# Monitoring report form for CDM project activity
## (Version 08.0)

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

| MONITORING REPORT | | | |
|---|---|---|---|
| **Title of the project activity** | Landfill Gas Recovery and Utilization at Bukit Tagar Sanitary Landfill, Hulu Selangor in Malaysia | | |
| **UNFCCC reference number of the project activity** | 2467 | | |
| **Version number of the PDD applicable to this monitoring report** | 21.3 | | |
| **Version number of this monitoring report** | 1.2 | | |
| **Completion date of this monitoring report** | 07/05/2021 | | |
| **Monitoring period number** | 5 | | |
| **Duration of this monitoring period** | 01/04/2020-31/12/2020 inclusive of both days | | |
| **Monitoring report number for this monitoring period** | 1.0 | | |
| **Project participants** | KUB-Berjaya Enviro Sdn. Bhd. (KBE)<br>ACT Commodities B.V.<br>BP Gas Marketing Limited<br>ACT Financial Solutions B.V.<br>Vert Conservation Pte Ltd. | | |
| **Host Party** | Malaysia | | |
| **Applied methodologies and standardized baselines** | • Applied methodologies: ACM0001 – "Flaring or use of landfill gas" (Version 18.0)<br>Standardized baselines: Not applicable | | |
| **Sectoral scopes** | 13 – Waste handling and disposal | | |
| **Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period** | Amount achieved before 1 January 2013 | Amount achieved from 1 January 2013 until 31 December 2020 | Amount achieved from 1 January 2021 |
| | Not applicable | 234,298 $tCO_2e$ | Not applicable |
| **Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD** | 206,294 $tCO_2e$ | | |

# SECTION A. Description of project activity

## A.1. General description of project activity

The Bukit Tagar Sanitary Landfill (BTSL) is operated by KUB-Berjaya Enviro Sdn. Bhd. and located in Hulu Selangor, Malaysia. The landfill receives municipal solid waste (MSW) from the country's capital, Kuala Lumpur and Selayang district in Selangor State.

The main objective for the Clean Development Mechanism (CDM) project is to avoid direct emissions of greenhouse gases (GHGs) from the landfill into the atmosphere through active extraction. The gas collected is destructed by high temperature enclosed flare as well as is used for power generation using Gas Engines with high efficiency.

Carbon emissions are reduced through two major activities:

| Emission Reduction Aspects | How will emissions be reduced? |
|---|---|
| Landfill gas (LFG) Extraction and Destruction (Methane ($CH_4$) avoidance) | Instead of releasing LFG (consisting $CH_4$) to the atmosphere, the gas will be collected and destroyed in enclosed flares and Gas Engines |
| Power Generation (Fuel replacement) | Less carbon dioxide ($CO_2$) will be emitted by replacing electricity generated from grid power with electricity produced from LFG (considered as renewable) |

LFG extraction from Phase 1, Phase 2, and Phase 3 Cells has continued to operate during this monitoring period.

One (1) high temperature enclosed flare with a maximum capacity of 2,500 $Nm^3$/hr is in operation while the remaining portion of the gas captured was sent to a unit of 1.2MW Gas Engine (Gas Engine No.1), two (2) units of 1.56MW Gas Engines (Gas Engine No.2 and No.3) and three (3) units of 2MW Gas Engine (Gas Engine No.4, No. 5 and No. 6) to generate electricity. The electricity produced by the gas engines is exported to the grid.

The 5$^{th}$ monitoring period of 2$^{nd}$ crediting period is from 01/04/2020 to 31/12/2020 (inclusive of both days). The total emission reductions achieved during this monitoring period is 234,298 $tCO_2e$.

## A.2. Location of project activity

| Information | Description |
|---|---|
| Host Party(ies) | Malaysia |
| Region/ State/ Province, etc. | State of Selangor |
| City/ Town/ Community, etc. | Mukim Sg. Tinggi, District of Hulu Selangor<br>The project location is situated approximately 5km to the west of the Bukit Tagar Interchange along the North-South Expressway and 40km from central Kuala Lumpur. The landfill is easily accessible via expressway and a dedicated Bukit Tagar Interchange has been developed for access from the North-South Expressway. The landfill is situated in a leased agricultural land, surrounded by hectares of oil palm plantations and rubber trees. |
| Physical/ Geographical location | Latitude / Longitude / Description<br>3°30'168" / 101°28'428" / North<br>3°29'07" / 101°28'452" / South<br>3°29'46" / 101°28'20" / West<br>3°29'69" / 101°29'268" / East |

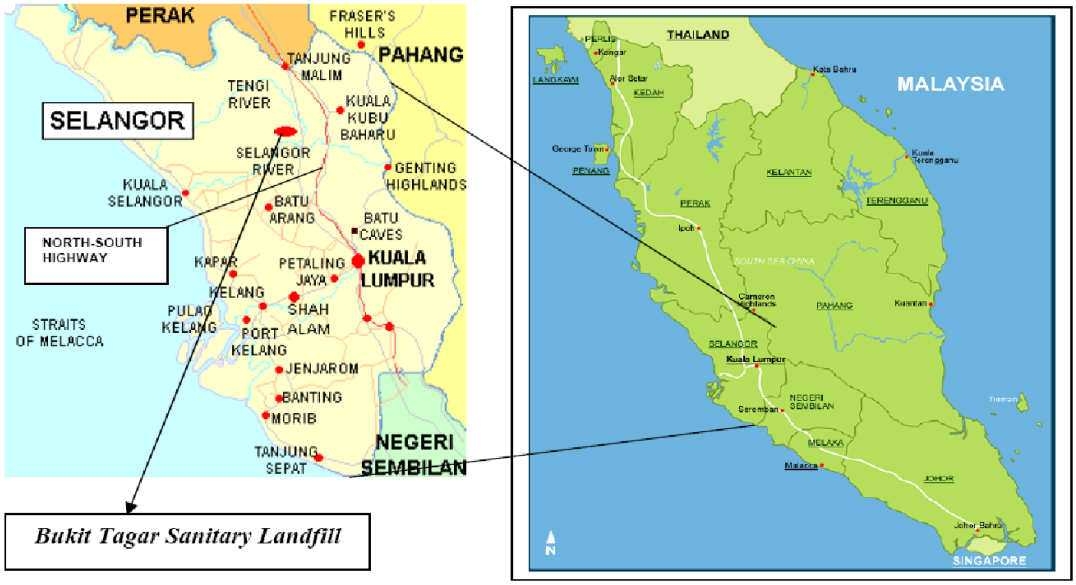



***Figure 1: Location of BTSL and Selangor State***

## A.3. Parties and project participants

| Parties involved | Project participants | Indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|---|---|---|
| Malaysia (Host Party) | KUB-Berjaya Enviro Sdn. Bhd. (KBE) (Private) | No |
| Netherlands | ACT Commodities B.V.[1] | No |
| United Kingdom of Great Britain and Northern Ireland | BP Gas Marketing Limited[2] | No |
| Switzerland | ACT Financial Solutions B.V.[3] | No |
| Sweden | Vert Conservation Pte Ltd.[4] | No |

[1] Valid as of 30/10/2017 until 31/12/2020. https://cdm.unfccc.int/Projects/DB/DNV-CUK1238680609.1/view
[2] Valid as of 31/10/2017 until 31/12/2020. https://cdm.unfccc.int/Projects/DB/DNV-CUK1238680609.1/view
[3] Valid as of 15/10/2020. https://cdm.unfccc.int/Projects/DB/DNV-CUK1238680609.1/view
[4] Valid as of 27/11/2020. https://cdm.unfccc.int/Projects/DB/DNV-CUK1238680609.1/view

## A.4. References to applied methodologies and standardized baselines

The project has applied the following approved methodology and tools:

**Approved Methodology:**

ACM0001: “Flaring or use of landfill gas – Version 18.0”

**Methodological Tools referred to include:**

- “Emissions from solid waste disposal sites” (*Version 07.0*);
- “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (*Version 02.0*);
- “Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion” (*Version 02*)
- “Project emissions from flaring” (*Version 02.0.0*);
- “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (*Version 03.0*); and
- “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period” (*Version 03.0.1*).

## A.5. Crediting period type and duration

| | |
|---|---|
| Date of Registration | 28/08/2009 |
| Type of Crediting Period | Renewable (7 Years) |
| 1st Crediting Period | 28/08/2009 – 27/08/2016 (Both dates inclusive) |
| 2nd Crediting Period | 28/08/2016 – 27/08/2023 (Both dates inclusive) |

## SECTION B. Implementation of project activity

### B.1. Description of implemented project activity

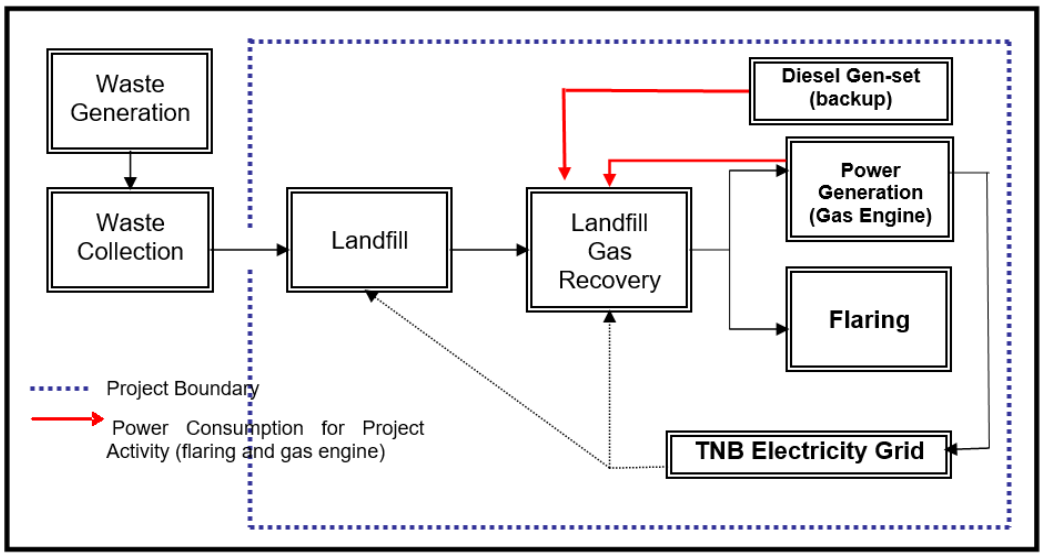
The landfill is being developed in phases. The detailed information on the phases is presented below:

| Cell | Status of Filling | Duration of Filling | Amount of Waste Disposed (t) |
|---|---|---|---|
| Advance Cell | Closed | Apr 2005 – Nov 2007 | 1,429,323.47 |
| Phase 1 | Closed | Nov 2007 – Dec 2011 | 3,730,406.57 |
| Phase 2 | Closed | Aug 2010 – Dec 2017 | 6,243,457.40 |
| Phase 3 | Operation | Jan 2018 - On-going | 2,971,803.93 (Latest Dec 2020) |

Relevant dates for the project activities tabulated below:

| Bukit Tagar Project | Construction Start Date | Date of Commission | Operation Status |
|---|---|---|---|
| Second flaring system (Flare No.2) | 22/01/2010 | 07/08/2010 | Operating |
| Gas Engine No.1 | 03/01/2011 (Delivery to the site) | 01/06/2011 | Operating |
| Gas Engine No.2 | 06/08/2012 (Signed-off Delivery Order) | 06/12/2013[5] | Operating |
| Gas Engine No.3 | 06/08/2012 (Signed-off Delivery Order) | 06/12/2013[6] | Operating |
| Gas Engine No.4 | 26/12/2014 (Signed-off Delivery Order) | 26/10/2015[7] | Operating |
| Gas Engine No.5 & 6 | 05/03/2018 (Signed-off Delivery Order) | 10/05/2019[8] | Operating |

The landfill gas recovery, flaring, and power generation system can be illustrated below:




*Note: Diesel generator which will be used as a backup for project activities during the power failure of the grid is added into the chart*

***Figure 2:*** **Overall LFG Recovery, Flaring and Power Generation Design**

[5] Letter to Sustainable Energy Development Authority (SEDA) Malaysia on Notification on Initial Operation Date (IOD) Occurrence on 06/12/2013.
[6] Letter to Sustainable Energy Development Authority (SEDA) Malaysia on Notification on Initial Operation Date (IOD) Occurrence on 06/12/2013.
[7] Letter to Sustainable Energy Development Authority (SEDA) Malaysia on Notification on Initial Operation Date (IOD) Occurrence on 15/12/2015.
[8] Letter to Sustainable Energy Development Authority (SEDA) Malaysia on Notification on Initial Operation Date (IOD) Occurrence on 10/05/2019.

**Description of the installed technologies**

The technology applied and transferred into this project has been implemented and proven in Europe (Denmark and Germany) as well as in China (extraction and flaring system).

The detailed technical description is further described below:

**Gas Extraction System in Advance Cell**

Q2 Engineering Sdn. Bhd., a subsidiary of Q2 A/S of Denmark was appointed as the turnkey contractor to construct the gas extraction and flaring system for Advance Cell. 42 vertical gas extraction pipes were installed in the landfill to extract the LFG. These wells were connected to 8 units of main gas collection pipes that led to the LFG flaring system.

***Figure 3: An Example of Vertical Well Installed in Advance Cell***

These vertical wells can be individually regulated and controlled. The advanced cell has stopped operation and caped in this monitoring period.

**Gas Extraction System in Phase 1 Cell**

Stage 1 of Phase 1 Cell was completed in August 2010 and closed in December 2011. The gas extraction from the phase 1 cell continued during this monitoring period. The design of the gas extraction wells is based on a series of horizontal gas extraction wells constructed over the entire Phase 1 Cell.

***Figure 4: Horizontal Gas Extraction Wells in Phase 1 Cell***

**High-Temperature Enclosed Flaring System (Flare No.2)**

The high-temperature enclosed flaring system was installed to cater for the extra LFG extracted from Phase 1 and 2 Cell. The flare system included a containerised blower and flaring system with a maximum capacity to flare off 2,500 $Nm^3$/hr LFG.

***Figure 5: High-Temperature Enclosed Flares***

Details of Flare No. 2 specifications are listed below:

| Specifications | Details |
|---|---|
| Manufacturer | Fairyland Environmental Technology, China |
| Gas flow | Maximum – 2,500 $Nm^3$/hr |
| Retention time | >0.3 seconds at 800-1,000$^oC$ |
| Gas blower | Twin-lobe roots blower |
| Gas analysers | Gas analysers for $CH_4$ and $O_2$ |

**Gas Extraction System in Phase 2 Cell**

Phase 2 Cell was completed in July 2010. 12 lines of horizontal wells with gas pipelines were installed in the landfill to extract the LFG. The cell stopped receiving waste started in December 2017. The design of the gas extraction wells is based on a series of horizontal gas extraction wells constructed over the cell.

**Gas Extraction System in Phase 3 Cell**

Phase 3 Cell was completed in Dec 2017. 28 lines of horizontal wells with gas pipelines were installed in the landfill to extract the LFG. Phase 3 cell still in operation during this monitoring period, the expected end of life span for phase 3 cell is December 2023.

**Gas Analyser and Data Logging**

Monitoring of the correct functioning of the flare system was provided by a continuous-logging system which examines the operational parameters of the flare. The gas analyzing system is multi-functional environmental monitoring equipment that can monitor up to 14 different measurements and data logging channels. Data from the logging system was presented on a local screen (on-line data) and stored in a local personal computer (PC) unit with external communication via the Global System for Mobile Communications (GSM).

Data were downloaded directly from the built-in data logger to a PC and were also transmitted to an external server and PC as a back-up.

**Gas Engine Energy Power Plants**

A high-efficiency (electrical efficiency > 42%) Gas Engine (net dispatch of 1 MW) was chosen for the generation of electricity from LFG.


***Figure 6: Gas Engines (GE1, GE2, GE3, GE4, GE5 and GE6) Photos***

To ensure that good quality LFG arrives at Gas Engine No.1, LFG pre-treatment system comprising of a chiller (made in Germany) and activated carbon filter was also set up to remove moisture and impurities such as hydrogen sulphide ($H_2S$) and siloxanes before Gas Engines. A landfill gas blower was installed to ensure that the required gas pressure for Gas Engines are maintained. With the additional gas extraction of LFG in Phase 2, two (2) units of 1.56 MW gas engines were delivered to the site on 06/08/2012. The gas engines were commissioned on 06/12/2013. In addition to the new gas engine installation, an additional pipeline equipped with skid-mounted LFG gas blower was installed in September 2012.

An additional 2MW gas engine was delivered to the site on 18/09/2015. The gas engine was commissioned on 26/10/2015. Two (2) units of 2MW Gas Engine (Gas Engine No. 5 and No. 6) were also delivered to site on the 05/03/2018. The gas engine was commissioned on 10/05/2019 to generate electricity. The details of specification for Gas Engines are tabulated below:

| Specifications | Gas Engines | | | |
|---|---|---|---|---|
| | No.1 | No.2 & 3 | No.4 | No.5 & 6 |
| Manufacturer (Origin) | MWM (Germany) | MWM (Germany) | MTU | MWM (Germany) |
| Model | TCG 2020 V12 | TCG 2020 V16 | GB1948B5 | TCG 2020 V20 |
| Electric power output (net to grid) | 1 MW (total max. gross output 1.2 MW) | 1.56 MW | 2 MW | 2 MW |
| Voltage | 11 kV | 415 V | 11000V | 11kV |
| Frequency | 50 Hz | 50 Hz | 50 Hz | 50 Hz |
| Minimum heating value (LHV) | 5.9 kWh/$m^3$ | 5.0 kWh/$m^3$ | 5.0 kWh/$m^3$ | 5.0 kWh/$m^3$ |

## Centralised SCADA System

The Centralized (Supervisory Control and Data Acquisition) SCADA Interface was developed to integrate all existing SCADA or operation monitor systems, ranging from individual Flare to Gas Engines. The objective of the integrated monitoring system is aimed to improve the efficiency of staff movement, monitoring process, and data collection as well as serving as additional storage of the database. The new system offered a remote monitoring option which allows access through internet connection for view-only if provided with the correct authentication key.


***Figure 7: Centralized SCADA Interface***

**Implementation status of project activity**

For the reporting period of 01/04/2020 to 31/12/2020, the key CDM activities implemented are described below:

**Gas Extraction System in Phase 1, 2, and 3 Cells and Flare No.2**

The flaring system in Phase 1 Cell was completed during the 2nd monitoring period and started its operation on 07/08/2010. The LFG extracted from Phase 1, 2, and 3 Cells is transferred via a transfer pipe and fed to Flare No.2.

The total running time for Flare No.2 is 3% in this monitoring period. The shutdown of Flare No. 2 is mainly due to most of the gas is supplied to gas engines instead of the flare.

The details on the downtime of the system (over the monitoring period covered by this report) are presented in **Appendix 1**.

**Power Generation**

During this monitoring period, the power generated from Gas Engine No.1, No.2, and No.3 continued to be uploaded to the grid.

Gas Engine No.4 was commissioned on 26/10/2015, on the other hand, Gas Engine No.5 and No.6 were commissioned on 10/05/2019. The supply of landfill gas for Gas Engines comes from an independent piping system to GSSF1 (Gas Engine No.1), GSS1 (Gas Engine No.2 and No.3), GSS2 (Gas Engine No. 4). and GSS3 (Gas Engine No. 5 and No.6).

The properties of the landfill gas are monitored by independent monitoring equipment, i.e. temperature, pressure, methane content, and flow rate for GSS1, GSS2, GSS3, and GSSF1. The power generated from the gas engines is uploaded to the grid.

The total running time for Gas Engines in this monitoring period is tabulated as below:

| No | Description | Total Running Time (%) |
|---|---|---|
| 1 | Gas Engine No. 1 | 96% |
| 2 | Gas Engine No. 2 | 79% |
| 3 | Gas Engine No. 3 | 76% |
| 4 | Gas Engine No. 4 | 69% |
| 5 | Gas Engine No. 5 | 88% |
| 6 | Gas Engine No. 6 | 88% |

The shutdown of GEs mainly due to the service and maintenance for all the engines and major overhaul for GE No. 4.

The details on the downtime of Gas Engine No.1, No.2, No.3, No.4, No.5, and No.6 are presented in **Appendix 2**.

## B.2. Post-registration changes

### B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies, standardized baselines or other methodological regulatory documents

| Item No. | Type of Change | Description of Change | Date of approval by EB |
|---|---|---|---|
| 1 | Temporary deviation | The deviation is related to the usage of grid electricity by the gas engines 2 & 3 auxiliaries and gas supply system (GSS) are calculated since meter EL6 is not connected to capture the data (PRC-2467-002) | 11/09/2015 |

No temporary deviations have been applied during this monitoring period.

### B.2.2. Corrections

| Item No. | Type of Change | Description of Change | Date of approval by EB |
|---|---|---|---|
| 1 | Correction | The correction is related to the internal use of power generated for the landfill operation was not successful and was not approved by the relevant authorities and the grid operator. This was due to technical constraints and deleted the onsite utilization from the PDD | 09/05/2012 |

### B.2.3. Changes to the start date of the crediting period

No changes to the start date of the crediting period during this monitoring period.

### B.2.4. Inclusion of monitoring plan

No inclusion of a monitoring plan to the registered PDD that was not included at registration.

### B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

| Item No. | Type of Change | Description of Change | Date of approval by EB |
|---|---|---|---|
| 1 | Revision of monitoring plan | The revision is related to alternative measurement and handling of data during emergency conditions for methane content, flow meters and electricity meter. | 09/05/2012 |
| 2 | Revision of monitoring plan | The change is related to the increase of power generation approximately 3MW and installation of an additional pipeline and flare system equipped with skid mounted LFG gas blower to handle any excess LFG captured which is expected to be commissioned at the beginning of year 2014 (PRC-2467-001) | 09/09/2013 |
| 3 | Revision of monitoring plan | The change is on non-implementation of Flare No.3 (PRC-2467-003) | 12/11/2015 |
| 4 | Revision of monitoring plan | The change is related to the increase of power generation approximately 2MW and include diesel generator as backup for | 15/11/2016 |

| Item No. | Type of Change | Description of Change | Date of approval by EB |
|---|---|---|---|
| | | project activities during the power failure of the grid (PRC-2467-004) | |
| 5 | Revision of monitoring plan | The change related to the Flaring system No.1 was stopped. A Gas Supply System F1 (GSS F1) was built instead of the original Flaring No.1. Gas engine No. 1 which was attached to Flare 2 previously has been converted to GSS F1 (PRC-2467-005). | 21/06/2018 |
| 6 | Revision of monitoring plan | The revision is related to the increase of power generation from 5.5MW to 9.5MW with the addition of two (2) gas engines with an installed capacity of 2MW each (PRC-2467-006) | 12/06/2020 |

### B.2.6. Changes to project design

| Item No. | Type of Change | Description of Change | Date of approval by EB |
|---|---|---|---|
| 1 | Permanent changes from project design | The change is related to the increase of power generation approximately 3MW and installation of an additional pipeline and flare system equipped with skid mounted LFG gas blower to handle any excess LFG captured which is expected to be commissioned at the beginning of year 2014 (PRC-2467-001) | 09/09/2013 |
| 2 | Permanent changes from project design | The change is on non-implementation of Flare No.3 (PRC-2467-003) | 12/11/2015 |
| 3 | Permanent changes from project design | The change is related to the increase of power generation approximately 2MW and include diesel generator as backup for project activities during the power failure of the grid (PRC-2467-004) | 15/11/2016 |
| 4 | Permanent changes from project design | The revision is related to the increase of power generation from 5.5MW to 9.5MW with the addition of two (2) gas engines with an installed capacity of 2MW each (PRC-2467-006) | 12/06/2020 |

### B.2.7. Changes specific to afforestation or reforestation project activity

Not applicable to this project activity.

## SECTION C. Description of monitoring system

### Monitoring Methodology

The basis of the monitoring plan (MP) was formulated based on the approved methodology ACM0001 – *Flaring or use of landfill gas (Version 18.0).*

*Tool to determine the mass flow of a greenhouse gas in a gaseous stream*

The MP referred to the *Tool to determine the mass flow of a greenhouse gas in a gaseous stream*. Referring to the tools, for LFG temperatures below 60°C, moisture could be neglected due to its very low influence on final results and thus, the measurement in wet or dry basis are not important (as reflected in the amendments to ACM0001, version 9.1 onwards). In the case where the LFG temperature exceeds 60°C, the same basis for both $CH_4$ concentration and flow measurement will be considered according to the tools.

The detailed description of the calculation applied to the CER Calculation Sheet is as shown in **Appendix 3**.

*Transmission and Distribution Losses ($TDL_y$)*

According to page 65 of the registered PDD, version 21.3, the Transmission and Distribution Losses ($TDL_{k,y}$) value applied in this project is 7.74% from 2017 onwards. This value was reported in the Tenaga Nasional Berhad (TNB)[9] Annual Report 2016[10].

### Operation and Management Structure for Monitoring

The organization structure for the Bukit Tagar CDM monitoring team is shown below:

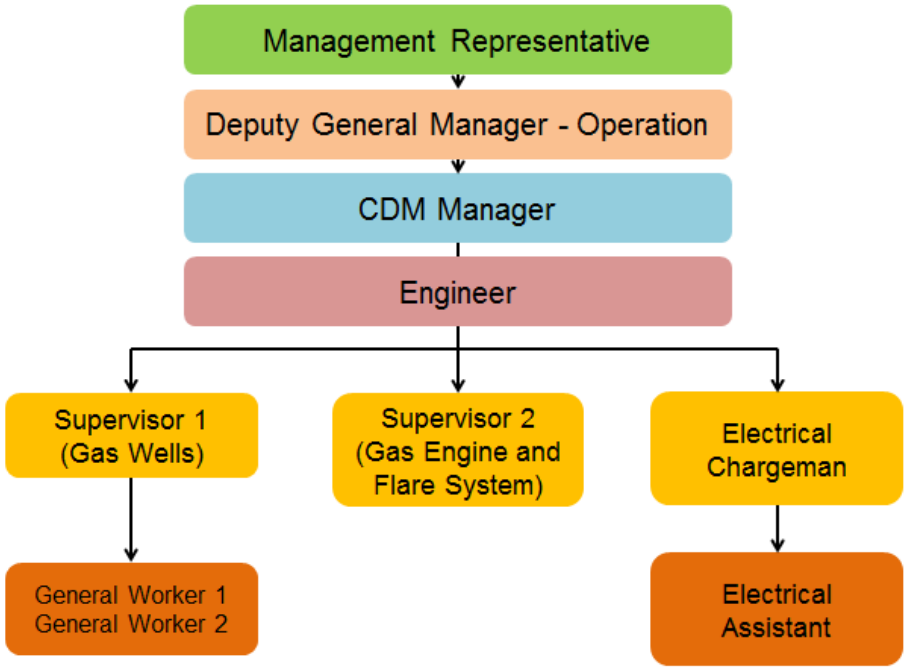



***Figure 8: Organisational Structure for CDM Monitoring for BTSL LFG Recovery and Utilisation Project***

The roles and responsibilities of the monitoring team in carrying out the MP are detailed as follow:

[9] Tenaga Nasional Berhad is the largest electricity provider in Malaysia and is responsible for the grid transmission and distribution in Peninsular Malaysia.

[10] https://www.tnb.com.my/assets/annual_report/TNB_Annual_Report_2016.pdf

***Table 1: Responsibilities of the CDM Monitoring Team***

| Role | Responsibility in CDM monitoring |
|---|---|
| Management Representative | • Reports to and obtain decisions from management on CDM-related matters<br>• Chairs internal meetings on CDM matters<br>• Signs off official correspondence for external parties |
| Deputy General Manager - Operation | • Reports to the management representative (MR)<br>• Oversees entire operation of landfills (including LFG management system)<br>• Covers responsibility of CDM Manager when he is not available |
| CDM Manager | • Reports to the Deputy General Manager - Operation<br>• Oversees and coordinates the entire CDM monitoring plan<br>• Verifies and signs off all relevant monitoring records<br>• Ensures Quality Control / Quality Assurance (QC/QA) is carried out<br>• Ensures all data are recorded and necessary documentations are prepared according to the requirements of CDM monitoring<br>• Responsible in optimising the LFG extraction and utilisation system |
| Engineer | • Reports to the CDM Manager<br>• Assists the CDM Manager in performing CDM monitoring works<br>• To monitor daily operation for landfill gas operations<br>• To assist in daily monitoring records for all CDM related equipment<br>• To prepare daily summary record for landfill gas operation |
| CDM Consultant | • Provides advice on all CDM-related matters<br>• Prepares monitoring reports for verifications<br>• Liaises with the verifier on verification process<br>• Conducts regular audits on CDM monitoring |
| Supervisors | • Report to the CDM Manager on CDM monitoring issues<br>• Check and ensure that the flaring system is functional<br>• Ensure all data recording devices are functioning and calibrated as planned (including performing QA/QC)<br>• Check and sign the daily monitoring log sheets for CDM monitoring<br>• Supervise general workers in maintenance work and record monitored parameters for CDM monitoring<br>• Identify maintenance requirement and contact the supplier if maintenance and support are needed<br>• Optimise the flare operation together with the CDM Manager<br>• Responsible with the security of locked Programmable Logic Controller (PLC) control room. The supervisor will hold the door key for the PLC control room |
| General Workers | • Perform regular operational and maintenance tasks<br>• Record necessary readings in daily monitoring log sheets and request verification from the supervisors on the log sheets<br>• Report any fault to supervisor-in-charge or the electrical chargeman |

The team is overall headed by the MR who oversees the entire CDM monitoring implementation. The MR receives direct updates and support from the site staff headed by the Deputy General Manager - Operation. The Deputy General Manager – Operation is supported by the CDM Manager who is the key coordinator to all CDM monitoring matters on-site. The CDM Manager is assisted by an engineer, a group of technicians and workers who will perform the daily recording and checking tasks.

The CDM Consultant (Eco-Ideal Consulting Sdn. Bhd.) was appointed to assist KBE in ensuring that the monitoring plan and requirements were done according to the MP. The consultant played the role of a trainer

and conducted independent audits as part of the QA/QC procedures set up for this project. During this monitoring period, one (1) CDM Management Meeting was held on 22/07/2020.

**Relevant Monitoring Points**

The parameters monitored during the monitoring period are illustrated in the following figure:

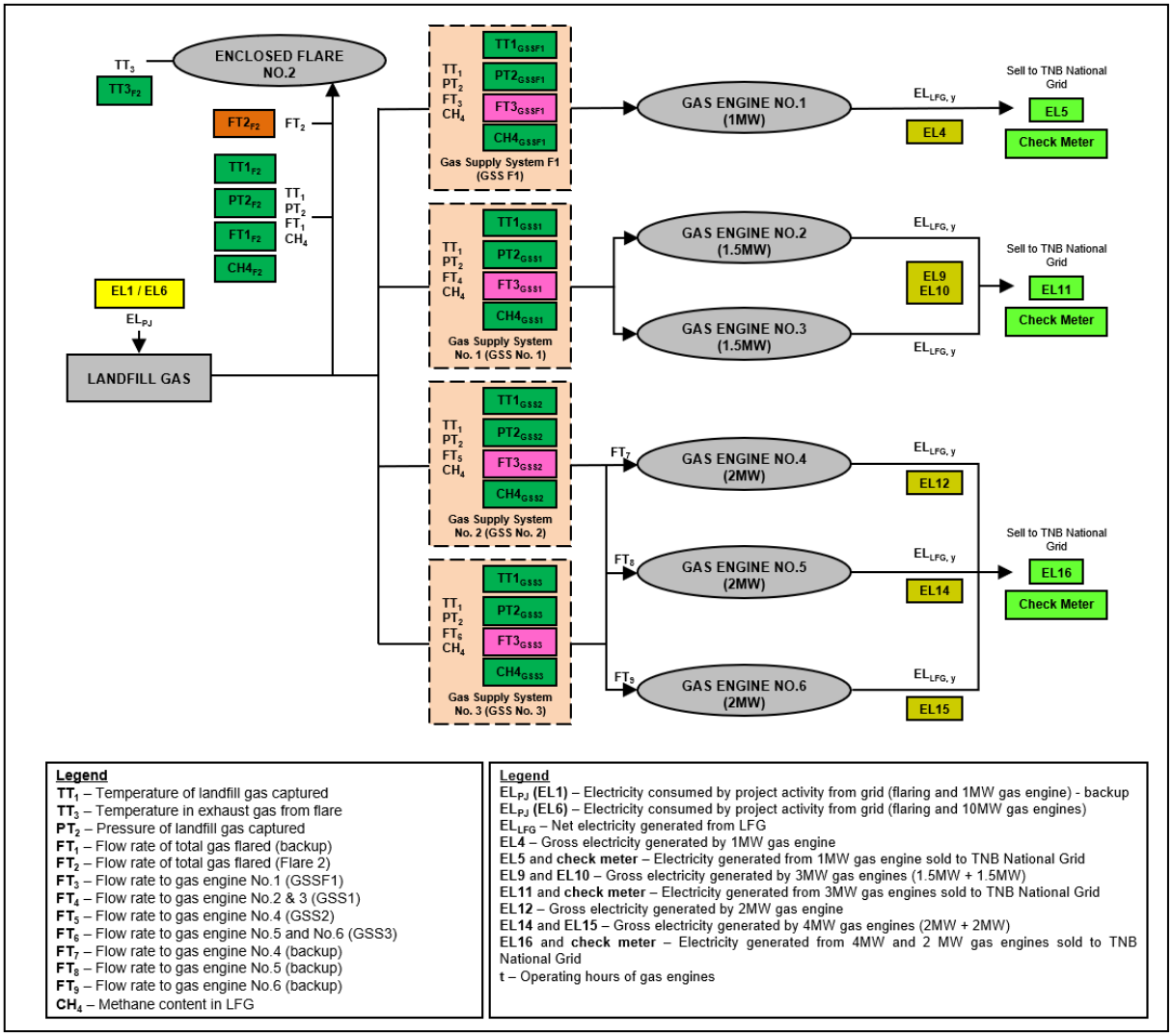



***Figure 9: Key Parameters Monitored under the CDM Monitoring Plan***

Landfill gas will be captured and send to Enclosed Flare No.2, Gas Supply System F1 (GSS F1), Gas Supply System No.1 (GSS No.1), Gas Supply System No.2 (GSS No.2), and Gas Supply System No.3 (GSS No.3). The flow rate of total gas flared by Enclosed Flare No.2 is monitored by FT2 while the flow rate of gas to gas engines are monitored by FT3 (GSS F1), FT4 (GSS No.1) and FT5 (GSS No.2), FT6 (GSS No.3) respectively. Each gas engines also have their meter to record the flow supply from GSS, where FT7 for gas engine no.4, FT8 is for gas engine no.5, FT9 is for gas engine no.6 respectively.

The gross electricity generated by each gas engine is monitored using EL4, EL9, EL10 and EL12, EL14, and EL15. The amount will be compared with EL5, EL11, and EL16 which are managed by Tenaga National Berhad to obtain the lower amount so that the result is conservative. As data will be captured separately in the flaring and power generation system (Flare No.2, Gas Engine No.1, and so forth), a specific subscript will be assigned to the monitoring parameters of the different equipment installed.

Relevant regulations on LFG project activities shall be monitored and updated upon renewal of each crediting period. Changes to regulations, if any will be converted to the amount of methane in the LFG which is flared in the baseline due to a requirement in year y ($F_{CH4,BL,R,y}$).

**Data Recording and Documentation**

All relevant data/measurements of the parameters taken were recorded and kept in an appropriate format and archived after the crediting period to ensure that the data are accessible especially during the monitoring and verification process of the project.

Data were recorded in the following way:

*Continuous Monitoring – Data in Softcopy:*
Data logger (automatic recording in the computer)

*Manual Recording – Data in Hardcopy:*
Daily monitoring log sheets and record books (manual recording)

Based on the MP, key parameters (temperature, pressure, the flow of gas, $CH_4$ concentration in biogas) were continuously monitored and recorded via the data logger at the control room.

As a back-up data recording system, the on-site workers were required to manually record certain monitored parameters in daily monitoring log sheets. These records were filed and kept in the office which can be accessible by the CDM Manager and technicians whenever necessary. These log sheets (in hard copies) were scanned for electronic filing every month.

A summary of the data directly monitored is tabulated below:

***Table 2: CDM Monitoring Parameters, Frequency and Archiving***

| Parameter | CDM ID | Equipment ID | Monitoring equipment | Recording frequency | Documentations | Data archive |
|---|---|---|---|---|---|---|
| Temperature | $T_t$ ($T_{TT1,F2}$)<br>$T_t$ ($T_{TT1,GSS1}$)<br>$T_t$ ($T_{TT1,GSS2}$)<br>$T_t$ ($T_{TT1,GSS3}$)<br>$T_t$ ($T_{TT1,GSSF1}$) | $TT_{1,Flare}$ No.2/GSS1/GSS2/GSS3/GSSF1 | Thermocouple | Every 1 min (auto)<br>Daily (manual) – as back-up | Softcopy<br>Hardcopy | (.MDB MS Access database)<br>Daily log sheet will be scanned into PDF format for archiving |
| Flare Temperature | $T_{EG,m}$ ($T_{Flare,F2}$) | $TT_{3,Flare}$ Flare No.2 | Thermocouple | Every 1 min (auto)<br>Daily (manual) – as back-up | Softcopy<br>Hardcopy | (.MDB MS Access database)<br>Daily log sheet will be scanned into PDF format for archiving |
| Pressure | $P_t$ ($P_{PT2,F2}$)<br>$P_t$ ($P_{PT2,GSS1}$)<br>$P_t$ ($P_{PT2,GSS2}$)<br>$P_t$ ($P_{PT2,GSS3}$)<br>$P_t$ ($P_{PT2,GSSF1}$) | $PT_{2,Flare}$ No.2/GSS1/GSS2/GSS3/GSSF1 | Pressure Gauge | Every 1 min (auto)<br>Daily (manual) – as back-up | Softcopy<br>Hardcopy | (.MDB MS Access database)<br>Daily log sheet will be scanned into PDF format for |

| Parameter | CDM ID | Equipment ID | Monitoring equipment | Recording frequency | Document ations | Data archive |
|---|---|---|---|---|---|---|
| | | | | | | archiving |
| Flowrate | $V_{t,wb}$ ($LFG_{total,\ Flare\ No.2,y}$)<br>$V_{t,wb}$ ($LFG_{flare,\ Flare\ No.2,y}$)<br>$V_{t,wb}$ ($LFG_{electricity,GSS,y}$) | $FT_{1,Flare\ No.2}$<br>$FT_{2,\ Flare\ No.2}$<br>$FT_{3,GSS1/GSS2/GSS3/GSS\ F1}$ | V-Cone Differential Pressure Flowmeter | Every 1 min (auto)<br>Daily (manual) – as back-up | Softcopy<br>Hardcopy | (.MDB MS Access database)<br>Daily log sheet will be scanned into PDF format for archiving |
| Methane Fraction | $V_{CH4,m,db}$ ($W_{CH4,Flare\ No.2/GSS,y}$) | $CH_{4,Flare\ No.2/GSS1/GSS2/GSS3/GSS\ F1}$ | Continuous Infrared Gas Analyser | Every 1 min (auto)<br>Daily (manual) – as back-up | Softcopy<br>Hardcopy | (.MDB MS Access database)<br>Daily log sheet will be scanned into PDF format for archiving |
| Electricity consumed by the project | $EG_{PJ,y}$ ($EL_{PJ,y}$) | $EL_{PJ}$ (EL1, EL6) | kWh meter | Daily (manual) | Softcopy (scanned copy)<br>Hardcopy | Data recorded will be compiled into MS Excel and aggregated for monthly amount<br>Daily log sheet will be scanned for archiving |
| Electricity generated by LFG | $EG_{PJ,y}$ ($EL_{LFG,GE\ No.1,y}$)<br>$EG_{PJ,y}$ ($EL_{LFG,GE\ No.2,y}$)<br>$EG_{PJ,y}$ ($EL_{LFG,GE\ No.3,y}$)<br>$EG_{PJ,y}$ ($EL_{LFG,GE\ No.4,y}$)<br>$EG_{PJ,y}$ ($EL_{LFG,GE\ No.5,y}$)<br>$EG_{PJ,y}$ ($EL_{LFG,GE\ No.6,y}$) | $EL_{LFG,GE\ No.1}$ (EL4)<br>$EL_{LFG,GE\ No.2}$ (EL9)<br>$EL_{LFG,GE\ No.3}$ (EL10)<br>$EL_{LFG,GE\ No.4}$ (EL12)<br>$EL_{LFG,GE\ No.5}$ (EL14)<br>$EL_{LFG,GE\ No.6}$ (EL15) | kWh meter | Daily (manual) | Softcopy (scanned copy)<br>Hardcopy | Data recorded will be compiled into MS Excel and aggregated for monthly amount<br>Daily log sheet will be scanned for archiving |
| | $EG_{PJ,y}$ ($EL_{LFG,y}$) | $EL_{LFG}$<br>(EL5, EL11, and EL16 TNB main energy meters)<br>TNB check | kWh meter | Monthly bills provided by TNB | Softcopy (scanned copy)<br>Hardcopy | Monthly TNB bills will be scanned for archiving |

| Parameter | CDM ID | Equipment ID | Monitoring equipment | Recording frequency | Document ations | Data archive |
|---|---|---|---|---|---|---|
| | | energy meters | | | | |

**NOTE:**

Data recorded by the flow meters were normalised to $Nm^3$ with the temperature and pressure monitored automatically via the software. Thus, there was no need to normalise the recorded flow further.

## Monitoring Equipment and Equipment Calibration

The list of CDM monitoring equipment used is shown in Table 3 below.

***Table 3: List of CDM Monitoring Equipment and Calibration for Flare No.2***

| No | Item | Parameters | Equipment ID | CDM Monitoring ID | Unit | Manufacturer | Model No. | Serial No. | Accuracy | Range | Last Calibration Date & Cert No. | Recommended Next Calibration Date | Recommended Frequency of Calibration |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Flare System** | | | | | | | | | | | | | |
| 1 | Temperature Transmitter | Temperature (T) | $TT_{1,Flare\ No.2}$ | $T_t$ ($T_{TT1,F2}$) | $^0C$ | Honeywell | STT25M-0-EN0-000-000-000-00-3D | B839917437 | ±0.5% of span | 0-100°C | 18/09/2019 & CTT 3709-19 (01/04/2020 - 13/12/2020) | 17/09/2020 | Annually |
| | | | | | | | | | | | 14/12/2020 & CTT 5165-20 (14/12/2020 - 31/12/2020) | 13/12/2021 | |
| 2 | Temperature Transmitter | Flare Temperature ($T_{flare,y}$) | $TT_{3,Flare\ No.2}$ | $T_{EG,m}$ ($T_{Flare,F2}$) | $^0C$ | Honeywell | STT25M-0-EN0-000-000-000-00-3D | B838901937 | ±0.5% of span | 0-1200°C | 18/09/2019 & CTT 3710 -19 (01/04/2020 - 13/12/2020) | 17/09/2020 | Annually |
| | | | | | | | | | | | 14/12/2020 & CTT 5166 - 20 (14/12/2020 - 31/12/2020) | 13/12/2021 | |
| 3 | Pressure Sensor | Pressure Transmitter (P) | $PT_{2,Flare\ No.2}$ | $P_t$ ($P_{PT2,F2}$) | kPa | Rosemount | 3051TG1A2B21AB4K5M5 | 5916057 | ±0.1% | 0-40 kpa | 18/09/2019 & CTP 5856-19 (01/04/2020 - 13/12/2020) | 17/09/2020 | Annually |
| | | | | | | | | | | | 14/12/2020 & CTP 7359 - 20 (14/12/2020 - 31/12/2020) | 13/12/2021 | |
| 4 | Flow Meter | Total Biogas Flow Rate ($LFG_{total,y}$) | $FT_{1,Flare\ No.2}$ | $V_{t,wb}$ ($LFG_{total,Flare\ No.2,y}$) | $NM^3/hr$ | Flow transmitter – Rosemount Differential Pressure Transmitter – Kingways Control Vcone | 3051CD1A22A1AM5B4K5 | 4972946 / FT119 (8102101) | ±1% | 3-5000$Nm^3/h$ | 04/06/2018 & CTP 3706 - 18 (01/04/2020 - 13/12/2020) | 03/06/2020 | 24 months |
| | | | | | | | | | | | 14/12/2020 & CTP 7321 - 20 (14/12/2020 - 31/12/2020) | 13/12/2022 | |
| 5 | Flow Meter | Flaring Biogas Flow Rate ($LFG_{flare,y}$) | $FT_{2,Flare\ No.2}$ | $V_{t,wb}$ ($LFG_{flare,Flare\ No.2,y}$) | $NM^3/hr$ | Flow transmitter – Rosemount Differential Pressure Transmitter – Kingways Control Vcone | 3051CD1A22A1AM5K5Q4 | 5476627 / FT140 (10031701) | ±0.5% | 3-5000$Nm^3/h$ | 04/06/2018 & CTP3705 - 18 (01/04/2020 -13/12/2020) | 03/06/2020 | 24 months |
| | | | | | | | | | | | 14/12/2020 & CTP 7322 - 20 (14/12/2020 - 31/12/2020) | 13/12/2022 | |
| **Gas Analysers** | | | | | | | | | | | | | |
| 6 | $CH_4$ Meter | Methane fraction of LFG | $CH_{4,Flare\ No.2}$ | $V_{CH4,m,db}$ ($W_{CH4,Flare\ No.2,y}$) | % | Guardian Plus | 97460 | 33542 | ±2% of full scale | 0-100% | 18/09/2019 & CTM 1609-19 (01/04/2020 - 31/12/2020) | 17/09/2020 | Annually |
| | | | | | | | | | | | Current date of calibration is not applicable, due to analyser was broken, new analyser will be replaced | NA | |

According to VVS, version 2.0, section 9.2.6, paragraph 366, page 65:

366. If, during the verification of a certain monitoring period, the DOE identifies that the calibration has been delayed and the calibration has been implemented after the monitoring period in consideration (i.e. the results of delayed calibration are available), referring to the illustrative examples in the appendix below, the DOE may conclude its verification, provided the following conservative approach is adopted in the calculation of GHG emission reductions or net anthropogenic GHG removals:
(a) Applying the maximum permissible error of the instrument to the measured values taken during the period between the scheduled date of calibration and the actual date of calibration, if the results of the delayed calibration do not show any errors in the measuring equipment, or if the error is smaller than the maximum permissible error; or

(b) Applying the error identified in the delayed calibration test, if the error is beyond the maximum permissible error of the measuring equipment.

During this monitoring period, TT1, TT3, PT2, FT1, FT2, and CH4 has a delay in calibration, The equipment calibration error for all the parameters are less than the equipment accuracy error, according to VVS, version 2.0, paragraph 366 (a) stated above, the maximum permissible error of the equipment accuracy error was applied which tabulated below as a conservative approach:

| No | Equipment | Calibration Date | Calibration Error | Accuracy Error | MPE applied | Period | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | TT1 | 14/12/2020 | ±0.2% | ±0.5% | ±0.5% | 17/09/2020-13/12/2020 | The impact of applying this error to the flow normalisation is negligible |
| 2 | TT3 | 14/12/2020 | ±0.05% | ±0.5% | ±0.5% | 17/09/2020-13/12/2020 | No impact as flare was shutdown |
| 3 | PT2 | 14/12/2020 | ±0.05% | ±0.1% | ±0.1% | 17/09/2020-13/12/2020 | The impact of applying this error to the flow normalisation is negligible |
| 4 | FT1 | 14/12/2020 | ±0.05% | ±1.0% | ±1.0% | 03/06/2020-13/12/2020 | There is no impact to the CER calculation due to FT1 is a backup meter |
| 5 | FT2 | 14/12/2020 | ±0.03% | ±0.5% | ±0.5% | 03/06/2020-13/12/2020 | No impact as flare was shutdown |
| 6 | CH4 | Not applicable, due to the CH4 analyser was broken and cannot be fixed, new analyser will be replaced | | ±2.0% | ±2.0% | 17/09/2020-31/12/2020 | No impact as flare was shutdown |

***Table 4: List of CDM Monitoring Equipment and Calibration for GSS1 (GE No. 2 and GE No. 3)***

| No | Item | Parameters | Equipment ID | CDM Monitoring ID | Unit | Manufacturer | Model No. | Serial No. | Accuracy | Range | Last Calibration Date & Cert No. | Recommended Next Calibration Date | Recommended Frequency of Calibration |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gas Supply System** | | | | | | | | | | | | | |
| 1 | Temperature Transmitter | Temperature (T) | $TT_{1,GSS1}$ | $T_t$ ($T_{TT1,GSS1}$) | $^0C$ | Honeywell | STT25M-0-ENS-000-000-000-00-3H | B527143837 | ±1% | 0-100°C | 18/09/2019 & CTT 3711-19 (01/04/2020 - 13/12/2020) | 17/09/2020 | Annually |
| | | | | | | | | | | | 14/12/2020 & CTT 5167 - 20 (14/12/2020 - 31/12/2020) | 13/12/2021 | |
| 2 | Pressure Sensor | Pressure Transmitter (P) | $PT_{2,GSS1}$ | $P_t$ ($P_{PT2,GSS1}$) | kPa | Rosemount | 3051TG1A2B21AB 4E5Q4 | 5584784 | ±0.25% | 0-40 kpa | 21/02/2020 & CTP 2282-20 (01/04/2020 - 13/12/2020) | 20/02/2021 | Annually |
| | | | | | | | | | | | 14/12/2020 - CTP 7360 - 20 (14/12/2020 - 31/12/2020) | 13/12/2021 | |
| 3 | Flow Meter | Flow Rate of Total Gas to Energy ($LFG_{electricity,y}$) | $FT_{3,GSS1}$ | $V_{t, wb}$ ($LFG_{electricity,GSS1,y}$) | $NM^3/hr$ | Rosemount | 3051 CD1A22A1AM5B4 DFK5 | 5988022 | ±0.5% | 200-2,000 $Nm^3/h$ | 11/10/2018 & CTP 5490-18 (01/04/2020 - 13/12/2020) | 10/10/2020 | 24 months |
| | | | | | | | | | | | 14/12/2020 & CTP 7356 -20 (14/12/2020 - 31/12/2020) | 13/12/2022 | |
| 4 | $CH_4$ Meter | Methane fraction of LFG | $CH_{4,GSS1}$ | $V_{CH4,m,db}$ ($W_{CH4,GSS1,y}$) | % | Guardian Plus | 97460 | 33436 | ±2% of full scale | 0-100% | 26/07/2019 & AL-E/0198-0719 (01/04/2020 - 13/12/2020) | 25/07/2020 | Annually |
| | | | | | | | | | | | 14/12/2020 & CTM 1736 -20 (14/12/2020 - 21/12/2020) | 13/12/2021 | |
| **Power Generation and Electricity Consumption** | | | | | | | | | | | | | |
| 5 | Power meter | Grid for project activity | $EL_{PJ}$ (EL6) | $EG_{EC,y}$ ($EL_{PJ,y}$) | kWh | IME | NEMO 96HD+ | 2661930098 | Class 0.5S | 0-250/5A | 25/01/2018 &SP/RA/2018/065/002 (01/04/2020 - 08/12/2020) | 24/01/2021 | 36 months |
| 6 | Power meter | Gross generation from GE No.2 | $EL_{LFG,GE\ No.2}$ (EL9) | $EG_{PJ,y}$ ($EL_{LFG,GE\ No.2,y}$) | kWh | EDMI Limited | MK6G Genius 2000-0601-140-N-G-240 | 211516862 | Class 0.5S | 99999999.99kWh | 25/01/2018 & SP/RA/2018/065/003 (01/04/2020 - 08/12/2020) | 24/01/2020 | 24 months |
| | | | | | | | | | | | 09/12/2020 & SP/RA/2020/689/001-005 (09/12/2020 - 31/12/2022) | 08/12/2022 | |
| 7 | Power meter | Gross generation from GE No.3 | $EL_{LFG,GE\ No.3}$ (EL10) | $EG_{PJ,y}$ ($EL_{LFG,GE\ No.3,y}$) | kWh | EDMI Limited | MK6G Genius 2000-0601-140-N-G-240 | 211516863 | Class 0.5S | 99999999.99kWh | 25/01/2018 & SP/RA/2018/065/004 (01/04/2020 - 08/12/2020) | 24/01/2020 | 24 months |
| | | | | | | | | | | | 09/12/2020 & SP/RA/2020/689/002 (09/12/2020 - 31/12/2022) | 08/12/2022 | |
| 8 | Power meter | Electricity sold to grid (MWh) - recorded by grid operator | $EL_{LFG}$ (EL11) | $EG_{PJ,y}$ ($EL_{LFG,y}$) | kWh | EDMI Limited | Mk6E | 908705152 | Class 0.5S | 99,999,999kWh | 06/12/2009 & TNBM/PJ/09/076 (01/04/2020 - 31/12/2020) | 05/12/2014 | 5 years |
| 9 | Power meter | Electricity sell to grid (MWh) - check energy meter recorded by grid operator | - | - | kWh | EDMI Limited | Mk6E | 908705154 | Class 0.5S | 99,999,999kWh | 06/12/2009 & TNBM/PJ/09/076 (01/04/2020 - 31/12/2020) | 05/12/2014 | 5 years |

According to VVS, version 2.0, section 9.2.6, paragraph 366, page 65:

366. If, during the verification of a certain monitoring period, the DOE identifies that the calibration has been delayed and the calibration has been implemented after the monitoring period in consideration (i.e. the results of delayed calibration are available), referring to the illustrative examples in the appendix below, the DOE may conclude its verification, provided the following conservative approach is adopted in the calculation of GHG emission reductions or net anthropogenic GHG removals:
(a) Applying the maximum permissible error of the instrument to the measured values taken during the period between the scheduled date of calibration and the actual date of calibration, if the results of the delayed calibration do not show any errors in the measuring equipment, or if the error is smaller than the maximum permissible error; or

(b) Applying the error identified in the delayed calibration test, if the error is beyond the maximum permissible error of the measuring equipment.

During this monitoring period, TT1, FT3, CH4, EL9 and EL10 has a delay in calibration, The equipment calibration error for all the parameters are less than the equipment accuracy error, according to VVS, version 2.0, paragraph 366 (a) stated above, the maximum permissible error of the equipment accuracy error was applied which tabulated below as a conservative approach:

| No | Equipment | Calibration Date | Calibration Error | Accuracy Error | MPE applied | Period | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | TT1 | 14/12/2020 | ±0.2% | ±1.0% | ±1.0% | 17/09/2020-13/12/2020 | The impact of applying this error to the flow normalisation is negligible |
| 2 | FT3 | 14/12/2020 | ±0.1% | ±0.5% | ±0.5% | 10/10/2020-13/12/2020 | - |
| 3 | CH4 | 14/12/2020 | ±0.0% | ±2.0% | ±2.0% | 25/07/2020-13/12/2020 | - |
| 4 | EL9 | 09/12/2020 | ±0.13% | ±0.5% | ±0.5% | 01/04/2020-08/12/2020 | - |
| 5 | EL10 | 09/12/2020 | ±0.27% | ±0.5% | ±0.5% | 01/04/2020-08/12/2020 | - |

According to VVS, version 2.0, section 9.2.6, paragraph 368, page 65:

368. If the results of the delayed calibration are not available, or the calibration has not been conducted at the time of the verification, the DOE, prior to finalizing the verification, shall request the project participants to conduct the required calibration and shall determine whether the project participants have calculated GHG emission reductions or net anthropogenic GHG removals conservatively using the approach mentioned in paragraph 366.

During this monitoring period, EL11 is owned by the grid operator which is not within the control of the project owner and the calibration has not been conducted at the time of verification.Due to overdue in calibration, the maximum permissible error of equipment accuracy error was applied which is listed as below:
EL11 - Due to delay in calibration, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL11 from 01/04/2020 - 31/12/2020 as a conservative approach.

## *Table 5: List of CDM Monitoring Equipment and Calibration for GSS2 (GE No. 4)*

| No | Item | Parameters | Equipment ID | CDM Monitoring ID | Unit | Manufacturer | Model No. | Serial No. | Accuracy | Range | Last Calibration Date & Cert No. | Recommended Next Calibration Date | Recommended Frequency of Calibration |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gas Supply System** | | | | | | | | | | | | | |
| 1 | Temperature Transmitter | Temperature (T) | $TT_{1,GSS2}$ | $T_t$ ($T_{TT1,GSS2}$) | $^0C$ | Autrol | ATT2100-S11HA3E1-M1 | ATT21004151000 | ±0.1% | 0-100°C | 18/09/2019 & CTT 3712-19 (01/04/2020 - 13/12/2020) | 17/09/2020 | Annually |
| | | | | | | | | | | | 14/12/2020 - CTT 5168 -20 (14/12/2020 - 31/12/2020) | 13/12/2021 | Annually |
| 2 | Pressure Sensor | Pressure Transmitter (P) | $PT_{2,GSS2}$ | $P_t$ ($P_{PT2,GSS2}$) | kPa | Autrol | APT3200-G4M11E11S1-M1 | APT3200-4150998 | ±0.075% of span | -100-1,500kPa | 18/09/2019 & CTP 5857-19 (01/04/2020 - 13/12/2020) | 17/09/2020 | Annually |
| | | | | | | | | | | | 14/12/2020 & CTP 7361 -20 (14/12/2020 -31/12/2020) | 13/12/2021 | Annually |
| 3 | Flow Meter | Flow Rate of Total Gas to Energy ($LFG_{electricity,y}$) | $FT_{3,GSS2}$ | $V_{t, wb}$ ($LFG_{electricity,GSS2,y}$) | $NM^3/hr$ | Binder | EIA-C100000-1MA100-D1104501-21BS2410 | C150327 | 2.5% of reading + 0.2% of full scale | 0.25-25 Nm/s | 10/12/2018 & C150327 (01/04/2020 - 31/12/2020) | 09/12/2020 | 24 months |
| | | | | | | | | | | | 19/02/2021 & 0678 | 18/02/2023 | |
| 4 | Flow Meter | Flow Rate of Total Gas to Energy ($LFG_{electricity,y}$) | $FT_{3,GE4}$ (FT7) | $V_{t, wb}$ ($LFG_{electricity,GE4,y}$) | $NM^3/hr$ | SUTO (CS-iTEC) | S450 | 5215-8535 | ±(1.5% of reading + 0.3% FS) | 30.9 -185 m/s | 23/11/2015 & RGfs2015-0089 (01/04/2020 - 31/12/2020) | 22/11/2016 | Annually |
| | | | | | | | | | | | 31/03/2021 & 06950450 | 30/3/2022 | |
| **Gas Analyser** | | | | | | | | | | | | | |
| 5 | $CH_4$ Meter | Methane fraction of LFG | $CH_{4,GSS2}$ | $V_{CH4,m,db}$ ($W_{CH4,GSS2,y}$) | % | Edinburgh | Guardian NG | 14464 | ±2% of full scale | 0-100% | 03/02/2020 & AL-ED/0242/0220 (01/04/2020 - 13/12/2020) | 02/02/2021 | Annually |
| | | | | | | | | | | | 14/12/2020 & AL-ED/0270/1220 (14/12/2020 - 31/12/2020) | 13/12/2021 | Annually |
| **Power Generation and Electricity Consumption** | | | | | | | | | | | | | |
| 6 | Power meter | Gross generation from GE No.4 | $EL_{LFG,GE\ No.4}$ (EL12) | $EG_{PJ,y}$ ($EL_{LFG,GE\ No.4,y}$) | kWh | EDMI | 2000-6N00-30A31-04-L00-02A2-1D | 213545834 | Class 0.5S | 99999999.99kWh | 08/08/2018 & SP/RA/2018/463/001-001 (01/04/2020 - 08/12/2020) | 07/08/2020 | 24 months |
| | | | | | | | | | | | 09/12/2020 & SP/RA/2020/689/003 (09/12/2020 -31/12/2020) | 08/12/2022 | 24 months |

According to VVS, version 2.0, section 9.2.6, paragraph 366, page 65:

366. If, during the verification of a certain monitoring period, the DOE identifies that the calibration has been delayed and the calibration has been implemented after the monitoring period in consideration (i.e. the results of delayed calibration are available), referring to the illustrative examples in the appendix below, the DOE may conclude its verification, provided the following conservative approach is adopted in the calculation of GHG emission reductions or net anthropogenic GHG removals:
(a) Applying the maximum permissible error of the instrument to the measured values taken during the period between the scheduled date of calibration and the actual date of calibration, if the results of the delayed calibration do not show any errors in the measuring equipment, or if the error is smaller than the maximum permissible error; or

(b) Applying the error identified in the delayed calibration test, if the error is beyond the maximum permissible error of the measuring equipment.

During this monitoring period, TT1, PT2, FT3, FT7, and EL12 has a delay in calibration, The equipment calibration error for all the parameters except PT2 are less than the equipment accuracy error, according to VVS, version 2.0, paragraph 366 (a) stated above, the maximum permissible error of the equipment accuracy error was applied to all parameter except PT2 which tabulated below as a conservative approach. According to VVS, version 2.0, paragraph 366 (b), stated above, the maximum permissible error of ±0.8% which is the equipment calibration error was applied to PT2 as a conservative approach.

| No | Equipment | Calibration Date | Calibration Error | Accuracy Error | MPE applied | Period | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | TT1 | 14/12/2020 | ±0.0% | ±0.1% | ±0.1% | 17/09/2020-13/12/2020 | The impact of applying this error to the flow normalisation is negligible |
| 2 | PT2 | 14/12/2020 | ±0.8% | ±0.075% | ±0.8% | 17/09/2020-13/12/2020 | The impact of applying this error to the flow normalisation is negligible |
| 3 | FT3 | 19/02/2021 | ±1.2% | ±2.7% | ±2.7% | 09/12/2020-31/12/2020 | - |
| 4 | FT7 | 31/03/2021 | ±0.65% | ±1.8% | ±1.8% | 01/04/2020-31/12/2020 | There is no impact to the CER calculation due to FT**7** is a backup meter**,** in case $GSS2_{FT3}$ malfunction, there is no malfunction of $GSS2_{FT3}$ during this monitoring period**.** |
| 5 | EL12 | 09/12/2020 | ±0.13% | ±0.5% | ±0.5% | 07/08/2020-08/12/2020 | - |

***Table 6: List of CDM Monitoring Equipment and Calibration for GSSF1 (GE No. 1)***

| No | Item | Parameters | Equipment ID | CDM Monitoring ID | Unit | Manufacturer | Model No. | Serial No. | Accuracy | Range | Last Calibration Date & Cert No. | Recommended Next Calibration Date | Recommended Frequency of Calibration |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gas Supply System** | | | | | | | | | | | | | |
| 1 | Temperature Transmitter | Temperature (T) | $TT_{1,GSS\ F1}$ | $T_t$ ($T_{TT1,\ GSS\ F1}$) | $^0C$ | PR Electronics | 5335A | 100944768 | ≤ ± 0.05% of span | 0-100°C | 18/09/2019 & CTT 3708-19 (01/04/2020 - 13/12/2020)<br>14/12/2020 & CTT 5164-20 (14/12/2020 - 31/12/2020) | 17/09/2020<br>13/12/2021 | Annually |
| 2 | Flow Meter | Flow Rate of Total Gas to Energy ($LFG_{electricity,y}$) | $FT_{3,\ GSS\ F1}$ | $V_{t,\ wb}$ ($LFG_{electricity,GSS\ F1,y}$) | $NM^3/hr$ | Flow transmitter – Rosemount Differential Pressure Transmitter – Kingways Control Vcone | 3051CD1A22A1AM5B4 K5Q4 / KVS08IIKC23FSN | 02768007 / FT161 (11011001) | +0.5% | 0-64kPa | 18/09/2019 & CTP 5855-19 (01/04/2020 - 31/12/2020) | 17/09/2021 | 24 months |
| 3 | Pressure Sensor | Pressure Transmitter (P) | $PT_{2,\ GSS\ F1}$ | $P_t$ ($P_{PT2,\ GSS\ F1}$) | kPa | Rosemount | 3051TG1A2B21AB4E5 M5Q4 | 02492864 | +0.25% | 0 to 207 kPa | 18/09/2019 & CTP 5854-19 (01/04/2020 - 13/12/2020)<br>14/12/2020 & CTP 7358 -20 (14/12/2020 - 31/12/2020) | 17/09/2020<br>13/12/2021 | Annually |
| **Gas Analysers** | | | | | | | | | | | | | |
| 4 | CH4 Analyser | Methane fraction of LFG | $CH_{4,\ GSS\ F1}$ | $V_{CH4,\ m,\ db}$ ($W_{CH4,GSS\ F1,y}$) | % | Cubic- Ruiyi | Gasboard-3200 | 2190 5310 2610 0000 0001 | <1.0% | 0-100% | 05/06/2019 & 2019060507 (01/04/2020 - 13/12/2020)<br>14/12/2020 - CTM 1735 -20 (14/12/2020 - 31/12/2020 ) | 04/06/2020<br>13/12/2021 | Annually |
| **Power Generation and Electricity Consumption** | | | | | | | | | | | | | |
| 5 | Power meter | Total electricity generation (MWh) - recorded by project site (Backup) | $EL_{LFG,GE\ No.1}$ (EL1) | $EG_{PJ,y}$ ($EL_{LFG,GE\ No.1,y}$) | kWh | IME Nemo | 96HD+ | 2167890035 | Class 0.5S | 99999999.99kWh | 25/01/2018 & SP/RA/2018/065/001-004 (01/04/2020 - 31/12/2020) | 24/01/2021 | 36 months |
| 6 | Power meter | Total electricity generation (MWh) - recorded by project site | $EL_{LFG,GE\ No.1}$ (EL4) | $EG_{PJ,y}$ ($EL_{LFG,GE\ No.1,y}$) | kWh | EDMI | Genius | 210225256 | Class 0.5S | 99999999.99kWh | 14/03/2019 & SP/RA2019/146/001-001 (01/04/2020 - 31/12/2020) | 13/03/2021 | 24 months |
| 7 | Power meter | Electricity sell to grid (MWh) - recorded by grid operator | $EL_{LFG}$ (EL5) | $EG_{PJ,y}$ ($EL_{LFG,y}$) | kWh | Itron | SL761A071 | 53099690 | Class 0.20 | 999999999kWh | 01/04/2011 & TNBM-QR-064 (01/04/2020 - 31/12/2020) | 31/03/2016 | 5 years |
| 8 | Power meter | Electricity sell to grid (MWh) - check energy meter recorded by grid operator | - | - | kWh | Itron | SL761A071 | 53099691 | Class 0.20 | 999999999kWh | 01/04/2011 & TNBM-QR-064 (01/04/2020 - 31/12/2020) | 31/03/2016 | 5 years |

According to VVS, version 2.0, section 9.2.6, paragraph 366, page 65:

366. If, during the verification of a certain monitoring period, the DOE identifies that the calibration has been delayed and the calibration has been implemented after the monitoring period in consideration (i.e. the results of delayed calibration are available), referring to the illustrative examples in the appendix below, the DOE may conclude its verification, provided the following conservative approach is adopted in the calculation of GHG emission reductions or net anthropogenic GHG removals:
(a) Applying the maximum permissible error of the instrument to the measured values taken during the period between the scheduled date of calibration and the actual date of calibration, if the results of the delayed calibration do not show any errors in the measuring equipment, or if the error is smaller than the maximum permissible error; or

(b) Applying the error identified in the delayed calibration test, if the error is beyond the maximum permissible error of the measuring equipment.

During this monitoring period, TT1, PT2, and CH4 has a delay in calibration, The equipment calibration error for CH4 is less than the equipment accuracy error, according to VVS, version 2.0, paragraph 366 (a) stated above, the maximum permissible error of the equipment accuracy error was applied to CH4. On the other hand, The equipment calibration error for TT1 and PT2 are more than the equipment accuracy error, according to VVS, version 2.0, paragraph 366 (b), stated above, the maximum permissible error of the equipment calibration error was applied to TT1 and PT2 as a conservative approach.

| No | Equipment | Calibration Date | Calibration Error | Accuracy Error | MPE applied | Period | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | TT1 | 14/12/2020 | ±0.2% | ±0.05% | ±0.2% | 17/09/2020-13/12/2020 | The impact of applying this error to the flow normalisation is negligible |
| 2 | PT2 | 14/12/2020 | ±0.7% | ±0.25% | ±0.7% | 17/09/2020-13/12/2020 | The impact of applying this error to the flow normalisation is negligible |
| 3 | CH4 | 14/12/2020 | ±0.0% | ±1.0% | ±1.0% | 04/06/2020-13/12/2020 | - |

According to VVS, version 2.0, section 9.2.6, paragraph 368, page 65:

368. If the results of the delayed calibration are not available, or the calibration has not been conducted at the time of the verification, the DOE, prior to finalizing the verification, shall request the project participants to conduct the required calibration and shall determine whether the project participants have calculated GHG emission reductions or net anthropogenic GHG removals conservatively using the approach mentioned in paragraph 366.

During this monitoring period, EL5 is owned by the grid operator which is not within the control of the project owner and the calibration has not been conducted at the time of verification.Due to overdue in calibration, the maximum permissible error of equipment accuracy error was applied which is listed as below:

EL5 - Due to delay in calibration, the maximum permissible error of ±0.2% which is the equipment accuracy error was applied to EL5 from 01/04/2020 - 31/12/2020 as a conservative approach.

## *Table 7: List of CDM Monitoring Equipment and Calibration for GSS3 (GE No. 5 and GE No.6)*

| No | Item | Parameters | Equipment ID | CDM Monitoring ID | Unit | Manufacturer | Model No. | Serial No. | Accuracy | Range | Last Calibration Date & Cert No. | Recommended Next Calibration Date | Recommended Frequency of Calibration |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gas Supply System** | | | | | | | | | | | | | |
| 1 | Temperature Transmitter | Temperature (T) | $TT_{1,GSS3}$ | $T_t$ ($T_{TT1,GSS3}$) | 0C | Status Instrument | SEM 710 | 155132 - 0001 | ± 2.0% | 0 - 100'0 | 22/02/2019 & 1902 0016/TE/BT (01/04/2020 - 13/12/2020) | 21/02/2020 | Annually |
| | | | | | | | | | | | 14/12/2020 & CTT 5128-20 (14/12/2020- 13/12/2020) | 13/12/2021 | |
| 2 | Pressure Sensor | Pressure Transmitter (P) | $PT_{2,GSS3}$ | $P_t$ ($P_{PT2,GSS3}$) | kPa | Endress + Hauser | PMP51 - BD21JA1 KGCGMJA1 | N7014C21129 | ± 0.15% | 0-40kPa | 25/07/2018 & P18-0142 (01/04/2020 - 13/12/2020) | 24/07/2019 | Annually |
| | | | | | | | | | | | 14/12/2020 & CTP 7323-20 (14/12/2020 - 31/12/2020) | 13/12/2021 | |
| 3 | Flow Meter | Flow Rate of Total Gas to Energy ($LFG_{electricity,y}$) | $FT_{3,GSS3}$ | $V_{t,\,wb}$ ($LFG_{electricity,GSS3,y}$) | $NM^3$/hr | Rosemount | 2051CD2A02A1AS5M5 C1Q4 | 3604693 | 0.065% | 0-937mbar | 17/08/2018 & 11834565 (01/04/2020 - 13/12/2020) | 16/08/2020 | 24 months |
| | | | | | | | | | | | 14/12/2020 & CTP 7357-20 (14/12/2020 - 31/12/2020) | 13/12/2021 | |
| 4 | Flow Meter | Flow Rate of Total Gas to Energy ($LFG_{electricity,y}$) | $FT_{3,GE5}$ (FT8) | $V_{t,\,wb}$ ($LFG_{electricity,GE5,y}$) | $NM^3$/hr | Binder | Combimass | C180382 | 2.5% ± 0.1% | 21-1800Nm³/h | 26/07/2018 & BKTGR-FM2 (01/04/2020 - 31/12/2020) | 25/07/2020 | 24 months |
| | | | | | | | | | | | 06/04/2021 & 0681 | 05/04/2023 | |
| 5 | Flow Meter | Flow Rate of Total Gas to Energy ($LFG_{electricity,y}$) | $FT_{3,GE6}$ (FT9) | $V_{t,\,wb}$ ($LFG_{electricity,GE6,y}$) | $NM^3$/hr | Binder | Combimass | C180381 | 2.5% ± 0.1% | 21-1800Nm³/h | 26/07/2018 & BKTGR-FM1 (01/04/2020 - 31/12/2020) | 25/07/2020 | 24 months |
| | | | | | | | | | | | 06/04/2021 & 0680 | 05/04/2023 | |
| **Gas Analyser** | | | | | | | | | | | | | |
| 6 | $CH_4$ Meter | Methane fraction of LFG | $CH_{4,GSS3}$ | $V_{CH4,m,db}$ ($W_{CH4,GSS3,y}$) | % | Edihburgh Sensors | Guardian NG | 17167 | ± 2% | 0-100% | 27/01/2020 & 2607 (01/04/2020 - 31/12/2020) | 26/01/2021 | Annually |
| **Power Generation and Electricity Consumption** | | | | | | | | | | | | | |
| 7 | Power meter | Gross generation from GE No.5 | $EL_{LFG,GE\ No.5}$ (EL14) | $EG_{PJ,y}$ ($EL_{LFG,GE\ No.5,y}$) | kWh | Mk6N GENIUS EDMI | MK6N 2000 - 6N00-30F31-04-L00-12E3-1E | 218287221 | Class 0.5S | 99999999.99kWh | 27/04/2018 & 218287221-4422186 (01/04/2020 - 08/12/2020) | 26/04/2020 | 24 months |
| | | | | | | | | | | | 09/12/2020 & SP/RA/2020/689/004 (09/12/2020 - 31/12/2020) | 08/12/2022 | |
| 8 | Power meter | Gross generation from GE No.6 | $EL_{LFG,GE\ No.6}$ (EL15) | $EG_{PJ,y}$ ($EL_{LFG,GE\ No.6,y}$) | kWh | Mk6N GENIUS EDMI | MK6N 2000 - 6N00-30F31-04-L00-12E3-1E | 218287222 | Class 0.5S | 99999999.99kWh | 27/04/2018 &218287222-4422186 (01/04/2020 - 08/12/2020) | 26/04/2020 | 24 months |
| | | | | | | | | | | | 09/12/2020 & SP/RA/2020/689/005 (09/12/2020 -31/12/2020) | 08/12/2022 | |
| 9 | Power meter | Electricity sold to grid (MWh) - recorded by grid operator | $EL_{LFG}$ (EL16) | $EG_{PJ,y}$ ($EL_{LFG,y}$) | kWh | Genius | MK6E | 918703332 | Class 0.5S | 99999999.99kWh | 11/5/2019 (01/04/2020 - 11/08/2020) | 10/05/2024 | 5 years |
| | | | | | | | | | | | 12/8/2020 (12/08/2020 - 31/12/2020) | 11/08/2025 | |
| 10 | Power meter | Electricity sell to grid (MWh) - check energy meter recorded by grid operator | - | - | kWh | Genius | MK6E | 918703333 | Class 0.5S | 99999999.99kWh | 11/5/2019 (01/04/2020 - 11/08/2020) | 10/05/2024 | 5 years |
| | | | | | | | | | | | 12/8/2020 (12/08/2020 - 31/12/2020) | 11/08/2025 | |

According to VVS, version 2.0, section 9.2.6, paragraph 366, page 65:

366. If, during the verification of a certain monitoring period, the DOE identifies that the calibration has been delayed and the calibration has been implemented after the monitoring period in consideration (i.e. the results of delayed calibration are available), referring to the illustrative examples in the appendix below, the DOE may conclude its verification, provided the following conservative approach is adopted in the calculation of GHG emission reductions or net anthropogenic GHG removals:
(a) Applying the maximum permissible error of the instrument to the measured values taken during the period between the scheduled date of calibration and the actual date of calibration, if the results of the delayed calibration do not show any errors in the measuring equipment, or if the error is smaller than the maximum permissible error; or

(b) Applying the error identified in the delayed calibration test, if the error is beyond the maximum permissible error of the measuring equipment.

During this monitoring period, TT1, PT2, FT3, FT8, FT9, EL14, and EL15 has a delay in calibration, The equipment calibration error for TT1, FT8, FT9, EL14 and EL15 are less than the equipment accuracy error, according to VVS, version 2.0, paragraph 366 (a) stated above, the maximum permissible error of the equipment accuracy error was applied to TT1, FT8, FT9, EL14 and EL15. On the other hand, The equipment calibration error for PT2 and FT3 are more than the equipment accuracy error, according to VVS, version 2.0, paragraph 366 (b), stated above, the maximum permissible error of the equipment calibration error was applied to PT2 and FT3 as a conservative approach.

| No | Equipment | Calibration Date | Calibration Error | Accuracy Error | MPE applied | Period | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | TT1 | 14/12/2020 | ±0.2% | ±2.0% | ±2.0% | 01/04/2020-13/12/2020 | The impact of applying this error to the flow normalisation is negligible |
| 2 | PT2 | 14/12/2020 | ±0.25% | ±0.15% | ±0.25% | 01/04/2020-13/12/2020 | The impact of applying this error to the flow normalisation is negligible |
| 3 | FT3 | 14/12/2020 | ±0.16% | ±0.065% | ±0.16% | 16/08/2020–13/12/2020 | - |
| 4 | FT8 | 06/04/2021 | ±1.0% | ±2.6% | ±2.6% | 25/07/2020 – 31/12/2020 | There is no impact to the CER calculation due to FT8 is a backup meter |
| 5 | FT9 | 06/04/2021 | ±1.0% | ±2.6% | ±2.6% | 25/07/2020 – 31/12/2020 | There is no impact to the CER calculation due to FT9 is a backup meter |
| 6 | EL14 | 09/12/2020 | ±0.05% | ±0.5% | ±0.5% | 26/04/2020-08/12/2020 | - |
| 7 | EL15 | 09/12/2020 | ±0.13% | ±0.5% | ±0.5% | 26/04/2020-08/12/2020 | - |

The summary of the delay in calibration which the maximum permissible error (MPE) or the equipment calibration error applied are tabulated below:

| No | Equipments | Maximum Permissible Error (MPE) | | MPE Applied | Period of Application |
|---|---|---|---|---|---|
| | | Accuracy Error | Calibration Error | | |
| **Flare 2** | | | | | |
| 1 | TT1 | ±0.5% | ±0.2% | ±0.5% (Accuracy error) | 17/09/2020-13/12/2020 |
| 2 | TT3 | ±0.5% | ±0.05% | ±0.5% (Accuracy error) | 17/09/2020-13/12/2020 |
| 3 | PT2 | ±0.1% | ±0.05% | ±0.1% (Accuracy error) | 17/09/2020-13/12/2020 |
| 4 | FT1 | ±1.0% | ±0.05% | ±1.0% (Accuracy error) | 03/06/2020-13/12/2020 |
| 5 | FT2 | ±0.5% | ±0.03% | ±0.5% (Accuracy error) | 03/06/2020-13/12/2020 |
| 6 | CH4 | ±2.0% | No calibration done due to broken of analyser, new analyser will be replaced | ±2.0% (Accuracy error) | 17/09/2020-31/12/2020 |
| **GSS1** | | | | | |
| 7 | TT1 | ±1.0% | ±0.2% | ±1.0% (Accuracy error) | 17/09/2020-13/12/2020 |
| 8 | FT3 | ±0.5% | ±0.1% | ±0.5% (Accuracy error) | 10/10/2020-13/12/2020 |
| 9 | CH4 | ±2.0% | ±0.0% | ±2.0% (Accuracy error) | 25/07/2020-13/12/2020 |
| 10 | EL9 | ±0.5% | ±0.13% | ±0.5% (Accuracy error) | 01/04/2020-08/12/2020 |
| 11 | EL10 | ±0.5% | ±0.27% | ±0.5% (Accuracy error) | 01/04/2020-08/12/2020 |
| **GSS2** | | | | | |
| 12 | TT1 | ±0.1% | ±0.0% | ±0.1% (Accuracy error) | 17/09/2020-13/12/2020 |
| 13 | PT2 | ±0.075% | ±0.8% | ±0.8% (Calibration error) | 17/09/2020-13/12/2020 |
| 14 | FT3 | ±2.7% | ±1.2% | ±2.7% (Accuracy error) | 09/12/2020-31/12/2020 |
| 15 | FT7 | ±1.8% | ±0.65% | ±1.8% (Accuracy error) | 01/04/2020-31/12/2020 |
| 16 | EL12 | ±0.5% | ±0.13% | ±0.5% (Accuracy error) | 07/08/2020-08/12/2020 |
| **GSSF1** | | | | | |
| 17 | TT1 | ±0.05% | ±0.2% | ±0.2% (Calibration error) | 17/09/2020-13/12/2020 |
| 18 | PT2 | ±0.25% | ±0.7% | ±0.7% (Calibration error) | 17/09/2020-13/12/2020 |
| 19 | CH4 | ±1.0% | ±0.0% | ±1.0% (Accuracy error) | 04/06/2020-13/12/2020 |
| **GSS3** | | | | | |
| 20 | TT1 | ±2.0% | ±0.2% | ±2.0% (Accuracy error) | 01/04/2020-13/12/2020 |
| 21 | PT2 | ±0.15% | ±0.25% | ±0.25% (Calibration error) | 01/04/2020-13/12/2020 |
| 22 | FT3 | ±0.065% | ±0.16% | ±0.16% (Calibration error) | 16/08/2020–13/12/2020 |
| 23 | FT8 | ±2.6% | ±1.0% | ±2.6% (Accuracy error) | 25/07/2020 – 31/12/2020 |
| 24 | FT9 | ±2.6% | ±1.0% | ±2.6% (Accuracy error) | 25/07/2020 – 31/12/2020 |

| No | Equipments | Maximum Permissible Error (MPE) | | MPE Applied | Period of Application |
|---|---|---|---|---|---|
| | | Accuracy Error | Calibration Error | | |
| 25 | EL14 | ±0.5% | ±0.05% | ±0.5% (Accuracy error) | 26/04/2020-08/12/2020 |
| 26 | EL15 | ±0.5% | ±0.13% | ±0.5% (Accuracy error) | 26/04/2020-08/12/2020 |

With reference to the CDM validation and verification standard for project activities, version 02.0, section 9.2.6, paragraph 368, "If the results of the delayed calibration are not available, or the calibration has not been conducted at the time of the verification, the DOE, prior to finalizing the verification, shall request the project participants to conduct the required calibration and shall determine whether the project participants have calculated GHG emission reductions or net anthropogenic GHG removals conservatively using the approach mentioned in paragraph 366 above".

During this monitoring period, there is equipment that is not within the control of the project owner and the calibration has not been conducted at the time of verification. The summary of the equipment is tabulated below:

| No | Equipments | Maximum Permissible Error (MPE) | Period of Application |
|---|---|---|---|
| | | Accuracy Error | |
| **GSSF1** | | | |
| 1 | EL5 | ±0.2% | 01/04/2020 - 31/12/2020 |
| **GSS1** | | | |
| 2 | EL11 | ±0.5% | 01/04/2020 - 31/12/2020 |

***Data Collection (for the whole monitoring period)***

Based on the monitoring plan, key parameters (temperature, pressure, the flow of gas, $CH_4$ concentration in LFG and amount of electricity consumption and generation) were continuously monitored and recorded via the data logger at the control rooms. Continuous data were logged and archived every minute in the database file. These raw data were compiled and analysed for the calculation of Certified Emission Reductions (CERs).

As a back-up data recording system, the on-site workers have manually recorded certain monitored parameters in the Daily Monitoring Log Sheets. These records were scanned into soft copies for electronic filing every month.

Data recorded manually (not recorded in the data logger system), i.e. electricity consumed were recorded in daily monitoring log sheets on a daily basis and compiled in Microsoft (MS) Excel format weekly.

**Data Processing**

The data logged were archived in .db file format and compiled.

Data recorded were further processed to yield the results required. A specific computation programme (in MS Access) was developed by the CDM Consultant to process continuously-monitored data to the required format and summary. An example of data aggregation on-site for the flow rate of LFG at the main pipe is shown as follows:

**Parameter: $FT_1$ (Flow rate of LFG at main pipe)**

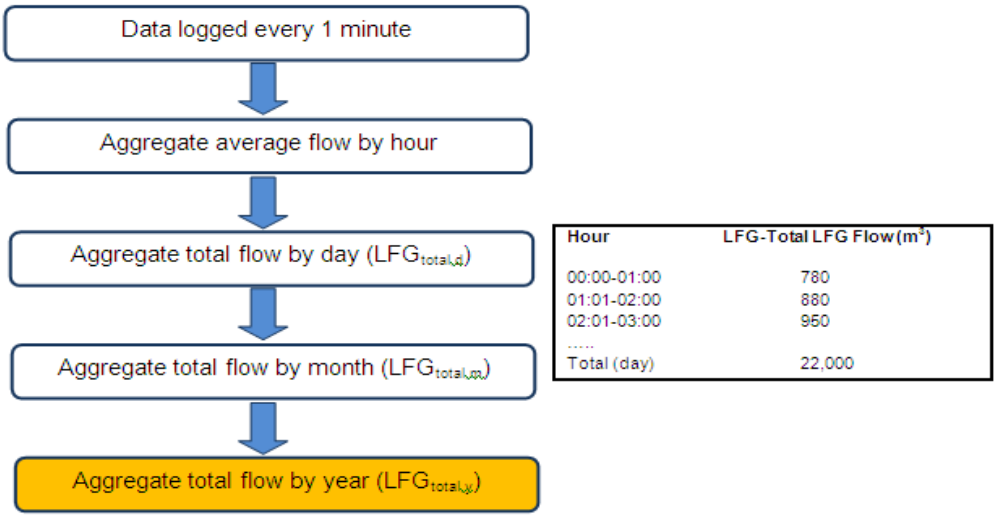



***Figure 10: Example of Data Aggregation for Continuous Monitoring***

Raw data logged at one (1) minute's interval were used to compute the hourly average. Subsequently, daily readings were computed, followed by aggregation into monthly and finally, yearly summaries.

Similar average values were computed for parameters such as the temperature, pressure, and % $CH_4$.

**Quality Assurance and Quality Control (QA & QC)**

*Documented Procedures and QA/QC Measures*

QA/QC was applied throughout the monitoring period:

- Daily inspection of LFG extraction, flaring, and monitoring systems;
- Checking and counter-signing of data forms by the CDM Manager;
- Data security (restricted access, password control) was applied to ensure the integrity of data;
- Inspection, observations, incidents, and follow-up actions were documented;
- Independent audits were carried out by external consultants; and
- Data were analysed on a weekly basis to determine any irregularities.

*Data Management and Storage*

A proper data back-up system has been set up to ensure that the data will not be compromised in case of any unforeseen incidents at the site resulting in total loss of data. The retention/archiving period for verification and CER issuance documents should be kept in electronic form for at least 2 years after the crediting period.

*Continuous Monitoring (data logging system)*

The data from continuous monitoring (data logger) was primarily stored in the hard disk located in the control rooms. To ensure that all data recorded are safe and properly archived, the following back-up system was applied for this project:

| Types of back-up | Frequency | Back-up location |
|---|---|---|
| Manual back-up using a portable hard disk (HD) | Monthly | Control rooms |
| Automatic back-up to the CDM Manager's PC located at the site office, BTSL | Weekly | On-site (site office) |
| Data server in the CDM Consultant's office (Eco-Ideal Consulting Sdn. Bhd., Unit C10-4, Tower C, Wisma Goshen, Bangsar Trade Centre, Kuala Lumpur, Malaysia) | Weekly | Off-site (consultant's office) |

The data stored in the data server located at the CDM Consultant's office will be used as the primary back-up data in case of any emergency resulting in the loss of data from the flare data recording system. The automatic data back-up system based on internet data transmission can be illustrated as follows:

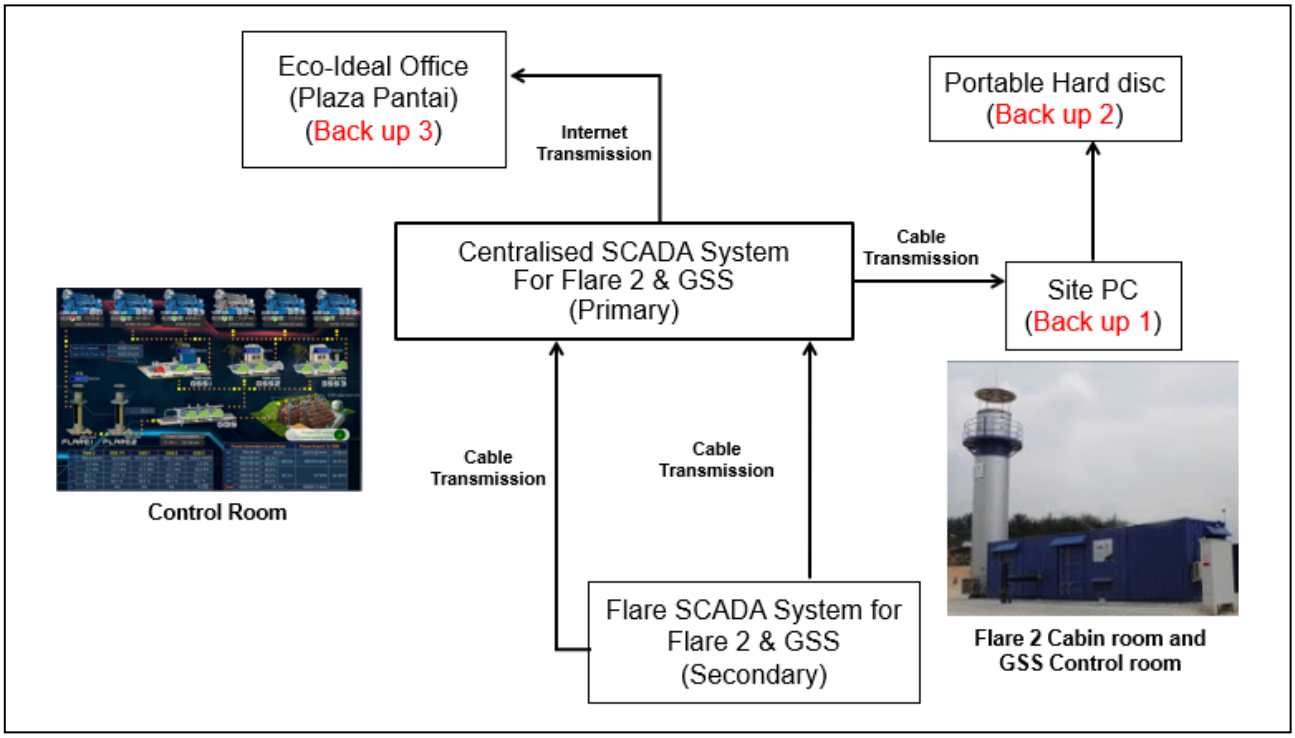



***Figure 11: Automatic Data Back-Up for Flaring and GSS System at BTSL***

*Manual Recording*

Daily operational data (consisting of CDM parameters monitored) recorded manually was backed-up by scanning all the daily monitoring log sheets on a weekly basis. These data were primarily stored in the computer at the cabin office next to the flare cabin. A copy of these scanned log sheets was handed to the CDM Consultant on a monthly basis for secondary back-up.

*Training*

Training is important to ensure that all the involved staff is provided with the needed knowledge and skills to undertake their roles effectively according to the CDM MP.

The staff has also attended several technical/operational trainings as listed below:

| No. | Description | Date | No. of participants |
|---|---|---|---|
| 1 | Landfill Gas – gas extraction | 15/06/2020 | 7 |
| 2 | GBS Operation | 11/11/2020 | 6 |

## SECTION D. Data and parameters

### D.1. Data and parameters fixed ex ante

**ACM0001: "Flaring or use of landfill gas" (Version 18.0)**

| Data / Parameter | $OX_{top\_layer}$ |
|---|---|
| Unit | Dimensionless |
| Description | Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline |
| Source of data | Consistent with how oxidation is accounted for in the methodological tool "Emissions from solid waste disposal sites" |
| Value(s) applied) | 0.1 |
| Choice of data or measurement methods and procedures | - |
| Purpose of data | Baseline emissions calculation |
| Additional comment | - |

| Data / Parameter | $GWP_{CH4}$ |
|---|---|
| Unit | $tCO_2e/tCH_4$ |
| Description | Global Warming Potential of $CH_4$ |
| Source of data | IPCC |
| Value(s) applied) | 25 |
| Choice of data or measurement methods and procedures | Shall be updated according to any future COP/MOP decisions |
| Purpose of data | Baseline emissions calculation |
| Additional comment | 25 for the second commitment period. Shall be updated according to any future COP/MOP decisions |

| Data / Parameter | $\eta_{PJ}$ |
|---|---|
| Unit | Dimensionless |
| Description | Efficiency of the LFG capture system that will be installed in the project activity |
| Source of data | - |
| Value(s) applied) | 90% |
| Choice of data or measurement methods and procedures | - |
| Purpose of data | Baseline emissions calculation |
| Additional comment | Technical specification of the LFG capture system to be installed (if available) or a default value of 90% |

| **Data / Parameter** | $\varphi_{default}$ |
|---|---|
| Unit | - |
| Description | Default value for the model correction factor to account for model uncertainties |
| Source of data | - |
| Value(s) applied) | 0.75 |
| Choice of data or measurement methods and procedures | - |
| Purpose of da | Baseline emissions calculation |
| Additional comment | $\Phi_y = \varphi_{default}$. 0.75 for Application A, humid/wet conditions |

| **Data / Parameter** | **OX** |
|---|---|
| Unit | - |
| Description | Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste) |
| Source of data | Based on an extensive review of published literature on this subject, including the "IPCC 2006 Guidelines for National Greenhouse Gas Inventories" |
| Value(s) applied) | 0.1 |
| Choice of data or measurement methods and procedures | - |
| Purpose of data: | Baseline emission calculation |
| Additional comment: | - |

| **Data / Parameter** | **F** |
|---|---|
| Unit | - |
| Description | Fraction of methane in the SWDS gas (volume fraction) |
| Source of data | IPCC 2006 Guidelines for National Greenhouse Gas Inventories |
| Value(s) applied) | 0.5 |
| Choice of data or measurement methods and procedures | - |
| Purpose of data | Baseline emissions calculation |
| Additional comment | - |

| **Data / Parameter** | $DOC_{f,default}$ |
|---|---|
| Unit | Weight fraction |
| Description | Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS |
| Source of data | IPCC 2006 Guidelines for National Greenhouse Gas Inventories |
| Value(s) applied) | 0.5 |
| Choice of data or measurement methods and procedures | - |
| Purpose of data | Baseline emissions calculation |
| Additional comment | $DOC_{f,y} = DOC_{f,default}$ |

| Data / Parameter | $MCF_{default}$ |
|---|---|
| Unit | - |
| Description | Methane Correction Factor |
| Source of data | IPCC 2006 Guidelines for National Greenhouse Gas Inventories |
| Value(s) applied) | 1.0 |
| Choice of data or measurement methods and procedures | - |
| Purpose of data | Baseline emissions calculation |
| Additional comment | $MCF_y = MCF_{default}$. |

| Data / Parameter | $DOC_j$ |
|---|---|
| Unit | - |
| Description | Fraction of degradable organic carbon in the waste type *j* (weight fraction) |
| Source of data | IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 2.4 and 2.5) |
| Value(s) applied) | The following values for the different waste types *j* are applied: |

| Waste type *j* | $DOC_j$ (% wet basis) |
|---|---|
| **Wood and wood products** | 43 |
| **Pulp, paper and cardboard (other than sludge)** | 40 |
| **Food, food waste, beverages and tobacco (other than sludge)** | 15 |
| **Textiles** | 24 |
| **Garden, yard and park waste** | 20 |
| **Glass, plastic, metal, other inert waste** | 0 |

| | |
|---|---|
| Choice of data or measurement methods and procedures | - |
| Purpose of data | Baseline emissions calculation |
| Additional comment | - |

<table>
<tr><td>Data / Parameter</td><td>kj</td></tr>
<tr><td>Unit</td><td>1/yr</td></tr>
<tr><td>Description</td><td>Decay rate for the waste type j</td></tr>
<tr><td>Source of data</td><td>IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)</td></tr>
<tr><td>Value(s) applied)</td><td>The following values for the different waste types j is applied:<br><br>Default values for $k_j$
<table>
<tr><th colspan="2" rowspan="2">Waste type j</th><th>Tropical (MAT > 20°C)</th></tr>
<tr><th>Wet (MAP > 1,000 mm)</th></tr>
<tr><td rowspan="2">Slowly degrading</td><td>Pulp, paper, cardboard (other than sludge), textiles</td><td>0.07</td></tr>
<tr><td>Wood, wood products and straw</td><td>0.035</td></tr>
<tr><td>Moderately degrading</td><td>Other (non-food) organic putrescible garden and park waste</td><td>0.17</td></tr>
<tr><td>Rapidly degrading</td><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>0.40</td></tr>
</table>
Note: MAT – mean annual temperature, MAP – mean annual precipitation, PET – potential evapotranspiration. MAP/PET is the ratio between the mean annual precipitation and the potential evapotranspiration.</td></tr>
<tr><td>Choice of data or measurement methods and procedures</td><td>-</td></tr>
<tr><td>Purpose of data</td><td>Baseline emissions calculation</td></tr>
<tr><td>Additional comment</td><td>-</td></tr>
</table>

**“Project emissions from flaring” (Version 02.0.0)**

| **Data / Parameter** | **$SPEC_{flare}$** |
|---|---|
| Unit | Temperature - °C<br>Flow rate or heat flux – kg/h or $m^3/h$ |
| Description | Manufacturer’s flare specifications for temperature and flow rate and maintenance schedule |
| Source of data | Flare manufacturer |
| Value(s) applied) | Minimum and maximum operating temperature = 0 to 1,200°C<br>Minimum and maximum inlet flow rate = 0 – 2,500 $Nm^3/h$ |
| Choice of data or measurement methods and procedures | - |
| Purpose of data | Baseline emissions calculation |
| Additional comment | - |

**"Baseline, project and/ or leakage emissions from electricity consumption and monitoring of electricity generation" (Version 02.0)**

| **Data / Parameter** | **$TDL_{k,y}$** |
|---|---|
| Unit | - |
| Description | Average technical transmission and distribution losses for providing electricity to source *k* in year *y* |
| Source of data | Tenaga Nasional Berhad (TNB) Annual Report 2016[11] in page 61 |
| Value(s) applied) | 7.74% |
| Choice of data or measurement methods and procedures | Average calculated from year 2014 – 2016<br>2014 – 8.15%<br>2015 – 7.68%<br>2016 – 7.39% |
| Purpose of data | Project emissions calculation and baseline emissions |
| Additional comment | For the project emission calculation, TDL of 7.74% is applied from 2017 onwards.<br><br>7.74% is calculated from the average of TDL from year 2014 – 2016, the % of the average TDL calculated is higher if compare to TDL in year 2016. This can be concluded that the TDL 7.74% apply for project emission from 2017 onwards is considered conservative approach. |

**"Tool to calculate the emission factor for an electricity system" (Version 05.0)**

| **Data / Parameter** | **$EF_{grid,OM,y}$** |
|---|---|
| Unit | $tCO_2/MWh$ |
| Description | Operating margin emission factor for the grid in year *y* |
| Source of data | 2014 Grid connected baseline for Peninsular Malaysia by Green Tech Centre (GTC) CDM Secretariat |
| Value(s) applied) | 0.6532 |
| Choice of data or measurement methods and procedures | The $EF_{grid,OM,y}$ was calculated and published by Green Tech Centre (GTC) CDM Secretariat in 2014 using version 04.0 of the tool. For 2nd crediting period, the emission factor of 2014 is recalculated using $W_{OM}$ = 0.25 according to the "Tool to calculate the emission factor for an electricity system", version 05.0, paragraph 84 (b). |
| Purpose of data | Calculation of Combined margin emissions factor $EF_{grid,CM,y}$ |
| Additional comment | - |

11 https://www.tnb.com.my/assets/annual_report/TNB_Annual_Report_2016.pdf

| Data / Parameter | $EF_{grid,BM,y}$ |
|---|---|
| Unit | $tCO_2/MWh$ |
| Description | Build margin emission factor for the grid in year *y* |
| Source of data | 2014 Grid connected baseline for Peninsular Malaysia by Green Tech Centre (GTC) CDM Secretariat |
| Value(s) applied) | 0.7350 |
| Choice of data or measurement methods and procedures | The $EF_{grid,BM,y}$ was calculated and published by Green Tech Centre (GTC) CDM Secretariat in 2014 using version 04.0 of the tool. For 2nd crediting period, the emission factor of 2014 is recalculated using $W_{BM}$ = 0.75 according to the "Tool to calculate the emission factor for an electricity system", version 05.0, paragraph 84 (b). |
| Purpose of data | Calculation of Combined margin emissions factor $EF_{grid,CM,y}$ |
| Additional comment | - |

| Data / Parameter | $EF_{grid,CM,y}$ |
|---|---|
| Unit | $tCO_2/MWh$ |
| Description | Combined margin emission factor for the grid in year *y* |
| Source of data | 2014 Grid connected baseline for Peninsular Malaysia by Green Tech Centre (GTC) CDM Secretariat |
| Value(s) applied) | 0.7146 |
| Choice of data or measurement methods and procedures | The EFgrid,CM,y is calculated using published data by Green Tech Centre (GTC) CDM Secretariat in 2014 using version 04.0 of the tool. For 2nd crediting period, the emission factor of 2014 is recalculated according to the "Tool to calculate the emission factor for an electricity system", version 05.0 |
| Purpose of data | Baseline and project emissions calculation |
| Additional comment | - |

| **Data / Parameter** | **$MM_{H2O}$** |
|---|---|
| Unit | kg/kmol |
| Description | Molecular mass of $H_2O$ |
| Source of data | Methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" *(Version 03.0)* |
| Value(s) applied) | 18.0152 |
| Choice of data or measurement methods and procedures | - |
| Purpose of data | Baseline emissions calculation |
| Additional comment | - |

| **Data / Parameter** | **$R_U$** |
|---|---|
| Unit | $Pa.m^3/kmol.K$ |
| Description | Universal ideal gases constant |
| Source of data | Methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" *(Version 03.0)* |
| Value(s) applied) | 8,314 |
| Choice of data or measurement methods and procedures | - |
| Purpose of data | Baseline emissions calculation |
| Additional comment | - |

| **Data / Parameter** | **$MM_{CO2}$** |
|---|---|
| Unit | kg/kmol |
| Description | Molecular mass of greenhouse gas $CO_2$ |
| Source of data | Methodological tool "Tool to determine the mass flow of a greenhousegas in a gaseous stream" *(Version 03.0)* |
| Value(s) applied) | 44.01 |
| Choice of data or measurement methods and procedures | - |
| Purpose of data | Baseline emissions calculation |
| Additional comment | - |

| Data / Parameter | $MM_{CH4}$ |
|---|---|
| Unit | kg/kmol |
| Description | Molecular mass of $CH_4$ |
| Source of data | Methodological tool "Tool to determine the mass flow of a greenhousegas in a gaseous stream" *(Version 03.0)* |
| Value(s) applied) | 16.04 |
| Choice of data or measurement methods and procedures | - |
| Purpose of data | Baseline emissions calculation |
| Additional comment | - |

| Data / Parameter | $MM_{O2}$ |
|---|---|
| Unit | kg/kmol |
| Description | Molecular mass of gas $O_2$ |
| Source of data | Methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" *(Version 03.0)* |
| Value(s) applied) | 32.00 |
| Choice of data or measurement methods and procedures | - |
| Purpose of data | Baseline emissions calculation |
| Additional comment | - |

## D.2. Data and parameters monitored

**ACM0001: "Flaring or use of landfill gas – Version 18.0"**

| Data/Parameter | Management of SWDS |
|---|---|
| Unit | - |
| Description | Management of SWDS |
| Measured/calculated/ default | - |
| Source of data | Different sources of data available:<br>(a) Origin design of the landfill;<br>(b) Technical specification for the management of the SWDS; or<br>(c) Local or national regulations. |
| Value(s) of monitored parameter | Local or national regulations, the reporting is based on the environmental monitoring report submitted to Department of Environment |
| Monitoring equipment | - |
| Measuring/reading/recording frequency | Annually |
| Calculation method (if applicable) | Refer to the original design of the landfill to monitor any practice to increase methane generation during the implementation of the project activity.<br><br>Any change in the management of the SWDS after the implementation of the project activity will be justified by referring to technical or regulatory specifications. |
| QA/QC procedures | - |
| Purpose of data/parameter | - |
| Additional comments | - |

| Data / Parameter | $Op_{j,h}$ |
|---|---|
| Unit | - |
| Description | Operation of the equipment that consumes the LFG |
| Measured/calculated/default | Measured |
| Source of data | Project participant |
| Value(s) applied | On or Off for flare temperature and gas engine |
| Value(s) of monitored parameter | On or Off for flare temperature and gas engine, refer to $T_{EG,m}$ |

| Dates | Operating Time (Hr) for Flare No.2 |
|---|---|
| 01 – 30/04/2020 | 68 |
| 01 – 31/05/2020 | 77 |
| 01 – 30/06/2020 | 26 |
| 01 – 31/07/2020 | 26 |
| 01 – 31/08/2020 | 5 |
| 01 – 30/09/2020 | 0 |
| 01 – 31/10/2020 | 0 |
| 01 – 30/11/2020 | 0 |
| 01 – 31/12/2020 | 0 |
| **Total** | **201** |

Some of the operating hour for flare 2 is 0 due to the shutdown of flare 2.

<table>
<tr><td></td><td>
<table>
<tr><th rowspan="2">Dates</th><th colspan="6">Operating Time (Hr) for Gas Engines</th></tr>
<tr><th>No.1</th><th>No.2</th><th>No.3</th><th>No.4</th><th>No.5</th><th>No.6</th></tr>
<tr><td>01 – 30/04/2020</td><td>720</td><td>663</td><td>715</td><td>0</td><td>643</td><td>665</td></tr>
<tr><td>01 – 31/05/2020</td><td>720</td><td>719</td><td>73</td><td>291</td><td>464</td><td>470</td></tr>
<tr><td>01 – 30/06/2020</td><td>706</td><td>614</td><td>614</td><td>471</td><td>573</td><td>577</td></tr>
<tr><td>01 – 31/07/2020</td><td>685</td><td>193</td><td>599</td><td>395</td><td>685</td><td>683</td></tr>
<tr><td>01 – 31/08/2020</td><td>713</td><td>670</td><td>667</td><td>618</td><td>717</td><td>717</td></tr>
<tr><td>01 – 30/09/2020</td><td>679</td><td>520</td><td>588</td><td>675</td><td>644</td><td>639</td></tr>
<tr><td>01 – 31/10/2020</td><td>735</td><td>554</td><td>485</td><td>739</td><td>736</td><td>737</td></tr>
<tr><td>01 – 30/11/2020</td><td>674</td><td>650</td><td>657</td><td>631</td><td>640</td><td>633</td></tr>
<tr><td>01 – 31/12/2020</td><td>725</td><td>618</td><td>613</td><td>730</td><td>729</td><td>704</td></tr>
<tr><td>Total</td><td>6,356</td><td>5,201</td><td>5,011</td><td>4,551</td><td>5,831</td><td>5,825</td></tr>
</table>
Some operating hour is 0 due to shutdown of engines.
</td></tr>
<tr><td>Monitoring equipment</td><td>-</td></tr>
<tr><td>Measuring/reading/recording frequency</td><td>Hourly</td></tr>
<tr><td>Calculation method (if applicable)</td><td>For each equipment unit using the LFG monitor that the plant is operating in hour h by the monitoring any one or more of the following three parameters:<br>• Temperature – Determine the location for temperature measurements and minimum operational temperature based on the manufacturer’s specifications of the burning equipment. Document and justify the location and minimum threshold in the PDD;<br>• Flame – Flame detection system is used to ensure that the equipment is in operation;<br>• Products generated. Monitor the generation of steam for the case of boilers and air-heaters and glass for the case of glass melting furnaces. This option is not applicable to brick kilns<br><br>Flare temperature will be selected for monitoring. Gas engine operation hours will be used for cross-checking.<br><br>Opj,h = 0 when:<br>• One of more temperature measurements are missing or below the minimum threshold in hour h (instantaneous measurements are made at least every minute); or<br>• Flame is not detected continuously in hour h (instantaneous measurements are made at least every minute).<br>• No products are generated in the hour h.<br>• If gas engine not in operation.<br><br>Otherwise, Opj,h = 1.</td></tr>
<tr><td>QA/QC procedures</td><td>The operation of the equipment that consumes the LFG will be monitored using temperature. The parameter will be measured continuously using a temperature transmitter. The transmitter sensor is installed at the middle top of the enclosed flare stack. Minimum operational temperature in the exhaust gas of the enclosed flare is 500°C. The exhaust gas from the enclosed flares is expected to be in the range of 800-1,200°C. Temperatures above 500°C indicate that the flare is operated in a reliable way where the default value of destruction efficiency of 90% is valid. Temperature transmitter shall be tested, calibrated, and maintained</td></tr>
</table>

| | |
|---|---|
| | regularly. The detailed information on the temperature is described under $T_{EG,m.}$<br><br>The other method to cross-check with the temperature is the operation of gas engines. The operating hour for gas engines is based on actual documented operating hours from site. |
| Purpose of data/parameter | Baseline emissions calculation |
| Additional comment | - |

| **Data / Parameter** | $EG_{PJ,y}$ ($EL_{LFG,GE\ No.1,y}$, $EL_{LFG,GE\ No.2,y}$, $EL_{LFG,GE\ No.3,y}$, $EL_{LFG,GE\ No.4,y}$, $EL_{LFG,GE\ No.5,y}$, $EL_{LFG,GE\ No.6,y}$) |
|---|---|
| Unit | MWh |
| Description | Amount of electricity generated using LFG by the project activity in year *y* |
| Measured/calculated/default | Measured |
| Source of data | Data as measured by electricity meters.<br><br>This parameter was measured separately for the gas engines, i.e. Gas Engine No.1 (1 meter), Gas Engine No.2 and No.3 (1 meter), and Gas Engine No.4, Gas Engine No.5, and Gas Engine No.6 (1 meter). Therefore, three (3) sets of equipment have to be used for the monitoring period. |
| Value(s) of monitored parameter | Electricity meters will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. The readings will be double-checked by the electricity distribution company.<br><br>As a quality control procedure, the amount of electricity uploaded to the grid will be measured by other electricity meters (EL5, EL11, and EL16) and compared with the net amount derived from above. The lower value of the amount will be taken as the net amount for emission reduction calculations. The comparison is tabulated as below: |

| **Electricity Meter** | |
|---|---|
| **Installed on-site** | **Owned by Grid Operator** |
| EL4 | EL5 |
| EL9, and EL10 | EL11 |
| EL12, EL14, and EL15 | EL16 |

In the case of a temporary situation where EL16 malfunctions leading to no readings captured, the power generated and uploaded to the grid for Gas Engine No.4, Gas Engine No.5, and Gas Engine No.6 will use the reading captured by EL12, EL14, and EL15. The recorded reading shall be derived based on 95% confidence interval principles (source: "IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories", page 6.6). The lower bound of a 95% confidence interval with reference to the above-mentioned guideline will be applied. An additional 10% will be deducted to the lower bound of the interval boundaries calculated to account for transmission and distribution losses, according to paragraph 231 b) (ii) of "CDM Project Standard for CDM project activities" (Version 02.0).

The detailed calculation was shown in the CER calculation sheet under each monthly '$EL_{PJ}$' tab.

| Dates | Net electricity generated (MWh) $EG_{PJ,y}$ | | | Total amount of electricity generated (MWh) |
|---|---|---|---|---|
| | $EL_{LFG,GE\ No.1,y}$ | $EL_{LFG,GE\ No.2,y}$ & $EL_{LFG,GE\ No.3,y}$ | $EL_{LFG,GE\ No.4,y}$& $EL_{LFG,GE\ No.5,y}$& $EL_{LFG,GE\ No.6,y}$ | |
| 01 – 30/04/2020 | 537.10 | 1,270.89 | 2,206.02 | 4,014.01 |
| 01 – 31/05/2020 | 509.06 | 724.65 | 1,853.66 | 3,087.38 |
| 01 – 30/06/2020 | 559.85 | 1,031.21 | 2,235.36 | 3,826.42 |
| 01 – 31/07/2020 | 464.05 | 734.68 | 2,356.99 | 3,555.72 |
| 01 – 31/08/2020 | 566.95 | 1,067.46 | 2,842.98 | 4,477.39 |
| 01 – 30/09/2020 | 523.25 | 911.77 | 2,805.72 | 4,240.74 |
| 01 – 31/10/2020 | 670.95 | 966.23 | 3,202.95 | 4,840.14 |
| 01 – 30/11/2020 | 636.80 | 1,245.69 | 2,485.23 | 4,367.72 |
| 01 – 31/12/2020 | 687.93 | 1,226.79 | 2,675.96 | 4,590.68 |
| **Total** | **5,155.95** | **9,179.37** | **22,664.87** | **37,000.19** |

According to CDM Project Standard for Project Activities, version 2.0, Section 8.3.5, Paragraph 241 (a) (i) (a), the CERs estimated (2019 – 2023) above for the increased capacity of 4MW gas engines is only claimed up to 20% (additional 1.1 MW) of the upload capacity stated in original registered PDD (5.5MW). The total maximum upload capacity of 6.6MW is deducted using the actual electricity generated divided by the operation hour.

During this monitoring period, the total power upload to the grid (MW) is calculated by multiplying the total power upload to the grid (MWh) with the corresponding operating hours of the gas engines (hr). The periods whereby the total power upload to the grid (MW) exceed 6.6MW are identified. The total power upload to the grid for Aug 2020, Oct 2020, Nov 2020, and Dec 2020 have exceeded 6.6MW. As a result, the additional MW generated from GE No. 4, GE No. 5, and GE No. 6 is deducted from the calculation. The net electricity generated for Aug 2020, Oct 2020, Nov 2020, and Dec 2020 is applied in the CER sheet.

Monitoring equipment

| Item | $EG_{PJ,y}$ ($EL_{LFG,GE\ No.1,y}$) Description (EL4) | $EG_{PJ,y}$ ($EL_{LFG,GE\ No.1,y}$) Description (EL5) | |
|---|---|---|---|
| | 01/04/2020 – 31/12/2020 | 01/04/2020 – 31/12/2020 | |
| | | Main meter | Check meter |
| Type | EDMI Genius Power Meter | Itron (SL761A071) Power Meter | |
| Accuracy class | Class 0.5S | Class 0.20 | |
| Serial No. | 210225256 | 53099690 | 53099691 |
| Calibration frequency | 24 months | 5 years | |
| Date of last calibration | 14/03/2019 | 01/04/2011 | |
| Validity | 24 months | 5 years (Type 2 according to the Malaysian Grid Code, version 1/2010) | |

According to VVS, version 2.0, paragraph 368, page 65:

EL5 (Itron, serial no.: 53099690) – The meter is owned by the grid operator, TNB and thus, it is not within the control of the project owner. However, due to delay in calibration, the maximum permissible error of ±0.2% which is the equipment accuracy error was applied to EL5 from 01/04/2020 – 31/12/2020 as a conservative approach.

| Item | $EG_{PJ,y}$ ($EL_{LFG,GE\ No.2,y}$) Description (EL9) | | $EG_{PJ,y}$ ($EL_{LFG,GE\ No.3,y}$) Description (EL10) | |
|---|---|---|---|---|
| | 01/04/2020 – 08/12/2020 | 09/12/2020 – 31/12/2020 | 01/04/2020 – 08/12/2020 | 09/12/2020 – 31/12/2020 |
| Type | EDMI Limited (Genius) Power Meter | | EDMI Limited (Genius) Power Meter | |
| Accuracy class | Class 0.5S | | Class 0.5S | |
| Serial No. | 211516862 | | 211516863 | |
| Calibration frequency | 24 months | | 24 months | |
| Date of last calibration | 25/01/2018 | | 25/01/2018 | |
| Date of current calibration | 09/12/2020 | | 09/12/2020 | |
| Validity | 24 months | | 24 months | |

According to VVS, version 2.0, paragraph 366 (a), page 65:

EL9 and EL10 was calibrated on 09/12/2020. The equipment calibration error for EL9 and EL10 is 0.13% and 0.27% respectively. The equipment accuracy error for EL9 and EL10 is 0.5% which is higher than the equipment calibration error. As a result, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL9 and EL10 from 01/04/2020 – 08/12/2020 as a conservative approach.

| Item | $EG_{PJ,y}$ ($EL_{LFG,y}$) Description (EL11) | |
|---|---|---|
| | 01/04/2020 – 31/12/2020 | |
| | Main energy meter | Check energy meter |
| Type | EDMI (Mk6E) Power Meter | |
| Accuracy class | Class 0.5S | |
| Serial No. | 908705152 | 908705154 |
| Calibration frequency | 5 years | |
| Date of last calibration | 06/12/2009 | |
| Validity | 5 years (Type 2 according to the Malaysian Grid Code, version 1/2010) | |

According to VVS, version 2.0, paragraph 368, page 65:

EL 11 (EDMI Limited, serial no.: 908705152) – The meter is owned by the grid operator, TNB and thus, it is not within the control of the project owner. However, due to delay in calibration, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL11 from 01/04/2020 – 31/12/2020 as a conservative approach.

| Item | $EG_{PJ,y}$ ($EL_{LFG,GE\ No.4,y}$) Description (EL12) |
|---|---|
| | **01/04/2020 – 31/12/2020** |
| Type | EDMI Limited (2000-6N00-30A31-04-L00-02A2-1D) Power Meter |
| Accuracy class | Class 0.5S |
| Serial No. | 213545834 |
| Calibration frequency | 24 months |
| Date of last calibration | 08/08/2018 |
| Date of current calibration | 09/12/2020 |
| Validity | 24 months |

According to VVS, version 2.0, paragraph 366 (a), page 65:

EL12 was calibrated on 09/12/2020. The equipment calibration error for EL12 is 0.13%. The equipment accuracy error for EL12 is 0.5% which is higher than the equipment calibration error. As a result, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL12 from 07/08/2020 – 08/12/2020 as a conservative approach.

| Item | $EG_{PJ,y}$ ($EL_{LFG,GE\ No.5,y}$) Description (EL14) | | $EG_{PJ,y}$ ($EL_{LFG,GE\ No.6,y}$) Description (EL15) | |
|---|---|---|---|---|
| | **01/04/2020 – 08/12/2020** | **09/12/2020 – 31/12/2020** | **01/04/2020 – 08/12/2020** | **09/12/2020 – 31/12/2020** |
| Type | Mk6N Genius EDMI | | Mk6N Genius EDMI | |
| Accuracy class | Class 0.5S | | Class 0.5S | |
| Serial No. | 218287221 | | 218287222 | |
| Calibration frequency | 24 months | | 24 months | |
| Date of last calibration | 27/04/2018 | | 27/04/2018 | |
| Date of current calibration | 09/12/2020 | | 09/12/2020 | |
| Validity | 24 months | | 24 months | |

According to VVS, version 2.0, paragraph 366 (a), page 65:

EL14 and EL15 was calibrated on 09/12/2020. The equipment calibration error for EL14 and EL15 are 0.05% and 0.13% respectively. The equipment accuracy error for EL14 and EL15 is 0.5% which is higher than the equipment calibration error. As a result, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL14 from 26/04/2020 – 08/12/2020 as a conservative approach.

<table>
<tr><td></td><td>
<table>
<tr><td rowspan="3">Item</td><td colspan="2">$EG_{PJ,y}$ ($EL_{LFG,y}$) Description (EL16)</td></tr>
<tr><td colspan="2">01/04/2020 – 31/12/2020</td></tr>
<tr><td>Main energy meter</td><td>Check energy meter</td></tr>
<tr><td>Type</td><td colspan="2">Genius (MK6E)</td></tr>
<tr><td>Accuracy class</td><td colspan="2">Class 0.5S</td></tr>
<tr><td>Serial No.</td><td>918703332</td><td>918703333</td></tr>
<tr><td>Calibration frequency</td><td colspan="2">5 years</td></tr>
<tr><td>Date of last calibration</td><td>11/05/2019</td><td>11/05/2019</td></tr>
<tr><td>Date of current calibration</td><td>12/08/2020</td><td>12/08/2020</td></tr>
<tr><td>Validity</td><td colspan="2">5 years (Type 2 according to the Malaysian Grid Code, version 1/2010)</td></tr>
</table>
</td></tr>
<tr><td>Measuring/reading/recording frequency</td><td>Measured continuously with electricity meter installed</td></tr>
<tr><td>Calculation method (if applicable)</td><td>N/A</td></tr>
<tr><td>QA/QC procedures</td><td>Electricity meters (except the meters owned by the grid operator, i.e. EL4, EL9, EL10, EL12, EL14, and EL15) will be checked and calibrated regularly according to manufacturer’s recommendations.<br><br>The meters EL5, EL11, and EL16 are owned by the grid operator and thus, they are not within the control of the project owner. The calibration of these meters will be based on the grid operator’s requirement and standard practice.</td></tr>
<tr><td>Purpose of data/parameter</td><td>Baseline emissions calculation</td></tr>
<tr><td>Additional comment</td><td>This parameter is required for calculating baseline emissions associated with electricity generation ($BE_{EC,y}$) using the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”.<br><br>The meters EL5, EL11, and EL16 are owned by the grid operator and thus, they are not within the control of the project. The calibration of the meters will be based on the grid operator’s requirement and standard practice.</td></tr>
</table>

| **Data / Parameter** | **$EG_{EC,y}$** |
|---|---|
| Unit | MWh |
| Description | Amount of electricity consumed by the project activity in year *y* |
| Measured/calculated/default | Measured |
| Source of data | The consumption of electricity ex-post will be measured by ammeters (electricity meters).<br><br>The quantity of electricity consumed by project activity will be recorded by installed electricity meter EL6 which measured the total electricity consumed by the project activity (Flare 2, Gas Engine No.1, Gas Engine No.2, Gas Engine No.3, Gas Engine No.4, Gas Engine No.5, Gas Engine No.6, GSS No.1, GSS No.2, GSS No.3 and GSS F1)<br><br>In case of temporary situation such as the installed electricity meter mal-functioned (EL6) leading to no readings captured, **$EG_{EC,y}$** shall be estimated or calculated as described as below: |

1. Using the backup meter EL1 which recorded the actual power consumption for Flare 2 and GSSF1;
2. For Gas Engine No. 2, Gas Engine No.3, Gas Engine No.4, Gas Engine No.5, Gas Engine No.6, GSS No.1 GSS No.2, and GSS No.3, the power consumption will be estimated using the power rating (technical specifications) of the system involved during the power generation. The power consumed will be calculated based on the operating maximum capacity for the full period, including the 10% addition to account for transmission and distribution losses, according to PRC-2467-02. In the case of project GHG emissions related to the consumption of electricity, the estimate shall include an addition of 10% to account for transmission and distribution losses.

In the case of a temporary situation where EL1 malfunctions leading to no readings captured, the power consumption for Flare 2 and GSS F1 will use the estimated historical data (Sept 2014 to Aug 2016) of 56.93 MWh per month and compared with the calculated future 24 months' data prior to the malfunction period and, whichever value that is higher will be applied for the project emissions calculation.

The higher power consumption selected for the project emission calculation shall be derived based on 95% confidence interval principles (source: "IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories", page 6.6). The upper bound of 95% confidence interval with reference to the above-mentioned guideline to be applied. Additional 10% will be added to the upper bound of the interval boundaries calculated to account for transmission and distribution losses, according to PRC-2467-02. In the case of project GHG emissions related to the consumption of electricity, the estimate shall include an addition of 10% to account for transmission and distribution losses.

Value(s) of monitored parameter

| Dates | Electricity consumed $EG_{EC,y}$ (EL6) (MWh) |
|---|---|
| 01 – 30/04/2020 | 270.54 |
| 01 – 31/05/2020 | 240.07 |
| 01 – 30/06/2020 | 286.78 |
| 01 – 31/07/2020 | 331.62 |
| 01 – 31/08/2020 | 321.23 |
| 01 – 30/09/2020 | 292.47 |
| 01 – 31/10/2020 | 316.66 |
| 01 – 30/11/2020 | 295.74 |
| 01 – 31/12/2020 | 301.13 |
| **Total** | **2,656.23** |

<table>
<tr><td>Monitoring equipment</td><td>
<table>
<tr><th>Item</th><th>Electricity consumed from grid for project activity<br>$EG_{EC,y}$ ($EL_{PJ,y}$) (EL6) (MWh)<br>01/04/2020 – 31/12/2020</th></tr>
<tr><td>Type</td><td>IME NEMO 96HO+<br>Power Meter</td></tr>
<tr><td>Accuracy class</td><td>Class 0.5S</td></tr>
<tr><td>Serial No.</td><td>2661930098</td></tr>
<tr><td>Calibration frequency</td><td>36 months</td></tr>
<tr><td>Date of last calibration</td><td>25/01/2018</td></tr>
<tr><td>Validity</td><td>3 years according to manufacturer’s recommendation</td></tr>
</table>
</td></tr>
<tr><td>Measuring/reading/recording frequency</td><td>Continuous measurement</td></tr>
<tr><td>Calculation method (if applicable)</td><td>N/A</td></tr>
<tr><td>QA/QC procedures</td><td>Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. The readings will be double-checked by the electricity distribution company</td></tr>
<tr><td>Purpose of data/parameter</td><td>Project emission calculation</td></tr>
<tr><td>Additional comment</td><td>This parameter is required for calculating project emissions from electricity consumption due to an alternative waste treatment process t ($PE_{EC,y}$) using the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”</td></tr>
</table>

<table>
<tr><td>Data / Parameter</td><td>$f_y$</td></tr>
<tr><td>Unit</td><td>-</td></tr>
<tr><td>Description</td><td>Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year y</td></tr>
<tr><td>Measured/calculated/default</td><td></td></tr>
<tr><td>Source of data</td><td>Onsite records of the gas analyzers.</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><th>Dates</th><th>Flare No.2 Value (%)</th><th>GSS1 Value (%)</th><th>GSS2 Value (%)</th><th>GSS3 Value (%)</th><th>GSSF1 Value (%)</th></tr>
<tr><td>01 – 30/04/2020</td><td>0.60</td><td>0.61</td><td>0.00</td><td>0.63</td><td>0.64</td></tr>
<tr><td>01 – 31/05/2020</td><td>0.64</td><td>0.63</td><td>0.60</td><td>0.65</td><td>0.64</td></tr>
<tr><td>01 – 30/06/2020</td><td>0.65</td><td>0.60</td><td>0.58</td><td>0.57</td><td>0.63</td></tr>
<tr><td>01 – 31/07/2020</td><td>0.61</td><td>0.65</td><td>0.60</td><td>0.56</td><td>0.61</td></tr>
<tr><td>01 – 31/08/2020</td><td>0.61</td><td>0.57</td><td>0.56</td><td>0.57</td><td>0.63</td></tr>
<tr><td>01 – 30/09/2020</td><td>0.00</td><td>0.62</td><td>0.59</td><td>0.57</td><td>0.62</td></tr>
<tr><td>01 – 31/10/2020</td><td>0.00</td><td>0.59</td><td>0.61</td><td>0.58</td><td>0.62</td></tr>
<tr><td>01 – 30/11/2020</td><td>0.00</td><td>0.59</td><td>0.64</td><td>0.60</td><td>0.62</td></tr>
<tr><td>01 – 31/12/2020</td><td>0.00</td><td>0.59</td><td>0.61</td><td>0.59</td><td>0.62</td></tr>
<tr><td>Average</td><td>0.62</td><td>0.60</td><td>0.60</td><td>0.59</td><td>0.62</td></tr>
</table>
Some of the CH4 readings are 0 is due to the shutdown of flare 2 and gas engines.
</td></tr>
<tr><td>Monitoring equipment</td><td></td></tr>
<tr><td>Measuring/reading/recording frequency</td><td>For application A: Once for the crediting period ($f_y = f$)</td></tr>
<tr><td>Calculation method (if applicable)</td><td>N/A</td></tr>
<tr><td>QA/QC procedures</td><td>-</td></tr>
<tr><td>Purpose of data/parameter</td><td>Baseline emissions calculation</td></tr>
<tr><td>Additional comment</td><td>This is for reporting purposes, and not applied in the ER calculation</td></tr>
</table>

<table>
<tr><td>Data / Parameter</td><td>$T_{EG,m}$ ($T_{Flare,F2}$)</td></tr>
<tr><td>Unit</td><td>°C</td></tr>
<tr><td>Description</td><td>Temperature in the exhaust gas of the enclosed flare in minute m</td></tr>
<tr><td>Measured/calculated/default</td><td>Measured</td></tr>
<tr><td>Source of data</td><td>Project participant</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><th>Dates</th><th>$T_{EG,m}$ ($T_{Flare,F2}$) (°C)</th></tr>
<tr><td>01 – 30/04/2020</td><td>741.85</td></tr>
<tr><td>01 – 31/05/2020</td><td>692.38</td></tr>
<tr><td>01 – 30/06/2020</td><td>823.12</td></tr>
<tr><td>01 – 31/07/2020</td><td>647.28</td></tr>
<tr><td>01 – 31/08/2020</td><td>623.12</td></tr>
<tr><td>01 – 30/09/2020</td><td>0.00</td></tr>
<tr><td>01 – 31/10/2020</td><td>0.00</td></tr>
<tr><td>01 – 30/11/2020</td><td>0.00</td></tr>
<tr><td>01 – 31/12/2020</td><td>0.00</td></tr>
<tr><td>Average</td><td>705.55</td></tr>
</table>
Some of the temperatures in the exhaust gas is zero due to the shutdown of flare 2.
</td></tr>
<tr><td>Monitoring equipment</td><td>
<table>
<tr><th rowspan="2">Item</th><th>$T_{EG,m}$ ($T_{Flare,F2}$) Description</th></tr>
<tr><th>01/04/2020 – 31/12/2020</th></tr>
<tr><td>Type</td><td>Honeywell (STT25M-0-EN0-000-000-000-00 3D) Temperature Transmitter</td></tr>
<tr><td>Accuracy class</td><td>± 0.5% of span</td></tr>
<tr><td>Serial No.</td><td>B838901937</td></tr>
<tr><td>Calibration frequency</td><td>Annually</td></tr>
<tr><td>Date of last calibration</td><td>18/09/2019</td></tr>
<tr><td>Date of current calibration</td><td>14/12/2020</td></tr>
<tr><td>Validity</td><td>1 year</td></tr>
</table>
According to VVS, version 2.0, paragraph 366 (a), page 65:<br><br>TT3 was calibrated on 14/12/2020. The equipment calibration error is 0.05%. The equipment accuracy error for TT3 is 0.5% which is higher than the equipment calibration error. As a result, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to TT3 from 17/09/2020 – 13/12/2020 as a conservative approach. There is no impact to the flare data as during these periods, shutdown was observed.
</td></tr>
<tr><td>Measuring/reading/recording frequency</td><td>Once per minute</td></tr>
<tr><td>Calculation method (if applicable)</td><td>Measure the temperature of the exhaust gas in the flare by an appropriate temperature measurement equipment.<br><br>The temperature of the exhaust gas in the flares is measured by temperature transmitters.</td></tr>
</table>

| | |
|---|---|
| | The exhaust gas from the enclosed flares is expected to be in the range of 800 – 1,200°C. Temperatures above 500°C indicate that the flare is operated in a reliable way where the default value of destruction efficiency of 90% is valid. Minimum operational temperature in the exhaust gas of the enclosed flare is 500°C. |
| QA/QC procedures | Temperature measurement equipment is calibrated in accordance with the maintenance schedule |
| Purpose of data/parameter | Baseline emissions calculation |
| Additional comment | Any unexpected changes such as a sudden increase/drop in temperature will be noted in the site records along with any corrective action that was implemented to correct the issue. Monitoring of this parameter is applicable in case of enclosed flares. Measurements are required to determine if manufacturer's flare specifications for operating temperature are met |

| **Data / Parameter** | **$Flame_m$** |
|---|---|
| Unit | Flame on or Flame off |
| Description | Flame detection of flare in the minute *m* |
| Measured/calculated/default | Measured |
| Source of data | Project participant |
| Value(s) of monitored parameter | On or Off, refer to $\mathbf{V_{t,wb}}$ |
| Monitoring equipment | Fixed installation optical flame detector: Ultra-violet detector |
| Measuring/reading/recording frequency | Once per minute. Detection of flame recorded as a minute that the flame was on, otherwise recorded as a minute that the flame was off. |
| Calculation method (if applicable) | Measured using a fixed installation optical flame detector: Ultra Violet detector |
| QA/QC procedures | The flame detection will be monitored and cross checked with the amount of gas sent to flare (FT2) and gas engine (FT3). If there is data for FT2 and FT3, means the flame is on. Equipment will be maintained and calibrated in accordance with manufacturer's recommendations |
| Purpose of data/parameter | Baseline emissions calculation |
| Additional comment | Applicable to all flares |

| **Data / Parameter** | **$V_{t,wb}$ ($LFG_{Flare,\ Flare\ No.2,y}$, $LFG_{53lectricity,GSS1,y}$, $LFG_{53lectricity,GSS2,y}$ $LFG_{53lectricity,GSSF1,y}$, $LFG_{53lectricity,GSS3,y}$)** |
|---|---|
| Unit | $m^3$ wet gas/h |
| Description | Volumetric flow of the gaseous stream in time interval *t* on a wet basis |
| Measured/calculated/default | Measured |
| Source of data | Onsite records of the flow meters. There is an independent flow meter to measure the gas sent to Flare 2 (FT1F2 & FT2F2), GSS1 (FT3GSS1), GSS2 (FT3GSS2), GSS3 (FT3GSS3) and GSS F1 (FT3GSSF1).<br><br>There are two (2) sets of flow meter to measure the gas sent to Gas Engine No.4, Gas Engine No.5 and Gas Engine No. 6. 1st set of the meter will measure the total amount of gas sent to GSS2 ($FT3_{GSS2}$) and GSS3 ($FT3_{GSS3}$) before sent to respective gas engines. Another set of the meter will measure the total amount of gas sent to specific Gas Engine No. 4 (FT7), Gas Engine No. 5 (FT8) and Gas Engine No. 6 (FT9). In the case of temporary situation where $FT3_{GSS2}$ or $FT3_{GSS3}$ malfunctions leading to no readings captured, the flow of gas sent to gas engines will use the reading captured by respective flow meter (FT7, FT8 and FT9). The recorded reading shall be derived based on 95% confidence interval principles (source: "IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories", page 6.6). The lower bound of 95% confidence interval with reference to the above-mentioned guideline will be applied. Alternately, the record from the daily manual log-sheet will be used to calculate the lower bound of 95% confidence interval. The lower bound of the interval boundaries calculated will be applied to the period for the constant data as a conservative approach.<br><br>There are two (2) sets of flow meter ($FT1_{F2}$ & $FT2_{F2}$) to measure the gas sent to Flare 2. Flow obtained from $FT2_{F2}$ will be used for the calculation. During temporary malfunctioning of $FT2_{F2}$ or data logging system resulting in unrepresentative data, the value of $FT1_{F2}$ will be used for the calculation.<br><br>According to CDM Project Standard for Project Activities, version 2.0, Section 8.3.5, Paragraph 241 (a) (i) (a), the CERs estimated (2019 – 2023) above for the increase capacity of 4MW gas engines is only claimed up to 20% (additional 1.1 MW) of the upload capacity stated in original registered PDD (5.5MW).<br><br>In the case of the total actual electricity uploaded to grid is more than 6.6MW, the additional flow will be deducted from the calculation. The additional flow (from any of the flow meters) will be calculated based on the MWh calculated in $EG_{PJ,y}$ by using the estimated unit amount of $m^3$ to produce the additional electricity generation. |
| Value(s) of monitored parameter | ***$LGF_{total}$ – Total amount of LFG sent to flare/captured during the project at normal temperature and pressure:***<br><br>**Flare No.2**<br>According to ACM0001, version 18, page 15, if the LFG is used for multiple purposes (e.g. flaring or energy generation), and all methane destruction devices are verified to be operational (e.g. by means of flame detector records, energy generated), a single flow meter may be used to record the flow into multiple destruction devices. |

However, as Gas Engine No.1 was converted to GSSF1 which started to operate on 01/06/2017, only one flow meter (FT2) remained for Flare No. 2, therefore, no comparison was done started from June 17 onwards.

| Dates | $V_{t,wb}$ ($LFG_{Flare,Flare\ No.2,y}$) $FT_{2,\ Flare\ No.2}$ ($Nm^3$) |
|---|---|
| 01 – 30/04/2020 | 63,640.43 |
| 01 – 31/05/2020 | 51,110.35 |
| 01 – 30/06/2020 | 21,123.03 |
| 01 – 31/07/2020 | 14,953.98 |
| 01 – 31/08/2020 | 2,909.42 |
| 01 – 30/09/2020 | 0.00 |
| 01 – 31/10/2020 | 0.00 |
| 01 – 30/11/2020 | 0.00 |
| 01 – 31/12/2020 | 0.00 |
| **Total** | **153,737** |

Some of the FT2 reading is 0 is due to the shutdown of flare.

**GSSF1 (Gas Engine No.1), GSS1 (Gas Engine No.2 and 3), GSS2 (Gas Engine No.4) and GSS3 (Gas Engine No.5 and No.6)**

According to ACM0001, version 18, page 15, if the LFG is used for multiple purposes (e.g. flaring or energy generation), and all methane destruction devices are verified to be operational (e.g. by means of flame detector records, energy generated), a single flow meter may be used to record the flow into multiple destruction devices. In the case where LFG is just sent to the power plants (gas engines) for electricity generation, one flow meter can be used provided that these meters used are calibrated periodically by an officially accredited entity. The total LFG captured was the same as the total LFG sent to the gas engines for GSS F1, GSS1, GSS2, and GSS3 respectively during the monitoring period.

| Dates | $V_{t,\ wb}$ ($LFG_{electrcity,GSS1,y}$) $FT_{3,\ GSS1}$ ($Nm^3$) | $V_{t,\ wb}$ ($LFG_{electrcity,GSS2,y}$) $FT_{3,\ GSS2}$ ($Nm^3$) | $V_{t,\ wb}$ ($LFG_{54lectricity,\ GSS3\ \ ,y}$) $FT_{3,\ GSS3}$ ($Nm^3$) | $V_{t,\ wb}$ ($LFG_{54lectricity,GSSF1,y}$) $FT_{3,\ GSSF1}$ ($Nm^3$) |
|---|---|---|---|---|
| 01 – 30/04/2020 | 836,477 | 0 | 1,313,141 | 429,997 |
| 01 – 31/05/2020 | 443,888 | 241,476 | 702,245 | 374,178 |
| 01 – 30/06/2020 | 694.084 | 347,345 | 780,442 | 376,162 |
| 01 – 31/07/2020 | 456,215 | 211,764 | 1,040,717 | 288,459 |
| 01 – 31/08/2020 | 756,906 | 370,625 | 1,229,177 | 409,623 |
| 01 – 30/09/2020 | 606,855 | 462,682 | 936,597 | 347,314 |
| 01 – 31/10/2020 | 652,694 | 537,818 | 1,226,828 | 469,061 |
| 01 – 30/11/2020 | 744,657 | 454,080 | 984,937 | 386,817 |
| 01 – 31/12/2020 | 743,588 | 523,816 | 1,048,905 | 424,988 |
| **Total** | **5,935,363** | **3,149,606** | **9,262,990** | **3,506,599** |

The reading for FT3 GSS2 is 0 is due to the shutdown of gas engine (major overhaul).

Monitoring equipment

| Item | Flare No.2, $LFG_{flare,Flare\ No.2,y}$ ($FT_{1,\ Flare\ No.2}$) | |
|---|---|---|
| | 01/04/2020 – 13/12/2020 | 14/12/2020 – 31/12/2020 |
| Type | Flow transmitter – Rosemount<br>Differential Pressure Transmitter – Kingways Control Vcone | |
| Accuracy class | ± 1% | |
| Serial No. | 4972946 (Rosemount) / FT119 (8102101) (Kingways) | |
| Calibration frequency | 24 months | |
| Date of last calibration | 04/06/2018 | |
| Date of current calibration | 14/12/2020 | |
| Validity | 24 months | |

**Flare 2**

According to VVS, version 2.0, paragraph 366 (a), page 65:

FT1 was calibrated on 14/12/2020. The equipment calibration error is 0.05%. The equipment accuracy error for FT1 is 1.0% which is higher than the equipment calibration error. As a result, the maximum permissible error of ±1.0% which is the equipment accuracy error was applied to FT1 from 03/06/2020 – 13/12/2020 as a conservative approach. There is no impact to the CER sheet due to FT1 is a backup meter in case FT2 malfunction, there is no malfunction of FT2 during this monitoring period.

| Item | Flare No.2, $LFG_{flare,Flare\ No.2,y}$ ($FT_{2,\ Flare\ No.2}$) | |
|---|---|---|
| | 01/04/2020 – 13/12/2020 | 14/12/2020 – 31/12/2020 |
| Type | Flow transmitter – Rosemount<br>Differential Pressure Transmitter – Kingways Control Vcone | |
| Accuracy class | ± 0.5% | |
| Serial No. | 5476627 (Rosemount)<br>/ FT140 (10031701) (Kingways) | |
| Calibration frequency | 24 months | |
| Date of last calibration | 04/06/2018 | |
| Date of current calibration | 14/12/2020 | |
| Validity | 24 months | |

**Flare 2**

According to VVS, version 2.0, paragraph 366 (a), page 65:

FT2 was calibrated on 14/12/2020. The equipment calibration error is 0.03%. The equipment accuracy error for FT2 is 0.5% which is higher than the equipment calibration error. As a result, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to FT2 from 03/06/2020 – 13/12/2020 as a conservative approach. There is no impact to the flare data as during these periods, shutdown was observed.

| Item | GSS1, $LFG_{electricity,GSS1,y}$ ($FT_{3, GSS1}$) | |
|---|---|---|
| | 01/04/2020 – 13/12/2020 | 14/12/2020 – 31/12/2020 |
| Type | Flow transmitter – Rosemount | |
| Accuracy class | ± 0.5% | |
| Serial No. | 5988022 | |
| Calibration frequency | 24 months | |
| Date of last calibration | 11/10/2018 | |
| Date of current calibration | 14/12/2020 | |
| Validity | 24 months | |

**GSS 1**

According to VVS, version 2.0, paragraph 366 (a), page 65:

FT3 was calibrated on 14/12/2020. The equipment calibration error is 0.1%. The equipment accuracy error for FT3 is 0.5% which is higher than the equipment calibration error. As a result, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to FT3 from 10/10/2020 – 13/12/2020 as a conservative approach.

| Item | GSS2, $LFG_{electricity,GSS2,y}$ ($FT_{3, GSS2}$) |
|---|---|
| | 01/04/2020 – 31/12/2020 |
| Type | Flow transmitter – Binder |
| Accuracy class | ± 2.5% of reading + 0.2% of full scale |
| Serial No. | C150327 |
| Calibration frequency | 24 months |
| Date of last calibration | 10/12/2018 |
| Date of current calibration | 19/02/2021 |
| Validity | 24 months |

**GSS 2**

According to VVS, version 2.0, paragraph 366 (a), page 65:

FT3 was tested on 19/02/2021. The percentage error is 1.2%. The equipment accuracy error for FT3 is 2.7% which is higher than the equipment testing error. As a result, the maximum permissible error of ±2.7% which is the equipment accuracy error was applied to FT3 from 09/12/2020 – 31/12/2020 as a conservative approach**.**

| Item | Gas Engine No. 4 $LFG_{electricity,GE4}$ (FT7) |
|---|---|
| | **01/04/2020 – 31/12/2020** |
| Type | Flow transmitter – SUTO (CS-iTEC) S450 |
| Accuracy class | ±(1.5% of reading + 0.3% FS) |
| Serial No. | 5215-8535 |
| Calibration frequency | 12 months |
| Date of last calibration | 23/11/2015 |
| Date of current calibration | 31/03/2021 |
| Validity | 12 months |

**GSS2**

According to VVS, version 2.0, paragraph 366 (b), page 65:

FT7 was calibrated on 31/03/2021, The equipment calibration error is 0.65%. The equipment accuracy error for FT7 is 1.8% which is higher than the calibration error. As a result, the maximum permissible error of ±1.8% which is the equipment accuracy error was applied to FT7 from 01/04/2020 – 31/12/2020 as a conservative approach. However, there is no impact to the CER sheet due to FT7 is a backup meter in case $GSS3_{FT3}$ malfunction, there is no malfunction of $GSS3_{FT3}$ during this monitoring period.

| Item | GSS3, $LFG_{electricity,GSS3,y}$ ($FT_{3, GSS3}$) | |
|---|---|---|
| | **01/04/2020 – 13/12/2020** | **14/12/2020 – 31/12/2020** |
| Type | Flow transmitter – Rosemount | |
| Accuracy class | ± 0.065% | |
| Serial No. | 3604693 (Rosemount) | |
| Calibration frequency | 24 months | |
| Date of last calibration | 17/08/2018 | |
| Date of current calibration | 14/12/2020 | |
| Validity | 24 months | |

**GSS 3**

According to VVS, version 2.0, paragraph 366 (b), page 65:

FT3 was calibrated on 14/12/2020. The equipment calibration error is 0.16%. The equipment accuracy error for FT3 is 0.065% which is lower than the equipment calibration error. As a result, the maximum permissible error of ±0.16% which is the equipment calibration error was applied to FT3 from 16/08/2020 – 13/12/2020 as a conservative approach.

| Item | Gas Engine No. 5 $LFG_{electricity,GE5}$ (FT8) |
|---|---|
| | **01/04/2020 – 31/12/2020** |
| Type | Flow transmitter – Binder |
| Accuracy class | 2.5% ± 0.1% |
| Serial No. | C180382 |
| Calibration frequency | 24 months |
| Date of last calibration | 26/07/2018 |
| Date of current calibration | 06/04/2021 |
| Validity | 24 months |

| Item | Gas Engine No. 6 $LFG_{electricity,GE5}$ (FT9) |
|---|---|
| | **01/04/2020 – 31/12/2020** |
| Type | Flow transmitter – Binder |
| Accuracy class | 2.5% ± 0.1% |
| Serial No. | C180381 |
| Calibration frequency | 24 months |
| Date of last calibration | 26/07/2018 |
| Date of current calibration | 06/04/2021 |
| Validity | 24 months |

GE5 & GE6 backup flow meters, i.e. FT8 and FT9 flow meters were calibrated on 06/04/2021. The calibration frequency of the flow meters was revised to 24 months, and the percentage error is 1.0%. The equipment accuracy error for FT8 and FT9 is 2.6% which is higher than the equipment calibration error. Due to delay in calibration, the maximum permissible error of ±2.6% which is the equipment accuracy error was applied to FT8 and FT9 from 25/07/2020 – 31/12/2020 as a conservative approach. FT8 and FT9 flow meters are backup meters and will be used in case where $GSS3_{FT3}$ flow meter malfunctions. Hence, during this monitoring period, the application of maximum permissible error had no impact to the CER sheet since there is no malfunction of $GSS3_{FT3}$.

| Item | GSSF1, $LFG_{electricity,GSSF1,y}$ ($FT_{3, GSSF1}$) |
|---|---|
| | **01/04/2020 – 31/12/2020** |
| Type | Flow transmitter – Rosemount<br>Differential Pressure Transmitter – Kingways Control Vcone |
| Accuracy class | ± 0.5% |
| Serial No. | 02768007 (Rosemount) / FT161 (11011001) (Kingways) |
| Calibration frequency | 24 months |
| Date of last calibration | 18/09/2019 |
| Validity | 24 months |

| | |
|---|---|
| Measuring/reading/recording frequency | Continuous if not specified in the underlying methodology/tool |

| | |
|---|---|
| Calculation method (if applicable) | Instruments with recordable electronic signal (analogical or digital) is used |
| QA/QC procedures | Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory for all projects applying large scale methodology (ies). Calibration and frequency of calibration is according to manufacturer's specifications |
| Purpose of data/parameter | Baseline emissions calculation |
| Additional comment | This parameter is monitored in Option B |

| **Data / Parameter** | **$V_{CH4,m,db}$ ($W_{CH4,Flare\ No.2,y}$, $W_{CH4,GSS1,y}$, $W_{CH4,GSS2,y}$, $W_{CH4,GSSF1,y}$, $W_{CH4,GSS3,y}$)** |
|---|---|
| Unit | $m^3$ $CH_4$ / $m^3$ dry gas |
| Description | Volumetric fraction of greenhouse gas $CH_4$ in minute *m* on a dry basis |
| Measured/calculated/default | Measured |
| Source of data | Onsite records of the gas analyzers.<br><br>In case of temporary situation such as the installed $CH_4$ gas analyser mal-functioned or giving unrepresentative results due to data logging problem, the $V_{CH4}$ shall be measured manually with portable gas analyser. For any affected day, the calculation of the values measured using the portable analyser will be based on the Guidelines to calculate the fraction of methane in the landfill gas from periodical measurements (Version 01). As conservative approach, the lower bound of the 95% Confidence Interval will be applied as per guideline. |

Value(s) of monitored parameter

| Dates | Flare No.2 Value (%) | GSS1 Value (%) | GSS2 Value (%) | GSS3 Value (%) | GSSF1 Value (%) |
|---|---|---|---|---|---|
| 01 – 30/04/2020 | 0.60 | 0.61 | 0.00 | 0.63 | 0.64 |
| 01 – 31/05/2020 | 0.64 | 0.63 | 0.60 | 0.65 | 0.64 |
| 01 – 30/06/2020 | 0.65 | 0.60 | 0.58 | 0.57 | 0.63 |
| 01 – 31/07/2020 | 0.61 | 0.65 | 0.60 | 0.56 | 0.61 |
| 01 – 31/08/2020 | 0.61 | 0.57 | 0.56 | 0.57 | 0.63 |
| 01 – 30/09/2020 | 0.00 | 0.62 | 0.59 | 0.57 | 0.62 |
| 01 – 31/10/2020 | 0.00 | 0.59 | 0.61 | 0.58 | 0.62 |
| 01 – 30/11/2020 | 0.00 | 0.59 | 0.64 | 0.60 | 0.62 |
| 01 – 31/12/2020 | 0.00 | 0.59 | 0.61 | 0.59 | 0.62 |
| **Average** | **0.62** | **0.60** | **0.60** | **0.59** | **0.62** |

Some of the CH4 reading is 0 is due to the shutdown of flares and gas engines.

Monitoring equipment

| Item | Flare No.2, $W_{CH4,Flare\ No.2,y}$ ($CH_{4,\ Flare\ No.2}$) |
|---|---|
| | **01/04/2020 – 13/12/2020** |
| Type | Guardian Plus (97460) Infra-Red Gas Monitor |
| Accuracy class | ± 2% |
| Serial No. | 33542 |
| Calibration frequency | Annually |
| Date of last calibration | 18/09/2019 |
| Date of current calibration | NA, analyser was broken, new analyser will be replaced |
| Validity | 1 year |

**Flare 2**

According to VVS, version 2.0, paragraph 366 (a), page 65:

Due to delay in calibration, the maximum permissible error of ±2.0% which is the equipment accuracy error was applied to CH4 from 17/09/2020 – 31/12/2020 as a conservative approach. There is no impact to the flare data as during these periods as flare was shutdown.

| Item | GSS1, $W_{CH4,GSS1,y}$ ($CH_{4, GSS1}$) | |
|---|---|---|
| | 01/04/2020 – 13/12/2020 | 14/12/2020 – 31/12/2020 |
| Type | Guardian Plus (97460) Infra-Red Gas Monitor | |
| Accuracy class | ± 2% | |
| Serial No. | 33436 | |
| Calibration frequency | Annually | |
| Date of last calibration | 26/07/2019 | |
| Date of current calibration | 14/12/2020 | |
| Validity | 1 year | |

**GSS1**

According to VVS, version 2.0, paragraph 366 (a), page 65:

CH4 was calibrated on 14/12/2020. The equipment calibration error is 0.0%. The equipment accuracy error for CH4 is 2.0% which is higher than the equipment calibration error. As a result, the maximum permissible error of ±2.0% which is the equipment accuracy error was applied to CH4 from 25/07/2020 – 13/12/2020 as a conservative approach.

| Item | GSS2, $W_{CH4,GSS2,y}$ ($CH_{4, GSS2}$) | |
|---|---|---|
| | 01/04/2020 – 13/12/2020 | 14/12/2020 – 31/12/2020 |
| Type | Edinburgh Guardian Ng | |
| Accuracy class | ± 2% | |
| Serial No. | 14464 | |
| Calibration frequency | Annually | |
| Date of last calibration | 03/02/2020 | |
| Date of current calibration | 14/12/2020 | |
| Validity | 1 year | |

| Item | GSS3, $W_{CH4,GSS3,y}$ ($CH_{4, GSS3}$) |
|---|---|
| | 01/04/2020 – 31/12/2020 |
| Type | Edihburgh Sensors |
| Accuracy class | ± 2% |
| Serial No. | 17167 |
| Calibration frequency | Annually |
| Date of last calibration | 27/01/2020 |
| Validity | 1 year |

| Item | GSSF1, $W_{CH4,GSSF1,y}$ ($CH_{4,GSSF1}$) | |
|---|---|---|
| | 01/04/2020 – 13/12/2020 | 14/12/2020 – 31/12/2020 |
| Type | Cubic-Ruiyi | |
| Accuracy class | ± 1.0% | |
| Serial No. | 21905310261000000001 | |
| Calibration frequency | Annually | |
| Date of last calibration | 05/06/2019 | |
| Date of current calibration | 14/12/2020 | |
| Validity | 1 year | |

**GSSF1**

According to VVS, version 2.0, paragraph 366 (a), page 65:

CH4 was calibrated on 14/12/2020. The equipment calibration error is 0.0%. The equipment accuracy error for CH4 is 1.0% which is higher than the equipment calibration error. As a result, the maximum permissible error of ±1.0% which is the equipment accuracy error was applied to CH4 from 04/06/2020 – 13/12/2020 as a conservative approach.

| Item | Portable Gas Analyser, $W_{CH4,y}$ ($CH_4$) |
|---|---|
| | 01/04/2020 – 31/12/2020 |
| Type | Geotech |
| Accuracy class | ± 0.5% |
| Serial No. | G505823 |
| Calibration frequency | Annually |
| Date of last calibration | 25/10/2018 |
| Date of current calibration | 01/02/2021 |
| Validity | 1 year |

During the following period, a portable $CH_4$ gas analyser was used to measure the $CH_4$ content of the biogas due to unrepresentative results provided by the installed $CH_4$ gas analysers:

**GSS1**

- 8:27:07pm, 23/09/2020 – 11:13:07am, 15/12/2020
- 2:58:05am – 8:53:06am, 19/12/2020
- 1:00:07pm, 19/12/2020 – 11:59:05pm, 31/12/2020

Due to delay in calibration, the maximum permissible error of ±0.55% which is the equipment calibration error was applied to manual $CH_4$ records during these periods as a conservative approach.

**GSS2**

- 11:35:00pm, 12/08/2020 – 6:52:06pm, 19/09/2020
- 1:43:06pm, 23/12/2020 – 5:23:06pm, 29/12/2020
- 2:57:07pm, 30/12/2020 – 11:59:06pm, 31/12/2020

| | |
|---|---|
| | Due to delay in calibration, the maximum permissible error of ±0.55% which is the equipment calibration error was applied to manual $CH_4$ records during these periods as a conservative approach.<br><br>**GSS3**<br>• 1:48:06pm, 03/06/2020 – 6:55:06pm, 19/09/2020<br><br>Due to delay in calibration, the maximum permissible error of ±0.55% which is the equipment calibration error was applied to manual $CH_4$ records during this period as a conservative approach. |
| Measuring/reading/recording frequency | The $CH_4$ fraction were measured continuously with certified equipment or measured manually with a portable gas analyser during emergency cases |
| Calculation method (if applicable) | Raw data logged at 1 minute's interval was used to compute the daily average readings |
| QA/QC procedures | Calibration should include zero verification with an inert gas (e.g. N2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period |
| Purpose of data/parameter | Baseline emission calculation |
| Additional comment | This parameter is monitored in Option B |

| **Data / Parameter** | **$T_t$ ($T_{TT1,F2}$, $T_{TT1,GSS1}$, $T_{TT1,GSS2}$, $T_{TT1,GSSF1}$, $T_{TT1,GSS3}$)** |
|---|---|
| Unit | K |
| Description | Temperature of the gaseous stream in time interval *t* |
| Measured/calculated/default | Measured |
| Source of data | Onsite records of the temperature. In the case of temporary situation where Tt malfunctions leading to no readings captured, according to Tool to determine the mass flow of a greenhouse gas in a gaseous stream Version 03.0, data substitution procedure is as follow: |

| **Duration of Missing Data** | **Data Substitution procedure** |
|---|---|
| Less than six hours | Use the weighted average of the four hours period immediately before and four hours period immediately after the outage |
| Six to 24 hours | Use the upper bound of 95% confidence interval of the data spanning 24 hours prior to and 24 hours after the outage, whichever results in more conservative estimate of emission reductions |
| One to seven days | Use the upper bound of 95% confidence interval of the data spanning 72 hours prior to and 72 hours after the outage, whichever results in more conservative estimate of emission reductions |
| Greater than one week | No data may be substituted |

Value(s) of monitored parameter

| Dates | $T_t$ (°C) | | | | |
|---|---|---|---|---|---|
| | $T_{TT1,F2}$ | $T_{TT1,GSS1}$ | $T_{TT1,GSS2}$ | $T_{TT1,GSS3}$ | $T_{TT1,GSSF1}$ |
| 01 – 30/04/2020 | 37.12 | 46.69 | 0.00 | 59.12 | 47.15 |
| 01 – 31/05/2020 | 35.09 | 42.78 | 46.55 | 54.63 | 46.65 |
| 01 – 30/06/2020 | 32.96 | 45.11 | 46.85 | 54.43 | 47.07 |
| 01 – 31/07/2020 | 31.74 | 41.37 | 44.47 | 54.06 | 45.86 |
| 01 – 31/08/2020 | 31.26 | 46.63 | 45.13 | 57.40 | 47.69 |
| 01 – 30/09/2020 | 0.00 | 44.97 | 44.86 | 55.40 | 47.05 |
| 01 – 31/10/2020 | 0.00 | 40.83 | 43.34 | 53.15 | 45.83 |
| 01 – 30/11/2020 | 0.00 | 39.90 | 42.97 | 52.20 | 45.11 |
| 01 – 31/12/2020 | 0.00 | 38.57 | 43.12 | 51.95 | 45.24 |
| **Average** | **33.64** | **42.98** | **44.66** | **54.70** | **46.40** |

Some of the temperature of the gaseous stream reading is 0 is due to the shutdown of flares and gas engines.

Monitoring equipment

| Item | Flare No.2, $T_t$ ($T_{TT1,F2}$) | |
|---|---|---|
| | **01/04/2020 - 13/12/2020** | **14/12/2020 - 31/12/2020** |
| Type | Honeywell (STT25M-0-EN0-000-000-000-00-3D) Temperature Transmitter | |
| Accuracy class | ± 0.5% of span | |
| Serial No. | B839917437 | |
| Calibration frequency | Annually | |
| Date of last calibration | 18/09/2019 | |
| Date of current calibration | 14/12/2020 | |
| Validity | 1 year | |

**Flare 2**

According to VVS, version 2.0, paragraph 366 (a), page 65:

TT1 was calibrated on 14/12/2020. The equipment calibration error is 0.2%. The equipment accuracy error for TT1 is 0.5% which is higher than the equipment calibration error. As a result, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to TT1 from 17/09/2020 – 13/12/2020 as a conservative approach. The impact of applying this error to the flow normalisation is negligible.

| Item | GSS1, $T_t$ ($T_{TT1,GSS1}$) | |
|---|---|---|
| | **01/04/2020 - 13/12/2020** | **14/12/2020 - 31/12/2020** |
| Type | Honeywell (STT25M-0-ENS-000-000-000-00-3H) Temperature Transmitter | |
| Accuracy class | ± 1% | |
| Serial No. | B527143837 | |
| Calibration frequency | Annually | |
| Date of last calibration | 18/09/2019 | |
| Date of current calibration | 14/12/2020 | |
| Validity | 1 year | |

**GSS1**

According to VVS, version 2.0, paragraph 366 (a), page 65:

TT1 was calibrated on 14/12/2020. The equipment calibration error is 0.2%. The equipment accuracy error for TT1 is 1.0% which is higher than the equipment calibration error. As a result, the maximum permissible error of ±1.0% which is the equipment accuracy error was applied to TT1 from 17/09/2020 – 13/12/2020 as a conservative approach. The impact of applying this error to the flow normalisation is negligible.

| Item | GSS2, $T_t$ ($T_{TT1,GSS2}$) | |
|---|---|---|
| | 01/04/2020 - 13/12/2020 | 14/12/2020 - 31/12/2020 |
| Type | Autrol (ATT2100-S11HA3E1-M1) Temperature Transmitter | |
| Accuracy class | ± 0.1% | |
| Serial No. | ATT21004151000 | |
| Calibration frequency | Annually | |
| Date of last calibration | 18/09/2019 | |
| Date of current calibration | 14/12/2020 | |
| Validity | 1 year | |

**GSS2**

According to VVS, version 2.0, paragraph 366 (a), page 65:

TT1 was calibrated on 14/12/2020. The equipment calibration error is 0.0%. The equipment accuracy error for TT1 is 0.1% which is higher than the equipment calibration error. As a result, the maximum permissible error of ±0.1% which is the equipment accuracy error was applied to TT1 from 17/09/2020 – 13/12/2020 as a conservative approach. The impact of applying this error to the flow normalisation is negligible.

| Item | GSS3, $T_t$ ($T_{TT1,GSS3}$) | |
|---|---|---|
| | 01/04/2020 - 13/12/2020 | 14/12/2020 - 31/12/2020 |
| Type | Status Instrument (SEM 710) | |
| Accuracy class | ± 2.0% | |
| Serial No. | 155132 – 0001 | |
| Calibration frequency | Annually | |
| Date of last calibration | 22/02/2019 | |
| Date of current calibration | 14/12/2020 | |
| Validity | 1 year | |

**GSS3**

According to VVS, version 2.0, paragraph 366 (a), page 65:

TT1 was calibrated on 14/12/2020. The equipment calibration error is 0.2%. The equipment accuracy error for TT1 is 2.0% which is higher than the equipment calibration error. As a result, the maximum permissible error of ±2.0% which is the equipment accuracy error was applied to TT1 from

21/02/2020 – 13/12/2020 as a conservative approach. The impact of applying this error to the flow normalisation is negligible.

| Item | GSSF1, $T_t$ ($T_{TT1,GSSF1}$) | |
|---|---|---|
| | 01/04/2020 - 13/12/2020 | 14/12/2020 - 31/12/2020 |
| Type | PR Electronics (5335A) Temperature Transmitter | |
| Accuracy class | ≤ ± 0.05% of span | |
| Serial No. | 100944768 | |
| Calibration frequency | Annually | |
| Date of last calibration | 18/09/2019 | |
| Date of current calibration | 14/12/2020 | |
| Validity | 1 year | |

**GSSF1**

According to VVS, version 2.0, paragraph 366 (b), page 65:

TT1 was calibrated on 14/12/2020. The equipment calibration error is 0.2%. The equipment accuracy error for TT1 is 0.05% which is lower than the equipment calibration error. As a result, the maximum permissible error of ±0.2% which is the equipment calibration error was applied to TT1 from 17/09/2020 – 13/12/2020 as a conservative approach. The impact of applying this error to the flow normalisation is negligible.

| | |
|---|---|
| Measuring/reading/recording frequency | Measured continuously by temperature meter |
| Calculation method (if applicable) | Raw data logged at 1 minute's interval was used to compute the daily average readings |
| QA/QC procedures | Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications |
| Purpose of data/parameter | Baseline emission calculation |
| Additional comment | Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency). However, if the applicability condition related to the gaseous stream flow temperature being below 60ºC is adopted, this parameter must be monitored continuously to assure the applicability condition is met |

| **Data / Parameter** | **$P_t$ ($P_{PT2,F2}$, $P_{PT2,GSS1}$, $P_{PT2,GSS2}$, $P_{PT2,GSSF1}$, $P_{PT2,GSS3}$)** |
|---|---|
| Unit | Pa |
| Description | Pressure of the gaseous stream in time interval *t* |
| Measured/calculated/default | Measured |
| Source of data | Onsite records of the pressure sensors. In the case of temporary situation where Pt malfunctions leading to no readings captured, according to Tool to determine the mass flow of a greenhouse gas in a gaseous stream Version 03.0, data substitution procedure is as follow: |

| Duration of Missing Data | Data Substitution procedure |
|---|---|
| Less than six hours | Use the weighted average of the four hours period immediately before and four hours period immediately after the outage |
| Six to 24 hours | Use the lower bound of 95% confidence interval of the data spanning 24 hours prior to and 24 hours after the outage, whichever results in more conservative estimate of emission reductions |
| One to seven days | Use the lower bound of 95% confidence interval of the data spanning 72 hours prior to and 72 hours after the outage, whichever results in more conservative estimate of emission reductions |
| Greater than one week | No data may be substituted |

Value(s) of monitored parameter

| Average Gauge Pressure (Dates) | $P_t$ (kPa) | | | | |
|---|---|---|---|---|---|
| | $PT_{PT2,F2}$ | $PT_{PT2,GSS1}$ | $PT_{PT2,GSS2}$ | $PT_{PT2,GSS3}$ | $PT_{PT2,GSSF1}$ |
| 01 – 30/04/2020 | 1.28 | 18.00 | 0.00 | 18.00 | 17.58 |
| 01 – 31/05/2020 | 0.62 | 17.91 | 16.80 | 16.69 | 17.77 |
| 01 – 30/06/2020 | 0.72 | 17.94 | 17.59 | 16.77 | 17.92 |
| 01 – 31/07/2020 | 0.35 | 17.86 | 18.23 | 17.46 | 17.88 |
| 01 – 31/08/2020 | 0.19 | 17.45 | 18.15 | 17.55 | 18.00 |
| 01 – 30/09/2020 | 0.00 | 18.00 | 18.27 | 17.62 | 18.21 |
| 01 – 31/10/2020 | 0.00 | 18.00 | 17.84 | 17.25 | 18.90 |
| 01 – 30/11/2020 | 0.00 | 18.00 | 18.31 | 17.66 | 18.84 |
| 01 – 31/12/2020 | 0.00 | 15.74 | 18.79 | 18.10 | 18.31 |
| **Average** | **0.63** | **17.66** | **18.00** | **17.46** | **18.16** |

Some of the gauge pressure reading is 0 is due to the shutdown of flares and gas engines.

| Average Absolute Pressure (Dates) | $P_t$ (kPa) | | | | |
|---|---|---|---|---|---|
| | $PT_{PT2,F2}$ | $PT_{PT2,GSS1}$ | $PT_{PT2,GSS2}$ | $PT_{PT2,GSS3}$ | $PT_{PT2,GSSF1}$ |
| 01 – 30/04/2020 | 102.61 | 119.33 | 101.33 | 119.32 | 118.90 |
| 01 – 31/05/2020 | 101.95 | 119.23 | 118.12 | 118.02 | 119.10 |
| 01 – 30/06/2020 | 102.05 | 119.27 | 118.91 | 118.09 | 119.25 |
| 01 – 31/07/2020 | 101.68 | 119.18 | 119.56 | 118.79 | 119.20 |
| 01 – 31/08/2020 | 101.52 | 118.78 | 119.47 | 118.87 | 119.32 |
| 01 – 30/09/2020 | 101.33 | 119.32 | 119.60 | 118.95 | 119.54 |
| 01 – 31/10/2020 | 101.33 | 119.32 | 119.16 | 118.57 | 120.23 |
| 01 – 30/11/2020 | 101.33 | 119.32 | 119.64 | 118.99 | 120.16 |
| 01 – 31/12/2020 | 101.33 | 117.07 | 120.12 | 119.43 | 119.63 |
| **Average** | **101.68** | **118.98** | **117.32** | **118.78** | **119.48** |

Some of the absolute pressure reading is constant at 101.33, for example, Flare 2, it occurred during the month from 01/09/2020 to 31/12/2020, this is due to the shutdown of Flare No. 2, there was no result for PT2. The absolute pressure reading is 101.33.

Referring to the Tool to determine the mass flow of a greenhouse gas in a gaseous stream (Version 2.0), page 11, the pressure at normal conditions is 101,325 Pa. The values of the absolute pressure are calculated by adding the ambient pressure at normal conditions to the gauge pressure.

Monitoring equipment

| Item | Flare No.2, $P_t$ ($PT_{PT2,F2}$) | |
|---|---|---|
| | 01/04/2020 - 13/12/2020 | 14/12/2020 - 31/12/2020 |
| Type | Rosemount (3051TG1A2B21AB4K5M5) | |
| Accuracy class | ± 0.1% | |
| Serial No. | 5916057 | |
| Calibration frequency | Annually | |
| Date of last calibration | 18/09/2019 | |
| Date of current calibration | 14/12/2020 | |
| Validity | 1 year | |

**Flare 2**

According to VVS, version 2.0, paragraph 366 (a), page 65:

PT2 was calibrated on 14/12/2020. The equipment calibration error is 0.05%. The equipment accuracy error for PT2 is 0.1% which is higher than the equipment calibration error. As a result, the maximum permissible error of ±0.1% which is the equipment accuracy error was applied to PT2 from 17/09/2020 – 13/12/2020 as a conservative approach. The impact of applying this error to the flow normalisation is negligible

| Item | GSS1, $P_t$ ($PT_{PT2,GSS1}$) | |
|---|---|---|
| | 01/04/2020 - 13/12/2020 | 14/12/2020 - 31/12/2020 |
| Type | Rosemount (3051TG1A2B21AB4E5Q4) Pressure Transmitter | |
| Accuracy class | ± 0.25% | |
| Serial No. | 5584784 | |
| Calibration frequency | Annually | |
| Date of last calibration | 21/02/2020 | |
| Date of current calibration | 14/12/2020 | |
| Validity | 1 year | |

| Item | GSS2, $P_t$ ($PT_{PT2,GSS2}$) | |
|---|---|---|
| | 01/04/2020 - 13/12/2020 | 14/12/2020 - 31/12/2020 |
| Type | Autrol (APT3200-G4M11E11S1-M1) Pressure Transmitter | |
| Accuracy class | ± 0.075% of span | |
| Serial No. | APT3200-4150998 | |
| Calibration frequency | Annually | |
| Date of last calibration | 18/09/2019 | |
| Date of current calibration | 14/12/2020 | |
| Validity | 1 year | |

**GSS2**

According to VVS, version 2.0, paragraph 366 (b), page 65:

PT2 was calibrated on 14/12/2020. The equipment calibration error is 0.8%. The equipment accuracy error for PT2 is 0.075% which is lower than the equipment calibration error. As a result, the maximum permissible error of ±0.8% which is the equipment accuracy error was applied to PT2 from 01/04/2020 – 13/12/2020 as a conservative approach. The impact of applying this error to the flow normalisation is negligible.

| Item | GSS3, $P_t$ ($PT_{PT2,GSS3}$) | |
|---|---|---|
| | **01/04/2020 - 13/12/2020** | **14/12/2020 - 31/12/2020** |
| Type | Endress + Hauser (PMP51-BD21J1KGCGMJA1) | |
| Accuracy class | ± 0.15% | |
| Serial No. | N7014C21129 | |
| Calibration frequency | Annually | |
| Date of last calibration | 25/07/2018 | |
| Date of current calibration | 14/12/2020 | |
| Validity | 1 year | |

**GSS3**

According to VVS, version 2.0, paragraph 366 (b), page 65:

PT2 was calibrated on 14/12/2020. The equipment calibration error is 0.25%. The equipment accuracy error for PT2 is 0.15% which is lower than the equipment calibration error. As a result, the maximum permissible error of ±0.25% which is the equipment calibration error was applied to PT2 from 01/04/2020 – 13/12/2020 as a conservative approach. The impact of applying this error to the flow normalisation is negligible.

| Item | GSSF1, $P_t$ ($PT_{PT2,GSSF1}$) | |
|---|---|---|
| | **01/04/2020 - 13/12/2020** | **14/12/2020 - 31/12/2020** |
| Type | Rosemount (3051TG1A2B21AB4E5M5Q4) Pressure Transmitter | |
| Accuracy class | ± 0.25% | |
| Serial No. | 02492864 | |
| Calibration frequency | Annually | |
| Date of last calibration | 18/09/2019 | |
| Date of current calibration | 14/12/2020 | |
| Validity | 1 year | |

**GSSF1**

According to VVS, version 2.0, paragraph 366 (b), page 65:

PT2 was calibrated on 14/12/2020. The equipment calibration error is 0.7%. The equipment accuracy error for PT2 is 0.25% which is lower than the equipment calibration error. As a result, the maximum permissible error of ±0.7% which is the equipment calibration error was applied to PT2 from

| | |
|---|---|
| | 17/09/2020 – 13/12/2020 as a conservative approach. The impact of applying this error to the flow normalisation is negligible. |
| Measuring/reading/recording frequency | Measured continuously by a pressure transmitter |
| Calculation method (if applicable) | Instruments with recordable electronic signal (analogical or digital) is used |
| QA/QC procedures | Periodic calibration against a primary device must be performed periodically and records of calibration procedures must be kept available as well as the primary device and its calibration certificate. Pressure transducers (either capacitive or resistive) must be calibrated monthly |
| Purpose of data/parameter | Baseline emission calculation |
| Additional comment | Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore, it should be metered only when performing such measurements (with same frequency) |

| **Data / Parameter** | **$P_{H2O,t,Sat}$** |
|---|---|
| Unit | Pa |
| Description | Saturation pressure of $H_2O$ at temperature $T_t$ in time interval *t* |
| Measured/calculated/default | Calculated |
| Source of data | Tool to determine the mass flow of a greenhouse gas in a gaseous stream (Version 03.0) |
| Value(s) of monitored parameter | **101,325 Pa** |
| Monitoring equipment | |
| Measuring/reading/recording frequency | - |
| Calculation method (if applicable) | This parameter is solely a function of a gaseous stream temperature $T_t$ and can be found at reference [1] for a total pressure equal to 101,325 Pa |
| QA/QC procedures | - |
| Purpose of data/parameter | Baseline emissions calculation |
| Additional comment | [1] Fundamentals of Classical Thermodynamics; Gordon J. Van Wylen, Richard E. Sonntag and Borgnakke; 4º Edition 1994, John Wiley & Sons, Inc. |

| **Data / Parameter** | **$V_{CO2,t,db}$** |
|---|---|
| Unit | $m^3$ gas $CO_2$ / $m^3$ dry gas |
| Description | Volumetric fraction of greenhouse gas $CO_2$ in the gaseous stream in time interval *t* on a dry basis |
| Measured/calculated/default | Measured |
| Source of data | The $V_{CO2}$ shall be measured manually with portable gas analyser. A minimum sampling frequency of one sample per week to be conducted. As conservative approach, the lower bound of the 95% Confidence Interval will be applied for the data collected. |
| Value(s) of monitored parameter | 37.06% |
| Monitoring equipment | Portable gas analyser |
| Measuring/reading/recording frequency | Continuous if not specified in the underlying methodology/tool |
| Calculation method (if applicable) | Continuous gas analyser operating in dry-basis |
| QA/QC procedures | Calibration should include zero verification with an inert gas (e.g. $N_2$) and at least one reading verification with a standard gas (single calibration gas or |

| | |
|---|---|
| | mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period |
| Purpose of data/parameter | Baseline emissions calculation |
| Additional comment | - |

| **Data / Parameter** | $\mathbf{V_{O2,t,db}}$ |
|---|---|
| Unit | $m^3$ gas $O_2$ / $m^3$ dry gas |
| Description | Volumetric fraction of greenhouse gas $O_2$ in the gaseous stream in time interval *t* on a dry basis |
| Measured/calculated/default | Measured |
| Source of data | On site measurement |
| Value(s) of monitored parameter | 0.34% |
| Monitoring equipment | Continuous gas analyser operating in dry-basis |
| Measuring/reading/recording frequency | Continuous if not specified in the underlying methodology/tool |
| Calculation method (if applicable) | - |
| QA/QC procedures | Calibration should include zero verification with an inert gas (e.g. $N_2$) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period |
| Purpose of data/parameter | Baseline emissions calculation |
| Additional comment | - |

| Data / Parameter | **Status of biogas destruction device** |
|---|---|
| Unit | - |
| Description | Operational status of biogas destruction devices |
| Measured/calculated/default | Measured |
| Source of data | On-site measurement |
| Value(s) of monitored parameter | On or Off, refer to $V_{t,wb}$ and operating hour of Gas engines ($\mathbf{Op_{j,h}}$). |
| Monitoring equipment | Monitoring and documenting may be undertaken by recording the energy production from methane captured or the operation of the flare by means of a flame detector to demonstrate the actual destruction of methane, unless a different method is specified in the underlying methodology/tool. Emission reductions will not accrue for periods in which the destruction device is not operational |
| Measuring/reading/recording frequency | Continuous if not specified in the underlying methodology/tool |
| Calculation method (if applicable) | N/A |
| QA/QC procedures | The operational status will be monitored and cross checked with the amount of gas sent to flare (FT2), and also the operating hour for Gas Engines. |
| Purpose of data/parameter | Baseline emissions calculation |
| Additional comment | For flame detector devices, refer to the methodological tool “Project emissions from flaring” |

| **Data / Parameter** | **$FC_{i,j,y}$** |
|---|---|
| Unit | ton/yr |
| Description | Quantity of fuel type i combusted in process j during the year y |
| Measured/calculated/default | Measured |
| Source of data | Onsite measurements |
| Value(s) of monitored parameter | 0.03 |
| Monitoring equipment | Fuel meter |
| Measuring/reading/recording frequency | Continuously |
| Calculation method (if applicable) | The measurement from the fuel meter is in litre, for the calculation, the amount of diesel in litre will be converted to tonne/year by multiply the density of diesel (kg/l) |
| QA/QC procedures | The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records |
| Purpose of data/parameter | Project emissions calculation |
| Additional comment | - |

| **Data / Parameter** | **$EF_{CO2,i,y}$** |
|---|---|
| Unit | $tCO_2/GJ$ |
| Description | Weighted average $CO_2$ emission factor of fuel type i in year y |
| Measured/calculated/default | Default (Option D was applied in the calculation) |
| Source of data | Option A will be used if the value is available from the fuel supplier in invoices; Option D will be used if there is no data available from the fuel supplier. |
| Value(s) of monitored parameter | 0.0741 |
| Monitoring equipment | - |
| Measuring/reading/recording frequency | If the values are provided by the fuel supplier, the measurements should be undertaken in line with national or international fuel standards.<br>If the value is according to IPCC default value, any future revision of the IPCC Guidelines should be taken into account. |
| Calculation method (if applicable) | For a): The $CO_2$ emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated<br>For d): Any future revision of the IPCC Guidelines should be taken into account |
| QA/QC procedures | - |
| Purpose of data/parameter | Project emissions calculation |
| Additional comment | - |

| **Data / Parameter** | **$NCV_{i,y}$** |
|---|---|
| Unit | GJ/ton |
| Description | Weighted average net calorific value of fuel type i in year y |
| Measured/calculated/default | Default (Option D was applied in the calculation) |
| Source of data | Option A will be used if the value is available from the fuel supplier in invoices; Option D will be used if there is no data available from the fuel supplier. |
| Value(s) of monitored parameter | 43 |

| | |
|---|---|
| Monitoring equipment | - |
| Measuring/reading/recording frequency | For a): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated.<br>For d): Any future revision of the IPCC Guidelines should be taken into account |
| Calculation method (if applicable) | 1 For a): The NCV emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated.<br>For d): Any future revision of the IPCC Guidelines should be taken into account |
| QA/QC procedures | If option A value is used for the calculation, verify if the values under a) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a) should have ISO17025 accreditation or justify that they can comply with similar quality standards. |
| Purpose of data/parameter | Project emissions calculation |
| Additional comment | - |

## D.3. Implementation of sampling plan

**CH4**

According to PDD version 21.3, the source of data for $v_{CH4,m,db}$ (Volumetric fraction of greenhouse gas CH4 in minute m on a dry basis), in case of temporary situation such as the installed $CH_4$ gas analyser mal-functioned or giving unrepresentative results due to data logging problem, the $VCH_4$ shall be measured manually with portable gas analyser. For any affected day, the calculation of the values measured using the portable analyser will be based on the Guidelines to calculate the fraction of methane in the landfill gas from periodical measurements (Version 01). As conservative approach, the lower bound of the 95% Confidence Interval will be applied as per guideline.

**Sample Design**

The sample design for the manual measurement using portable gas analyser is according to Guidelines to calculate the fraction of methane in the landfill gas from periodical measurements (Version 01),

**Sample Size**

Referring to the Guideline, a systematic random sampling scheme should be implemented. All samples taken on the fraction of methane in the landfill gas should be included in the calculations. A minimum of 4 measurements of fraction of methane in the landfill gas per year should be conducted.

The example of the methane measurement for GSS2 for the affected period during this monitoring period from 12/08/2020 to 19/09/2020 is demonstrated as below, a total number of 39 data was collected. The $CH_4$ reading was collected in the morning between 0900 – 1100 every week (refer to appendix 4 for the data recording sheet).

**Analysis of Data**

The data recorded was derived based on 95% confidence interval principles (source: "IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories", page 6.6). The lower bound of the interval boundaries calculated was applied to the affected period as a conservative approach; the detail calculation is described as below.

The following formula explains how to calculate the lower bound of the fraction of methane in the landfill gas.

1. Calculate sample mean (μ).

$$\mu_{WCH4,y} = \frac{\sum_{m=1}^{n_m} w_{CH4,m,y}}{n_m}$$

Where:

$\mu_{WCH4,y}$ = Mean of the fraction of methane in the landfill gas in year $y$ ($m^3CH_4/m^3$ LFG)
$w_{CH4,m,y}$ = Monitored fraction of methane in the landfill gas in measurement $m$ in year $y$ ($m^3CH_4/m^3$ LFG)
$n_m$ = Number of measurements $m$ in year $y$ (minimum is 4)

2. Calculate the sample standard deviation (σ).

$$\sigma_{WCH4,y} = \sqrt{\frac{\sum_{m=1}^{n_m} (w_{CH4,m,y} - \mu_{CH4,y})^2}{n_m - 1}}$$

Where:

$\sigma_{WCH4,y}$ = Standard deviation of the fraction of methane in the landfill gas in year $y$ ($m^3CH_4/m^3$ LFG)

3. Calculate the 95% confidence interval.

$$\mu_{WCH4,y} - t \cdot \frac{\sigma_{WCH4,y}}{\sqrt{n_m}} \leq w_{CH4,y} \leq \mu_{WCH4,y} + t \cdot \frac{\sigma_{WCH4,y}}{\sqrt{n_m}}$$

Where:

$t$ = Value from standard $t$ distribution for a confidence level of 95% with degrees of freedom $n_m$-1

4. Use the lower bound of the 95% confidence interval obtained below to ensure conservativeness.

$$w_{CH4,lb,y} = \mu_{WCH4,y} - t \cdot \frac{\sigma_{WCH4,y}}{\sqrt{n_m}}$$

Where:

$w_{CH4,lb,y}$ = Lower bound of the 95% confidence interval of fraction of methane in the landfill gas ($m^3CH_4/m^3$ LFG)

The results calculated using the formula described above is presented as below:

GSS2 (12/08/2020 – 19/09/2020)

| Date | $CH_{4,hr}$ reading (%) | $(CH_4 - m_{CH4})^2$ |
|---|---|---|
| 12/8/2020 08:21:00 | 56.90 | 0.08847 |
| 13/8/2020 09:09:00 | 58.20 | 1.00513 |
| 14/8/2020 09:01:00 | 58.10 | 0.81462 |
| 15/8/2020 08:21:00 | 59.00 | 3.24924 |
| 16/8/2020 08:10:00 | 59.00 | 3.24924 |
| 17/8/2020 09:17:00 | 56.60 | 0.35693 |
| 18/8/2020 08:14:00 | 55.90 | 1.68334 |
| 19/8/2020 08:08:00 | 56.00 | 1.43385 |
| 20/8/2020 09:09:00 | 58.10 | 0.81462 |
| 21/8/2020 08:13:00 | 57.60 | 0.16206 |
| 22/8/2020 08:08:00 | 56.50 | 0.48642 |
| 23/8/2020 09:10:00 | 56.90 | 0.08847 |
| 24/8/2020 09:17:00 | 55.80 | 1.95283 |
| 25/8/2020 08:47:00 | 56.30 | 0.80539 |
| 26/8/2020 09:16:00 | 57.80 | 0.36308 |
| 27/8/2020 08:17:00 | 56.20 | 0.99488 |
| 28/8/2020 08:21:00 | 56.10 | 1.20437 |
| 29/8/2020 09:01:00 | 57.30 | 0.01052 |
| 30/8/2020 08:16:00 | 57.60 | 0.16206 |
| 31/8/2020 08:11:00 | 57.10 | 0.00949 |
| 1/9/2020 08:01:00 | 58.70 | 2.25770 |
| 2/9/2020 07:49:00 | 57.70 | 0.25257 |
| 3/9/2020 08:08:00 | 56.90 | 0.08847 |
| 4/9/2020 08:15:00 | 57.00 | 0.03898 |
| 5/9/2020 09:17:00 | 56.80 | 0.15796 |
| 6/9/2020 08:07:00 | 58.20 | 1.00513 |
| 7/9/2020 08:28:00 | 57.30 | 0.01052 |
| 8/9/2020 09:01:00 | 57.30 | 0.01052 |
| 9/9/2020 08:09:00 | 56.90 | 0.08847 |
| 10/9/2020 09:01:00 | 56.70 | 0.24744 |
| 11/9/2020 08:49:00 | 56.80 | 0.15796 |
| 12/9/2020 08:33:00 | 57.00 | 0.03898 |
| 13/9/2020 09:00:00 | 57.40 | 0.04103 |
| 14/9/2020 08:40:00 | 56.70 | 0.24744 |
| 15/9/2020 07:55:00 | 56.30 | 0.80539 |
| 16/9/2020 08:47:00 | 55.90 | 1.68334 |
| 17/9/2020 08:15:00 | 56.70 | 0.24744 |
| 18/9/2020 09:00:00 | 57.80 | 0.36308 |
| 19/9/2020 08:21:00 | 59.60 | 5.77231 |
| $m_{CH4,hr}$ | 57.19744 | |
| Variance | 0.85394 | |
| $s_{CH4,hr} = \sqrt{\sum (CH_{4,hr} - m_{CH4,hr})^2] / (n_m}$ | 0.92409 | |
| $(t \times s_{CH4,hr}) / \sqrt{n_m}$ | 0.29956 | |
| | | |
| t (95%; df = 19) | 2.02439 | |
| $n_m$ | 39 | |
| df = $n_m$ - 1 | 38 | |
| | | |
| | | |
| Calculation of 95% of confidence interval boundaries | | |
| Low value | Parameter | High value |
| 56.89788 | ≤ $CH_{4,hr}$ ≥ | 57.49699 |

The lower bound of the $CH_4$ reading which is 56.90% was applied to the affected period which was from 12/0812020 – 19/09/2020.

**Tt and Pt**

During this monitoring period, there was delay in calibration for TT1 and PT2, the maximum permissible error was applied as a conservative approach to demonstrate the impact of applying the MPE to the normalisation error is negligible.

The steps for the demonstration are listed as below:
Step 1: Calculate the total no. of days affected for the monitoring period

Step 2: Calculate the sample size

Step 3: Select the sample

Step 4: Tabulate the parameter needed for calculation

Step 5: Calculate the new TT1 or PT2 after applying the MPE

Step 6: Calculate the actual flow and new actual flow after applying the MPE
The formula to convert normalised flow to actual flow is presented as below:

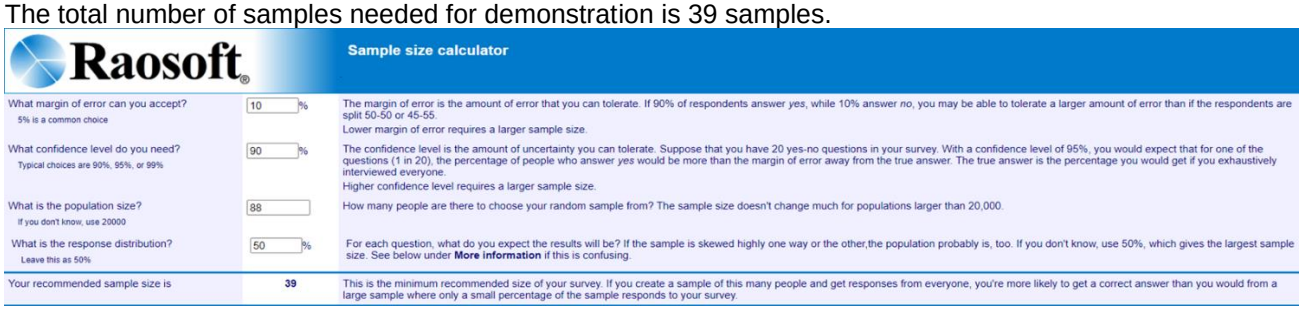
$$\text{Actual flow rate } (m_3/hr) = \frac{\text{Normalised flow rate } (m_3/hr) \times 101.325 \text{ kPa} \times (\text{Measured temperature } (°C) + 273.15 \text{ K})}{273.15 \text{ K} \times (\text{Measured pressure (kPa)} + 101.325 \text{ kPa})}$$

Step 7: Calculate the difference between the actual flow and new flow after applying new TT1 or PT2

Step 8: Conclusion

**Demonstration**

The example of the PT2 for GSS1 for the affected period during this monitoring period from 17/09/2020 - 13/12/2020 is demonstrated as below. The total number of affected days is 88 days. The total number of samples[12] needed for the demonstration is calculated using the 90% confidence interval, 10% margin of error. The total number of samples needed for demonstration is 39 samples.



Raosoft®

Sample size calculator

| | | |
|---|---|---|
| What margin of error can you accept? 5% is a common choice | 10 % | The margin of error is the amount of error that you can tolerate. If 90% of respondents answer *yes*, while 10% answer *no*, you may be able to tolerate a larger amount of error than if the respondents are split 50-50 or 45-55.<br>Lower margin of error requires a larger sample size. |
| What confidence level do you need? Typical choices are 90%, 95%, or 99% | 90 % | The confidence level is the amount of uncertainty you can tolerate. Suppose that you have 20 yes-no questions in your survey. With a confidence level of 95%, you would expect that for one of the questions (1 in 20), the percentage of people who answer *yes* would be more than the margin of error away from the true answer. The true answer is the percentage you would get if you exhaustively interviewed everyone.<br>Higher confidence level requires a larger sample size. |
| What is the population size? If you don't know, use 20000 | 88 | How many people are there to choose your random sample from? The sample size doesn't change much for populations larger than 20,000. |
| What is the response distribution? Leave this as 50% | 50 % | For each question, what do you expect the results will be? If the sample is skewed highly one way or the other,the population probably is, too. If you don't know, use 50%, which gives the largest sample size. See below under **More information** if this is confusing. |
| Your recommended sample size is | 39 | This is the minimum recommended size of your survey. If you create a sample of this many people and get responses from everyone, you're more likely to get a correct answer than you would from a large sample where only a small percentage of the sample responds to your survey. |

The parameter needed for calculation listed below is tabulated:

1. Normalised flow (Nm3/hr)
2. Temperature ((℃)
3. Pressure (kPa)

[12] http://www.raosoft.com/samplesize.html

| Equation | | A | G = FxAx(B+E)/(Ex(C+F)) | H = FxAx(B+E)/(Ex(D+F)) | I = G-H | B | C | D = Cx(1+MPE) | E | F |
|---|---|---|---|---|---|---|---|---|---|---|
| Date | Hour (24hr) | Normalised Flow rate Advance Cell LFG ($Nm^3/hr$) | Measured Flowrate ($m^3/hr$) | Measured Flowrate ($m^3/hr$) | Measured Flowrate ($m^3/hr$) Column D & E | Average TT(°C) | Average PT2(kPa)1 | Pressure (PT2) | Standard Temp (°K) | Standard Pressure (kPa) |
| 17/9/2020 | 0 | 482.77 | 479.42 | 478.92 | 0.00 | 46.30 | 18.00 | 18.13 | 273.15 | 101.325 |
| | 1 | 483.12 | 479.52 | 479.01 | 0.00 | 46.14 | 18.01 | 18.13 | 273.15 | 101.325 |
| | 2 | 480.72 | 476.92 | 476.42 | 0.00 | 45.98 | 18.00 | 18.12 | 273.15 | 101.325 |
| | 3 | 480.82 | 476.80 | 476.30 | 0.00 | 45.82 | 18.00 | 18.12 | 273.15 | 101.325 |
| | 4 | 479.17 | 475.08 | 474.58 | 0.00 | 45.76 | 17.99 | 18.12 | 273.15 | 101.325 |
| | 5 | 478.45 | 474.24 | 473.74 | 0.00 | 45.69 | 18.00 | 18.12 | 273.15 | 101.325 |
| | 6 | 476.83 | 472.52 | 472.02 | 0.00 | 45.61 | 18.00 | 18.12 | 273.15 | 101.325 |
| | 7 | 477.44 | 473.06 | 472.56 | 0.00 | 45.58 | 18.00 | 18.13 | 273.15 | 101.325 |
| | 8 | 479.86 | 476.47 | 475.97 | 0.00 | 46.27 | 18.01 | 18.13 | 273.15 | 101.325 |
| | 9 | 479.92 | 478.78 | 478.27 | 0.00 | 47.76 | 18.00 | 18.13 | 273.15 | 101.325 |
| | 10 | 477.70 | 479.48 | 478.98 | 0.00 | 49.72 | 18.00 | 18.12 | 273.15 | 101.325 |
| | 11 | 476.51 | 479.21 | 478.70 | 0.00 | 50.34 | 18.00 | 18.12 | 273.15 | 101.325 |
| | 12 | 476.96 | 479.59 | 479.08 | 0.00 | 50.29 | 18.00 | 18.13 | 273.15 | 101.325 |
| | 13 | 477.19 | 479.11 | 478.60 | 0.00 | 49.82 | 18.00 | 18.13 | 273.15 | 101.325 |
| | 14 | 476.08 | 479.38 | 478.88 | 0.00 | 50.75 | 18.00 | 18.13 | 273.15 | 101.325 |
| | 15 | 476.22 | 479.97 | 479.46 | 0.00 | 51.06 | 18.00 | 18.13 | 273.15 | 101.325 |
| | 16 | 480.39 | 482.51 | 482.00 | 0.00 | 49.93 | 18.00 | 18.12 | 273.15 | 101.325 |
| | 17 | 481.81 | 482.57 | 482.07 | 0.00 | 49.04 | 18.00 | 18.13 | 273.15 | 101.325 |
| | 18 | 482.89 | 482.95 | 482.44 | 0.00 | 48.55 | 18.00 | 18.12 | 273.15 | 101.325 |
| | 19 | 484.61 | 483.33 | 482.82 | 0.00 | 47.67 | 18.00 | 18.13 | 273.15 | 101.325 |
| | 20 | 486.18 | 483.44 | 482.93 | 0.00 | 46.74 | 18.01 | 18.14 | 273.15 | 101.325 |
| | 21 | 485.60 | 482.05 | 481.55 | 0.00 | 46.17 | 18.00 | 18.13 | 273.15 | 101.325 |
| | 22 | 484.64 | 480.76 | 480.25 | 0.00 | 45.93 | 17.99 | 18.12 | 273.15 | 101.325 |
| | 23 | 483.43 | 479.56 | 479.06 | 0.00 | 45.96 | 18.00 | 18.13 | 273.15 | 101.325 |
| | | | 11,496.74 | 11,484.61 | 0.001 | | | | 273.15 | 101.325 |

The actual flow (G) and new actual flow after applying the MPE (H) was calculated as shown above. The difference between G and H was calculated (I) which conclude that the difference before and after applying the MPE is insignificant.

**$VCO_{2,t,db}$**

According to PDD version 21.3, the source of data for $v_{CO2,t,db}$ (Volumetric fraction of gas $CO_2$ in the gaseous stream in time interval t on a dry basis) is measured manually with portable gas analyser. measured manually with portable gas analyser. A minimum sampling frequency of one sample per week to be conducted. As conservative approach, the lower bound of the 95% Confidence Interval will be applied for the data collected.

The example of the $CO_2$ measurement for this monitoring period is demonstrated as below, a total number of 40 data was collected. The weekly data was average to monthly data. The example of the weekly data is presented below:

KUB - BERJAYA ENVIRO SDN BHD

RENEWABLE ENERGY CENTRE

LANDFILL GAS PROJECT : GAS ANALYSIS FOR - CO2

MANUAL RECORD

| No. | Date | $CO_2$ % | Recorded By |
|---|---|---|---|
| 1 | 30/09/2020 | 38.1 | MHS |
| 2 | 05/10/2020 | 29.0 | MHS |
| 3 | 13/10/2020 | 39.2 | MHS |
| 4 | 21/10/2020 | 37.6 | MHS |
| 5 | 28/10/2020 | 37.2 | Man |

**Analysis of Data**

The data recorded was derived based on 95% confidence interval principles (source: "IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories", page 6.6). The lower bound of the interval boundaries calculated was applied to the affected period as a conservative approach; the detail calculation is described as below.

The following formula explains how to calculate the lower bound of the $CO_2$.

1. Calculate sample mean (μ).

$$\mu_{WCO2,y} = \frac{\sum_{m=1}^{n_m} w_{CO2,m,y}}{n_m}$$

Where:

$\mu_{WCO2,y}$ = Mean of the fraction of CO2 in the landfill gas in year *y* ($m^3CO_2/m^3$ LFG)

$w_{CO2,m,y}$ = Monitored fraction of CO2 in the landfill gas in measurement *m* in year *y* ($m^3CO_2/m^3$ LFG)

$n_m$ = Number of measurements *m* in year *y* (minimum is 4)

2. Calculate the sample standard deviation (σ).

$$\sigma_{WCO2,y} = \sqrt{\frac{\sum_{m=1}^{n_m} (w_{CO2,m,y} - \mu_{C02,y})^2}{n_m - 1}}$$

Where:

$\sigma_{WCO2,y}$ = Standard deviation of the fraction of CO2 in the landfill gas in year *y* ($m^3CO_2/m^3$ LFG)

3. Calculate the 95% confidence interval.

$$\mu_{WCO2,y} - t \cdot \frac{\sigma_{WCO2,y}}{\sqrt{n_m}} \leq w_{CO2,y} \leq \mu_{WCO2,y} + t \cdot \frac{\sigma_{WCO2,y}}{\sqrt{n_m}}$$

Where:

*t* = Value from standard *t* distribution for a confidence level of 95% with degrees of freedom $n_m$-1

4. Use the lower bound of the 95% confidence interval obtained below to ensure conservativeness.

$$w_{CO2,lb,y} = \mu_{WCO2,y} - t \cdot \frac{\sigma_{WCO2,y}}{\sqrt{n_m}}$$

Where:

$w_{CO2,lb,y}$ = Lower bound of the 95% confidence interval of fraction of CO2 in the landfill gas ($m^3CO_2/m^3$ LFG)

The results calculated using the formula described above is presented as below:

| $CO_2$ 95% confidence interval analysis | | |
|---|---|---|
| **Date** | **CO2 reading (%)** | **$(CO2 - m_{CO2})^2$** |
| Apr-20 | 37.78 | 0.00732 |
| May-20 | 38.68 | 0.65520 |
| Jun-20 | 38.93 | 1.12242 |
| Jul-20 | 36.32 | 2.38874 |
| Aug-20 | 37.70 | 0.02741 |
| Sep-20 | 37.06 | 0.64892 |
| Oct-20 | 38.25 | 0.14780 |
| Nov-20 | 38.20 | 0.11185 |
| Dec-20 | 37.88 | 0.00021 |
| **$m_{CO2}$** | **37.86556** | |
| **Variance** | 0.63873 | |
| **$s_{CO2} = \sqrt{[\sum (CO2 - m_{CO2})^2] / (n_m - 1)}$** | 0.79921 | |
| **$(t \times s_{CO2,hr}) / \sqrt{n_m}$** | 0.61433 | |
| | | |
| **t (95%; df = 16)** | 2.30600 | *t standard distribution value* |
| **$n_m$** | 9 | *Number of measurements m* |
| **$df = n_m - 1$** | 8 | *Degrees of freedom* |
| | | |
| | | |
| **Calculation of 95% of confidence interval boundaries** | | |
| **Low value** | **Parameter** | **High value** |
| **37.25123** | **≤ CO2 ≥** | **38.47988** |

According to VVS, version 2.0, paragraph 366 (a), page 65, portable gas analyser was calibrated on 01/02/2021. The equipment calibration error for $CO_2$ is ±0.25%. The equipment accuracy error for portable gas analyser is ±0.5%which is higher than the equipment calibration error. As a result:

- Due to delay calibration, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to $CO_2$ for this monitoring period. The $CO_2$ reading after MPE applied is 37.06%.

## SECTION E. Calculation of emission reductions or net anthropogenic removals

### E.1. Calculation of baseline emissions or baseline net removals

The total baseline emissions according to ACM0001 (Version 18.0) were calculated according to the equations below:

$$BE_y = BE_{CH4,y} + BE_{EC,y} + BE_{HG,y} + BE_{NG,y}$$

| | | |
|---|---|---|
| $BE_y$ | = | Baseline emissions in year *y* (t $CO_2e$/yr) |
| $BE_{CH4,y}$ | = | Baseline emissions of methane from the SWDS in year *y* (t $CO_2e$/yr) |
| $BE_{EC,y}$ | = | Baseline emissions associated with electricity generation in year *y* (t $CO_2$/yr) |
| $BE_{HG,y}$ | = | Baseline emissions associated with heat generation in year *y* (t $CO_2$/yr) |
| $BE_{NG,y}$ | = | Baseline emissions associated with natural gas use in year *y* (t $CO_2$/yr) |

$$BE_{CH4} = \left(\left(1 - OX_{top\_layer}\right) \times F_{CH4,PJ,y} - F_{CH,BL,y}\right) \times GWP_{CH4}$$

| | | |
|---|---|---|
| $BE_{CH4,y}$ | = | Baseline emissions of methane from the SWDS in year *y* (t $CO_2e$/yr) |
| $OX_{top\_layer}$ | = | Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline (dimensionless) |
| $F_{CH4,PJ,y}$ | = | Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t $CH_4$/yr) |
| $F_{CH4,BL,y}$ | = | Amount of methane in the LFG that would be flared in the baseline in year *y* (t $CH_4$/yr) |
| $GWP_{CH4}$ | = | Global warming potential of $CH_4$ (t $CO_2e$/t $CH_4$) |

$$F_{CH4,PJ,y} = \eta_{PJ} \times BE_{CH4,SWDS,y}/GWP_{CH4}$$

| | | |
|---|---|---|
| $F_{CH4,PJ,y}$ | = | Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t $CH_4$/yr) |
| $BE_{CH4,SWDS,y}$ | = | Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* (t $CO_2e$/yr) |
| $\eta_{PJ}$ | = | Efficiency of the LFG capture system that will be installed in the project activity |
| $GWP_{CH4}$ | = | Global warming potential of $CH_4$ (t $CO_2e$/t $CH_4$) |

$$BE_{CH4,SWDS,y} = \varphi_y \times (1 - f_y) \times GWP_{CH4} \times (1 - OX) \times \frac{16}{12} \times F \times DOC_{f,y} \times MCF_y \times \sum_{x=1}^{y} \sum_{j} \left( W_{j,x} \times DOC_j \times e^{-k_j \times (y-x)} \times \left(1 - e^{-k_j}\right) \right)$$

| | | |
|---|---|---|
| $BE_{CH4,SWDS,y}$<br>$PE_{CH4,SWDS,y}$<br>$LE_{CH4,SWDS,y}$ | = | Baseline, project or leakage methane emissions occurring in year *y* generated from waste disposal at a SWDS during a time period ending in year *y* (t $CO_2$e/yr) |
| $x$ | = | Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period ($x$ = 1) to year *y* ($x$ = *y*) |
| $y$ | = | Year of the crediting period for which methane emissions are calculated (*y* is a consecutive period of 12 months) |
| $DOC_{f,y}$ | = | Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year *y* (weight fraction) |
| $W_{j,x}$ | = | Amount of solid waste type *j* disposed or prevented from disposal in the SWDS in the year *x* (t) |

$$F_{CH4,flared,y} = F_{CH4,sent\_flare,y} - \frac{PE_{flare,y}}{GWP_{CH4}}$$

| | | |
|---|---|---|
| $F_{CH4,flared,y}$ | = | Amount of methane in the LFG which is destroyed by flaring in year *y* (t $CH_4$/yr) |
| $F_{CH4,sent\_flare,y}$ | = | Amount of methane in the LFG which is sent to the flare in year *y* (t $CH_4$/yr) |
| $PE_{flare,y}$ | = | Project emissions from flaring of the residual gas stream in year *y* (t $CO_2$e/yr) |
| $GWP_{CH4}$ | = | Global warming potential of $CH_4$ (t $CO_2$e/t $CH_4$) |

Baseline emissions associated with electricity generation ($BE_{EC,y}$)

$$BE_{EC,y} = \sum_{k} EC_{BL,k,y} \times EF_{EF,k,y} \times \left(1 + TDL_{k,y}\right)$$

| | | |
|---|---|---|
| $BE_{EC,y}$ | = | Baseline emissions from electricity consumption in year *y* (t $CO_2$ / yr) |
| $EC_{BL,k,y}$ | = | Quantity of electricity that would be consumed by the baseline electricity consumer *k* in year *y* (MWh/yr) |
| $EF_{EF,k,y}$ | = | Emission factor for electricity generation for source *k* in year *y* (t $CO_2$/MWh) |
| $TDL_{k,y}$ | = | Average technical transmission and distribution losses for providing electricity to source *k* in year *y* |
| $k$ | = | Sources of electricity consumption in the baseline |

## Determination of $BE_{CH4,y}$

## Flare No.2

| Month | $F_{CH4,flared,y} = F_{CH4,sent\_flare,y} - \frac{PE_{flare,y}}{GWP_{CH4}}$ | | | | | | | $F_{CH4,PJ,y} = F_{CH4,flared,y}$ | $BE_{CH4} = \left((1 - OX_{top\_layer}) \times F_{CH4,PJ,y} - F_{CH,BL,y}\right) \times GWP_{CH4}$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Quantity of LFG to Flare No.2<br>FT2 Flare No.2,y ($Nm^3$) | Methane average fraction Flare No.2<br>WCH4 | Density of Methane Flare No.2<br>DCH4 ($t/Nm^3$) | Amount of methane in LFG sent to Flare No.2<br>FCH4,sent_flare ($t_{CH4}$) | Project emissions from flaring of residual gas stream<br>PEflare ($tCO_2e$) | Global Warming Potential Flare No.2<br>GWPCH4 ($tCO_2e/tCH_4$) | Amount of methane in LFG destroyed by flaring<br>FCH4,flared ($tCH_4$) | Amount of methane in LFG flared/used in project activity<br>FCH4, PJ ($tCH_4$) | Fraction of oxidised methane in LFG in top layer of SWDS in baseline<br>$OX_{top\_layer}$ | Baseline emissions of methane from SWDS<br>$BE_{CH4}$ ($tCO_2e$) |
| 1/4/2020 - 30/4/2020 | 63,640.43 | 0.60 | 0.0007157 | 27.28 | 71.04 | 25 | 24.44 | 24.44 | 0.10 | 549.81 |
| 1/5/2020 - 31/5/2020 | 51,110.35 | 0.64 | 0.0007157 | 23.54 | 66.37 | 25 | 20.89 | 20.89 | 0.10 | 469.97 |
| 1/6/2020 - 30/6/2020 | 21,123.03 | 0.65 | 0.0007157 | 9.82 | 26.45 | 25 | 8.76 | 8.76 | 0.10 | 197.04 |
| 1/7/2020 - 31/7/2020 | 14,953.98 | 0.61 | 0.0007157 | 6.51 | 21.94 | 25 | 5.64 | 5.64 | 0.10 | 126.82 |
| 1/8/2020 - 31/8/2020 | 2,909.42 | 0.61 | 0.0007157 | 1.27 | 9.94 | 25 | 0.87 | 0.87 | 0.10 | 19.63 |
| 1/9/2020 - 30/9/2020 | 0.00 | 0.00 | 0.0007157 | 0.00 | 0.00 | 25 | 0.00 | 0.00 | 0.10 | 0.00 |
| 1/10/2020 - 31/10/2020 | 0.00 | 0.00 | 0.0007157 | 0.00 | 0.00 | 25 | 0.00 | 0.00 | 0.10 | 0.00 |
| 1/11/2020 - 30/11/2020 | 0.00 | 0.00 | 0.0007157 | 0.00 | 0.00 | 25 | 0.00 | 0.00 | 0.10 | 0.00 |
| 1/12/2020 - 31/12/2020 | 0.00 | 0.00 | 0.0007157 | 0.00 | 0.00 | 25 | 0.00 | 0.00 | 0.10 | 0.00 |

During this monitoring period, TT1, TT3, PT2, FT1, FT2, and CH4 has a delay in calibration, The equipment calibration error for all the parameters are less than the equipment accuracy error
According to VVS, version 2.0, paragraph 366 (a) stated above, the maximum permissible error of the equipment accuracy error was applied which tabulated below as a conservative approach

| No | Equipment | Calibration Date | Calibration Error | Accuracy Error | MPE applied | Period | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | TT1 | 14/12/2020 | ±0.2% | ±0.5% | ±0.5% | 17/09/2020-13/12/2020 | The impact of applying this error to the flow normalisation is negligible |
| 2 | TT3 | 14/12/2020 | ±0.05% | ±0.5% | ±0.5% | 17/09/2020-13/12/2020 | No impact as flare was shutdown |
| 3 | PT2 | 14/12/2020 | ±0.05% | ±0.1% | ±0.1% | 17/09/2020-13/12/2020 | The impact of applying this error to the flow normalisation is negligible |
| 4 | FT1 | 14/12/2020 | ±0.05% | ±1.0% | ±1.0% | 03/06/2020-13/12/2020 | There is no impact to the CER calculation due to FT1 is a backup meter |
| 5 | FT2 | 14/12/2020 | ±0.03% | ±0.5% | ±0.5% | 03/06/2020-13/12/2020 | No impact as flare was shutdown |
| 6 | CH4 | Not applicable, due to the CH4 analyser was broken and cannot be fixed, new analyser will be replaced | | ±2.0% | ±2.0% | 17/09/2020-31/12/2020 | No impact as flare was shutdown |

FT2 - The MPE was applied at Jun20_Main tab, July20_Main tab, Aug20_Main tab, Sept20_Main tab, Oct20_Main tab, Nov20_Main tab, and Dec20_Main tab (column E)
CH4 - The MPE was applied at Sept20_Main tab, Oct20_Main tab, Nov20_Main tab, and Dec20_Main tab (column F)
There was no impact for the application due to flare was shutdown for this monitoring period

**GSS1**

| Month | $BE_{CH4} = \left( \left(1 - OX_{top\_layer}\right) \times F_{CH4,PJ,y} - F_{CH,BL,y} \right) \times GWP_{CH4}$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Density of Methane GSS1 DCH4 (t/Nm3) | Quantity of Landfill Gas Fed into GSS1 FT3 LFG electricity,y ($m^3$ LFG) | Average methane fraction of the Landfill Gas Fed into GSS1 $W_{CH_4}$ | Amount of methane in LFG used for electricity generation GSS1 $F_{CH4,EL}$ ($tCH_4$) | Amount of methane in LFG flared/used in project activity GSS1 $F_{CH4,PJ}$ ($tCH_4$) | Global Warming Potential GSS1 $GWP_{CH4}$ ($tCO_2e/tCH_4$) | Fraction of oxidised methane in LFG in top layer of SWDS in baseline, GSS1 $OX_{top\_layer}$ | Baseline emissions of methane from SWDS GSS1 $BE_{CH4}$ ($tCO_2e$) |
| **1/4/2020 - 30/4/2020** | 0.0007157 | 836,477.10 | 0.61 | 368.11 | 368.11 | 25 | 0.10 | 8,282.38 |
| **1/5/2020 - 31/5/2020** | 0.0007157 | 443,887.73 | 0.63 | 200.14 | 200.14 | 25 | 0.10 | 4,503.18 |
| **1/6/2020 - 30/6/2020** | 0.0007157 | 694,083.68 | 0.60 | 300.15 | 300.15 | 25 | 0.10 | 6,753.34 |
| **1/7/2020 - 31/7/2020** | 0.0007157 | 456,215.39 | 0.65 | 211.74 | 211.74 | 25 | 0.10 | 4,764.18 |
| **1/8/2020 - 31/8/2020** | 0.0007157 | 756,906.30 | 0.57 | 310.38 | 310.38 | 25 | 0.10 | 6,983.62 |
| **1/9/2020 - 30/9/2020** | 0.0007157 | 606,854.51 | 0.62 | 267.41 | 267.41 | 25 | 0.10 | 6,016.80 |
| **1/10/2020 - 31/10/2020** | 0.0007157 | 652,693.66 | 0.59 | 273.45 | 273.45 | 25 | 0.10 | 6,152.69 |
| **1/11/2020 - 30/11/2020** | 0.0007157 | 744,656.67 | 0.59 | 312.63 | 312.63 | 25 | 0.10 | 7,034.11 |
| **1/12/2020 - 31/12/2020** | 0.0007157 | 743,587.69 | 0.59 | 311.37 | 311.37 | 25 | 0.10 | 7,005.72 |

During this monitoring period, TT1, FT3, CH4 has a delay in calibration, , The equipment calibration error for all the parameters are less than the equipment accuracy error
According to VVS, version 2.0, paragraph 366 (a) stated above, the maximum permissible error of the equipment accuracy error was applied which tabulated below as a conservative approach

| No | Equipment | Calibration Date | Calibration Error | Accuracy Error | MPE applied | Period | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | TT1 | 14/12/2020 | ±0.2% | ±1.0% | ±1.0% | 17/09/2020-13/12/2020 | The impact of applying this error to the flow normalisation is negligible |
| 2 | FT3 | 14/12/2020 | ±0.1% | ±0.5% | ±0.5% | 10/10/2020-13/12/2020 | - |
| 3 | CH4 | 14/12/2020 | ±0.0% | ±2.0% | ±2.0% | 25/07/2020-13/12/2020 | - |

FT3 - The MPE was applied at Oct20_Main tab, Nov20_Main tab, and Dec20_Main tab (column N)
CH4 - The MPE was applied at July20_Main tab, Aug20_Main tab, Sept20_Main tab, Oct20_Main tab, Nov20_Main tab, and Dec20_Main tab (column M)
TT1 - The MPE was applied and demonstrated in ER3_BTSL_Normalised Flow_GSS1_TT1_Template_170920-121220

## GSS2

| Month | $BE_{CH4} = \left(\left(1 - OX_{top\_layer}\right) \times F_{CH4,PJ,y} - F_{CH,BL,y}\right) \times GWP_{CH4}$ | | | | | | | | $BE_y = BE_{CH4,y}$ |
|---|---|---|---|---|---|---|---|---|---|
| | Density of Methane<br>GSS2<br>DCH4 (t/Nm3) | Quantity of Landfill Gas Fed into the<br>GSS2<br>FT3 LFG electricity,y ($m^3$ LFG) | Average methane fraction of the Landfill Gas Fed into the<br>GSS2<br>WCH4 | Amount of methane in LFG used for electricity generation<br>GSS2<br>FCH4,EL ($tCH_4$) | Amount of methane in LFG flared/used in project activity<br>GSS2<br>FCH4, PJ ($tCH_4$) | Global Warming Potential<br>GSS2<br>GWPCH4 ($tCO_2e/tCH_4$) | Fraction of oxidised methane in LFG in top layer of SWDS in baseline<br>GSS2<br>$OX_{top\_layer}$ | Baseline emissions of methane from SWDS<br>GSS2<br>$BE_{CH4}$ ($tCO_2e$) | Total Baseline Emissions<br>GSS2<br>($tCO_2e$) |
| 1/4/2020 - 30/4/2020 | 0.0007157 | 0.00 | 0.00 | 0.00 | 0.00 | 25 | 0.1 | 0.00 | 0.00 |
| 1/5/2020 - 31/5/2020 | 0.0007157 | 241,475.96 | 0.60 | 103.31 | 103.31 | 25 | 0.1 | 2,324.54 | 2,324.54 |
| 1/6/2020 - 30/6/2020 | 0.0007157 | 347,345.43 | 0.58 | 144.50 | 144.50 | 25 | 0.1 | 3,251.33 | 3,251.33 |
| 1/7/2020 - 31/7/2020 | 0.0007157 | 211,763.82 | 0.60 | 90.52 | 90.52 | 25 | 0.1 | 2,036.63 | 2,036.63 |
| 1/8/2020 - 31/8/2020 | 0.0007157 | 370,624.83 | 0.56 | 149.33 | 149.33 | 25 | 0.1 | 3,360.02 | 3,360.02 |
| 1/9/2020 - 30/9/2020 | 0.0007157 | 462,681.86 | 0.59 | 195.85 | 195.85 | 25 | 0.1 | 4,406.57 | 4,406.57 |
| 1/10/2020 - 31/10/2020 | 0.0007157 | 537,817.79 | 0.61 | 235.37 | 235.37 | 25 | 0.1 | 5,295.90 | 5,295.90 |
| 1/11/2020 - 30/11/2020 | 0.0007157 | 454,080.37 | 0.64 | 207.97 | 207.97 | 25 | 0.1 | 4,679.36 | 4,679.36 |
| 1/12/2020 - 31/12/2020 | 0.0007157 | 523,815.77 | 0.61 | 226.84 | 226.84 | 25 | 0.1 | 5,103.79 | 5,103.79 |

During this monitoring period, TT1, PT2, FT3, and FT7 has a delay in calibration, The equipment calibration error for all the parameters except PT2 are less than the equipment accuracy error
According to VVS, version 2.0, paragraph 366 (a) stated above, the maximum permissible error of the equipment accuracy error was applied except PT2 which tabulated below as a conservative approach
According to VVS, version 2.0, paragraph 366 (b), stated above, the maximum permissible error of ±0.8% which is the equipment calibration error was applied to PT2 as a conservative approach

| No | Equipment | Calibration Date | Calibration Error | Accuracy Error | MPE applied | Period | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | TT1 | 14/12/2020 | ±0.0% | ±0.1% | ±0.1% | 17/09/2020-13/12/2020 | The impact of applying this error to the flow normalisation is negligible |
| 2 | PT2 | 14/12/2020 | ±0.8% | ±0.075% | ±0.8% | 17/09/2020-13/12/2020 | The impact of applying this error to the flow normalisation is negligible |
| 3 | FT3 | 19/02/2021 | ±1.2% | ±2.7% | ±2.7% | 09/12/2020-31/12/2020 | - |
| 4 | FT7 | 31/03/2021 | ±0.65% | ±1.8% | ±1.8% | 01/04/2020-31/12/2020 | There is no impact to the CER calculation due to FT**7** is a backup meter, in case $GSS2_{FT3}$ malfunction, there is no malfunction of $GSS2_{FT3}$ during this monitoring period. |

FT3 - The MPE was applied at Dec20_Main tab (column R)
FT7 - The MPE was applied and demonstrated in O8 - Manual Record of FT7-FT9 MPE Apr-Dec 2020
TT1 - The MPE was applied and demonstrated in ER4_BTSL_Normalised Flow_GSS2_TT1_170920-131220
PT2 - The MPE was applied and demonstrated in ER4_BTSL_Normalised Flow_GSS2_PT2_170920-131220

**GSS3**

| Month | $BE_{CH4} = \left(\left(1 - OX_{top\_layer}\right) \times F_{CH4,PJ,y} - F_{CH,BL,y}\right) \times GWP_{CH4}$ | | | | | | | | $BE_y = BE_{CH4,y}$ |
|---|---|---|---|---|---|---|---|---|---|
| | Density of Methane GSS 3 DCH4 (t/Nm3) | Quantity of Landfill Gas Fed into the GSS 3 FT3 LFG electricity,y ($m^3$ LFG) | Average methane fraction of the Landfill Gas Fed into the GSS 3 WCH4 | Amount of methane in LFG used for electricity generation GSS 3 FCH4,EL ($tCH_4$) | Amount of methane in LFG flared/used in project activity GSS 3 FCH4, PJ ($tCH_4$) | Global Warming Potential GSS 3 GWPCH4 ($tCO_2e/tCH_4$) | Fraction of oxidised methane in LFG in top layer of SWDS in baseline GSS 3 $OX_{top\_layer}$ | Baseline emissions of methane from SWDS GSS 3 $BE_{CH4}$ ($tCO_2e$) | Total Baseline Emissions GSS 3 ($tCO_2e$) |
| **1/4/2020 - 30/4/2020** | 0.0007157 | 1,313,140.59 | 0.626 | 588.18 | 588.18 | 25 | 0.1 | 13,234.04 | 13,234.04 |
| **1/5/2020 - 31/5/2020** | 0.0007157 | 702,245.10 | 0.647 | 325.29 | 325.29 | 25 | 0.1 | 7,318.99 | 7,318.99 |
| **1/6/2020 - 30/6/2020** | 0.0007157 | 780,442.48 | 0.571 | 318.98 | 318.98 | 25 | 0.1 | 7,176.98 | 7,176.98 |
| **1/7/2020 - 31/7/2020** | 0.0007157 | 1,040,717.04 | 0.565 | 420.50 | 420.50 | 25 | 0.1 | 9,461.14 | 9,461.14 |
| **1/8/2020 - 31/8/2020** | 0.0007157 | 1,056,031.61 | 0.566 | 427.53 | 427.53 | 25 | 0.1 | 9,619.49 | 9,619.49 |
| **1/9/2020 - 30/9/2020** | 0.0007157 | 936,597.23 | 0.574 | 385.04 | 385.04 | 25 | 0.1 | 8,663.35 | 8,663.35 |
| **1/10/2020 - 31/10/2020** | 0.0007157 | 1,076,489.98 | 0.581 | 447.70 | 447.70 | 25 | 0.1 | 10,073.26 | 10,073.26 |
| **1/11/2020 - 30/11/2020** | 0.0007157 | 943,054.61 | 0.599 | 404.33 | 404.33 | 25 | 0.1 | 9,097.43 | 9,097.43 |
| **1/12/2020 - 31/12/2020** | 0.0007157 | 905,284.17 | 0.594 | 385.05 | 385.05 | 25 | 0.1 | 8,663.53 | 8,663.53 |

Referring to demo power upload tab (table 3, cell N53, N55, N56, and N57) in the CER sheet, the actual amount of LFG fed to GSS3 for Aug 2020, Oct - Dec 2020 is more than the amount of LFG required to generate 6.6MW, therefore additional actual LFG fed to gas engines is deducted from the CER sheet (Refer to BECH4_GSS 3 tab, cell C29, C31, C32, and C33)

During this monitoring period, TT1, PT2, FT3, FT8, and FT9 has a delay in calibration, The equipment calibration error for TT1, FT8, and FT9 are less than the equipment accuracy error
According to VVS, version 2.0, paragraph 366 (a) stated above, the maximum permissible error of the equipment accuracy error was applied to TT1, FT8, FT9, EL14 and EL15 as a conservative approach
The equipment calibration error for PT2 and FT3 are more than the equipment accuracy error, according to VVS, version 2.0, paragraph 366 (b),
the maximum permissible error of the equipment calibration error was applied to PT2 and FT3 as a conservative approach

| No | Equipment | Calibration Date | Calibration Error | Accuracy Error | MPE applied | Period | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | TT1 | 14/12/2020 | ±0.2% | ±2.0% | ±2.0% | 01/04/2020-13/12/2020 | The impact of applying this error to the flow normalisation is negligible |
| 2 | PT2 | 14/12/2020 | ±0.25% | ±0.15% | ±0.25% | 01/04/2020-13/12/2020 | The impact of applying this error to the flow normalisation is negligible |
| 3 | FT3 | 14/12/2020 | ±0.16% | ±0.065% | ±0.16% | 16/08/2020–13/12/2020 | - |
| 4 | FT8 | 06/04/2021 | ±2.6% | ±1.0% | ±2.6% | 25/07/2020 – 31/12/2020 | There is no impact to the CER calculation due to FT8 is a backup meter |
| 5 | FT9 | 06/04/2021 | ±2.6% | ±1.0% | ±2.6% | 25/07/2020 – 31/12/2020 | There is no impact to the CER calculation due to FT9 is a backup meter |

TT1 - The MPE was applied and demonstrated in ER5_BTSL_Normalised Flow_GSS3_TT1_010420-131220
PT2 - The MPE was applied and demonstrated in ER5_BTSL_Normalised Flow_GSS3_PT2_010420-131220
FT3 - The MPE was applied at Aug20_Main tab, Sept20_Main tab, Oct20_Main tab, Nov20_Main tab and Dec20_Main tab (column V)
FT8 & FT9 - The MPE was applied and demonstrated in O8 - Manual Record of FT7-FT9 MPE Apr-Dec 2020

**GSSF1**

$$BE_{CH4} = \left( \left(1 - OX_{top\_layer}\right) \times F_{CH4,PJ,y} - F_{CH,BL,y} \right) \times GWP_{CH4}$$

| Month | Density of Methane GSSF1<br>DCH4 (t/Nm3) | Quantity of Landfill Gas Fed into GSSF1<br>FT3 LFG electricity,y ($m^3$ LFG) | Average methane fraction of the Landfill Gas Fed into GSSF1<br>$W_{CH_4}$ | Amount of methane in LFG used for electricity generation GSSF1<br>$F_{CH4,EL}$ ($tCH_4$) | Amount of methane in LFG flared/used in project activity GSSF1<br>$F_{CH4,PJ}$ ($tCH_4$) | Global Warming Potential GSSF1<br>$GWP_{CH4}$ ($tCO_2e/tCH_4$) | Fraction of oxidised methane in LFG in top layer of SWDS in baseline, GSSF1<br>$OX_{top\_layer}$ | Baseline emissions of methane from SWDS GSSF1<br>$BE_{CH4}$ ($tCO_2e$) |
|---|---|---|---|---|---|---|---|---|
| **1/4/2020 - 30/4/2020** | 0.0007157 | 429,996.96 | 0.64 | 195.71 | 195.71 | 25 | 0.10 | 4,403.42 |
| **1/5/2020 - 31/5/2020** | 0.0007157 | 374,177.82 | 0.64 | 171.41 | 171.41 | 25 | 0.10 | 3,856.77 |
| **1/6/2020 - 30/6/2020** | 0.0007157 | 376,161.93 | 0.63 | 169.68 | 169.68 | 25 | 0.10 | 3,817.77 |
| **1/7/2020 - 31/7/2020** | 0.0007157 | 288,459.38 | 0.61 | 126.91 | 126.91 | 25 | 0.10 | 2,855.47 |
| **1/8/2020 - 31/8/2020** | 0.0007157 | 409,622.91 | 0.63 | 183.60 | 183.60 | 25 | 0.10 | 4,130.92 |
| **1/9/2020 - 30/9/2020** | 0.0007157 | 347,313.85 | 0.62 | 153.76 | 153.76 | 25 | 0.10 | 3,459.65 |
| **1/10/2020 - 31/10/2020** | 0.0007157 | 469,060.77 | 0.62 | 207.31 | 207.31 | 25 | 0.10 | 4,664.53 |
| **1/11/2020 - 30/11/2020** | 0.0007157 | 386,816.54 | 0.62 | 171.38 | 171.38 | 25 | 0.10 | 3,856.04 |
| **1/12/2020 - 31/12/2020** | 0.0007157 | 424,988.36 | 0.62 | 188.22 | 188.22 | 25 | 0.10 | 4,234.93 |

During this monitoring period, TT1, PT2, and CH4 has a delay in calibration has a delay in calibration, The equipment calibration error for CH4 is less than the equipment accuracy error
According to VVS, version 2.0, paragraph 366 (a) stated above, the maximum permissible error of the equipment accuracy error was applied to CH4 as a conservative approach
On the other hand, The equipment calibration error for TT1 and PT2 are more than the equipment accuracy error, according to VVS, version 2.0, paragraph 366 (b),
the maximum permissible error of the equipment calibration error was applied to TT1 and PT2 as a conservative approach.

| No | Equipment | Calibration Date | Calibration Error | Accuracy Error | MPE applied | Period | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | TT1 | 14/12/2020 | ±0.2% | ±0.05% | ±0.2% | 17/09/2020-13/12/2020 | The impact of applying this error to the flow normalisation is negligible |
| 2 | PT2 | 14/12/2020 | ±0.7% | ±0.25% | ±0.7% | 17/09/2020-13/12/2020 | The impact of applying this error to the flow normalisation is negligible |
| 3 | CH4 | 14/12/2020 | ±0.0% | ±1.0% | ±1.0% | 04/06/2020-13/12/2020 | - |

CH4 - The MPE was applied at June20_Main tab, July20_Main tab, Aug20_Main tab, Sept20_Main tab, Oct20_Main tab, Nov20_Main tab, and Dec20_Main tab (column I)
TT1 - The MPE was applied and demonstrated in ER2_BTSL_Normalised Flow_GSSF1_TT1_Template_170920-121220
PT2 - The MPE was applied and demonstrated in ER2_BTSL_Normalised Flow_GSSF1_PT2_170920-131220

**Determination of $BE_{EC, y}$**

**GSS1**

| Month | $BE_{EC,y} = \sum_k EC_{BL,k,y} \times EF_{EF,k,y} \times (1 + TDL_{k,y})$ | | | |
|---|---|---|---|---|
| | Quantity of electricity generated GSS 1 $EC_{BL,k}$ (MWh) | Emission factor for electricity generation GSS1 $FE_{EL,k}$ ($tCO_2$/MWh) | Average technical transmission and distribution losses GSS1 $TDL_k$ | Baseline emission for electricity GSS1 $BE_{EC,y}$ ($tCO_2$) |
| 1/4/2020 - 30/4/2020 | 1,270.89 | 0.7146 | 0.0774 | 978.47 |
| 1/5/2020 - 31/5/2020 | 724.65 | 0.7146 | 0.0774 | 557.92 |
| 1/6/2020 - 30/6/2020 | 1,031.21 | 0.7146 | 0.0774 | 793.94 |
| 1/7/2020 - 31/7/2020 | 734.68 | 0.7146 | 0.0774 | 565.64 |
| 1/8/2020 - 31/8/2020 | 1,067.46 | 0.7146 | 0.0774 | 821.85 |
| 1/9/2020 - 30/9/2020 | 911.77 | 0.7146 | 0.0774 | 701.98 |
| 1/10/2020 - 31/10/2020 | 966.23 | 0.7146 | 0.0774 | 743.91 |
| 1/11/2020 - 30/11/2020 | 1,245.69 | 0.7146 | 0.0774 | 959.07 |
| 1/12/2020 - 31/12/2020 | 1,226.79 | 0.7146 | 0.0774 | 944.51 |

During this monitoring period, EL9 and EL10 has a delay in calibration, , The equipment calibration error for all the parameters are less than the equipment accuracy error
According to VVS, version 2.0, paragraph 366 (a) stated above, the maximum permissible error of the equipment accuracy error was applied which tabulated below as a conservative approach

| No | Equipment | Calibration Date | Calibration Error | Accuracy Error | MPE applied | Period | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | EL9 | 09/12/2020 | ±0.13% | ±0.5% | ±0.5% | 01/04/2020-08/12/2020 | - |
| 2 | EL10 | 09/12/2020 | ±0.27% | ±0.5% | ±0.5% | 01/04/2020-08/12/2020 | - |

EL9 and EL10 - The MPE was applied at Apr 20 EL PJ, May 20 EL PJ, June 20 EL PJ, July 20 EL PJ, Aug 20 EL PJ, Sept 20 EL PJ, Oct 20 EL PJ, Nov 20 EL PJ, and Dec 20 EL PJ (cell F17)
EL11 - The MPE of ±0.5% was applied at Apr 20 EL PJ, May 20 EL PJ, June 20 EL PJ, July 20 EL PJ, Aug 20 EL PJ, Sept 20 EL PJ, Oct 20 EL PJ, Nov 20 EL PJ, and Dec 20 EL PJ (cell G17)

**GSS2 and GSS3**

| Month | $BE_{EC,y} = \sum_k EC_{BL,k,y} \times EF_{EF,k,y} \times (1 + TDL_{k,y})$ | | | | $BE_y = BE_{EC,y}$ |
|---|---|---|---|---|---|
| | Quantity of electricity generated<br>GSS 2 + GSS 3<br>ECBL,k (MWh) | Emission factor for electricity generation<br>GSS 2 + GSS 3<br>EFEL,k ($tCO_2$/MWh) | Average technical transmission and distribution losses<br>GSS 2 + GSS 3<br>TDLk | Baseline emission for electricity<br>GSS 2 + GSS 3<br>$BE_{EC,y}$($tCO_2$) | Total Baseline Emissions<br>GSS 2 + GSS 3<br>($tCO_2e$) |
| 1/4/2020 - 30/4/2020 | 2,206.02 | 0.7146 | 0.0774 | 1698.43 | 1,698.43 |
| 1/5/2020 - 31/5/2020 | 1,853.66 | 0.7146 | 0.0774 | 1427.15 | 1,427.15 |
| 1/6/2020 - 30/6/2020 | 2,235.36 | 0.7146 | 0.0774 | 1721.03 | 1,721.03 |
| 1/7/2020 - 31/7/2020 | 2,356.99 | 0.7146 | 0.0774 | 1814.67 | 1,814.67 |
| 1/8/2020 - 31/8/2020 | 2,842.98 | 0.7146 | 0.0774 | 2188.84 | 2,188.84 |
| 1/9/2020 - 30/9/2020 | 2,805.72 | 0.7146 | 0.0774 | 2160.15 | 2,160.15 |
| 1/10/2020 - 31/10/2020 | 3,202.95 | 0.7146 | 0.0774 | 2465.99 | 2,465.99 |
| 1/11/2020 - 30/11/2020 | 2,485.23 | 0.7146 | 0.0774 | 1913.40 | 1,913.40 |
| 1/12/2020 - 31/12/2020 | 2,675.96 | 0.7146 | 0.0774 | 2060.25 | 2,060.25 |

Referring to demo power upload tab (table 2, cell N27, N29, N30, and N31) in CER sheet, the power upload (MW) to grid for Aug 2020, Oct - Dec 2020 is more than 6.6MW, therefore additional power is deducted from the CER sheet (Refer to BEEC_GE4&GE5&GE6 tab, cell B19, B21, B22, and B23).

During this monitoring period, EL12, EL14 and EL15 has a delay in calibration, The equipment calibration error for all the parameters are less than the equipment accuracy error
According to VVS, version 2.0, paragraph 366 (a) stated above, the maximum permissible error of the equipment accuracy error was applied to EL12, EL14 and EL15 as a conservative approach

| No | Equipment | Calibration Date | Calibration Error | Accuracy Error | MPE applied | Period | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | EL12 | 09/12/2020 | ±0.13% | ±0.5% | ±0.5% | 07/08/2020-08/12/2020 | - |
| 2 | EL14 | 09/12/2020 | ±0.05% | ±0.5% | ±0.5% | 26/04/2020-08/12/2020 | - |
| 3 | EL15 | 09/12/2020 | ±0.13% | ±0.5% | ±0.5% | 26/04/2020-08/12/2020 | - |

EL12 - The MPE was applied at Aug 20 EL PJ, Sept 20 EL PJ, Oct 20 EL PJ, Nov 20 EL PJ, and Dec 20 EL PJ (cell H17)
EL14 - The MPE of ±0.5% was applied at Apr 20 EL PJ, May 20 EL PJ, June 20 EL PJ, July 20 EL PJ, Aug 20 EL PJ, Sept 20 EL PJ, Oct 20 EL PJ, Nov 20 EL PJ, and Dec 20 EL PJ (cell I17)
EL15 - The MPE of ±0.5% was applied at Apr 20 EL PJ, May 20 EL PJ, June 20 EL PJ, July 20 EL PJ, Aug 20 EL PJ, Sept 20 EL PJ, Oct 20 EL PJ, Nov 20 EL PJ, and Dec 20 EL PJ (cell J17)

**GSSF1**

| Month | $BE_{EC,y} = \sum_k EC_{BL,k,y} \times EF_{EF,k,y} \times (1 + TDL_{k,y})$ | | | |
|---|---|---|---|---|
| | Quantity of electricity generated GSSF1<br>$EC_{BL,k}$ (MWh) | Emission factor for electricity generation GSSF1<br>$EF_{EL,k}$ ($tCO_2/MWh$) | Average technical transmission and distribution losses GSSF1<br>$TDL_k$ | Baseline emission for electricity GSSF1<br>$BE_{EC,y}$ ($tCO_2$) |
| 1/4/2020 - 30/4/2020 | 537.10 | 0.7146 | 0.0774 | 413.52 |
| 1/5/2020 - 31/5/2020 | 509.06 | 0.7146 | 0.0774 | 391.93 |
| 1/6/2020 - 30/6/2020 | 559.85 | 0.7146 | 0.0774 | 431.04 |
| 1/7/2020 - 31/7/2020 | 464.05 | 0.7146 | 0.0774 | 357.28 |
| 1/8/2020 - 31/8/2020 | 566.95 | 0.7146 | 0.0774 | 436.50 |
| 1/9/2020 - 30/9/2020 | 523.25 | 0.7146 | 0.0774 | 402.85 |
| 1/10/2020 - 31/10/2020 | 670.95 | 0.7146 | 0.0774 | 516.57 |
| 1/11/2020 - 30/11/2020 | 636.80 | 0.7146 | 0.0774 | 490.28 |
| 1/12/2020 - 31/12/2020 | 687.93 | 0.7146 | 0.0774 | 529.65 |

For this project, the following applies:

1. With reference to ACM0001, Version 18.0, page 21, $EC_{BL,k,y}$ is equivalent to the net amount of electricity generated using LFG in year *y* ($EG_{PJ,y}$). $EF_{EL,k,y} = EF_{grid,CM,y}$ *and therefore,* $BE_{EC,y} = \Sigma\ EG_{PJ,y} \times EF_{grid,CM,y} \times (1 + TDL_{k,y})$.
2. The total electricity generated ($EL_{LFG,y}$) is the amount based on the monthly invoices to the grid operator (Tenaga National Berhad (TNB)) which is also the lower reading from the comparison between (EL4 + EL9 + EL10 + EL12) and (EL5 + EL11 + EL16).
3. EL5 - The MPE of ±0.2% was applied at Apr 20 EL PJ, May 20 EL PJ, June 20 EL PJ, July 20 EL PJ, Aug 20 EL PJ, Sept 20 EL PJ, Oct 20 EL PJ, Nov 20 EL PJ, and Dec 20 EL PJ (cell C17)

**Total Baseline Emissions**

$BE_y = BE_{CH4,y} + BE_{EC,y}$

| Month | $BE_{CH4,y}$ | | | | | Total $BE_{CH4}$ | $BE_{EC,y}$ | | | Total $BE_{EC}$ | Total $BE_y$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flare No.2 | GSS1 | GSS2 | GSSF1 | GSS3 | | GSS1 | GSSF1 | GSS2 + GGS3 | | |
| **1/4/2020 - 30/4/2020** | 549 | 8,282 | 0 | 4,403 | 13,234 | 26,468 | 978 | 413 | 1,698 | 3,089 | 29,557 |
| **1/5/2020 - 31/5/2020** | 469 | 4,503 | 2,324 | 3,856 | 7,318 | 18,470 | 557 | 391 | 1,427 | 2,375 | 20,845 |
| **1/6/2020 - 30/6/2020** | 197 | 6,753 | 3,251 | 3,817 | 7,176 | 21,194 | 793 | 431 | 1,721 | 2,945 | 24,139 |
| **1/7/2020 - 31/7/2020** | 126 | 4,764 | 2,036 | 2,855 | 9,461 | 19,242 | 565 | 357 | 1,814 | 2,736 | 21,978 |
| **1/8/2020 - 31/8/2020** | 19 | 6,983 | 3,360 | 4,130 | 9,619 | 24,111 | 821 | 436 | 2,188 | 3,445 | 27,556 |
| **1/9/2020 - 30/9/2020** | 0 | 6,016 | 4,406 | 3,459 | 8,663 | 22,544 | 701 | 402 | 2,160 | 3,263 | 25,807 |
| **1/10/2020 - 31/10/2020** | 0 | 6,152 | 5,295 | 4,664 | 10,073 | 26,184 | 743 | 516 | 2,465 | 3,724 | 29,908 |
| **1/11/2020 - 30/11/2020** | 0 | 7,034 | 4,679 | 3,856 | 9,097 | 24,666 | 959 | 490 | 1,913 | 3,362 | 28,028 |
| **1/12/2020 - 31/12/2020** | 0 | 7,005 | 5,103 | 4,234 | 8,663 | 25,005 | 944 | 529 | 2,060 | 3,533 | 28,538 |
| **Total** | **1,360** | **57,492** | **30,454** | **35,274** | **83,304** | **207,884** | **7,061** | **3,965** | **17,446** | **28,472** | **236,356** |

Note: The Baseline Emission figure has been rounded down for conservativeness

## E.2. Calculation of project emissions or actual net removals

The total project emissions according to ACM0001 (Version 18.0) were estimated according to the equations below:

$$PE_y = PE_{EC,y} + PE_{FC,y} + PE_{DT,y} + PE_{SP,y}$$

$PE_y$ = Project emissions in year $y$ (t $CO_2$/yr)

$PE_{EC,y}$ = Emissions from consumption of electricity due to the project activity in year $y$ (t $CO_2$/yr)

$PE_{FC,y}$ = Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year $y$ (t $CO_2$/yr)

$PE_{DT,y}$ = Emissions from the distribution of compressed/liquefied LFG using trucks, in year $y$ (t $CO_2$/yr)

$PE_{SP,y}$ = Emissions from the supply of LFG to consumers through a dedicated pipeline, in year $y$ (t $CO_2$/yr)

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EF,j,y} \times (1 + TDL_{j,y})$$

$PE_{EC,y}$ = Project emissions from electricity consumption in year $y$ (t $CO_2$ / yr)

$EC_{PJ,j,y}$ = Quantity of electricity consumed by the project electricity consumption source $j$ in year $y$ (MWh/yr)

$EF_{EF,j,y}$ = Emission factor for electricity generation for source $j$ in year $y$ (t $CO_2$/MWh)

$TDL_{j,y}$ = Average technical transmission and distribution losses for providing electricity to source $j$ in year $y$

$j$ = Sources of electricity consumption in the project

| Month | Electricity consumed by project activity<br>ELPJ,y (MWh) | Coefficient for grid electricity<br>EF grid,y | Transmission and Distribution Losses<br>TDL,y | Total Project Emission from project activity<br>(tCO2e) |
|---|---|---|---|---|
| 1/4/2020 - 30/4/2020 | 270.54 | 0.7146 | 0.0774 | 208.29 |
| 1/5/2020 - 31/5/2020 | 240.07 | 0.7146 | 0.0774 | 184.83 |
| 1/6/2020 - 30/6/2020 | 286.78 | 0.7146 | 0.0774 | 220.79 |
| 1/7/2020 - 31/7/2020 | 331.62 | 0.7146 | 0.0774 | 255.32 |
| 1/8/2020 - 31/8/2020 | 321.23 | 0.7146 | 0.0774 | 247.31 |
| 1/9/2020 - 30/9/2020 | 292.47 | 0.7146 | 0.0774 | 225.18 |
| 1/10/2020 - 31/10/2020 | 316.66 | 0.7146 | 0.0774 | 243.80 |
| 1/11/2020 - 30/11/2020 | 295.74 | 0.7146 | 0.0774 | 227.69 |
| 1/12/2020 - 31/12/2020 | 301.13 | 0.7146 | 0.0774 | 231.84 |

$PE_{FC,j,y}$, for this project, is the emission from diesel backup generators.

| Month | Quantity of diesel combusted (Liter) | Diesel Density (kg/l) | Quantity of diesel combusted (t/month) | $COEF_{diesel,y} = NCV_{diesel,j} \times EF_{CO2,diesel,y}$ | | | Total Project Emission from project activity |
|---|---|---|---|---|---|---|---|
| | | | | Weighted average net calorific value of diesel (GJ/t) | Weighted average $CO_2$ emission factor of diesel | $CO_2$ emission coefficient of diesel ($tCO_2$/mass of volume unit) | |
| | | | $FC_{diesel}$ | $NCV_{diesel,j}$ | $EF_{CO2,diesel,y}$ | $COEF_{diesel,y}$ | (tCO2e) |
| 1/4/2020 - 30/4/2020 | 6 | 0.84 | 0.01 | 43 | 0.0741 | 3.19 | 0.02 |
| 1/5/2020 - 31/5/2020 | 3 | 0.84 | 0.00 | 43 | 0.0741 | 3.19 | 0.01 |
| 1/6/2020 - 30/6/2020 | 4 | 0.84 | 0.00 | 43 | 0.0741 | 3.19 | 0.01 |
| 1/7/2020 - 31/7/2020 | 3 | 0.84 | 0.00 | 43 | 0.0741 | 3.19 | 0.01 |
| 1/8/2020 - 31/8/2020 | 4 | 0.84 | 0.00 | 43 | 0.0741 | 3.19 | 0.01 |
| 1/9/2020 - 30/9/2020 | 4 | 0.84 | 0.00 | 43 | 0.0741 | 3.19 | 0.01 |
| 1/10/2020 - 31/10/2020 | 5 | 0.84 | 0.00 | 43 | 0.0741 | 3.19 | 0.01 |
| 1/11/2020 - 30/11/2020 | 6 | 0.84 | 0.01 | 43 | 0.0741 | 3.19 | 0.02 |
| 1/12/2020 - 31/12/2020 | 3 | 0.84 | 0.00 | 43 | 0.0741 | 3.19 | 0.01 |

## Total Project Emissions

$PE_y = PE_{EC,y} + PE_{FC,y}$

| Month | $PE_{EC}$ | $PE_{FC}$ | Total $PE_y$ |
|---|---|---|---|
| 1/4/2020 - 30/4/2020 | 209 | 1 | 210 |
| 1/5/2020 - 31/5/2020 | 185 | 1 | 186 |
| 1/6/2020 - 30/6/2020 | 221 | 1 | 222 |
| 1/7/2020 - 31/7/2020 | 256 | 1 | 257 |
| 1/8/2020 - 31/8/2020 | 248 | 1 | 249 |
| 1/9/2020 - 30/9/2020 | 226 | 1 | 227 |
| 1/10/2020 - 31/10/2020 | 244 | 1 | 245 |
| 1/11/2020 - 30/11/2020 | 228 | 1 | 229 |
| 1/12/2020 - 31/12/2020 | 232 | 1 | 233 |
| **Total** | **2,049** | **9** | **2,058** |

Note: The project emission has been rounded up for conservativeness

## E.3. Calculation of leakage emissions

No leakage emissions.

## E.4. Calculation of emission reductions or net anthropogenic removals

| | Baseline GHG emissions or baseline net GHG removals (t $CO_2e$) | Project GHG emissions or actual net GHG removals (t $CO_2e$) | Leakage GHG emissions (t $CO_2e$) | GHG emission reductions or net anthropogenic GHG removals (t $CO_2e$) | | | |
|---|---|---|---|---|---|---|---|
| | | | | Before 01/01/ 2013 | From 01/01/ 2013 until 31/12/ 2020 | From 01/01/ 2021 | Total amount |
| **Total** | 236,356 | 2,058 | 0 | N/A | 234,298 | NA | 234,298 |

## E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD

| Amount achieved during this monitoring period (t $CO_2e$) | Amount estimated ex ante for this monitoring period in the PDD (t $CO_2e$) |
|---|---|
| 234,298 | 206,294* |

### E.5.1. Explanation of calculation of "amount estimated ex ante for this monitoring period in the PDD"

The total CER estimated for 2020 (01/01/2020 – 31/12/2020) in PDD version 21.3 is 274,559 $tCO_2e$, there is 366 days in 2020, as a result, the CER per day for 2020 is 750 $tCO_2e$, total CER estimated for 01/04/2020 – 31/12/2020 (275 days) is 206,294 $tCO_2e$.

## E.6. Remarks on increase in achieved emission reductions

The total CERs achieved in the 5$^{th}$ monitoring period of 2$^{nd}$ crediting period was 13.57% higher as compared to the value reported in the ex-ante calculations.

The total increase of 13.57% is due to the following reasons:

1. The ex-post average methane concentration is 61% which is higher compared to the ex-ante value of 50% (Default value as applied stated in CER sheet, version 21).
2. Average operating hour for all engines is 83% compared to 90% applied in CER sheet, version 21

## E.7. Remarks on scale of small-scale project activity

Not applicable.

# Appendix 1: Details on the downtime of Flare No.2

| Date | Time | | Problem Description |
|---|---|---|---|
| | Shut Down | Restart | |
| 1/4/2020 | 0:00 | 7/4/2020 14:39 | - Proper shutdown - to check on gas stability. |
| 10/4/2020 | 10:51 | 30/4/2020 23:59 | - Proper shutdown - to check on gas stability. |
| 1/5/2020 | 00:00 | 15/5/2020 10:10 | - Proper shutdown - to check gas stability. |
| 18/5/2020 | 15:30 | 31/5/2020 23:59 | - Proper shutdown - to check gas stability. |
| 1/6/2020 | 00:00 | 4/6/2020 16:01 | - Proper shutdown - to check gas stability. |
| 5/6/2020 | 18:12 | 30/6/2020 23:59 | - Proper shutdown - to check gas stability. |
| 1/7/2020 | 00:00 | 6/7/2020 07:25 | - Proper shutdown - to check gas stability. |
| 7/7/2020 | 09:25 | 31/7/2020 23:59 | - Proper shutdown - to check gas stability. |
| 1/8/2020 | 00:00 | 26/8/2020 09:21 | - Proper shutdown - to check gas stability. |
| 26/8/2020 | 14:35 | 31/8/2020 23:59 | - Proper shutdown - to check gas stability. |
| 1/9/2020 | 00:00 | 30/9/2020 23:59 | - Proper shutdown - to check gas stability. |
| 1/10/2020 | 00:00 | 30/10/2020 23:59 | - Proper shutdown - to check gas stability. |
| 1/11/2020 | 00:00 | 30/11/2020 23:59 | - Proper shutdown - to check gas stability. |
| 1/12/2020 | 00:00 | 31/12/2020 23:59 | Proper shutdown - to check gas stability. |

# Appendix 2: Details on the downtime of Gas Engine No.1, No.2, No.3, No.4, No.5 and No.6

**Gas Engine No.1**

| Date | Time | | Problem Description |
|---|---|---|---|
| | Shut Down | Restart | |
| 12/5/2020 | 08:37 | 15:38 | Proper shutdown for normal service at 1,500 hrs interval by SPE. |
| 20/5/2020 | 18:22 | 23:49 | Collective faulty can - BNS. |
| 21/5/2020 | 08:15 | 08:26 | Proper shutdown - to check on gas quality. |
| 22/8/2020 | 12:38 | 13:34 | Proper shutdown - to check on gas filler + air intake filter. |
| | 16:57 | 17:13 | TNB power surge few seconds. HT pump trip. |
| 29/5/2020 | 09:50 | 18:09 | Proper shutdown - for panel modification works |
| 5/6/2020 | 11:28 | 12:45 | Proper shutdown - to check on engine load unstable. |
| | 12:14 | 12:45 | Proper shutdown - to check on throttle valve. |
| | 15:43 | 16:55 | To change throttle valve end rod. |
| 6/6/2020 | 10:32 | 10:55 | Combustion chamber A6. |
| 12/6/2020 | 14:49 | 18:12 | Combustion chamber B. |
| 17/6/2020 | 21:32 | 22:43 | TNB power failure. Site total shutdown. |
| 18/6/2020 | 14:37 | 15:29 | Proper shutdown - to check on crankcase issue - pressure high (Negative valve) |
| | 16:06 | 16:29 | Proper shutdown - to check on crankcase issue - pressure high (Negative valve) |
| 26/6/2020 | 09:09 | 09:09 | Proper shutdown - To swap crankcase regulator from GE2 to GE1. |
| | 10:38 | 11:33 | Combustion chamber A5, clean sparks plug, combustion chamber B2. |
| | 15:06 | 16:13 | TNB power surge few minutes. |
| 30/6/2020 | 11:06 | 11:33 | Combustion chamber B2. Restart Gas engine. |
| 30/6/2020 | 12:27 | 14:09 | Combustion chamber B6. Change sparks plug. |
| 5/7/2020 | 07:01 | 09:36 | Engine speed. Air compressor faulty. |
| 8/7/2020 | 10:17 | 9/7/2020 22:03 | TNB power surge few seconds. HT pump trip overload. SPE to change HT pump. |
| 15/7/2020 | 09:29 | 20:14 | Proper shutdown for Pre-treatment service ( i- GDU ii- Radiator iii- Scrubber tank ). |
| 19/7/2020 | 06:55 | 07:58 | Engine speed. Air compressor for solenoid valve failure. |
| 21/7/2020 | 07:44 | 07:55 | Combustion chamber B6. Change spark plug GE2. |
| 20/7/2020 | 15:49 | 16:17 | Proper shutdown - to change HT pump rotation. |
| 22/7/2020 | 15:25 | 15:49 | TNB power surge few seconds. |
| 23/7/2020 | 11:33 | 11:57 | TNB power surge few seconds. |
| 25/7/2020 | 10:17 | 11:41 | TNB power failure. |
| 28/7/2020 | 08:43 | 14:30 | TNB power failure. |
| 31/7/2020 | 07:09 | 07:40 | TNB power failure. |
| | 12:24 | 12:52 | Generator Bearing A. |
| 1/8/2020 | 20:05 | 20:54 | Engine speed. Compressor GSSF1 faulty. Change with spare unit (Repaired unit). |
| 9/8/2020 | 09:45 | 14:35 | GSSF1 trip. Air compressor faulty. |
| 10/8/2020 | 13:40 | 15:13 | TNB power failure. Site total shutdown. |
| | 17:24 | 18:38 | TNB power failure. Site total shutdown. |
| | 19:31 | 11/8/2020 10:01 | Combustion chamber B5. Change with spare unit. Unable to restart immediately due to Voltage drop (TNB). |
| 14/8/2020 | 17:57 | 20:21 | TNB power failure. Site total shutdown. |

| Date | Time | | Problem Description |
|---|---|---|---|
| | Shut Down | Restart | |
| 16/8/2020 | 17:20 | 19:06 | TNB power failure. Site total shutdown. |
| 18/8/2020 | 08:52 | 11:46 | TNB power failure. Site total shutdown. |
| 3/9/2020 | 00:59 | 01:14 | Combustion chamber B5. Clean Spark plug. |
| 5/9/2020 | 10:40 | 11:27 | TNB Power failure few minutes. |
| 7/9/2020 | 20:18 | 20:38 | Combustion chamber B4. Change spark plug spare unit. |
| 10/9/2020 | 15:02 | 15:53 | TNB power surge few seconds, Jacket water engine outlet , HT Pump trip. |
| 16/9/2020 | 07:48 | 08:08 | Combustion chamber B5.Change Spark plug,spare unit GE2. |
| 18/9/2020 | 09:24 | 19/9/2020 19:41 | Proper shutdown - For GBS 2 pipe connection to main gas pipe.2 main pipe location phase 2 and phase 3. |
| 23/9/2020 | 17:53 | 18:50 | Proper shutdown to remove condensate water inside scrubber tank. |
| 25/9/2020 | 07:34 | 09:13 | TNB Power failure. Site total shutdown. |
| 30/9/2020 | 14:44 | 16:06 | Engine speed (Air compressor faulty) |
| 7/10/2020 | 19:45 | 19:58 | Combustion chamber B1. Change with spare unit. |
| 8/10/2020 | 13:54 | 16:26 | Proper shutdown to remove condensate water from scrubber tank. |
| 17/10/2020 | 07:54 | 09:00 | Proper shutdown to service air compressor for solenoid valve. |
| 19/10/2020 | 09:06 | 11:33 | Proper shutdown to service GSS F1 flame arrestor + moisture separator. |
| 23/10/2020 | 08:35 | 09:33 | Combustion chamber average. GSS F1 trip. |
| 24/10/2020 | 15:27 | 16:38 | Combustion chamber A5, change spark plug. |
| 3/11/2020 | 15:01 | 15:41 | GSSF1 trip, Computer and PLC Shutdown. |
| 5/11/2020 | 19:16 | 19:48 | Combustion chamber B4. Change Spark plug. |
| 13/11/2020 | 16:47 | 14:50 | Combustion chamber A3. Change Spark plug. Gas mixer jammed, SPE to service. |
| 16/11/2020 | 17:06 | 18:13 | TNB Power failure, Site total Shutdown. |
| 23/11/2020 | 08:51 | 18:07 | Proper shutdown for normal service at 1,500hrs internal by SPE. |
| 24/11/2020 | 02:37 | 13:40 | Combustion chamber B2, change spark plug. |
| 25/11/2020 | 03:26 | 03:36 | Combustion chamber B2, change spark plug. |
| 29/11/2020 | 14:51 | 16:02 | Combustion chamber A1, change spark plug. |
| 14/12/2020 | 15:22 | 16:35 | Proper shutdown - For CDM equipment calibration by Nectar |
| 14/12/2020 | 18:02 | 18:44 | Gas pressure gas control. system GSSF1 trip. |
| 23/12/2020 | 16:53 | 18:48 | TNB Power failure, Site total Shutdown. |
| 27/12/2020 | 13:53 | 15:01 | TNB Power failure, Site total Shutdown. |
| 28/12/2020 | 04:16 | 04:51 | Combustion chamber B1. Change with spare unit. |
| 29/12/2020 | 04:08 | 17:34 | Receiver temperature high.LT pump jammed. |

**Gas Engine No.2**

| Date | Time | | Problem Description |
|---|---|---|---|
| | Shut Down | Restart | |
| 1/4/2020 | 09:47 | 09:59 | Combustion chamber A3. Clean spark plug. |
| 8/4/2020 | 06:30 | 07:05 | Combustion chamber A3. Clean spark plug. |
| 9/4/2020 | 17:35 | 17:50 | Combustion Chamber B6. |
| 9/4/2020 | 19:26 | 19:58 | Combustion Chamber B6. |
| 22/4/2020 | 06:33 | 24/4/2020 14:28 | Combustion chamber B6. GCP panel, PLC hang. Unable to restart immediately. |
| 4/5/2020 | 09:29 | 09:35 | Combustion chamber B4. Change spark plug (GE 3). |
| | 10:34 | 10:51 | Combustion chamber A6. Change spark plug (GE 3). |
| 11/5/2020 | 18:35 | 18:49 | Safety Chain. TNB power surge. |
| 12/5/2020 | 00:53 | 01:31 | Combustion chamber B8. |
| | 07:58 | 09:11 | Combustion Chamber A7. Clean spark plug. |
| 15/5/2020 | 15:48 | 17:40 | Combustion chamber B6. Change new spark plug (SN 003/2020 ). |
| 22/5/2020 | 09:34 | 13:32 | Proper shutdown to service at 1,500 hrs interval by SPE. |
| | 16:55 | 17:37 | TNB Power surge few seconds. Gen CB trip. |
| 28/5/2020 | 09:26 | 15:51 | Proper shutdown for relay calibration works at PPU Bukit Tagar by RA Power. |
| 29/5/2020 | 09:55 | 18:13 | Proper shutdown for panel modification works at LV room for WTP Power supply. |
| 31/5/2020 | 14:18 | 15:30 | Receiver temperature high. |
| 3/6/2020 | 15:26 | 15:53 | Receiver temperature high. LT water pump trip. |
| 4/6/2020 | 06:53 | 07:02 | Combustion chamber A1. |
| 5/6/2020 | 14:17 | 14:49 | To swap 3-way valve from GE2 to GE3. |
| 6/6/2020 | 00:16 | 00:35 | System reset. |
| 11/6/2020 | 08:47 | 09:17 | Combustion Chamber A4, A5, B6. |
| | 12:37 | 13:00 | Gas pressure gas control system. |
| 12/6/2020 | 16:12 | 16:27 | Gas pressure gas control system. |
| 13/6/2020 | 05:27 | 16/6/2020 15:36 | Collective faulty VME 32A1 (card 1), VME 32A1 (card 2). |
| 17/6/2020 | 21:24 | 18/6/2020 17:14 | TNB power failure. Site total shutdown, Unable to restart immediately, busbar = OV VCB failure. Chen Guan to check. |
| 19/6/2020 | 13:09 | 13:15 | Combustion chamber A7. Change spark plug. |
| 26/6/2020 | 09:14 | 09:32 | Proper shutdown - to swap crankcase regulator from GE1 to GE2. |
| | 15:05 | 15:33 | TNB power surge few minutes. |
| 29/6/2020 | 14:01 | 15:49 | Proper shutdown - SPE to service crankcase regulator. |
| 6/7/2020 | 06:52 | 28/7/2020 17:44 | Proper shutdown - major overhaul works at 46,000 h internal. |
| 28/7/2020 | 18:52 | 19:54 | Proper shutdown to swap HT 2 way valve with LT 3 way valve (motor). |
| 31/7/2020 | 07:13 | 18:14 | TNB power failure. Incoming 33kv at DG Room trip. |
| 5/8/2020 | 10:02 | 21:02 | Proper shutdown to service GE2 after 50 h internal - (Overhaul). To install new HT 3-way valve motor. |
| 6/8/2020 | 12:35 | 16:55 | Proper shutdown to install new 3 way valve motor for LT. |

| Date | Time | | Problem Description |
|---|---|---|---|
| | Shut Down | Restart | |
| 10/8/2020 | 13:40 | 12/8/2020<br>14:18 | TNB power failure. Site total shutdown. Unable to restart immediately due to busbar = OV VCB.SPE to check on 3 way valve. |
| 14/8/2020 | 17:57 | 20:26 | TNB power failure. Site total shutdown. |
| 16/8/2020 | 17:20 | 21:55 | TNB power failure. Site total shutdown. |
| 18/8/2020 | 08:52 | 11:48 | TNB power failure. Site total shutdown. |
| 31/8/2020 | 14:00 | 14:11 | Jacket water engine outlet |
| 5/9/2020 | 10:40 | 11:35 | TNB Power failure few minutes. |
| 18/9/2020 | 09:24 | 19/9/2020<br>20:17 | Proper shutdown - For GBS 2 pipe connection to main gas pipe.2 main pipe location phase 2 and phase 3. |
| 23/9/2020 | 20:27 | 21:18 | Gas pressure gas control system. GSS 1 trip, CH4 unstable. |
| 24/9/2020 | 11:27 | 14:17 | Combustion chamber average. CH4 unstable. |
| 24/9/2020 | 15:11 | 30/9/2020<br>23:59 | Reverse power, cpu failure. TNB busbar trip. TNB 33 kv line cable fault. |
| 1/10/2020 | 00:00 | 6/10/2020<br>16:33 | H116 Ext,quick stop with heat removal. Safety chain voltage unbalance. Mareli motor will come and check on alternator side. |
| 7/10/2020 | 09:57 | 11:14 | Combustion chamber A7. |
| 8/10/2020 | 09:15 | 12:31 | Proper shutdown - To service GSS1 moisture separator and flame arrestor. |
| 8/10/2020 | 13:18 | 15:44 | Control deriation combustion chamber control. |
| 9/10/2020 | 18:42 | 10/10/2020<br>09:17 | H116 Ext quick stop with heat removal -Safety chain. |
| 10/10/2020 | 12:10 | 15:47 | Control deriation combustion chamber control deriation. |
| 10/10/2020 | 18:53 | 19:18 | H116 Ext quick stop with heat removal. |
| 12/10/2020 | 19:10 | 19:17 | TNB power surge. |
| 12/10/2020 | 20:30 | 13/10/2020<br>15:28 | H116 Ext quick stop with heat removal - safety chain. |
| 25/10/2020 | 20;35 | 26/10/2020<br>16:21 | Proper shutdown - Repairing work at PPU Bukit Tagar by TNB. SPE to service at 1, 500hrs internal, schedule maintenance |
| 4/11/2020 | 08:49 | 13:03 | Proper shutdown - To repair exhaust chimney by SPN. |
| 16/11/2020 | 17:05 | 20:06 | TNB Power failure, Site total Shutdown. |
| 28/11/2020 | 00:31 | 30/11/2020 | Mains Fault. SPE Swap CPU with GE3.E198. 2 Actual power. |
| 9/12/2020 | 13:37 | 14:33 | Proper shutdown for Genius Meter Calibration |
| 14/12/2020 | 13:26 | 14:29 | Proper shutdown. For CDM equipment calibration by Nectar. |
| 17/12/2020 | 21:21 | 22:01 | Gas pressure gas control. System GSS 2 trip, CH4 Low. |
| 19/12/2020 | 02:32 | 03:05 | Gas pressure gas control. System GSS 1 trip, CH4 high. |
| 23/12/2020 | 16:53 | 25/12/2020<br>16:55 | TNB Power failure. Site is total Shutdown. |
| 27/12/2020 | 13:53 | 30/12/2020<br>16:52 | TNB Power failure, Site is total Shutdown. TNB 32KV transmission line cable fault. |

**Gas Engine No.3**

| Date | Time | | Problem Description |
|---|---|---|---|
| | Shut Down | Restart | |
| 1/4/2020 | 11:07 | 11:21 | Combustion chamber B4 & B6. Clean spark plug. |
| 5/4/2020 | 07:08 | 08:48 | Combustion chamber B4. Clean spark plug. |
| 7/4/2020 | 15:50 | 15:58 | Combustion chamber B6. |
| | 17:37 | 17:47 | Combustion Chamber A1. Clean spark plug. |
| 9/4/2020 | 22:06 | 22:34 | Combustion Chamber B1 & B7. |
| 13/4/2020 | 08:16 | 08:52 | Combustion Chamber A7. |
| 15/4/2020 | 02:00 | 02:11 | Combustion Chamber A7. |
| 17/4/2020 | 04:32 | 04:41 | Combustion Chamber A1. Clean spark plug. |
| | 06:41 | 06:41 | Combustion Chamber A1. |
| 20/4/2020 | 19:29 | 19:54 | Combustion Chamber A7. |
| 21/4/2020 | 05:57 | 07:13 | Combustion Chamber A2. |
| | 10:05 | 10:31 | Combustion Chamber A1. |
| | 14:46 | 15:00 | Combustion Chamber A1. |
| 23/4/2020 | 05:48 | 06:13 | Combustion chamber A6. Change new spark plug |
| 26/4/2020 | 07:59 | 08:24 | Combustion Chamber A5. Change with spare unit. |
| 27/4/2020 | 01:18 | 01:29 | Combustion chamber A5. Change new spark plug |
| | 13:44 | 13:54 | Combustion chamber B2. |
| 30/4/2020 | 17:11 | 17:27 | Combustion chamber A2. Change spark plug spare unit |
| 4/5/2020 | 09:01 | 31/5/2020 | Proper shutdown for major service works by SPE at 46,000 hrs interval. |
| | | 23:59 | |
| 1/6/2020 | 00:00 | 4/6/2020 | Major overhaul works at 46,000 hours interval. |
| | | 13:29 | |
| 5/6/2020 | 14:19 | 14:43 | To swap 3-way valve from GE3 to GE2. |
| 6/6/2020 | 07:37 | 07:45 | Combustion chamber average. |
| | 21:59 | 22:15 | Gas pressure gas control system. |
| 8/6/2020 | 10:13 | 10:20 | Combustion chamber B4, B6. |
| 9/6/2020 | 09:45 | 16:26 | Proper shutdown to service at 50 hrs interval after overhaul. |
| 10/6/2020 | 22:59 | 23:03 | Gas pressure gas control system. |
| 11/6/2020 | 08:17 | 09:15 | Combustion Chamber A7, A8, B4. |
| | 12:37 | 12:50 | Gas pressure gas control system. |
| 12/6/2020 | 16:12 | 16:30 | Gas pressure gas control system. |
| 17/6/2020 | 21:24 | 18/6/2020 | TNB power failure. Site total shutdown, Unable to restart immediately, busbar = OV VCB failure. Chen Guan to check. |
| | | 19:19 | |
| 10/7/2020 | 16:10 | 16:24 | Gas pressure gas control system. |
| 14/7/2020 | 09:16 | 16/7/2020 | Proper shutdown - for Pre-treatment service (i- GDU ii- Radiator iii- Scrubber tank ). |
| | | 12:14 | |
| 23/7/2020 | 11:33 | 14:03 | TNB Power surge few seconds. |
| 25/7/2020 | 10:54 | 28/7/2020 | TNB power failure. Unable to restart immediately, busbar = OV VCB.TNB cable faulty at PPU Bukit Tagar. |
| | | 18:09 | |
| 28/7/2020 | 20:04 | 20:14 | Proper shutdown to swap HT 2 way valve with LT 3 way valve (motor). |
| 29/7/2020 | 00:54 | 01:07 | Combustion chamber A4, change sparks plug, used unit. |
| 31/7/2020 | 07:13 | 18:54 | TNB power failure. Incoming 33kv at DG Room trip. |
| 9/8/2020 | 09:51 | 10:24 | Combustion average. |
| 10/8/2020 | 13:40 | 12/8/2020 | |

| Date | Time | | Problem Description |
|---|---|---|---|
| | Shut Down | Restart | |
| | | 12:06 | TNB power failure. Site total shutdown. Unable to restart immediately due to busbar = OV VCB.TNB trip. |
| 14/8/2020 | 17:57 | 20:54 | TNB power failure. Site total shutdown. |
| 16/8/2020 | 17:20 | 21:22 | TNB power failure. Site total shutdown. |
| 18/8/2020 | 08:52 | 12:01 | TNB power failure. Site total shutdown. |
| 24/8/2020 | 09:05 | 18:51 | Proper shutdown - to service at 1,500 hrs internal by SPE. |
| 25/8/2020 | 00:14 | 10:41 | Oil sampling point, oil leaking. SPE to site. |
| 5/9/2020 | 10:40 | 11:51 | TNB Power failure few minutes. |
| 18/9/2020 | 09:25 | 19/9/2020 | Proper shutdown for GBS 2 pipe connection to main gas pipe. 2 main pipe location, phase 2 and phase 3 |
| | | 20:03 | |
| 23/9/2020 | 20:27 | 24/9/2020 | Gas pressure gas control system. GSS 1 trip, CH4 unstable. |
| | | 14:35 | |
| 25/9/2020 | 07:34 | 28/9/2020 | TNB power failure. Site total shutdown, TNB busbar trip. TNB 33kv line cable fault. |
| | | 13:37 | |
| 1/10/2020 | 11:06 | 11:38 | Proper shutdown - To swap AVR Card with GE2. |
| 1/10/2020 | 17:16 | 17:33 | H116 Ext, quick stop with heat removal. Safety chain. |
| 1/10/2020 | 21:05 | 22:35 | H116 Ext, quick stop with heat removal. Safety chain. |
| 1/10/2020 | 23:14 | 2/10/2020 | H116 Ext, quick stop with heat removal. Safety chain. |
| | | 10;58 | |
| 6/10/2020 | 22:01 | 22:31 | Combustion chamber B6 / B8 - Change with spare unit. |
| 7/10/2020 | 00:12 | 02:36 | Combustion chamber B6 / B8 - Change with spare unit. |
| 8/10/2020 | 09:15 | 12:43 | Proper shutdown - To service GSS1 moisture separator and flame arrestor. |
| 19/10/2020 | 00:49 | 29/10/2020 | Jacket water engine outlet.HT pump earth fault. |
| | | 00:40 | |
| 6/11/2020 | 12:58 | 15:43 | Receiver temperature high.LT Fan trip. |
| 13/11/2020 | 08:58 | 17:38 | Proper shutdown for normal service at 1,500hrs internal. |
| 16/11/2020 | 17:05 | 20:00 | TNB Power failure, Site total Shutdown. |
| 26/11/2020 | 12:33 | 28/11/2020 | Combustion chamber B6. E198.2 Actual Power, PLC unable to communicate. |
| | | 11:50 | |
| 29/11/2020 | 05:52 | 06:54 | Combustion chamber B6. Change Spark plug. |
| 29/11/2020 | 20:11 | 20:22 | Combustion chamber B3. Change Spark plug. |
| 2/12/2020 | 17:12 | 17:50 | Combustion chamber A4 change spark plug |
| 9/12/2020 | 14:35 | 15:01 | Proper shutdown. For Genius Meter Calibration. |
| 14/12/2020 | 13:26 | 14:35 | Proper shutdown. For CDM equipment calibration by Nectar. |
| 17/12/2020 | 21:21 | 22:12 | Gas pressure gas control system. GSS1 trip CH4 Low. |
| 19/12/2020 | 02:32 | 03:11 | Gas pressure gas control system. GSS1 trip CH4 high. |
| 23/12/2020 | 16:53 | 25/12/2020 | TNB Power failure. Site total Shutdown. Change new spark plug S/N 006/2020.Combustion chamber B6. |
| | | 21:16 | |
| 27/12/2020 | 13:53 | 30/12/2020 | TNB Power failure. Site total Shutdown. TNB 33KV transmission line cable fault. |
| | | 17:19 | |

**Gas Engine No.4**

| Date | Time | | Problem Description |
|---|---|---|---|
| | Shut Down | Restart | |
| 1/4/2020 | 00:00 | 30/4/2020 23:59 | Major Overhaul work at 22364 hours by MPS. |
| 1/5/2020 | 00:00 | 18/5/2020 13:01 | Major Overhaul work at 22364 hours by MPS. |
| 20/5/2020 | 09:17 | 15:18 | Proper shutdown to service at 50 hrs after major overhaul work. |
| | 17:19 | 17:38 | LOLO T - Exhaust B 10. |
| | 18:17 | 23:26 | LOLO T - Exhaust B 10. |
| 21/5/2020 | 07:52 | 10:15 | Proper shutdown to check on GE4 cylinder Head B10. |
| 22/5/2020 | 05:08 | 05:17 | Status X 20 - Module faulty. |
| | 09:41 | 09:46 | Status X 20 - Module faulty. |
| | 16:55 | 19:18 | TNB power surge few seconds. |
| 25/5/2020 | 10:59 | 14:06 | Pro Act B. Reset Ok! |
| 27/5/2020 | 12:09 | 12:20 | Pro Act B. Reset Ok! |
| 29/5/2020 | 09:55 | 18:28 | Proper shutdown for panel modification works at LV Room |
| 31/5/2020 | 14:13 | 15:13 | Gas pressure > min. |
| 3/6/2020 | 07:45 | 6/6/2020 07:05 | 33 KV transmission line trip, To identity the fault. |
| 9/6/2020 | 16:33 | 10/6/2020 8:37 | Safety sensor reserve 1. GSS 2 trip. |
| 10/6/2020 | 10:42 | 18:56 | Proper shutdown to synchronize GSS2 and GSS3 PT2 pressure at main header. |
| 13/6/2020 | 12:31 | 17/6/2020 07:37 | Proper shutdown - Electrical poles # 029, for 33 kV transmission line got hit by car. |
| 17/6/2020 | 21:19 | 19/6/2020 16:08 | TNB power failure. Site total shutdown, Unable to restart immediately, starter failure to change new parks. |
| 24/6/2020 | 03:48 | 3:52 | X20 - module faulty. |
| 26/6/2020 | 15:05 | 18:05 | - TNB power surge few minutes. |
| 26/6/2020 | 20:36 | 27/6/2020 10:19 | SM 3018 safety sensor reverse. GSS2 trip. |
| 2/7/2020 | 06:38 | 3/7/2020 11:18 | Status X- 20 module faulty. |
| 3/7/2020 | 15:01 | 15:22 | Proper shutdown - to check on GE4 by MPS. |
| 4/7/2020 | 00:54 | 5/7/2020 13:53 | Safety sensor reserve 1. |
| 8/7/2020 | 10:12 | 17:56 | TNB Power surge few seconds. |
| 10/7/2020 | 05:39 | 11:16 | GSS 2 trip - CH4 low - low. Safety sensor reverse. |
| 13/7/2020 | 11:33 | 14/7/2020 09:19 | Proper shutdown - to testing on GSS 2 and GSS 3 synchronize #2. |
| 15/7/2020 | 00:34 | 17:12 | Tecjet shutdown. GSS 2 trip. |
| 17/7/2020 | 10:18 | 19/7/2020 12:12 | TNB power surge few seconds. |
| 20/7/2020 | 11:37 | 21/7/2020 09:57 | Proper shutdown - to service Tecjet by MPS. |
| 21/7/2020 | 12:48 | 13:04 | Proper shutdown - To check Tecjet condition. |

| Date | Time | | Problem Description |
|---|---|---|---|
| | Shut Down | Restart | |
| | 15:57 | 20:18 | Proper shutdown - To check Tecjet condition. |
| 22/7/2020 | 15:25 | 19:37 | TNB Power surge few seconds. |
| 23/7/2020 | 11:33 | 18:19 | TNB Power surge few seconds. |
| 25/7/2020 | 10:24 | 21:32 | TNB Power failure. |
| 25/7/2020 | 22:31 | 26/7/2020<br>13:52 | GSS 2 trip.CH4 low - low. |
| 26/7/2020 | 18:38 | 18:51 | Safety sensor reserve 1.GSS 2 trip, PT 1 low - low. |
| 26/7/2020 | 19:15 | 27/7/2020<br>13:52 | Safety sensor reserve 1.GSS 2 trip, PT 1 low - low. |
| 27/7/2020 | 19:44 | 29/7/2020<br>14:53 | Safety sensor reserve 1.GSS 2 trip, PT 1 low - low. |
| 29/7/2020 | 20:18 | 31/7/2020<br>15:46 | Safety sensor reserve 1.GSS 2 trip, PT 1 low - low. |
| 1/8/2020 | 10:13 | 3/8/2020<br>20:39 | Safety sensor reserve 1.GSS 2 trip, CH4 low. MPS to install new tecjet for GE4. |
| 4/8/2020 | 10:38 | 11:49 | Proper shutdown - to testing new tecjet by MPS. |
| | 14:40 | 15:03 | Proper shutdown - to testing new tecjet by MPS. |
| 15/8/2020 | 14:31 | 17:13 | A8 LOLO. Ignition coil faulty. change with spare unit. |
| 10/8/2020 | 13:40 | 15:32 | TNB power failure. Site total shutdown. |
| | 17:24 | 18:50 | TNB power failure. Site total shutdown. |
| 13/8/2020 | 14:02 | 14:06 | Proper shutdown - to restart GSS2. |
| 14/8/2020 | 17:57 | 20:45 | TNB power failure. Site total shutdown. |
| 16/8/2020 | 17:20 | 20:48 | TNB power failure. Site total shutdown. |
| 18/8/2020 | 08:52 | 12:04 | TNB power failure. Site total shutdown. |
| 21/8/2020 | 12:08 | 12:18 | Main protection failure. HIHi T-Intake. |
| 25/8/2020 | 17:14 | 18:03 | LOLO T-Exhaust A8. Clean spark plug. |
| | 18:44 | 26/8/2020<br>18:04 | LOLO T-Exhaust A8. Ignition coil failure. Change new ignition coil by MPS. |
| 27/8/2020 | 08:31 | 10:59 | PLC lost connection.PRO ACT B jammed, service Ok. |
| 28/8/2020 | 08:06 | 19:49 | Proper shutdown - to service at 1,500 hrs internal by MPS. |
| 29/8/2020 | 12:56 | 15:49 | Proper shutdown - To replace new PRO ACT B by MPS.MPS to check on exhaust leaking. |
| 2/9/2020 | 11:27 | 11:31 | SM11 Status X-20 - Model faulty. |
| 3/9/2020 | 18:35 | 19:08 | TNB power surge few seconds. GSS2 trip. |
| 4/9/2020 | 01:44 | 1:58 | Status X20 - Module faulty. |
| 4/9/2020 | 16:28 | 16:40 | TNB power surge few second. GSS trip. |
| 5/9/2020 | 10:40 | 11:42 | TNB power failure few minutes. |
| 5/9/2020 | 22:12 | 22:22 | SM 400 Connection from alarm logger to PLC out of order. |
| 6/9/2020 | 14:12 | 14:17 | GSS 2 trip. PT 2 high |
| 10/9/2020 | 03:21 | 3:38 | SM318 - Safety sensor reverse 1. |
| 11/9/2020 | 16:42 | 16:48 | Mains protection |
| 18/9/2020 | 09:28 | 19/9/2020<br>20:12 | Proper shutdown - For GBS 2 pipe connection to main gas pipe. 2 main pipe location, phase 2 and phase 3. |
| 20/9/2020 | 18:39 | 18:46 | TNB power surge few seconds. GSS2 trip. |
| 24/9/2020 | 09:45 | 9:50 | GSS trip, PT2 high. |
| 25/9/2020 | 07:34 | 08:43 | TNB power failure. Site total shutdown. |

| Date | Time | | Problem Description |
|---|---|---|---|
| | Shut Down | Restart | |
| 12/10/2020 | 16:37 | 16:49 | TNB power surge. |
| 13/10/2020 | 14:23 | 14:32 | Combustion chamber B7, B6, A5. GBS 1 trip. |
| 3/11/2020 | 15:01 | 16:22 | GSS2 trip, CH4 below set point. |
| 4/11/2020 | 04:57 | 6/11/2020 20:12 | To service at 25,690hrs,1,500hrs Internal by MPS. |
| 14/11/2020 | 12:56 | 13:53 | Mixture water temperature inlet high. Radiator Fun # 2 and # 10 trip. |
| 16/11/2020 | 17:05 | 18:35 | TNB Power failure, Site total Shutdown. |
| 20/11/2020 | 03:00 | 03:06 | Safety sensor reserve. GSS2 trip, CH4 Low-Low. |
| 20/11/2020 | 03:55 | 04:04 | Safety sensor reserve. GSS2 trip, CH4 Low-Low. |
| 24/11/2020 | 15:27 | 16:05 | Safety sensor reserve. GSS2 trip. |
| 27/11/2020 | 21:02 | 28/11/2020 | Proper shutdown - Request by TNB for poles repairing works. TNB transmission pole 33KV got hit by lorry. |
| 9/12/2020 | 15:04 | 15:39 | Proper shutdown. For Genius Meter Calibration. |
| 23/12/2020 | 16:53 | 20:11 | TNB Power failure, Site total Shutdown. |
| 27/12/2020 | 13:53 | 14:14 | TNB Power failure, Site total Shutdown. |

**Gas Engine No.5**

| Date | Time | | Problem Description |
|---|---|---|---|
| | Shut Down | Restart | |
| 5/4/2020 | 06:52 | 6/4/2020 12:42 | Deviation power control. Change new throttle valve ( B side ) - by SPE. |
| 7/4/2020 | 12:48 | 9/4/2020 12:38 | Proper shutdown - Electrical pole # 230 for GE4, GE5 & GE6 got hit by lorry. |
| 16/4/2020 | 16:28 | 17:21 | Gas pressure gas control system. GSS 3 trip, CH4 analyser trip. |
| 27/4/2020 | 16:38 | 17:00 | Throttle valve position (sensor faulty ). |
| | 22:30 | 22:38 | Throttle valve position (sensor faulty ). |
| 1/5/2020 | 22:03 | 17/5/2020 16:42 | Major 33 KV PPU Sime Darby trip. To identity / determine the damage and cable fault. |
| 20/5/2020 | 18:21 | 22:54 | Gas pressure gas control system. GSS 3 trip. |
| 21/5/2020 | 09:38 | 15:45 | Proper shutdown for normal service at 1,500 hrs interval by SPE. |
| 22/5/2020 | 16:55 | 18:33 | TNB power surge few seconds. GSS 3 trip, Engine speed. |
| 29/5/2020 | 09:56 | 17:36 | Proper shutdown for panel modification works at LV Room for WTP power supply. |
| 31/5/2020 | 13:38 | 15:33 | DZR short circuit output stage. Gas pressure gas control system. |
| 3/6/2020 | 07:45 | 5/6/2020 19:06 | 33 KV transmission line trip, To identity the fault. |
| 6/6/2020 | 16:15 | 16:57 | DZR short circuit output stage. |
| 10/6/2020 | 10:40 | 18:42 | Proper shutdown - To synchronize GSS2 and GSS3 PT2 pressure at main header. |
| 13/6/2020 | 12:29 | 16/6/2020 14:37 | Proper shutdown - Electrical poles # 029,for 33 kV transmission line got hit by car. |
| 17/6/2020 | 00:16 | 00:28 | G197 Thrpttle valve position. |
| | 21:20 | 22:42 | TNB power failure. Site total shutdown. |
| 18/6/2020 | 07:44 | 07:51 | Proper shutdown - to check on throttle valve. |
| | 12:44 | 13:43 | Proper shutdown - to check on throttle valve position by SPE. |
| | 15:14 | 18:03 | Proper shutdown - to check on throttle valve position. |
| 26/6/2020 | 15:05 | 16:01 | TNB power surge few minutes. |
| 27/6/2020 | 06:02 | 6:23 | Combustion chamber B9, change new sparks plug, (S/N: 001/2020 GE5/GE6). |
| 5/7/2020 | 07:40 | 08:02 | Combustion chamber A3, change sparks plug, |
| 8/7/2020 | 10:16 | 12:37 | TNB Power surge few seconds. |
| 13/7/2020 | 11:34 | 12:47 | Proper shutdown - to testing on GSS 2 and GSS 3 synchronize #2. |
| | 19:56 | 20:40 | Proper shutdown to normalize GSS 2 and GSS 3 system. |
| 15/7/2020 | 00:34 | 01:32 | Gas Pressure. |
| 16/7/2020 | 11:53 | 17/7/2020 18:41 | Proper shutdown for Pre-treatment service ( i- GDU ii- Radiator iii- Scrubber tank ). |
| 19/7/2020 | 12:15 | 12:26 | Combustion chamber A3, change sparks plug, (S/N :GE5/GE6 004/2020). |
| 22/7/2020 | 11:03 | 13:21 | Proper shutdown - to check oil leaking at fly wheel O-seal. |
| 23/7/2020 | 11:33 | 12:03 | TNB Power surge few seconds. |
| 25/7/2020 | 10:52 | 12:09 | TNB power failure. |
| | 17:59 | 20:08 | TNB power failure. |
| 26/7/2020 | 22:21 | 22:42 | Combustion chamber B/O. Cleaned spark plug. |

| Date | Time | | Problem Description |
|---|---|---|---|
| | Shut Down | Restart | |
| 28/7/2020 | 08:29 | 14:15 | TNB power failure. |
| 29/7/2020 | 10:19 | 16:39 | Proper shutdown - for normal service at 1,500 hrs internal by SPE. |
| 31/7/2020 | 07:07 | 11:54 | TNB power failure. |
| | 15:52 | 16:04 | Safety Chain. |
| 7/8/2020 | 02:27 | 03:15 | Combustion chamber A5, change sparks plug, |
| 8/8/2020 | 06:14 | 06:50 | Combustion chamber A5, change sparks plug, (S/N:GE5/GE6 009/2020). |
| 10/8/2020 | 06:07 | 07:12 | Combustion Chanber A5. |
| | 13:40 | 15:13 | TNB power failure. Site total shutdown. |
| | 17:24 | 18:46 | TNB power failure. Site total shutdown. |
| 14/8/2020 | 17:57 | 20:38 | TNB power failure. Site total shutdown. |
| 16/8/2020 | 17:20 | 17/8/2020 09:17 | TNB power failure. Site total shutdown. |
| 18/8/2020 | 08:52 | 11:51 | TNB power failure. Site total shutdown. |
| 26/8/2020 | 07:09 | 07:29 | Combustion chamber B6, change new sparks plug, (S/N :GE5/GE6 015/2020). |
| 29/8/2020 | 13:02 | 13:17 | Combustion chamber B4, change new sparks plug, (S/N :GE5/GE6 016/2020). |
| 3/9/2020 | 18:36 | 19:18 | TNB power surge few seconds. GSS 3 trip. |
| 4/9/2020 | 01:49 | 02:17 | Combustion chamber A6, Clean spark plug. |
| 4/9/2020 | 16:28 | 16:44 | TNB power surge few seconds. GSS 3 trip. |
| 5/9/2020 | 10:40 | 11:46 | TNB power failure few minutes. |
| 5/9/2020 | 22:18 | 22:29 | S200 engine speed. |
| 7/9/2020 | 08:02 | 08:18 | Combustion chamber B7. Change sparks plug, S/N :GE5/GE6 028/2020. |
| 10/9/2020 | 03:21 | 08:21 | GSS 3 trip belting compressor faulty. Combustion chamber A6. Change spark plug, S/ : GE5/GE6 018/2020. |
| 11/9/2020 | 21:13 | 22:05 | Combustion chamber B2. Change spark plug S/N: GE5/GE6 027/2020. |
| 18/9/2020 | 09:27 | 19/9/2020 20:26 | Proper shutdown - for GBS 2 pipe connection to main gas pipe,2 main pipe location phase 2 and phase 3. |
| 22/9/2020 | 19:23 | 19:35 | Combustion chamber A10. S/N: GE5/GE6 033/2020 |
| 23/9/2020 | 20:31 | 24/9/2020 15:13 | Combustion chamber A7.CH4 unstable. |
| 24/9/2020 | 20:11 | 21:12 | Combustion chamber B10. Change spark plug S/N: GE5/GE6 032/2020. |
| 25/9/2020 | 07:33 | 19:53 | TNB power failure, Site total shutdown. Critical fault A6. Check engine SPE to check. |
| 26/9/2020 | 09:00 | 09:17 | Combustion chamber B1, Change spark plug S/N: GE5/GE6 030/2020. |
| 30/9/2020 | 10:42 | 11:03 | Combustion chamber A9 & B8. |
| 30/9/2020 | 11:55 | 12:12 | Combustion chamber A9 & A8. |
| 3/10/2020 | 10:32 | 17:20 | Proper shutdown - To service at 1,500hrs internal by SPE. |
| 4/10/2020 | 11;59 | 12:16 | Combustion chamber A1, Change new spark plug S/N: GE5/GE6 038/2020. |
| 5/10/2020 | 11:45 | 12:01 | Combustion chamber A7, Change new spark plug S/N: GE5/GE6 037/2020. |
| 7/10/2020 | 00:36 | 01:07 | Combustion chamber A3. |

| Date | Time | | Problem Description |
|---|---|---|---|
| | Shut Down | Restart | |
| 8/10/2020 | 09;20 | 09:35 | Combustion chamber B5, Change spark plug S/N: GE5/GE6 040/2020. |
| 8/10/2020 | 13:59 | 14:09 | Combustion chamber A2, Change spark plug S/N: GE5/GE6 039/2020. |
| 13/10/2020 | 07:05 | 07:20 | Gas pressure gas control system. GSS 2 trip |
| 14/10/2020 | 20:01 | 20:40 | Combustion chamber A5, Change spark plug S/N: GE5/GE6 041/2020. |
| | | | |
| 22/10/2020 | 14:23 | 14:32 | Combustion chamber B7,B6,A5. GBS 1 trip. |
| 3/11/2020 | 15:01 | 18:58 | GSS 2 trip, CH4 below set point. |
| 4/11/2020 | 10:19 | 6/11/2020 | Proper shutdown to install EFD Sensor at transmission line by Chen Guan. |
| | | 15:28 | |
| 12/11/2020 | 04:54 | 06:12 | Safety chain, CH4 Low-Low. |
| 14/11/2020 | 23:41 | 23:51 | Q311 CH4 Value Low. Signal lost |
| 16/11/2020 | 17:05 | 18:27 | TNB Power failure, Site total Shutdown. |
| 18/11/2020 | 14:58 | 16:03 | Genset protection |
| 19/11/2020 | 06:44 | 07:02 | Combustion chamber B3.S/N: GE5/GE6 046/2020 |
| 20/11/2020 | 02:59 | 03:24 | CH4 value, GSS 3 trip. |
| 21/11/2020 | 01:29 | 01:56 | CH4 value, CH4 sensor signal lost. |
| 25/11/2020 | 13:36 | 14:48 | Engine speed. |
| 27/11/2020 | 21:02 | 28/11/2020 | Proper shutdown - Request by TNB for poles repairing works. TNB transmission pole 33KV got hit by lorry. |
| | | 13:12 | |
| 9/12/2020 | 10:12 | 18:42 | Proper shutdown. For normal service at 1,500h internal by SPE. |
| 23/12/2020 | 16:53 | 20:31 | TNB Power failure, Site total Shutdown. |
| 27/12/2020 | 13:53 | 16:26 | TNB Power failure, Site total Shutdown. |
| 29/12/2020 | 04:21 | 04:49 | Combustion chamber A3, Change spark plug S/N GE5/GE6 050/2020. |

**Gas Engine No.6**

| Date | Time | | Problem Description |
|---|---|---|---|
| | Shut Down | Restart | |
| 7/4/2020 | 12:48 | 9/4/2020 12:52 | Proper shutdown - Electrical pole # 230 for GE4, GE5 & GE6 got hit by lorry. |
| 16/4/2020 | 16:28 | 16:52 | Gas pressure gas control system. GSS3 trip, CH4 analyser trip. |
| 30/4/2020 | 08:53 | 15:57 | Proper shutdown 0 for normal service at 1,500 hrs interval by SPE. |
| 6/5/2020 | 22:03 | 17/5/2020 16:38 | Major 33 KV PPU Sime Darby trip. To identity / determine the damage and cable fault. |
| 20/5/2020 | 18:21 | 23:19 | Gas pressure gas control system. GSS 3 trip. |
| 22/5/2020 | 16:55 | 18:49 | TNB power surge few seconds. GSS 3 trip, Engine speed. |
| 29/5/2020 | 09:55 | 17:31 | Proper shutdown for panel modification works at LV Room for WTP power supply. |
| 31/5/2020 | 14:13 | 15:01 | Gas pressure gas control system. |
| 3/6/2020 | 07:45 | 5/6/2020 19:10 | 33 KV transmission line trip, To identity the fault. |
| 10/6/2020 | 10:40 | 18:39 | Proper shutdown - To synchronize GSS2 and GSS3 PT2 pressure at main header. |
| 13/6/2020 | 12:28 | 16/6/2020 14:32 | Proper shutdown - Electrical poles # 029, for 33 kV transmission line got hit by car. |
| 17/6/2020 | 21:20 | 22:39 | TNB power failure. Site total shutdown. |
| 26/6/2020 | 15:05 | 15:38 | TNB power failure. Site total shutdown. |
| 27/6/2020 | 23:08 | 28/6/2020 00:57 | Combustion chamber B9,change sparks plug, (S/N : 001/2020 GE5/GE6). |
| 2/7/2020 | 23:45 | 3/7/2020 00:13 | Combustion chamber A1. Cleaned spark plug. |
| 4/7/2020 | 13:14 | 13:39 | Combustion chamber A5. |
| 5/7/2020 | 19:17 | 17:40 | Combustion chamber A7. Cleaned spark plug. |
| 8/7/2020 | 10:17 | 12:33 | TNB Power surge few seconds. |
| 13/7/2020 | 11:35 | 12:52 | Proper shutdown - to testing on GSS 2 and GSS 3 synchronize #2. |
| | 19:56 | 20:37 | Proper shutdown to normalize GSS 2 and GSS 3 system. |
| 14/7/2020 | 03:09 | 04:20 | Combustion chamber A3, change sparks plug, (S/N :GE5/GE6 003/2020). |
| | 11:43 | 12:05 | Combustion chamber A3. Clean spark plug. |
| 15/7/2020 | 00:35 | 01:40 | Gas Pressure Gas control system. |
| 16/7/2020 | 11:44 | 17/7/2020 19:22 | Combustion chamber A5, change new sparks plug, (S/N :GE5/GE6 005/2020). |
| 18/7/2020 | 19:26 | 19:55 | Combustion chamber A6. Clean spark plug. |
| 19/7/2020 | 16:56 | 19:28 | Combustion chamber B5, change with spare unit (GE2). |
| 20/7/2020 | 10:12 | 18:28 | Proper shutdown - for normal service at 1,500 hrs internal by SPE. Change spark plug - combustion chamber A3 (S/N: GE5/GE6 007/2020). |
| 23/7/2020 | 11:33 | 12:07 | TNB Power surge few seconds. |
| 24/7/2020 | 19:47 | 20:36 | Combustion chamber A7, change sparks plug, (S/N:GE5/GE6 006/2020). |
| 25/7/2020 | 10:17 | 12:13 | TNB power failure. |
| | 17:59 | 20:10 | TNB power failure. |
| 28/7/2020 | 08:29 | 14:17 | TNB power failure. |
| 31/7/2020 | 07:07 | 15:07 | TNB power failure. |

| Date | Time | | Problem Description |
|---|---|---|---|
| | Shut Down | Restart | |
| 4/8/2020 | 10:57 | 11:09 | Combustion chamber A8. Clean spark plug. |
| 7/8/2020 | 09:17 | 9:30 | Combustion chamber B8, change sparks plug, (S/N :GE5/GE6 008/2020). |
| 10/8/2020 | 13:40 | 15:50 | TNB power failure. Site total shutdown. |
| | 17:24 | 18:43 | TNB power failure. Site total shutdown. |
| 12/8/2020 | 11:33 | 12:03 | Combustion chamber B7. Restart Gas Engine 6.Change new spark plug. (S/N: GE5/GE6 010/2020). |
| 14/8/2020 | 17:57 | 20:34 | TNB power failure. Site total shutdown. |
| 16/8/2020 | 17:20 | 17/8/2020 09:11 | TNB power failure. Site total shutdown. |
| 18/8/2020 | 01:46 | 02:13 | Combustion chamber B4, B9. Change spark plug, new unit. 1. (B4 S/N: GE5/GE6 013/2020) 2. (B9 S/N: GE5/GE6 011/2020). |
| | 08:52 | 12:10 | TNB power failure. Site total shutdown. |
| 22/8/2020 | 02:15 | 02:58 | Combustion chamber A2. Change spark plug, new unit (S/N: GE5/GE6 012/2020). |
| 26/8/2020 | 07:13 | 07:27 | Combustion chamber B6. Change new spark plug (S/N: GE5/GE6 014/2020). |
| 3/9/2020 | 18:36 | 19:03 | TNB power surge few seconds, GSS3 trip. |
| 4/9/2020 | 16:28 | 17:07 | TNB power surge few seconds. GSS3 trip. Combustion chamber A9,change spark plug S/N : GE5/GE6 017/2020. |
| 5/9/2020 | 10:40 | 11:56 | TNB failure few minutes. |
| 10/9/2020 | 03:21 | 07:55 | GSS3 trip, Belting compressor faulty. |
| 18/9/2020 | 09:27 | 19/9/2020 21:17 | Proper shutdown - for GBS 2 pipe connection to main gas pipe,2 main pipe location phase 2 and phase 3. |
| 23/9/2020 | 20:32 | 24/9/2020 14:13 | Engine speed.CH4 unstable. |
| 25/9/2020 | 07:33 | 20:52 | TNB power failure, site total shutdown. SPE to service at 1,500hrs interval. |
| 26/9/2020 | 01:40 | 01:27 | Jacket water Gk Inlet. |
| 26/9/2020 | 03:03 | 03:17 | Jacket water Gk Inlet. |
| 26/9/2020 | 05:00 | 09:03 | Jacket water Gk Inlet. |
| 26/9/2020 | 22:12 | 22:28 | Jacket water Gk Inlet. |
| 26/9/2020 | 23:42 | 23:53 | Jacket water Gk Inlet. |
| 27/9/2020 | 00:43 | 00:52 | Jacket water Gk Inlet. |
| 27/9/2020 | 01:59 | 02:45 | Jacket water Gk Inlet. |
| 27/9/2020 | 04:29 | 04:44 | Jacket water Gk Inlet. |
| 28/9/2020 | 17:09 | 18:13 | Combustion chamber B10. |
| 7/10/2020 | 00:44 | 1:31 | Combustion chamber A4. |
| 8/10/2020 | 05:14 | 06:11 | Jacket water Gk Inlet. |
| 8/10/2020 | 09:31 | 10:02 | Jacket water Gk Inlet. |
| 8/10/2020 | 21:46 | 21:51 | Jacket water Gk Inlet. |
| 8/10/2020 | 23:14 | 23:41 | Jacket water Gk Inlet. |
| 9/10/2020 | 02:34 | 02:42 | Jacket water Gk Inlet. |
| 9/10/2020 | 03:14 | 03:25 | Jacket water Gk Inlet. |
| 9/10/2020 | 04:55 | 05:42 | Jacket water Gk Inlet. |
| 13/10/2020 | 07:05 | 08:19 | Gas pressure gas control system. GSS 2 trip. |
| 22/10/2020 | 14:39 | 14:56 | Combustion chamber A5, A6, A8. GBS 1 trip. |

| Date | Time | | Problem Description |
|---|---|---|---|
| | Shut Down | Restart | |
| 23/10/2020 | 15:15 | 15:32 | Combustion chamber A7, Change spark plug S/N: GE5/GE6 044/2020. |
| 24/10/2020 | 00:24 | 01:52 | Combustion chamber A8, Change spark plug S/N: 042/2020. |
| 25/10/2020 | 14:37 | 15;04 | Combustion chamber A3, Change spark plug S/N GE5/GE6 043/2020. |
| 28/10/2020 | 17:45 | 18:16 | Combustion chamber A6, Change spark plug S/N GE5/GE6 045/2020. |
| 3/11/2020 | 15:01 | 16:09 | GSS 2 trip, CH4 below set point. |
| 4/11/2020 | 10:19 | 6/11/2020<br>15:50 | Proper shutdown to install EFD Sensor at transmission line by Chen Guan. |
| 12/11/2020 | 04:54 | 07:37 | Safety chain, CH4 Low-Low. |
| 14/11/2020 | 23:41 | 15/11/2020<br>9:36 | Q311 CH4 Value Low. Signal lost |
| 16/11/2020 | 17:05 | 18:24 | TNB Power failure, Site total Shutdown. |
| 18/11/2020 | 14:58 | 15:21 | Genset protection. |
| 20/11/2020 | 02:59 | 03:38 | CH4 Value, GSS3 trip. |
| 21/11/2020 | 01:29 | 01:50 | CH4 Value, CH4 Sensor signal lost. |
| 25/11/2020 | 13:36 | 14:47 | Engine speed. Reset OK. |
| 27/11/2020 | 04:02 | 04:44 | Combustion chamber A3, Change spark plug S/N GE5/GE6 021/2020. |
| 27/11/2020 | 21:03 | 28/11/2020<br>11:44 | - Proper shutdown - Request by TNB for poles repairing works. TNB transmission pole 33KV got hit by lorry. |
| 1/12/2020 | 09:00 | 19:46 | For normal service at 1,500h internal by SPE. |
| 1/12/2020 | 20:46 | 20:54 | Combustion chamber A3, Change spark plug S/N GE5/GE6 020/2020. |
| 2/12/2020 | 10:38 | 18:44 | Proper to repair engine leaking. |
| 9/12/2020 | 10:29 | 11:14 | Jacket water engine outlet. Temperature high sensor faulty, change new unit. |
| 9/12/2020 | 15:42 | 16:05 | Proper shutdown for Genius Meter Calibration. |
| 10/12/2020 | 11:43 | 14:39 | Combustion chamber A3, Change spark plug S/N GE5/GE6 019/2020. |
| 20/12/2020 | 23:00 | 21/12/2020<br>9:04 | GCM Communication Electrical fault. |
| 23/12/2020 | 16:53 | 21:09 | TNB Power failure, Site total Shutdown. |
| 23/12/2020 | 12:28 | 12:45 | Safety sensor reserve. GSS2 trip, CH4 Low. |
| 27/12/2020 | 13:53 | 16:35 | TNB Power failure, Site total Shutdown. |

# Appendix 3: Description on the calculation applied in ER Calculation Sheet for Tool to determine the mass flow of a greenhouse gas in a gaseous stream, version 03.0

Referring to the tools, for LFG temperatures below 60 °C, moisture could be neglected due to its very low influence on final results and thus, the measurement in wet or dry basis is not important (as reflected in the amendments to ACM 0001, version 9.1 onwards). In the case where the LFG temperature exceeds 60°C, the same basis for both methane concentration and flow measurement will be considered according to the tools.

There are 6 measurement options as tabulated below:

| Option | Flow of gaseous stream | Volumetric fraction |
|---|---|---|
| A | Volume flow – dry basis | dry or wet basis[3] |
| B | Volume flow – wet basis | dry basis |
| C | Volume flow – wet basis | wet basis |
| D | Mass flow – dry basis | dry or wet basis |
| E | Mass flow – wet basis | dry basis |
| F | Mass flow – wet basis | wet basis |

During this monitoring period, for Flare No.2 with LFG temperature exceeding 60°C, option B measurement was selected and was applied in the CER calculation.

**Determination of the absolute humidity of the gaseous stream**

The absolute humidity is a parameter required for Option B. It can be determined from the measurement of moisture content (Option 1) or by assuming the gaseous stream is dry or saturated in a simplified conservative approach (Option 2).

Option 2 which assumes that the gaseous stream is dry or saturated in a simplified conservative approach was selected for the CER calculation.

**Option 2: Simplified calculation without measurement of the moisture content**

This option provides a simple and conservative approach to determine the absolute humidity by assuming the gaseous stream is dry or saturated depending on which is the conservative situation. If it is conservative to assume that the gaseous stream is dry, then $m_{H2O,t,db}$ is assumed to equal to 0. If it is conservative to assume that the gaseous stream is saturated, then $m_{H2O,t,db}$ is assumed to be equal to the saturation absolute humidity ($m_{H2O,t,db,sat}$) and is calculated using the equation below:

$$m_{H2O,t,db,Sat} = \frac{p_{H2O,t,Sat} \times MM_{H2O}}{(P_t - p_{H2O,t,Sat}) \times MM_{t,db}}$$

Where:

| | | |
|---|---|---|
| $m_{H2O,t,db,sat}$ | = | Saturation absolute humidity in time interval *t* on a dry basis (kg $H_2O$/kg dry gas) |
| $p_{H2O,t,Sat}$ | = | Saturation pressure of $H_2O$ at temperature $T_t$ in time interval *t* (Pa) |
| $T_t$ | = | Temperature of the gaseous stream in time interval *t* (K) |
| $P_t$ | = | Absolute pressure of the gaseous stream in time interval *t* (Pa) |
| $MM_{H2O}$ | = | Molecular mass of $H_2O$ (kg $H_2O$/kmol $H_2O$) |
| $MM_{t,db}$ | = | Molecular mass of the gaseous stream in a time interval *t* on a dry basis (kg dry gas/kmol dry gas) |

| Parameter | Formula / description |
|---|---|
| $p_{H20,t,Sat}$ | 1 \| 2 \| 3<br>Filonenko/ Ginzburg (1973) and Filonenko et al. (1971) \| 0…100 \| $p_s = \exp(6.416 + 17.3 \cdot t / (238+t))$, (2)<br>$P_s$ – Saturation pressure of $H_2O$<br>t – LFG Temperature |
| $P_t$ | **Absolute Pressure**<br>$P_a = P_g + P_{at}$<br>$P_a = P_g + 101325$<br>where,<br>$P_a$ = Absolute Pressure,<br>$P_g$ = Gauge Pressure,<br>$P_{at}$ = Atmospheric Pressure. |
| $MM_{H2O}$ | 18.0152 kg/kmol<br>Default value from the tool |
| $MM_{t,db}$ | $MM_{t,db} = \sum_k (v_{k,t,db} * MM_k)$<br>Where:<br>$MM_{t,db}$ = Molecular mass of the gaseous stream in time interval *t* on a dry basis (kg dry gas/kmol dry gas)<br>$v_{k,t,db}$ = Volumetric fraction of gas *k* in the gaseous stream in time interval *t* on a dry basis ($m^3$ gas k/$m^3$ dry gas)<br>$MM_k$ = Molecular mass of gas *k* (kg/kmol)<br>k = All gases, except $H_2O$, contained in the gaseous stream (e.g. $N_2$, $CO_2$, O2, CO, H2, $CH_4$, $N_2O$, NO, NO2, $SO_2$, $SF_6$ and PFCs ). See available simplification below<br>Default value for $MM_{i,k}$, Gases involve in the calculation are $CH_4$, $CO_2$, and $O_2$ |

| Data / Parameter: | $MM_i$ |
|---|---|
| Data unit: | kg/kmol |
| Description: | Molecular mass of greenhouse gas *i* |
| Value to be applied: | |

| Compound | Structure | Molecular mass (kg / kmol) |
|---|---|---|
| Carbon dioxide | $CO_2$ | 44.01 |
| Methane | $CH_4$ | 16.04 |
| Nitrous oxide | $N_2O$ | 44.02 |
| Sulfur hexafluoride | $SF_6$ | 146.06 |
| Perfluoromethane | $CF_4$ | 88.00 |
| Perfluoroethane | $C_2F_6$ | 138.01 |
| Perfluoropropane | $C_3F_8$ | 188.02 |
| Perfluorobutane | $C_4F_{10}$ | 238.03 |
| Perfluorocyclobutane | c-$C_4F_8$ | 200.03 |
| Perfluoropentane | $C_5F_{12}$ | 288.03 |
| Perfluorohexane | $C_6F_{14}$ | 338.04 |

| Any comment: | |
|---|---|

| Data / Parameter: | $MM_k$ |
|---|---|
| Data unit: | kg/kmol |
| Description: | Molecular mass of gas *k* |
| Value to be applied: | For gases *k* that are greenhouse gases appy values for $MM_i$. |

| Compound | Structure | Molecular mass (kg / kmol) |
|---|---|---|
| Nitrogen | $N_2$ | 28.01 |
| Oxygen | $O_2$ | 32.00 |
| Carbon monoxide | CO | 28.01 |
| Hydrogen | $H_2$ | 2.02 |
| Nitric oxide | NO | 30.01 |
| Nitrogen dioxide | $NO_2$ | 46.01 |
| Sulfur dioxide | $SO_2$ | 64.06 |

| Any comment: | |
|---|---|

**Option B of measurement options**

The volumetric flow of the gaseous stream in time interval *t* on a dry basis ($V_{t,db}$) is determined by converting the measured volumetric flow from wet basis to dry basis as follows:

$$V_{t,tb} = V_{t,wb}/(1 + v_{H2O,t,db})$$

Where:

$V_{t,db}$ = Volumetric flow of the gaseous stream in time interval *t* on a dry basis ($m^3$ dry gas/h)

$V_{t,wb}$ = Volumetric flow of the gaseous stream in time interval *t* on a wet basis ($m^3$ wet gas/h)

$v_{H2O,t,db}$ = Volumetric fraction of $H_2O$ in the gaseous stream in time interval *t* on a dry basis ($m^3$ $H_2O$/$m^3$ dry gas)

The volumetric fraction of $H_2O$ in time interval *t* on a dry basis ($v_{H2O,t,db}$) is estimated according to the equation below:

$$v_{H2O,t,db} = \frac{m_{H2O,t,db} * MM_{t,db}}{MM_{H2O}}$$

Where:

| | | |
|---|---|---|
| $v_{H2O,t,db}$ | = | Volumetric fraction of $H_2O$ in the gaseous stream in time interval *t* on a dry basis ($m^3$ $H_2O$/$m^3$ dry gas) |
| $m_{H2O,t,db}$ | = | Absolute humidity in the gaseous stream in time interval *t* on a dry basis (kg $H_2O$/kg dry gas) |
| $MM_{t,db}$ | = | Molecular mass of the gaseous stream in time interval *t* on a dry basis (kg dry gas/kmol dry gas) |
| $MM_{H2O}$ | = | Molecular mass of $H_2O$ (kg $H_2O$/kmol $H_2O$) |

The absolute humidity of the gaseous stream ($m_{H2O,t,db}$) is determined using Option 2 above ($MM_{t,db}$) which is as demonstrated above.

Example of the calculation using the *Tool to determine the mass flow of a greenhouse gas in a gaseous stream*, version 03.0.

| ID | Date | TT1(°C) | T | (°C) | PT1(kPa) | PT2(kPa) | CH4(%) | CO2(%) | O2(%) | FT1(Nm3/h) | T2(Nm3/h) | | O2 | MCH4 | MCO2 | MMt,db | MH2O | Patm | Pt | PH2O,T,SAT | mH2O,t,db,SAT | vH2O,t,db | Calculated VFT1,t,db | Calculate VFT2,t,d | New FT2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | 9/17/12 0:18 | 54.59 | | 55.47 | -6.62 | 18.56 | 56.23 | 41.01 | 1.48 | 1734.53 | 1735.36 | 3 | .00 | 16.04 | 44.01 | 27.5414 | 18.0152 | 101325 | 119885 | 15425.0598 | 0.0966 | 0.1477 | 1511.3559 | 1512.079 | 1735.36 |
| 41 | 9/17/12 0:19 | 54.56 | | 56.08 | -6.7 | 18.47 | 56.23 | 41.07 | 1.46 | 1732.16 | 1732.06 | 3 | .00 | 16.04 | 44.01 | 27.5514 | 18.0152 | 101325 | 119795 | 15402.8173 | 0.0964 | 0.1475 | 1509.4459 | 1509.36 | 1732.06 |
| 42 | 9/17/12 0:20 | 54.58 | | 55 | | | | | 1.44 | 1738.58 | 1735.62 | | | | | | 52 | 101325 | 119845 | 1541 | | | | | 1735.62 |
| 43 | 9/17/12 0:21 | 54.52 | | 55 | | | | | 1.44 | 1739.38 | 1738.58 | | | | | | 52 | 101325 | 119835 | 1537 | | | | | 1738.58 |
| 44 | 9/17/12 0:22 | 54.48 | | 56 | | | | | 1.45 | 1729.11 | 1729.14 | | | | | | 52 | 101325 | 119755 | 1534 | | | | | 1729.14 |
| 45 | 9/17/12 0:23 | 54.45 | | 56 | | | | | 1.44 | 1738.51 | 1737.52 | | | | | | 52 | 101325 | 119845 | 1532 | | | | | 1737.52 |
| 46 | 9/17/12 0:24 | 54.45 | | 56 | | | | | 1.42 | 1740.07 | 1731.62 | | | | | | 52 | 101325 | 119885 | 1532 | | | | | 1731.62 |
| 47 | 9/17/12 0:25 | 54.45 | | 56 | | | | | 1.42 | 1744.68 | 1740.56 | 3 | .00 | 16.04 | 44.01 | 27.7107 | 18.0152 | 101325 | 119845 | 1532 | | | | | 1740.56 |
| 48 | 9/17/12 0:26 | 54.45 | | 56 | | | | | 1.41 | 1730.11 | 1730.75 | 3 | .00 | 16.04 | 44.01 | 27.5926 | 18.0152 | 101325 | 119815 | 1532 | | | | | 1730.75 |
| 49 | 9/17/12 0:27 | 54.46 | | 863.3 | -6.69 | 18.51 | 56.32 | 41.18 | 1.41 | 1736.86 | 1736.63 | 3 | .00 | 16.04 | 44.01 | 27.6082 | 18.0152 | 101325 | 119835 | 1532 | | | | | 1736.63 |
| 50 | 9/17/12 0:28 | 54.45 | | 62.88 | -6.66 | 18.52 | 56.35 | 41.28 | 1.42 | 1739.13 | 1738.74 | 3 | .00 | 16.04 | 44.01 | 27.6603 | 18.0152 | 101325 | 119845 | 1532 | | | | | 1738.74 |
| 51 | 9/17/12 0:29 | 54.45 | | 61.84 | -6.83 | 18.46 | 56.33 | 41.38 | 1.42 | 1736.58 | 1736.99 | 3 | .00 | 16.04 | 44.01 | 27.7011 | 18.0152 | 101325 | 119785 | 1532 | | | | | 1736.99 |
| 52 | 9/17/12 0:30 | 54.47 | | 61.23 | -6.64 | 18.51 | 56.55 | 41.25 | 1.42 | 1738.74 | 1738.31 | 3 | .00 | 16.04 | 44.01 | 27.6791 | 18.0152 | 101325 | 119835 | 1539 | | | | | 1738.31 |
| 53 | 9/17/12 0:31 | 54.45 | | 61.38 | -6.62 | 18.38 | 56.29 | 41.22 | 1.39 | 1726.35 | 1725.67 | 3 | .00 | 16.04 | 44.01 | 27.6146 | 18.0152 | 101325 | 119705 | 1532 | | | | | 1725.67 |
| 54 | 9/17/12 0:32 | 54.33 | | 60.02 | -6.57 | 18.38 | 56.41 | 41.26 | 1.4 | 1729.69 | 1729.51 | 3 | .00 | 16.04 | 44.01 | 27.6547 | 18.0152 | 101325 | 119705 | 15233.2038 | 0.0950 | 0.1458 | 1509.5762 | 1509.41 | 1729.51 |
| 55 | 9/17/12 0:33 | 54.34 | | 59.92 | -6.88 | 18.17 | 56.61 | 41.24 | 1.4 | 1715.27 | 1714.58 | 3 | .00 | 16.04 | 44.01 | 27.6780 | 18.0152 | 101325 | 119495 | 15240.5448 | 0.0952 | 0.1462 | 1496.5023 | 1495.90 | 1714.58 |
| 56 | 9/17/12 0:34 | 54.33 | | 60.91 | -6.81 | 18.26 | 56.55 | 41.41 | 1.35 | 1718.76 | 1718.25 | 3 | .00 | 16.04 | 44.01 | 27.7272 | 18.0152 | 101325 | 119585 | 15233.2038 | 0.0948 | 0.1460 | 1499.8176 | 1499.37 | 1718.25 |
| 57 | 9/17/12 0:35 | 54.36 | | 863.2 | -6.65 | 18.33 | 56.76 | 41.37 | 1.32 | 1723.68 | 1723.68 | 3 | .00 | 16.04 | 44.01 | 27.7336 | 18.0152 | 101325 | 119655 | 15255.2360 | 0.0949 | 0.1461 | 1503.9220 | 1503.92 | 1723.68 |
| 22 | 9/17/12 0:00 | 54.71 | | 67.23 | -6.92 | 18.34 | 56.34 | 41.35 | 1.39 | 1726.12 | 1723.94 | 3 | .00 | 16.04 | 44.01 | 27.6799 | 18.0152 | 101325 | 119665 | 15514.3056 | 0.0969 | 0.1490 | 1502.3323 | 1500.43 | 1723.94 |
| 23 | 9/17/12 0:01 | 54.68 | | 66.77 | -6.67 | 18.5 | 56.53 | 41.49 | 1.36 | 1741.43 | 1740.42 | 3 | .00 | 16.04 | 44.01 | 27.7624 | 18.0152 | 101325 | 119825 | 15491.9527 | 0.0964 | 0.1485 | 1516.2837 | 1515.40 | 1740.42 |
| 24 | 9/17/12 0:02 | 54.69 | | 66.53 | -6.73 | 18.4 | 56.5 | 41.41 | 1.36 | 1737.25 | 1736.15 | 3 | .00 | 16.04 | 44.01 | 27.7223 | 18.0152 | 101325 | 119725 | 15499.4006 | 0.0966 | 0.1487 | 1512.3485 | 1511.39 | 1736.15 |
| 25 | 9/17/12 0:03 | 54.66 | | 64.89 | -6.51 | 18.6 | 56.35 | 40.96 | 1.37 | 1735.63 | 1734.69 | 3 | .00 | 16.04 | 44.01 | 27.5034 | 18.0152 | 101325 | 119925 | 15477.0661 | 0.0971 | 0.1482 | 1511.6362 | 1510.81 | 1734.69 |
| 26 | 9/17/12 0:04 | 54.68 | | 63.16 | -6.51 | 18.62 | 56.33 | 41.05 | 1.41 | 1739.65 | 1739.17 | 3 | .00 | 16.04 | 44.01 | 27.5526 | 18.0152 | 101325 | 119945 | 15491.9527 | 0.0970 | 0.1483 | 1514.9589 | 1514.54 | 1739.17 |

## Document information

| *Version* | *Date* | *Description* |
|---|---|---|
| 08.0 | 6 April 2021 | Revision to:<br>• Reflect the “Clarification: Regulatory requirements under temporary measures for post-2020 cases” (CDM-EB109-A01-CLAR). |
| 07.0 | 31 May 2019 | Revision to:<br>• Ensure consistency with version 02.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN);<br>• Add a section on remarks on the observance of the scale limit of small-scale project activity during the crediting period;<br>• Add "changes specific to afforestation or reforestation project activity" as a possible post-registration changes;<br>• Clarify the reporting of net anthropogenic GHG removals for A/R project activities between two commitment periods;<br>• Make editorial improvements. |
| 06.0 | 7 June 2017 | Revision to:<br>• Ensure consistency with version 01.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN);<br>• Make editorial improvements. |
| 05.1 | 4 May 2015 | Editorial revision to correct version numbering. |
| 05.0 | 1 April 2015 | Revisions to:<br>• Include provisions related to delayed submission of a monitoring plan;<br>• Provisions related to the Host Party;<br>• Remove reference to programme of activities;<br>• Overall editorial improvement. |
| 04.0 | 25 June 2014 | Revisions to:<br>• Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0));<br>• Include provisions related to standardized baselines;<br>• Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1;<br>• Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*;<br>• Editorial improvement. |
| 03.2 | 5 November 2013 | Editorial revision to correct table in page 1. |
| 03.1 | 2 January 2013 | Editorial revision to correct table in section E.5. |
| 03.0 | 3 December 2012 | Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB 70, Annex 11). |

| *Version* | *Date* | *Description* |
|---|---|---|
| 02.0 | 13 March 2012 | Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20). |
| 01.0 | 28 May 2010 | EB 54, Annex 34. Initial adoption. |

Decision Class: Regulatory
Document Type: Form
Business Function: Issuance
Keywords: monitoring report