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H these TYPE III - OTHER PROJECT ACTIVITIES

Project participants shall take into account the General Guidelines to the SSC CDM methodologies, information on additionality (attachment A to Appendix B) provided at: <http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html> *mutatis mutandis*.

III.G. Landfill Methane Recovery

Technology/measure

1. This methodology comprises measures to capture and combust methane from landfills (i.e., solid waste disposal sites) used for disposal of residues from human activities including municipal, industrial, and other solid wastes containing biodegradable organic matter.

~~2. The recovered methane from the above measures may also be utilised for the following applications instead of flaring or combustion:~~

- ~~(a) Thermal or electrical energy generation directly; or~~
- ~~(b) Thermal or electrical energy generation after bottling of upgraded biogas; or~~
- ~~(c) Thermal or electrical energy generation after upgrading and distribution using one of the following options:~~
  - ~~(i) Upgrading and injection of biogas into a natural gas distribution grid with no significant transmission constraints; or~~
  - ~~(ii) Upgrading and transportation of biogas via a dedicated piped network to a group of end users; or~~
- ~~(d) Hydrogen production.~~

~~3. If the recovered methane is used for project activities covered under paragraph 2 (a), that component of the project activity shall use a corresponding category under type I.~~

~~4. If the recovered methane is used for project activities covered under paragraph 2 (b) or 2 (c) relevant provisions in AMS III.H related to upgrading of biogas, bottling of biogas, injection of biogas into a natural gas distribution grid and transportation of biogas via a dedicated piped network shall be used.~~

~~5. If the recovered methane is used for project activities covered under paragraph 2 (d) that component of the project activity shall use corresponding methodology AMS III.O.~~

6. Different options to utilise the recovered landfill gas as detailed in paragraph 3 of AMS-III.H (version 16) are eligible for use under this methodology. The relevant procedures in AMS-III.H shall be followed in this regard.

7. Measures are limited to those that result in aggregate emission reductions of less than or equal to 60 kt CO_2 equivalent annually from all type III components of the project activity.

Boundary

8. The project boundary is the physical, geographical site of the landfill where the gas is captured and destroyed/used.

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III.G. Landfill Methane Recovery (cont)

Baseline

9. The baseline scenario is the situation where, in the absence of the project activity, biomass and other organic matter are left to decay within the project boundary and methane is emitted to the atmosphere. Baseline emissions shall exclude methane emissions that would have to be removed to comply with national or local safety requirement or legal regulations:

$$BE_y = BE_{CH4,SWDS,y} - MD_{reg,y} * GWP_{CH4} \quad (1)$$

Where:

$BE_{CH4,SWDS,y}$ Methane emission potential of a solid waste disposal site (in tCO_2e), calculated using the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site". The tool may be used:

- With the factor "f=0.0" assuming that no methane is captured and flared.
- With the definition of year x as 'the year since the landfill started receiving wastes, x runs from the first year of landfill operation (x=1) to the year for which emissions are calculated (x=y)'.

The amount of waste type "j" deposited in each year "x" ($W_{j,x}$) shall be determined by sampling (as specified in the tool), in the case wastes are generated during the crediting period. Alternatively, for existing SWDS, if the pre-existing amount and composition of the wastes in the landfill are unknown, they can be estimated by using parameters related to the attended population or industrial activity, or by comparison with other landfills with similar conditions in regional or national levels.

$MD_{reg,y}$ Methane emissions that would be captured and destroyed to comply with national or local safety requirement or legal regulations in the year "y" (t_{CH4})

GWP_{CH4} Global Warming Potential for methane (value of 21)

~~**Yearly Methane Generation Potential**~~

Project Activity Emissions

10. Project activity emissions consist of

(a) CO_2 emissions from use of fossil fuel or electricity ~~related to the power~~ used by the project activity facilities ($PE_{power,y}$); ~~Emission factors for electricity shall be calculated as described in category I.D.~~

(b) Emissions from flaring or combustion of the gas stream ($PE_{flare,y}$);

(c) Emissions from the landfill gas upgrading process ($PE_{process,y}$), where applicable.

$$PE_y = PE_{Power,y} + PE_{flare,y} + PE_{process,y} \quad (2)$$

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III.G. Landfill Methane Recovery (cont)

Where:

PE_y	Project emissions in year y (tCO_2e)
$PE_{power,y}$	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year y (tCO_2e)
$PE_{flare,y}$	Emissions from flaring or combustion of the landfill gas stream in the year y (tCO_2e)
$PE_{process,y}$	Emissions from the landfill gas upgrading process in the year y (tCO_2e), determined by following the relevant procedures described in Annex 1 of AMS-III.H

11. Project emissions from electricity consumption are determined as per the procedures described in AMS-I.D: Grid connected renewable electricity generation. For project emissions from fossil fuel consumption the emission factor for the fossil fuel shall be used (tCO2/tonne). Local values are to be used, if local values are difficult to obtain, IPCC default values may be used. If recovered landfill gas is used to power auxiliary equipment of the project it should be taken into account accordingly, using zero as its emission factor.

12. In case flaring (single or multiple) is used to destroy all or part of the recovered landfill gas, project emissions from flaring in year y ($PE_{flare,y}$ in tCO2e) shall be determined following the procedure described in the "Tool to determine project emissions from flaring gases containing methane" for each flare respectively.

Leakage

13. If the methane recovery technology is equipment transferred from another activity ~~or if the existing equipment is transferred to another activity~~, leakage effects are to be considered.

Emission Reductions

14. ~~Emission reductions achieved by the project activity in each year will be assessed ex-post through direct measurement of the amount of methane fuelled, flared or gainfully used. The amount of methane recovered and gainfully used, fuelled or flared shall be monitored ex-post, using continuous flow meters. The fraction of methane in the landfill gas should be measured with a continuous analyser or, alternatively, with periodical measurements at a 95% confidence level.~~ . ~~Temperature and pressure of the landfill gas are required to determine the density of methane combusted.~~

15. ~~In case of project activities covered under paragraph 2(b) the project participants shall maintain a biogas (or methane) balance based on:~~

~~(a) Continuous measurement of the amount of biogas captured at the landfill gas recovery system;~~

~~(b) Continuous measurement of the amount of biogas used for various purposes in the project activity: e.g. heat, electricity, flare, hydrogen production, injection into natural gas distribution grid, etc. The difference is considered as loss due to physical leakage and deducted from the emission reductions.~~

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III.G. Landfill Methane Recovery (cont)

16. ~~Regular maintenance should ensure optimal operation of flares. The flare efficiency, defined as the fraction of time in which the gas is combusted in the flare, multiplied by the efficiency of the flaring process, shall be monitored as per the Tool to determine project emissions from flaring gases containing methane. One of the two following options shall be used to determine the efficiency of the flaring process in an enclosed flare:~~

~~(a) To adopt a 90% default value; or~~

~~(b) To perform a continuous monitoring of the efficiency.~~[1]

~~If option (a) is chosen, continuous check of compliance with the manufacturers specification of the flare device (temperature, biogas flow rate) should be done. If in any specific hour any of the parameters is out of the range of specifications, 50% of default value should be used for this specific hour. For open flare 50% default value should be used, as it is not possible in this case to monitor the efficiency. If at any given time the temperature of the flare is below 500^{0}C, 0% default value should be used for this period.~~

17. The emission reduction achieved by the project activity can be estimated ex-ante in the PDD by:

$$ER_{y,estimated} = BE_y - PE_y - LE_y \quad (3)$$

The actual emission reduction achieved by the project during the crediting period will be calculated using the amount of methane recovered and destroyed/gainfully used by the project activity, calculated as:

$$ER_{y,calculated} = (MD_y - MD_{reg,y}) * GWP_{CH4} - PE_y - LE_y \quad (4)$$

Where:

MD_y Methane captured and destroyed/gainfully used by the project activity in the year "y" (t_{CH4}). ~~In case of flaring/fuelling it shall be measured using the conditions of the flaring process:~~

$$MD_y = D_{CH4,y} \cdot w_{CH4,y} \cdot \sum_i LFG_{i,y} \quad \sout{D_{CH4,y} \cdot w_{CH4,y} \cdot LFG_{burnt,y} \cdot FE \cdot GWP_{CH4}} \quad (5)$$

Where:

~~$LFG_{burnt,y}$~~ ~~Landfill gas[2] flared or used as fuel in the year "y" (m^3).~~

$LFG_{i,y}$ Landfill gas destroyed via method *i* (flaring, fuelling, combustion, injection in a grid, etc.) in the year y (m^3_{LFG})

$w_{CH4,y}$ Methane content in landfill gas in the year y (volume ~~mass~~ fraction, m^3_{CH4}/m^3_{LFG}).

$D_{CH4,y}$ Density of methane at the temperature and pressure of the landfill gas in the year y (tonnes/m^3).

[1] ~~The procedures described in the Methodological Tool to determine project emissions from flaring gases containing methane shall be used.~~

[2] ~~Landfill gas and methane content measurements shall be on the same basis (wet or dry).~~

18. The method for integration of the terms in equation above to obtain the results for one year of measurements within the confidence level, as well as the methods and instruments used for metering, recording and processing the data obtained, shall be described in the project design document and monitored during the crediting period.

19. Project activities where a portion of the recovered landfill gas is destroyed through flaring and the other portion is used for energy may consider applying the flare efficiency to the portion of the landfill gas used for energy, if separate measurements of the respective flows are not performed. When the amount of methane that is combusted for energy and that is flared is separately monitored, a destruction efficiency of 100% can be used for the amount that is combusted for energy.[3]

Monitoring

20. Flow meters, sampling devices and gas analysers shall be subject to regular maintenance, testing and calibration to ensure accuracy.

21. Relevant parameters shall be monitored as indicated in the Table below. The applicable requirements specified in the "General Guidelines to SSC CDM Methodologies" (e.g. calibration requirements, sampling requirements) are also an integral part of the monitoring guidelines specified below and therefore shall be referred by the project participants.

Project activity under a programme of activities

The following conditions apply for use of this methodology in a project activity under a programme of activities:

22. In case the project activity involves the replacement of equipment, and the leakage effect of the use of the replaced equipment in another activity is neglected, because the replaced equipment is scrapped, an independent monitoring of scrapping of replaced equipment needs to be implemented. The monitoring should include a check if the number of project activity equipment distributed by the project and the number of scrapped equipment correspond with each other. For this purpose scrapped equipment should be stored until such correspondence has been checked. The scrapping of replaced equipment should be documented and independently verified

[3] Conditions apply: The energy component shall be either developed under a Type I SSC methodology or included in the project boundary with the energy output being monitored.

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III.G. Landfill Methane Recovery (cont)

Table III.G: Parameters for monitoring during the crediting period

No.	Parameter	Description	Unit	Monitoring/ recording Frequency	Measurement Methods and Procedures
1.	$PE_{power,y}$	Parameters related to emissions from electricity and/or fuel consumption	tCO_2e		As per the procedure in the AMS-I.D. Electricity consumption is directly metered or alternatively be determined by assuming that all relevant electrical equipment operate at full rated capacity, plus 10% to account for distribution losses, for 8760 hours per annum.
2.	$PE_{flare,y}$	Emissions from flaring or combustion of the landfill gas stream in the year *y*	tCO_2e		As per the "Tool to determine project emissions from flaring gases containing Methane".
3.	$PE_{process,y}$	Emissions from the landfill gas upgrading process	tCO_2e		As per relevant provisions in AMS-III.H.
4.	$LFG_{i,y}$	Landfill gas destroyed via method *i* in year *y*	m^3	Continuous flow measurement with accumulated volume recording (e.g. hourly/daily accumulated reading)	In all cases, the amount of landfill gas recovered, fuelled, flared or otherwise utilized (e.g. injected into a natural gas distribution grid or distributed via a dedicated piped network) shall be monitored *ex post*, using continuous flow meters. The methane content measurement shall be carried out close to a location in the system where a landfill gas flow measurement takes place.

5.	$w_{CH4,y}$	Methane content in landfill gas in the year *y*	%, volume basis		The fraction of methane in the gas should be measured with a continuous analyser (values are recorded with the same frequency as the flow) or, alternatively, with periodical measurements at a 90/10 confidence/precision level. It shall be measured using equipment that can directly measure methane content in the landfill gas - the estimation of methane content of landfill gas based on measurement of other constituents of landfill gas such as CO_2 is not permitted. The methane content measurement shall be carried out close to a location in the system where a landfill gas flow measurement takes place, and at the same basis (wet or dry).
6.	*T*	Temperature of the landfill gas	°C	Shall be measured at the same time when methane content in landfill gas ($w_{CH4,y}$) is measured	The temperature of the gas is required to determine the density of the methane combusted. If the landfill gas flow meter employed measures flow, pressure and temperature and displays or outputs the normalised flow of landfill gas, then there is no need for separate monitoring of pressure and temperature of the landfill gas.
7.	*P*	Pressure of the landfill gas	Pa	Shall be measured at the same time when methane content in landfill gas ($w_{CH4,y}$) is measured	The pressure of the gas is required to determine the density of the methane combusted. If the landfill gas flow meter employed measures flow, pressure and temperature and displays or outputs the normalised flow of landfill gas, then there is no need for separate monitoring of pressure and temperature of the landfill gas.

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III.G. Landfill Methane Recovery (cont)

History of the document

Version	Date	Nature of revision
07	EB 63, Annex XX 29 September 2011	To cover among others, more types of gainful use of landfill gas
06	EB 38, Annex 12 14 March 2008	To exclude the consideration of landfill gas collection efficiency in the ex-ante calculation of emission reduction; To include the possibility for pipeline transport of the recovered landfill gas.
05	EB 33, Annex 20 27 July 2007	To include emissions from the pre-existing waste in the baseline calculations.
04	EB 28, Annex 21 15 December 2006	To take into account the 2006 IPCC Guidelines for National Greenhouse Gas Inventories as well as to include a revision of the parameters of the first order decay (FOD) model as per the Methodological Tool titled "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site".
03	EB 25, Annex 26 21 July 2006	To clarify the procedure for estimating the baseline emissions as well as the procedure for estimating ex-ante emission reductions to be provided in the Project Design Document (CDM-SSC-PDD)
02	EB 24, Meeting Report, Para. 64 12, May 2006	Introduced the interim applicability condition i.e. 25 ktCO2e/y limit from all Type III categories.
01	EB 23, Annex 21 24 February 2006	Initial adoption.
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