MONITORING AND REPORTING FOR CARBON CREDITS AT ADRIANOPOLIS

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ABSTRACT
The Kyoto Protocol mandates that greenhouse gas (GHG) emissions be reduced. The landfill industry is increasingly being viewed as an economically and technically attractive way of accomplishing a portion of the required emission reductions. One of the most effective ways to reduce GHG emissions from landfills is to implement or improve the collection and destruction of landfill gas (LFG) being generated. Policies and regulations governing the validation of these reductions have created a need for improved monitoring and reporting of LFG destruction. This paper presents a case study of the monitoring and reporting for a Clean Development Mechanism (CDM) project in Brazil.

A brief review of different methodologies for monitoring and reporting destruction of LFG currently approved for CDM projects provides background information on policies and regulations which the methodologies are intended to meet. The specific project design document and monitoring plan for the site are presented along with current modifications that the CDM executive board has made to the methodology used. The background on requirements is concluded by a review of the economic and technical validity of the methodologies and the ability to implement them in different areas of the world.

A detailed analysis of a monitoring and reporting methodology that was used at the site is then presented. The site is located in Brazil and required reports that would meet the validity requirements of their stakeholders while aiding in the maximization of methane collection and destruction. The individual methods utilized to collect gas field data manually and data at the LFG combustor atomically are examined. The methodology is comprehensive utilizing techniques from automated numerical analysis and trending to manual review and verification of questionable data. Aspects necessary for acquiring valid data and reports as well as concise information that can be utilized for improving LFG production are practiced at the site.

The case study concludes with results of the audit to validate the carbon credits requested by the site. The audit is one of the areas where clear, concise and transparent reporting is valuable. Additionally the study suggests that there are methodologies which provide operational and economic benefits to a variety of landfill projects world wide.

INTRODUCTION

This case study examines the monitoring and reporting used to obtain certified emission reductions (CER) or carbon credits for a large scale, waste handling and disposal, clean development mechanism (CDM) project. The project is reducing methane emissions through active collection and destruction of landfill gas (LFG). The project is located in Brazil and is a joint venture between an environmental finance company, EcoSecurities, and a Brazilian civil engineering and construction company, S.A. Paulista. Landfill gas is collected and destroyed at two different sites, Lixao de Marambaia (Marambaia) and Aterro Sanitario de Adrianopolis (Adrianopolis) both located adjacent to Rio de Janeiro.

Marambaia is a closed landfill that has approximately 2 million tonnes of waste in place. It operated from 1986 until late 2002. Adrianopolis started accepting trash shortly after Marambaia closed and is currently accepting 1,000 tonnes of municipal solid waste per day and is designed to accommodate up to 3,000 tonnes per day. Both sites have been approved for installation of a gas collection system, leachate drainage system, modular electric generation plant and flare facility. Currently the LFG is being flared and CER are being issued based on the monitoring and reporting of the LFG collection and flare operation. Electric generation both for site use as well as for export to the local grid is planned for next year.

CDM & CER BACKGROUND

As environmental consciousness heightens several new strategies and regulations are being conceived and implemented to reduce greenhouse gas (GHG) emissions. A predecessor to these is the Kyoto Protocol, which was established by the United Nations Framework Convention on Climate Change (UNFCCC) over ten years ago. Currently over 180 countries have ratified the treaty. The intent of the Kyoto Protocol is to reduce GHG emissions to

a level at least 5 percent lower than the level emitted in 1990. There are several different strategies and mechanisms included in the Kyoto protocol. One of them is called the Clean Development Mechanism (CDM).

The CDM is defined by article 12 of the Kyoto Protocol and is intended to help developing countries achieve sustainable development while simultaneously providing developed countries with an additional means to achieve their emission reduction commitments. This is done by constructing projects in developing countries that have real, measurable and long term reductions in GHG emissions. The emission reductions are monitored and reported to an independent auditing and verifying entity for certification. The certified emission reduction (CER) can be transferred to developed countries and used to help meet their reduction commitment set forth in the Kyoto Protocol.

There are several types of CDM projects and several different GHG emissions which are trying to be reduced. Some GHGs are more harmful to the environment than others so emission reductions are quantified as equivalent reduction in carbon dioxide. These reductions in carbon dioxide are often referred to as reduction in carbon emission or reduction in carbon footprint. The CER that is obtained through approved CDM projects can be subtracted from the countries actual total equivalent carbon dioxide emissions and thus the CER is often called a carbon credit.

Waste handling and disposal projects are economically attractive, in part, because methane is considered by the UNFCCC to be a GHG that has a carbon dioxide equivalence of 21. Therefore, if one tonne of methane emissions is reduced it is equivalent to reducing 21 tonnes of carbon dioxide emissions. This at times makes the capital cost of methane emission reduction equipment economically viable. The collection and destruction of LFG is often viewed as a technically attractive option for emission reduction also. The equipment, technology and knowledge are able to be transferred to and implemented in developing countries. While there are other GHG emissions that occur in waste handling and disposal projects the largest GHG emissions are from methane releases. Therefore capturing the LFG and combusting it to destroy the methane component provides the largest reduction in GHG emissions and the most cost effective option to reduce GHG emissions from most landfills.

CDM Requirements

There are several procedures that are mandated by the UNFCCC to ensure that the CER is accurate, real and measurable. One of the keystone items to demonstrate real emission reduction is the requirement for the project reductions to be additional to any that would have occurred in the absence of the project. A baseline or business as usual scenario must be determined to demonstrate what reductions are additional, solely due to the project. The baseline methodology must be approved and since the UNFCCC requires that CDM project activities be public, transparent and accountable, the project design document (PDD) and monitoring plan (MP) must be approved and publicly available.

Baseline Methodology: This project utilized methodology AM0003: Simplified financial analysis for landfill gas capture projects. The project was registered November 18th 2004 under the first version of the methodology, however over the last four years there have been three additional revisions. The revisions affected the monitoring methodology more than the baseline emissions determination. This project was one of the first waste handling and disposal CDM projects registered and the methodology was developed specifically for this project. Therefore, little documentation was necessary to justify the choice of the methodology or to demonstrate that it was applicable to this specific project.

The baseline or business as usual scenario was established by listing all possible scenarios then evaluating them financially without considering income from CER. If under any scenario it was economically attractive to undertake the project without benefit of CER then the reductions could not be considered additional and the project would be denied. During baseline determination it was noted that while there are no regulatory requirements for LFG to be flared in Brazil, there was an agreement to install some gas vents and flares at Marambaia for safety reasons. While there was no mention of the amount of gas to be flared there was indication that the wells would extend into the landfill less than five percent the landfills estimated depth. With this information a conservative estimate that these vents and flares would capture and destroy 20% of the LFG generated by the refuse mass was assumed. Therefore only 80% of any emission reductions generated from Marambaia would be considered additional and qualify for CER.

Another important aspect of the baseline determination is the project boundary. Four different emission sources were considered. Direct on site emissions which were identified as fugitive emissions from the landfill. This is where the bulk of the reductions would be generated. In the baseline scenario the LFG would be uncontrolled and released to the atmosphere. With the project in place it was estimated that 85% of the generated methane would be captured and destroyed. While estimation of the potential emission reductions was important, only actual measured and verified reductions would be certified.

The next emission sources considered were direct off site emissions. While the emissions generated by transportation of equipment to the project site could be added here, the one time transportation emissions were excluded from the

project boundary. Also the potential reduction of direct off site emissions due to use of electricity generated from LFG on site, which would relieve the need to use grid power, was excluded from the project boundary.

Indirect on site emissions generated from electricity used to operate the project, when the project is not running on power generated though the combustion of LFG, is subtracted from the emission reductions to become carbon neutral. The one time emission from construction of the project was excluded as it was assumed that these emissions would occur if an alternative project was constructed as well. The indirect off site emissions from transportation of waste to the landfill were excluded as waste would need to be transported to the landfill even if the project did not take place.

Monitoring Methodology and Plan: While the methodology to determine baseline or business as usual scenarios has not change much since the project was registered the monitoring methodology has had some changes. Most notably is the addition of the 'Tool to determine project emissions from flaring gases containing methane' which was added to version four. This tool provides the methodology to determine flare efficiency. For enclosed flares it provides two options. Projects can use a default value of 90% efficiency, if the flare is continuously operated in accordance with the manufacture's specifications, or continuously monitoring the destruction efficiency and using the actual monitored value. In both cases the temperature of the exhaust gas must be monitored and if the temperature is less than 500°C the efficiency is assumed to be zero. It is also necessary to determine and state which method is to be used in the PDD and MP.

As the project studied was approved under version 1 it did not need to use one of the options listed above. Instead the flare efficiency is measured periodically and assumed to be constant between measurements. Currently the approved project design document (PDD) and monitoring plan (MP) require flare efficiency to be determined semi annually at a minimum. If there is a significant variation from the last monitored value the efficiency must be monitored monthly until stable results are obtained. In addition to the flare efficiency the flow rate of LFG to the flare, gross electricity produced and fraction of methane in the LFG must be measured continuously.

Monitoring and reporting has been required for personal and environmental safety on most landfills in developed countries for sometime. However the monitoring and reporting for these types of projects are typically somewhat infrequent when compared to the continuous readings that are required for CDM projects. Additionally previous safety monitoring typically concentrated on detecting migration of methane off site or accumulation of explosive levels of methane. The required monitoring and recording for CDM projects had to be somewhat different than the standard for the landfill industry but still technically valid, feasible and able to be implemented in developing countries. The current methodologies have been designed specifically for these CDM projects where monitoring and reporting methane destruction is the primary intent. The requirement of some CDM projects to have continuous flare efficiency monitoring is the latest progression in LFG destruction monitoring and reporting.

Quality assurance/quality control (QA/QC): To ensure the accuracy of the monitoring and reporting CDM projects require QA/QC procedures. For this project daily manual monitoring records are checked for anomalies and filed for future reference. Automated LFG flow readings and methane concentration readings are checked with other automated readings such as flare temperature, concentration of carbon dioxide and oxygen in the LFG to ensure that the readings are valid. Questionable readings are quarantined and undergo more rigorous inspection. Trending, comparison to historical averages and correlation to other operational data received can often discern unusual changes in operations from inaccurate or invalid readings. Valid readings immediately calculate gross emission reductions. Weekly, the automated data is reviewed and adjustments for emissions resulting from energy and pilot gas used on site are subtracted from the gross emission reductions to generate net emission reductions for the project.

Manual gas field records are taken weekly or as necessary and checked for anomalies. If the gas field inspections show an unintended release of LFG corrective actions are taken immediately. Technicians are issued reminders list to ensure that daily, weekly and monthly tasks are completed. Management reviews the list with technicians during site visits. During regular site visits management address any necessary training needs and audit any outstanding site tasks. A key component of the QA/QC policy is service and calibration of measurement equipment. All instrumentation is maintained, serviced and calibrated in accordance with the manufactures specifications. In addition the analyzer that monitors the concentration of methane being flared is equipped with an automatic calibration system. The system automatically checks known calibration gases hourly and records the results. If necessary the analyzer will recalibrate itself. The project engineer checks the calibration readings daily to ensure accurate methane readings.

EQUIPMENT UTILIZED

This project has been actively collecting and destroying LFG for over a year. The first phase of construction was complete during the first quarter of 2007. The second phase of construction is planned for the third quarter of 2009. During the first phase of construction the gas collection

system and flare was installed. An effort has been made to ensure that the equipment is the best available technology for the application and is sufficient to meet the UNFCCC requirements. There has also been an effort to minimizing the amount of equipment necessary.

FLARE STATION (Novagerar monitoring report 2008)

The gas collection system is monitored with a GEM2000 and Accuflo wellheads. The collection system is monitored weekly or as necessary for tuning and QA/QC. The total gas flow to the flare is monitored for gas composition by a LANDTEC field analytical unit (FAU) every two minutes. The data is transmitted by the field server unit (FSU) every four minutes to a secured database where is it checked for validly and available for review through an online service. The FAU is equipped with an automatic calibration system that checks its performance against a known calibration gas every hour. If the analyzer is out of calibration by more than the user defined amount an automatic calibration will be performed to bring the analyzer back into calibration. After the gas composition is know the gas passes a thermal mass flow meter to record the flow rate of the LFG being flared. A reading from the flow meter is taken by the FSU every two minutes, combined with the gas composition reading and sent to the secure database for validity checking and processing. The last auditable monitoring data is the flare efficiency. This is currently done manually every six months. This project was initiated before the equipment to perform continual flare efficiency monitoring was available from LANDTEC and before it was an option in the monitoring methodology.

With the monitoring equipment above the project has been successful in having all of their reported emissions for 2007 certified. However in addition to the required monitoring devices the flare is equipped with other sensors that are also read, transmitted and verified as back up and justification to the primary readings as well as useful from an operational standpoint. These include; flare gas temperature at different locations in the stack, flare damper position, unit power, blower operation, main valve position and several other flare operational alarms/status indicators. The flare being used was manufactured by John Zink Company LLC and essentially any of the data that is shown on the flare's operational display is transmitted and available to view though the online service.

VERIFICATION &VALIDATION

While utilizing the correct methodologies, monitoring equipment and protocols are critical for CDM projects verification and validation is necessary at several places along the way. Good QA/QC, training and documentation helps but from the original PDD to the request for issuance of CER each step of the process needs to be verified or validated.

Much verification happens on site during the data collection and reporting process. The strict QA/QC and data review process verifies that data being used is correct. Weekly verification of the emission reductions are held on site and more comprehensive internal audits and verifications are completed before the request for issuance of CER is submitted. In addition to the onsite audits an independent third party, accredited as a designated operational entity (DOE) is required that review all aspects of the project. Prior to the project being registered all aspects of the design monitoring and methodologies must be validated. Then after the project is operational and is requesting certification of claimed emission reductions the operation, monitoring and reporting of the reductions must be verified.

Project registration

Prior to the project being registered the PDD requires validation. For this project it was a three phase process and began December of 2002. The first phase was a desk review of the PDD. The second phase consisted of interviews with project stake holders and the last phase included resolving identified issues and issuance of the validation report. This project validation occurred between December 2002 and August 2004. The project was successfully registered November 18, 2004.

During the desk review the PDD and MP underwent several minor revisions. In February 2004 the final version of the PDD and MP was submitted to the DOE for final review. The second phase of the validation was proceeding concurrently. In February 2003 stakeholders were interviewed to resolve questions about GHG calculations, monitoring and management systems as well as the baseline assumptions. The third phase of the validation resolved outstanding issues though communications with the project participants. Results of all findings were documented in the validation report and published on the CDM website to

ensure full transparency of the validation process. Though the process was long the ultimate outcome was that the project met all necessary UNFCCC requirements and the project was approved.

Verification and certification

On a yearly basis a monitoring report delineating emission reductions is submitted for issuance or CER. As with the project registration a DOE is required to review the project and requested emission reductions. During the verification objective evidence that the emissions report meets the requirements of the MP, PDD and approved methodology must be clear. Additionally the data reported must be complete and transparent. The primary objective of the verification is independent and objective determination of the monitored GHG emission reductions. The verification is based on the registered PDD and MP.

During February of 2008 a monitoring report was submitted and the DOE initiated a three stage verification process. First a complete review and risk assessment of the project activates was completed. This included reviewing all sources of project emissions, emission reductions, protocols used to establish GHG emissions, the collection and handling of data and any controls of data collection and handling. The second stage involved verification that the MP was implemented and verification of the data presented in the monitoring report. This stage required both a site visit and a desk review of the monitoring report. Once two stages are completed by an assessment team a recommendation is made and documented. The recommendation as well as all documentation used by the assessment team is forwarded to a technical reviewer to check that the review was complete and all recommendations are justified. If sufficient evidence for the reported emission reductions is not obtainable then the emission reductions will not be verified or certified. If misstatements are found in the reported emission reduction then the requested reductions will be discounted and only emission reductions that are determine to have been achieved will be verified and certified.

Results of First Verification: When the DOE compared the monitoring report with the approved PDD it was found to be consistent. The parameters in the MP matched the monitoring methodology and were included in the monitoring report. It was determined that the calibrated meters, automatic data collection and procedures used were sufficient quality assurance for the data. The physical site review demonstrated that the instrumentation used to generate the data was in compliance with the approved PDD. The monitoring mechanism was found to be in compliance with the registered MP, reliable and effective.

The calculation of the emission reductions were determined to be correct however initially some questions were raised and a new information request and corrective action request were made. During the two day audit responses were provided and the request closed. The management system and quality assurance was found to be in place and compliant with CDM requirements. At the completion of the audit it was determined that all emission reductions claimed in the monitoring report were accurate and all reductions were verified and certified.

CONCLUSION

Current approved monitoring methodologies when combined with quality equipment, good project QA/QC and management can provide accurate, transparent and auditable data that will stand up to rigorous scrutiny. The equipment and technology necessary to successfully complete waste handling and disposal CDM projects is transferable to developing countries.

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