CARBON CAPITAL MARKETS®

UNFCCC Joint Implementation Monitoring Report (001) for the Project Activity:

Landfill Methane Capture and Flaring At Yalta and Alushta Landfills, Ukraine

JI Project Reference Number: 0050

Monitoring period: 2008-06-01 – 2010-03-31

Version 3

Date: 2011-02-17

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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 in Ukraine on the Black Sea 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 the anaerobic conditions created in the landfill body and contains approximately 50% methane ("CH4"). 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/1FC65W96MRGI985P0SSYVODU119FSC/details

The Project has been implemented and monitored in accordance with its Monitoring Plan. No deviation from the Monitoring Plan has occurred. The starting date of the project, in accordance with the registered PDD, is June 1, 2008. The first monitoring/verification period has been defined as a period from 2008-06-01 to 2010-03-31. 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 54,560 tCO2eq during the first Monitoring period from 2008-06-01 to 2010-03-31.

A summary of calculation of the emission reductions is included as Annex 1 to this report.

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.

It should be noted that the emission reductions are claimed several months after the registered starting date in the PDD. The emission reductions are claimed starting September 07, 2008 for Alushta and from November30, 2008 for Yalta, since the formal operation of the Project started later than expected due to a prolonged commissioning period.

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.

2. PARTIES INVOLVED

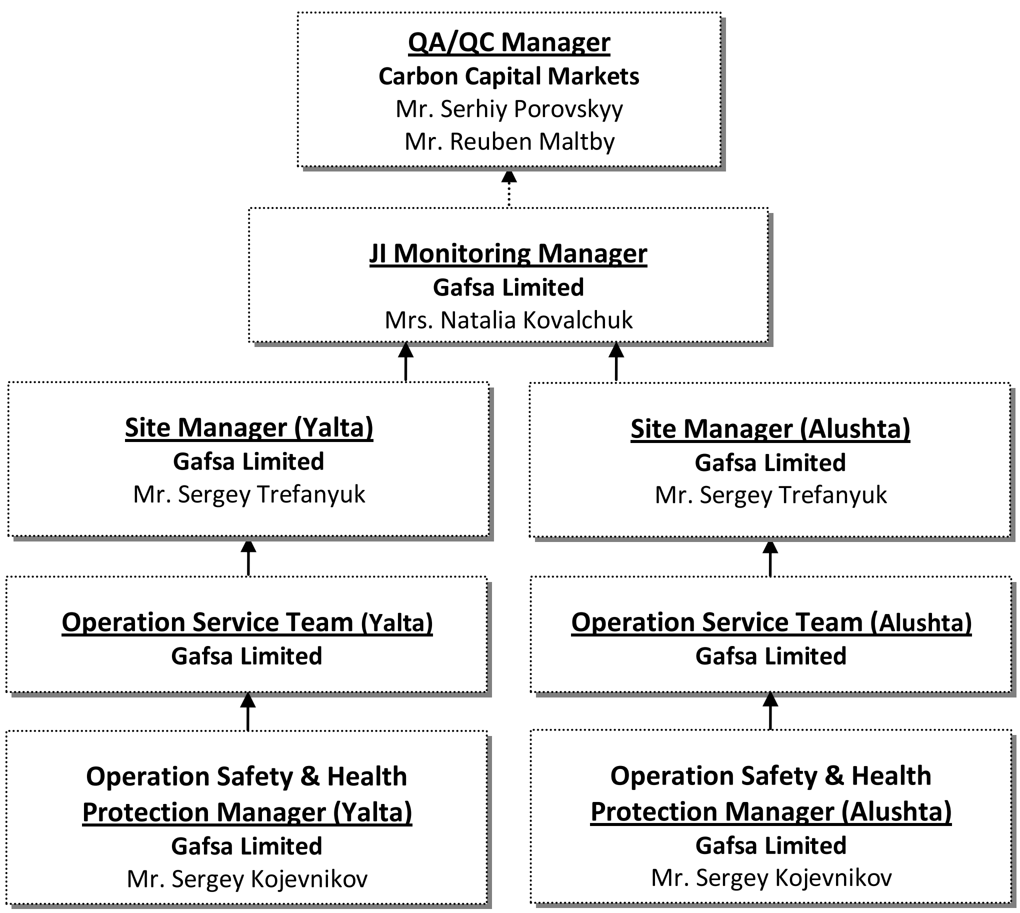
2.1. The Parties Involved in the JI Project Activity

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 and revised by:	
Mr. Serhiy Porovskyy / Mr. Reuben Maltby	**Carbon Capital Markets Ltd (“CCM”)**

2.3. Parties Involved in the Project Monitoring and Compliance Activities



3. KEY MONITORING ACTIVITIES

3.1. Monitoring Background and Measured Parameters

The calculations of Emission Reductions 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 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 was used to calculate Project Emissions from gasoline consumption ($\mathbf{ET_y*CEF_{thermal,y}}$), in tCO_2 (See Table A.1.2, Annex 1).
- 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 for further details). A complete summary of the Monitoring Parameters, as in accordance with the Monitoring Plan 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_{CH4}[1]	%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_{O2}	%O2 in LFG	%				
W_{CO2}	%CO2 in LFG	%				
FV_{RG}	Volumetric flow rate of the residual gas	m^3/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}[2]	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.

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

[2] 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
W_{CH4}	%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.
W_{O2}	%O2 in LFG	%				
W_{CO2}	%CO2 in LFG	%				
FV_{RG}	Volumetric flow rate of the residual gas	m^3/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.
T_{flare}	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
Other Flare Parameter	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
Other Flare Parameter	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; the SD card used has capacity to store data for at least 30 months (2.5 years), which is sufficient for a verification period.

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 or ZIP 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, and backed-up onto the CCM's protected server. The weekly data sets are processed by the QA/QC Manager 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):

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

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:

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

Where :
ER_y - emission reductions by the project in the year "y", in tCO_2e
$MD_{project,y}$ - amount of methane destroyed/combusted in the year "y", in tCH_4
$MD_{reg,y}$ **-** amount of methane that would have been destroyed/combusted in the year "y" in absence of the project activity, in tCH_4
GWP_{CH4} - approved Global Warming Potential value for methane, equals to 21 tCO_2e/tCH_4
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_2 emissions intensity of the fossil fuel used to generate thermal/mechanical energy, in tCO_2e/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:

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

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[3], 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, $\mathbf{MD_{reg,y} = 0}$.

Considering that for the current Project activity $\mathbf{MD_{project,y}}=\mathbf{MD_{flared,y}}$, the final form of the emissions reduction formula that was used to calculate emission reductions from the project activity is:

$$\mathbf{ER_y = MD_{flared,y} * GWP_{CH4} - ET_y * CEF_{thermal,y}} \qquad (4)$$

<u>Calculation of Amount of Methane Destroyed/Combusted by the Project Activity ($\mathbf{MD_{flared}}$)</u>

In accordance with the Monitoring Plan of the registered PDD, in order to calculate $\mathbf{MD_{flared,y}}$ in the year "y", the project emissions from flaring of the residual gas stream in the year "y" ($\mathbf{PE_{flare,y}}$) 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 $\mathbf{PE_{flare,y}}$:

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 ($\mathbf{T_{flare}}$) 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 of using the "Default Flare Efficiency Approach" rather than "Continuous Monitoring Approach" was taken based on the initial issue with monitoring of exhaust gas parameters (specifically, concentration of O_2 in the exhaust gas) and operational requirement of installation of the second thermocouple not linked to the plant automatic self-adjustment system.

[3] 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 first verification period, has been issued by the local authority (Ref. Statement #108 dated on 03/02/2011 by Department of Municipal Building and Development, Alushta, 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	GWP_{CH4}	21	tCO_2e/tCH_4
Universal ideal gas constant	R_u	8,314.472	$Pa.m^3/kmol.K$
Molecular mass of methane	MM_{CH4}	16.04	kg/kmol
Molecular mass of oxygen	MM_{O2}	32.00	kg/kmol
Molecular mass of carbon dioxide	MM_{CO2}	44.01	kg/kmol
Molecular mass of nitrogen	MM_{N2}	28.02	kg/kmol
Atomic mass of carbon	AM_C	12.00	kg/kmol
Atomic mass of oxygen	AM_O	16.00	kg/kmol
Atomic mass of hydrogen	AM_H	1.01	kg/kmol
Atomic mass of nitrogen	AM_N	14.01	kg/kmol
Density of methane gas at normal conditions	$\rho_{CH4,n}$	0.716	kg/m^3
Atmospheric pressure at normal conditions	P_n	101,325	Pa
Temperature at normal conditions	T_n	273.15	K

It is important to clarify that the measured values of W_{CH4}, W_{O2}, and W_{CO2} (in %) were converted into fraction in order to be used in calculation. Thus, the volumetric fractions of CH4, O2, and CO2 in the residual gas in the minute "m" were received as:

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

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 ($LFG_{electricity}$) 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":

$$\mathbf{LFG_{total,y} = LFG_{flare,y} + LFG_{electricity,y}} \qquad (6)$$

is simplified to:

$$\mathbf{LFG_{total,y} = LFG_{flare,y}} \qquad (7)$$

This approach is deemed conservative since the applied default efficiency of the flare (≤ 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" ($\mathbf{LFG_{total,m} = LFG_{flare,m}}$) 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 m^3/h – was named $\mathbf{FV_{RG,m}}$ ($\mathbf{FV_{RG,m}} = \mathbf{LFG_{total,m} = LFG_{flare,m}}$) 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:

- $\eta_{flare,h}$ is 0% if the temperature in the exhaust gas of the flare ($\mathbf{T_{flare}}$) is below 500 °C for more than 20 minutes during the hour "*h*".
- $\eta_{flare,h}$ is 50%, if the temperature in the exhaust gas of the flare ($\mathbf{T_{flare}}$) 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*".
- $\eta_{flare,h}$ is 90%, if the temperature in the exhaust gas of the flare ($\mathbf{T_{flare}}$) 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 ^oC. <u>To be conservative</u>, this temperature (700 ^oC) instead of the lower temperature (500 ^oC), specified in the Tool, was used to check whether $\mathbf{T_{flare}}$ value meets the necessary requirement.

The assumption that incorporates measurement of $\mathbf{T_{flare}}$ 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* $\mathbf{T_{flare}}$ ≥ 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

- $\eta_{flare,h}$ is 90%, if the sum of Quality factors for each calendar hour *h* is 60;
- $\eta_{flare,h}$ is 50%, if the sum of Quality factors for each calendar hour *h* is less than 60 but more or equals 40;
- $\eta_{flare,h}$ 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[4] (**$ET*CEF_{thermal}$**), was calculated from the Incremental quantity of gasoline used in the year "y" (**ET_y**), in TJ, and the CO_2 emissions intensity of gasoline to generate thermal/mechanical energy (**$CEF_{thermal,y}$**), in tCO_2/TJ.

The Incremental quantity of gasoline used in the year "y" (**ET_y**) was received from the weekly measured values of gasoline used (in Litres), accumulated into monthly/annual values (in Litres), and then the annual values were converted into TJ (TeraJoules) by multiplying on the Gasoline Energy Content[5], which equals to $34.66*10^{-6}$ TJ/Litre.

The emissions intensity of gasoline to generate thermal/mechanical energy (**$CEF_{thermal,y}$**) was calculated from the Gasoline Carbon (C) Emission Factor[6], which equals to 18.9 tC/TJ, converted for CO_2 emission. The received emission intensity of gasoline to generate thermal/mechanical energy **$CEF_{thermal,y}$=69.3** (tCO_2/TJ).

The Table A.1.2 (Annex 1) provides the summary of the calculation of the Project Emissions from gasoline consumption, in tCO_2.

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 solely depends on a number of decimal digits to be shown and does not affect the accuracy of the results.

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[4] 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.

[5] Source: CANMET Energy Diversification Research Laboratory

[6] 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 **54,560 tCO2eq for the period from 2008-06-01 to 2010-03-31**. A 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 first monitoring report and verification period reported for this project. The Monitoring report covers the period from 2008-06-01 to 2010-03-31.

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 ($\boldsymbol{\eta_{flare,h}}$)[7] for each operational hour "*h*"[8]. 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 $\mathbf{PE_{flare,m}}$ and Emission Reductions from flaring $\mathbf{ER_m}$ for the minute "*m*". The accumulated weekly values $\mathbf{PE_{flare,w}}$ and $\mathbf{ER_w}$ are also shown in the "Calc Sheet".

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

[8] 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 $\mathbf{T_{flare}} \geq 700$ °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 ($\mathbf{ER_y}$) for the year "y": 2008 (Partial year from 01 June to 31 December); 2009 (Full year from 01 January till 31 December); and 2010 (Partial year from 01 January till 31 March), and total for the monitoring period (from 2008-06-01 to 2010-03-31).
- 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[9]

Equipment (Manufacturer, ID, Serial #)	Frequency	Maintenance	Calibration
LFG Gas Analyzer HOFGAS-Assay (NUK)	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.
Yalta ID K10128: A141, Serial# 4006.32/2;	Monthly	Check function control for measuring gas pump; Clean filter mat in Cabinet fan	
Alushta ID K10129: A141, Serial# 4006.32/1	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	

[9] 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"

Equipment (Manufacturer, ID, Serial #)	Frequency	Maintenance	Calibration
Gas Flow Meter[10]: (Elster-Instromet AG) Yalta ID K10128, FIR61.5 (inc. PIR61.5 and TIR61.5), Serial# 10510655; Alushta ID K10129, FIR61.5 (inc. PIR61.5 and TIR61.5), Serial# 10510656	Weekly	Lubrication of system	
	Semi-annually	Check mechanical smooth running	
	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[11]			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	25.03.2010 (Alushta) 26.03.2010 (Yalta)	02.04.2010
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

[10] 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.

[11] 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

(2009 June 1 to 2010 March 31)

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

$$ER_y = MD_{flared,y} * GWP_{CH4} - ET_y * CEF_{thermal,y} \quad (4)$$

Emission Reductions from flaring (MD_{flared}*GWP_{CH4}):

The first part of the equation (4), the Emission Reductions from flaring ($ER_{flare}=MD_{flared}*GWP_{CH4}$), 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 $ER_{flare,mon}$, annual $ER_{flare,y}$, and the total values of the Emission Reductions from flaring, in tCO_2e.

Table A.1.1: Emission Reductions from Flaring

MONTH	YEAR					
	2008		2009		2010	
	ALUSHTA	YALTA	ALUSHTA	YALTA	ALUSHTA	YALTA
	$ER_{flare,mon}$, tCO_2e	$ER_{flare,mon}$, tCO_2e	$ER_{flare,mon}$, tCO_2e	$ER_{flare,mon}$, tCO_2e	$ER_{flare,mon}$, tCO_2e	$ER_{flare,mon}$, tCO_2e
JANUARY	N/A	N/A	1,317	2,444	1,319	1,283
FEBRUARY	N/A	N/A	1,810	3,510	1,581	593
MARCH	N/A	N/A	2,060	4,004	1,625	468
APRIL	N/A	N/A	1,293	2,374	N/A	N/A
MAY	N/A	N/A	2,071	3,054	N/A	N/A
JUNE	0	0	1,652	2,603	N/A	N/A
JULY	0	0	479	1,887	N/A	N/A
AUGUST	0	0	1,494	2,248	N/A	N/A
SEPTEMBER	112	0	1,548	1,752	N/A	N/A
OCTOBER	272	0	1,117	1,523	N/A	N/A
NOVEMBER	661	0	545	956	N/A	N/A
DECEMBER	1,227	661	1,375	1,643	N/A	N/A
Yalta/Alushta $ER_{flare,y}$, tCO_2e	2,272	661	16,761	27,998	4,525	2,344
Project Activity $ER_{flare,y}$, tCO_2e	2,933		44,759		6,869	
Monitoring Period Total ER_{flare}, tCO_2e	54,561					

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

The second part of the equation (4), the Project emissions from gasoline consumption (**$ET*CEF_{thermal}$**), was calculated from the Incremental quantity of gasoline used in the year "y" (**ET_y**), in TJ, and the CO_2 emissions intensity of gasoline to generate thermal/mechanical energy (**$CEF_{thermal,y}$**), in tCO_2/TJ.

The Incremental quantity of gasoline used in the year "y" (**ET_y**) was received from the weekly measured values of gasoline used (in Litres), accumulated into monthly/annual values (in Litres), and then the annual values were 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 (**$CEF_{thermal,y}$**) was calculated from the Gasoline Carbon (C) Emission Factor, which equals to 18.9 tC/TJ, converted for CO_2 emission. The received emission intensity of gasoline to generate thermal/mechanical energy **$CEF_{thermal,y}$=69.3** (tCO_2/TJ).

The Table A.1.2 provides the summary of the calculation of the Project Emissions from gasoline consumption, in tCO_2. Note that the startup fossil fuel – gasoline – is no longer needed, due to an operational upgrade finalized by October 2009. Consequently, there was no project emissions from gasoline consumption since October 2009, hence, **$ET*CEF_{thermal}$** = 0 in 2010.

Table A.1.2: Project Emissions from Gasoline Consumption

PERIOD	ALUSHTA Project Emissions from gasoline consumption ($ET_y*CEF_{thermal,y}$), tCO_2	YALTA Project Emissions from gasoline consumption ($ET_y*CEF_{thermal,y}$), tCO_2	PROJECT ACTIVITY Project Emissions* from gasoline consumption ($ET_y*CEF_{thermal,y}$), tCO_2
2008 (Partial Year: JUN-DEC)	0.223	0.032	0
2009 (Full Year: JAN-DEC)	0.259	0.923	1
2010 (Partial Year: JAN-MAR)	0.000	0.000	0
Total* for the Monitoring Period, tCO_2	**0**	**1**	**1**

* - values are automatically rounded to be used in the Table A.1.3; rounding did not affect the accuracy of calculation of the final value of the Project Emission Reductions for the 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_2e.

The total value of the Project Emission Reductions during the monitoring period from 2008-06-01 to 2010-03-31 is 54,560 tCO_2e.

Table A.1.3: Project Emission Reductions

PERIOD	Project Emission Reductions from flaring ($MD_{flared,y}$*GWP_{CH4}), tCO_2e	Project Emissions from gasoline consumption (ET_y*$CEF_{thermal,y}$), tCO_2	Project Emission Reductions ER_y, tCO_2e
2008 (Partial Year: JUN-DEC)	2,933	0	2,933
2009 (Full Year: JAN-DEC)	44,759	1	44,758
2010 (Partial Year: JAN-MAR)	6,869	0	6,869
Project Total for the Monitoring Period, tCO_2	**54,561**	**1**	**54,560**

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/ uncertainty	Link to PDD / Tool
LFG Flow Meter[12]: (Elster-Instromet AG)	FIR61.5	$FV_{RG,m}$ = $LFG_{total,m}$ = $LFG_{flare,m}$	Volumetric flow rate of residual gas in dry basis at normal conditions in the minute “m”, in m^3/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. 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); Uncertainty level is Low	**PDD:** $LFG_{total,y}$, $LFG_{flare,y}$, $LFG_{electricity,y}$ **Tool** $FV_{RG,h}$
LFG Gas Analyzer HOFGAS-Assay (NUK)	A141	$W_{CH4,m}$ $W_{O2,m}$ $W_{CO2,m}$	Volumetric fraction of CH4, O2, and CO2 in the residual gas in the minute “m”, in % Vol.	Measurement of CH4, O2, and CO2 in LFG on dry basis. Gas sampling is done at the top of dewatering tank, system inlet. 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); Uncertainty level is Low	**PDD:** $W_{CH4,y}$ W_{O2}, $W_{CO2,r}$ **Tool** $fv_{CH4,h}$, $fv_{O2,h}$, $fv_{CO2,h}$

[12] 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.

Equipment	Ref. ID	Parameter(s)	Description	Notes	Frequency/ uncertainty	Link to PDD / Tool
Fluegas Analyzer HOFGAS-Assay FlueGas (NUK)	A151	$W_{CH4ex,m}$ $W_{O2ex,m}$	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). 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); Uncertainty level is Low	**PDD:** W_{CH4ex} W_{O2ex} **Tool** $t_{O2,h}$, $fv_{CH4,FG,h}$ (conversion from % Vol into mg/m3 will be performed as per Tool p.13)
Temperature Transmitter (FlowComp)	TIR61.5	**T**	Temperature of the landfill gas, in ^oC	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); Uncertainty level is Low	**PDD:** **T**
Pressure Transmitter (Rosemount)	PIR61.5	**P**	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); Uncertainty level is Low	**PDD:** **P**
Thermo-couple (Jumo)	TIRCAH 81.24	T_{flare}	Temperature of the exhaust gas of the enclosed flare, in ^oC	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 then Type N. The parameter T_{flare} is equivalent to the parameter T_{ex} 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); Uncertainty level is Low	**PDD:** T_{ex} **Tool** T_{flare}

Equipment	Ref. ID	Parameter(s)	Description	Notes	Frequency/ uncertainty	Link to PDD / Tool
LFG piston generator counter (control panel)	UMG-60	**h**	Operating hours of the energy plant	This is monitored to ensure that CH4 destruction is only claimed for CH4 used in the biogas generator when it is operational.	Continuous but documented weekly; Uncertainty level is Low	**PDD:** **h**
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" ($\mathbf{ET_y}$). (See explanation in the Section 3.3, pp.10-11)	Weekly; Uncertainty level is Low/Medium	**PDD:** $\mathbf{ET_y}$
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	**PDD/Tool** 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	**PDD/Tool** Other Flare operation parameters according to the Annex 13 EB28 (Tool)

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

Parameter(s)	Description	Notes	Link to PDD / Tool
$fv_{CH4,m}$, $fv_{CO2,m}$, $fv_{O2,m}$, and $fv_{N2,m}$	Volumetric fraction of CH4, O2, CO2, and N2 in the residual gas in the minute "m".	The volumetric fractions of three gases (CH4, CO2, and O2), represented by parameters $fv_{CH4,m}$, $fv_{CO2,m}$, and $fv_{O2,m}$, are converted into fraction from continuously monitored measured parameters W_{CH4}, W_{O2}, and W_{CO2} (in Vol. %). The volumetric fraction of N2 ($fv_{N2,m}$) is calculated in accordance with the Tool, as: $fv_{N2,m}=1-(fv_{CH4,m}+fv_{CO2,m}+fv_{O2,m})$	**Tool** $fv_{i,h}$
$PE_{flare,m}$, $PE_{flare,w}$, $PE_{flare,mon}$, $PE_{flare,y}$	Project Emissions from flaring the residual gas stream in the minute "m", week "w", month "mon" and year "y", in tCO_2e	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). 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.	**PDD/Tool** $PE_{flare,y}$
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.	**PDD** ET_y
$CEF_{thermal,y}$	CO_2 emissions intensity of gasoline to generate thermal/mechanical energy, in tCO_2/TJ	Calculated from the Gasoline Carbon (C) Emission Factor to be applied for CO2 emissions.	**PDD** $CEF_{thermal}$
	Regulatory requirements* relating to LFG projects (National regulations) *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. Required for any changes to the adjustment factor (**AF**) or directly $MD_{reg,y}$.	**PDD** Regulatory requirements relating to LFG projects

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

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