SUBJECT: In reference to the Adjustment Factor of 10%, adopted in the PROBIOGAS-JP ER calculations.

Dear SGS team,

As stated in the PDD, there is no regulation that obligates the landfill to destroy methane.

According to the methodology ACM0001 version 5: *"Consolidated baseline methodology for landfill gas project activities"*:

> *"In cases where regulatory or contractual requirements do not specify $MD_{reg,y}$ an "Adjustment Factor" (AF) shall be used and justified, taking into account the project context"*

So, the adjustment factor used was estimated taking into account:

1. Destruction of CH_4 in the baseline scenario: The methane is combusted at the top of the wells, by means of destruction in a low efficiency manner. The "tool to determine project emissions from flaring gases containing methane", used as a conservative reference, says that for open flares, 50% of destruction efficiency should be used;

2. Percentage of methane vented through the passive system: the site operator has installed a simple passive venting system. As stated in the Landtec material[1] "The passive systems are not as efficient as the active systems". The probable reasons for this low efficiency of passive systems are:
    a. It relies on barometric pressure: according to the Landtec material[1], the LFG seeks the equilibrium with the atmospheric pressure. The waste coverage, LFG generation among other factors causes some delays in this pressure stabilization, resulting in higher or lower pressure oscillations compared to the atmospheric. This results in LFG flow through a less resistant ways, becoming favorable the leak of LFG through the coverage;
    b. The well influence ratio: each well has an influence ratio in active systems. This ratio is estimated mainly by the waste voids in the landfill, the biogas generation, the coverage permeability, and the atmospheric pressure. This ratio, for an active system in Brazil is estimated to be around 25 meters. However, according to the Landtec material[1], the wells in passive systems have a minimum influence or effect comparing with the active systems.

[1] Project engineering for landfill gas systems (Projetos de Engenharia de sistemas de gás de aterros Sanitarios – Enfoque prático) – Practical approach, course material, Landtec.

c. Preferred pathway: “Methane is lighter than air and carbon dioxide is heavier than air. However, they *"... will not separate by their individual density...*", but rather move, "... *as a mass in accordance with the density of the mixture and other gradients such as temperature and partial pressure*" (EPA, April 1992). This usually results in landfill gas moving upward through the landfill surface” through the surface soils into ambient air;
d. Coverage permeability: according to “*Geotechnical Study and Evaluation of the Methane Retention Efficiency of the Top Cover in Muribeca and Aguazinha Landfills*”[2], a test was made with a similar coverage with the same thickness (40cm) used at the João Pessoa Landfill. The results presented shows 10% of methane retention by this coverage.

The above mentioned characteristics show that the passive systems are less efficient than active systems. The PP estimate around 65% of collection efficiency for the PROBIOGAS-JP, however this number was never tested. The IPCC guidelines 2006 measured in 11 closed landfill sites (where the collection efficiency is greater than in operational landfill site) an average collection efficiency of 37% for active systems.
The active systems avoid the LFG leakage through the surface by creating a negative pressure gradient (suction) in the landfill cells. In a conservative manner, it seems reasonable to estimate that 50% of the LFG collected in active systems are collected in passive systems. So, the percentage of the LFG that flows to the passive wells is 37% x 50% = 18.5%.

3. Wells that actually destroys methane: The construction of the wells at the João Pessoa landfill does not support flaring of landfill gas. The wells are meant to function as “escape routes” for leachate and gases that otherwise could build up the pressure inside the landfill cells. The landfill operators usually set fire at the top of the wells randomly, without any systematic procedures. Frequently, the weather (rain and wind) blow out the flames. As there is no procedure to set fire in the LFG, most of the wells release the LFG directly to the atmosphere. However, to ensure the conservativeness of the AF, it is estimated that 50% of the wells of the landfill are effectively destroying methane.

The Adjustment Factor is calculated by dividing the methane destruction efficiency in the Baseline with the methane destruction efficiency in the Project Activity. This number is estimated using:

1. Collection efficiency: it was estimated to be around 65% for this project;

[2] Geotechnical Study and Evaluation of the Methane Retention Efficiency of the Top cover in Muribeca and Aguazinha Landfills, M.O.H. Mariano, D.F. Victor,, L.C.C. Lima, A.C, Cantilino, J.F.T. Jucá, M.C.M. Alves, & A.R. Brito, presented during the VI Brasilian Congress of Environmental Engineer..

2. The flare destruction efficiency: It is a default value based on the "Tool to determine project emissions from flaring gases containing methane[3]" approved by the Methodologies Panel (90% - enclosed flare);

Therefore, the adjustment factor is calculated by the formula presented below:

$$AF = \frac{50\% \times 37\% \times 50\% \times 50\%}{65\% \times 90\%} = 7{,}9\%$$

In order to be conservative, the AF used for the project activity was 10%.

Yours sincerely,

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[3] EB 28 Meeting report, annex 13, available at: http://cdm.unfccc.int/methodologies/Tools/eb28_repan13.pdf., accessed on October 25th.