Pre-project Monitoring and Calculation of $NQ_{discount}$

Baseline Monitoring

Passive flares and other non-qualifying destruction devices are often installed at landfills for purposes other than methane destruction, and therefore are not amenable to simple monitoring. For example, flares installed for odor control may be used intermittently and without any instrumentation tracking gas flow and methane concentration. This makes assessing baseline methane destruction from passive flares extremely difficult to quantify. Quantification is further exacerbated by the fact that passive flares are not necessarily designed to accommodate metering equipment; for example, in many cases passive flares do not have sufficient straight pipe length to control for turbulence. These limitations, combined with the low flow rates generally seen at passive flares greatly limit the number and type of metering equipment that can be used.

The Reserve recognizes that the constraints on monitoring landfill gas from passive flares are unique to each landfill. We have attempted to make this methodology as flexible as possible to make it widely applicable. Any deviations from this methodology will require a formal request for variance.

Monitoring

Non-qualifying destruction devices (e.g. passive flares) must be monitored for a period of at least three months. This period must occur prior to the project start date to ensure that the measured gas flow is not decreased by the addition of project wells or pressure changes that result from the project activity. Methane destruction from the chosen period must be extrapolated to one year based on the 90% upper confidence limit of the methane destruction identified in this period. Therefore, monitoring for more than three months, or with greater than weekly frequency, may lessen statistical uncertainty and reduce the required deduction.

Gas flow must be measured weekly at a minimum, and must be normalized to scfm (as defined in the landfill protocol). If gas flows fall below the measurable range for the chosen metering device, the minimum flow value of the chosen metering device must be applied to that time interval. Methane concentration must also be measured at least weekly.

One measurement should be entered for each day for which readings were taken. If continuous measurements were taken, these should be averaged. If a single measurement was taken, then this value should be used. Therefore, if a daily monitoring plan is chosen for the three month period, a total of 90 data points will be available (one per day). However, if weekly measurements are taken, then only 13 data points will be available for the analysis (one per week). Alternatively, irregular measurement intervals (for example, if someone is on-site three consecutive days) or bi-weekly measurements can be used as well, allowing for anywhere between 13 and 90 data points for any 90 day period. However, no more than one data point per calendar day may be applied and all collected data must be used.

All metering equipment used in pre-project monitoring is subject to the same maintenance, calibration, and QA/QC requirements outlined previously for project metering equipment.

Configuration

As the configuration of passive flares will be unique to each landfill, it is not possible to dictate a single monitoring methodology. Rather, the following options have been devised as acceptable configurations.

1. Each passive flare will be monitored individually for both flow and methane concentration according to the schedule outlined above.
2. Wells from two or more passive flares may be connected to a single flare with a single set of meters for both flow and methane concentration. Additional engineering may be required to ensure that the altered pressure characteristics of the system do not decrease total gas flow. The flow characteristics of this system will require substantiation from engineering documents and calculations and will be assessed by the verifier.
3. Wells from two or more passive flares may be connected with the active collection system and monitored separately from the new project wells while under vacuum from the blower.

Calculation

Please use Equation 1 to calculate the $NQ_{discount}$.

Equation 1. Calculation of pre-project discount for a non-qualifying device.

$$NQ_{Discount} = 525{,}600 * CH4_{\min}$$

Where,		Units
$NQ_{Discount}$ =	Adjustment to account for the methane which would have been combusted in the baseline, non-qualifying combustion device	scf CH_4
$CH4_{min}$ =	90% UCL of the average methane destroyed per minute in the metered period (must be >3 months)	scfm CH_4
525,600 =	Minutes in one year	min./yr

$$CH4_{\min} = 90\%UCL\left(LFG_t\right) * 90\%UCL\left(PP_{CH4,t}\right)$$

90%UCL =	The 90% upper confidence limit of the average of all values	
LFG_t =	Flow rate of landfill gas metered from the pre-project non-qualifying system	scfm
$PP_{CH4,t}$ =	Methane fraction of the landfill gas in time interval *t* =1 day	scf CH4 / scf lfg

$$90\%UCL = mean + t_{value} * \left(\frac{SD}{\sqrt{n}}\right)$$

mean =	Sample mean	scf or %
t_{value} =	The 90% t-value coefficient for data set with degrees of freedom *DF* (use Excel feature: =TINV(0.1,DF)	
SD =	Standard deviation of the sample	scf or %
n =	Sample size	
DF =	Degrees of freedom (= n-1)	

Example

The following example (Table 1) demonstrates the necessary calculation for pre-project deduction of a non-qualifying device. The calculations outlined above are represented by the first three columns of data, The final conversions to tCO2e/yr are done using Equation 5-3 in the landfill protocol.

Note that although the measurements had average values yielding a deduction of 5,961 tCO2e/yr, due to the limited data and variability of the measurements, the appropriate deduction is 7,830 tCO2e/yr. If, instead of weekly data there was daily data over this three month period that yielded the exact same mean and standard deviation, the additional data alone would have lowered the deduction to only 6,807 tCO2/yr. Alternately, if the data had been more consistent and showed a standard deviation for the flow data of only 6 with the same mean, then the deduction with 14 samples would have been only 6,689 tCO2/yr. Therefore, the added uncertainty deduction of this method is directly related to the level of variability in the data and the number of samples.

Table 1. Example dataset and calculation of $NQ_{discount}$.

	Calculated According to Equation 1 (above)				Calculated According to Equation 5-3 (protocol)	
	CH4 (%)	Flow (scfm)	Flow CH4 (scfm)	CH4/yr (scf/yr)	CH4/yr (t/yr)	t CO2e/yr
6/1/2008	56.7%	48	27	14,304,730	274	5,760
6/8/2008	55.3%	75	41	21,799,260	418	8,778
6/15/2008	58.1%	21	12	6,412,846	123	2,582
6/22/2008	54.0%	90	49	25,544,160	490	10,286
6/29/2008	55.6%	47	26	13,734,979	263	5,531
7/6/2008	56.3%	23	13	6,805,994	131	2,741
7/13/2008	57.2%	70	40	21,045,024	404	8,475
7/20/2008	58.0%	15	9	4,572,720	88	1,841
7/27/2008	52.3%	89	47	24,465,103	469	9,852
8/3/2008	55.7%	42	23	12,295,886	236	4,951
8/10/2008	54.8%	51	28	14,689,469	282	5,915
8/17/2008	62.1%	19	12	6,201,554	119	2,497
8/24/2008	59.3%	66	39	20,570,933	394	8,284
8/31/2008	57.6%	70	40	21,192,192	406	8,534
Mean	**56.6%**	**51.86**	**28**	**14,803,281**	**284**	**5,961**
SD	0.02	25.70				
n	14	14				
DF	13	13				
90% t-value	1.77	1.77				
UCL at 90%	**57.8%**	**64.02**	**37**	**19,443,275**	**373**	**7,830**