments	Conc.
(g)	<p>Were any concerns relating to the conformity of the actual project activity and its operation with the registered project design document identified and informed the project participants?</p> <p>Have project participants addressed the concerns and supplied relevant additional information?</p>	<p>Four CARs, eight CLs and one FAR were raised and informed to the PPs through the verification process.</p> <p>The project participants addressed the concerns and supplied relevant additional information.</p>	OK

Completeness of Monitoring Report and comments raised by the verification team

Req. for Issuance

Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
00		IV. General guidelines				
01	2	3. The Project standard requires project participants to prepare a monitoring report for verification and certification by completing a monitoring report form and providing all necessary information and documentation to demonstrate compliance of the project activity with all applicable CDM rules and requirements.	DR	The MR is a fully completed Monitoring Report Form and provides all necessary information and documentation to demonstrate compliance of the project activity with all applicable CDM rules and requirements.	OK	OK
02	2	9. Any data, values and formulae included in electronic spreadsheets provided must be accessible and verifiable.	DR	Data, values and formulae provided are accessible and verifiable.	OK	OK
03	2	10. The F-CDM-MR must be completed in English, and all attached documents must be in English or contain a full translation of relevant sections into English. <i>(According to Para. 9 (d) of "GUIDELINES ON COMPLETENESS CHECK OF REQUESTS FOR ISSUANCE", all documents are in English or contain a full translation of relevant sections into English in cases where the DOE considers the provision of the original document to be necessary for the purposes of transparency.)</i>	DR	The MR is completed in English language.	OK	OK
04	2	11. The F-CDM-MR must be completed using the same format without modifying its font, document headings, logos, and without any other alteration to the form.	DR	The MR is completed using the same format without any modification.	OK	OK
05	2	12. Tables and their columns in the F-CDM-MR may not be modified or deleted, but rows may be added as needed. Additional appendices may be added.	DR	Tables and their columns in the MR are not modified or deleted.	OK	OK

Appendix A

						Req. for Issuance	
Section Seq. No.	Ref. No.	Requirement	MoV	Comments		Draft Conc.	Final Conc.
06	2	13. If a section of the F-CDM-MR is not applicable, it must be explicitly stated that the section is left blank intentionally.	DR	It is explicitly stated as "N/A" in the section of F-CDM-MR where is not applicable.		OK	OK
07	2	14. The format used for presentation of values in the F-CDM-MR should be in an internationally recognized format, for example digit grouping should be done in thousands and a decimal point should be marked with a dot (.), not with a comma (,). (e.g. 1,000 representing one thousand and 1.0 representing one. Large numbers should be presented using the short scale naming system e.g. million = 10^6 and billion = 10^9 .)	DR	The values in the MR are presented in international standard format.		OK	OK
08	19	5. and 6. Is the CDM-MR (monitoring report form) the latest version at the time of the publication on UNFCCC CDM website? (If the CDM-Executive Board (the Board) revises the CDM-MR, the revisions will come into effect once adopted by the Board.)	DR	The latest version of the CDM-MR (ver. 03.1) is used.		OK	OK
100		V. Specific guidelines					

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
1.01	2	<p>Indicate on the cover page the following information:</p> <p>(a) Title of the project activity;</p> <p>(b) Reference number of the project activity;</p> <p>(c) Version number of the monitoring report;</p> <p>(d) Completion date of the monitoring report (DD/MM/YYYY);</p> <p>(e) Registration date of the project activity (DD/MM/YYYY);</p> <p>(f) Monitoring period number and duration of this monitoring period (first and last days included (DD/MM/YYYY – DD/MM/YYYY));</p> <p>(g) Project participant(s);</p> <p>(h) Host Party(ies);</p> <p>(i) Sectoral scope(s) and applied methodology(ies);</p> <p>(j) Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD;</p> <p>(k) Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period.</p> <p><i>(The information of (a), (B), (C), (e), (f), (g), (h), (i) shall be consistent with that obtained from the registered PDD and the UNFCCC CDM website.)</i></p>	DR	<p>The following information is provided:</p> <p>(a) Nubika Jaya Biogas Extraction for Bio-Hydrogen Production;</p> <p>(b) 2421;</p> <p>(c) Version 3.0;</p> <p>(d) 26/08/2013;</p> <p>(e) 30/06/2009;</p> <p>(f) 2nd Monitoring Period (01/08/2010 - 31/07/2012);</p> <p>(g) PT Nubika Jaya;</p> <p>Mitsubishi UFJ Morgan Stanley Securities Co., Ltd.</p> <p>(h) Indonesia;</p> <p>(i) Sectoral scope:</p> <p>13: Waste Handling and Disposal (AMS-III.H. ver. 09),</p> <p>5: Chemical Industries (AMS-III.O. ver. 01);</p> <p>(j) 88,362 tCO₂e;</p> <p>(k) 27,012 tCO₂e.</p>	OK	OK

Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
A.		Description of project activity				
A.1.		Purpose and general description of project activity				
A.1.01	2	Provide a brief summary of the detailed description given in section B.1 below in terms of: (a) Purpose of the project activity and the measures taken for GHG emission reductions or net anthropogenic GHG removals by sinks; (b) Brief description of the installed technology and equipment; (c) Relevant dates for the project activity (e.g. construction, commissioning, continued operation periods, etc.); (d) Total GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period.	DR	<p>The following information is provided:</p> <p>(a) Reduction of GHG emissions by integrating methane recovery from palm oil mill effluent using anaerobic digester and replacement of LPG used as fuel and feedstock in hydrogen production plant with biogas.</p> <p>(b) Combination of biogas production by anaerobic digestion of wastewater at the palm oil mill and hydrogen production by the steam reforming of the biogas generated,</p> <p>(c) Construction started: 2007 Commissioning completed: 06/02/2009 Continued operation started: 06/02/2009</p> <p>(d) 27,012 tCO₂e</p> <p>The description on the change to the start date of the 1st crediting period from 30/06/2009 to 01/05/2010 in A.1 and B.2.5 is not necessary because the change has already been approved by the EB on 26/08/2010 and confirmed on the UNFCCC website.</p>	CL 01	OK
A.2.		Location of project activity				
A.2.01	2	Provide the following information on the location of the project activity (a) Host Party(ies); (b) Region/ State/ Province, etc.; (c) City/ Town/ Community, etc.; (d) Physical/ Geographical location.	DR	<p>Information of the location of the project activity is included in A.2.</p> <p>(a) Indonesia (b) North Sumatera (c) Labuhan Batu, Kota Pinang, Sisumut (d) Kota Pinang is located at 1°53' 51" N latitude and 100°04' 59" E longitude. The Project is located within the boundary of NUBIKA's palm oil mill facility, adjacent to the existing wastewater treatment lagoons.</p>	OK	OK

Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
A.3.		Parties and project participant(s)				
A.3.01	2	List in the table below Party(ies) and project participant(s) involved in the project activity.	DR	Party(ies) and project participant(s) involved in the project activity are as follows: - PT Nubika Jaya (Indonesia); - Mitsubishi UFJ Morgan Stanley Securities Co., Ltd. (Japan)	OK	OK
A.4.		Reference of applied methodology				
A.4.01	2	Indicate the exact reference (number, title, version) of: (a) The applied methodology(ies) (e.g. ACM0001 "Consolidated baseline and monitoring methodology for landfill gas project activities" (Version 11.0)); (b) Any tools and other methodologies to which the applied methodology(ies) refers (e.g. "Tool for demonstration and assessment of additionality" (Version 05.2.1)). Refer to the UNFCCC CDM website for the exact reference of the applied methodologies and tools.	DR	(a) - AMS-III.H: Methane Recovery in Wastewater Treatment, ver. 09. - AMS-III.O: Hydrogen production using methane extracted from biogas, ver. 01. (b) - Tool to determine project emissions from flaring gases containing methane, - Tool to calculate project and leakage CO2 emission from fossilfuel combustion.	OK	OK
A.5.		Crediting period of project activity				
A.5.01	2	Provide the type, start date and length of the crediting period corresponding to this monitoring period.	DR	Type, start date and length of the crediting period is included in A.5: - Renewable, - 01/05/2010, - 01/05/2010 - 30/04/2017 (7 years).	OK	OK

Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
B.		Implementation of the project activity				
B.1.		Description of implemented registered project activity				
B.1.01	2	Provide information on the implementation status of the project activity during this monitoring period in accordance with the applicable provision for description of implemented registered CDM project activity in the Project standard.	DR/OA	<p>Although many shutdowns in the plant operation due to the troubles of the oleochemical factory occurred , the project activity was totally implemented in accordance with the revised monitoring plan. The PP has continuously strived to improve the monitoring activity as follows:</p> <ul style="list-style-type: none"> - Reduction of moisture and H₂S in biogas, - Operation start of hydrogen production plant since April 2012, - Preparation of spare flow meters (F-00 to F-06) to reduce the risk of data loss during off-site calibration, - Improvement of data recording procedure, - Improvement of biogas production efficiency from anaerobic digestion sysytem, etc. <p>The response to FAR 03 raised in the 1st verification is not included in B.1 and Section C, while the training activity has been actually implemented in this monitoring period.</p>	CL 02	OK
B.1.02	2	For the description of the installed technology(ies), technical process and equipment, include diagrams, where appropriate. Note: If applicable, present information on any request for prior approval by the Board of changes to the registered CDM project activity in B.2.1, B.2.2, B.2.3, B.2.4 and/or B.2.5.	DR/OA	<p>The description of the installed technology(ies), technical process and equipment including diagrams is provided.</p> <p>The process flow is as follows:</p> <ul style="list-style-type: none"> - H₂S and moisture removal in biogas, - Anaerobic digestion of wastewater and open flare, - Hydrogen production plant and PSA. - Eight lagoons, 	OK	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
B.2.		Post registration changes				
B.2.1.		Temporary deviations from registered monitoring plan or applied methodology				
B.2.1.01	2	<p>Indicate whether any temporary deviations have been applied during this monitoring period. If applied, provide a description of the deviation(s) in accordance with applicable provisions for temporary deviations from the registered monitoring plan or applied methodologies in the Project standard.</p> <p>This should include the reasons for the deviation(s), how it deviates from the monitoring plan and/or applied methodology(ies), the duration for which the deviation(s) is(are) applicable and justification on the conservativeness of the approach.</p> <p>For deviation(s) that require prior approval by the Board, include the date of approval and reference number.</p>	DR/OA	<p>It is confirmed through the on-site assessment that any temporary deviations have not been applied during this monitoring period</p> <p>"Not Applicable" is indicated in B.2.1 for temporary deviations.</p>	OK	OK
B.2.2.		Corrections				
B.2.2.01	2	<p>Indicate whether any corrections to project information or parameters fixed at validation have been approved during this monitoring period or submitted with this monitoring report.</p> <p>In cases where the correction(s) and the revised PDD are approved prior to the submission of this monitoring report for request for issuance, provide the approval date and reference number. Otherwise, provide the version number and the completion date of the revised PDD.</p>	DR/OA	<p>It is confirmed through the on-site assessment that any corrections have not been applied during this monitoring period.</p> <p>"Not Applicable" is indicated in B.2.2 for corrections.</p>	OK	OK

Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
B.2.3.		Permanent changes from registered monitoring plan or applied methodology				
B.2.3.01	2	Indicate whether any permanent changes from the registered monitoring plan or applied methodologies have been approved during this monitoring period or submitted with this monitoring report. In cases where the change(s) and the revised PDD are approved prior to the submission of this monitoring report for request for issuance, provide the approval date and reference number. Otherwise, provide the version number and the completion date of the revised PDD.	DR/OA	The request for permanent change submitted in the 1st monitoring period was approved by the CDM-EB on 19/07/2011. As the issues contained in B.2.3 are limited to the permanent changes during the 2nd monitoring period, the above description is not necessary.	CL 03	OK
B.2.4.		Changes to project design of registered project activity				
B.2.4.01	2	Indicate whether any changes to the project design of the project activity have been approved during this monitoring period or submitted with this monitoring report. In cases where the change(s) and the revised PDD are approved prior to the submission of this monitoring report for request for issuance, provide the approval date and reference number. Otherwise, provide the version number and the completion date of the revised PDD.	DR/OA	The changes to project design of registered project activity submitted in the 1st monitoring period were approved by the CDM-EB on 19/07/2011. As the issues contained in B.2.4 are limited to the project design changes during the 2nd monitoring period, the above description is not necessary.	CL 04	OK
B.2.5.		Changes to start date of crediting period				
B.2.5.01	2	Indicate whether any changes to the start date of the crediting period have been approved during this monitoring period or submitted with this monitoring report. In cases where the changes and the revised PDD are approved prior to the submission of this monitoring report for request for issuance, provide the approval date and reference number.	DR	Refer to A.1.01.	CL 01	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.	
B.2.6.		Types of changes specific to afforestation or reforestation project activity					
B.2.6.01	2	Indicate whether any changes specific to afforestation or reforestation project activities have been applied during this monitoring period based on applicable provisions in the Project standard that do not require prior approval by the Board. If changes were applied, provide the version number and the completion date of the revised PDD.	DR	Not Applicable.	NA	NA	
C.		Description of monitoring system					
C.01	2	Provide a description of the monitoring system based on the applicable provision for description of monitoring system in the Project standard.	DR/OA	The data collection procedures, organizational structure, roles and responsibilities of personnel, and emergency procedures for the monitoring system are included in Section C.	OK	OK	
C.02	2	Include diagrams of the monitoring system and the information flow where appropriate.	DR/OA	The diagrams of the monitoring system with monitoring points and the information flow are included in Section C.	OK	OK	
D.		Data and parameters					
D.01	2	Provide information on all data and parameters in accordance with applicable provisions for data and parameters in the Project standard, using the tables provided in D.1 and D.2 below.	DR	Information on all data and parameters is provided in D.1 and D.2 using the tables.	OK	OK	

Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
D.1.		Data and parameters fixed ex ante or at renewal of crediting period				
D.1.01	2	Data that are fixed before registration and/or at the renewal of crediting period and are used during this monitoring period should be included here under section D.1. For "Value(s) applied", use one table to report multiple values referring to the same data and parameter, if applicable. Reference(s) to electronic spreadsheets may be used, if necessary.	DR	Fixed values of P _N , T _N , R, GWP _{CH4} , SFC _{LPG} , MW _{CO2} , MW _{C3H8} , MW _{C4H10} , MW _{CH4} , EF _{CO2,Diesel} and NCV _{Diesel} are included in Section D.1. It is not clear why leakage is not included in the cell of "Purpose of data" in D.1. These parameters are used in the calculation of leakage.	CL 05	OK
D.2.		Data and parameters monitored				
D.2.01	2	For "Monitoring equipment" in the table below , provide information on type, accuracy class, serial number, calibration frequency, date of last calibration and validity. For "Value(s) of monitored parameter", use one table to report multiple values referring to the same data and parameter, if applicable. Reference(s) to electronic spreadsheets may be used, if necessary.	DR/OA	Information on monitoring equipment and value(s) of monitoring parameter are provided in D.2. The following issues are raised: 1) The calibration frequency of F-01, F-02, F-03, F-04, F-05 and F-06 in the MR (every year) is not consistent with that in the revised PDD (every 2 years). 2) It is not clear whether the flow meters (F-01 (V_{AD}) and F-06 (V_{H2,T})) are replaced or not during this monitoring period. (Their serial number are changed from the information in the 1st MR) If replaced, the change is to be clearly described in B.1 and D.2. 3) Serial numbers of F-04 and F-05 in the MR are not consistent with those in their calibration records. 4) The calibration date and frequency of the flow meter F-00 are not consistent with those in the 1st MR. 5) The quarterly data of LPG composition (m₁ & m₂) and EF_{LPG} are not included using table.	CL 06	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments		Draft Conc.	Final Conc.
D.3.		Implementation of sampling plan					
D.3.01	2	If data and parameters monitored described in section D.2 above are determined by a sampling approach, provide a description on how project participants implemented the sampling efforts and surveys for those data and parameters according to the sampling plan. Include: (a) Description of implemented sampling design; (b) Collected data (electronic spreadsheets may be attached and referenced); (c) Analysis of the collected data; (d) Demonstration on whether the required confidence/precision has been met.	DR/OA	Not Applicable.		NA	NA
E.		Calculation of emission reductions or GHG removals by					
E.1.		Calculation of baseline emissions or baseline net GHG removals by sinks					
E.1.01	2	Provide sample calculations for all formulae used and calculation of baseline emissions or baseline net GHG removals by sinks, applying actual values. Attach electronic spreadsheets to present full calculations in the monitoring report.	DR	The calculation of baseline emissions using actual values is provided. ER calculation spreadsheet sheet is also attached.		OK	OK
E.2.		Calculation of project emissions or actual net GHG removals by sinks					
E.2.01	2	Provide sample calculations for all formulae used and calculation of project emissions or actual net GHG removals by sinks, applying actual values. Attach electronic spreadsheets to present full calculations in the monitoring report.	DR	The calculation of project emissions using actual values is provided. ER calculation spreadsheet sheet is also attached.		OK	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
E.3.		Calculation of leakage				
E.3.01	2	Provide sample calculations for all formulae used and calculation of leakage, applying actual values. Attach electronic spreadsheets to present full calculations in the monitoring report.	DR	The calculation of leakage using actual values is provided. ER calculation spreadsheet sheet is also attached.	OK	OK
E.4.		Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks				
E.4.01	2	Summarize the results of sections E.1, E.2, E.3 above and provide GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period, using the table below.	DR	The results in E.1, E.2 and E.3 are summarized. GHG emission reductions are included.	OK	OK
E.5.		Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in				
E.5.01	2	Provide a comparison of actual GHG emission reductions or net anthropogenic GHG removal of the project activity achieved during this monitoring period with the estimates in the registered PDD.	DR	Comparison of actual values of the emission reductions achieved during the 2nd monitoring period with the estimates in the approved revised PDD is included.	OK	OK
E.6.		Remarks on difference from estimated value in registered				
E.6.01	2	Explain the cause of any increase in the actual GHG emission reductions achieved during this monitoring period based on the applicable provision for calculation of GHG emission reductions in the Project standard.	DR	There is no increase in the actual emission reductions achieved during the 2nd monitoring period.	OK	OK

Table 3 Requirements for Verification and CARs/CLs/FARs requested by the verification team

Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
VVS B.		B. General verification approach				
VVS B.0.07	1	<p>212. In addition to the monitoring documentation the DOE shall review:</p> <p>(a) The registered PDD and the monitoring plan, including any approved revised monitoring plan and/or changes from the registered PDD, and the corresponding validation opinion;</p> <p>(b) The validation report;</p> <p>(c) Previous verification reports, if any;</p> <p>(d) The applied monitoring methodology;</p> <p>(e) The monitoring report to verify that it is as per the standardized format;³³</p> <p>(f) Any other information and references relevant to the project activity's emission reductions (e.g. IPCC reports, data on electricity generation in the national grid or laboratory analysis and national regulations);</p> <p>33 See EB 54 report, annex 34, where the CDM Executive Board has provided a standardized format for the monitoring report to improve consistency in reporting of the implementation and monitoring of the project activity by project participants.</p>	DR	<p>The following documents were reviewed:</p> <p>(a) Approved revised PDD, ver. 4.1.0, 31/05/2011; Validation opinion, ver. 01.2, 31/05/2011; Registered PDD, ver. 3.4.2, 15/05/2009;</p> <p>(b) Validation report, JQA-C0083-VaR, ver. 1.2, 26/06/2009;</p> <p>(c) 1st Verification Report, ver.3.1, 10/02/2012;</p> <p>(d) AMS-III.H, "Methane Recovery in Wastewater Treatment", ver. 09 (Sectoral Scope, 13); - AMS-III.O, "Hydrogen production using methane extracted from biogas", ver. 01 (Sectoral Scope, 5); - Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion, ver. 02; - Tool to determine project emissions from flaring gases containing methane;</p> <p>(e) MR, ver. 1.0, 09/10/2012 and revised MR, ver. 3.0 26/08/2013;</p> <p>(f) IUPAC definition for P_N and T_N; IPCC data for GWP_{CH4}.</p>	OK	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
VVS B.0.08	1	213. In addition to reviewing the monitoring documentation, the DOE shall determine whether the project participants have addressed the FARs identified during validation or previous verification(s).	DR	<p>It is confirmed through the review of the documents and the interview with the PPs that the PPs have appropriately addressed the five FARs raised in the 1st verification as shown below:</p> <p>FAR 01: The daily data records and the interview with the PPs show that the biogas has never been used as feedstock for hydrogen production in the first monitoring period due to the deactivation of the Ni catalyst in the hydrogen production plant which was occurred during the commissioning test. The use of biogas as feedstock is to be confirmed in the next periodic verification as it is essential feature of the CDM Project.</p> <p>FAR 02: Since PPs recognize the possible risk of data loss during the off-site calibration of some monitoring equipment (for 1-1.5 months), PPs are requested to establish an appropriate measure to avoid data loss for the next verification period.</p> <p>FAR 03: Although PPs verbally explained their training activities during the 1st monitoring period, any documented procedures/ records could not be confirmed. Documented CDM training plan and its record format are to be prepared for the next verification period.</p> <p>FAR 04: Monitoring data of F-01 and F-03 shown in Biogas Journal are calculated as daily values. Original data (hourly readings) are recorded in other data sheet. As many calculation errors are found between Biogas Journal and the original data sheet, the PPs are requested to improve the data sheet format for the next verification period.</p> <p>FAR 05: The PPs are requested to take necessary actions to ensure the accurate monitoring of V_{AD} for the next monitoring period, such as adjustment/ replacement of meter F-01.</p>	OK	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
VVS D		D. Verification of compliance				
VVS D.1		1. Compliance of the project implementation with the registered project design document				
VVS D.1.02	1	<p>227. The DOE shall, by means of an on-site visit, assess that all physical features of the project activity in the registered PDD are in place and that the project participants have operated the project activity as per the registered PDD or any approved revised PDD. If an on-site visit is not conducted, the DOE shall justify the rationale of the decision.</p> <p>The DOE shall physically visit every project/baseline facilities, irrespective of whether they are used regularly or irregularly, to confirm the compliance of the project implementation with the registered PDD or approved revised PDD.</p>	DR/OA	<p>The on-site visit was conducted on 06-07/11/2012. It is confirmed through the on-site visit and the interview with the PPs that all physical features of the project activity in the approved revised PDD are in place:</p> <ol style="list-style-type: none"> 1) Methane capture system (MCS), <ul style="list-style-type: none"> - Lagoon 1-8, - AD reactors (3 fixed roof and one floating roof tanks) 2) Biogas purification system to remove H₂S and moisture, <ul style="list-style-type: none"> - Wet and dry processing facilities, - Air dryer, 3) Flaring system (Open flare), 4) Hydrogen production plant, <ul style="list-style-type: none"> - Steam reformer, - Shift converter, - PSA for hydrogen purification, 5) Biomass-fired power generation plant, 6) Diesel oil generator for emergency use, 7) Monitoring equipment (7 flow meters, F-00 - 06; COD analyzer, CH₄ analyzer, etc.) 	OK	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
VVS D.1.03	1	<p>228. For each monitoring period, the DOE shall report:</p> <p>(a) The implementation status of the project. For project activities that consist of more than one site, the DOE shall describe the status of implementation and starting date of operation for each site. For project activities with phased implementation, the DOE shall state the progress of the proposed project activity achieved in each phase under verification. If the phased implementation is delayed, the DOE shall describe the reasons and present the expected implementation dates;</p> <p>(b) The actual operation of the project activity;</p> <p>(c) Information (data and variables) provided in the monitoring report that is different from that stated in the registered PDD or any approved revised PDD, and has caused an increase in estimates of the emission reductions in the current monitoring period or is highly likely to increase the estimates of emission reductions in the future monitoring periods;³⁵</p> <p>35 Discrepancies may include higher water availability than expected in the PDD, which may increase the electricity output from a hydropower plant, or a higher plant load factor owing to higher bagasse availability during the crushing season, which increases the production of steam and electricity.</p>	DR/OA	<p>(a) The implementation status of the project is described in Section 3.2.1 of the verification report. The proposed project activity consists of only one site and is not phased implementation;</p> <p>(b) The actual operation of the project is described in Section 3.2.2 of the verification report;</p> <p>(c) The data and variables provided in the MR are consistent with the approved revised PDD. The comparison of the emission reductions achieved in this monitoring period and estimated in the approved revised PDD is described in Section 3.6.3 of the verification report.</p>	OK	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
VVS D.2		2. Compliance of the monitoring plan with the monitoring methodology including applicable tool(s)				
VVS D.2.02	1	230. The DOE shall determine whether the project implementation is in accordance with the provisions of the registered PDD and/or an approved revised PDD. The DOE shall check whether the equations of monitoring parameters described in the monitoring plan are fully in accordance with the applied methodology.	DR/OA	It is confirmed that the implementation of the project activity is in accordance with the description in the approved revised PDD.	OK	OK
VVS D.2.03	1	231. For monitoring aspects that are not specified in the methodology, particularly in the case of small-scale methodologies (e.g. additional monitoring parameters, monitoring frequency and calibration frequency), the DOE should bring to the attention of the Board issues which may enhance the level of accuracy and completeness of the monitoring plan.	DR/OA	It is confirmed that there are no monitoring aspects that are not specified in the methodology. The actual calibration frequency of the flow meters is determined as per their calibration certificate and/or manufacturer's specification, while the approved revised PDD states every two year's calibration.	OK	OK
VVS D.2.04	1	232. The DOE shall provide a statement whether the monitoring plan is in accordance with the approved methodology applied by the registered CDM project activity or an approved revised PDD. The DOE shall provide a statement whether the equations of monitoring parameters described in the monitoring plan are fully in accordance with the applied methodology.	DR/OA	The statement that the monitoring plan is in accordance with the methodologies AMS-III.H. (Ver. 09) and AMS-III.O (ver. 01) is provided in Section 3.3 of the verification report. It is also stated in Section 3.6.2 that the equations of monitoring parameters described in the monitoring plan are fully in accordance with the applied methodology.	OK	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
VVS D.3		3. Compliance of monitoring activities with the registered monitoring plan				
VVS D.3.02	1	<p>234. The DOE shall determine whether:</p> <p>(a) The monitoring plan has been properly implemented and followed by the project participants;</p> <p>(b) All parameters stated in the monitoring plan and relevant Board decisions³⁷ have been monitored and updated as applicable, including:</p> <p>(i) Project emission parameters;</p> <p>(ii) Baseline emission parameters;</p> <p>(iii) Leakage parameters;</p> <p>(iv) Management and operational system: the responsibilities and authorities for monitoring and reporting are in accordance with the responsibilities and authorities stated in the monitoring plan.</p> <p>37 For example, a decision at the thirty-fifth meeting of the CDM Executive Board provides clarification for the project activities that apply the approved methodology AM0001. This asks the DOE to check the value of w based on the past one year period during verification, which was not clearly stated in the approved methodology.</p>	DR/OA	<p>Followings are confirmed through the review of relevant documents, on-site inspections and the interview with the PPs:</p> <p>(a) The monitoring plan has been properly implemented and followed by the PP;</p> <p>(b) All parameters are appropriately monitored as follows:</p> <p>(i) As per AMS-III.H, the project emissions of $PE_{MCS,y,power}$, $PE_{MCS,y,ww,treated}$, $PE_{MCS,y,s,final}$, $PE_{MCS,y,fugitive}$ and $PE_{MCS,y,dissolved}$ are monitored. However, as per Para 34 of AMS-III.H, project emissions are examined and then excluded. As per AMS-III.O, the project emissions of $PE_{y,power}$, $PE_{y,final}$ and $PE_{y,chem}$ are examined and then excluded.</p> <p>(ii) V_D, V_F, X_{CH4}, $V_{H2,T}$, $M_{LPG,FEED}$, LPG composition (m_1 and m_2) are monitored as baseline emission parameters.</p> <p>(iii) V_{AD}, V_D, V_F, X_{CH4} are monitored as leakage parameters.</p> <p>(iv) Organizational structure and reporting structure of monitoring team are shown in Figs. 1 and 2. These are in accordance with those in the monitoring plan of the approved revised PDD.</p>	OK	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
VVS D.3.03	1	234. The DOE shall determine whether: (c) The equipment used for monitoring is in accordance with section 4. below and is controlled and calibrated in accordance with the monitoring plan, the applied methodology, the Board guidance, local/national standards, or as per the manufacturers specification; (d) Monitoring results are consistently recorded as per approved frequency; (e) Quality assurance and quality control procedures have been applied in accordance with the monitoring plan or the revised monitoring plan.	DR/OA	(c) The equipment used for monitoring is controlled and calibrated in accordance with the monitoring plan, Board guidance and manufacturer's specification. (d) Monitoring frequency (Monitoring and Recording) of gas flow meter, COD analysis, CH4 analysis, LPG analysis, hours of flame detection in flaring, amount of sludge is consistently recorded as per the approved revised monitoring plan. (e) <u>The PPs is required to establish the management system to ensure the calibration frequency of monitoring equipment without delay for the next monitoring period, such as making of the calibration schedule plan and the clarification of role and responsibility of CDM staffs.</u>	FAR 01	OK
VVS D.3.04	1	235. The DOE shall state whether monitoring has been carried out in accordance with the monitoring plan contained in the registered PDD, approved revised PDD or the accepted revised monitoring plan.	DR/OA	It is stated in Section 3.4 of the verification report that the actual monitoring was implemented in accordance with the revised monitoring plan.	OK	OK
VVS D.3.05	1	236. The DOE shall list each parameter required by the monitoring plan and state how it verified the information flow (from data generation, aggregation, to recording, calculation and reporting) for these parameters including the values in the monitoring reports.	DR/OA	Twenty monitoring parameters required by the monitoring plan are listed in Section 3.4.1 of the verification report. And the information flow for these parameters is also stated in Section 3.4.1.	OK	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
VVS D.4		4. Compliance with the calibration frequency requirements for measuring instruments				
VVS D.4.01	1	<p>237. The DOE shall determine whether the calibration of those measuring equipments that have an impact on the claimed emission reductions is conducted by the project participants at a frequency specified in the applied monitoring methodology and/or the monitoring plan.</p> <p>If different types of calibration method and/or calibration frequency are applied to single measuring equipment in the monitoring methodology and/or the monitoring plan, the DOE shall confirm whether all different calibration requirements are satisfied.</p>	DR/OA	Through the review of calibration certificates and the interview with the PPs, JQA confirms that the calibration of measuring equipments is partly not conducted at a frequency specified in the applied monitoring methodology, the revised monitoring plan and/or manufacturer's specifications. Refer to CAR 01 for details.	OK	OK
VVS D.4.02	1	<p>238. If, during verification of a certain monitoring period, the DOE identifies that the calibration has been delayed and the calibration has been implemented after the monitoring period in consideration (i.e. the results of delayed calibration are available), the DOE may conclude its verification, provided the following conservative approach is adopted in the calculation of emission reductions:</p> <p>(a) Applying the maximum permissible error³⁸ of the instrument to the measured values taken during the period between the scheduled date of calibration and the actual date of calibration, if the results of the delayed calibration do not show any errors in the measuring equipment, or if the error is smaller than the maximum permissible error; or</p> <p>(b) Applying the error identified in the delayed calibration test, if the error is beyond the maximum permissible error of the measuring equipment.</p> <p>38 The maximum permissible errors of all the measuring instruments are specified by the respective manufacturers as part of their technical specifications.</p>	DR/OA	<p>Followings are confirmed through the review of calibration certificates and the interview with the PPs:</p> <p><u>Delayed calibration of F-02, F-03, F-04, F-05, F-06, COD analyzer and FCDiesel are identified. The values of the baseline and leakage emissions are not corrected in a conservative manner, taking into consideration the delayed calibration, during the period between the scheduled date and the actual date of calibration.</u></p> <p><u>(a) The maximum permissible errors of these equipment are to be applied in the calculation of baseline and leakage emissions.</u></p> <p><u>(b) The error identified in the delayed calibration test is to be applied if the error is beyond the maximum permissible error.</u></p>	CAR 01	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
VVS D.4.03	1	239. The DOE shall confirm that the error has been applied: (a) In a conservative manner, such that the adjusted measured values of the delayed calibration shall result in fewer claimed emission reductions; (b) For all measured values taken during the period between the scheduled date of calibration and the actual date of calibration.	DR/OA	Refer to VVS D.4.02.	OK	OK
VVS D.4.04	1	240. In cases where the results of the delayed calibration are not available, or the calibration has not been conducted at the time of verification, the DOE, prior to finalizing verification, shall request the project participants to conduct the required calibration and shall determine whether the project participants have calculated the emission reductions conservatively using the approach mentioned in paragraph 238 above.	DR/OA	The calibration certificate of F-04 in 2012, FCDiesel in 2011, FT20.v in 2011 and 2012 are not provided.	CL 07	OK
VVS D.4.05	1	241. In cases where the DOE determines that it is not possible for the project participants to conduct the calibration at a frequency specified by either the applied methodology, guidance provided by the Board, and/or the registered monitoring plan due to reasons beyond the control of project participants, ³⁹ the DOE, shall follow the requirements for post registration changes in section of E of this Standard. 39 For example, due to the contractual terms between the project participant and purchasing/selling entities.	DR/OA	It is confirmed through the review of the calibration certificates and the interview with the PPs that all calibration can be conducted at a frequency specified by the approved revised monitoring plan.	OK	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
VVS D.4.06	1	242. In cases where neither the monitoring methodology nor the monitoring plan specify any requirements for calibration frequency for measuring equipments, the DOE shall determine whether the equipments are calibrated either in accordance with the specifications of the local/national standards, or as per the manufacturers specification. If neither local/national standards nor the manufacturers specification are available, international standards may be used. Refer to appendix 1 for an illustrative example to apply the above requirements.	DR/OA	The calibration frequency of monitoring equipment such as diesel flow meter (FC_{Diesel}) and weighbridge ($S_{y,\text{final}}$) is based on the calibration certificate.	OK	OK
VVS D.4.07	1	243. The DOE shall report whether the calibration is conducted at the frequency as specified by the methodology, monitoring plan of the registered PDD or the approved revised monitoring plan. If different types of calibration method and/or calibration frequency are applied to single measuring equipment in the monitoring methodology and/or the monitoring plan, every calibration conducted shall be reported.	DR/OA	It is stated in Section 3.5 of the verification report that the calibration of all monitoring equipment were conducted according to the methodologies, approved revised monitoring plan, manufacturer's recommendation and calibration certificate. Delayed calibration was appropriately addressed during the verification.	OK	OK
VVS D.5		5. Assessment of data and calculation of emission reductions				
VVS D.5.02	1	245. The DOE shall determine whether: (a) A complete set of data for the specified monitoring period is available. If only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, the DOE shall either raise a CAR for the project participants to comply with the requirements of appendix 1 of the Project standard or submit a request for deviation prior to submitting the request for issuance, if appropriate;	DR/OA	(a) A complete set of data for the 2nd monitoring period is provided: - Monthly calculation of baseline emissions from methane recovery, - Monthly calculation of baseline emissions from the displaced LPG feedstock in the hydrogen production plant, - Monthly calculation of baseline emissions from avoidance of LPG as fuel to reformer burner, - Monthly calculation of total baseline emissions, - Monthly calculation of methane loss from physical leakage of biogas, - Monthly calculation of emission reductions, - Other relevant documents.	OK	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
VVS D.5.03	1	<p>245. The DOE shall determine whether:</p> <p>(b) Information provided in the monitoring report has been cross-checked with other sources such as plant logbooks, inventories, purchase records, laboratory analysis;</p> <p>The DOE shall cross-check among data measured/ aggregated by the same measuring equipment/system but aggregated by different interval (e.g., minutely, hourly, daily, etc.) to confirm the accuracy of the data, with reference to the latest version of "Guideline on the application of materiality in verifications" and "Standard for sampling and surveys for CDM project activities and programme of activities".</p> <p>The DOE shall cross-check the data measured by measuring equipment with comparable information such as sales/purchase record, production data, energy consumption data, etc. If such information is not available, the DOE shall take alternate attempt to the extent possible.</p>	DR/OA	(b) Information provided in the monitoring report has been cross-checked with daily data logbooks of biogas plant and hydrogen production plant operations, LPG quarterly composition record, purchase record of LPG, etc.	OK	OK
VVS D.5.04	1	<p>245. The DOE shall determine whether:</p> <p>(c) Calculations of baseline emissions, and project activity emissions and leakage, as appropriate, have been carried out in accordance with the formulae and methods described in the monitoring plan and the applied methodology document, and the impact of the irregular or temporal use of backup system, if any, on the calculation of baseline emissions, project emissions, leakage and emission reductions is considered appropriate, in accordance with the formulae and methods described in the monitoring plan and the applied methodology;</p> <p>(d) Any assumptions used in emission calculations have been justified;</p> <p>(e) Appropriate emission factors,⁴⁰ IPCC default values and other reference values have been correctly applied.</p>	DR/OA	(c) The quarterly data of LPG composition are not appropriately applied in the calculation of RCO₂/H₂, RH₂/LPG and MW_{LPG} in the MR and ER calculation spreadsheet.	CAR 02	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
		40 The Board emphasized that in order to ensure an accurate determination of the ex post grid emission factor during the issuance stage, the project participants should endeavour to use the data vintage for year (y) in which the project generation occurs and report it in the monitoring report submitted to the DOE for verification. If, at the time of the submission of the monitoring report to the DOE, the data vintage from year (y) is not available and data from year (y-1) or (y-2) is being used, the DOE shall, during verification, assess whether more recent data has become publicly available and shall, if appropriate, raise a Corrective Action Request to project participants to incorporate the more recent data into the calculation of grid emission factor.		<p><u>1) The daily quantity of methane production was calculated not using the daily methane concentration, but using monthly averaged methane concentration.</u></p> <p><u>2) The amounts of VD and VF since Sep 2011 in Table 1 of the MR are not consistent with those in Biogas Journal (logbook data).</u></p> <p><u>The value of VAD is used in the calculation of biogas generated in Table 5 of the MR and the ER calculation spreadsheet, whereas the value of VTR is used in the calculation of baseline emissions from methane recovery.</u></p> <p>(d) No assumption is used in the emission calculations for this project activity.</p> <p>(e) The parameters such as PN, TN, R, GWPCH₄, SFCLPG, EFLPG, EFCO₂, Diesel, NCVDiesel, LPG composition are correctly applied from IPCC, IUPAC, manufacture's specification, etc.</p>	CAR 03	OK
					CL 08	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
VVS D.5.05	1	<p>246. The verification report shall contain:</p> <p>(a) An indication of whether data were not available because activity levels or non-activity parameters were not monitored in accordance with the registered monitoring plan as well as any actions taken by the DOE to ensure that the most conservative assumption theoretically possible has been made;</p> <p>(b) A description of how the DOE cross-checked reported data, and an explanation of the every process, result of cross-check and/or alternate attempt for cross-check;</p> <p>(c) A confirmation that appropriate methods and formulae for calculating baseline emissions, project emissions and leakage have been followed and an assessment whether appropriate method and formulae for calculating baseline emissions, project emissions, leakage and emission reductions have been followed with respect to the irregular or temporal use of backup system, if any;</p> <p>(d) An opinion as to whether assumptions, emission factors and default values that were applied in the calculations have been justified</p>	DR/OA	<p>(a) It is described in Section 3.6.1 of the verification report that a complete set of data covering the whole the monitoring period was provided.</p> <p>(b) It is also described in Section 3.6.1 of the verification report that the reported data were cross-checked with daily data logbooks such as Biogas Facility Daily Report and Hydrogen Facility Daily Report.</p> <p>(c) The confirmation of the appropriate methods and formulae for calculating baseline emissions, project emissions and leakage is contained in Section 3.6.2 of the verification report.</p> <p>(d) The justification of the eight default values and factors applied is contained in Section 3.6.2 of the verification report.</p>	OK	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
VVS E		E. Post registration changes				
VVS E.0.02	1	248. The DOE shall determine whether the changes do not require prior approval by the Board in accordance with appendix 1 of Project standard.	DR/OA	It is confirmed through the on-site assessment and the review of the relevant documents that there are no changes which require prior approval by the Board.	OK	OK
VVS E.0.03	1	249. Where the changes are identified by or submitted to the DOE contracted to conduct the verification, the DOE shall determine whether the changes are solely of a type(s) listed in appendix 1 of the Project standard and: (a) In such cases, the DOE shall submit the changes as part of the request for issuance in accordance with the Project cycle procedure; (b) In all other cases, the DOE shall submit the changes via the request for approval of post registration changes process of the Project cycle procedure.	DR/OA	Refer to VVS E.0.02.	OK	OK
VVS E.0.04	1	250. Where the changes are submitted to a DOE prior to the commencement of verification, the DOE shall submit the changes via the request for approval of post registration changes process of the Project Cycle Procedure.	DR/OA	Not applicable. Such changes are not submitted to the DOE prior to the commencement of verification.	NA	NA
VVS E.1		1. Temporary deviations from the registered monitoring plan and/or monitoring methodology				
VVS E.1.02	1	252. If the DOE identifies that the project participants have deviated from the registered monitoring plan and/or methodology, and where the provisions of appendix 1 of the Project standard do not apply, the DOE shall seek prior approval from the Board with respect to the acceptability of the deviations in accordance with the Project cycle procedure.	DR/OA	It is confirmed through the on-site assessment and the review of the relevant documents that there are no temporary deviations which require prior approval by the Board.	OK	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
VVS E.1.03	1	253. The DOE shall determine whether the deviation is likely to lead to a reduction in the accuracy of the calculation of emission reductions. In cases where the DOE considers that the deviation will lead to a reduction in the accuracy of the calculation of emission reductions, the DOE shall request the project participants to apply conservative assumptions or discount factors to the calculations to the extent required to ensure that emission reductions will not be over-estimated as a result of the deviation.	DR/OA	Refer to VVS E.1.02.	OK	OK
VVS E.1.04	1	254. For cases where a deviation from the monitoring plan may be applicable to the monitoring period under verification, and part of the subsequent monitoring period, the DOE shall verify the exact period to which the deviation applies.	DR/OA	Refer to VVS E.1.02.	OK	OK
VVS E.1.05	1	255. Where the deviation is identified during verification, the DOE shall indicate in the verification report how the monitoring report reflects the application of the approved guidance from the Board regarding the deviation from the provisions of the registered monitoring plan and/or methodology.	DR/OA	No deviation was identified. Refer to Section 3.7.1 of the verification report.	OK	OK
VVS E.1.06	1	256. Where the deviation is identified prior to verification, the DOE shall state its opinion on whether the deviation reflects the application of the approved guidance from the Board regarding the deviation from the provisions of the registered monitoring plan and/or methodology and as per the applicable provisions of the Project Standard.	DR/OA	No deviation was identified. Refer to Section 3.7.1 of the verification report.	OK	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
VVS E.2		2. Corrections				
VVS E.2.02	1	258. If the DOE identifies that the project participants have made corrections to project information or parameters determined at validation, the DOE shall determine whether: (a) The corrected information is an accurate reflection of actual project information; and/or (b) The corrected parameters are in accordance with the applied methodology and/or selected monitoring plan.	DR/OA	It is confirmed through the on-site assessment and the review of the relevant documents that there are no corrections to project information or parameters determined at validation.	OK	OK
VVS E.2.03	1	259. The DOE shall describe how the corrected information accurately reflects the actual project information and/or how the corrected parameters reflect the application of the applied methodology and/or monitoring plan.	DR/OA	No corrections made by the PP was identified. Refer to Section 3.7.2 of the verification report.	OK	OK
VVS E.3		3. Changes to the start date of the crediting period				
VVS E.3.01	1	260. If the project participants wish to change the start date of the crediting period in accordance with section H of the Project standard, the DOE shall determine whether the proposed changes result in a less conservative baseline.	DR	There is no change of the starting date of the crediting period.	OK	OK
VVS E.3.02	1	261. The DOE shall indicate if the requirements in the Project standard have been met and shall submit a request for post registration changes in accordance with the Project cycle procedure.	DR/OA	Refer to Section 3.7.3 of the verification report.	OK	OK
VVS E.4		4. Permanent changes from the registered monitoring plan or monitoring methodology				
VVS E.4.02	1	263. The DOE shall determine whether the changes to the monitoring plan contained in the registered PDD proposed by the project participants are in compliance with the applied methodology and do not reduce the level of accuracy of the monitoring compared with the requirements contained in the registered monitoring plan.	DR/OA	It is confirmed through the on-site assessment and the review of the relevant documents that there are no permanent changes from the approved revised monitoring plan.	OK	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
VVS E.4.03	1	264. In cases where the proposed changes refer to a later version of the applied methodology in the registered PDD, the DOE shall determine whether the application of any later version of the applied methodology and tools does not impact the conservativeness of the monitoring and verification process, including the related emission reduction calculations.	DR/OA	Refer to VVS E.4.02.	OK	OK
VVS E.4.04	1	265. If the DOE identifies that the project participants are unable to implement the monitoring plan contained in the registered PDD and it will not be possible to monitor the registered CDM project activity in accordance with a monitoring plan that would comply with the applied methodology and any applicable tools or the relevant provisions of appendix 1 of the Project standard, the DOE shall request guidance from the Board concerning the acceptability of the permanent changes in accordance with the section on post registration changes in the Project cycle procedure.	DR/OA	It is confirmed through the on-site assessment and the review of the relevant documents that there are no issues which the PPs are unable to implement the approved revised monitoring plan.	OK	OK
VVS E.4.05	1	266. The DOE shall determine whether the permanent changes are likely to lead to a reduction in the accuracy of the calculation of emission reductions. In cases where the DOE considers that the permanent changes will lead to a reduction in the accuracy of the calculation of emission reductions, the DOE shall request the project participants to apply conservative assumptions or discount factors to the calculations to the extent required to ensure that emission reductions will not be over-estimated as a result of the permanent change.	DR/OA	Refer to VVS E.4.02.	OK	OK
VVS E.4.06	1	267. Where permanent changes are identified during verification, the DOE shall indicate in the verification report how the revised PDD reflects the application of the approved guidance from the Board regarding the permanent changes from the provisions of the registered monitoring plan and/or methodology.	DR/OA	It is confirmed through the on-site assessment and the review of the relevant documents that no permanent changes from the approved revised monitoring plan or monitoring methodology are identified. Refer to Section 3.7.4 of the verification report.	OK	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
VVS E.4.07	1	268. Where permanent changes are identified prior to verification, the DOE shall state its opinion on whether the permanent changes reflect the application of the approved guidance from the Board regarding the deviation from the provisions of the registered monitoring plan and/or methodology.	DR/OA	Refer to VVS E.4.06.	OK	OK
VVS E.5		<u>5. Changes to the project design of a registered project activity</u>				
VVS E.5.02	1	270. If the DOE identifies that the project design in the implementation or operation of the project activity does not conform with the description contained in the registered PDD or the relevant provisions of appendix 1 of the Project standard, the DOE shall request guidance from the Board concerning the acceptability of the proposed or actual changes in accordance with the section on post registration changes in the Project cycle procedure.	DR/OA	It is confirmed through the on-site assessment and the review of the relevant documents that there are no changes to the project design of the approved revised PDD.	OK	OK
VVS E.5.03	1	271. In case of actual changes, the DOE shall, by means of an on-site visit and review of the submitted revised PDD by the project participants, which describes the nature and extent of the actual changes, determine whether this description accurately reflects the implementation, operation and monitoring of the modified project activity.	DR/OA	Refer to VVS E.5.02.	OK	OK
VVS E.5.04	1	272. The DOE shall conduct an on-site inspection to assess the impacts of the actual changes on the compliance of the monitoring plan, the applied monitoring methodology and tools and/or the level of accuracy of the monitoring activity.	DR/OA	Refer to VVS E.5.02.	OK	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
VVS E.5.05	1	273. The DOE shall, by means of reviewing the revised PDD against applicable additionality and methodological requirements, determine whether the proposed or actual changes would adversely affect the conclusions of the validation report of the registered PDD with regard to: (a) Additionality of the project activity; (b) Scale of the project activity; (c) Applicability and application of approved baseline methodology under which the project activity has been registered; or (d) The compliance of the monitoring plan with the applied monitoring methodology.	DR/OA	Refer to VVS E.5.02.	OK	OK
VVS E.5.06	1	274. If the proposed or actual changes affect the additionality of the project activity then the DOE shall confirm that: (a) In the case of investment analysis, project participants have only modified the key parameters in the original spreadsheet calculations affected by the proposed or actual changes to the project activity; (b) In the case where only barriers have been claimed to demonstrate additionality, project participants have demonstrated that the barriers are still valid under the new circumstances.	DR/OA	Refer to VVS E.5.02.	OK	OK
VVS E.5.07	1	275. In cases where the proposed or actual changes impact the implementation of the project activity and where the original methodology would no longer be applicable, and where the project participant applies a later version of the methodology or another methodology that is applicable to the project activity, the DOE shall confirm that the applied methodology and tools do not impact the conservativeness of the monitoring and verification process and the related emission reduction calculations.	DR/OA	Refer to VVS E.5.02.	OK	OK
VVS E.5.08	1	276. The DOE shall assess whether the revised PDD complies with the applied monitoring methodology and tools or any later version of the methodology or the requirements of another methodology that is applicable to the project activity.	DR/OA	Refer to VVS E.5.02.	OK	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
VVS E.5.09	1	277. Where the proposed or actual changes are identified during verification, the DOE shall indicate its opinion in the verification report on how the revised PDD reflects the application of the approved guidance from the Board regarding the proposed or actual changes from the provisions of the registered monitoring plan and/or methodology and as per the applicable provisions of the Project Standard.	DR/OA	It is confirmed through the on-site assessment and the review of the relevant documents that no changes to the project design of a revised project activity are identified. Refer to Section 3.7.5 of the verification report.	OK	OK
VVS E.5.10	1	278. Where the permanent changes are identified prior to verification, the DOE shall state its opinion on whether the permanent changes reflect the application of the approved guidance from the Board regarding the deviation from the provisions of the registered monitoring plan and/or methodology and as per the applicable provisions of the Project Standard.	DR/OA	No change to the project design of a registered project activity was identified prior to verification. Refer to Section 3.7.5 of the verification report.	OK	OK
VVS E.5.11	1	279. The DOE shall provide an opinion containing: (a) A description of the proposed or actual changes as compared to the description in the registered PDD; (b) An assessment on when the changes occurred, reasons for these changes taking place, whether the changes would have been known prior to registration of the project activity, and how the changes would impact the overall operation/ability of the project activity to deliver emission reductions as stated in the PDD; (c) An assessment regarding whether the changes would adversely affect the conclusions of the validation report of the registered PDD with regard to: (i) Additionality of the project activity; (ii) Scale of the project activity; (iii) Applicability and application of approved baseline methodology under which the project activity has been registered or the later version of the applied methodology; (iv) The compliance of the monitoring plan with applied monitoring methodology; or (v) The level of accuracy of the monitoring compared with the requirements contained in the registered monitoring plan.	DR/OA	Refer to VVS E.5.09.	OK	OK

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Section Seq. No.	Ref. No.	Requirement	MoV	Comments	Draft Conc.	Final Conc.
VVS E.5.12	1	280. In validating the revised PDD containing the proposed and actual changes, and in preparing the validation opinion, the DOE shall include information on how: (a) The proposed revisions ensure that the level of accuracy and completeness ⁴¹ in the monitoring and verification process is not reduced as a result of the revision. The DOE shall, using objective evidence, assess the accuracy and completeness of each proposed revision to the monitoring plan, including the frequency of measurements, the quality of monitoring equipment (e.g. calibration requirements, and the quality assurance and quality control procedures); (b) The proposed revisions are in accordance with the monitoring methodology. In cases where the proposed revision refers to a later version of the applied methodology, the DOE shall confirm that this application does not compromise the conservativeness in the monitoring and verification process and of the emission reduction calculations; (c) The findings of previous verification reports, if any, have been taken into account.	DR/OA	Refer to VVS E.5.09.	OK	OK
VVS E.5.13	1	281. If the DOE determines that the proposed or actual changes to the project activity comply with the requirements established in the Project Standard, the DOE shall submit the documents to the Board following the Project cycle procedure for post registration changes.	DR/OA	Refer to VVS E.5.09.	OK	OK
VVS E.5.14	1	282. If the DOE determines that the proposed or actual changes to the project activity do not comply with the requirements established in the Project Standard, the DOE shall issue a negative validation opinion or should request guidance from the Board.	DR/OA	Refer to VVS E.5.09.	OK	OK

Table 4 Resolution of CARs and CLs raised during the verification process

Draft Conc.	CARs / CLs / FARs raised by the Verification Team	Project Participant's Response	DOE Comments and Conclusion	Final Conc.
FARs raised in the 1st verification				
FAR 01	The daily data records and the interview with the PPs show that the biogas has never been used as feedstock for hydrogen production in the first monitoring period due to the deactivation of the Ni catalyst in the hydrogen production plant which was occurred during the commissioning test. The use of biogas as feedstock is to be confirmed in the next periodic verification as it is essential feature of the CDM Project.	The PPs describe in B.1 of the revised MR that actions to reduce H ₂ S and moisture in biogas have been taken during the 2nd monitoring period and eventually Nubika succeed the production of hydrogen from biogas as feedstock in April 2012.	During the 2nd monitoring period, the PPs have continuously strived to reduce both H ₂ S and moisture contents in biogas. Eventually, the PPs succeeded in feeding biogas as the feedstock for hydrogen production in April 2012 and the plant has been fully operated since June 2012. Through the review of the relevant documents such as Hydrogen Plant Journal, etc., on-site observation and the interview with the PPs, JQA confirms that the hydrogen production plant using biogas as feedstock has been fully operated since June 2012, in compliance with the approved revised PDD.	OK
FAR 02	Since PPs recognize the possible risk of data loss during the off-site calibration of some monitoring equipment (for 1-1.5 months), PPs are requested to establish an appropriate measure to avoid data loss for the next verification period.	The PPs describe in B.1 of the revised MR that spare flow meters (F-00 to F-06) were prepared to reduce possible risk of data loss during the off-site calibration, and the main meter and its spare meter were alternately used for the continuous monitoring.	To reduce the risk of data loss during off-site calibration, the PPs have prepared spare flow meters (F-00 to F-06). When the monitoring equipments are due for calibration, they are switched to their spare flow meters while waiting for the calibration sent to accredited calibration entity. Through the review of calibration certificates, on-site inspection and the interview with the PPs, JQA confirms that the spare flow meters of F-00 to F-06 are prepared and used during the off-site calibration of the main flow meters.	OK
FAR 03	Although PPs verbally explained their training activities during the 1st monitoring period, any documented procedures/ records could not be confirmed. Documented CDM training plan and its record format are to be prepared for the next verification period.	The PPs describe in B.1 of the revised MR that the contents and discussion of CDM training conducted on 23/08/2011 and 30/07/2012 were documented in the meeting minutes.	The PPs have scheduled an annual training and information meeting to keep the staffs responsible for monitoring and reporting of the data up-to-date. During the 2nd monitoring period, the training was conducted on 23/08/2011 and 30-31/07/2012 under the cooperation of the CDM consultant. The minutes of the training and the list of attendee with their signatures were provided. Through the review of the minutes and materials used in the training and the interview with the PPs, JQA confirms that the training is appropriately implemented every year during the 2nd monitoring period in accordance with the approved revised monitoring plan.	OK

Draft Conc.	CARs / CLs / FARs raised by the Verification Team	Project Participant's Response	DOE Comments and Conclusion	Final Conc.
FAR 04	Monitoring data of F-01 and F-03 shown in Biogas Journal are calculated as daily values. Original data (hourly readings) are recorded in other data sheet. As many calculation errors are found between Biogas Journal and the original data sheet, the PPs are requested to improve the data sheet format for the next verification period.	The PPs describe in B.1 of the revised MR that Nubika has improved the data sheet format of biogas journal to reduce errors in the calculation and transcription.	The PPs have improved the data sheet format of biogas journal such that the monitoring data of biogas flows are all done hourly. This action is taken to reduce the calculation errors when transferring the data from the journal into the computerized format. Through the review of the relevant data documents and the cross-check of the data in the sheet, JQA confirms that the data sheet format was appropriately improved.	OK
FAR 05	The PPs are requested to take necessary actions to ensure the accurate monitoring of V_{AD} for the next monitoring period, such as adjustment/ replacement of meter F-01.	The PPs describe in B.1 of the revised MR that Nubika has taken continuous efforts to improve accuracy of monitoring data of V_{AD} including the switch of the main meter F-01 to its spare meter.	<p>To check the accuracy and reliability of V_{AD} monitoring data measured by the flow meter F-01, the existing flow meter was replaced with a new spare meter on 14/07/2011. From the comparison of V_{AD} with V_{TR} ($= V_D + V_F$), it was found that the accuracy and reliability level of V_{AD} monitoring data since 14/07/2011 had not been improved by the replacement of the flow meter F-01.</p> <p>Through further review of relevant monitoring data and manufacturer's specification of the flow meter F-01, and the interview with the PPs, JQA has confirmed that there was a large discrepancy between the actual flow rate of biogas collected from the anaerobic digester (AD) and optimal measurement range of the flow meter F-01 installed in the AD plant. The mismatched installation of the flow meter F-01 led to a reduction in the accuracy level of the V_{AD} monitoring data.</p> <p>As the PPs failed to ensure the accurate monitoring of V_{AD} in the 2nd monitoring period, CAR 04 was newly raised to resolve this issue.</p>	--

Draft Conc.	CARs / CLs / FARs raised by the Verification Team	Project Participant's Response	DOE Comments and Conclusion	Final Conc.
CARs/CLs/FARs raised in the 2nd verification				
CAR 01	<p>Delayed calibration of F-02, F-03, F-04, F-05, F-06, COD analyzer and FC_{Diesel} are identified. The values of the baseline and leakage emissions are not corrected in a conservative manner, taking into consideration the delayed calibration, during the period between the scheduled date and the actual date of calibration.</p> <p>(a) The maximum permissible errors of these equipment are to be applied in the calculation of baseline and leakage emissions.</p> <p>(b) The error identified in the delayed calibration test is to be applied if the error is beyond the maximum permissible error.</p>	<p>Delayed calibration are confirmed for F-04, F-05, F-06, and COD analyzer. For F-02 and F-03, spare flow meters calibration certificates cover the period of monitoring, while the last calibration certificate of FC_{Diesel} is provided. PP has revised both Monitoring Report and ER calculation spreadsheet to address the delayed calibration of all the confirmed parameters.</p>	<p>It is confirmed through the on-site inspection, the calibration certificates and the interview with the PP that the main flow meters of F-02 and F-03 were switched to their spare meters during the off-site calibration of the main meters. Therefore, the monitoring with F-02 and F-03 covered the whole monitoring period.</p> <p>As for the flow meters of F-04, F-05 and F-06, the measured values of the delayed calibration are corrected as follows:</p> <p>- F-04: The values of M_{LPG,FEED} measured from 04/04/2012 to 31/07/2012 are increased by applying a maximum uncertainty of 4% in the approved revised PDD. This parameter is used in the calculation of m_{H2,LPG} and increased values lead to a conservative calculation of B_{LPG,FEED}.</p> <p>- F-05: The value of M_{LPG,FUEL} data is 0 during the 2nd monitoring period. Therefore, the delayed calibration of F-05 from 28/04/2011 to 07/11/2011 does not affect the calculation of emission reductions.</p> <p>- F-06: The values of V_{H2,T} measured from 01/06/2011 to 15/11/2011 are decreased by applying a maximum uncertainty of 4% in the approved revised PDD. This parameter is used in the calculation of m_{H2,T} and decreased values lead to a conservative calculation of As for the delayed calibration of Spectrophotometer, the measured values are corrected as follows:</p> <p>- COD_{y,ww,untreated}: The measured data from 29/05/2011 to 18/12/2011 are decreased by applying a maximum permissible error of the instrument with 0.5%. The decreased values are conservatively used in the calculation of</p> $COD_{y,removed,AD} = COD_{y,ww,untreated} - COD_{y,ww,treated_AD}$ <p>- COD_{y,ww,treated_AD}: The measured data from 29/05/2011 to 18/12/2011 are increased by applying a maximum permissible error of the instrument with 0.5%. The increased values are conservatively used in the calculation of</p> $COD_{y,removed,AD} = COD_{y,ww,untreated} - COD_{y,ww,treated_AD}$ <p>- COD_{y,ww,treated}: The measured data from 29/05/2011 to 18/12/2011 are increased by applying a maximum permissible error of the instrument with 0.5%.</p>	OK
CAR 02	<p>The quarterly data of LPG composition are not appropriately applied in the calculation of R_{CO2/H2}, R_{H2/LPG} and MW_{LPG} in the MR and ER calculation spreadsheet.</p>	<p>PP has revised both Monitoring Report (ver. 2.2) and ER calculation spreadsheet (ver. 2.1) to include the quarterly data of LPG composition for the calculation of baseline emissions, including EF_{LPG} and LPG density.</p>	<p>The quarterly data of m₁, m₂ issued by the supplier are correctly applied to the calculation of R_{CO2/H2}, R_{H2/LPG} and MW_{LPG} in the revised MR and revised ER calculation spreadsheet.</p>	OK

Draft Conc.	CARs / CLs / FARs raised by the Verification Team	Project Participant's Response	DOE Comments and Conclusion	Final Conc.
CAR 03	<p>1) The daily quantity of methane production was calculated not using the daily methane concentration, but using monthly averaged methane concentration.</p> <p>2) The amounts of V_D and V_F since Sep 2011 in Table 1 of the MR and the ER calculation spreadsheet are not consistent with those in Biogas Journal (logbook data).</p>	<p>1) PP has revised both Monitoring Report and ER calculation spreadsheet in version 2.0 to calculate the monthly methane concentration back from the total daily quantity of methane production. As such, the quantity of methane production is calculated based on the actual daily methane concentration.</p> <p>2) Due to the update of data sheet for Biogas plant in response to FAR 04 raised in the 1st verification, the data of V_D and V_F were mistakenly swapped from Sep 2011 to July 2012.</p>	<p>1) The daily quantity of methane production (BE_{CH_4}) is calculated using daily methane concentration (X_{CH_4}) and daily amount of biogas (V_{TR}). The monthly data of BE_{CH_4} in Table 1 of the revised MR and ER calculation spreadsheet are correctly calculated.</p> <p>2) It is confirmed that the data of V_D and V_F in Table 1 of the revised MR and therevised ER calculation spreadsheet are corrected and calculated appropriately.</p>	OK
CAR 04	The PPs are further requested to take necessary actions such as changes to the appropriate measurement range of flow meter to ensure the accurate monitoring of V_{AD} , taking into account the actual flow rate of biogas.	The flow meters F-01 to F-03 were further replaced with the new meters having smaller diameter on 04/06/2013. A two-week monitoring test conducted in July 2013 showed accuracy improvement in monitoring of the biogas flow. The test resulted in 1 to 2 % difference between V_{AD} and V_{TR} .	The PPs replaced the existing flow meters F-01 to F-03 with a new meter having an appropriate measurement range on 04/06/2013, taking into account the actual flow data of biogas monitored during the 2nd monitoring period. A two-week monitoring test using the replaced flow meter F-01 demonstrated that the accuracy level of the monitoring system was much improved and the difference between V_{AD} and V_{TR} was decreased to an accuracy level of 1-2%. Thus, CAR 04 is resolved.	OK
CL 01	The description on the change to the start date of the 1st crediting period from 30/06/2009 to 01/05/2010 in A.1 and B.2.5 is not necessary because the change has already been approved by the EB on 26/08/2010 and confirmed on the UNFCCC website.	PP has deleted the description on the change to the start date of the 1st crediting period in Monitoring Report (ver. 2.2).	The description is removed from A.1 and B.2.5 of the revised MR.	OK
CL 02	The response to FAR 03 raised in the 1st verification is not included in B.1 and Section C, while the training activity has been actually implemented in this monitoring period.	The response to FAR 03 on the implementation of training activity is included in section B.1 and Section C of revised MR (ver. 2.2).	The response to FAR 03 on the implementation of training activity was added in Section B.1 and Section C of the revised MR. The date and minutes of CDM Staff training which was conducted on 23/08/2011 and 30-31/07/2012 were also added in Section B.1 and Section C of the revised MR.	OK
CL 03	The request for permanent change submitted in the 1st monitoring period was approved by the CDM-EB on 19/07/2011. As the issues contained in B.2.3 are limited to the permanent changes during the 2nd monitoring period, the above description is not necessary.	PP has deleted the description on the request for permanent change addressed during the 1st monitoring period in Monitoring Report (ver. 2.2).	The description is removed from B.2.3 of the revised MR.	OK

Draft Conc.	CARs / CLs / FARs raised by the Verification Team	Project Participant's Response	DOE Comments and Conclusion	Final Conc.
CL 04	The changes to project design of registered project activity submitted in the 1st monitoring period were approved by the CDM-EB on 19/07/2011. As the issues contained in B.2.4 are limited to the project design changes during the 2nd monitoring period, the above description is not necessary.	PP has deleted the description on the changes to project design of registered project activity addressed during the 1st monitoring period in Monitoring Report (ver. 2.2).	The description is removed from B.2.4 of the revised MR.	OK
CL 05	It is not clear why leakage is not included in the cell of "Purpose of data" in D.1. These parameters are used in the calculation of leakage.	PP has added the description of "leakage" in the cell of "Purpose of data" of Section D.1 for all the relevant parameters in Monitoring Report (ver. 2.2).	The description of "leakage" is appropriately added for all the relevant parameters in D.1 of the revised MR.	OK
CL 06	<p>1) The calibration frequency of F-01, F-02, F-03, F-04, F-05 and F-06 in the MR (every year) is not consistent with that in the revised PDD (every 2 years).</p> <p>2) It is not clear whether the flow meters (F-01 (V_{AD}) and F-06 ($V_{H2,T}$)) are replaced or not during this monitoring period. (Their serial number are changed from the information in the 1st MR) If replaced, the change is to be clearly described in B.1 and D.2.</p> <p>3) Serial numbers of F-04 and F-05 in the MR are not consistent with those in their calibration records.</p> <p>4) The calibration date and frequency of the flow meter F-00 are not consistent with those in the 1st MR.</p> <p>5) The quarterly data of LPG composition (m_1 & m_2) and EF_{LPG} are not included using table.</p>	<p>1) PP has corrected and revised the calibration frequency of F-01 to F-06 in Monitoring Report (ver. 2.2) according to the revised monitoring plan, applied methodologies, manufacturer's recommendation and calibration certificates.</p> <p>2) The switching of flow meters are described in section B.1. of revised MR (ver. 2.2).</p> <p>3) Serial Number of F-04 and F-05 (both main and spare) are clarified in section D.2. of revised MR (ver. 2.2).</p> <p>4) The calibration date and frequency of flowmeter F-00 (both main and spare flow meters) have been corrected to be consistent with 1st MR.</p> <p>5) Quarterly values of LPG composition and $EFLPG$ are added using table in Section D.2. of revised MR (ver. 2.2).</p>	<p>1) The revision of calibration frequency for gas flow meters is confirmed in the revised MR as follows:</p> <ul style="list-style-type: none"> - F-00 and F-01: every 2 years by the approved revised monitoring plan, - F-02 and F-03: every year by the calibration certificates, - F-04, F-05 and F-06: every year by the manufacturer's specification. <p>2) It is confirmed through on-site inspection, calibration certificates and the interview with the PP that all gas flow meters (F-00, F-01, F-02, F-03, F-04, F-05 and F-06) are switched to spare flow meters during the 2nd monitoring period in order to avoid unavailability of monitoring data during off-site calibration. The alternative use of them is clearly described in Section B.1 of the revised MR.</p> <p>3) It is confirmed through on-site inspection, calibration certificates and the interview with the PP that the serial numbers of all flow meters including the main and spare ones are correctly described in Sections B.1 and D.2 of the revised MR.</p> <p>4) The calibration date and frequency of the flow meter F-00 (both main and spare flow meters) are appropriately corrected in Section D.2 of the revised Monitoring Report.</p> <p>5) The quarterly data of LPG composition (m_1 & m_2) and EF_{LPG} are described in Section D.2 using table.</p>	OK
CL 07	The calibration certificate of F-04 in 2012, FC_{Diesel} in 2011, $FT_{20,y}$ in 2011 and 2012 are not provided.	The certificates of FC_{Diesel} in 2011 and $FT_{20,y}$ in 2011 are provided. The latest certificate of F-04 calibrated in 213 is provided.	The calibration certificates of FC_{Diesel} and $FT_{20,y}$ in 2011, and F-04 in 2013 are provided.	OK
CL 08	The value of V_{AD} is used in the calculation of biogas generated in Table 5 of the MR and ER calculation spreadsheet, whereas the value of V_{TR} is used in the calculation of baseline emissions from methane recovery.	The value of V_{TR} is used in both Table 5 and calculation of baseline emissions from methane recovery in the revised MR (ver. 2.2).	It is confirmed that the V_{TR} data is used in Table 5 of the revised MR and revised ER calculation spreadsheet to calculate the actual methane generation rate from the wastewater.	OK

Draft Conc.	CARs / CLs / FARs raised by the Verification Team	Project Participant's Response	DOE Comments and Conclusion	Final Conc.
FAR 01	The PPs is required to establish the management system to ensure the calibration frequency of monitoring equipment without delay for the next monitoring period, such as making of the calibration schedule plan and the clarification of role and responsibility of CDM staffs.			

Certificate

Name **Dr. Tadashi Yoshida**
Assessor No. **CDM-AS-104**
Date of registration **8th October 2010**

This is to certify that **Dr. Tadashi Yoshida**
is registered as CDM Assessor
by Japan Quality Assurance Organization.

Date 16th April 2012

Japan Quality Assurance Organization



Senior Executive

Team Leader Qualification

The above mentioned assessor is qualified as Team Leader.

Date of qualification *4th December, 2012*

Date *4th December, 2012*

Japan Quality Assurance Organization



Senior Executive

Appendix B

Grant of technical area within CDM/JI sectoral scope

Name: Dr.Tadashi Yoshida

Sectoral Scope(SS)		Technical Area(TA)		Granted date
SS1	Energy industries (renewable / non-renewable sources)	TA 1.1:	Thermal energy generation from fossil fuels and biomass including thermal electricity from solar (COMPLEX)	
		TA 1.2:	Energy generation from renewable energy sources	28th Dec. 2010
SS2	Energy distribution	TA 2.1:	Electricity distribution	
		TA 2.2:	Heat distribution	
SS3	Energy demand	TA 3.1:	Energy demand	
SS4	Manufacturing industries	TA 4.1:	Cement sector (COMPLEX)	
		TA 4.2:	Aluminum (COMPLEX)	
		TA 4.3:	Iron and steel (COMPLEX)	
		TA 4.4:	Refinery (COMPLEX)	28th Dec. 2010
		TA 4.5:	Chemical industry (COMPLEX)	28th Dec. 2010
		TA 4.6:	Other production	28th Dec. 2010
SS5	Chemical industry	TA 5.1:	Chemical process industries (COMPLEX)	28th Dec. 2010
SS6	Construction	TA 6.1:	Construction	
SS7	Transport	TA 7.1:	Transport	
SS8	Mining/Mineral production	TA 8.1:	Mining and mineral processes, excluding those included in TA 8.2 below	
		TA 8.2:	Oil and gas industry, coal mine methane recovery and use (COMPLEX)	
SS9	Metal production	TA 9.1:	Metal production	
SS10	Fugitive emissions from fuels (solid, oil and gas)	TA 10.1:	Mining and mineral processes, excluding those included in TA 10.2 below	
		TA 10.2:	Oil and gas industry, coal mine methane recovery and use (COMPLEX)	
SS11	Fugitive emissions from production and consumption of halocarbons and sulphur hexafluoride	TA 11.1:	Chemical process industries (COMPLEX)	28th Dec. 2010
		TA 11.2:	GHG capture and destruction	
SS12	Solvents use	TA 12.1:	Chemical process industries (COMPLEX)	28th Dec. 2010
SS13	Waste handling and disposal	TA 13.1:	Waste handling and disposal	29th May 2012
		TA 13.2:	Animal waste management	
SS14	Afforestation and reforestation/Land-use, land-use change and forestry	TA 14.1:	Forestry	
SS15	Agriculture	TA 15.1:	Agriculture	
		TA 15.2:	Animal waste management	

This is to certify that Dr. Tadashi Yoshida is granted the above technical areas within sectoral scopes by the Japan Quality Assurance Organization.

Date: 29 May 2012

Director of the Global Environment Department
Japan Quality Assurance Organization

浅輪 紀男 Norio Asawa

Certificate

Name **Ms. Akiko Furuya**

Assessor No. **CDM-AS-106**

Date of registration **1st June 2011**

This is to certify that **Ms. Akiko Furuya**
is registered as **CDM** Assessor
by Japan Quality Assurance Organization.

Date 16th April 2012

Japan Quality Assurance Organization



Senior Executive

Team Leader Qualification

The above mentioned assessor is qualified as Team Leader.

Date of qualification

Date

Japan Quality Assurance Organization

Senior Executive

Appendix B

Grant of technical area within CDM/JI sectoral scope

Name: Ms. Akiko Furuya

Sectoral Scope(SS)		Technical Area(TA)		Granted date
SS1	Energy industries (renewable / non-renewable sources)	TA 1.1:	Thermal energy generation from fossil fuels and biomass including thermal electricity from solar (COMPLEX)	1st June.2011
		TA 1.2:	Energy generation from renewable energy sources	
SS2	Energy distribution	TA 2.1:	Electricity distribution	
		TA 2.2:	Heat distribution	
SS3	Energy demand	TA 3.1:	Energy demand	
SS4	Manufacturing industries	TA 4.1:	Cement sector (COMPLEX)	
		TA 4.2:	Aluminum (COMPLEX)	
		TA 4.3:	Iron and steel (COMPLEX)	
		TA 4.4:	Refinery (COMPLEX)	
		TA 4.5:	Chemical industry (COMPLEX)	
		TA 4.6:	Other production	
SS5	Chemical industry	TA 5.1:	Chemical process industries (COMPLEX)	
SS6	Construction	TA 6.1:	Construction	
SS7	Transport	TA 7.1:	Transport	
SS8	Mining/Mineral production	TA 8.1:	Mining and mineral processes, excluding those included in TA 8.2 below	
		TA 8.2:	Oil and gas industry, coal mine methane recovery and use (COMPLEX)	
SS9	Metal production	TA 9.1:	Metal production	
SS10	Fugitive emissions from fuels (solid, oil and gas)	TA 10.1:	Mining and mineral processes, excluding those included in TA 10.2 below	
		TA 10.2:	Oil and gas industry, coal mine methane recovery and use (COMPLEX)	
SS11	Fugitive emissions from production and consumption of halocarbons and sulphur hexafluoride	TA 11.1:	Chemical process industries (COMPLEX)	
		TA 11.2:	GHG capture and destruction	
SS12	Solvents use	TA 12.1:	Chemical process industries (COMPLEX)	
SS13	Waste handling and disposal	TA 13.1:	Waste handling and disposal	1st June.2011
		TA 13.2:	Animal waste management	1st June.2011
SS14	Afforestation and reforestation/Land-use, land-use change and forestry	TA 14.1:	Forestry	
SS15	Agriculture	TA 15.1:	Agriculture	1st June.2011
		TA 15.2:	Animal waste management	

This is to certify that Ms. Akiko Furuya is granted the above technical areas within sectoral scopes by the Japan Quality Assurance Organization.

Date: 16th Apr. 2012

Director of the Global Environment Department
Japan Quality Assurance Organization

浅輪 紀男

Norio Asawa

Certificate

Name **Mr. Hiroshi Motokawa**

Reviewer No. **CDM-TR-102**

Date of registration **14th July 2010**

This is to certify that Mr. Hiroshi Motokawa
is registered as CDM Technical Reviewer
by Japan Quality Assurance Organization.

Date **16th April 2012**

Japan Quality Assurance Organization



Senior Executive

Appendix B

Grant of technical area within CDM/JI sectoral scope

Name: Mr. Hiroshi Motokawa

Sectoral Scope(SS)		Technical Area(TA)		Granted date
SS1	Energy industries (renewable / non-renewable sources)	TA 1.1:	Thermal energy generation from fossil fuels and biomass including thermal electricity from solar (COMPLEX)	28th Dec. 2010
		TA 1.2:	Energy generation from renewable energy sources	
SS2	Energy distribution	TA 2.1:	Electricity distribution	
		TA 2.2:	Heat distribution	
SS3	Energy demand	TA 3.1:	Energy demand	
SS4	Manufacturing industries	TA 4.1:	Cement sector (COMPLEX)	
		TA 4.2:	Aluminum (COMPLEX)	
		TA 4.3:	Iron and steel (COMPLEX)	
		TA 4.4:	Refinery (COMPLEX)	
		TA 4.5:	Chemical industry (COMPLEX)	
		TA 4.6:	Other production	
SS5	Chemical industry	TA 5.1:	Chemical process industries (COMPLEX)	
SS6	Construction	TA 6.1:	Construction	
SS7	Transport	TA 7.1:	Transport	
SS8	Mining/Mineral production	TA 8.1:	Mining and mineral processes, excluding those included in TA 8.2 below	
		TA 8.2:	Oil and gas industry, coal mine methane recovery and use (COMPLEX)	
SS9	Metal production	TA 9.1:	Metal production	
SS10	Fugitive emissions from fuels (solid, oil and gas)	TA 10.1:	Mining and mineral processes, excluding those included in TA 10.2 below	
		TA 10.2:	Oil and gas industry, coal mine methane recovery and use (COMPLEX)	
SS11	Fugitive emissions from production and consumption of halocarbons and sulphur hexafluoride	TA 11.1:	Chemical process industries (COMPLEX)	
		TA 11.2:	GHG capture and destruction	
SS12	Solvents use	TA 12.1:	Chemical process industries (COMPLEX)	
SS13	Waste handling and disposal	TA 13.1:	Waste handling and disposal	1st Feb.2011
		TA 13.2:	Animal waste management	
SS14	Afforestation and reforestation/Land-use, land-use change and forestry	TA 14.1:	Forestry	
SS15	Agriculture	TA 15.1:	Agriculture	
		TA 15.2:	Animal waste management	

This is to certify that Mr. Hiroshi Motokawa is granted the above technical areas within sectoral scopes by the Japan Quality Assurance Organization.

Date: 16th Apr. 2012

Director of the Global Environment Department
Japan Quality Assurance Organization

浅輪 紀男

Norio Asawa

Certificate

Name **Dr. Hiroshi Kuribayashi**

Reviewer No. **CDM-TR-205**

Date of registration **14th March 2011**

This is to certify that Dr. Hiroshi Kuribayashi
is registered as CDM Technical Reviewer
by Japan Quality Assurance Organization.

Date **16th April 2012**

Japan Quality Assurance Organization



Senior Executive

Appendix B

Grant of technical area within CDM/JI sectoral scope

Name: Dr. Hiroshi Kuribayashi

Sectoral Scope(SS)		Technical Area(TA)		Granted date
SS1	Energy industries (renewable / non-renewable sources)	TA 1.1:	Thermal energy generation from fossil fuels and biomass including thermal electricity from solar (COMPLEX)	
		TA 1.2:	Energy generation from renewable energy sources	
SS2	Energy distribution	TA 2.1:	Electricity distribution	
		TA 2.2:	Heat distribution	
SS3	Energy demand	TA 3.1:	Energy demand	
SS4	Manufacturing industries	TA 4.1:	Cement sector (COMPLEX)	
		TA 4.2:	Aluminum (COMPLEX)	
		TA 4.3:	Iron and steel (COMPLEX)	
		TA 4.4:	Refinery (COMPLEX)	14th Mar. 2011
		TA 4.5:	Chemical industry (COMPLEX)	14th Mar. 2011
		TA 4.6:	Other production	14th Mar. 2011
SS5	Chemical industry	TA 5.1:	Chemical process industries (COMPLEX)	14th Mar. 2011
SS6	Construction	TA 6.1:	Construction	
SS7	Transport	TA 7.1:	Transport	
SS8	Mining/Mineral production	TA 8.1:	Mining and mineral processes, excluding those included in TA 8.2 below	
		TA 8.2:	Oil and gas industry, coal mine methane recovery and use (COMPLEX)	
SS9	Metal production	TA 9.1:	Metal production	
SS10	Fugitive emissions from fuels (solid, oil and gas)	TA 10.1:	Mining and mineral processes, excluding those included in TA 10.2 below	
		TA 10.2:	Oil and gas industry, coal mine methane recovery and use (COMPLEX)	
SS11	Fugitive emissions from production and consumption of halocarbons and sulphur hexafluoride	TA 11.1:	Chemical process industries (COMPLEX)	
		TA 11.2:	GHG capture and destruction	
SS12	Solvents use	TA 12.1:	Chemical process industries (COMPLEX)	
SS13	Waste handling and disposal	TA 13.1:	Waste handling and disposal	
		TA 13.2:	Animal waste management	
SS14	Afforestation and reforestation/Land-use, land-use change and forestry	TA 14.1:	Forestry	
SS15	Agriculture	TA 15.1:	Agriculture	
		TA 15.2:	Animal waste management	

This is to certify that Dr. Hiroshi Kuribayashi is granted the above technical areas within sectoral scopes by the Japan Quality Assurance Organization.

Date: 16th Apr. 2012

Director of the Global Environment Department
Japan Quality Assurance Organization

浅輪 紀男

Norio Asawa

Appendix C

Expertise and Experience of Assessors and Technical Reviewers

Tadashi YOSHIDA

He holds a Bachelor's degree, a Master's degree and Ph.D. in chemical engineering. Before joining JQA, he had been engaged in the research and development in a field of chemical processes for 34 years at a national research institute and published over 100 technical papers and articles mainly about the coal liquefaction and natural gas convention technologies. He has successfully completed GHG Validator/Verifier Training Program and also ISO 14001 Training Course to be qualified as provisional auditor. He has participated in various CDM projects, both validation and verification in JQA.

Akiko FURUYA

She holds a Bachelor's degree in agriculture and Master's degree in environmental study. Before joining JQA, she had worked as an environmental consultant and engaged in environmental and social impact analysis of overseas large-scale development projects, survey of overseas environmental legislation and Official Development Assistance (ODA) projects, writing PDD and monitoring reports for CDM projects. She has successfully completed GHG Validator/Verifier Training Program, also ISO 14001 Training Course to be qualified as a provisional auditor. She has participated in various CDM projects, both validation and verification in JQA.

Hiroshi MOTOKAWA

He holds a Bachelor's degree in economics. Before joining JQA, he had been engaged in planning and management of the recycling facility, also engaged in the studies of Life Cycle Assessment at Consulting firm. His expertise is LCA study including ecological balances of the energy production systems such as thermal power, hydropower, etc. He has successfully completed GHG Validator/Verifier Training Program, also ISO 14001 Training Course to be qualified as a provisional auditor. He has participated in various CDM projects, both validation and verification in JQA.

Hiroshi KURIBAYASHI

He holds a Bachelor's degree in Engineering and a Ph.D. in Applied Chemistry of

Appendix C

Engineering. He had been engaged with the various projects related to chemistry, refinery, and environment for 34 years at the engineering firms in Japan. Besides, he had been dispatched to the Environmental Agency of Argentina as a CDM expert for five years and contributed for establishing CDM scheme. In JQA, he had been a member of the CDM/JI Certification Committee for 5 years.