



UNFCCC Joint Implementation Monitoring Report (002)  
for the Project Activity:  
**Landfill Methane Capture and Flaring**  
**At Yalta and Alushta Landfills, Ukraine**

JI Project Reference Number: 0050

Monitoring period: 2010-04-01 – 2011-10-31

Version 1

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## **TABLE OF CONTENTS**

|   |    |
|---|----|
| 1. GENERAL PROJECT INFORMATION .....  | 3  |
| 1.1. Project Background .....   | 3  |
| 1.2. Methodology Applied to the Project Activity .....  | 3  |
| 2. PARTIES INVOLVED.....  | 4  |
| 2.1. The Parties Involved in the JI Project Activity .....                                    | 4  |
| 2.2. Party Responsible for Preparation and Submission of the Monitoring Report .....          | 4  |
| 2.3. Parties Involved in the Project Monitoring and Compliance Activities .....               | 4  |
| 3. KEY MONITORING ACTIVITIES.....   | 5  |
| 3.1. Monitoring Background and Measured Parameters .....                                      | 5  |
| Table 3.1.1: Main Continuously Measured Parameters (Default Approach), Yalta Project .....    | 5  |
| Table 3.1.2: Main Continuously Measured Parameters (Default Approach), Alushta Project .....  | 6  |
| Table 3.1.3: Other Flare Parameters (Default Approach), Both Sites.....                       | 6  |
| 3.2. Data Collection and Processing.....  | 6  |
| 3.3. ERU Calculation Procedure .....  | 7  |
| Table 3.3.1: Constants Used for Calculation of Emission Reductions.....                       | 9  |
| 4. MONITORING RESULTS .....   | 12 |
| 4.1. Emission Reductions .....  | 12 |
| 4.2. Monitoring Period.....   | 12 |
| 4.3. Presentation of Monitoring Results.....  | 12 |
| 5. QUALITY ASSURANCE AND CONTROL MEASURES .....   | 14 |
| Table 5.1: Calibration and Maintenance Schedule .....   | 14 |
| Table 5.2: Last Calibration Performed .....   | 15 |
| ANNEX 1: SUMMARY OF CALCULATION OF THE EMISSION REDUCTIONS DURING THE MONITORING PERIOD ..... | 16 |
| Table A.1.1: Emission Reductions from Flaring.....  | 16 |
| Table A.1.2: Project Emissions from Gasoline Consumption.....                                 | 17 |
| Table A.1.3: Project Emission Reductions.....   | 18 |
| ANNEX 2: SUMMARY OF MONITORING PARAMETERS.....  | 19 |
| Table A.2.1: Measured Monitoring Parameters for the Project Activity:.....                    | 19 |
| Table A.2.2: Calculated Monitoring Parameters for the Project Activity .....                  | 22 |
| Table A.2.3: Monitoring Equipment Legend for the Project Activity.....                        | 23 |

## 1. GENERAL PROJECT INFORMATION

### 1.1. Project Background

The project “Landfill methane capture and flaring at Yalta and Alushta landfills (hereinafter referred to as “the sites”), Ukraine” (hereinafter referred to as “the Project” consists of developing two Landfill Gas (“LFG”) collection and flaring systems in order to avoid emissions of methane being released into the atmosphere. The Project is located in the Autonomous Republic of Crimea, Ukraine, at the municipal landfills of Yalta and Alushta. The towns of Yalta and Alushta are located approximately 30 km apart. Yalta has a population of 150,000 inhabitants and Alushta has 60,000 inhabitants.

LFG production results from waste decay in anaerobic conditions created in the landfill body with approximately 50% methane (“CH<sub>4</sub>”) in its content. Consequently LFG is a powerful greenhouse gas (“GHG”) contributing to global warming. Additionally, LFG is a fire hazard and a cause of bad odours in the vicinity of landfills. By capturing the LFG, GHG emissions are reduced, local environmental impacts are mitigated and the operational safety of the site is increased.

Further background information on this project can be obtained from the Project Design Document (“PDD”) available on the UNFCCC - JI website:

URL: <http://ji.unfccc.int/JIITLProject/DB/1FC65W96MRGI985POSSYVODU119FSC/details>

**The Project has been implemented and monitored in accordance with its Monitoring Plan and the same monitoring procedures applied for the 1<sup>st</sup> Verification Period, which has been already finalized. No deviation from the Monitoring Plan has occurred. The starting date of the Project’s second (2<sup>nd</sup>) Monitoring / Verification Period, in continuity to its 1<sup>st</sup> Verification Period, is April 1, 2010. The second (2<sup>nd</sup>) Monitoring/ Verification period has been defined as a period from 2010-04-01 to 2011-10-31. The “Default Flare Efficiency Approach” specified in the Annex 13 EB 28 Methodological “Tool to determine project emissions from flaring gases containing methane” (hereinafter referred to as “Tool”) has been applied in the ERU calculation procedure. The calculated Project Emission Reductions amount to 63,048 tCO<sub>2</sub>eq during the second (2<sup>nd</sup>) Monitoring period from 2010-04-01 to 2011-10-31.**

A summary of calculation of the emission reductions is included as Annex 1 to this report. It should be noted that due to the upgrade of the systems<sup>1</sup> the Project does not use any fossil fuel for its operational activities (with emissions from gasoline consumption = 0, See Table A.1.2), thus representing an example of a sustainable Project Activity.

A summary of monitoring parameters, as in accordance with the Monitoring Plan (Section D of the registered PDD) is included as Annex 2 to this report.

### 1.2. Methodology Applied to the Project Activity

The project applies the methodology ACM0001 ver. 05 (consolidated baseline and monitoring methodology for landfill gas projects activities) for baseline calculation and monitoring activities.

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<sup>1</sup> It was noted in the Monitoring Report 001: the Project fossil fuel (gasoline) consumption has been zero (0) since October 2009.

## **2. PARTIES INVOLVED**

### **2.1. The Parties Involved in the JI Project Activity**

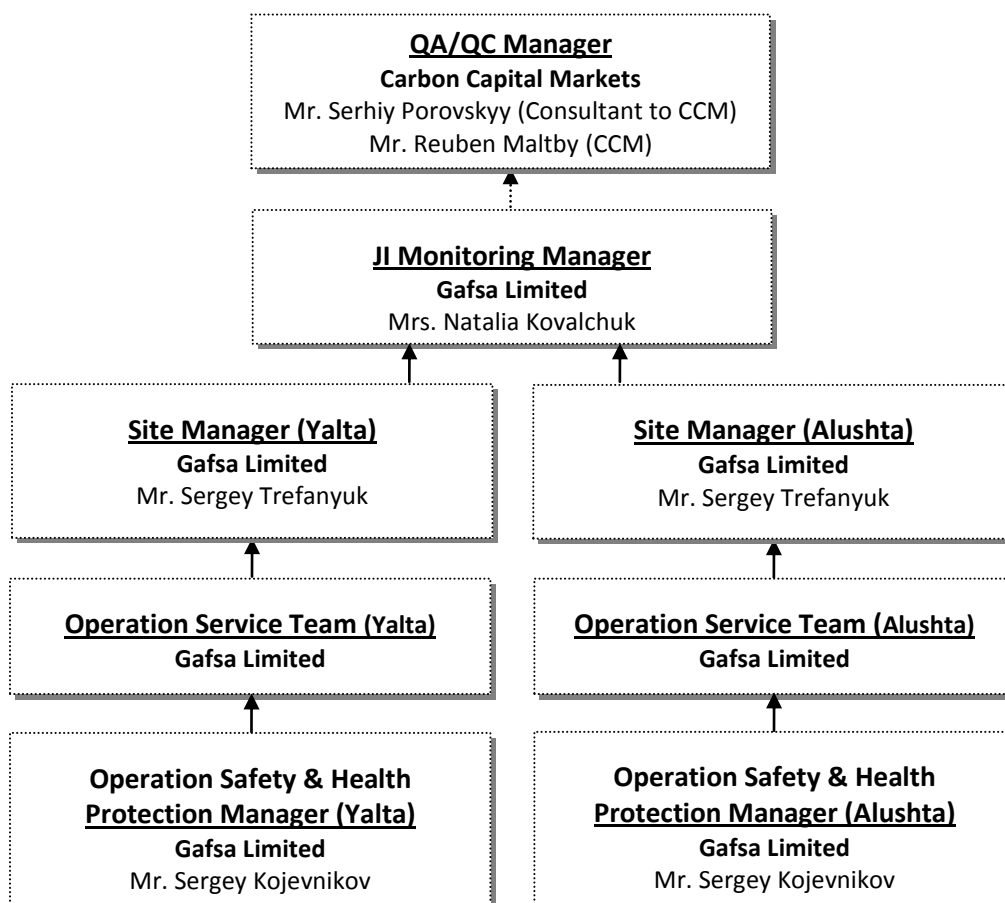
|                                  |  |
|----------------------------------|--|
| Host country                     | Ukraine  |
| Host country Project Participant | Gafsa-Skhid LLC (thereafter referred to as “Gafsa-Skhid”)    |
| Other parties                    | United Kingdom   |
| Annex-1 Project Participant      | Carbon Capital Markets Ltd (thereafter referred to as “CCM”) |
| Project assets manager           | Carbon Assets Fund Ukraine, LLC (referred as “CAF-UA”)       |
| Technical developer              | Gafsa Limited (thereafter referred to as “Gafsa”)            |

### **2.2. Party Responsible for Preparation and Submission of the Monitoring Report**

**This monitoring report was developed / revised by:**

|   |   |
|---|---|
| <b>Mr. Serhiy Porovskyy / Mr. Reuben Maltby</b> | <b>Carbon Capital Markets Ltd (“CCM”)</b> |
|---|---|

### **2.3. Parties Involved in the Project Monitoring and Compliance Activities**



### 3. KEY MONITORING ACTIVITIES

#### 3.1. Monitoring Background and Measured Parameters

Similar to the 1<sup>st</sup> Monitoring/Verification period, the calculations of Emission Reductions for the 2<sup>nd</sup> Monitoring/Verification period have been performed using:

- Raw data obtained from the on-site Memographs RSG10 (PLC), which automatically record operational and monitoring parameters for each site for every operational minute. The main continuously monitored parameters used in calculations are outlined in the Table 3.1.1 for the Yalta site and in The Table 3.1.2 –for the Alushta site. Other flare parameters, which were considered to define a default value of the flare efficiency, are outlined in the Table 3.1.3.
- Fossil fuel (gasoline) consumption data, which was reported on a weekly basis by the Site Manager in the Weekly Monitoring Report. The data has been checked and confirmed by the JI Monitoring Manager. The data indicates that, in consistency with the part of the 1<sup>st</sup> Monitoring/Verification period from October 2009, there was no consumption of fossil fuel (gasoline) during the 2<sup>nd</sup> Monitoring/Verification period by the Project Activity. With the purpose of formal compliance to the Monitoring Plan of the Project, the summary table of the Project Emissions from gasoline consumption ( $ET_v * CEF_{thermal,y}$ ), in tCO<sub>2</sub>, is provided in the Annex 1 (See Table A.1.2).
- Relevant constants as per the Tool summarized in the Table 3.3.1 (See Section 3.3)

The Tables 3.1.1 through 3.1.3 reference only the parameters used in the ERU Calculation Procedure (See Section 3.3). A complete summary of the Monitoring Parameters, as in accordance with the Monitoring Plan of the registered PDD ,is included as Annex 2 to this report.

**Table 3.1.1: Main Continuously Measured Parameters (Default Approach), Yalta Project**

| Parameter     | Data variable                               | Data Unit         | Equipment                     | Reference ID        | Serial #  | Note  |
|---------------|---|-------------------|-------------------------------|---------------------|-----------|---|
| $W_{CH_4}^2$  | %CH4 in LFG                                 | %                 | Gas Analyzer                  | K10128, A141        | 4006.32/2 | Measurement of CH4, O2, and CO2 in LFG on dry basis. Gas sampling is done at the top of dewatering tank, system inlet.                        |
| $W_{O_2}$     | %O2 in LFG                                  | %                 |                               |                     |           |   |
| $W_{CO_2}$    | %CO2 in LFG                                 | %                 |                               |                     |           |   |
| $FV_{RG}$     | Volumetric flow rate of the residual gas    | m <sup>3</sup> /h | Gas Flow Meter (Turbine type) | K10128, FIR61.5     | 10510655  | Measurement of LFG flow in dry basis recorded at NTP. Flow meter is located before the flow separation to supply gas generator and the flare. |
| $T_{flare}^3$ | Temperature in the exhaust gas of the flare | °C                | Thermocouple                  | K10128, TIRCAH81.24 | 5885-00   | Measurement of the exhaust gas temperature. Thermocouple is placed at the top temperature measuring slot of the enclosed flare.               |

<sup>2</sup> In the registered PDD the data unit for this parameter is m<sup>3</sup> CH4/m<sup>3</sup> LFG, while the Gas analyzer record represents the required volumetric fraction but expressed in % (Vol.% m<sup>3</sup> CH4/m<sup>3</sup> LFG).

<sup>3</sup> Measurement of this parameter is required by the Tool and has been used together with the additional monitored parameters (Table 3.3) in order to determine and assign a default value of the flaring efficiency  $\eta_{flare,h}$  in an hour *h*.

**Table 3.1.2: Main Continuously Measured Parameters (Default Approach), Alushta Project**

| Parameter                | Data variable                               | Data Unit         | Equipment                     | Reference ID        | Serial #  | Note  |
|--------------------------|---|-------------------|-------------------------------|---------------------|-----------|---|
| <b>W<sub>CH4</sub></b>   | %CH4 in LFG                                 | %                 | Gas Analyzer                  | K10129, A141        | 4006.32/1 | Measurement of CH4, O2, and CO2 in LFG on dry basis. Gas sampling is done at the top of dewatering tank, system inlet.                        |
| <b>W<sub>O2</sub></b>    | %O2 in LFG                                  | %                 |                               |                     |           |   |
| <b>W<sub>CO2</sub></b>   | %CO2 in LFG                                 | %                 |                               |                     |           |   |
| <b>FV<sub>RG</sub></b>   | Volumetric flow rate of the residual gas    | m <sup>3</sup> /h | Gas Flow Meter (Turbine type) | K10129, FIR61.5     | 10510656  | Measurement of LFG flow in dry basis recorded at NTP. Flow meter is located before the flow separation to supply gas generator and the flare. |
| <b>T<sub>flare</sub></b> | Temperature in the exhaust gas of the flare | °C                | Thermocouple                  | K10129, TIRCAH81.24 | 5885-00   | Measurement of the exhaust gas temperature. Thermocouple is placed at the top temperature measuring slot of the enclosed flare.               |

**Table 3.1.3: Other Flare Parameters (Default Approach), Both Sites**

| Parameter                    | Meaning  | Possible Value | Note  |
|------------------------------|--|----------------|---|
| <b>Other Flare Parameter</b> | Automatic continuous monitoring of the operational status of the flare         | ON/OFF         | If any of operational conditions does not meet necessary requirement for optimal flaring performance, the flare automatically turns-off. Thus, only data records (minutes) for which the flare was “ON” were pre-qualified to be considered in calculation of ERUs                              |
| <b>Other Flare Parameter</b> | Automatic continuous monitoring of the operational status of the flaring plant | Ready/Alarm    | If any of operational conditions does not meet necessary requirement for optimal plant performance, the flaring plant’s status automatically turns “Alarm”. Thus, only data records (minutes) for which the plant had “Ready” status were pre-qualified to be considered in calculation of ERUs |

### 3.2. Data Collection and Processing

All measured monitored parameters are automatically recorded by Memograph RSG10 (PLC). The data, which is protected from alteration, is stored and processed in the following way:

- 1) Stored on-site in SD memory card, placed in the PLC memory-slot at each site; the SD cards used have capacity to store data for the entire lifetime of the Project<sup>4</sup>.

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<sup>4</sup> The Site Manger has confirmed that the placed SD cards store data continuously and contain all data since the Project has been functional. The capacity of the SD cards is enough to store about 5,000 operational days for each site and, currently, the SD-cards are filled for approximately 10% of their capacity by the Project data.

- 2) Stored by the Site Manager directly from the PLC into Site Manager’s password protected computer. The data is stored in RSD format, which protects data from any alteration and can be opened only with special software supplied by the Equipment manufacturer. Then, a Raw Gas data and a Plant Events Log are saved from RSD file into Excel spreadsheet and sent together with an on-site Registry log and a Weekly Monitoring Report to the JI Manager for a cross-check and review.
- 3) JI Monitoring Manager stores both RSD cumulative file and all Excel raw data spreadsheets, checks the data and prepares a Weekly data set – a RAR archive which contains raw data spreadsheets, registry log, and a Weekly Monitoring Report.
- 4) Weekly data sets are submitted to QA/QC Manager (via email), stored by the QA/QC Manager (CCM), and backed-up onto the CCM’s protected server. The weekly data sets are processed by the QA/QC Manager (Consultant to CCM) in accordance with the ERU calculation procedure.

### 3.3. ERU Calculation Procedure

#### Emissions Reduction Formula

The monitored data is used to calculate the JI project’s ERUs. The general formula from the methodology ACM0001 “Consolidated monitoring methodology for landfill gas project activities” for emission reductions of landfill gas projects is listed as below (See also Section D.1.2.2 in the PDD):

$$ER_y = (MD_{project,y} - MD_{reg,y}) * GWP_{CH4} + EL_y * CEF_{electricity,y} - ET_y * CEF_{thermal,y} \quad (1)$$

Since the project activity has not imported/exported electricity from/to the grid, the net quantity of electricity exported ( $EL_y$ ) is zero and the part of the equation (1)  $EL_y * CEF_{electricity,y} = 0$ . Therefore, the formula is amended to be:

$$ER_y = (MD_{project,y} - MD_{reg,y}) * GWP_{CH4} - ET_y * CEF_{thermal,y} \quad (2)$$

Where :

- $ER_y$  - emission reductions by the project in the year “y”, in tCO<sub>2</sub>e
- $MD_{project,y}$  - amount of methane destroyed/combusted in the year “y”, in tCH<sub>4</sub>
- $MD_{reg,y}$  - amount of methane that would have been destroyed/combusted in the year “y” in absence of the project activity, in tCH<sub>4</sub>
- $GWP_{CH4}$  - approved Global Warming Potential value for methane, equals to 21 tCO<sub>2</sub>e/tCH<sub>4</sub>
- $ET_y$  - incremental quantity of fossil fuel, defined as difference of fossil fuel used in the baseline and fossil use during project, for energy requirement on site under project activity during the year “y”, in TJ
- $CEF_{thermal,y}$  - CO<sub>2</sub> emissions intensity of the fossil fuel used to generate thermal/mechanical energy, in tCO<sub>2</sub>e/TJ

The amount of methane that would have been destroyed/combusted in the year “y” in absence of the project activity  $MD_{reg,y}$  can be calculated using the formula:

$$MD_{reg,y} = MD_{project,y} * AF \quad (3)$$

Where, **AF** is the Adjustment Factor, which is defined as the ratio of the destruction efficiency of the collection and destruction system mandated by regulatory or contractual requirements to that of the collection and destruction system in the Project activity.

For this JI Project activity, as there are currently no regulatory or contractual requirements relating to landfill gas projects in Ukraine<sup>5</sup>, nor are any planned in the near future, and no systems for landfill gas recovery or combustion were present at the site before the Project implementation, **AF=0** and, hence, **MD<sub>reg, y</sub> = 0**.

Considering that for the current Project activity **MD<sub>project, y</sub> = MD<sub>flared, y</sub>**, the final form of the emissions reduction formula that was used to calculate emission reductions from the project activity is:

$$ER_y = MD_{flared, y} * GWP_{CH_4} - ET_y * CEF_{thermal, y} \quad (4)$$

#### Calculation of Amount of Methane Destroyed/Combusted by the Project Activity (MD<sub>flared</sub>)

In accordance with the Monitoring Plan of the registered PDD, in order to calculate **MD<sub>flared, y</sub>** in the year “y”, the project emissions from flaring of the residual gas stream in the year “y” (**PE<sub>flare, y</sub>**) has to be calculated. For this purpose, the methodological Tool (Annex 13 EB28) has been used.

Generally, the Tool involves the following steps in order to calculate **PE<sub>flare, y</sub>**:

STEP 1: Determination of the mass flow rate of the residual gas that is flared

STEP 2: Determination of the mass fraction of carbon (C), hydrogen (H), oxygen (O) and nitrogen (N) in the residual gas

STEP 3: Determination of the volumetric flow rate of the exhaust gas on a dry basis

STEP 4: Determination of methane mass flow rate of the exhaust gas on a dry basis

STEP 5: Determination of methane mass flow rate of the residual gas on a dry basis

STEP 6: Determination of the hourly flare efficiency

STEP 7: Calculation of annual project emissions from flaring based on measured hourly values or based on default flare efficiencies.

The Tool offers two options for determining the flare efficiency for the enclosed flare.

Option 1 (“Default Flare Efficiency Approach”) is to apply the default efficiency values (90%, 50%, or 0%) depending on the measured temperature of the exhaust gas (**T<sub>flare</sub>**) and operational parameters.

Option 2 (“Continuous Monitoring Approach”) is to continuously monitor all the required parameters of the residual and exhaust gas in order to calculate the flare efficiency.

**As described in the registered PDD, Option 2 (“Continuous Monitoring Approach”) would be used where possible; otherwise, Option 1 (“Default Flare Efficiency Approach”) will be used. For the reported Monitoring period “Default Flare Efficiency Approach” has been applied.**

The decision that the “Default Flare Efficiency Approach” shall be applied for the 2<sup>nd</sup> Monitoring / Verification period, rather than “Continuous Monitoring Approach”, was analogical to the 1<sup>st</sup> Monitoring / Verification period. Apart of keeping consistency of the applied monitoring procedures, the reason for that decision relied to the operational requirement of installation of the second thermocouple not linked to the plant automatic self-adjustment system.

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<sup>5</sup> This provision is regulated by the National Building Norms of Ukraine (“DBN”); a written confirmation that the regulatory requirements were not changed during the period, which covers the second Monitoring / Verification period, has been issued by the local authority (Ref. Statement #732 dated on 23/11/2011 by the Communal Company of the Yalta City Municipality, Yalta, Autonomous Republic of Crimea, Ukraine).



Due to the use of the “Default Flare Efficiency Approach”, the Steps 3 and 4 are not applicable. Consequently, only STEPs 1, 2, 5, 6, and 7 were considered in the procedure for calculation of the project emissions from flaring. The Table 3.3.1 provides a list of the constants used in the relevant equations from the Tool.

**Table 3.3.1: Constants Used for Calculation of Emission Reductions**

| Parameter                                   | ID                       | Value     | SI Unit                             |
|---|--------------------------|-----------|-------------------------------------|
| Global Warming Potential of methane         | <b>GWP<sub>CH4</sub></b> | 21        | tCO <sub>2</sub> e/tCH <sub>4</sub> |
| Universal ideal gas constant                | <b>R<sub>u</sub></b>     | 8,314.472 | Pa.m <sup>3</sup> /kmol.K           |
| Molecular mass of methane                   | <b>MM<sub>CH4</sub></b>  | 16.04     | kg/kmol                             |
| Molecular mass of oxygen                    | <b>MM<sub>O2</sub></b>   | 32.00     | kg/kmol                             |
| Molecular mass of carbon dioxide            | <b>MM<sub>CO2</sub></b>  | 44.01     | kg/kmol                             |
| Molecular mass of nitrogen                  | <b>MM<sub>N2</sub></b>   | 28.02     | kg/kmol                             |
| Atomic mass of carbon                       | <b>AM<sub>C</sub></b>    | 12.00     | kg/kmol                             |
| Atomic mass of oxygen                       | <b>AM<sub>O</sub></b>    | 16.00     | kg/kmol                             |
| Atomic mass of hydrogen                     | <b>AM<sub>H</sub></b>    | 1.01      | kg/kmol                             |
| Atomic mass of nitrogen                     | <b>AM<sub>N</sub></b>    | 14.01     | kg/kmol                             |
| Density of methane gas at normal conditions | <b>ρ<sub>CH4,n</sub></b> | 0.716     | kg/m <sup>3</sup>                   |
| Atmospheric pressure at normal conditions   | <b>P<sub>n</sub></b>     | 101,325   | Pa                                  |
| Temperature at normal conditions            | <b>T<sub>n</sub></b>     | 273.15    | K                                   |

It is important to clarify that the measured values of **W<sub>CH4</sub>**, **W<sub>O2</sub>**, and **W<sub>CO2</sub>** (in %) were converted into fraction in order to be used in calculation. Thus, the volumetric fractions of CH<sub>4</sub>, O<sub>2</sub>, and CO<sub>2</sub> in the residual gas in the minute “m” were received as:

$$fv_{CH4,m} = W_{CH4,m}/100\%, \quad fv_{O2,m} = W_{O2,m}/100\%, \quad fv_{CO2,m} = W_{CO2,m}/100\% \quad (5)$$

Additionally, as described in the PDD, there is only one flow meter measuring the LFG before it is diverted to the flare and the LFG electricity generator. From the Emission Reductions calculation standpoint the LFG electricity generator will be treated like a flare, with the same (default) efficiency being applied. Consequently, the portion of the flow that has been used and destroyed by the LFG power generator (**LFG<sub>electricity</sub>**) will be treated like it has been flared and, hence, will be incorporated with the actual LFG flow to the flare. Therefore, a general formula that links LFG flow for the year “y”:

$$\text{LFG}_{\text{total},y} = \text{LFG}_{\text{flare},y} + \text{LFG}_{\text{electricity},y} \quad (6)$$

is simplified to:

$$\text{LFG}_{\text{total},y} = \text{LFG}_{\text{flare},y} \quad (7)$$

**This approach is deemed conservative since the applied default efficiency of the flare ( $\leq 90\%$ ) is less than the destruction efficiency of a power generation unit (100%).**

As the LFG flow measured is done automatically for every minute “m” ( $\text{LFG}_{\text{total},m} = \text{LFG}_{\text{flare},m}$ ) in dry basis and at normal conditions, the parameter – volumetric flow rate of the residual gas in dry basis at normal conditions in the minute “m”, in  $\text{m}^3/\text{h}$  – was named  $\text{FV}_{\text{RG},m}$  ( $\text{FV}_{\text{RG},m} = \text{LFG}_{\text{total},m} = \text{LFG}_{\text{flare},m}$ ) to keep consistency with the formulas’ IDs provided by the Tool.

It is also important to explain the mechanism and assumptions used in order to apply the default flare efficiency values.

The Tool (Annex 13 EB 28) specifies the following rule to assign a default value of the flare efficiency:

- $\eta_{\text{flare},h}$  is 0% if the temperature in the exhaust gas of the flare ( $T_{\text{flare}}$ ) is below 500 °C for more than 20 minutes during the hour “h”.
- $\eta_{\text{flare},h}$  is 50%, if the temperature in the exhaust gas of the flare ( $T_{\text{flare}}$ ) is above 500 °C for more than 40 minutes during the hour “h”, but the manufacturer’s specifications on proper operation of the flare are not met at any point in time during the hour “h”.
- $\eta_{\text{flare},h}$  is 90%, if the temperature in the exhaust gas of the flare ( $T_{\text{flare}}$ ) is above 500 °C for more than 40 minutes during the hour “h” and the manufacturer’s specifications on proper operation of the flare are met continuously during the hour “h”.

However, as is in accordance with the manufacturer’s recommendations for the high-temperature / high-efficiency enclosed flares, the flare’s efficiency is above 99% when the exhaust temperature is equal or above 700 °C. To be conservative, this temperature (700 °C) instead of the lower temperature (500 °C), specified in the Tool, was used to check whether  $T_{\text{flare}}$  value meets the necessary requirement.

The assumption that incorporates measurement of  $T_{\text{flare}}$  with the additional continuously measured parameters (See Table 3.1.3) in order to select and assign the default flare efficiency value is:

If in any minute (data point) of the hour  $h$   $T_{\text{flare}} \geq 700$  C, and the Flare status is "ON", and the Plant Status is "Ready" this minute meets ALL operational requirements and is assigned with a Quality factor "1"; otherwise, Quality factor is "0"; when there are less than 60 data points for the hour  $h$ , the missing data points are assumed to have "0" Quality factor

- $\eta_{\text{flare},h}$  is 90%, if the sum of Quality factors for each calendar hour  $h$  is 60;
- $\eta_{\text{flare},h}$  is 50%, if the sum of Quality factors for each calendar hour  $h$  is less than 60 but more or equals 40;
- $\eta_{\text{flare},h}$  is 0% if the sum of Quality factors for each calendar hour  $h$  is less than 40.

The second part of the equation (4), the Project emissions from consumption of a fossil fuel<sup>6</sup> ( $ET * CEF_{thermal}$ ), is zero (0) as no fossil fuel has been consumed by the Project Activity for the reported 2<sup>nd</sup> Monitoring period.

However, as the formality, the procedure of calculating Project emissions from consumption of gasoline ( $ET * CEF_{thermal}$ ) has been applied and summarized in the Table A.1.2 (Annex 1). Under that procedure, the Project emissions from consumption of gasoline ( $ET * CEF_{thermal}$ ) shall be calculated from the Incremental quantity of gasoline used in the year “y” ( $ET_y$ ), in TJ, and the CO<sub>2</sub> emissions intensity of gasoline to generate thermal/mechanical energy ( $CEF_{thermal,y}$ ), in tCO<sub>2</sub>/TJ. The Incremental quantity of gasoline used in the year “y” ( $ET_y$ ) to be received from the weekly measured values of gasoline used (in Litres), accumulated into monthly/annual values (in Litres), and then the annual values to be converted into TJ (TeraJoules) by multiplying on the Gasoline Energy Content<sup>7</sup>, which equals to  $34.66 * 10^{-6}$  TJ/Litre. The emissions intensity of gasoline to generate thermal/mechanical energy ( $CEF_{thermal,y}$ ) to be calculated from the Gasoline Carbon (C) Emission Factor<sup>8</sup>, which equals to 18.9 tC/TJ, converted for CO<sub>2</sub> emission. The received emission intensity of gasoline to generate thermal/mechanical energy  $CEF_{thermal,y} = 69.3$  (tCO<sub>2</sub>/TJ).

**To assure the highest possible accuracy, the ERU calculation procedure has been applied to calculate Project Emissions from flaring ( $PE_{flare,m}$ ) and Emission Reductions from flaring ( $ER_m$ ) for every minute “m”. The received values of  $PE_{flare,m}$  and  $ER_m$  were accumulated to present weekly  $PE_{flare,w}$  and  $ER_w$  values shown in the ERU Calculation Workbooks (See Section 4.3 for details), as well as monthly ( $ER_{flare,mon}$ ) and annual ( $ER_{flare,y}$ ) values, which are outlined in the Table A.1.1 (Annex 1).**

**It’s important to note that calculated weekly, monthly, and annual values are obtained by summing up relevant minute/weekly/monthly values without any additional mathematic operation (like data averaging or rounding); an automatic rounding happens only in order to show the final results, which does not affect the highest accuracy of the results.**

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<sup>6</sup> In PDD, diesel was mentioned as the fossil fuel for a start-up generator, while in practice a gasoline start-up generator was installed and used from the beginning of Project operation till the end of September 2009.

<sup>7</sup> Source: CANMET Energy Diversification Research Laboratory

<sup>8</sup> Source: Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories - Workbook Vol. 2 Page 1.1

## **4. MONITORING RESULTS**

### **4.1. Emission Reductions**

The calculated Net Emission Reductions amount to **63,048 tCO<sub>2</sub>eq for the period from 2010-04-01 to 2011-10-31**. The summary of calculation of the Emission Reductions during the Monitoring period is included as Annex 1 to this report.

### **4.2. Monitoring Period**

This is the second (2<sup>nd</sup>) Monitoring and Verification period reported for this project. The Monitoring report covers the period from 2010-04-01 to 2011-10-31.

### **4.3. Presentation of Monitoring Results**

In accordance with the “Data collection and processing procedure” (Section 3.2), each week Raw data files together with a Weekly Monitoring Report and a weekly technical Registry file are presented as a Weekly Data Set and submitted to the QA/QC Manager by the JI Monitoring Manager. Each Weekly Data Set has been named either as “Yalta YYYYMMDD-YYYYMMDD” for the Yalta Project data or “Alushta YYYYMMDD-YYYYMMDD” for the Alushta Project data, where YYYYMMDD-YYYYMMDD indicates a start and an end date of the reported week.

The ERU Calculation results are presented as Excel workbooks with files named “YaltaERUCalc-DEFAULT-YYYYMMDD-YYYYMMDD” for the Yalta Project and “AlushtaERUCalc-DEFAULT-YYYYMMDD-YYYYMMDD” for Alushta, where YYYYMMDD-YYYYMMDD indicates a start and an end date of the reported week. Each weekly ERU Calculation workbook has an explanation of its structure and the assumptions used in the ERU Calculation procedure. This explanation is provided in the “Read Me” spreadsheet. The raw data is transferred from the Raw Data Gas file, which corresponds to the calculated week, into the “ResidualGasData” and “ExhaustGasData” worksheets. All required measured parameters from the “ResidualGasData” and “ExhaustGasData” worksheets (See Section 3.1 above) are linked to the “A” worksheet. The “A” worksheet is designed to a) perform necessary unit conversion of the measured values to be applied in the ERU Calculation procedure (See Section 3.3); b) determine a default value of the flare efficiency ( $\eta_{\text{flare,h}}$ )<sup>9</sup> for each operational hour “h”<sup>10</sup>. The worksheet “B” contains all constants required for calculation (See Table 3.3.1). A comprehensive calculation is presented in the “Calc Sheet”, which links the data from the worksheets “A” and “B” and, following the STEPs 1, 2, 5, 6, and 7 of the Tool, results with the values of Project Emissions from flaring  $PE_{\text{flare,m}}$  and Emission Reductions from flaring  $ER_m$  for the minute “m”. The accumulated weekly values  $PE_{\text{flare,w}}$  and  $ER_w$  are also shown in the “Calc Sheet”.

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<sup>9</sup> To be applied for calculation of the project emissions and emission reductions from flaring, the value of ( $\eta_{\text{flare,h}}$ ) is converted into fraction (0.0 for 0% default flare efficiency; 0.5 for 50%; and 0.9 for 90%).

<sup>10</sup> The default value of the flare efficiency is assigned as a function of quantity of operational minutes when all operational requirements are met (See Table 3.1.3 for the list of additional parameters been continuously monitored) and the temperature of the exhaust gas  $T_{\text{flare}} \geq 700$  °C (refer to the Section 3.3 for explanation).

Summary of the results were presented in the “YYYYMMDD-1PV ERUs FINAL SUMMARY” excel workbook. This file contains:

- Separately for Yalta and Alushta: all weekly values, monthly and annual values of the Emission Reductions from flaring; weekly/monthly/annual amounts of used fossil fuel (gasoline) and resulting annual Project Emissions from gasoline consumption; and finally the Net Emission Reductions (**ER<sub>y</sub>**) for the year “y”: 2010 (Partial year from 01 April to 31 December); and 2011 (Partial year from 01 January till 31 October); and total for the monitoring period (from 2010-04-01 to 2011-10-31).
- Summary Tables A.1.1, A.1.2, and A.1.3, which are provided in the Annex 1 to this Monitoring report.

## 5. QUALITY ASSURANCE AND CONTROL MEASURES

All the monitoring data has been quality controlled for the following measures:

- 1) Certification/License provided by the manufacturers of instrumentation to accredited standard
- 2) Calibration certificates for instrumentation standard
- 3) JI database archives management regulation

Monitoring equipment calibration and certification has been performed by independent, external accredited laboratories or by the direct manufacturers, if applied.

Maintenance and operational calibration of the equipment has been carried by the Operation Service Team (Gafsa Limited) in accordance with the Calibration and Maintenance Schedule (Table 5.1 and Table 5.2) and detailed in the Weekly Monitoring reports submitted to QA/QC Manager (CCM).

**Table 5.1: Calibration and Maintenance Schedule<sup>11</sup>**

| Equipment (Manufacturer, ID, Serial #)   | Frequency     | Maintenance  | Calibration  |
|--|---------------|--|--|
| <u>LFG Gas Analyzer</u><br>HOFGAS-Assay (NUK)<br><br>Yalta ID K10128: A141,<br>Serial# 4006.32/2;<br><br>Alushta ID K10129: A141,<br>Serial# 4006.32/1 | Weekly        | Check function control for measuring gas cooler, condensate pump and cabinet fan; exchange filter in measuring gas filter  | On-site, using recommended calibration gas mixture with max pressure 300hPa. Before calibration - "zeroing" procedure should be carried out. For zeroing, the analyzer has to be flushed with nitrogen (N2) or opposite calibration gas. |
|  | Monthly       | Check function control for measuring gas pump; Clean filter mat in Cabinet fan   |  |
|  | Semi-annually | Dismount heat exchanger and clean measuring gas cooler; change hose in condensate pump; check function control for solenoid valve  |  |
|  | Yearly        | Change measuring gas pump; Pressure test entire system with 50 hPa (testing time 50 minutes); check function control for entire system; dismount and clean deflagration arrester |  |
| <u>Gas Flow Meter<sup>12</sup>:</u><br>(Elster-Instromet AG)   | Weekly        | Lubrication of system  |  |

<sup>11</sup> The table lists the maintenance and calibration requirements only for the equipment measurements from which were used for ERU Calculation during the reported Monitoring period. Maintenance procedures for all necessary components of the flaring plant have been provided in the Operational Manual by the manufacturer "Hofstetter Umwelttechnik AG"

<sup>12</sup> Turbine Gas Flow Counter incorporates LFG Gas flow meter (FIR61.5), pressure (PIR61.5) and temperature (TIR61.5) transmitters in order to provide a record of the LFG flow rate at NTP conditions.

**JI Project: Landfill Methane Capture and Flaring at Yalta and Alushta Landfills, Ukraine**  
**Monitoring Report for the period 2010-04-01 – 2011-10-31**

| Equipment (Manufacturer, ID, Serial #)                                  | Frequency     | Maintenance                     | Calibration  |
|---|---------------|---------------------------------|--|
| Yalta ID K10128, FIR61.5 (inc. PIR61.5 and TIR61.5), Serial# 10510655;  | Semi-annually | Check mechanical smooth running |  |
| Alushta ID K10129, FIR61.5 (inc. PIR61.5 and TIR61.5), Serial# 10510656 | Yearly        | Spin test                       |  |
|   | Every 2yr.    |                                 | Certified Calibration of the pressure transmitter (PIR61.5), temperature transmitter (TIR61.5), and the flow counter (FIR61.5) |
| Thermocouple (Jumo) TIRCAH 81.24, Series 5885-00 <sup>13</sup>          |               |                                 | Replace or repair with consequent certified calibration if malfunctioning  |

**Table 5.2: Last Calibration Performed**

| Description      | ID       | Calibration   |  |  |
|------------------|----------|---------------|--|--|
|                  |          | Frequency     | Date of last calibration                   | Scheduled Date of next calibration         |
| LFG Gas Analyzer | A141     | Weekly        | 29.10.2011 (Alushta)<br>23.10.2011 (Yalta) | 06.11.2011 (Alushta)<br>01.11.2011 (Yalta) |
| Gas Flow Meter   | PIR 61.5 | Every 2 Years | 22.01.2010                                 | 22.01.2012                                 |
|                  | TIR 61.5 | Every 2 Years | 22.01.2010                                 | 22.01.2012                                 |
|                  | FIR 61.5 | Every 2 Years | 22.01.2010                                 | 22.01.2012                                 |

<sup>13</sup> The thermocouples supplied with the flaring plant by manufacturer (Hofstetter) were tested for the entire series of Type S Thermocouples (original manufacturer Jumo)

## ANNEX 1: SUMMARY OF CALCULATION OF THE EMISSION REDUCTIONS DURING THE MONITORING PERIOD

(2010 April 1 to 2011 October 31)

As explained in the Section 3.3, the final formula that was used to calculate emission reductions from the project activity is:

$$ER_y = MD_{\text{flared},y} * GWP_{\text{CH}_4} - ET_y * CEF_{\text{thermal},y} \quad (4)$$

Emission Reductions from flaring ( $MD_{\text{flared}} * GWP_{\text{CH}_4}$ ):

The first part of the equation (4), the Emission Reductions from flaring ( $ER_{\text{flare}} = MD_{\text{flared}} * GWP_{\text{CH}_4}$ ), was calculated in accordance with the ERU Calculation procedure for every minute and then accumulated to present weekly/monthly/annual values. The Table A.1.1 shows the monthly  $ER_{\text{flare},\text{mon}}$ , annual  $ER_{\text{flare},y}$ , and the total values of the Emission Reductions from flaring, in tCO<sub>2</sub>e.

**Table A.1.1: Emission Reductions from Flaring**

| MONTH  | YEAR  |   |   |   |
|--|---|---|---|---|
|  | 2010  |   | 2011  |   |
|  | ALUSHTA   | YALTA   | ALUSHTA   | YALTA   |
|  | $ER_{\text{flare},\text{mon}}, \text{ tCO}_2\text{e}$ | $ER_{\text{flare},\text{mon}}, \text{ tCO}_2\text{e}$ | $ER_{\text{flare},\text{mon}}, \text{ tCO}_2\text{e}$ | $ER_{\text{flare},\text{mon}}, \text{ tCO}_2\text{e}$ |
| JANUARY  | N/A   | N/A   | 0   | 0   |
| FEBRUARY   | N/A   | N/A   | 0   | 0   |
| MARCH  | N/A   | N/A   | 917   | 0   |
| APRIL  | 1,812   | 984   | 935   | 2,541   |
| MAY  | 1,668   | 2,421   | 1,548   | 2,166   |
| JUNE   | 1,533   | 2,664   | 1,449   | 3,170   |
| JULY   | 1,389   | 2,428   | 846   | 3,296   |
| AUGUST   | 1,026   | 2,460   | 569   | 3,013   |
| SEPTEMBER  | 2,153   | 2,335   | 1,286   | 3,117   |
| OCTOBER  | 1,952   | 3,089   | 1,961   | 3,050   |
| NOVEMBER   | 66  | 2,985   | N/A   | N/A   |
| DECEMBER   | 0   | 2,219   | N/A   | N/A   |
| Yalta/Alushta $ER_{\text{flare},y}, \text{ tCO}_2\text{e}$           | 11,599  | 21,585  | 9,511   | 20,353  |
| Project Activity $ER_{\text{flare},y}, \text{ tCO}_2\text{e}$        | 33,184  |   | 29,864  |   |
| Monitoring Period Total $ER_{\text{flare},y}, \text{ tCO}_2\text{e}$ | 63,048  |   |   |   |



Project Emissions from Gasoline Consumption ( $ET * CEF_{thermal}$ )

The second part of the equation (4), the Project emissions from gasoline consumption ( $ET * CEF_{thermal}$ ), is zero (0) as no gasoline has been consumed by the Project Activity during the reported 2<sup>nd</sup> Monitoring period as the result of the systems' operational upgrade finalized by the end of September 2009<sup>14</sup>.

However, as the formality, the procedure of calculating Project emissions from gasoline consumption ( $ET * CEF_{thermal}$ ) has been applied and summarized in the Table A.1.2, with  $ET * CEF_{thermal} = 0$  in 2010 and 2011. Under that procedure, the Project emissions from consumption of gasoline ( $ET * CEF_{thermal}$ ) shall be calculated from the Incremental quantity of gasoline used in the year "y" ( $ET_y$ ), in TJ, and the CO<sub>2</sub> emissions intensity of gasoline to generate thermal/mechanical energy ( $CEF_{thermal,y}$ ), in tCO<sub>2</sub>/TJ. The Incremental quantity of gasoline used in the year "y" ( $ET_y$ ) to be received from the weekly measured values of gasoline used (in Litres), accumulated into monthly/annual values (in Litres), and then the annual values to be converted into TJ (TeraJoules) by multiplying on the Gasoline Energy Content, which equals to  $34.66 * 10^{-6}$  TJ/Litre. The emissions intensity of gasoline to generate thermal/mechanical energy ( $CEF_{thermal,y}$ ) to be calculated from the Gasoline Carbon (C) Emission Factor, which equals to 18.9 tC/TJ, converted for CO<sub>2</sub> emission. The received emission intensity of gasoline to generate thermal/mechanical energy  $CEF_{thermal,y} = 69.3$  (tCO<sub>2</sub>/TJ).

**Table A.1.2: Project Emissions from Gasoline Consumption**

| PERIOD   | ALUSHTA   | YALTA   | PROJECT ACTIVITY*   |
|--|---|---|---|
|  | Project Emissions from gasoline consumption<br>( $ET_y * CEF_{thermal,y}$ ), tCO <sub>2</sub> | Project Emissions from gasoline consumption<br>( $ET_y * CEF_{thermal,y}$ ), tCO <sub>2</sub> | Project Emissions from gasoline consumption<br>( $ET_y * CEF_{thermal,y}$ ), tCO <sub>2</sub> |
| 2010 (Partial Year: APR-DEC)                             | 0   | 0   | 0   |
| 2011 (Partial Year: JAN-OCT)                             | 0   | 0   | 0   |
| <b>Total* for the Monitoring Period, tCO<sub>2</sub></b> | <b>0</b>  | <b>0</b>  | <b>0</b>  |

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<sup>14</sup> Ref. to the 1<sup>st</sup> Monitoring Period.

Net Emission Reductions (ER)

The Table A.1.3 provides the summary of the calculation of the Project Emission Reductions in accordance with the formula (4), in tCO<sub>2</sub>e.

**The total value of the Project Emission Reductions during the 2<sup>nd</sup> Monitoring period from 2010-04-01 to 2011-10-31 is 63,048 tCO<sub>2</sub>e.**

**Table A.1.3: Project Emission Reductions**

| PERIOD  | PROJECT ACTIVITY<br>Emission<br>Reductions from<br>flaring<br>( $MD_{\text{flared},y} * GWP_{\text{CH}_4}$ ),<br>tCO <sub>2</sub> e | PROJECT ACTIVITY<br>Emissions from<br>gasoline consumption<br>( $ET_y * CEF_{\text{thermal},y}$ ), tCO <sub>2</sub> | PROJECT ACTIVITY<br>Emission Reductions<br>ER <sub>y</sub> , tCO <sub>2</sub> e |
|---|---|---|---|
| <b>2010 (Partial Year: APR-DEC)</b>                                 | 33,184  | 0   | 33,184  |
| <b>2011 (Partial Year: JAN-OCT)</b>                                 | 29,864  | 0   | 29,864  |
| <b>Project Total for the Monitoring<br/>Period, tCO<sub>2</sub></b> | <b>63,048</b>   | <b>0</b>  | <b><u>63,048</u></b>  |

## ANNEX 2: SUMMARY OF MONITORING PARAMETERS

The following Tables A.2.1 through A.2.3 provide a summary of monitoring measured (Table A.2.1) and calculated (Table A.2.2) parameters with their link to the PDD Monitoring Plan (Section D) and the Tool (Annex 13 EB 28); as well as the Equipment Legend (Table A.2.3) for the Project Activity. Some of the Monitoring parameters are not applicable for the selected Default flare efficiency approach. Applied Monitoring parameters are detailed in the Section 3 of this Monitoring Report.

**Table A.2.1: Measured Monitoring Parameters for the Project Activity:**

| Equipment   | Ref. ID | Parameter(s)  | Description  | Notes   | Frequency/<br>uncertainty   | Link to PDD / Tool  |
|---|---------|---|--|---|---|---|
| LFG Flow Meter <sup>15</sup> :<br>(Elster-Instromet AG) | FIR61.5 | $FV_{RG,m} =$<br>$LFG_{total,m} =$<br>$LFG_{flare,m}$ | Volumetric flow rate of residual gas in dry basis at normal conditions in the minute "m", in m <sup>3</sup> /h.                | Measurement of LFG flow in dry basis recorded at NTP. Flow meter is located before the flow separation to supply gas generator and the flare.<br>Explanation on the link to PDD parameters is provided in the Section 3.3, equations 6, 7, pp.9-10 of this Monitoring Report.                           | Continuous electronic recording (100% of data);<br>Uncertainty level is Low | <b>PDD:</b><br>$LFG_{total,y}$ , $LFG_{flare,y}$ ,<br>$LFG_{electricity,y}$<br><b>Tool</b><br>$FV_{RG,h}$     |
| LFG Gas Analyzer<br>HOFGAS-Assay<br>(NUK)               | A141    | $W_{CH4,m}$ $W_{O2,m}$<br>$W_{CO2,m}$                 | Volumetric fraction of CH <sub>4</sub> , O <sub>2</sub> , and CO <sub>2</sub> in the residual gas in the minute "m", in % Vol. | Measurement of CH <sub>4</sub> , O <sub>2</sub> , and CO <sub>2</sub> in LFG on dry basis. Gas sampling is done at the top of dewatering tank, system inlet.<br>These parameters are converted into $fv_{CH4,m}$ , $fv_{CO2,m}$ , and $fv_{O2,m}$ (See explanation in the Section 3.3, equation 5, p.9) | Continuous electronic recording (100% of data);<br>Uncertainty level is Low | <b>PDD:</b><br>$W_{CH4,y}$ $W_{O2}$ , $W_{CO2,r}$<br><b>Tool</b><br>$fv_{CH4,h}$ , $fv_{O2,h}$ , $fv_{CO2,h}$ |

<sup>15</sup> Turbine Gas Flow Counter incorporates LFG Gas flow meter (FIR61.5), pressure (PIR61.5) and temperature (TIR61.5) transmitters in order to provide a record of the LFG flow rate at NTP conditions.

**JI Project: Landfill Methane Capture and Flaring at Yalta and Alushta Landfills, Ukraine  
Monitoring Report for the period 2010-04-01 – 2011-10-31**

| <b>Equipment</b>                                     | <b>Ref. ID</b> | <b>Parameter(s)</b>                                     | <b>Description</b>  | <b>Notes</b>  | <b>Frequency/<br/>uncertainty</b>   | <b>Link to PDD / Tool</b>  |
|--|----------------|---|---|---|---|--|
| Fluegas Analyzer<br>HOFGAS-Assay<br>FlueGas<br>(NUK) | A151           | <b>W<sub>CH4ex,m</sub></b><br><b>W<sub>O2ex,m</sub></b> | Volumetric fraction of CH4 and O2 in the exhaust gas in the minute “m” on dry basis at NTP, in % Vol. | This is measured on dry basis at normal conditions in accordance with Annex 13 EB 28 (only applicable in the case of continuous monitoring of the flare efficiency).<br><br>Point of measurement is in the top (~80% of flare height) section of the flare and probes are adequate to high temperatures.  | Continuous electronic recording (100% of data);<br>Uncertainty level is Low | <b>PDD:</b><br><b>W<sub>CH4ex</sub> W<sub>O2ex</sub></b><br><br><b>Tool</b><br><b>t<sub>O2,h</sub> fv<sub>CH4,FG,h</sub></b> (conversion from % Vol into mg/m3 will be performed as per Tool p.13) |
| Temperature Transmitter<br>(FlowComp)                | TIR61.5        | <b>T</b>  | Temperature of the landfill gas, in °C  | Measurement of the LFG temperature at the point of flow/ pressure measurement. Since the LFG flow is recorded at NTP, the temperature is not used in calculations, but is recorded to be complete   | Continuous electronic recording (100% of data);<br>Uncertainty level is Low | <b>PDD:</b><br><b>T</b>  |
| Pressure Transmitter<br>(Rosemount)                  | PIR61.5        | <b>P</b>  | Pressure of the landfill gas  | Measurement of the LFG pressure at the point of flow/temperature measurement. Since the LFG flow is recorded at NTP, the pressure is not used in calculations, but is recorded to be complete   | Continuous electronic recording (100% of data);<br>Uncertainty level is Low | <b>PDD:</b><br><b>P</b>  |
| Thermo-couple<br>(Jumo)                              | TIRCAH 81.24   | <b>T<sub>flare</sub></b>                                | Temperature of the exhaust gas of the enclosed flare, in °C   | Measurement of the exhaust gas temperature. Thermocouple is placed at the top temperature measuring slot of the flare. Thermocouple used is of Type S, which is of a higher measuring standard than Type N. The parameter <b>T<sub>flare</sub></b> is equivalent to the parameter <b>T<sub>ex</sub></b> in the PDD in a case of “Default flare efficiency approach”; in a case of “Continuous monitoring of flare efficiency” the system may be upgraded with an additional thermocouple. | Continuous electronic recording (100% of data);<br>Uncertainty level is Low | <b>PDD:</b><br><b>T<sub>ex</sub></b><br><br><b>Tool</b><br><b>T<sub>flare</sub></b>  |

**JI Project: Landfill Methane Capture and Flaring at Yalta and Alushta Landfills, Ukraine**  
**Monitoring Report for the period 2010-04-01 – 2011-10-31**

| <b>Equipment</b>                             | <b>Ref. ID</b> | <b>Parameter(s)</b>              | <b>Description</b>  | <b>Notes</b>   | <b>Frequency/<br/>uncertainty</b>  | <b>Link to PDD / Tool</b>  |
|--|----------------|----------------------------------|---|--|--|--|
| LFG piston generator counter (control panel) | UMG-60         | <b>h</b>                         | Operating hours of the energy plant   | This is monitored to ensure that CH <sub>4</sub> destruction is only claimed for CH <sub>4</sub> used in the biogas generator when it is operational.  | Continuous but documented weekly; Uncertainty level is Low               | <b><u>PDD:</u></b><br><b>h</b>   |
| Manual Dip stick                             | N/A            | Weekly quantity of gasoline used | Amount of fossil fuel (gasoline) used by on-site start-up gasoline generator to meet project requirement, in Litres | All electricity generated on site using fossil fuel is covered by this parameter. The values of this parameter are accumulated monthly and annually and used in calculation of Incremental quantity of gasoline used in the year “y” ( <b>ET<sub>y</sub></b> ). (See explanation in the Section 3.3, pp.10-11) | Weekly; Uncertainty level is Low/Medium                                  | <b><u>PDD:</u></b><br><b>ET<sub>y</sub></b>  |
| Plant Control, Memograph RSG10               | A101           | Other Flare parameters           | Automatic continuous monitoring of the operational status of the flare  | If any of operational conditions does not meet necessary requirement for optimal flaring performance, the flare automatically turns-off. Thus, only data records (minutes) for which the flare was “ON” were pre-qualified to be considered in calculation of ERUs   | Continuous electronic recording (100% of data); Uncertainty level is Low | <b><u>PDD/Tool</u></b><br><br>Other Flare operation parameters according to the Annex 13 EB28 (Tool) |
| Plant Control, Memograph RSG10               | A101           | Other Flare parameters           | Automatic continuous monitoring of the operational status of the flaring plant                                      | If any of operational conditions does not meet necessary requirement for optimal plant performance, the flaring plant’s status automatically turns “Alarm”. Thus, only data records (minutes) for which the plant had “Ready” status were pre-qualified to be considered in calculation of ERUs                | Continuous electronic recording (100% of data); Uncertainty level is Low | <b><u>PDD/Tool</u></b><br><br>Other Flare operation parameters according to the Annex 13 EB28 (Tool) |

**JI Project: Landfill Methane Capture and Flaring at Yalta and Alushta Landfills, Ukraine**  
**Monitoring Report for the period 2010-04-01 – 2011-10-31**

**Table A.2.2: Calculated Monitoring Parameters for the Project Activity**

| Parameter(s)   | Description  | Notes  | Link to PDD / Tool   |
|--|--|--|--|
| $fv_{CH_4,m}$ , $fv_{CO_2,m}$ ,<br>$fv_{O_2,m}$ , and $fv_{N_2,m}$     | Volumetric fraction of CH <sub>4</sub> , O <sub>2</sub> , CO <sub>2</sub> , and N <sub>2</sub> in the residual gas in the minute “m”.        | The volumetric fractions of three gases (CH <sub>4</sub> , CO <sub>2</sub> , and O <sub>2</sub> ), represented by parameters $fv_{CH_4,m}$ , $fv_{CO_2,m}$ , and $fv_{O_2,m}$ , are converted into fraction from continuously monitored measured parameters $W_{CH_4}$ , $W_{O_2}$ , and $W_{CO_2}$ (in Vol. %).<br><br>The volumetric fraction of N <sub>2</sub> ( $fv_{N_2,m}$ ) is calculated in accordance with the Tool, as:<br>$fv_{N_2,m} = 1 - (fv_{CH_4,m} + fv_{CO_2,m} + fv_{O_2,m})$ | <u>Tool</u><br><br>$fv_{i,h}$                                      |
| $PE_{flare,m}$ , $PE_{flare,w}$ ,<br>$PE_{flare,mon}$ , $PE_{flare,y}$ | Project Emissions from flaring the residual gas stream in the minute “m”, week “w”, month “mon” and year “y”, in tCO <sub>2</sub> e          | Calculated using the methodological Tool (Annex 13 EB28), Steps 1 – 7 (Steps 3 and 4 are applicable only in a case of “Continuous flare efficiency monitoring”).<br><br>Calculation was performed as per ERU Calculation Procedure (Section 3.3) to calculate Project Emissions from flaring and Emission Reductions from flaring for every minute “m”. The received values were accumulated into weekly/monthly/annual values.  | <u>PDD/Tool</u><br><br>$PE_{flare,y}$                              |
| $ET_y$   | Incremental quantity of gasoline used in the year “y”, in TJ   | Calculated from the weekly measured values of gasoline used (in Litres), accumulated into monthly/annual values (in Litres), and then converted into TJ (TeraJoules) by multiplying on the Gasoline Energy Content.  | <u>PDD</u><br><br>$ET_y$   |
| $CEF_{thermal,y}$  | CO <sub>2</sub> emissions intensity of gasoline to generate thermal/mechanical energy, in tCO <sub>2</sub> /TJ                               | Calculated from the Gasoline Carbon (C) Emission Factor to be applied for CO <sub>2</sub> emissions.   | <u>PDD</u><br><br>$CEF_{thermal}$                                  |
|  | Regulatory requirements* relating to LFG projects (National regulations)<br><br>*This is an estimated parameter based upon a text statement. | A formal statement to be received from an official source to be submitted during Project Activity verification.<br><br>Required for any changes to the adjustment factor ( <b>AF</b> ) or directly $MD_{reg,y}$ .  | <u>PDD</u><br><br>Regulatory requirements relating to LFG projects |

**JI Project: Landfill Methane Capture and Flaring at Yalta and Alushta Landfills, Ukraine**  
**Monitoring Report for the period 2010-04-01 – 2011-10-31**

**Table A.2.3: Monitoring Equipment Legend for the Project Activity**

| <b>Equipment ID</b>               | <b>Drawing ID; Serial #</b>  | <b>Parameters monitored</b>                                  | <b>Equipment Description</b>  | <b>Notes</b>  |
|-----------------------------------|--|--|---|---|
| LFG Gas Analyzer (A 141)          | K- 10128 (Yalta) Serial# 4006.32/2<br>K- 10129 (Alushta) Serial# 4006.32/1 | Measured in %.Vol.:<br>$W_{CH4,m}$ $W_{O2,m}$<br>$W_{CO2,m}$ | HOFGAS-Assay(NUK)<br>Measuring range Vol%:<br>CH4: 0..100 %; O2: 0..25%;CO2: 0..100%<br><br>Uncertainty level: $U_{95}=\pm 1.0\%$     | Original manufacturer Calibration Certificate was provided. For proper operation the equipment has to be calibrated as per calibration procedure  |
| Fluegas Analyzer (A 151)          | K- 10128 (Yalta) Serial# 4006.41<br>K- 10129 (Alushta) Serial# 4006.63     | Measured in %.Vol.:<br>$W_{CH4ex,m}$ $W_{O2ex,m}$            | HOFGAS- Assay FlueGas (NUK)<br>Measuring range:<br>CH4: 0..2 % Vol.; O2: 0..21 % Vol.<br>Uncertainty level: $U_{95}<\pm 1.0\%$        | Original manufacturer Calibration Certificate was provided. For proper operation the equipment has to be calibrated as per calibration procedure  |
| LFG Flow meter (FIR 61.5)         | K- 10128 (Yalta) Serial# 10510655<br>K- 10129 (Alushta) Serial# 10510656   | $FV_{RG,m} =$<br>$LFG_{total,m} =$<br>$LFG_{flare,m}$        | LFG Flow meter (Elster-Instromet AG)<br>Measuring range:<br>50-1000 m <sup>3</sup> /h<br>Uncertainty level: $U_{95}=\pm 0.3\%$        | The Equipment is compensated with Pressure and Temperature transmitters. Original Certification is a part of Calibration Certificate for the Turbine Gas Flow Counter.<br>Recalibration Certificate by a Certified Lab is provided as per calibration procedure |
| Pressure Transmitter (PIR61.5)    | K- 10128 (Yalta) Serial# 8439984<br>K- 10129 (Alushta) Serial# 8439985     | <b>P</b>   | Pressure Transmitter (Rosemount)<br>Measuring range:<br>0.0..2.5 bar; max 10bar<br>Uncertainty level: $U_{95}=\pm 0.25\%$             | Original Certification is a part of Calibration Certificate for the Turbine Gas Flow Counter.<br>Recalibration Certificate by a Certified Lab is provided as per calibration procedure  |
| Temperature Transmitter (TIR61.5) | K- 10128 (Yalta) Ser.# 87002014213<br>K- 10129 (Alushta) Ser.# 87002014214 | <b>T</b>   | Temperature Transmitter (FlowComp)<br>Measuring range:<br>-50..+100 °C; max +120 °C<br>Uncertainty level: class A $U_{95}=\pm 1.0$ °C | Original Certification is a part of Calibration Certificate for the Turbine Gas Flow Counter.<br>Recalibration Certificate by a Certified Lab is provided as per calibration procedure  |
| Thermocouple (TIRCAH81.24)        | K- 10128 (Yalta) K- 10129 (Alushta) Series 5885-00                         | $T_{flare}$  | Thermocouple Type S (Jumo)<br>Measuring range:<br>0..+1600 °C<br>Uncertainty level: $U_{95}=\pm 1.5$ °C                               | Original manufacturer Calibration Certificate was provided for the Series of Thermocouples. For proper operation the equipment has to be calibrated as per calibration procedure  |