

VERIFICATION REPORT FOR VCS PROJECT 573'S SECOND MONITORING REPORT



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Summary:

NSF-ISR verified the second monitoring period of the “Corinth Abandoned Mine Methane Recovery Project” (the “Project”). In this Project methane from abandoned coal mines in southern Illinois was extracted, treated at a gas plant, and through an interstate pipeline sold to end-users for combustion. The project developer, Keyrock Energy, LLC, acquired this project from DTE Methane Resources, LLC, in 2011. The project was validated in 2010 by First Environment. This is the first monitoring period performed for Keyrock Energy, LLC.

The objective of the verification was to confirm the project’s ongoing adherence to the methodology and validated Project Description, and to verify the Project’s emission reductions during a reporting period from 1 May 2011 through 31 December 2012. NSF-ISR verified the asserted emission reductions against criteria found in CDM Approved baseline and monitoring methodology ACM0008 “Consolidated methodology for coal bed methane, coal mine methane and ventilation air methane capture and use for power (electrical or motive) and heat and/or destruction through flaring or flameless oxidation,” version 6, and Approved VCS Methodology Revision VMR0002, “Revision to ACM0008 to include Methane Capture and Destruction from Abandoned Coal Mines”, version 1.0.

NSF-ISR performed off-site document review and on-site verification audit activities for this reporting period. NSF-ISR received acceptable responses for all clarification requests and nonconformity findings issued. On the basis of work performed, NSF-ISR concluded with reasonable assurance that the Project’s asserted vintage 2011 and 2012 emission reductions were fairly stated. These amounted to 71,398 metric tons of carbon dioxide–equivalent emission reductions for vintage 2011, and 92,443 metric tons of carbon dioxide–equivalent emission reductions for vintage 2012. More detail concerning the findings that support this conclusion is provided in Section 4 of this report.

Table of Contents

Table of Contents	3
1 Introduction.	5
1.1 Objective	5
1.2 Scope and Criteria	5
1.3 Level of assurance	6
1.4 Summary Description of the Project.....	6
2 Validation Process, Findings and Conclusion	6
2.1 Validation Process	6
2.2 Validation Findings.....	6
2.2.1 Gap Validation.....	6
2.2.2 Methodology Deviations.....	6
2.2.3 Project Description Deviations	7
2.2.4 New Project Activity Instances.....	7
2.3 Validation Conclusion.....	7
3 Verification Process	7
3.1 Method and Criteria.....	7
3.2 Document Review	7
3.3 Interviews	8
3.4 Site Inspections	8
3.5 Resolution of Any Material Discrepancy	9
4 Verification Findings.....	9
4.1 Project Implementation Status	9
4.2 Accuracy of GHG Emission Reduction or Removal Calculations	10
4.3 Quality of Evidence to Determine GHG Emission Reductions or Removals	10

4.4	Management and Operational System	10
5	Verification conclusion	11
ANNEX A – List of Findings		13

1 INTRODUCTION

Project developer Keyrock Energy LLC engaged NSF-ISR to verify the second reporting period of the “Corinth Abandoned Mine Methane Recovery” project. The verification team consisted of John C. Shideler, PhD, lead verifier. An independent review of the verification results was performed by Michael DeBusschere, P.E. After evaluation, NSF-ISR determined that the potential for conflict-of-interest was low for NSF-ISR and for the verification team.

1.1 Objective

The objective of the verification of the second reporting period of the project was to determine whether methane recovered from the abandoned coal mines included in the project boundary had achieved emission reductions in accordance with the validated Project Description and the current monitoring report, and had remained in conformity with applicable VCS requirements.

1.2 Scope and Criteria

The scope of this verification, with respect to project boundaries, included extraction of methane from 14 abandoned coal mines in southern Illinois and its sale to a pipeline for destruction by end-users. Approximately 33 active extraction wells were located in Jefferson, Franklin, and Williamson counties, and a gas treatment plant was located in Williamson County at GPS coordinates N37.8691 W88.7879.

The project baseline included methane emissions from the abandoned mines as a result of venting. There were no emissions from the destruction of methane in the baseline. Project emissions included fugitive emissions from on-site equipment, onsite fuel consumption in equipment (compressors and boiler), methane released due to incomplete combustion in destruction devices, fugitive emission from pipeline transmission, and carbon dioxide emissions from the consumption of electricity at the project. Project emissions from the combustion of nonmethane hydrocarbons in the abandoned mine gas were not calculated as these were demonstrated to amount to less than 1% by mass of the gas composition.

For this verification the temporal scope was 1 May 2011 through 31 December 2011 for 2011 vintage emission reductions. The temporal scope was 1 January 2012 through 31 December 2012 for 2012 vintage emission reductions.

The scope with respect to greenhouse gases was methane (CH₄) and carbon dioxide (CO₂). The project also included combustion byproducts (CH₄ and nitrous oxide) in a combined emissions factor for electricity obtained from the local grid.

Criteria included the Verified Carbon Standard, version 3.3, the CDM Approved baseline and monitoring methodology ACM0008 “Consolidated methodology for coal bed methane, coal mine methane and ventilation air methane capture and use for power (electrical or motive) and heat and/or destruction through flaring or flameless oxidation,” version 6, and Approved VCS

Methodology Revision VMR0002, "Revision to ACM0008 to include Methane Capture and Destruction from Abandoned Coal Mines", version 1.0.

1.3 Level of assurance

This verification was conducted at the reasonable level of assurance.

1.4 Summary Description of the Project

The project collected methane through from 14 abandoned coal mines in three counties in southern Illinois, USA, treated it at a gas plant, and injected it into an interstate pipeline system. Approximately 33 borehole extraction wells placed negative pressure on mined-out underground coal seams, drawing gas to the surface. A portion of the extracted gas was consumed in compressors. Additional project emissions resulted from operation of a boiler and from fugitive emissions at the project's gas treatment plant, and from consumption of electricity.

2 VALIDATION PROCESS, FINDINGS AND CONCLUSION

2.1 Validation Process

2.2 Validation Findings

2.2.1 Gap Validation

Right of use was demonstrated by Keyrock Energy LLC through the Purchase and Sale Agreement between DTE Methane Resources, LLC, and Keyrock Energy LLC. The effective date of the purchase agreement was 1 June 2011, one month after the beginning of the reporting period. However, a separate provision in the Purchase and Sale Agreement conveyed some unsold carbon credits to Keyrock Energy, including unverified vintage 2011 credits generated beginning on 1 May 2011. From this evidence NSF-ISR has concluded that Keyrock Energy LLC has demonstrated a right of use of all VCU's verified from the date of 1 May 2011, onward.

2.2.2 Methodology Deviations

The following deviations to monitoring parameters were approved in the project validation report issued by First Environment in June 2010:

Instead of using the "*Tool to calculate the emission factor for CEF_{ELEC}* (carbon emissions factor [tCO₂/MWh] of electricity used by coal mine electricity system" to calculate a combined margin missions factor, the project used the US EPA e-GRID emissions factor for the SERC Midwest (SRMW) region.

Project gas flows were adjusted from ambient conditions to standard reference conditions at 60°F and one atmosphere of pressure, which is standard in the natural gas industry; this corresponds to a methane density of 0.68 kg/m³. This contrast with the methodology's defined normal conditions of temperature and pressure (20°C and 1 atm) and density of methane (0.67kg/m³).

(See also section 4.1 of this report.)

2.2.3 Project Description Deviations

Keyrock Energy LLC included in its Monitoring Report details pertaining to the change of project ownership from DTE Methane Resources, LLC, to Keyrock Energy LLC.

2.2.4 New Project Activity Instances

2.3 Validation Conclusion

Keyrock Energy LLC's project continues the implementation of the Corinth Abandoned Mine Methane Recovery Project in accordance with the validated Project Description.

3 VERIFICATION PROCESS

3.1 Method and Criteria

NSF-ISR verified reported project emission reductions according to the requirements of the Verified Carbon Standard (VCS) version 3.3; CDM ACM0008 Approved baseline and monitoring methodology ACM0008 "Consolidated methodology for coal bed methane, coal mine methane and ventilation air methane capture and use for power (electrical or motive) and heat and/or destruction through flaring or flameless oxidation," version 6; and Approved VCS Methodology Revision VMR0002, "Revision to ACM0008 to include Methane Capture and Destruction from Abandoned Coal Mines", version 1.0.

3.2 Document Review

The following table lists documents consulted during the document review process:

#	Title
1	VCS Monitoring Report for 1 May 2011 – 31 December 2012, "Corinth Abandoned Mine Methane Recovery Project, version 1.0" (2013-03-03)
2	Project Description (2010-11-18)
3	Validation report for the project, prepared by First Environment (2010-11)
4	Verification report for the project, prepared by First Environment (2011-06)
5	CDM ACM0008/Version 6, "Consolidated methodology for coal bed methane, coal mine methane and ventilation air methane capture and use for power (electrical or motive) and heat and/or destruction through flaring or flameless oxidation"
6	VRM0002, version 1.0, "Revision to ACM0008 to include Methane Capture and Destruction from Abandoned Coal Mines"
7	Keyrock Energy map of acreage and wells in Illinois.

8	Purchase and Sale Agreement between DTE Methane Resources, LLC, and Keyrock Energy LLC (November 2011)
9	Illinois Commerce Commission Pipeline Safety Exit Meeting Documentation Form (2012-09-06)

In addition, NSF-ISR reviewed records associated with the project, including calculation spreadsheets and monitoring instrument calibration records.

3.3 Interviews

Throughout the course of verification activities and during the site visit, NSF-ISR interviewed the following project personnel:

Person	Title	Organization
Chris Shea	Operations Manager	Keyrock Energy, LLC
Mark Benefiel	Facility Manager	Keyrock Energy, LLC
Russell Cook	President	Keyrock Energy, LLC
Ron Collings	Vice President	Ruby Canyon Engineering Inc.

3.4 Site Inspections

NSF-ISR Lead Verifier John Shideler visited the Keyrock Energy abandoned mine methane recovery project on 1-2 April 2013. The purpose of the visit was to conduct a site tour, interview the facility manager, and inspect records and equipment. Locations visited included Compressor Station 1, Compressor Station 2, extraction wells OBC M22-5, OBC M8-4, and OBC M8-6.

The lead verifier observed the electricity-driven compressor in operation at Compressor Station 1, and mine gas-driven compressors in operation at Compressor Station 2. He observed the Rosemount differential pressure temperature settings at extraction wells OBC M8-4 and OBC M8-6. All observations of equipment were consistent with information contained in the Project Description, with the exception of the standardized temperature settings recorded in Finding 7 and described below in Section 4.1 of this report.

3.5 Resolution of Any Material Discrepancy

NSF-ISR issued three Clarification Requests and four Nonconformities during the course of this verification engagement. Keyrock Energy, LLC, provided satisfactory information to close out the findings. Two of the findings of Nonconformity related to errors in monitoring. One involved measurement performed on a dry basis versus the wet basis prescribed in the methodology. Another involved the incorrect selection in monitoring instruments of a setting for adjusting readings to standard temperature. Two other nonconformities related to the initial use of an obsolete version of the VCS monitoring report template and to incomplete reporting of data parameters in the monitoring report. NSF-ISR approved the corrective actions which resulted in modifications to the Monitoring Report and a small revision to asserted emission reductions.

4 VERIFICATION FINDINGS

4.1 Project Implementation Status

The Corinth Abandoned Mine Methane Recovery Project was implemented and monitored from 1 May 2011 through 31 December 2012 in accordance with the validated Project Description. Approved methodology and Project Description deviations described in sections 2.2.2 and 2.2.3 of this report were continued during this reporting period.

Keyrock Energy LLC included in its Monitoring Report details pertaining to the change of project ownership from DTE Methane Resources, LLC, to Keyrock Energy LLC.

The following new deviations from the Project Description were evaluated and approved:

- (1) Instead of monitoring extracted gas methane concentration (PC_{CH_4}) and recording flow on a wet basis consistently, the project measured flow and methane concentration on a wet basis upstream of the gas treatment plant (AMM_{COMP} and AMM_{BOILER}) and on a dry basis (AMM_{GAS}) downstream of the gas treatment plant. This was contrary to the methodology, which prescribed consistent measurement on a wet basis for the parameter (PC_{CH_4}). This deviation is accepted without adjustment for two reasons. First, the temperature of the extracted gas was not significantly high (i.e. greater than 60°C, referencing UNFCCC “Tool to determine project emissions from flaring gases containing methane”), and therefore the difference between measured flow on a wet or dry basis is minimal. Second, the monitored gas flow and concentration for pipeline sales did not serve as a data element in calculating baseline emissions; the abandoned mines produce more methane than the *ex ante* decline curve calculations indicated. In accordance with the methodology, the baseline emission number used for emission reduction calculations was the lower of the measured methane produced by the mines or the validated *ex ante* calculated emissions.
- (2) The project had stated in its Project Description that it monitored extracted mine gas at the standard temperature of 60°F in accordance with natural gas industry practice. This deviation from the methodology was approved by First Environment in their validation report issued in June 2010. NSF-ISR found, however, that the project was only using 60°F as the standard temperature for parameter AMM_{GAS} , which was measured downstream of the gas treatment plant using a sales meter maintained by the interstate pipeline customer for the delivered

gas. For AMM_{COMP} and AMM_{BOILER} , project differential pressure transducers were set to adjust to a standard temperature of 68°F. This resulted in an overstatement of gas flow of approximately 1.5%. In response to a statement of nonconformity issued by NSF-ISR, the project adjusted the upstream gas flow numbers in its Monitoring Report version 1.2 to achieve consistency with the validated standard temperature deviation (see section 2.2.2 above).

4.2 Accuracy of GHG Emission Reduction or Removal Calculations

The project provided project spreadsheets that reproduced all the required equations in the ACM0008 and VMR0002 methodologies. Data were separately reported by vintage (partial 2011 calendar year, full 2012 calendar year). Conversion factors were provided and NSF-ISR traced them to approved sources (e.g. IPCC, the methodologies, or validated deviations).

Measured extracted gas from the abandoned mines exceeded the validated decline curve calculated emissions by approximately 250%. Per Eq. 26 of the VMR0002, baseline emissions used for emission reduction calculations were the lower decline curve calculated values.

NSF-ISR verified the methods used by the project to obtain monitoring information from gas flow meters and from the results of third-party gas composition gas chromatography laboratories, and found the methods to be sound. Gas flow data were logged and downloaded as computer files. Methane concentration numbers were manually transcribed in monthly records and subjected to quality control procedures to ensure accurate results. Instrumentation was calibrated on a scheduled basis and found to maintain a high degree of accuracy between calibrations.

4.3 Quality of Evidence to Determine GHG Emission Reductions or Removals

Project calculations of baseline emissions and emission reductions followed the required equations in ACM0008 and in VMR0002. After correction of the monitoring nonconformities referenced above in section 4.1 of this report, NSF-ISR assessed the reliability of reported information as high. Continuously monitored information (gas flow and methane concentration) met methodological requirements for the accurate calculation of emission reductions.

4.4 Management and Operational System

The project operated by Keyrock Energy LLC maintained in place personnel who had recovered methane at the site since 2002 when Illinois Methane first began extracting abandoned mine methane there. Key operational personnel were retained by DTE Methane when they acquired the project from Illinois Methane and again by Keyrock Energy LLC when it acquired the project from DTE Methane. NSF-ISR assessed the project management system and controls through its two-day on-site visit conducted on 1-2 April 2013 and through telephone interviews the previous week with Keyrock Energy's operations manager and president. In addition, NSF-ISR interviewed the project consultant, Ruby Canyon Engineering, and found the personnel assigned to the project to be knowledgeable and competent.

Keyrock Energy LLC did not have a formalized management system in place for the project that included documented procedures, internal audits and reviews of the management system. NSF-

ISR identified this as a heightened risk and adjusted the site visit duration and extent of checking accordingly. However, NSF-ISR found competent personnel and adherence to nondocumented procedures at every level of the organization. For example, Keyrock Energy operational personnel record daily plant operating valve settings, pressure and temperature readings, and engine operating parameters to define a baseline of normal operation, and to identify out of range characteristics when they occurred.

A control building located at the gas treatment plant contained a programmable logic controller (PLC) and a human-machine interface computer. It also contained Chromalox equipment to control the heater probes in the O₂ removal system. Instrumentation readings were sent to the PLC and monitored by a Wonderware software application. At the wellheads remote operations computers (ROCs) recorded Rosemount differential pressure readings which were downloaded monthly and retained in MDI files. At the plant ABB totalizers were read daily and manually recorded in a Daily Production Report. Field techs downloaded ROC data monthly from the well and compressor station fuel meters and copied into monthly files.

Keyrock Energy maintained a shared computer drive that facilitated the transfer of information from the project site to Keyrock Energy headquarters in Kingsport, Tennessee. There the operations manager created MDI files which were reviewed by the site facility manager. Consultant Ruby Canyon Engineering received data from the operations manager in Kingsport for use in the Monitoring Report.

NSF-ISR was able to reduce the risk presented by the informality of the management system by increased scrutiny of project parameters and sampling of evidence.

5 VERIFICATION CONCLUSION

Based upon the above verification work, performed in accordance with ISO 14064-3:2006 and the requirements of the Verified Carbon Standard, NSF-ISR has concluded with reasonable assurance and without qualification that the CO₂-e emission reductions reported by Keyrock Energy LLC for the Corinth Abandoned Mine Methane Recovery Project for the reporting period 1 May 2011 through 31 December 2012:

1. are, in all material respects, fairly stated;
2. are reported in conformity with the Verified Carbon Standard 3.3; and
3. are reported in conformity with the methodological requirements of the CDM Approved baseline and monitoring methodology ACM0008 "Consolidated methodology for coal bed methane, coal mine methane and ventilation air methane capture and use for power (electrical or motive) and heat and/or destruction through flaring or flameless oxidation," version 6, and Approved VCS Methodology Revision VMR0002, "Revision to ACM0008 to include Methane Capture and Destruction from Abandoned Coal Mines", version 1.0.

NSF-ISR has further concluded that there were no material changes to how the project was carried out compared to the description of the Project in the validated Project Description.

This Project reported emission reductions from two calendar year vintages. The first table below presents the verified emission reductions reported from a partial calendar year 2011. The second

table reports verified emission reductions from the full calendar year 2012.

Reporting period: From 1 May 2011 to 31 December 2011

Verified GHG Emission Reductions	tCO ₂ e, Vintage 2011
Baseline Emissions	119,880
Project Emissions	48,482
Leakage	0
Net GHG emission reductions or removals	71,398

Reporting period: From 1 January 2012 to 31 December 2012

Verified GHG Emission Reductions	tCO ₂ e, Vintage 2012
Baseline Emissions	162,483
Project Emissions	70,040
Leakage	0
Net GHG emission reductions or removals	92,443

ANNEX A – LIST OF FINDINGS

#, Type	Finding/Clarification	Reference	Evidence	Response	Verifier Conclusion
1 NC	The project monitoring report was not updated to the most recent VCS template as required by VCS rules.	VCS Program Guide, v. 3.4, p. 4	Examples of reporting headings that were not included in the monitoring report include: 1.2 Sectoral Scope and Project Type 1.4 Other Entities Involved in the Project 1.5 Project Start Date 1.6 Project Crediting Period 2.1 Implementation Status of the Project Activity 2.2 Deviations from the Monitoring Plan 3.2 Data and Parameters Monitored (use of table is prescribed) 3.3 Description of the Monitoring Plan 5 ADDITIONAL INFORMATION (if applicable)	The monitoring plan has been reissued using the current VCS monitoring report template.	The corrective action is accepted. No further action is required.
2 CR	Please clarify whether DTE Methane Resources LLC and Keyrock Energy LLC have completed the necessary release/accession formalities with the VCS Registry.	VCS Registration and Issuance Process, v. 3.4, 7.5.1 Note.	The VCS project database continues to list DTE Methane Resources LLC as the project proponent.	The VCS has updated project information in their database and on the VCSA registry to show Keyrock Energy, LLC as the current project developer.	The corrective action is accepted. No further action is required.
3 CR	Please clarify how Keyrock Energy will meet the requirement to retain Project documents and records for at least two years after the end	VCS Standard, v. 3.3, para. 3.17.1	The VCS imposes records retention obligations on project proponents.	The Purchase and Sales Agreement, Article II "Assets" Section 2.02 "Assets" paragraph (f) conveys the	The clarification is accepted. No further action is required.

	of the crediting period given the Project's ownership transition from DTE Methane Resources, LLC, to Keyrock Energy, LLC.			records of the project to the buyer as of the closing date of the sale.	
4 CR	Please explain how wells are counted and the number reported (33) is consistent with the information provided on the "Keyrock Acreage, Pipelines, and AMM Wells" map.	KRE Map of Acreage and Wells in IL.PDF	It appears from counting red dots that there are more than 33 wells in the project area connected to the collecting pipelines.	Keyrock Energy provided a new map, showing only wells that are part of the active project.	The clarification is accepted. No further action is required.
5 NC	The values for $AMM_{PJ,i,y}$ were not provided in the Monitoring Report.	VMR0002 , Eq. 26	Parameter $AMM_{PJ,i,y}$ is used as an input to equation 26 of the VMR0002 methodology.	The revised Monitoring Report v. 1.2 has amended Table 2 and Table 3 to show produced CH ₄ , and the resolution of Eq. 26 is now fully explained.	The corrective action is accepted. No further action is required.
6 NC	The Monitoring Report did not include a justification for deviating from the Project Description's statement that concentration of methane sold to the pipeline was measured	Project Description, p. 21, parameter PC_{CH_4} (for gas pipeline	As described in the Project Description, "The amount of Methane sent to NRU is estimated by adding back estimated volume vented at NRU to the gas discharged to pipeline. . . . The flow meter on the discharge to pipeline is a Daniel SR Orifice with a Fischer RTU Computer. Pipeline gas quality readings are a daily average from an on-line Instromet EnCal 200 gas analyzer." This	The revised Monitoring Report v. 1.2 has changed the measurement basis from wet to dry for parameter PC_{CH_4} downstream of the gas treatment plant,	The corrective action is accepted. No further action is required.

	on a wet basis.	sales)	suggests that mass-balance calculations are estimated based on data measured on a dry basis (downstream of the treatment plant) as well as on upstream data.	and justified why normalization of the two different bases is not necessary.	
7 NC	The standard temperature programmed in field and plant flowmeters varied from the standard defined in the Project Description.	Project Description, pp. 19-21	AMM _{COMP} , AMM _{NRU} , and AMM _{BOILER} , were described in the Project Description as having a programmed standard temperature of 60F. However, three sampled model # 3095 Rosemount meters (s/n 0068676, a spare; s/n 68733 in service at OBC M8-6; and s/n 68676 in service at OBC M8-4) showed that the programmed sample T was 68F. The result was an overstatement of flow of approximately 1.5%.	The project has adjusted the reported flows of AMM _{COMP} and AMM _{BOILER} to match the validated standard temperature of 60F.	The corrective action is accepted. No further action is required.