CDM: Recommendation Form for Small Scale Methodologies (version 01)

(To be used for presenting questions/proposals/amendments to the simplified methodologies for small-scale CDM project activity categories)

Date of SSC WG meeting:	26–29 April 2010, SSC WG 25
Title/Subject (give a small title or specify the subject of your submission, maximum 200 characters):	Revision of AMS-III.F to allow monitoring with direct measurement of real methane generation using Landfill Simulation Reactor
Indicative methodology to which your submission relates (refer the items of Appendix B of the Simplified Modalities and Procedures), if applicable.	AMS-III.F "Avoidance of methane emissions through controlled biological treatment of biomass"
Name of the authors of the query:	Dr.-Ing. Florian Koelsch Institution: Technical University Braunschweig F.koelsch@tu-bs.de, A.wiesbaum@tu-bs.de, rachot.indradesa@greenstream.net

Summary of the query:

Please use the space below to summarize the query related to SSC methodologies/categories SSC Modalities and Procedures provide recommendation/analysis of the SSC WG.

Original text from PP:

In the CDM small scale methodologies AMS-III.F and AMS-III.G, methane emission avoided is the amount of methane generated by organic matters of waste that otherwise would have been generated under the baseline conditions of a landfill where the waste should have been disposed. A CDM project activity could estimate the amount of potential methane avoided (ex-ante) with application of the first order decay model (FOD).

In case a project captures and destroys LFG (AMS-III.G), the project will monitor the real methane emission avoided during the crediting period (ex-post) through the actual measurement of methane content in the LFG captured and destroyed by the activities in the project. Methane in the LFG captured is generated from the real conditions of the landfill where the project activity takes place. The methane avoided, subsequently the emission reduction, is fairly derived from the real landfill conditions and the actual gas measurement.

In activities without capturing of LFG e.g. composting (AMS-III.F), no method of actual measurement of the methane emission avoided is yet available. The project will rely entirely on the FOD for determination of the amount of methane emission avoided during the crediting period (ex-post).

The first order decay model is a simplified method used to estimate methane generation from degradable organics. It has been widely used by landfill engineers to design gas extraction systems, flares and gas generators. It works with a limited set of statistical variables and factors mirroring a broad range of different climate and site conditions as well as the impact of varying waste composition. Over the years it has become obvious that the model shows serious limitations due to its simplicity and that it does in many cases not reflect the real methane generation of a landfill correctly. Thus, several advanced models have been developed to refine the calculations. However, all models suffer from similar technical and physical constraints, what is an endemic dilemma. The model variables are either too less sensitive or too small in number. If not, they are too difficult or too comprehensive to determine for practical use.

The project proponent is in the opinion that beside using FOD which has limitations, a project activity

where methane emission avoided from disposal of waste is without LFG capturing system (no methane is generated from specific landfill conditions and no LFG to be captured for the methane content to be measured); like the board scenarios of technologies applicable under AMS-III.F; should be given a possibility to measure the actual methane emission avoided.

One feasible option is the direct measurement of gas generation, which can be conducted either in the field or in large scale testing devices. First testing devices, called lysimeter or landfill simulation reactors (LSR), have been introduced as early as in 1980. Since then the methods have been refined and improved. First LSR were used to develop and validate gas generation models (such as FOD) under controlled conditions. Later LSR were adjusted in order to allow different cybernetics and – under certain condition - to determine the overall gas potential. Depending on the approach the LSR can be operated under various operation conditions corresponding to either landfill conditions or to artificially accelerated digestion processes (such as in biogas plants).

In order to make the LSR a useful monitoring instrument for the baseline it is essential that the reactor is operated in a way corresponding to the landfill conditions, which are expected in the absence of the project, usually the present landfill conditions. Hence the LSR will be used in the basic operation modus without applying any artificial support to the microbiological process, such as start-up injections, preheating, adding nutrients etc.

LSR measures are selected in a way that they are reflecting the landfill condition and operation. This comprises of an aerobic starting period (when the waste is still on the surface), irrigation with the typical leachate generation rate and temperature support to avoid energy losses.

It has been proven that a LSR operated this way generates a similar amount of gas per time period, as it would be generated in the landfill that the LSR is simulating. Hence LSR is the most appropriate and exact instrument to forecast gas yield. Further measurement of methane content in the gas generated by LSR will help determining the overall methane emission.

Projections on the gas yield are essential for the baseline emission and emission reduction calculations (as well as for scientific purposes, while engineers compensate simulation gaps by contingencies).

Hereby the project proponent would like to submit a request for revision of AMS-III.F in regards of the determination and monitoring of methane emissions avoided to be based on the use of LSR.

Recommendation by the SSC WG:

Please use the space below to provide amendments/change (in your expert view, if necessary).

Please refer to paragraph 13 of the meeting report of the SSC WG 25 (http://cdm.unfccc.int/Panels/ssc_wg).

Answer to authors of query by the SSC WG:

Please use the space below to provide answer to the authors of the above query.

The small-scale working group of the CDM Executive Board would like to thank the author for the submission.

The SSC WG agreed not to recommend the proposed revision of AMS-III.F because of the following fundamental issues:

1. There are many uncertainties associated with the landfill simulation reactor (LSR) approach, e.g.,

    - Unlike the landfill receiving all the wastes (regardless of particle size and aggregate state), pre-selection has to be carried out for LSR filling and operation. Generally, the fine fraction has higher content of biodegradable organic material than the coarse fraction; the latter may not significantly contribute to methane formation under some circumstances. If the coarse fraction is not (sufficiently) considered, gas formation from the LSR might be higher than would be from the landfill;
    - If coarse waste components would be shredded or size reduced by any other method, the

structure (and in particular the surface) of the waste compounds would be altered with the severe risk of increasing the biodegrading performance during the LSR test[1];

- Water (moisture) distribution in landfills is very difficult to assess and simulate because the waste mixture is quite inhomogeneous, so that it could lead to preferential flow paths, dry zones and/or submerged areas. In contrast, water distribution in a LSR might be more homogenous (also due to the more homogeneous input material), thus creating optimized conditions for biodegradation. Consequently, LFG emissions might be higher than would be from the full scale landfill;
- It is difficult to assess the extent to which the organic compounds become aerobically converted after being landfilled. This very much depends on the landfill operation technology. If the wastes are neither compacted nor covered, a significant share of the organics might become converted under aerobic conditions without or under limited methane generation. The project proponent is proposing to simulate an initial aerobic phase at the beginning of the LSR test, but this phase might be eventually shorter than the one at the full scale landfill. In consequence a greater share of the organic compounds would be transferred into biogas thus leading to an overestimation of the baseline emissions;
- The LSR is not able reproduce the conditions of pressure (compaction) and the diffusion of gases and liquids in conditions equivalent to the real landfills. Given this and the above issues, it is concluded that the kinetics of the decay (the time function) for each type of waste material and for the mixed waste composition measured in a LSR cannot be considered as equivalent to the kinetics of the anaerobic decay in a real landfill.

2. The following guidance, procedures, and/or standards are required for the operation of LSR:

- Guidance and procedures on the representative selection of the input waste fraction for the LSR as well as on the classification and sorting of the sample input wastes;
- Guidance on the determination of the operational parameters to ensure that the real conditions and processes that occur in the landfill whereby the MSW would have been deposited are simulated;
- Standard for design characteristics, set-up and operation of LSR, which are necessary for other project proponent to replicate and for DOE to verify such an approach.

The SSC WG noted that no standard or norm is available for the design and operation of LSR in this regard.

In addition, the following issue is also observed:

In the PDD, it was stated that the final stabilized biomass waste (SB) would be landfilled and the residual methane potential was envisaged to be negligible. However, it has been reported (e.g., Scheelhase, T. *et al.*[2]) that a residual biogas formation potential (GB21) remains even after a treatment period of several months. Therefore, methane emissions from the deposition of the SB fraction have to be taken into account and considered as project emission as it might be significant.

The project proponent may consider if the approach described in AMS-III-AF can be used to estimate such project emissions for the proposed treatment technology (MBT followed by landfill).

In summary, as also stated in the 2006 IPCC guidelines, the SSC WG is of the opinion that methane emissions from landfills is affected by a wide variety of factors including the composition of the waste, climatic conditions at the site where the landfill is located, characteristics of the landfill, waste disposal

[1] The SSC WG noted from literature that LSR has been extensively used for experimental studies with shredded waste where the primary aim was to speed up the biodegradation process

[2] Scheelhase, T., Bidlingmaier, W. (1997). Deponieverhalten von mechanisch-biologisch vorbehandelten Abfällen, In: Gallenkemper, B., Bidlingmaier, W., Doedens, H., Stegmann R. (Hrsg.): 5. Münsteraner Abfallwirtschaftstage, 27.01.-30.01.1997 in Münster, Bd. 10.

practices and others. Thus the IPCC default values used in the CDM methodologies and tools are derived from variety of sources such as experimental measurements, calculation using models, greenhouse gas inventories and other studies. The group agreed therefore that the proposed procedure has a high level of uncertainty with regard to how closely the LSR reproduces the conditions of the landfill.

Signed by the Chair, Mr. Peer Stiansen
Date: 29/04/2010

Signed by the Vice-Chair, Mr. Hugh Sealy
Date: 29/04/2010

Information to be completed by the secretariat	
SSC-Submission number	SSC_386
Date when the form was received at UNFCCC secretariat	29 April 2010
Date of transmission to the EB	29 April 2010
Date of posting in the UNFCCC CDM web site	29 April 2010