

HYDROSTAB®

SANERINGSTECHNIEK VOOR STORTPLAATSEN  
TECHNIQUE D'ASSAINISSEMENT POUR CET

Annex 4

**MONITORING PLAN**

**“HUNGARIAN PROGRAMME FOR REHABILITATION OF LANDFILLS  
THROUGH MITIGATION OF METHANE GAS EMISSIONS”**

**(9 JANUARY 2006)**

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## 1 INTRODUCTION

The monitoring methodology is created for the project activities that reduce greenhouse gas emissions through Landfill Gas Capture and Flaring.

This methodology provides with direct and continuous measurement of the actual quantity of landfill gas flared, the methane content in the flared landfill gas and when using a continuous flow meter, a continuous methane analyser. The basis for the monitoring of the emission reduction is the measuring of landfill gas amount and composition recovered for combustion.

The monitoring methodology is based on direct measurement of the amount of landfill gas captured and destroyed at the flare platform as shown in the diagram on the next page. The monitoring plan provides continuous measurement of the quantity and quality of burned LFG.

The emissions reductions are defined as the difference of emissions in the baseline situation and in the project situation. In the proposed project the volume of methane actually captured is an indication of the volume of methane that would have been emitted without the project, and this will be monitored.

## 2 PROJECT-SPECIFIC INDICATORS

### 2.1 FLOW DIAGRAM

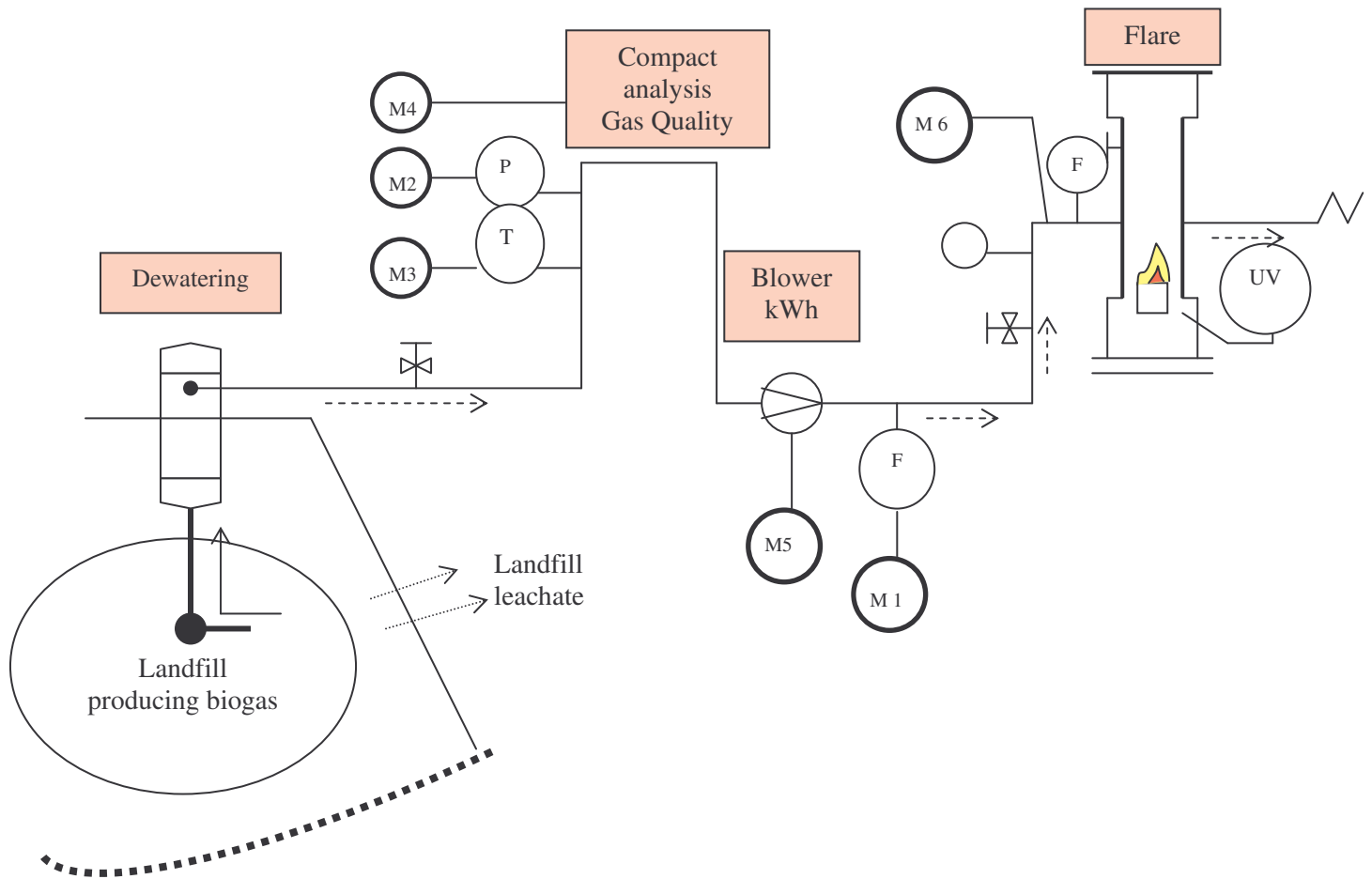
The flow diagram below presents the technical equipment at a landfill. The monitoring of the emission reduction will be done by measurement of technical parameters at a number of locations. These locations are indicated in the flow diagram (see flow diagram at the end of this section). Monitoring will occur at the following locations:

- M1 Flow measurement of biogas
- M2 Pressure measurement of biogas
- M3 Temperature measurement of biogas
- M4 Gas analysis (CH<sub>4</sub>, CO<sub>2</sub> and O<sub>2</sub>)
- M5 Operating time of ventilator
- M6 Operating time of the biogas flare

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## FLOW DIAGRAM – MONITORING SYSTEM



P = pressure

T = temperature

M1 to M6 – measurement points

F = flow

---> Gas flow

## 2.2 GENERAL MONITORING APPROACH

The general monitoring principles are based on:

- frequency;
- reliability;
- registration and reporting.

### Frequency of monitoring

In principle, the most important parameters will be monitored on-line. Examples are the measurement of gas flow, gas pressure and gas composition. Data will be registered electronically and recorded digitally. Data will become available on the daily basis.

As the amount of CH<sub>4</sub> will be the dominant compound in the project, major part of the instruments will be focused on the measurement of the quantity and quality of the biogas.

### Reliability

Monitoring of the landfill gas project is straight forward as there is a single parameter, that determines the larger part of the Emission Reduction achieved, namely the quantity of CH<sub>4</sub> extracted and fired. In case there will be no extraction of CH<sub>4</sub>, there will be no emission reduction.

Other parameters, except for the electricity production (kWh), are calculated on the basis of fixed parameters. For example: by measuring flow, temperature and pressure of the biogas, the exact quantity (in tonnes) is calculated.

The reliability of the monitoring will be determined by two factors, i.e. the accuracy of the measuring instruments and the technical quality of the equipment.

The accuracy of the instruments can be regarded as high, because major part of the instruments is produced by Swiss or German manufacturers and meet the highest DIN-standards or comparable. The estimate of the accuracy of the instruments is indicated below by the table. Accuracy is indicated as follows:

H = high

M = medium

L = low

### Registration and reporting

Registration of data will be done electronically on-site in Hungary and in Belgium. The control cabinet at the landfill will store all data. Responsible entity/person will be contracted before the end of the training of the local staff. The software will enable to produce reports at any interval that is desired (on-line, daily).

Reporting will be enabled through the Internet. The Consortium will be able to execute remote monitoring of the operation of the installations. Responsibilities for the data processing and final registration are under the Sponsor, Hydrostab België.

For the purpose of monitoring by the DOE (verifying organisation), reporting will be done at regular intervals, but at least every 6 months. Reports will present the data of the reporting period as well as the estimate for the entire crediting year.

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The monitoring system has been designed in such a way, that the registration of venting, flaring and incineration is measured on full-time basis. All data will be daily electronically and on paper registered, in Hungary as well as in Belgium.

Every hour all process parameters will be sampled and stored in the data-logger of the degassing installation. Once a day the data will be transferred to the monitoring station. The monitoring station is a PC containing a:

- modem for connection with the data-logger of the degassing installation;
- visualization system of the process for operating purposes;
- database to store the received process data and
- system to provide alarm signals to the operators.

## How to deal with missing data

When a failures occur at the degassing installation, following actions to limit the consequences as much as possible are mentioned:

### *No electrical power*

When no electrical power is available the blower of the degassing installation cannot operate. So no LFG-stream is available. The flow-meter detects no LFG-stream and no CO<sub>2</sub>eq will be counted. No special actions are possible to avoid this.

### *Failure flow meter*

To limit the time of operating with no flow signal in case of failure, the flow meter will be exchanged by a spare flow meter as soon as possible. Despite this quick exchange the degassing installation operates a short time without flow signal and CO<sub>2</sub>eq values. To determine the flow during this time span the average flow of the last 7 days will be used and so it is possible to calculate the reduced CO<sub>2</sub>eq.

Remark: The chance of a failure of the flow meter is very small.

### *Failure kWh-meter*

To limit the time of operating with no kWh meter in case of failure, this kWh meter will be exchanged by a spare kWh meter as soon as possible. Despite this quick exchange the degassing installation operates a short time without measuring the electrical power consumption. To determine the consumed electrical power consumption during this time span the average electrical power consumption of the last 7 days will be used.

Remark: The chance of a failure of the kWh meter is very small.

### *Failure methane analyser*

To limit the time of operating with no methane analyser in case of failure, this analyser will be exchanged with a spare analyser as soon as possible. Despite this quick exchange the degassing installation operates a short time without CH<sub>4</sub>-signal. To determine the CH<sub>4</sub>-content during this time span the average CH<sub>4</sub>-content of the last 7 days will be used.

## **2.3 KEY FACTORS FOR PROJECT PERFORMANCE**

Reporting format – for monitoring purposes a reporting format will be developed. This format will include data on:

- Waste disposed;

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- Biogas produced;
- Technical and/or organizational problems encountered;
- Key factors that might influence the envisaged emission reduction result.

Reporting on progress of project implementation - the first monitoring reports will report on the progress of the implementation of the project. It will indicate which landfill site has started to collect and flare methane and which landfill site has started to generate electricity. For this purpose the Sponsor will release 6-monthly Progress Reports.



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The operational data serves as the basis for verification of emission reductions. All data collected is kept electronically on-site in the monitoring database and double registered (electronically and on paper) in Belgium.

In the gas monitoring described above, the following items will be monitored as part of the operation procedures:

ID number	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/paper)	For how long is archived data to be kept?	Comment
1	LFG	Amount of flared methane	Tonnes CH <sub>4</sub>	measured	Continuous	100%	Daily: paper Monthly: electronic	Till completion of the crediting period	Measured conform complementary method (LFG temperature and pressure, flare temperature and working hours, %CH <sub>4</sub> , Sm <sup>3</sup> LFG/h, oxygen content)
2	LFG	Total amount of flared methane	Tonnes CH <sub>4</sub>	calculated	Daily	N/a	Daily: paper Monthly: electronic	Till completion of the crediting period	--
3	LFG	Amount of methane flaring in the baseline	Tonnes CH <sub>4</sub>	calculated	Each delivery	N/a	Annually: paper & electronic	Till completion of the crediting period	Burning of methane will be continuously. The control system is regulated in such a way that the extraction systems will be stopped in case malfunctioning of the flare. Un-burnt methane will thus not occur.

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4	Emission reduction	CO <sub>2</sub> eq content	Tonnes	calculated	Each delivery	N/a	Annually: paper & electronic	Till completion of the crediting period	--
5	Flare	Combustion temperature	Temperature °C	measured	Daily	N/a	Daily: paper Monthly: electronic	Till completion of the crediting period	There is a temperature gauge to measure a combustion temperature of the flare.
6	Flare	Gas flow rate	m <sup>3</sup> /h	measured	Continuous	N/a	Daily: paper Monthly: electronic	Till completion of the crediting period	--
7	Well pressure	Gas pressure in the wells	Pa	measured	Daily	N/a	Daily: paper Monthly: electronic	Till completion of the crediting period	--
8	Well flow	Gas flow rate	m <sup>3</sup> /h	measured	Daily	N/a	Daily: paper Monthly: electronic	Till completion of the crediting period	--
9	Wells and pipes	Integrity of collection system	N/a	N/a	Monthly	N/a	Monthly: paper electronic	Till completion of the crediting period	Visual control.

## 2.4 QUALITY CONTROL (QC) AND QUALITY ASSURANCE (QA) PROCEDURES ARE BEING UNDERTAKEN FOR DATA MONITORED

Monitoring procedures are formalised as part of documentation for NEN-ISO 9001:2000 certification.

Data	Uncertainty level of data (High/Medium/Low)	Are QA/QC procedures planned for these data?	Outline explanation why QA/QC procedures are or are not being planned.
1	Low	Yes	Amount of methane is a reliable indicator subject to routine checks. Calibration is executed monthly through use of calibration gas with exactly 50% of methane content.
2	Low	Yes	Amount of methane is a reliable indicator subject to routine checks. Calibration is executed monthly through use of calibration gas with exactly 50% of methane content.
3	Low	Yes	Amount of methane is a reliable indicator subject to routine checks. Calibration is executed monthly through use of calibration gas with exactly 50% of methane content.
4	Low	Yes	Amount of carbon dioxide is a reliable indicator subject to routine checks.
5	Low	Yes	Data reviewed as part of daily monitoring
6	Low	Yes	Data reviewed as part of daily monitoring
7,8	Low	Yes	Monitoring data used immediately to adjust well vacuum
9	Medium	Yes	Ensure integrity of collection system

To assure the correct service of the equipment en correct monitoring, the training of the local staff will be organised. Minimum two persons will be trained on the field of:

- general knowledge about the applied equipment at the landfill;
- reading and recording data;
- calibration methodology;
- emergency situation (for instance by too high oxygen level or electricity breakdown).

Chosen trainees must have a good understanding the processes and technology of the installation of landfill gas extraction. Verification and training starts parallel with preparation works for the installation.

At the plant there is also a guidebook on landfill gas extraction and utilisation in English and Hungarian available, where the operator can find an information about:

- operation manual;
- drawings;
- maintenance instructions;
- description of parts of the equipment;
- parameters for landfill gas composition, temperature and pressure.

## **3 LEAKAGE INDICATORS**

Activities outside the project boundaries are not a subject to monitoring as no leakage has been identified for the project.

There are no potential sources of emissions which are significant and reasonably attributable to the project activity, and which are not included in the project boundaries. The fact that biogas is extracted from the bioreactor will not result into a higher biogas production rate of the landfill body (expressed in m<sup>3</sup> per tonne waste).