

VERIFICATION REPORT

ECO Special Waste Management Pte. Ltd.

2nd Verification of
Dehydration and incineration
of sewage sludge in Singapore

CDM Reference No. 3042

Report No. GR12W0035D

25 September, 2013

JACO CDM

Verification Report

Date of first issue: 30 May, 2013	
Approved by: Michio HIRUTA CEO & President, JACO CDM	Project No.: UNFCCC ref. No. 3042
Client: ECO Special Waste Management Pte. Ltd.	Client ref.:

Summary:
JACO CDM has performed a verification of 2nd monitoring period of the CDM project "Dehydration and incineration of sewage sludge in Singapore". The verification is based on the currently valid documentation of the UN Framework Convention on Climate Change (UNFCCC). In this context, the relevant documents are the "Marrakech Accords".

The management of ECO Special Waste Management Pte. Ltd. is responsible for the preparation of the GHG emission data and the reported GHG emissions reductions of the "Dehydration and incineration of sewage sludge in Singapore" on the basis set out within the project Monitoring and Verification Plan indicated in the registered PDD version 06 dated 9 September 2010, which is complying with the consolidated methodology AM0025 version 11. The development and maintenance of records and reporting procedures in accordance with that plan, including the calculation and determination of GHG emission reductions from the project is the responsibility of the management of the project.

The verifier assesses that the project is implemented and operated as planned and described in the validated and registered PDD. Installed equipment being essential for generating emission reduction runs reliably and is calibrated appropriately. The monitoring system is in place and the project is generating GHG emission reductions.

The verifier assesses that the monitoring was done in accordance the monitoring plan and the GHG emission reduction in the Monitoring Report version 03 is calculated without material misstatements. We pointed out 1CAR, 10CLs and 1FAR.

Our opinion relates to the project's GHG emissions and resulting GHG emissions reductions reported and related to the valid and registered project baseline and monitoring, and its associated documents. Based on the information we have seen and evaluated, we confirm the following statement. :

Reporting period: From 01-05-2011 to 30-04-2012

Verified emission in the above reporting period:

Emission reductions:	23,716 tCO₂ equivalents
Baseline emissions:	50,891 tCO ₂ equivalents
Project emissions:	25,642 tCO ₂ equivalents
Leakage emissions:	1,533 tCO ₂ equivalents
Emission reductions:	23,716 tCO ₂ equivalents

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Work carried out by: Teruo FUKUDA, Takahiro YUGUCHI, Kei NIIDA			
Work verified by: Akihide Madenokoji			
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Abbreviations

BE	Baseline Emission
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CL	Clarification Request
DOE	Designated Operational Entity
DOC	Degradable Organic Carbon
DS	Dry Sludge
DWS	Dewatered Sludge
EB	Executive Board
EF	Emission Factor
ER	Emission Reduction
FAR	Forward Action Request
GHG	Green House Gas
GWP	Global Warming Potential
MPRS	Metering and Pressure Regulating Skid
MSW	Municipal Sewage Waste
NCV	Net Calorific Value
NEA	National Environment Agency
PDD	Project Design Document
PE	Project Emission
PUB	Public Utilities Board of Singapore
SG	Stack Gas
SGD	Singapore Dollar
STP	Sludge Treatment Plant
SMBC	Sumitomo Mitsui Banking Corporation
Sm ³	Volume (m ³) at standard condition
TMTS	Tuas Marine Transfer Station
UNFCCC	United Nations Framework Convention for Climate Change
VF	Vehicle Fuel
VVM	Validation and Verification Manual
WRP	Water Reclamation Plant

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Appendix 1: Verification Checklist

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1. INTRODUCTION

1.1 Objective

ECO Special Waste Management Pte. Ltd. has commissioned an independent verification by JACO CDM., Ltd of its CDM project “Dehydration and incineration of sewage sludge in Singapore” (UNFCCC ref. 3042).

The objective of the verification work is to comply with the requirements of paragraph 62 of the CDM modalities and procedures.

This assessment shall:

- (a) Ensure that the project activity has been implemented and operated as per the registered PDD and that all physical features (technology, project equipment, and monitoring and metering equipment) of the project are in place;
- (b) Ensure that 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 and verifiable and in accordance with applicable CDM requirements. The CDM Executive Board provided a standardized format for monitoring report to improve consistency in reporting of the implementation and monitoring of the project activity by project participants;
- (c) Ensure that actual monitoring systems and procedures comply with the monitoring systems and procedures described in the monitoring plan and the approved methodology;
- (d) Evaluate the data recorded and stored as per the monitoring methodology.

1.2 Scope

Verification scope is defined as an independent and objective review and ex post determination by the Designated Operating Entity of the monitored reduction in GHG emissions. The verification is based on the monitoring report provided, the validated and registered project design document and other related documents. These documents are reviewed against Kyoto Protocol requirements, UNFCCC rules and associated interpretations. JACO CDM, based on the recommendations in the Validation and Verification Standard, employs a risk-based approach in the verification, focusing on the identification of significant risks and reliability of project monitoring and generation of CERs.

The verification is not meant to provide any consulting towards the client. However, stated requests for clarifications and/or corrective actions may provide input for improvement of the project design.

The verification team was provided with a Monitoring Report version 01 on 17 October, 2012, covering the period 01 May, 2011 to 30 April, 2012 which was made publicly available on the UNFCCC web site¹ on 18 October, 2012 and serves as the basis for the assessment presented herewith. (/1/)

Based on this Monitoring report version 01 above and other related documents provided, a document review and a fact finding mission in the form of an on-site assessment has taken place.

JACO CDM has conducted a verification of 2nd monitoring period of the CDM project “Dehydration and incineration of sewage sludge in Singapore” Reference No.3042 registered on 13 September, 2010) based on the Kyoto Protocol requirements, modalities as agreed in Marrakech Accords and decisions of UNFCCC CDM EB, using the Validation and Verification Standard (VVS) version 03.0. /27/

1.3 Verification team

The verification team was formed considering the need of competence for the team members in the following aspects:

- Knowledge of the Kyoto Protocol and the Marrakech Accords
- Environmental and Social Impact Assessment

¹ <http://cdm.unfccc.int/UserManagement/FileStorage/M1NJVI7KPUX4C0TQBLF6D2R3W9HZOG>

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- Skills in environmental auditing
- Quality assurance
- Technical aspects (SS 1, 13)
- Monitoring concepts
- Political, economical and technical conditions in host country

According to these requirements JACO CDM has composed following verification team in accordance with the appointment rules of the JACO CDM QC Manual. The results of verification team activity were reviewed by the internal verifiers.

Verification team

Teruo FUKUDA	JACO CDM Team Leader (SS1, TA 1.2 & TA 13.1 qualified)
Takahiro YUGUCHI	JACO CDM Team Member (SS1, TA 1.2 qualified)
Kei NIIDA	Technical Expert (SS13, TA 13.1 & 2 qualified)

Internal verifiers

Akihide MADENOKOJI	General Manager of JACO CDM (SS1, TA 1.2 & TA 13.1 qualified)
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Duration of verification

Document Review: From 18 October, 2012 to 30 November, 2012

On-site Assessment: From 15 November, 2012 to 16 November, 2012

Reporting: From 19 November, 2012 to 29 May, 2013

1.4 GHG Project Description

The CDM project activity, "Dehydration and incineration of sewage sludge in Singapore" (Ref.: 3042) was implemented to reduce greenhouse gas emissions emanating from the dedicated sewage sludge landfill in Singapore. The previous sludge disposal process is well managed by Singapore's Public Utilities Board (PUB). Trenches are excavated and the sludge is mixed with soil in the trenches. The trenches are then covered with excavated soil. The disposed sewage sludge still contains significant amount of carbon that has the potential for methane production through biological decomposition. Considering the DOC (Degradable Organic Carbon) content of the sewage sludge, management of the disposal site, and methane gas detected at the surface of the disposal site by actual measurement, there was methane gas emission from the site and could continue release this methane emissions in the baseline scenario.

The project employs a Japanese made custom built vortex incinerator to specifically dehydrate and incinerate the sludge delivered to the project site from various water reclamation plants (WRPs) in Singapore. The project started construction in April, 2008, commissioned on 1st April 2009 and has been continuously operating to date. The registration date was 13 September 2010.

The 9 years non renewable crediting period of the project started 13 September, 2010, when the project was registered.

2. METHODOLOGY

The proposed assessment aims at being a risk based approach and is based on the methodology developed in the Validation and Verification Manual (for further information, see http://cdm.unfccc.int/Reference/Manuals/accr_man01.pdf) version 01.2, an initiative for all Applicant Entities, which aims to harmonize the approach, and quality of all such assessments.

In order to ensure transparency, a verification checklist was customized for the project, according to the Validation and Verification Standard 02.0. The checklist shows, in a transparent manner,

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criteria (requirements), means of verification and the results. The verification checklist serves the following purposes:

- It organizes, details and clarifies the requirements that a CDM/JI project is expected to meet;
- It ensures a transparent verification process where the verifier will document how a particular requirement has been proved and the result of verification.

The verification checklist consists of 2 tables. The different columns in these tables are described in Figure 1 below. The completed checklist is enclosed in Appendix 1 to this report.

Figure 1. Verification Checklist Tables

Table 1: Periodic Verification Checklist			
OBJECTIVE	Ref.	COMMENTS	Concl. (incl. FARs/CARs)
The requirements the project must meet	Gives reference to the sources of evidences for the comments and conclusions.	Description of circumstances and further commendation to the conclusion.	This is either acceptable based on evidence provided (OK), or a Corrective Action Request (CAR) of risk or non-compliance with stated requirements. The corrective action requests are numbered and presented to the client in the Verification report. Clarification Request (CL) is used when the verification team has identified a need for further clarification. The Periodic Verification has additional Forward Action Requests (FAR) . FAR indicates essential risks for further periodic verifications.

Periodic Verification Checklist Table 2: Resolution of Corrective Action and Forward Action Requests			
Draft report clarifications and corrective action requests by verification team	Ref. to checklist question at table 1 of periodic verification	Summary of project owner response	Verification team conclusion
Detailed FAR, CL and/or CAR pointed at previous tables.	Item at the tables where FAR/CL/CAR were found.	Answer of the project owner	Analysis and conclusion of the verification team

2.1 Review of project documentation

The monitoring report submitted by the client and additional background documents related to the project performance was reviewed. A complete list of all documents reviewed is shown in References (chapter 5 of this report).

2.2 On-site inspections

Verification team, Teruo FUKUDA and Takahiro YUGUCHI visited the Dehydration and incineration project site in TUAS of Singapore and relevant facilities on 15 and 16 November, 2012. Interviewed organizations and topics are summarized in Table 1 below.

Table 1 Interviewed Organization and Topics at Verification

Interviewed organizations/ visited sites	Interview topics/ Inspected items
ECO SWM Pte. Ltd. Project site in Tuas	Monitoring plan Monitoring Report and relevant documents GHG calculation and reporting procedures

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	Environment and socio-economic impacts Stakeholders comments Compliance with National laws and regulations Sludge treatment facilities & process Monitoring equipment Record storing
Sumitomo Mitsui Banking Corporation	ditto
PUB	Process of sewage water treatment Present situation of waste water treatment in Singapore Comment on the ECO STP's dehydration and incineration of sewage waste treatment plant

2.3 Resolution of Corrective and Forward Action Requests

The objective of this phase of the verification was to resolve the requests for corrective actions and any other outstanding issues which needed to be clarified for JACO CDM's positive conclusion on the GHG emission reduction calculation.

Findings established during the past verifications can either be seen as a non-fulfillment of criteria ensuring the proper implementation of a project or where a risk to deliver high quality emission reductions is identified.

Corrective Action Requests (CAR) is raised, where:

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

Clarification Request (CL) is raised, where:

- If information is insufficient or not clear enough to determine whether the applicable CDM requirements have been met.

Forward Action Requests (FAR) are raised, where:

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

To guarantee the transparency of the verification process, the concerns raised and responses that have been given are summarized in chapter 3 below and documented in more detail in the verification checklist in Appendix 1.

2.4 Internal Quality Control

As final step of verification, the final documentation including the verification report and the checklist have to undergo an internal quality control by JACO CDM's Certification Determination Committee (CDC) to ensure that all procedures have been followed and all conclusions are justified. After the documents have been satisfactorily approved, then only the request for issuance is submitted to the CDM-EB with the relevant documents. Two-third of the CDC members are selected from outside of JACO CDM.

3. VERIFICATION FINDINGS

The verification team assessed and verified the followings in line with the Verification Checklist in Appendix 1.

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3.1 Description of project activity

3.1.1. Discussion

(1) Purpose and general description of the project activity

The CDM project activity, dehydration and incineration of sewage sludge in Singapore (Ref : 3042) was implemented to reduce greenhouse gas emissions emanating from the dedicated sewage sludge landfill in Singapore. The previous sludge disposal process is well managed by Singapore's Public Utilities Board (PUB). Trenches are excavated and the sludge is mixed with soil in the trenches. The trenches are then covered with excavated soil. The disposed sewage sludge still contains significant amount of carbon that has the potential for methane production through biological decomposition. Considering the DOC (Degradable Organic Carbon) content of the sewage sludge, management of the disposal site, and methane gas detected at the surface of the disposal site by actual measurement, there was methane gas emission from the site and could continue release this methane emissions in the baseline scenario.

- Construction start date: 10/01/2008 (contract of major equipment)
- Commissioning date: 01/04/2009
- Total emission reductions achieved in this monitoring period: 23,716 tCO₂e

(2) Location of project activity

- The project site is located in Tuas district, Singapore.
- GPS coordinates : 103°38' E, 1°19' N

(3) Parties and project participants

Project Participants (Party) are as below.

ECO Special Waste Management Pte Ltd (Singapore)
Sumitomo Mitsui Banking Corporation (Japan)
Kajima Corporation (Japan)

The project participants are consistent with the registered project activity.

(4) Reference of applied methodology

The references of applied methodology and tools are indicated in the monitoring report as below. These are identical with those indicated in the registered PDD B.1.

(a) Approved baseline and monitoring methodology applied to the project activity is:

"Avoided emissions from organic waste through alternative waste treatment processes"
(AM0025 / version 11)

(b) Approved methodological tools applied to the project activity are:

"Tool for the demonstration and assessment of additionality" (version 05.2)
"Tool to calculate the emission factor for an electricity system" (version 01.1)
"Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"(version 04)

(5) Crediting period of the project activity:

Fixed crediting period 13/09/2010 – 12/09/2019 (9 years)
There is no change from the registered PDD.

(6) Remaining Issues, CARS, FARs from previous Validation or Verification

Project was registered on 13 September, 2010.

The open issue (FAR 1) at the validation regarding the CDM monitoring manual was resolved at the 1st verification.

In the 1st verification, the verification requested that the odour impact is to be confirmed at the next verification. The verification team confirmed from the interviews with project participant that there is no complaint about odour from nearby stakeholders.

3.1.2. Findings

None

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3.1.3. Conclusion

The project complies with the requirements.

3.2 Implementation of the Project

3.2.1 Discussion

3.2.1.1. Physical components

The actual system and facilities were checked at site.

- Rating: name plate and specification of each facility was checked with electricity connection diagram and PDD (Fig-5 & Table-1)
- The position of each facility: each position and material flow was checked with schematic drawing and PDD (Fig-5 & Table-1)

(1) Facilities in the PDD Table 1

The verification team confirmed by the site visit, relevant drawings and documents that the same facilities indicated in the registered PDD Table 1 are installed. (/3/,/4/)

- Dewatered and dry sludge pits: They are constructed as planned.
The verification team confirmed that the storing days of sludge are approximately 2 days and usually they are empty on Sunday when there is no work and no entry of sludge to the pits.
The verification team also confirmed from the interview with PUB staff that the conditions of the pits are daily monitored and controlled by PUB.(/46/) Therefore, it was confirmed that the waste is not stored longer than 10 days and it complies with the applicability condition of AM0025/ver.11.
- Sludge Dryer
The sludge dryer is Rotating type (KRD-330S) made by YAMATO SANKO of Japan and it was confirmed that it is the same rating as PDD, 8m length, 2.3 m of shell internal diameter and rotating speed of 2.32/min. It was also confirmed by the manufacturer of the Sludge dryer and contract document that the capacity is 5,325 kg/hr (65% water) which is the same as PDD (/4b/,/4e/,/4f/,/4g/)
- Vortex Incinerator
The Vortex Incinerator is rotating arm type (VI-200) made by YAMATO SANKO of Japan and it was confirmed that it is the same rating as PDD, 10.6m height and 5.8m diameter. It was also confirmed by the manufacturer of the Vortex incinerator and contract document that the capacity is 2,342 kg/hr (20% water) which is the same as PDD (/4c/, /4e/, /4f/, /4g/)
- Cyclone dust collector
 - Centrifugal multi-cyclone type
 - Centrifugal double-cyclone typeIt was confirmed that they conform to the PDD.
- Exhaust Gas Treatment System
It was confirmed that it is the same as PDD
- Waste water treatment system
It was confirmed that it conforms to the PDD.
It was confirmed that the treated water goes back to sewage water system of PUB.
- Landfill (Ash treatment): The verification team visited the Semakau Landfill site during the 1st verification. The fly ash and bottom ash are transported by 2000t barges from TUAS Marine Transport Station (TMTS) to Semakau Landfill.
It was confirmed that it conforms to the PDD.

(2) Receiving of sewage sludge (dewatered and dry) and ash transportation

- Sewage sludge are transported from 4 WRPs (Water Reclamation Plants) to the project site by vehicles. The vehicles are equipped with covers to prevent water from coming in contact with sludge.

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- Ashes are transported from the project site to TMTS by vehicles. Bottom ash is stored in big bins and fly ash is stored in small bulk bags. The vehicles are equipped with covers to prevent water from coming in contact with ash.

(3) Commissioning date: 01/04/2009 (/7/)

(4) Additional line (Train 6)

In the 1st verification, PP explained about additional line (Train 6) will be installed in May, 2012. (refer to the First Monitoring report, B.1 P7, Second Monitoring report, B.1 P 8)

It was confirmed by the commissioning report of train 6 that the train 6 was put into commercial operation from May 2012 and the ECO-STP plant had been operated under the same condition of the registered PDD without train 6 up to the end of the 2nd monitoring period. (**CL 2, FAR 1**)

3.2.1.2 Project boundaries

The verification team confirmed the project boundary by the on-site visit including following facilities.

(1) Facilities:

Dewatered & Dry sludge pit, Dewatered and Dry Sludge Hoppers, Sludge dryer, Cyclone, Vortex Incinerator, Exhaust gas treatment system, Waste water treatment system

(2) Gases: The verification team confirmed the description of Validation report §5.2 Table 7 as below.

- ① Baseline: it was confirmed by visiting the Changi Reclaimed Land that there is no electricity consumption and there is no thermal energy generation in the Changi Reclaimed Land.
- ② Project activity: It was confirmed that there is no possibility of the fossil based waste in the sewage sludge.

Project activity: CH₄ emission from waste water treatment system is not possible, because the waste water is sent back to sewer water system of WRP (PUB).

3.2.2. Findings

Clarification request 1

Please provide following information during the 2nd monitoring period regarding;

- (1) Special events (ex.: overhaul times, downtimes of equipment, exchange of equipment, etc.)
- (2) Any events or situations that occurred during the monitoring period, which may impact the applicability of the methodology?

If applicable, how were they addressed?

Response

(1) There were no special events.

(2) These were no events or situations which may impact the applicability of the methodology.

Conclusion

The verification team confirmed from the interviews with project participants and operation record of the ECO-STP plant that there were no special events which may impact the applicability of the methodology.

OK, CL 1 is clarified.

Clarification request 2

The evidence of the starting date of train 6 operation is to be provided and impact to the monitoring of 2nd monitoring period is to be explained.

Response

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The performance test of No. 6 train was conducted by Yamato Sanko during April 26 to April 28, 2012 and the performance test report dated 16 May, 2012 was provided.

The amount of sludge processed by No.6 train during performance test in 26, 27 April, 2012 was deducted from the DWS and DS for CER calculation. The deducted amount is recorded in the performance test report and the amount does not affect the CER.

Conclusion

The verification team confirmed by the daily record of the STP plant and interview with PP that the commercial operation started from 9 May, 2012. It was confirmed by the performance test report and CER calculation spreadsheet that all the sludge processed by No.6 train during the performance test in April 26 and 27 were deducted from DWS and DS for CER calculation of the 2nd monitoring period, even though the amount is small and no impact to CER. ("sludge collection" sheet in /2b/)

Forward Action Request 1

The impacts of the additional train No. 6 whose operation started in May, 2012 after the end of 2nd monitoring period are to be reported in accordance with the requirements of the CDM project standard section 12.8.3.4. /33/

Response

Regarding the train 6, the explanation was added to the PDD version 7 (foot note of page 3 /21c/) and the request for Post Registration Change will be applied before the 3rd verification.

The description will be added in the PDD for 3rd verification.

Conclusion

OK.

Request for the approval of the post registration change regarding the additional train No.6 is to be applied for the 3rd verification. The procedure complies with the requirements.

It was confirmed that the detail description of the train 6 will be added in the revised PDD before 3rd verification in accordance with the project standard section 12.8.3.4.

3.2.3. Conclusion

CL 1 and CL 2 were clarified.

FAR 1 was confirmed and the request for the approval of the post registration change regarding the additional train No.6 is to be applied for the 3rd verification.

The project complies with the requirements.

3.3 Post registration changes

3.3.1 Discussion

Post registration changes are discussed based on CDM VVS version 03.0 paragraph 247 ~ 282 and CDM Project Standard Version 02.1 paragraph 206 ~ 225 and its Appendix 1.

(1) Temporary deviations from registered monitoring plan or applied methodology

Stack gas volume flow rate, SGy measurement was temporarily deviated (partially) from registered monitoring plan due to the flow meter under calibration or under repair. (/1/,/2/)

During this period, ECO estimated the SGy basing on the assumption that the source of the GHG emissions operated at maximum design sludge burning capacity in accordance with the CDM Project Standard Annex 1 section 3.

As for detail, refer to section 3.5 and 3.7 of this report.

(2) Corrections that do not affect project design

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The verification team confirmed during the on-site visit by the name plate and interviews with the project participants that there are no corrections to project information or parameters fixed at validation, as described in the registered PDD.

(3) Permanent changes from registered monitoring plan or applied methodology

The verification team confirmed that the actual monitoring has been conducted in accordance with the registered monitoring plan or applied methodology except temporally deviation from registered monitoring plan described above (2).

(4) Changes to project design of registered project activity

At the time of implementation of the project and during this monitoring period, the WRPs in Bedok and Seletar have been decommissioned by PUB and the number of WRPs is reduced from 6 to 4. It was confirmed that the average additional distance for sludge transportation is reduced from 36km of the values of registered PDD to – 14km (negative). By the reduction of the transportation distance the leakage emission of sludge transportation from WRPs is reduced from 68tCO₂/yr to 47tCO₂/yr as described in the revised PDD. /21c/

The verification team confirmed that totally no impact of the reduction of the sludge transportation distance to the IRR because the sludge transportation is not under ECO's scope of services. /6/

There are no other changes to the project design of registered project activity for which the Project Standard version 02.1 section 12.8.3.4 paragraph 221 are applied as explained below.

i) Additional train No.6: As stated in section 3.2.1.1 (4), the train 6 was added and the operation started in May, 2012. Hence, the operation of train 6 is not covered in the 2nd monitoring period. However, the request for the approval of the post registration change regarding the additional train No.6 is to be applied for the 3rd verification as confirmed above. (FAR 1)

ii) Operational parameters:

- Volume of dried sludge and wet sludge: The sludge is supplied by PUB and the volume of the sludge is not within the control of project participants.
- the characteristics of the sludge: The sludge is supplied by PUB and the characteristics of the sludge are not within the control of project participants.
- N₂O emissions: N₂O emissions depend on the characteristics of the sludge and dehydration & incineration system. Hence, the N₂O emissions are not within the control of project participants.
- residual carbon in ash: Residual carbon in ash emissions depends on the characteristics of the sludge and dehydration & incineration system.

Hence, the residual carbon in ash is also not within the control of project participants.

These actual parameters are differing from the expected parameters but they are not within the control of project participants. Hence, the project standard version 02.1 section 12.8.3.4 paragraph 221 is not applicable.

In addition, the changes of above operational parameters do not adversely impact any of the followings and does not require prior approval by the Board as per CDM project standard Appendix 1. **(CL 10)**

- applicability & application of the applied methodology;
- the additionality;
- the scale of the project activity.

(5) Changes to start date of crediting period

There are no changes in the start date of crediting period. The start date of crediting period is the registration date, 13/09/2010.

3.3.2 Findings

Clarification request 10

(1) The impact of the changes of WRPs to the project activity is to be clarified.

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(2) The impacts of the actual parameters changes to the project activity are to be clarified.

Response

(1) Since the sludge transportation is not under ECO's scope of services, the reduction of sludge transportation distance has no impact to the project IRR.

(2) The impacts of the actual parameters changes are as below:

- Volume of dried sludge and wet sludge: In the 2nd monitoring period, the volume of wet sludge and dry sludge is reduced 18.3% and 56.6% respectively.
When the sludge is reduced 10% and 20% and assuming operating cost is reduced 10% and 20% accordingly, the calculated IRR is 1.32% and -1.97% respectively. Hence, due to the reduction of sludge IRR will be reduced and there is no adverse impact on the additionality of the project activity. /20/
- Due to changes in the characteristics of sludge which resulted in sub-optimum operation of the plant (e.g. generating more ash, etc.), the operation cost is increased and the IRR becomes worse. Hence, there is no adverse impact on the additionality of the project activity due to the changes in the characteristics of sludge.
- N2O emissions and residual carbon in ash: The cost impact of these parameters is small and there is no adverse impact on the additionality of the project activity.

Conclusion

(1) The verification team confirmed from the contract between PUB and STP /6a/ that the sludge transportation is done by PUB and not under ECO's scope of services, the change of WRPs has no impact to the project IRR.

(2) The verification team confirmed that the additionality of the project activity is not adversely affected by the actual parameters changes in volume of dry and wet sludge, characteristics of sludge, N2O emissions and residual carbon in ash, as stated below.

- Volume of wet sludge and dry sludge: The verification team confirmed that the unit sludge treatment fee is fixed as 60 SGD/ton for wet sludge and 58 SGD/ton for dry sludge. Hence due to the reduction of the volume of sludge the income (sludge treatment fee) is reduced linearly. The IRR calculation for sludge reduction by 10 and 20% is correctly calculated as 1.32% and -1.97% respectively by the project participant. /20/

In the 1st and 2nd monitoring period, the average annual sludge reduction is 19.0% for wet sludge and 59.8% for dry sludge /1/. This reduction is equivalent to 27.9 %² reduction of dry and wet sludge and the IRR in this condition is calculated as 3.20%. This value is calculated under conservative conditions such that even labor cost, land lease fee, maintenance cost and security deposit are also reduced by the biggest reduction rate (= -54.2%) among the actual reduction rate of cost parameters of IRR calculation³. /20/

Hence, it is concluded that the sludge reduction in the 2nd monitoring period does not adversely impact the additionality of the project activity.

- The verification team confirmed that the change of the characteristics of sludge affect the operation of the plant but it will not adversely impact the additionality of the project activity.
- N2O emissions and residual carbon in ash affect the emission reduction of the project activity but they will not adversely impact the additionality of the project activity.

3.3.3. Conclusion

CL 10 was clarified.

² Wet sludge and dry sludge in the Registered PDD: wet=160,000 ton/year, dry = 44,480 ton/year
Actual annual sludge volume in the 1st and 2nd monitoring period vs. design: wet=81.0%, dry 40.2%

∴ Equivalant total reduction of sludge = $(1 - (160,000 \times 0.81 + 44,480 \times 0.402) / (160,000 + 44,480)) \times 100 = 27.9 \%$

³ Actual reduction rate of cost parameters of IRR calculation (average of 1st and 2nd monitoring period):
Electricity: -24.1%, Natural gas: -54.2%, Ash: -23.2 /20/

Verification Report

It was confirmed that the changes of WRPs are not within the control of the project participants and the transportation of sludge is not under ECO's scope of services. Hence, the change of WRPs does not impact the additionality of the project activity. Also the verification team confirmed that the changes of actual operational parameters are not within the control of the project participants and the impacts by the change of actual operational parameters do not adversely impact the additionality of the project activity.

Hence, Appendix 1 of the project standard is applied to the project activity. /33/

The project complies with the requirements.

3.4 Compliance of the monitoring Plan with the monitoring methodology

3.4.1 Discussion

The monitoring plan describes all the necessary monitoring procedures for following parameters.

- Sewage Sludge Quantity
- Natural Gas Consumption
- NCV of Natural Gas
- Parameters Related to Leakage Emission from Increased Transport
- Electricity Consumption
- Ash Generation
- Residual Carbon Fraction
- Stack Gas Volume
- N₂O and CH₄ Fraction in stack gas

It was verified by assessment team that the monitoring plan of the registered PDD including the data and parameters required to be monitored, measurement procedures, monitoring frequency and QC/QA procedures is complying with the applied methodology AM0025 Version 11 /22/.

3.4.2 Findings

None.

3.4.3 Conclusion

It was verified by provided evidences and on-site assessment that the monitoring plan in the registered PDD of the project is in accordance with the applied methodology, AM0025 Version 11 /22/.

3.5 Compliance of monitoring with the monitoring plan

3.5.1 Discussion

The verification team confirmed the monitoring and metering/ recording systems by the on-site visit and the monitoring record of the STP plant as below.

- **W_j**: (Weight of Dewatered sludge and dry sludge)

Sludge are sent to Sludge Treatment Plant (STP) with each WRP ticket with different color.

In addition to that the dry sludge and dewatered sludge are also transported by different trucks and weighed separately by weigh bridge of STP plant. The weight is recorded by the weigh bridge operator and automatically recorded in the computer of the STP plant.

The verification team confirmed by the calibration reports of weigh bridge by a 3rd party "SAC" that the accuracy of the weigh bridge is within $\pm 10\text{kg}$ for the 30 ton range (average sludge weight including truck weight of the project) and complies with the monitoring plan. (/2/(x)(xi), /8/)

However, there were delays from the validity of the calibration of the weigh bridge. (CL 9)

- **EG_{PJ}**: Electricity consumption in the STP plant is monitored by SQUARE D meter of STP plant.

Verification Report

The electricity consumed in STP is a part of the electricity consumed in ECO-SWM plant. The electricity is supplied by SERAYA Energy Pte Ltd and the invoice is for the total electricity of ECO-SWM plant including the STP. (/2/(xiv))

The verification team confirmed for SQUARE D meter by the "Declaration of Conformity" report of the meter and the "Energy monitoring report" by a 3rd party "Electrique Energy & Metering Pte Ltd" that the accuracy of the meter is 0.5s and complies with the monitoring plan. (/9/)

- **Fcons:** LNG consumption for the auxiliary burner of the incineration is monitored by Metering and Pressure Regulating Skid (MPRS). (/2/(xii)) The data of the monthly invoice from City Gas is selected as monitored parameter. The data of the invoice is cross checked with the own reading of the same MPRS meter by the project participant.

The individual Gas meter of STP plant for each train is used for checking the operation of each line and not used for emission reduction calculation.

- **NCVfuel:** Gas company data is used. (/15/)
- **SG:** Stack gas flow meter

The verification team confirmed by the catalogue of meter supplier "ANSAC" and their commissioning report that the accuracy of the stack gas meter is within 1.5% which conforms the approved monitoring plan. (/2/(viii), /11/)

In the 2nd monitoring period, SGy has been monitored using ANSAC flow meter, however, there were some periods while the gas flow meters are out of calibration validity or had been dismantled for calibration in the manufacturer in USA and transportation for that purpose.

Blank period of SGy meters

Fig. 2 below indicates the blank period of SGy meters.

Fig. 2: Validity of SGy flow meter and blank period of meter

Flow meter Validity	2010	2011	2012
Train 1 Validity	23/09/2010 ~ 22/09/2011	(*4)	09/01/2012 ~ (*1)
Train 2 Validity	23/09/2010 ~ 22/09/2011		30/03/2012 ~ (*2)
Train 3 Validity	23/09/2010 ~ 22/09/2011		18/04/2012 ~ (*3)
Train 4 Validity	23/09/2010 ~ 22/09/2011		
Train 5 Validity		Under repair	
Replacement unit Validity			21/11/2011 ~ 20/11/2012
Monitoring Period	1st: 13/09/2010 ~ 30/04/2011	2nd: 01/05/2011 ~ 30/04/2012	

(*1): 09/01/2012 ~ 28/03/2012: replacement unit was used.

(*2): 30/03/2012 ~ 18/04/2012: replacement unit was used.

(*3): 18/04/2012 ~ 27/07/2012: replacement unit was used

(*4): [] blank period of flow meter

As shown in fig.2, in the 2nd monitoring period there are blank period while the flow meter is out of the calibration validity, under calibration work or under repair (in case of train 5). Such blank period is shown as below:

Train 1: 23/09/2011 ~ 08/01/2012

Train 2: 23/09/2011 ~ 29/03/2012

Verification Report

Train 3: 23/09/2011 ~ 18/04/2012

Train 4: 23/09/2011 ~ 30/04/2012

Train 5: 01/05/2011 ~ 30/04/2012 (under repair)

Estimate of SGy while flow meter is not valid

(1) According to the methodology AM0025 version 11, it is stipulated about SGy monitoring as below;

The stack gas flow rate is either directly measured or calculated from other variables where direct monitoring is not feasible. Where there are multiple stacks of the same type, it is sufficient to monitor one stack of each type. The stack gas volume flow rate may be estimated by summing the inlet biogas and air flow rates and adjusting for stack temperature. Air inlet flow rate should be estimated by direct measurement using a flow meter.

(2) The monitoring plan of the registered PDD states about SGy as below;

The flow rate of the stack gas will be monitored using a flow meter.

(3) CDM project standard Appendix 1 paragraph 3 states:

If project participants have temporarily not monitored parameters related to project GHG emissions or are unable to produce evidence related to such monitoring, prior approval by the Board is not required if project participants estimate these parameters assuming that the source of the GHG emissions operated at maximum capacity for the full period of the missing data.

In the actual monitoring activity, SGy is monitored using 4 flow meters of same type (There are 5 meters but No.5 meter is under repair during the 2nd monitoring period.). For the period while the flow meter is under calibration or under repair, the stack gas (SGy) is estimated using the monitored data as Fig. 3 below.

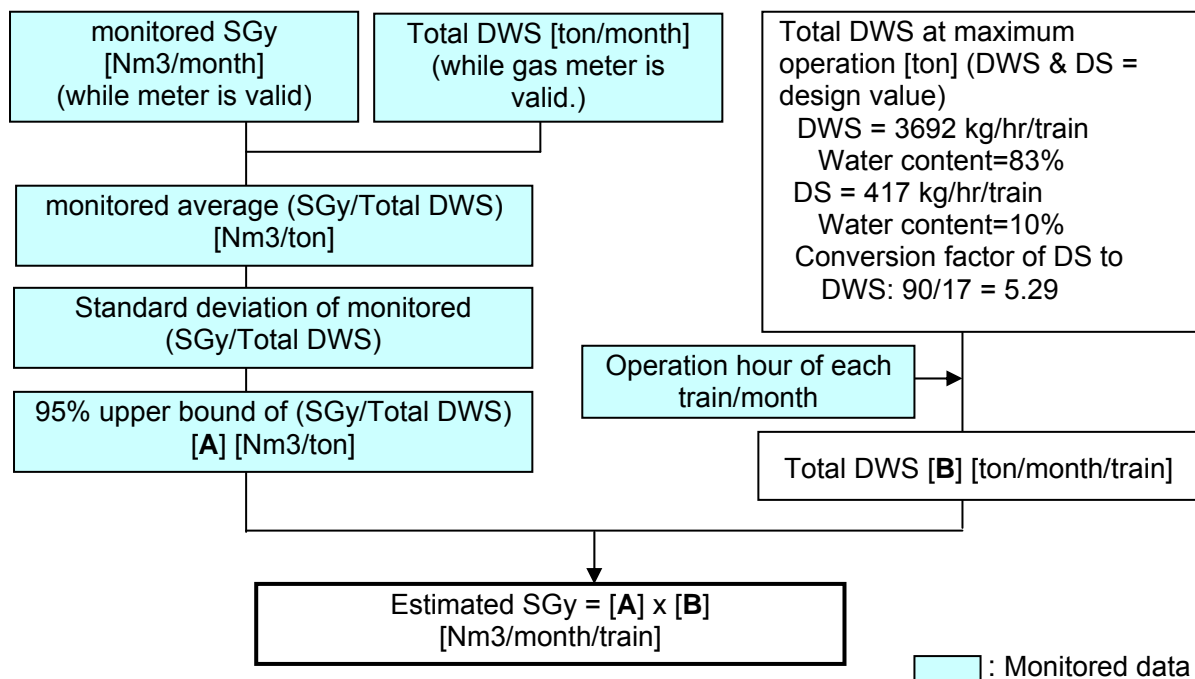


Fig. 3 Estimate of SGy while flow meters is not valid

As indicated in Fig.3, SGy for each train while the flow meter is not valid is estimated as follows.

Verification Report

- (i) Train 1 – 4: SGy during flow meter blank period is estimated based on the measured data of SGy while SGy meter is valid taking into account 95% confidence interval and also based on the condition that each train is operated at maximum capacity (= design capacity). (/2b/,/33/)
- (ii) Train 5: There is no measured data for train 5 and for the value of T5 the largest among T1 to T4 is applied.

The verification team considers that above estimate method is conservative and complies with the applied methodology AM0025 version 11, and CDM project standard paragraph 209 –211 and Appendix 1 paragraph 3.

The verification team confirmed from the assessment of CER calculation spreadsheet, that the estimate of SGy during blank period of the flow meters No.1 to No.4 and the flow meter No.5 is conservative and appropriate. (/2b/)

- **MC_{N2O} & MC_{CH4}**: Stack gas composition is based on the 3rd party laboratory certificate. (/2/(xv), /16/)
- **NO(1)**: Number of vehicles for sludge transportation, based on the tickets of PUB recorded at the weigh bridge of STP. (/2/(x), /13/)
- **NO(2)**: Number of vehicles for ash transportation (recorded by the Tickets of TMTS) (/2/(x),/19/)
- **NO(3)**: Number of barges for ash transportation. This number is calculated by total weight of ashes/ average transporting weight per trip by a 2000t barge of NEA. The average transporting weight is provided by NEA as 1,993 ton/trip. (/2/(x),/19/)
- **DT_{i,y}**: Average additional distance travelled compared to the baseline (PUB (Public Utilities Board) documents)
- **VFcons**: Vehicle fuel consumption (l/km) data was confirmed as below. (/2/(x), /19/)
Sludge transportation from WRPs to STP plant: 0.33 l/km (PUB transporters data)
Ash transportation from STP to TMTS: 0.5l/km (ECO data)
Ash transportation from TMTS Semakau (barge): 24.1/km (NEA data)
- **NCV_{fuel, transport}**: Calorific value of fuel (MJ/kg) is provided by Singapore Refining Company Private Limited as 43.52 MJ/kg (/19d/)
- **D_{fuel}**: fuel density is provided by Singapore Refining Company Private Limited as 0.8519 kg/l. (/19/)
- **A_{residual}**: The amount of ash is measured by the weigh bridge of TUAS TMTS for bottom ash and fly ash. The data is given to STP as tickets and recorded in STP. (/2/(xvi), /17/)
- **FC_{residual}**: 5 sets of samples each comprising of bottom ash and fly ash were quarterly taken and tested, the 2nd 3rd 4th data and 1st quarter of 2012 data by a test service company (Singapore Test Service) are available. (/17/)

Energy generated by the auxiliary fossil fuel added into incinerator is calculated. Its fraction of energy is 1.77% in 2011 and 3.76% in 2012. Both values are less than 50% of the total energy generated in the incinerator. It is confirmed the project complies with the applicability condition of the methodology AM0025/ version 11.(/2/(xviii))

3.5.2 Findings

Corrective Action Request 1

(1) The description of monitoring and calculation procedure of Natural Gas Consumption in the monitoring report version 01 is inconsistent.

- p10 (individual meter is used for CDM monitoring record and MPRS is for a counter check)
- p23 (monthly invoice reading is selected as monitored data)

(2) Please provide the comparison data of MPRS and individual meters.

Response

Verification Report

(1) The description of the monitoring report p10 is typo error. The MPRS reading will be used for $F_{\text{cons},y}$

(2) The individual meter is used for operation check. The MPRS reading is cross checked by the invoice from gas company. Examples of invoices are provided.

Conclusion

(1) The verification team confirmed that the monitoring report was corrected.

(2) The verification team was provided with the data of MPRS and invoice from city gas. The data of the monitoring report is appropriate.

3.5.3 Conclusion

CAR 1 was resolved.

In the 2nd monitoring period SGy was monitored by gas flow meters but there were some periods while the gas flow meters are out of calibration validity or had been dismantled for calibration in the manufacturer in USA and transportation for that purpose. The verification team considers that the estimate of SGy during such blank period of the flow meters No.1 to No.5 is conservative and the monitoring activity of the project complies with the monitoring plan, methodology AM0025 version 11. The verification team also confirmed that the estimate method during such periods complies with the CDM project standard. (/33/)

Other monitoring activities are in accordance with the registered monitoring plan.

The project complies with the requirements.

3.6 Management and Operational System

3.6.1 Discussion

The file management system has been established based on the procedure of the CDM Monitoring Manual (/5/), and data management to keep the relevant documents is under the responsibility of CDM Project Manager. The key parameters are measured by calibrated meters. It was confirmed by the calibration reports that the calibration of meters was carried out properly (/8/ - /11/). The monitored data are stored in the shelf cabinet in the project office and controlled by CDM Manager. Condition of document archiving was confirmed well during on-site assessment.

(1) Reporting procedures

The organization structure indicating the reporting procedures is described in the monitoring report. (p17)

The collection of the data will be undertaken by the plants' technician and will be checked and authenticated by the Section Manager. The CDM Project Manager then aggregates and reports the ER data calculated to the CDM Project Director on a monthly basis for the data approval prior to management reporting. On an annual basis and before verification process, a third party CDM expert will be engaged to check the data and ER calculations and assist ECO in the preparation of the monitoring report.

(2) Documented instructions

The organizational structure of monitoring and responsibility are stipulated in the monitoring report P17 which is consistent with PDD B.7.2. The organization chart, detail responsibility, qualification of CDM operational staff and procedure are stipulated in the CDM Monitoring Manual (/5/). The personnel training have been established for CDM monitoring operation. (CL 3)

(3) Qualification and training

The qualification and training are stipulated in the CDM Monitoring Manual (/5/). The personnel training have been established for CDM monitoring operation.

(4) Trouble shooting procedures

Verification Report

Emergency procedure for monitoring meters is stipulated in the CDM Monitoring Manual (/5/).

(5) Data archiving

CDM Section Manager has responsibility to archive all the CDM related documents such as raw data, certificates and/or calibration reports. /5/. CDM related documents and monitoring data are archived in paper and electronic as described in the PDD B.7.2 and the Monitoring Manual (/5/).

(6) Monitoring report

CDM Project Manager has responsibility to preparing emission reductions calculation and monitoring report.

(7) Internal audit and management review

Internal auditor is assigned and CDM director is responsible for data approval prior to management reporting.

3.6.2 Findings

Clarification Request 3

(1) Please provide the monitoring manual, if revised.

(2) Qualification and training for the 2nd monitoring period are to be explained.

Response

(1) There was no change in the monitoring manual in the monitoring period.

(2) The operating staff of the STP plant has not been changed. There is no new operating staff, thus training is considered not necessary.

Conclusion

The verification team confirmed from the on-site visit and interviews with plant manager that operating staff has not been changed, daily operation and monitoring activity was conducted as planned. The daily operation and monitored data are appropriately recorded and archived in the project office as stipulated in the ECO STP CDM monitoring manual. (/5a/,/18/,/44/)

3.6.3 Conclusion

CL 3 was clarified.

The management and operational system are in line with the registered monitoring plan.

The project complies with the requirements

3.7 Data and parameters

3.7.1 Discussion

A. Data and parameters fixed ex ante

The following data and parameters fixed ex ante are identical with those of the registered PDD and the 2nd monitoring report. The verification team considers that applying these data and parameters is complying with the registered monitoring plan.

- CEF_{elec} : The emission factor for electricity generation corresponding to electricity used in the project activity.
- EF_{fuel} : Emission factor for natural gas
- GWP_{N2O} : Global Warming Potential of nitrous oxide
- GWP_{CH4} : Global Warming Potential of methane
- AF_i : Adjustment factor for $MB_{reg,y}$
- ϕ : Model correction factor to account for model uncertainties of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
- f_i : Fraction of methane captured at the SWDS and flared, combusted or used in another manner

Verification Report

- OX, : Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
- F, : Fraction of methane in the SWDS gas (volume fraction)
- DOC_f, : Fraction of degradable organic carbon that can decompose
- MCF, : Methane correction factor
- DOC_j, : Fraction of degradable organic carbon (by weight) in the waste type *j*
- k_j, : Decay rate for the waste type *j*
- EF_{fuel, transport}: Decay rate for the waste type *j*
- DTi,y: Average additional distance travelled compared to baseline (**CL 4**)

B. Data and parameters monitored

(B-1) Baseline parameter

Monitored baseline parameter is W_j (Weight of Dewatered sludge and dry sludge) and complies with the monitoring plan of the registered PDD.

The verification team confirmed by the on-site visit that the flow of sludge and W_j information are as below.

Sludge is sent to STP plant with each WRP ticket with different color.

In addition to that the dry sludge and dewatered sludge are also transported by different trucks and weighed separately by weigh bridge of STP plant. The weight is recorded by the weigh bridge operator and automatically recorded in the computer of the STP plant.

Following reports are provided. (**CL 5**)

- ECO SWM Daily Loads Report
- CDM Monitoring Record
- CDM Annual Consolidated Data

The verification team confirmed that the baseline data (W_j data) is correctly monitored, recorded and reported.

(B-2) Project emission parameters

- EG_{PJ}: Electricity consumption in the STP plant is monitored by SQUARE D meter of STP plant. The electricity consumed in STP is a part of the electricity consumed in ECO-SWM plant. The electricity is supplied by SERAYA Energy Pte Ltd and the invoice is for the total electricity of ECO-SWM plant including the STP.

Following reports are provided.

- Daily Monitoring Record
- CDM Monitoring Record
- CDM Annual Consolidated Data
- Annual Emission Reduction Calculation Sheet

The verification team compared these data and monitoring report and confirmed that the data in the monitoring report/spreadsheet are consistent with evidences and correct. (ref. **CL6**)

- F_{cons}: LNG consumption for the auxiliary burner of the incineration is monitored by MPRS. The individual Gas meter of STP plant for each train is also used for monitoring of each train. The monthly invoice reading of gas company is used for emission reduction calculation. (**CAR 1**)

Following reports are provided.

- Daily Monitoring Record
- CDM Monitoring Record
- CDM Annual Consolidated Data
- Annual Emission Reduction Calculation Sheet

The verification team compared the data of F_{cons} in the monitoring report, spread sheet and the invoice of the city gas for the period of May, 2011 to April, 2012 and confirmed that they are consistent and correct. (/1/,/2/(iv),(xi), /15/)

Verification Report

• NCV_{fuel}: Gas company data. (CL 6)

The verification team compared the data NCV_{fuel} in the monitoring report, spread sheet and the invoice of the city gas and confirmed that they are consistent and correct. (/1/, /2/(iv),(xii),/15/)

• SG: Stack gas:

The verification team confirmed by the catalogue of meter supplier "ANSAC" and their commissioning report that the accuracy of the stack gas meter is within 1.5% which conforms the approved monitoring plan in the registered PDD. The verification team also confirmed that the monitoring had been conducted using these gas flow meters but as stated in 3.5 above, there were periods while the gas flow meters had been dismantled for calibration, maintenance in the manufacturer's factory in USA including transportation.

(1) SGy measured by valid flow meter

Measured SGy values while flow meters are valid are as shown in the tale 2 below. (/2b/)

Table 2: SGy measured by valid flow meter

Train	1	2	3	4	5
Period	01/05/2011- 22/09/2011, 09/01/2012- 30/04/2012	01/05/2011- 22/09/2011, 30/03/2012- 30/04/2012	22/09/2011- 22/09/2011, 19/04/2012 30/04/2012	01/05/2011- 22/09/2011	—
SGy (m3)	137,324,362	93,336,813	75,701,777	83,267,177	—

∴ Total measured SGy = 389,630,129 m3 ----- (i)

(2) Estimated SGy while flow meter is not valid.

Estimate of SGy while flow meter is not valid is done as described in 3.5.1 Fig. 3.

Estimated SGy results are shown in the CER calculation excel sheet. (/2b/)

Summary of the estimated SGy is indicated in Table 3-1.

Table 3-1: Estimated SGy while flow meter is not valid

Train		1	2	3	4	5
[SGy/Total DWS] 95% confidence interval limit upper bound (Nm3/ton) by flow meter measurement	Measurement Period	01/05-22/09/2011, 09/01-30/04/2012	01/05-22/09/2011, 30/03-30/04/2012	22/09-22/09/2011, 19/04-30/04/2012	01/05-22/09/2011	—
	Average Nm3/ton	4,341.85	4,538.17	4,061.64	4,577.38	—
	STDV	542.37	1400.85	965.04	163.49	—
	95% confidence interval	354.34	1,037.74	772.18	143.30	—
	95% confidence upper bound	4,696.19	5,575.91	4,833.81	4,720.69	5,575.91 (Max of train 1 ~ 4)
Estimated SGy	Period	23/09/2011-08/01/2012	23/09/2011-29/03/2012	23/09/2011-18/04/2012	23/09/2011-30/04/2012	01/05/2011-30/04/2012
	Operation hour	2487.5	4104.0	4635.75	4827.75	8206.5
	Total DWS ton/hr/train (Design data)	5.8997	5.8997	5.8997	5.8997	5.8997

Verification Report

	Total DWS of each train (ton)	14,675.37	24,212.15	27,349.29	28,482.02	48,415.45
	SGy (Nm3)	68,918,350	135,004,846	132,201,294	134,454,718	269,960,348

Total estimated SGy = 740,539,557 m3 ----- (ii)

∴ Total SGy = (i) + (ii) = 1,130,169,686 m3

Total SGy (SGy measured + SGy in the blank period which is calculated above) for 2011 and 2012 is aggregated as Table 3-2 below. (/2b/-(viii))

Table 3-2: SGy in 2011 and 2012

Month	Stack gas volume flow rate, m ³
2011	745,125,859.01
2012	385,043,826.58
Total SGy	1,130,169,685.59

The verification team confirmed that the SGy data in the monitoring report is correctly calculated based on the procedures explained above. (/2b/-(viii))

- MC_{N2O} & MC_{CH4}: Stack gas composition is based on the 3rd party laboratory certificate.

MC_{CH4} data for 1st quarter of 2012 is not available due to the laboratory's reason.

The maximum value among other certified values for this period is applied from conservative consideration. The verification team considers it is appropriate. (CL 6)

(B-3) Leakage parameter

- NO(1): Number of vehicles for sludge transportation, based on the tickets of PUB recorded at the weigh bridge of STP.

The data is recorded automatically along with the Wi measurement by truck scale and also it is controlled by PUB.

The verification team checked the number of vehicles data in the spread sheet by the daily weigh bridge record by random sampling and confirmed that they are consistent. (/2/(x), /13/)

In the monitoring report, the leakage emissions due to increased transportation of sludge in 2011 are conservatively estimated. /1c/

- NO(2): Number of vehicles for ash transportation (recorded by the Tickets of TMTS)

Ash transportation from project site to TMTS: The verification team checked the number of vehicles data in the tax invoice for refuse disposal/incineration fee (TMTS) by random sampling and confirmed that the data is consistent. (/2/(xi), /17a/)

- NO(3): Number of barges for ash transportation. This number is calculated by total weight of ashes/ average transporting weight per trip by a 2000t barge of NEA. The average transporting weight is provided by NEA as 1,993 ton/trip. (/19c/)

Ash transportation from TMTS to Semakau Landfill: The verification team checked the total ash amount, barge capacity of NEA and confirmed that the number of transportation is appropriate. (/2/(xi), /19/)

- VFcons: vehicle fuel consumption (l/km) data

Table 4: Vehicle fuel consumption rate

Type of transportation	VFcons (l/km)		Reference
	2011	2012	
Sludge transportation from WRPs to STP plant:	0.44	0.79	Transporter /19a/
Ash transportation from STP to TMTS	0.5	0.48	ECO-STP /19b/
Ash transportation from TMTS Semakau (barge)	24.11	19.29	NEA /19c/

Verification Report

The verification team confirmed by the reference documents that values of table 4 are correct. (/19/)

- $NCV_{fuel, transport}$: Calorific value of fuel (MJ/kg) is provided by Singapore Refining Company Private Limited as 43.52 MJ/kg (/19d/)
- D_{fuel} : fuel density is provided by Singapore Refining Company Private Limited as 0.8519 kg/l. (/19d/)

- $A_{residual}$: The amount of ash is measured by the weigh bridge of TUAS TMTS for bottom ash and fly ash. The data is given to STP as tickets and recorded in STP.

The verification team checked the ash data by sampling of tickets, spreadsheet and monitoring report and confirmed that they are consistent and correct. (/1/,/16/,/17/)

- $FC_{residual}$: 5 sets of samples each comprising of bottom ash and fly ash were 4 times taken (3 times in 2011 and 1 time in 2012) in the monitoring period and tested.

The verification team confirmed that data in the spreadsheet and monitoring report are conservative and appropriate. (/1/,/2/(xvii), /17d/) (CL 7)

3.7.2 Findings

Clarification Request 4

It is to be confirmed that the $DT_{i,y}$ is not changed.

Response

PP provided data from relevant entity that $DT_{i,y}$ is not changed.

Conclusion

The verification team confirmed by the information from PUB (Sep, 2008) and transporters e-mail (Sep, 2011) that the $DT_{i,y}$ data has not been changed.

Clarification Request 5

Please provide following documents.

- Actual Daily monitoring record of W_j is to be confirmed. (samples)

Response

Examples of daily monitoring record of W_j were provided.

Conclusion

The verification team was provided with daily records of W_j for randomly selected 3 months. (May 2011, September 2011, March 2012)

The verification team confirmed by these original W_j data that these data, data of the CER calculation spreadsheet and the monitoring report are consistent and correct. (/1/,/2b/,/13a/)

Clarification Request 6

Please provide following data (Project emission parameters)

(1) EG_{pj} :

- Invoice of SERAYA Energy Pte Ltd for ECO SWM electricity consumption
- ECO STP Account dept. data for electricity consumption in ECO SWM plant (internal data)
- Daily record of Ep_j by ECO-STP

(2) Records of F_{cons} , NCV_{fuel} , SG, MC_{N_2O} and MC_{CH_4}

Response

(1) Following documents are provided.

Invoice of SERAYA Energy Pte Ltd for ECO SWM: Examples

ECO STP account department data for electricity consumption in ECO SWM plant

Daily record of Ep_j monitored by SQUARE D meter

(2) F_{cons} , NCV_{fuel} : City gas invoices are provided.

SG: Daily records of SG were shown at site visit. The verification team checked the data by sampling.

Verification Report

MC_{N2O} and MC_{CH4}: 3rd party Laboratory test report was provided.

Conclusion

(1) The verification team compared the data of EG_{PJ,EF} in the monitoring report, spread sheet and the record of SQUARE D meter reading in the aggregated data of ECO-SWM account department for the period of January 2011 to April, 2012. The verification team confirmed that the direct comparison is difficult between the EG_{PJ,EF} and the electricity invoice of Seraya Energy but EG_{PJ,EF} is checked by the account department of ECO-SWM. The verification team confirmed that the data of ECO-SWM data and EG_{PJ,EF} is identical and considers that EG_{PJ,EF} data in the monitoring report is correct. (/1/,/2b/(iv),(xiv),/14/)

(2) The verification team confirmed that

F_{cons} and NCV_{fuel} are correctly described in the monitoring report and spreadsheet.

SG data is correctly recorded in the CDM daily monitoring record in accordance with the ECO-STP CDM manual. The daily monitoring record data is consistent with the spreadsheet and monitoring report.

MC_{N2O} and MC_{CH4}: The verification team confirmed that the laboratory data is applied to the CER calculation spreadsheet and monitoring report correctly with conservative consideration for MC_{CH4}.

Clarification Request 7

As for FC_{residual}, it is to be confirmed that the sampling is conducted to achieve maximum uncertainty of 20% at 95% confidence level.

Response

The sampling was conducted four times in accordance with the registered monitoring plan.

Bottom ash and Fly ash measurements in 2012 are exceeding the maximum uncertainty limit of 20% at 95% confidence interval. Therefore, the maximum value among the monitored data was taken for FC_{residual} calculation of 2012. The calculated FC_{residual} is 3.30%.

Conclusion

The verification team checked the residual carbon data of 3rd party laboratory and FC_{residual} calculation spreadsheet and confirmed that the calculation is appropriate. (/2-xviii/, /17d/) FC_{residual} is 1.77% in 2011 and 3.30% in 2012.

3.7.3 Conclusion

CL 4, CL 5, CL 6 and CL 7 were clarified.

SGy is estimated conservatively as per the applied methodology and CDM project standard.

The verification team confirmed that the monitored data in the evidence documents and spread sheet are consistent and correctly reported in the monitoring report.

3.8 Accuracy of equipment

3.8.1 Discussion

Detail information of meters is shown in table 5 below.

Table 5: Monitoring equipment

Meter		Type	Accuracy	Serial Number	Calibration date (Validity)
Wi	CARDINAL electronic weighbridge	No.205	±10kg	E23908-0347	05/06/2011 18/09/2011 25/12/2011 01/04/2012 (Quarterly) Ref. CL 9
EG _{pj}	SQUIRE D Power meter	PM800	0.5S	Power Logic PM800 Series	25/01/2008 (10 years) Accuracy check:

Verification Report

					yearly
Fcons	MPRS: Actaris Turbine Gas Meter	FLUXI 2080 TZ	0.29	QM0702503	21/02/2009 (10 years)
Fcons	Individual: RMG Gas Flow meter	TRZ 03-K	$\pm 1\%$ for 0.2 Q_{\max} to Q_{\max}	608167 608168 608169 608170 608171	The meter is used for checking of operation and not for monitoring the natural gas flow.
SGy	Innova-Mass TM Voltex Mass Flow Meter	SIERRA 241	$\pm 1.5\%$	1190357456 1190357458 1190357460 1190357459 1283718279 1301028392 (replace unit)	Ref. CL 8

- Weighbridge: The verification team was provided with the calibration report of the weigh bridge confirmed that the calibration is conducted quarterly by a 3rd party "SAC". The verification team confirmed by the calibration reports that the accuracy of the weigh bridge is within $\pm 10\text{kg}$ for the 30 ton range (average sludge weight including truck weight of the project) and complies with the monitoring plan. (/8/,/21/) There were delays in the validity of calibrations. (**CL 9**)
- Electricity meter (SQUARE D meter): The declaration by the manufacturer (Schneider Electric) for the conformity to IEC 61557-12 was provided. (/9a/) Also "Energy Monitoring Report" (Electrique Energie & Metering Pte Ltd, 20 Jun 2011) was provided. The verification team confirmed that the accuracy class of the electric meter is 0.5 class by IEC standard and the accuracy is checked and verified by a 3rd party. (/9b/) The calibration frequency is 10 years and the last calibration was conducted on 25 January 2008. Therefore the monitoring period (01/05/2011 to 30/04/2012) is covered by the validity of the meter. (/9a/)
- Natural gas: The verification team confirmed for MPRS meter based on the calibration certificate dated 21 Feb, 2009 by a 3rd party "ACTARIS Singapore Pte Ltd" that the average error of the meter is 0.29% for 20 -400m³/hr range. The calibration interval is 10 years. Therefore the monitoring period (13/09/2010 to 30/04/2011) is covered by the validity of the meter. (/10a/) Also, the verification team confirmed for individual gas meter based on the inspection certificate by a 3rd party "RMG" that the accuracy of the meter is within 1%. Both MPRS meter and individual meters comply with the monitoring plan. (/10/)
- Stack gas: The verification team confirmed that the accuracy ($\pm 1.5\%$) by the catalogue of SIERRA INSTRUMENTS and the Commissioning Report by ANSAC (8 Nov 2010) for the Sierra 241 Innova-Mass Vortex Mass Flow Meters. (/11a/,/11b/) The calibration frequency is annual and the validity is indicated in Fig. 2 above. As for the consideration during the blank period of the SGy meter, refer to section 3.5 and 3.7 of this report.

3.8.2 Findings

Clarification Request 8

- (1) Please provide the calibration record for: EG_{PJ} , F_{cons}
- (2) Please explain about monitoring equipment Fcons, unit of 0.29 of MPRS and error limit description of individual meter.
- (3) Calibration history of SGy meters

Response

- (1) Calibration record for following equipment was provided.

Verification Report

EG_{PJ}: Calibration was not conducted during the 2nd monitoring period because, the calibration frequency of EG_{PJ} meter is 10 years and valid throughout the 2nd monitoring period.

Fcons: Calibration was not conducted during the 2nd monitoring period because, the calibration frequency of MPRS meter is 10 years and valid throughout the 2nd monitoring period.

(2) Unit is % and the accuracy of MPRS meter is 0.29%,

(3) The calibration history is as below. The blank period of SGy meters was explained (section 3.5 above).

1st calibration was conducted in 23/09/2010 and the second calibration was as below.

1 st calibration	2 nd calibration
T1: 23/09/2011	10/02/2012
T2: 23/09/2011	28/03/2012
T3: 23/09/2011	25/07/2012
T4: 23/09/2011	04/09/2012
T5: ----- under repair -----	

Conclusion

(1) The validation team confirmed that the calibration of EG_{PJ} meter and MPRS meters are not conducted and this is in accordance with the manufacturers standard and acceptable.

(2) OK

(3) The calibration of SGy meters are confirmed by the calibration report. (/11c/)

Clarification Request 9

According to the weigh bridge calibration record, the calibration history of Wi monitoring meter is as follows.

08/02/2011, 05/06/2011 [28 days delay], 18/09/2011 [13 days delay], 25/12/2011 [7 days delay], 01/04/2012 [7 days delay]

There are delays between calibrations as shown in [] above.

It is to be confirmed how these delays are addressed.

Response

It was confirmed that the results of the delayed calibration did not show any errors of the weigh bridge, the monitored values while the validity is delayed are corrected by deducting the maximum permissible error (10kg) from each Wj measurement during the delayed period in accordance with the VVS 03.0 paragraph 238(a). (/2b/(xi))

Conclusion

The verification team confirmed by the calibration record that the delayed calibration did not show any errors of the weigh bridge and each Wj data is appropriately corrected in accordance with the VVS 03.0 paragraph 238(a).

3.8.3 Conclusion

CL 8 and CL 9 were clarified.

The accuracy level of each meter is appropriate and calibration of each meter has been conducted in accordance with the registered monitoring plan.

The project complies with the requirements.

3.9 Accuracy of Emission Reduction Calculations

3.9.1 Discussion

Parameters used for emission reduction calculation:

Verification Report

In the calculation of the emission reduction, following parameters are used for emission reduction calculation. (/2/(vi)(vii))

(1) Baseline emission:

It was confirmed that the same calculation formula as the registered PDD are used. (/2/(iii))

W_j: The verification team confirmed that the parameter W_j used in the baseline calculation in the CER spreadsheet is consistent with the original weigh bridge data, correctly calculated and reported in the monitoring report.

The calculated baseline emission is as below:

$$BE_{CH_4, SWDS, y} = [\text{Emission in 01/05/2011-31/12/2011}] + [\text{Emission in 2012}] = (33,183.27 - 13,572.8) + 31,281 \div 19,610 + 31,281 = \underline{50,891} \text{ tCO}_2\text{e} \text{ (/2b iii/, /32/)}$$

The verification team confirmed by the spreadsheet that the baseline emissions are correctly calculated and correctly reported in the monitoring report. (/1b/, /2b/-(iii))

(2) Project emission

It was confirmed that the same calculation formula as the registered PDD are used. (/2/(iv))

EG_{PJ,EF,y} (Electricity consumed): daily/ SQUARE D meter reading (cross checked by electricity bill by Seraya Energy)

The verification team confirmed that the parameters used in the project emission calculation in the CER spreadsheet is consistent with the original daily SQUARE D meter reading, correctly calculated and reported in the monitoring report.

$$PE_{elec, y} = 2,454.6 \text{ (2011)} + 1,154.02 \text{ (2012)} = \underline{3,608.6} \text{ tCO}_2\text{e}$$

F_{cons} (LNG): The monthly invoice by City Gas is used in accordance with the monitoring plan of the registered PDD.

Daily/ RMG Gas Flow Meter for each train are available but not complete because these meters are not equipped with temperature and gas pressure adjustment.

The average difference between the monthly invoice and the data of MPRS monitored by ECO –STP is less than 0.1% and marginal.

The verification team confirmed that the parameters used in the project emission calculation in the CER spreadsheet is consistent with the original City gas invoice, correctly calculated and reported in the monitoring report.

$$PE_{fuel, on-site, y} = 520.48 \text{ (2011)} + 480.58 \text{ (2012)} = \underline{1,001.06} \text{ tCO}_2\text{e}$$

SG_y (stack gas):

SG_y is stated in 3.7.1, table 3 above.

The verification team confirmed that the parameters used in the project emission calculation in the CER spreadsheet is consistent with above mentioned SG_y data and MC_{N₂O} & MC_{CH₄} values, correctly calculated and reported in the monitoring report.

$$PE_{i, y} = 7,530.98 \text{ (2011)} + 13,499.82 \text{ (2012)} = \underline{21,030.79} \text{ tCO}_2\text{e}$$

The project emission **PE_y** is calculated as Table 6 below.

Table 6: Project emission

	$PE_{elec, y}$	$PE_{fuel, on-site, y}$	$PE_{i, y}$	PE_y
2011	2,454.6	520.48	7,530.98	10,506.06
2012	1,154.02	480.58	13,499.82	15,134.42

The verification team confirmed by the spreadsheet that the project emissions are correctly calculated and correctly reported in the monitoring report. (/1b/, /2b/(iv))

(3) Leakage emission:

Verification Report

It was confirmed that the same calculation formula as the registered PDD are used. (/2/(v))

Emissions from the increased transport

The emissions from the increased transportation were calculated using monitored $NO_{vehicle}$ (1), VF_{cons} and $NCV_{fuel,transport}$ considering the distance from WRP to Project site and the distance from WRP to Disposal site (baseline: Changi disposal site)

In 2011, the calculated value is – 62 tCO₂e⁴ and this is conservatively set as zero.

In 2012, the calculated value is 5.23 tCO₂e.

∴ The calculated value = 0 tCO₂e (2011) + 5.23 tCO₂e (2012) = 5.23 tCO₂e

The verification team confirmed by the spreadsheet that the leakage emission is correctly calculated and correctly reported in the monitoring report. /2b/

Emissions due to ash transportation from project site to TMTS

The emissions due to ash transportation from project site to TMTS (TUAS Marine Transfer Station) were calculated using monitored $NO_{vehicle}$ (2) VF_{cons} and $NCV_{fuel,transport}$.

The calculated value = 7.96 tCO₂e (2011) + 3.29 tCO₂e (2012) = 11.25 tCO₂e

Emissions due to ash transportation from TMTS to Semakau landfill

The emissions due to ash transportation from TMTS to Semakau landfill are calculated using monitored $NO_{vehicle}$ (3) (number of barges), VF_{cons} and $NCV_{fuel,transport}$.

The calculated value = 23.68 tCO₂e (2011) + 8.06 tCO₂e (2012) = 31.74 tCO₂e

Emissions from the residual waste from MSW incineration

The emissions from the residual waste from MSW incineration are calculated using monitored $A_{residual}$ and certified $FC_{residual}$.

The calculated value = 826.95 tCO₂e (2011) + 656.65 tCO₂e = 1483.6 tCO₂e

Total leakage emissions L_y are as table 7 below.

Table 7: Leakage emission

(unit: tCO₂e)

Year	Increased transport	Ash transport project site to TMTS	Ash transport TMTS to landfill	Emission from Residual waste	Total
2011	0	7.96	23.68	826.95	858.59
2012	5.22	3.29	8.06	656.65	673.22
Total	5.22	11.25	31.74	1483.6	1531.81

The verification team confirmed by the spreadsheet that the leakage emissions are correctly calculated and correctly reported in the monitoring report. (/1b/, /2b/-(v))

3.9.2 Findings

None

3.9.3 Conclusion

The verification team confirmed by the spreadsheet and relevant evidence documents that the emission reductions during the monitoring period from 01/05/2011 to 30/04/2012 are correctly reported in the monitoring report as indicated in table 8 below. (/1b/, /2b/)

Table 8: Total emission reductions

⁴ The Leakage emission from increased transportation is negative. This is because 2 WRPs (Bedok and Seletar WRP) were decommissioned by PUB and the total travelling distance of WRP became shorter.

Verification Report

Time Period	Baseline emissions (tCO ₂ e)	Project emissions (tCO ₂ e)	Leakage (tCO ₂ e)	Emissions reductions (tCO ₂ e)
01 May – 31 Dec 2011	19,610	10,507	859	8,244
01 Jan – 30 Apr 2012	31,281	15,135	674	15,472
Total	50,891	25,642	1,533	23,716

Verification Report

4. VERIFICATION STATEMENT

JACO CDM has performed a verification of 2nd monitoring period of the CDM project "Dehydration and incineration of sewage sludge in Singapore". The verification is based on the currently valid documentation of the UN Framework Convention on Climate Change (UNFCCC). In this context, the relevant documents are the "Marrakech Accords".

The management of ECO Special Waste Management Pte. Ltd. is responsible for the preparation of the GHG emission data and the reported GHG emissions reductions of the "Dehydration and incineration of sewage sludge in Singapore" on the basis set out within the project Monitoring and Verification Plan indicated in the registered PDD version 06 dated 9 September 2010, which is complying with the consolidated methodology AM0025 version 11. The development and maintenance of records and reporting procedures in accordance with that plan, including the calculation and determination of GHG emission reductions from the project is the responsibility of the management of the project.

The verifier assesses that the project is implemented and operated as planned and described in the validated and registered PDD. Installed equipment being essential for generating emission reduction runs reliably and is calibrated appropriately. The monitoring system is in place and the project is generating GHG emission reductions.

The verifier assesses that the monitoring was done in accordance the monitoring plan and the GHG emission reduction in the Monitoring Report version 03 dated 04 September 2013 is calculated without material misstatements.

We pointed out 1CAR, 10CLs and 1FAR.

Our opinion relates to the project's GHG emissions and resulting GHG emissions reductions reported and related to the valid and registered project baseline and monitoring, and its associated documents. Based on the information we have seen and evaluated, we confirm the following statement.

Reporting period: From 01-05-2011 to 30-04-2012

Verified emission in the above reporting period:

Baseline emissions:	50,891 tCO ₂ equivalents
Project emissions:	25,642 tCO ₂ equivalents
Leakage emissions:	1,533 tCO ₂ equivalents
Emission reductions:	23,716 tCO ₂ equivalents

Date: 25 September, 2013



Michio HIRUTA
CEO, President of JACO CDM

Verification Report

5. References

Category 1 Documents:

List documents provided by the Client that relate directly to the GHG components of the project. These should have been used as direct sources of evidence for the verification conclusions, and are usually further checked through interviews with key personnel.

- /1a/ Monitoring Report, version 01 dated 17/10/2012 (for 01/05/2011 - 30/04/2012)
- /1b/ Monitoring Report, version 02 dated 29/05/2013 (for 01/05/2011 - 30/04/2012)
- /1c/ Monitoring Report, version 03 dated 04/09/2013 (for 01/05/2011 - 30/04/2012)
- /2a/ CER calculation spread sheet: (Version 01)
- /2b/ CER calculation spread sheet: (Version 02)
 - (0) Cover page
 - (i) Monitoring: List of parameters
 - (ii) Emission Reduction (ERs) calculation
 - (iii) Baseline Emission (BE) calculation
 - (iv) Project Emission (PE) calculation
 - (v) Leakage, Emission (LE) calculation
 - (vi) CDM Annual consolidated data
 - (vii) CDM Monitoring Record
 - (viii) Monitoring of Gas Volume Released into Atmosphere (Sept, 2010 – Apr, 2011)
 - (ix) Operation hour May 2011 to April 2012
 - (x) Monitoring of Sewage Sludge Collection
 - (xi) Correction of sludge weight (for the period of delayed calibration of weigh bridge)
 - (xii) Monitoring of Number of Trip, Barges (Sludge, Ash)
 - (xiii) Monitoring of Natural Gas Consumption
 - (xiv) Monitoring of Electricity Consumption
 - (xv) Monitoring of N₂O, CH₄, Carbon Residue by 3rd Party Lab
 - (xvi) Monitoring of Ash Generation
 - (xvii) Determination of FC residual at 95% confidence level
 - (xviii) Energy generated by aux. fossil fuel added in the incineration
 - (xix) Summary of Sludge property
- /3/ Single line diagram of STP
- /4a/ Material Balance Flow Calculation Sheet for STP Plant (After plant operation & before plant operation)
- /4b/ Sludge dryer drawing
- /4c/ Incinerator drawing
- /4d/ Dust collector drawing
- /4e/ Report for Commissioning of VORTEX SLUDGE DRYER & INCINERATOR by YAMATO SANKO MFG. CO., LTD. (30 July, 2009)
- /4f/ Confirmation by YAMATO SANKO about the capacity of Sludge dryer and Vortex incinerator (13 January, 2012)
- /4g/ Report for Commissioning of the train 6 VORTEX SLUDGE DRYER & INCINERATOR by YAMATO SANKO MFG. CO., LTD. (16 May, 2012)
- /5a/ CDM Monitoring Manual rev 02 (SWM-STP-MON-01) (18 Nov 2010)
- /5b/ Training record of STP (18, Nov, 2010)
- /5c/ Introduction of dehydration and incineration of sewage sludge project as CDM project and its monitoring requirements (18 Nov, 2010: STP training material)
- /6a/ Letter of Acceptance of tender (Contract between PUB and STP for treatment and disposal of sludge from WRP: 1 Apr, 2008)
- /6b/ Disposal of Bottom Ash/Fly Ash at Semakau Landfill (Permission by NEA) (12 Oct 2010)
- /7/ The Strait Times (Completion of the largest sludge treatment plant in Southeast Asia by ECO-SWM) (Newspaper dated 1 Apr, 2009)
- /8/ Weighbridge calibration report (Cardinal Electric weighbridge.)
[05/06/2011, 18/09/2011, 25/12/2011, 01/04/2012]
- /9a/ SQUARE D meter: Declaration of Conformity (accuracy requirement of IEC 62053-22) (25 Jan, 2008) [Calibration frequency: every 10 years]

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- /9b/ SQUARE D meter: Energy monitoring report by Electric Energie & Metering Pte Ltd (20 June 2011)
- /10a/ LNG gas flow meter: Official Calibration Certificate by ACTARIS Singapore (for MPRS meter) (21 Feb, 2009) [Calibration frequency: every 10 years]
- /10b/ LNG gas flow meter: Calibration report of gas flow meter (for LNG of each train to check operation of each train) (25 Sep, 2008)
- /11a/ Stack gas meter: Vortex Mass Flow Meter catalogue and documents
- /11b/ Stack gas meter: Gas Flow meter Commissioning report (4 Nov, 2008)
- /11c/ Stack gas meter: calibration report [(train 1): 10/02/2012, (train 2): 28/03/2012, (train 3): 25/07/2012, (train 4): 23/09/2010: (train 5): 01/09/2011]
- /12/ STP Train's total running time (May 2011 – Apr, 2012)
- /13a/ Daily report for dry and dewatered sludge amount monitored by STP weigh bridge (random sampling data)
- /13b/ Calorific value of dry and dewatered sludge
- /14a/ Electric consumption of ECO-SWM including STP plant (made by ECO-SWM account dept.)
- /14b/ Electricity of ECO-SWM monthly invoice from Seraya Energy
- /14c/ ECO-SWM Electricity meters list and pictures
- /14e/ Metering Code by Energy Market Authority of Singapore (EMA) (August 2009)
- /15a/ LNG: Daily record of natural gas of MPRS meter monitored by STP
- /15b/ LNG: Invoice and NCV of Natural Gas by City Gas Pte Ltd
- /15c/ LNG: Material Safety Data Sheet (MSDS) Natural Gas by ConocoPhillips (Specific gravity of natural gas: 0.63)
- /16a/ Stack gas: Air emission test report: MC_{N2O} by 3rd Party (Singapore Test Services) (3Q 2011, 4Q 2011, 1Q 2012, 2Q, 2012)
- /16b/ Stack gas: Air emission test report: CH₄ by 3rd Party (Singapore Test Services) (3Q 2011, 4Q 2011, 2Q 2012)
- /17a/ Tax Invoice for refuse disposal/ incineration fee and tickets (random sampling, TUAS Marine Transfer Station of NEA)
- /17b/ Ash: STP: Fly ash daily disposal record (random sample, May, 2011)
- /17c/ Ash: STP: Bottom ash daily disposal record (random sample, May, 2011)
- /17d/ Ash: Fly and Bottom ash analysis report by 3rd Party (Singapore Test Services) [(12/07/2011), (11/10/2011, 21/11/2011), (21/12/2011), (13/04/2012)]
- /18/ STP: Daily monitoring record by plant operator (random sampling data)
- /19a/ Transportation: STP e-mail record: Fuel consumption of truck: 0.44 l/km (2011), 0.79 l/km (2012))
- /19b/ Transportation: ECO-monthly Operation 2010 (truck for ash transportation: 0.5l/km (2011), 0.48l/km (2012))
- /19c/ Transportation: record of e-mail from NEA about barge transportation: 24.1l/km (2011), 19.3 l/km (2012), average transportation capacity (1993 ton/trip) (15/02/2012)
- /19d/ Transportation: the calorific value and density of the fuel (by Singapore refining Company Private Limited.
- /20/ Calculation of PIRR due to sludge volume reduction (by PP)

Category 2 Documents:

List background documents related to the design and/or methodologies employed in the design or other reference documents. Where applicable, Category 2 documents should have been used to cross-check project assumptions and confirm the validity of information given in the Category 1 documents and in verification interviews.

- /21a/ Registered PDD for the project (ref. 3042)
- /21b/ PDD Appendix 1 Investment Analysis (without CDM) 100910
- /21c/ Revised PDD version 07 (20 September 2013)
- /22/ Methodology “ Avoided emissions from organic waste through alternative waste treatment process” (AM0025/ version 11)
- /23/ Tool for the demonstration and assessment of additionality

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- /24/ Tool to calculate the emission factor for an electricity system (version 01.1)
- /25/ Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site (version 04)
- /26/ Validation report "Dehydration and incineration of sewage sludge in Singapore" (10 September, 2010).
- /27/ Validation and Verification Standard 02.0
- /28/ Deep Tunnel Sewage System by PUB
- /29a/ Changi Water reclamation Plant Process Schematic (PUB)
- /29b/ Changi Water reclamation Dryer Process (PUB)
- /30/ Semakau Landfill & TUAS Marine Transfer Station (NEA)
- /31/ Verification report for 1st monitoring period
- /32/ Monitoring report for the 1st monitoring period of the Project
- /33/ CDM project standard (CDM-EB70-A02)

Persons interviewed:

List persons interviewed during the verification, or persons contributed with other information that are not included in the documents listed above.

- /41/ Vincent Tang, CDM Project Manager, ECO Special Waste Management Pte. Ltd.
- /42/ Danny Tay, CDM Project Director, ECO Special Waste Management Pte. Ltd.
- /43/ Rick Reidinger, CEO (Acting), ECO Special Waste Management Pte. Ltd.
- /44/ Jester Asong, STP Plant Manager, ECO Special Waste Management Pte. Ltd.
- /45/ Arnold Bufi, Vice President, SMBC Singapore
- /46/ Kan Lock Meng, Principal Engineer, Water Reclamation (Plants) Department, PUB
- /47/ Ang Gek Choo, Senior Manager, Water Reclamation (Plants) Department, PUB

Appendix 1: Verification Checklist

2nd Periodic Verification Checklist

for

Dehydration and Incineration of Sewage Sludge in Singapore Project (CDM Ref. 3042)

Monitoring Period: 01-05-2011 to 30-04-2012

Based on VVS Version 03.0

Table 1: Periodic Verification Checklist

OBJECTIVE	Ref.	COMMENTS	Concl.(incl FARs/CARs)
0. Cover page			
0.1. Project title, reference number, monitoring period and version of the baseline and monitoring methodology applied to the project activity: Are they consistent with the Monitoring report spread sheet and the registered PDD?	/1/ /2/ /21/	- Project title : Dehydration and Incineration of Sewage Sludge in Singapore - Reference No. : 3042 - Monitoring period : 01/05/2011 – 30/04/2012 - Methodology : AM0025/version 11 Avoided emission from organic waste through alternative waste treatment processes - Project Participants : ECO Special Waste Management Pte Ltd Sumitomo Mitsui Banking Corporation Kajima Corporation - Host party : Singapore - Other party : Japan - Consultant company: Kajima Corporation (ref. PDD B.8)	OK
0.2. Registration date of the project activity Is the registration date is consistent with the monitoring period?	/1/	Registration date : 13/09/2010 Crediting period : 13/09/2010 – 12/09/2019 (9 years) 2nd monitoring period : 01/05/2011 – 30/04/2012	OK
A. Description of project activity			
A.1. Purpose and general description of the project activity Does the Monitoring report describe a brief summary of the project as below? - The purpose of the project activity and the measures taken to reduce greenhouse gas emissions; - Brief description of the installed technology and	/1/ /21/	- The purpose and brief description of the installed technology and equipment: The CDM project activity, dehydration and incineration of sewage sludge in Singapore (Ref : 3042) was implemented to reduce greenhouse gas emissions emanating from the dedicated sewage sludge landfill in Singapore. The previous sludge disposal process is well managed by Singapore's Public Utilities Board (PUB). Trenches are excavated and the sludge is mixed with soil in the trenches. The trenches are then covered with excavated soil. The disposed sewage sludge still contains significant amount of carbon that has the potential for methane production through	OK

Verification Checklist of Dehydration and Incineration of Sewage Sludge in Singapore

OBJECTIVE	Ref.	COMMENTS	Concl.(incl FARs/CARs)
<p>equipments;</p> <p>- Relevant dates for the project activity (e.g. construction, commissioning, continued operation periods, etc.)</p> <p>- Total emission reductions achieved in this monitoring period</p>		<p>biological decomposition. Considering the DOC (Degradable Organic Carbon) content of the sewage sludge, management of the disposal site, and methane gas detected at the surface of the disposal site by actual measurement, there was methane gas emission from the site and could continue release this methane emissions in the baseline scenario.</p> <p>- Construction start date: 10/01/2008 (contract of major equipment)</p> <p>- Commissioning date: 01/04/2009</p> <p>- Total emission reductions achieved in this monitoring period: 23,716 tCO₂e</p>	
<p>A.3.2. Location of project activity</p> <p>Is complete information of the location of the project activity: town, city, country and GPS coordinates described?</p>	<p>/1/ /21/</p>	<p>- The project site is located in Tuas district, Singapore.</p> <p>- GPS coordinates : 103°38' E, 1°19' N</p>	OK
<p>A.3.3. Parties and project participant(s)</p> <p>Are the project participants consistent with the registered project activity?</p>	<p>/1/ /21/</p>	<p>Project Participants (Party) are as below.</p> <p>ECO Special Waste Management Pte Ltd (Singapore)</p> <p>Sumitomo Mitsui Banking Corporation (Japan)</p> <p>Kajima Corporation (Japan)</p> <p>The project participants are consistent with the registered project activity.</p>	OK
<p>A.3.4. Reference of applied methodology</p> <p>Are the exact reference (number, title, version) indicated?</p> <p>(a) The applied methodology</p> <p>(b) Tools and other methodologies to which the applied methodology(ies) refers.</p>	<p>/1/ /21/ /22/</p>	<p>The exact references of applied methodology and tools are indicated in the monitoring report as below. These are identical with those indicated in the registered PDD B.1.</p> <p>(a) Approved baseline and monitoring methodology applied to the project activity is:</p> <p>“Avoided emissions from organic waste through alternative waste treatment processes” (AM0025 / version 11)</p> <p>(b) Approved methodological tools applied to the project activity are:</p> <p>“Tool for the demonstration and assessment of additionality” (version 05.2)</p> <p>“Tool to calculate the emission factor for an electricity system” (version 01.1)</p> <p>“Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”(version 04)</p>	OK
<p>A.3.5. Crediting period of the project activity and related information</p>	<p>/1/ /21/</p>	<p>Crediting period : Fixed crediting period 13/09/2010 – 12/09/2019 (9 years)</p> <p>This is consistent with the registered PDD.</p>	OK

Verification Checklist of Dehydration and Incineration of Sewage Sludge in Singapore

OBJECTIVE	Ref.	COMMENTS	Concl.(incl FARs/CARs)
If applicable, does the report include changes to the start date of the crediting period post-registration that have been accepted by the Board?			
A.3.6. Open issue by the validation or previous verification.	/1/ /21/ /26/ /31/	Project was registered on 13 September, 2010. The open issue (FAR 1) at the validation regarding the CDM monitoring manual was resolved at the 1 st verification. In the 1st verification, the verification requested that the odour impact is to be confirmed at the next verification. The verification team confirmed from the interviews with project participant that there is no complaint about odour from nearby stakeholders.	OK
B. Implementation of the project This part is covering the essential checks during the on-site inspection at the project's site, which is indispensably for 1st verification			
B.1 Description of implemented registered project activity Determine whether the project activity has been implemented and operated as per the registered PDD or any approved registered PDD, and that all physical features (technology, project equipment, and monitoring and metering equipment) of the project are in place			
B.1.1. Implementation status of the project - The starting date of the project: consistent with the registered PDD? - Is the information described regarding the actual operation of the project activity during the monitoring period, including information on special events? (ex.: overhaul times, downtimes of equipment, exchange of equipment, etc.) - Is a brief explanation described; (i) events or situations that occurred during the monitoring period, which may impact the	/1/ /21/	The starting date of the project: The starting date of the project was confirmed as 1 April, 2009. (ref. 1 st verification report) In the 1 st verification, PP explained about additional line (Train 6) will be installed in May, 2012. (refer to the First Monitoring report, B.1 P7, Second Monitoring report, B.1 P 8) Therefore, the operation of train 6 is not covered in the 2 nd monitoring period. Clarification request 1 Please provide following information during the 2nd monitoring period regarding; (1) Special events (ex.: overhaul times, downtimes of equipment, exchange of equipment, etc.)	CL 1

Verification Checklist of Dehydration and Incineration of Sewage Sludge in Singapore

OBJECTIVE	Ref.	COMMENTS	Concl.(incl FARs/CARs)												
applicability of the methodology? (ii) how the issues resulting from these events or situations are being addressed?		<p>(2) Any events or situations that occurred during the monitoring period, which may impact the applicability of the methodology?</p> <p>If applicable, how were they addressed?</p> <p><u>Clarification Request 2</u></p> <p>The evidence of the starting date of train 6 operation is to be provided and impact to the monitoring of 2nd monitoring period is to be explained.</p>	CL 2												
<p>B.1.2. Physical components</p> <p>Check the installation of all required facilities and equipment as described by the PDD. (VVS version 03.0 paragraph 227)</p>	/1/ /21/	<p>Key technical specifications of equipments:</p> <p>The verification team confirmed that following main equipment is installed and they are consistent with the registered PDD.</p> <table><thead><tr><th>Equipment</th><th>Specification</th></tr></thead><tbody><tr><td>Dewatered and Dry Sludge Pit</td><td><ul style="list-style-type: none">▪Dewatered Sludge Pit (32.5m x 9m x 5m) with storage capacity up to 2 days▪Dry Sludge Pit (24.5m x 9m x 5m) with storage capacity up to 3 days</td></tr><tr><td>Sludge Dryer</td><td><p>Rotating type model (KRD-330S) from Japanese manufacturer</p><ul style="list-style-type: none">▪ Size of 8m length and 2.3m of shell internal diameter▪ Rotating speed (shell) of 2.32/min▪ Sludge dehydration capacity of 5,325 kg/hr (65% water)</td></tr><tr><td>Vortex Incinerator</td><td><p>Rotating arm type model (VI-200) from Japanese manufacturer</p><ul style="list-style-type: none">▪ Size of 10.6m height and 5.8m in diameter▪ 6 rotating arms with 11 air nozzles per rotating arm▪ Sludge incineration capacity of 2,342 kg/hr (20% water)</td></tr><tr><td>Cyclone</td><td><p>Centrifugal multi-cyclone type dust collector</p><ul style="list-style-type: none">▪ 3.6m height with upper chamber containing 25 cylinders (φ266mm)<p>Centrifugal double-cyclone type dust collector</p><ul style="list-style-type: none">▪6.4m height and coated with anti-corrosion paint</td></tr><tr><td>Exhaust Gas</td><td><ul style="list-style-type: none">▪ SS mesh type media packing scrubber</td></tr></tbody></table>	Equipment	Specification	Dewatered and Dry Sludge Pit	<ul style="list-style-type: none">▪Dewatered Sludge Pit (32.5m x 9m x 5m) with storage capacity up to 2 days▪Dry Sludge Pit (24.5m x 9m x 5m) with storage capacity up to 3 days	Sludge Dryer	<p>Rotating type model (KRD-330S) from Japanese manufacturer</p> <ul style="list-style-type: none">▪ Size of 8m length and 2.3m of shell internal diameter▪ Rotating speed (shell) of 2.32/min▪ Sludge dehydration capacity of 5,325 kg/hr (65% water)	Vortex Incinerator	<p>Rotating arm type model (VI-200) from Japanese manufacturer</p> <ul style="list-style-type: none">▪ Size of 10.6m height and 5.8m in diameter▪ 6 rotating arms with 11 air nozzles per rotating arm▪ Sludge incineration capacity of 2,342 kg/hr (20% water)	Cyclone	<p>Centrifugal multi-cyclone type dust collector</p> <ul style="list-style-type: none">▪ 3.6m height with upper chamber containing 25 cylinders (φ266mm) <p>Centrifugal double-cyclone type dust collector</p> <ul style="list-style-type: none">▪6.4m height and coated with anti-corrosion paint	Exhaust Gas	<ul style="list-style-type: none">▪ SS mesh type media packing scrubber	OK
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OBJECTIVE	Ref.	COMMENTS	Concl.(incl FARs/CARs)
		<p>Treatment System</p> <ul style="list-style-type: none"> 2 scrubber circulation pumps 6 spray headers and 2 perforated plates 18m height inclusive of chimney <p>Wastewater Treatment System</p> <ul style="list-style-type: none"> Physical process – ash separation system comprising of ash settling tank, ash removal pump, ash filters and diffusers Chemical process – process tank and chemical dosing pump Cross-flow type cooling tower with capacity of 1.28 m3/min <p>Landfill (Ash treatment)</p> <ul style="list-style-type: none"> The fly ash and bottom ash is transported by 2000t barges from TUAS Marine Transport Station (TMTS) to Semakau Landfill. <p>Sewage sludge transportation</p> <ul style="list-style-type: none"> transported from 4 WRPs (Water Reclamation Plants) to the project site by vehicles (sludge and ash). <p>Ash transportation</p> <ul style="list-style-type: none"> transported from the project site to TMTS by vehicles. Bottom ash is stored in big bins and fly ash is stored in small bulk bags. 	
B.1.3. Project boundaries Check whether the project boundaries are still in compliance with the ones indicated by the PDD. (VVS227)	/1/ /21/	The verification team confirmed by the on-site visit that the project boundary is in compliance the registered PDD.	OK
B.1.4. On-site visit Was on-site visit conducted? If not, justify the rational of decision. (VVS227)	—	The verification team, T. FUKUDA and T. YUGUCHI of JACO CDM visited the project site on 14/11/2012.	OK
B.2. Post registration changes The DOE shall determine whether the changes do not require prior approval by the Board in accordance with appendix 1 of Project Standard.			
B.2.1. Temporary deviations from	/1/	Stack gas volume flow rate, SGy measurement was temporary deviated	OK

Verification Checklist of Dehydration and Incineration of Sewage Sludge in Singapore

OBJECTIVE	Ref.	COMMENTS	Concl.(incl FARs/CARs)
registered monitoring plan or applied methodology Check whether there are deviations from the registered monitoring plan and/or methodology.	/21/	(partially) from registered monitoring plan due to the flow meter under calibration or under repair. During this period, ECO estimated the SGy basing on the assumption that the source of the GHG emissions operated at maximum design sludge burning capacity in accordance with the CDM Project Standard Annex 1 section 3.	
B.2.2. Corrections Check whether there are any corrections to project information or parameters fixed at validation, as described in the registered PDD, made by project participants in a revised PDD comply with the requirements of the Project Standard.	/1/ /21/	There are no corrections to project information or parameters fixed at validation, as described in the registered PDD.	OK
B.2.3. Permanent changes from registered monitoring plan or applied methodology Check whether there are permanent changes from the registered monitoring plan and/or methodology.	/1/ /21/	There are no permanent changes from registered monitoring plan or applied methodology.	OK
B.2.4. Changes to project design of registered project activity Check whether there are proposed or actual changes to the project design of a registered CDM project activity.	/1/ /21/	There are no proposed or actual changes to the project design of a registered CDM project activity. <u>Clarification request 10</u> (1) The impact of the changes of WRPs to the project activity is to be clarified. (2) The impacts of the actual parameters changes to the project activity are to be clarified.	OK
B.2.5. Changes to start date of crediting period 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.	/1/ /41/ /42/	The project participants do not wish to change the start date of the crediting period.	OK
C. Description of monitoring system Verification of the monitoring plan of the project complies with the applied monitoring methodology.			

Verification Checklist of Dehydration and Incineration of Sewage Sludge in Singapore

OBJECTIVE	Ref.	COMMENTS	Concl.(incl FARs/CARs)
C.1. Monitoring plan & monitoring methodology			
C.1.1. Monitoring Plan Check whether the monitoring plan of the project in accordance with the approved methodology applied by the proposed CDM project activity. (VVS230)	/1/ /21/	<p>The verification team confirmed the monitoring and metering/ recording systems by the on-site visit and the monitoring record of the STP plant as below.</p> <ul style="list-style-type: none"> Wj: (Weight of Dewatered sludge and dry sludge) Sludge are sent to Sludge Treatment Plant (STP) with each WRP ticket with different color. In addition to that the dry sludge and dewatered sludge are also transported by different trucks and weighed separately by weigh bridge of STP plant. The weight is recorded by the weigh bridge operator and automatically recorded in the computer of the STP plant. The verification team confirmed by the calibration reports of weigh bridge by a 3rd party "SAC" that the accuracy of the weigh bridge is within $\pm 10\text{kg}$ for the 30 ton range (average sludge weight including truck weight of the project) and complies with the monitoring plan. (/2/(x)(xi), /8/) <p>However, there were delays from the validity of the calibration of the weigh bridge. The monitored data during such delayed period is correctly treated based on VVS paragraph 238. (CL 9)</p> <ul style="list-style-type: none"> EG_{PJ}: Electricity consumption in the STP plant is monitored by SQUARE D meter of STP plant. The electricity consumed in STP is a part of the electricity consumed in ECO-SWM plant. The electricity is supplied by SERAYA Energy Pte Ltd and the invoice is for the total electricity of ECO-SWM plant including the STP. (/2/(xiv)) The verification team confirmed for SQUARE D meter by the "Declaration of Conformity" report of the meter and the "Energy monitoring report" by a 3rd party "Electrique Energy & Metering Pte Ltd" that the accuracy of the meter is 0.5s and complies with the monitoring plan. (/9/) Fcons: LNG consumption for the auxiliary burner of the incineration is monitored by Metering and Pressure Regulating Skid (MPRS). (/2/(xii)) The data of the monthly invoice from City Gas is selected as monitored parameter. The data of the invoice is cross checked with the own reading of MPRS meter by PP. The individual Gas meter of STP plant for each train is used for checking the operation of each line and not used for emission reduction calculation. NCV_{fuel}: Gas company data is used. (/15/) SGy: Stack gas flow meter 	

Verification Checklist of Dehydration and Incineration of Sewage Sludge in Singapore

OBJECTIVE	Ref.	COMMENTS	Concl.(incl FARs/CARs)
		<p>The verification team confirmed by the catalogue of meter supplier "ANSAC" and their commissioning report that the accuracy of the stack gas meter is within 1.5%.</p> <p>In the 2nd monitoring period, there were periods while the gas flow meters had been dismantled for calibration, maintenance at the manufacturer in USA and transportation for the calibration.</p> <p>SGy during such period is based on historical measured data and calculated at 95% confidence interval. (/2/(viii),(ix), /11/)</p> <ul style="list-style-type: none"> • MC_{N2O} & MC_{CH4}: Stack gas composition is based on the 3rd party laboratory certificate. (/2/(xv), /16/) • NO(1): Number of vehicles for sludge transportation, based on the tickets of PUB recorded at the weigh bridge of STP. (/2/(x), /13/) • NO(2): Number of vehicles for ash transportation (recorded by the Tickets of TMTS) (/2/(x),/19/) • NO(3): Number of barges for ash transportation. This number is calculated by total weight of ashes/ average transporting weight per trip by a 2000t barge of NEA. The average transporting weight is provided by NEA as 1,993 ton/trip. (/2/(x),/19/) • DT_{i,y}: Average additional distance travelled compared to the baseline (PUB (Public Utilities Board) documents) • VFcons: Vehicle fuel consumption (l/km) data was confirmed as below. (/2/(x), /19/) <p>Sludge transportation from WRPs to STP plant: 0.44 l/km (2011), 0.79 l/km (2012): PUB transporters data (/19a/)</p> <p>Ash transportation from STP to TMTS: 0.5l/km (2011), 0.48 l/km (2012): ECO data (/19b/)</p> <p>Ash transportation from TMTS Semakau (barge): 24.11/km (2011), 19.29 l/km (2012): NEA data (/19c/)</p> <ul style="list-style-type: none"> • NCV_{fuel, transport}: Calorific value of fuel (MJ/kg) is provided by Singapore Refining Company Private Limited as 43.52 MJ/kg (/19d/) • D_{fuel}: fuel density is provided by Singapore Refining Company Private Limited as 0.8519 kg/l. (/19d/) • A_{residual}: The amount of ash is measured by the weigh bridge of TUAS TMTS for bottom ash and fly ash. The data is given to STP as tickets and recorded in STP. (/2/(xvi), /17/) • FC_{residual}: 5 sets of samples each comprising of bottom ash and fly ash were quarterly taken and tested, the 2nd 3rd 4th quarter of 2011 data and 1st quarter of 2012 data by a test service company (Singapore Test Service) 	

Verification Checklist of Dehydration and Incineration of Sewage Sludge in Singapore

OBJECTIVE	Ref.	COMMENTS	Concl.(incl FARs/CARs)
		<p>are available. (/17/)</p> <p>Energy generated by the auxiliary fossil fuel added into incinerator is calculated. Its fraction of energy is 1.77% in 2011 and 3.78% in 2012. Both values are less than 50% of the total energy generated in the incinerator. It is confirmed the project complies with the applicability condition of the methodology AM0025/ version 11.(/2/(xviii))</p> <p>As mentioned above, the SGy monitoring is not possible during the flow meter calibration, maintenance in USA and transportation. SGy during such period is based on historical measured data and calculated at 95% confidence interval. This is considered as temporary deviation from registered monitoring plan.</p> <p>Except for SGy, the monitoring activities are in accordance with the registered monitoring plan.</p>	
<p>C.1.2. Request for revision of Monitoring Plan</p> <p>In case if the monitoring plans of the project is not in accordance with the monitoring methodology, was the request for revision of the monitoring plan done? (VVS250)</p>	/1/	NA	
<p>C.1.3. Monitoring activities & Monitoring plan</p> <p>Check whether the PP implemented monitoring activities in accordance with the approved monitoring plan.(VVS 234, 235)</p>	/1/ /2/	<p><u>Corrective Action Request 1</u></p> <p>(1) The description of monitoring and calculation procedure of Natural Gas Consumption is inconsistent.</p> <ul style="list-style-type: none"> - p10 (individual meter is used for CDM monitoring record and MPRS is for a counter check) - p23 (monthly invoice reading is selected as monitored data. <p>(2) Please provide the comparison data of MPRS and individual meters.</p>	
<p>C.1.4. Monitoring Aspect</p> <p>Are there any monitoring aspects of the project activity that are not specified in the methodology (e.g. additional monitoring parameters, monitoring frequency and calibration frequency)? (VVS231)</p>	/1/ /21/	Not applicable.	
C.2. Management and Operational System			

Verification Checklist of Dehydration and Incineration of Sewage Sludge in Singapore

OBJECTIVE	Ref.	COMMENTS	Concl.(incl FARs/CARs)
In order to ensure a successful operation of a Client project and the credibility and verifiability of the ERs achieved, the project must have a well defined management and operational system. (VVS234 (b))			
C.2.1. Reporting procedures Check how reports with relevance for the later determination of emission reductions will be generated	/1/ /21/ /41- /45/	The organization structure indicating the reporting procedures is described in the monitoring report. (p17) The collection of the data will be undertaken by the plants' technician and will be checked and authenticated by the Section Manager. The CDM Project Manager then aggregates and reports the ER data calculated to the CDM Project Director on a monthly basis for the data approval prior to management reporting. On an annual basis and before verification process, a third party CDM expert will be engaged to check the data and ER calculations and assist Eco in the preparation of the monitoring report.	OK
C.2.2. Documented instructions Check whether the personnel performing tasks with sensitivity for the monitoring of emission reductions have access and knowledge of documented instructions, forming a part of the project's management system.	/1/ /5/ /41- /45/	The organizational structure of monitoring and responsibility are stipulated in the monitoring report P17 which is consistent with PDD /3/ B.7.2. The organization chart, detail responsibility, qualification of CDM operational staff and procedure are stipulated in the CDM Monitoring Manual /5/. The personnel training have been established for CDM monitoring operation. Clarification Request 3 (1) Please provide the monitoring manual, if revised.	CL 3
C.2.3. Documentation The system should be documented by manuals and instructions for all procedures and routines with relevance to the quality of emission reductions. The accessibility of such documentations to persons working on the project has to be secured.	/1/ /5/	ditto	(CL 13)
C.2.4. Qualification and training The system should describe the requirements on qualification and the need of training programs for all persons working on the emission reduction project. Performed training programs and	/1/ /5/	The organizational structure of monitoring and responsibility are stipulated in the monitoring report P17 which is consistent with PDD /3/ B.7.2. The organization chart, detail responsibility, qualification of CDM operational staff and procedure are stipulated in the CDM Monitoring Manual /5/. The personnel training have been established for CDM monitoring operation. Clarification Request 3	CL 3

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OBJECTIVE	Ref.	COMMENTS	Concl.(incl FARs/CARs)
certificates should be archived by the system.		(2) Qualification and training for the 2nd monitoring period are to be explained.	
C.2.5. Allocation of responsibilities The allocation of responsibilities should be documented in written manner.	/1/ /5/ /21/	Roles and responsibilities are stipulated in the CDM Monitoring Manual /5/ and the Monitoring Report Section C. They are in line with the Monitoring Plan of the registered PDD.	OK
C.2.6. Emergency procedures The system should contain procedures which provide emergency concepts in case of unexpected problems with data access and/or data quality.	/1/ /5/	Emergency procedure for monitoring meters is stipulated in the CDM Monitoring Manual.	OK
C.2.7. Data archiving The system should provide routines for the archiving of all data which is required for verifying the project's performance in the context of consecutive verifications.	/1/ /5/ /41- /45/	CDM Section Manager has responsibility to archive all the CDM related documents such as raw data, certificates and/or calibration reports. /5/. CDM related documents and monitoring data are archived in paper and electronic as described in the PDD B.7.2 and the Monitoring Manual /5/. The verification team confirmed by the on-site visit that the data archiving is appropriate.	OK
C.2.8. Monitoring report The system includes procedures for the calculation of emission reductions and the preparation of the monitoring report.	/1/ /5/ /41- /45/	CDM Project Manager has responsibility to preparing emission reductions calculation and monitoring report.	OK
C.2.9. Internal QA/QC The system includes internal control procedures, which allow the identification and solution of problems at an early stage.	/1/ /5/ /41- /45/	Internal auditor is assigned and CDM director is responsible for data approval prior to management reporting.	OK
D. Data and parameters Especially for data of baseline emissions there might be the necessity to include external data sources. The access to such data and a proof of data quality should be part of verification. If it is deemed to be necessary, an entity delivering such			

Verification Checklist of Dehydration and Incineration of Sewage Sludge in Singapore

OBJECTIVE	Ref.	COMMENTS	Concl.(incl FARs/CARs)
data should be audited. (VVS234(b))			
D.1. Data and parameters fixed ex ante or at renewal of crediting period			
D.1.1. Data and parameters Are all the data and parameters fixed ex ante or at renewal of crediting period listed and described properly?	/1/ /2/ /13/- /19/ /21/	The following data and parameters fixed ex ante or at renewal of crediting period are identical with those of the registered PDD and the 1 st monitoring report. CEF _{elec} , EF _{fuel} , GWP _{N2O} , GWP _{CH4} , AF, ϕ , f, OX, F, DOC _f , MCF, DOC _j , k _j , EF _{fuel, transport} DTi,y (Average additional distance travelled compared to baseline): It is identical with the data of 1 st monitoring report. Clarification Request 4 It is to be confirmed that the DTi,y is not changed.	CL 4
D.2 Data and parameters monitored			
D.2.1. Type and sources of internal data Acquire information on type and source of internal and external GHG data, which is used in calculations of emission reductions. e.g..” continuous direct measurements”, “site-specific correlations”, “periodic direct measurements”, “use of models” and/or “use of default emissions factors”.	/1/ /2/ /12/- /15/	Type and sources of internal and external GHG data are indicated in the monitoring report suitably.	OK
D.2.2. Baseline emission parameter (VVS234(b)) (1) Are all the parameters listed in accordance with the monitoring plan? (2) Is the information flow of each parameter appropriate?	/1/ /2/ /13/	<ul style="list-style-type: none"> Wj: (Weight of Dewatered sludge and dry sludge) Sludge is sent to STP plant with each WRP ticket with different color. In addition to that the dry sludge and dewatered sludge are also transported by different trucks and weighed separately by weigh bridge of STP plant. The weight is recorded by the weigh bridge operator and automatically recorded in the computer of the STP plant. Following reports are prepared. (CL 5) ECO SWM Daily Loads Report CDM Monitoring Record CDM Annual Consolidated Data Clarification Request 5	CL 5

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OBJECTIVE	Ref.	COMMENTS	Concl.(incl FARs/CARs)
		<p>Please provide following documents.</p> <p>- Actual Daily monitoring record of Wj (Example)</p>	
<p>D.2.3. Project emission parameter (VVS234(b))</p> <p>(1) Are all the parameters listed in accordance with the monitoring plan?</p> <p>(2) Is the information flow of each parameter appropriate?</p>	<p>/1/ /2/ /14/ /15/ /16/</p>	<ul style="list-style-type: none"> EG_{PJ}: Electricity consumption in the STP plant is monitored by SQUARE D meter of STP plant. The electricity consumed in STP is a part of the electricity consumed in ECO-SWM plant. The electricity is supplied by SERAYA Energy Pte Ltd and the invoice is for the total electricity of ECO-SWM plant including the STP. Following reports are prepared. <ul style="list-style-type: none"> Daily Monitoring Record CDM Monitoring Record CDM Annual Consolidated Data Annual Emission Reduction Calculation Sheet Fcons: LNG consumption for the auxiliary burner of the incineration is monitored by MPRS. The individual Gas meter of STP plant for each train is also used for monitoring of each train. The monthly invoice reading of gas company is used for emission reduction calculation. (CAR 1) Following reports are prepared. <ul style="list-style-type: none"> Daily Monitoring Record CDM Monitoring Record CDM Annual Consolidated Data Annual Emission Reduction Calculation Sheet NCV_{fuel}: Gas company data. (CL 6) SG: Stack gas flow meter The verification team confirmed by the catalogue of meter supplier "ANSAC" and their commissioning report that the accuracy of the stack gas meter is within 1.5%. MC_{N2O} & MC_{CH4}: Stack gas composition is based on the 3rd party laboratory certificate. (CL 6) <p>Clarification Request 6</p> <p>Please provide following data (Project emission parameters)</p> <p>(1) EG_{PJ}:</p> <ul style="list-style-type: none"> Invoice of SERAYA Energy Pte Ltd for ECO SWM electricity consumption ECO STP Account dept. data for electricity consumption in ECO 	<p>CL 6</p>

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OBJECTIVE	Ref.	COMMENTS	Concl.(incl FARs/CARs)
		SWM plant (internal data) - Daily record of Epj by ECO-STP (2) Records of F_{cons}, NCV_{fuel}, SG, MC_{N2O} and MC_{CH4}	
D.2.4. Leakage parameter (VVS234(b)) (1) Are all the parameters listed in accordance with the monitoring plan? (2) Is the information flow of each parameter appropriate?	/1/ /2/ /17/- /18/	<ul style="list-style-type: none"> • NO(1): Number of vehicles for sludge transportation, based on the tickets of PUB recorded at the weigh bridge of STP. • NO(2): Number of vehicles for ash transportation (recorded by the Tickets of TMTS) • NO(3): Number of barges for ash transportation. This number is calculated by total weight of ashes/ average transporting weight per trip by a 2000t barge of NEA. The average transporting weight is provided by NEA as 1,726 ton/trip. • VFcons: vehicle fuel consumption (l/km) data (CL 7). Sludge transportation from WRPs to STP plant: Ash transportation from STP to TMTS: Ash transportation from TMTS Semakau (barge): • $NCV_{fuel, transport}$: Calorific value of fuel (MJ/kg) is provided by Singapore Refining Company Private Limited as 43.52 MJ/kg • D_{fuel}: fuel density is provided by Singapore Refining Company Private Limited as 0.8519 kg/l. • $A_{residual}$: The amount of ash is measured by the weigh bridge of TUAS TMTS for bottom ash and fly ash. The data is given to STP as tickets and recorded in STP. • $FC_{residual}$: 5 sets of samples each comprising of bottom ash and fly ash were 4 times taken (3 times in 2011 and 1 time in 2012) in the monitoring period and tested. The verification team confirmed that conservative data is applied. Clarification Request 7 As for $FC_{residual}$, it is to be confirmed that the sampling is conducted to achieve maximum uncertainty of 20% at 95% confidence level.	CL 7
D.2.5. Quality assurance Does external or internal data collection underlie sufficient quality assurance routines?	/1/ /5/ /41/- /45/	As for the calibration of monitoring equipment, refer to D.2.8 below. The verification team confirmed by the on-site visit that quality assurance activity has been carried out appropriately as planned.	OK
Monitoring Equipment & Compliance with the			

Verification Checklist of Dehydration and Incineration of Sewage Sludge in Singapore

OBJECTIVE	Ref.	COMMENTS	Concl.(incl FARs/CARs)																														
<p>calibration frequency requirements for measuring instruments</p> <p>The accuracy of equipment used for monitoring is in accordance with the relevant guidance provided by the CDM Executive Board and is controlled and calibrated in accordance with the monitoring plan (VVS234 (c), 237 - 243)</p>																																	
<p>D.2.6. Monitoring and metering equipment</p> <p>Check whether the required metering systems have been installed. The meters have to comply with appropriate quality standards applicable for the used technology.</p>	<p>/1/ /8/- /11/</p>	<p>Detail information of meters is below. Table D.1</p> <table><tr><th>Meter</th><th>Type</th><th>Accu racy</th><th>Serial Number</th><th>Calibration date (Validity)</th></tr><tr><td>Wi</td><td>CARDINAL electronic weighbridge</td><td>No.205</td><td>±10k g</td><td>E23908- 0347</td></tr><tr><td>EG_{pi}</td><td>SQURE D Power meter</td><td>PM800</td><td>0.5S</td><td>05/06/2011 18/09/2011 01/04/2012 (Quarterly) 25/01/2008 (10 years) Accuracy check: yearly</td></tr><tr><td>Fcons</td><td>MPRS: Actaris Turbine Gas Meter</td><td>FLUXI 2080 TZ</td><td>0.29</td><td>QM070250 3</td></tr><tr><td>Fcons</td><td>Individual: RMG Gas Flow meter</td><td>TRZ 03- K</td><td>±1%f or 0.2 Q_{max} to Q_{max}</td><td>608167 608168 608169 608170 608171</td></tr><tr><td>SGy</td><td>Innova- MassTM Voltex Mass Flow Meter</td><td>SIERRA 241</td><td>±1.5 %</td><td>1190357456 1190357458 1190357460 1190357459 1283718279</td></tr></table> <p>Clarification Request 8</p>	Meter	Type	Accu racy	Serial Number	Calibration date (Validity)	Wi	CARDINAL electronic weighbridge	No.205	±10k g	E23908- 0347	EG _{pi}	SQURE D Power meter	PM800	0.5S	05/06/2011 18/09/2011 01/04/2012 (Quarterly) 25/01/2008 (10 years) Accuracy check: yearly	Fcons	MPRS: Actaris Turbine Gas Meter	FLUXI 2080 TZ	0.29	QM070250 3	Fcons	Individual: RMG Gas Flow meter	TRZ 03- K	±1%f or 0.2 Q _{max} to Q _{max}	608167 608168 608169 608170 608171	SGy	Innova- MassTM Voltex Mass Flow Meter	SIERRA 241	±1.5 %	1190357456 1190357458 1190357460 1190357459 1283718279	
Meter	Type	Accu racy	Serial Number	Calibration date (Validity)																													
Wi	CARDINAL electronic weighbridge	No.205	±10k g	E23908- 0347																													
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Fcons	MPRS: Actaris Turbine Gas Meter	FLUXI 2080 TZ	0.29	QM070250 3																													
Fcons	Individual: RMG Gas Flow meter	TRZ 03- K	±1%f or 0.2 Q _{max} to Q _{max}	608167 608168 608169 608170 608171																													
SGy	Innova- MassTM Voltex Mass Flow Meter	SIERRA 241	±1.5 %	1190357456 1190357458 1190357460 1190357459 1283718279																													

CL 8

Verification Checklist of Dehydration and Incineration of Sewage Sludge in Singapore

OBJECTIVE	Ref.	COMMENTS	Concl.(incl FARs/CARs)
		<p>(1) Please provide the calibration record for: EGPJ, Fcons</p> <p>(2) Please explain about monitoring equipment Fcons, unit of 0.29 of MPRS</p> <p>(3) Calibration history of SGy meters</p> <p>Clarification Request 9 According to the weigh bridge calibration record, the calibration history of Wi monitoring meter is as follows. 08/02/2011, 05/06/2011 [28 days delay], 18/09/2011 [13 days delay], 25/12/2011 [7 days delay], 01/04/2012 [7 days delay]</p> <p>There are delays between calibrations as shown in [] above. It is to be confirmed how these delays are addressed.</p>	CL 9
<p>D.2.7. Data acquisition and data processing systems</p> <p>Check the eligibility of applied systems.</p>	/1/ /5/	The data acquisition and data processing has been carried out appropriately in accordance the ECO STP monitoring manual.	OK
<p>D.2.8. Calibration and quality assurance</p> <p>Is the calibration conducted in accordance with the frequency as specified by the methodology, monitoring plan of the registered PDD or approved revised monitoring plan?</p>	/1/ /5/ /8/- /11/	Ref. CL 9 above.	(CL 9)
<p>D.2.9. Delayed Calibration</p> <p>In case of delayed calibration or the calibration has not been conducted at the time of verification, does the calculation adopt conservative approach? (VVS 238)</p>	/1/ /2/ /8/- /11/	ditto	(CL 9)
D.3. Implementation of sampling plan			
<p>D.3. Sampling procedures</p> <p>Are the sampling procedures in accordance with UNFCCC standard practice?</p>	/1/ /2/	NA	
D.4. Other monitoring issues			

Verification Checklist of Dehydration and Incineration of Sewage Sludge in Singapore

OBJECTIVE	Ref.	COMMENTS	Concl.(incl FARs/CARs)
D.4.1. Significance and reporting risks Assess the significance and reporting risks related to the different external or internal data sources. Potential reporting risks may be related to the calculation methods, accuracy of data sources and data collection and/or the information systems from which data is obtained. The significance of and risks associated with the data source indicate the level of verification effort required at a later stage.	/1/ /2/ /5/ /41/- /45/	The verification team assessed reporting risks; - Calculation methods except SGy are based on the methodology. Calculation method of SGy for the flow meter blank period is confirmed conservative. - Accuracy of data sources: metering equipment is properly calibrated (Except SGy meter) - Data collection and/or information systems (record of project site and data processing system) are confirmed appropriate from the on-site visit.	OK
D.4.2. Emergency procedures Are there any procedures which will be applicable if there is no access to relevant external or internal data?	/1/ /2/ /5/ /41/- /45	The verification team confirmed that there was no emergency during the monitoring period.	OK
E. Calculation of emission reductions GHG emission reductions achieved by/resulting from the proposed CDM project activity shall be calculated applying the selected methodology.			
E.0. Assessment of data for calculation			
E.0.1. Complete set of data Check whether the complete set of data for the specified monitoring period available. If not, was the most conservative assumption taken, or a request of deviation raised? (VVS245 (a))	/1/ /2/ /9/- /19/	CER calculation spreadsheet was provided. The verification team confirmed that the complete set of data is available for the specified monitoring period available except SGy. SGy data is not available due to flow meter calibration and repair. The verification team confirmed that the SGy is estimated with the most conservative assumptions as stated in 3.5 above.	OK
E.0.2. Cross-check Information provided in the monitoring report is to be cross-checked with other sources such as plant log books, inventories, purchase records, laboratory analysis (VVS245 (b))	/1/ /5/ /41/- /45/	The verification team confirmed from the interviews with project participants and monitoring record that calculation conducted by ECO-STP has been cross-checked by a third party CDM expert as per the monitoring plan. (/41/,/42/)	OK

Verification Checklist of Dehydration and Incineration of Sewage Sludge in Singapore

OBJECTIVE	Ref.	COMMENTS	Concl.(incl FARs/CARs)
E.0.3. Assumptions in emission calculation Justify any assumptions used in emission calculations. (VVS245 (d))	/1/ /2/ /21/	All calculations except SGy estimate are based on the methodology. The verification team confirmed that SGy estimate method is conservative as explained in 3.5 above.	OK
E.0.5. Appropriate emission factor Check whether appropriate emission factors, IPCC default values and other reference values have been correctly applied. (VVS245 (e))	/1/ /2/ /21/	The emission factors are identical with the values of registered PDD.	OK
Emission Reduction Calculation			
E.1. Calculation of baseline emissions Check whether the calculations of baseline emissions have been carried out in accordance with the formulae and methods described in the monitoring plan and the applied methodology document (VVS245 (c))	/1/ /2/	Baseline calculation spreadsheet was provided. (/2b/(iii)) The verification team confirmed that the calculations of baseline have been carried out in accordance with the formulae and methods described in the monitoring plan and the applied methodology document.	OK
E.2. Calculation of project emissions Check whether the calculations of project emissions have been carried out in accordance with the formulae and methods described in the monitoring plan and the applied methodology document (VVS245 (c))	/1/	Project emission calculation spreadsheet was provided. (/2b/(iv))) The verification team confirmed that the calculations of project emissions have been carried out in accordance with the formulae and methods described in the monitoring plan and the applied methodology document.	OK
E.3. Calculation of leakage emissions Check whether the calculations of leakage emissions have been carried out in accordance with the formulae and methods described in the monitoring plan and the applied methodology document (VVS245 (c))	/1/ /2/	Leakage emission calculation spreadsheet was provided. (/2b/(v)) The verification team confirmed that the calculations of leakage emissions have been carried out in accordance with the formulae and methods described in the monitoring plan and the applied methodology document.	OK
E.4. Summary of calculation of emission reductions Check whether the calculated summary is	/1/ /2/	Emission Reduction Calculation spread sheet was provided. (/2b/(ii)). The verification team confirmed that the calculations of emission reductions have been carried out in accordance with the formulae and methods described in the monitoring plan and the applied methodology document.	OK

Verification Checklist of Dehydration and Incineration of Sewage Sludge in Singapore

OBJECTIVE	Ref.	COMMENTS	Concl.(incl FARs/CARs)
described in accordance with the monitoring plan and the applied methodology document (VVS245 (c))			
E.5. Comparison of actual emission reductions with estimates in registered PDD: Is the comparison provided in the monitoring report? (VVS 228)	/1/ /2/ /21/	The comparison is described in the monitoring report.	OK
E.6. Remarks on difference from estimated value in registered PDD: Is the description 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? (VVS 228)	/1/ /2/ /21/	Actual values are 23,716 tCO ₂ and far smaller than the estimated values in ex-ante calculation 69,141 tCO ₂ .	OK

Table 2: Resolution of Corrective Action and Forward Action Requests

Draft report clarifications and forward action request by audit team	Ref. to checklist Table 1 to 3	Summary of project owner response	Audit team conclusion
<p><u>Corrective Action Request 1</u> (1) The description of monitoring and calculation procedure of Natural Gas Consumption is inconsistent.</p> <ul style="list-style-type: none"> - p10 (individual meter is used for CDM monitoring record and MPRS is for a counter check) - p23 (monthly invoice reading is selected as monitored data) <p>(2) Please provide the comparison data of MPRS and individual meters.</p>	<p>Table 1 C.1.3</p>	<p>(1) The description of the monitoring report p10 is typo error. The MPRS reading will be used for $F_{cons,y}$</p> <p>(2) The individual meter is used for operation check. The monthly invoice reading is selected as monitored parameter and the MPRS reading is used for cross check. Examples of invoices are provided.</p>	<p>OK</p> <p>(1) The verification team confirmed the description is corrected in the revised monitoring report version 02.</p> <p>(2) The verification team was provided with the data of MPRS and invoice from city gas. The data of the monitoring report is appropriate. The deviation between invoice and MPRS reading by ECO STP is negligible (max: 0.05%) (/2 (viii))</p>
<p><u>Clarification request 1</u> Please provide following information during the monitoring period regarding;</p> <p>(1) Special events (ex.: overhaul times, downtimes of equipment, exchange of equipment, etc.)</p> <p>(2) Any events or situations that occurred during the monitoring period, which may impact the applicability of the methodology?</p> <p>If applicable, how were they addressed?</p>	<p>Table 1 B.1.1</p>	<p>(1) There were no special events.</p> <p>(2) These were no events or situations which may impact the applicability of the methodology.</p>	<p>The verification team confirmed from the interviews with project participants and operation record of the ECO-STP plant that there were no special events which may impact the applicability of the methodology.</p>
<p><u>Clarification Request 2</u> The evidence of the starting date of train 6 operation is to be provided and impact to the monitoring of 2nd monitoring period is to be explained.</p>	<p>Table 1 B.1.1</p>	<p>The performance test of No. 6 train was conducted by Yamato Sanko during April 26 to April 28, 2012 and the performance test report dated 16 May, 2012 was provided. It was confirmed from the daily record of the STP plant and interview with PP that the commercial operation of train 6 started from 9 May, 2012.</p> <p>The amount of sludge processed by No.6 train during performance test in 26,27 April, 2012 was deducted from</p>	<p>OK</p> <p>The verification team confirmed by the daily record of the STP plant and interview with PP that the commercial operation started from 9 May, 2012.</p> <p>It was confirmed by the performance test report and CER calculation spreadsheet that all the sludge processed by No.6 train during the performance test in April 26 and 27 were deducted from DWS and DS for CER</p>

		the DWS and DS for CER calculation. The deducted amount is recorded in the performance test report and the amount does not affect the CER.	calculation of the 2nd monitoring period, even though the amount is small and no impact to CER. ("sludge collection" sheet in /2b/)
			<p><u>Forward Action Request 1</u></p> <p>The impacts of the additional train No. 6 whose operation started in May, 2012 after the end of 2nd monitoring period are to be reported in accordance with the requirements of the CDM project standard section 12.8.3.4. /33/</p>
<p><u>Clarification Request 3</u></p> <p>(1) Please provide the monitoring manual, if revised.</p> <p>(2) Qualification and training for the 2nd monitoring period are to be explained.</p>	<p>Table 1</p> <p>C.2.2</p> <p>C.2.4</p>	<p>(2) There was no change in the monitoring manual in the monitoring period.</p> <p>(3) The operating staff of the STP plant has not been changed. There is no new operating staff, thus training is considered not necessary.</p>	<p>The verification team confirmed from the on-site visit and interviews with plant manager that operating staff has not been changed, daily operation and monitoring activity was conducted as planned. The daily operation and monitored data are appropriately recorded and archived in the project office as stipulated in the ECO STP CDM monitoring manual. (/5a/,/18/,/44/)</p>
<p><u>Clarification Request 4</u></p> <p>It is to be confirmed that the DTi,y is not changed.</p>	<p>Table 1</p> <p>D.1.1</p>	<p>PP provided data from relevant entity that DTi,y is not changed.</p>	<p>OK</p> <p>The verification team confirmed by the information from PUB (Sep, 2008) and transporters e-mail (Sep, 2011) that the DTi,y data has not been changed.</p>
<p><u>Clarification Request 5</u></p> <p>Please provide following documents.</p> <p>- Actual Daily monitoring record of Wj (samples)</p>	<p>Table 1</p> <p>D.2.2</p>	<p>Examples of daily monitoring record of Wj were provided.</p>	<p>OK</p> <p>The verification team was provided with daily records of Wj for randomly selected 3 months. (May 2011, September 2011, March 2012)</p> <p>The verification team confirmed by these original Wj data that these data, data of the CER calculation spreadsheet and the monitoring report are consistent and correct. (/1/,/2b/,/13a/)</p>

<p>Clarification Request 6 Please provide following data (Project emission parameters)</p> <p>(1) EG_{pj}:</p> <ul style="list-style-type: none"> - Invoice of SERAYA Energy Pte Ltd for ECO SWM electricity consumption - ECO STP Account dept. data for electricity consumption in ECO SWM plant (internal data) - Daily record of Epj by ECO-STP <p>(2) Records of F_{cons}, NCV_{fuel}, SG, MC_{N2O} and MC_{CH4}</p>	<p>Table 1 D.2.3</p>	<p>(1) Following documents are provided.</p> <ul style="list-style-type: none"> -Invoice of SERAYA Energy Pte Ltd for ECO SWM: Examples -ECO STP account department data for electricity consumption in ECO SWM plant -Daily record of Epj monitored by SQUARE D meter <p>(2) F_{cons}, NCV_{fuel}: City gas invoices are provided.</p> <p>SG: Daily records of SG were shown at site visit. The verification team checked the data by sampling.</p> <p>MC_{N2O} and MC_{CH4}: 3rd party Laboratory test report was provided.</p>	<p>OK</p> <p>(1) The verification team compared the data of $EG_{PJ,EF}$ in the monitoring report, spread sheet and the record of SQUARE D meter reading in the aggregated data of ECO-SWM account department for the period of January 2011 to April, 2012. The verification team confirmed that the direct comparison is difficult between the $EG_{PJ,EF}$ and the electricity invoice of Seraya Energy but $EG_{PJ,EF}$ is checked by the account department of ECO-SWM. The verification team confirmed that the data of ECO-SWM data and $EG_{PJ,EF}$ is identical and considers that $EG_{PJ,EF}$ data in the monitoring report is correct. (/1/,/2b/(iv),(xiv),/14/)</p> <p>(2) The verification team confirmed that F_{cons} and NCV_{fuel} are correctly described in the monitoring report and spreadsheet.</p> <p>SG data is correctly recorded in the CDM daily monitoring record in accordance with the ECO-STP CDM manual. The daily monitoring record data is consistent with the spreadsheet and monitoring report.</p> <p>MC_{N2O} and MC_{CH4}: The verification team confirmed that the laboratory data is applied to the CER calculation spreadsheet and monitoring report correctly with conservative consideration for MC_{CH4}.</p>
<p>Clarification Request 7 As for $FC_{residual}$, it is to be confirmed that the sampling is conducted to achieve maximum uncertainty of 20% at 95% confidence level.</p>	<p>Table 1 D.2.4</p>	<p>The sampling was conducted four times in accordance with the registered monitoring plan.</p> <p>Bottom ash and Fly ash measurements in 2012 are exceeding the maximum uncertainty limit of 20% at 95% confidence interval. Therefore, the maximum value among the</p>	<p>OK</p> <p>The verification team checked the residual carbon data of 3rd party laboratory and $FC_{residual}$ calculation spreadsheet and confirmed that the calculation is appropriate. (/2-xvii/, /17d/) $FC_{residual}$ is 1.77% in 2011 and 3.30% in 2012.</p>

		monitored data was taken for FC_{residual} calculation of 2012. The calculated FC_{residual} is 3.30%.	
Clarification Request 8 (1) Please provide the calibration record for: EGPJ, Fcons (2) Please explain about monitoring equipment Fcons, unit of 0.29 of MPRS (3) Calibration history of SGy meters	Table 1 D.2.6	<p>(1) Calibration record for following equipment was provided. EGPJ: Calibration was not conducted during the 2nd monitoring period because, the calibration frequency of EGPJ meter is 10 years and valid throughout the 2nd monitoring period. Fcons: Calibration was not conducted during the 2nd monitoring period because, the calibration frequency of MPRS meter is 10 years and valid throughout the 2nd monitoring period.</p> <p>(2) Unit is % and the accuracy of MPRS meter is 0.29%, (3) The calibration history is as below. The blank period of SGy meters was explained (section 3.5 above). 1st calibration 2nd calibration T1: 23/09/2011 – 10/02/2012 T2: 23/09/2011 – 28/03/2012 T3: 23/09/2011 – 25/07/2012 T4: 23/09/2011 – 04/09/2012 T5: ----- under repair -----</p>	OK (1) The validation team confirmed that the calibration of EGPJ meter and MPRS meters are not conducted and this is in accordance with the manufacturers standard and acceptable. (2) OK (3) The calibration of SGy meters are confirmed by the calibration report. (/11c/)
Clarification Request 9 According to the weigh bridge calibration record, the calibration history of Wi monitoring meter is as follows. 08/02/2011, 05/06/2011 [28 days delay], 18/09/2011 [13 days delay], 25/12/2011 [7 days delay], 01/04/2012 [7 days delay] There are delays between calibrations as shown in [] above.	Table 1 D.2.6	It was confirmed that the results of the delayed calibration did not show any errors of the weigh bridge, the monitored values while the validity is delayed are corrected by deducting the maximum permissible error (10kg) from each Wj measurement during the delayed period in accordance with the VVS 03.0 paragraph 238(a).	OK The verification team confirmed by the calibration record that the delayed calibration did not show any errors of the weigh bridge and each Wj data is appropriately corrected in accordance with the VVS 03.0 paragraph 238(a).

It is to be confirmed how these delays are addressed.			
<p>Clarification request 10</p> <p>(1) The impact of the changes of WRPs to the project activity is to be clarified.</p> <p>(2) The impacts of the actual parameters changes to the project activity are to be clarified.</p>	<p>B.2.4</p>	<p>(1) Since the sludge transportation is not under ECO's scope of services, the reduction of sludge transportation distance has no impact to the project IRR.</p> <p>(2) The impacts of the actual parameters changes are as below:</p> <ul style="list-style-type: none"> Volume of dried sludge and wet sludge: In the 2nd monitoring period, the volume of wet sludge and dry sludge is reduced 18.3% and 56.6% respectively. <p>When the sludge reduced 10% and 20%, the calculated IRR is 1.32% and -1.97% respectively. Hence, due to the reduction of sludge IRR will be reduced and there is no adverse impact on the additionality of the project activity. /20/</p> <ul style="list-style-type: none"> Due to changes in the characteristics of sludge which resulted in sub-optimum operation of the plant (e.g. generating more ash, etc.), the operation cost is increased and the IRR becomes worse. Hence, there is no adverse impact on the additionality of the project activity due to the changes in the characteristics of sludge. N2O emissions and residual carbon in ash: The cost impact of these parameters is small and there is no adverse impact on the additionality 	<p>OK</p> <p>(1) The verification team confirmed from the contract between PUB and STP /6a/ that the sludge transportation is done by PUB and not under ECO's scope of services, the change of WRPs has no impact to the project IRR. /6/</p> <p>(2) The verification team confirmed that the additionality of the project activity is not adversely affected by the actual parameters changes in volume of dry and wet sludge, characteristics of sludge, N2O emissions and residual carbon in ash, as stated below.</p> <ul style="list-style-type: none"> Volume of wet sludge and dry sludge: The verification team confirmed that the unit sludge treatment fee is fixed as 60 SGD/ton for wet sludge and 58 SGD/ton for dry sludge. Hence due to the reduction of the volume of sludge the income (sludge treatment fee) is reduced linearly. The IRR calculation for sludge reduction by 10 and 20% is correctly calculated as 1.32% and -1.97% respectively by the project participant. /20/ <p>In the 1st and 2nd monitoring period, the average annual sludge reduction is 19.0% for wet sludge and 59.8% for dry sludge /1/. This reduction is equivalent to 27.9 %⁵ reduction of dry and wet sludge and the IRR in this condition is calculated as 3.20%. This</p>

⁵ Wet sludge and dry sludge in the Registered PDD: wet=160,000 ton/year, dry = 44,480 ton/year

Actual annual sludge volume in the 1st and 2nd monitoring period vs. design: wet=81.0%, dry 40.2%

∴ Equivalant total reduction of sludge = $(1 - (160,000 \times 0.81 + 44,480 \times 0.402) / (160,000 + 44,480)) \times 100 = 27.9 \%$

		of the project activity.	<p>value is calculated under conservative conditions such that even labor cost, land lease fee, maintenance cost and security deposit are also reduced by the biggest reduction rate (= -54.2%) among the actual reduction rate of cost parameters of IRR calculation⁶. /20/</p> <p>Hence, it is concluded that the sludge reduction in the 2nd monitoring period does not adversely impact the additionality of the project activity.</p> <ul style="list-style-type: none"> • The verification team confirmed that the change of the characteristics of sludge affect the operation of the plant but it will not adversely impact the additionality of the project activity. • N2O emissions and residual carbon in ash affect the emission reduction of the project activity but they will not adversely impact the additionality of the project activity.
<p><u>Forward Action Request 1</u></p> <p>The impacts of the additional train No. 6 whose operation started in May, 2012 after the end of 2nd monitoring period are to be reported in accordance with the requirements of the CDM project standard section 12.8.3.4. /33/</p>	<p>Table 2, CL 2</p>	<p>Regarding the train 6, the explanation was added to the PDD version 7 (foot note of page 3 /21c/) and the request for Post Registration Change will be applied before the 3rd verification.</p> <p>The description will be added in the PDD for 3rd verification.</p>	<p>OK</p> <p>Request for the approval of the post registration change regarding the additional train No.6 is to be applied for the 3rd verification. The procedure complies with the requirements.</p> <p>It was confirmed that the detail description of the train 6 will be added in the revised PDD before 3rd verification in accordance with the project standard section 12.8.3.4.</p>

⁶ Actual reduction rate of cost parameters of IRR calculation (average of 1st and 2nd monitoring period):
Electricity: -24.1%, Natural gas: -54.2%, Ash: -23.2 /20/