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VCS METHODOLOGY ELEMENT ASSESSMENT REPORT

Interception, Recovery and Use of Methane from CBM Seeps that would otherwise be released to the Atmosphere

REPORT FOR:
SOUTHERN UTE INDIAN TRIBE GROWTH FUND

DNV report number: 2010-9352
Revision 02

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Report No: 2010-9352, rev. 02

VCS METHODOLOGY ELEMENT ASSESSMENT REPORT

Date of first issue: 11 November 2010	Project No.: PRJC-253366-2010-CCS-USA
Approved by: Miguel Rescalvo Regional Manager, North America	Organizational unit: Sustainability and Innovation Climate Change and Environmental Services
Client: Southern Ute Indian Tribe Growth Fund	Client ref.: Michael Huisenga

Name of Methodology: Interception, Recovery and Use of Methane from CBM Seeps that would otherwise be released to the Atmosphere

Version: 9

Assessment Phases:

☒ Desk Review
☒ Follow up interviews
☒ Resolution of outstanding issues

Assessment Status

☐ Corrective Actions Requested
☐ Clarifications Requested
☒ Full Approval by DNV
☐ Rejected

In summary, it is DNV's opinion that the proposed VCS methodology element "Interception, Recovery and Use of Methane from CBM Seeps that would otherwise be released to the Atmosphere" as described in version 6 of 21 September 2010, meets all relevant VCS requirements for VCS methodology elements. DNV thus recommends the methodology element for approval.

Note:

DNV reviewed the version 10 of 23 May 2011 of the proposed VCS methodology element after the methodology element finishes its assessment by the second validator. DNV does not find any major changes of the proposed methodology element, and therefore can confirm that all the conclusions in this report are still valid. DNV thus recommend the methodology element of version 10 of 23 May 2011 for approval.

Report No.: 2010-9352	Subject Group: Environment
Report title: Interception, Recovery and Use of Methane from CBM Seeps that would otherwise be released to the Atmosphere	
Work carried out by: Weidong Yang	
Work verified by:	

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VCS METHODOLOGY ELEMENT ASSESSMENT REPORT

Barbara Toole O'Neil		
Date of this revision: 25 May 2011	Rev. No.: 02	Number of pages: 10

or responsible organisational unit

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Abbreviations

CAR	Corrective action request
CBM	Coal Bed Methane
CDM	Clean development mechanism
CDM EB	CDM Executive Board
CL	Clarification request
DNV	Det Norske Veritas
GWP	Global warming potential
MED	Methodology element documentation
VCS	Voluntary Carbon Standard
VCSA	VCS Association

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1 ASSESSMENT STATEMENT

Det Norske Veritas (U.S.A.), Inc. (DNV) has performed an assessment of the proposed Voluntary Carbon Standard (VCS) methodology element "Interception, Recovery and Use of Methane from CBM Seeps that would otherwise be released to the Atmosphere". The assessment was performed on the basis of VCS criteria for methodology development.

The review of the methodology element documentation and the subsequent follow-up interviews has provided DNV with sufficient evidence to determine the fulfillment of the VCS criteria for methodology development.

The methodology element was prepared based on the requirement of VCS 2007.1 and VCS Program Normative Document: Double Approval Process, v1.0.

The methodology element belongs to the sectoral scope of 08 and 10 (mining/mineral production and fugitive emissions from fuels (solid, oil and gas)).

In summary, it is DNV's opinion that the methodology element "Interception, Recovery and Use of Methane from CBM Seeps that would otherwise be released to the Atmosphere" as described in the methodology element document (MED) of version 6 of 21 September 2010, meets all relevant VCS requirements for VCS methodology element. DNV recommends for approval the methodology element.

2 INTRODUCTION

Southern Ute Indian Tribe Growth Fund has commissioned Det Norske Veritas (U.S.A.), Inc. (DNV) as the first validator to perform an assessment of the methodology element "Interception, Recovery and Use of Methane from CBM Seeps that would otherwise be released to the Atmosphere". This report summarizes the findings of the assessment of the methodology element, performed on the basis of VCS criteria for methodology elements. VCS criteria refer to VCS standard 2007.1 and the subsequent VCS Program Normative Documents /2//3/.

3 METHODOLOGY

The assessment consisted of the following three phases:

- A desk review of the new methodology
- Follow-up interviews
- The resolution of outstanding issues and the issuance of the final assessment report and opinion.

The following sections outline each step in more detail.

3.1 Desk Review of the New Methodology

The following table lists the documentation that was reviewed during the assessment:

/1/ WSP Environment & Energy, Methodology element documentation "Interception, Recovery and Use of Methane from CBM Seeps that would otherwise be released to the Atmosphere", version 2 of 06 August 2010, version 6 of 21 September 2010.

/2/ VCSA, Voluntary Carbon Standard 2007.1, 18 November 2008.

/3/ VCSA, VCS Program Normative Document: Double Approval Process, v1.0, 18 June 2009.

/4/ CDM EB, Combined tool to identify the baseline scenario and demonstrate additionality, version 2.2, EB 28 Report Annex 14.

/5/ CDM EB, 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 version 7.

3.2 Follow-up Interviews

Date	Name	Organization	Topics

/6/	September – October 2010	Michael Huisenga	WSP Environment & Energy	• The methodology element's eligibility criteria; • The baseline approach and additionality; • Project boundary; • Emissions, including leakage; • Monitoring, data and parameters.
/7/	September – October 2010	Eric Christensen	WSP Environment & Energy	
/8/	September – October 2010	Kyle Siesser	Southern Ute Indian Tribe - Growth Fund Department of Energy	

3.3 Resolution of Outstanding Issues

The objective of this phase of the assessment was to resolve any outstanding issues which needed be clarified prior to DNV's conclusion on the methodology element. The assessment findings relate to the methodology element as documented and described in the initial methodology element documentation /1/. In order to ensure transparency the issues raised and the methodology element developer's response are documented in Appendix A.

Findings established during the assessment can refer to a non-fulfillment of VCS criteria or a risk to the fulfillment of methodology element objectives. Corrective action requests (CAR) are issued, where:

- Mistakes have been made with a direct influence on methodology application; or
- VCS specific requirements have not been met; or

A request for clarification (CL) may be used where additional information is needed to fully clarify an issue.

Assessment Table: Resolution of Corrective Action and Clarification Requests		
Draft report clarifications and corrective action requests	***Summary of methodology element developer response***	***Assessment conclusion***
If the conclusions from the draft assessment are either a CAR or a CL, these should be listed in this section.	*The responses given by the methodology element developer during the communications with the assessment team should be summarized in this section.*	*This section should summarize the assessment team's responses and final conclusions.*

Figure 1 Assessment Table

3.4 Internal Quality Control

The assessment report underwent a technical review before the approval of the methodology element assessment by DNV. The technical review was performed by a technical reviewer qualified in accordance with DNV's qualification scheme.

3.5 Assessment Team

			Type of involvement					
Role/Qualification	***Last Name***	***First Name***	Desk review	Interviews	Reporting	Supervision of work	Technical review	Expert input
Project Manager	Stevenson	Sam				√		
VCS validator / methodology expert	Yang	Weidong	√	√	√			
Technical Reviewer / sector expert	Toole O'Neil	Barbara					√	

4 ASSESSMENT FINDINGS

The findings of the assessment are stated in the following sections. The final assessment findings relate to the methodology element as documented and described in the revised methodology element documentation.

4.1 Eligibility Criteria

The eligibility criteria for the methodology element are clearly defined in the MED. DNV was able to confirm that the eligibility criteria were appropriate and adequate

requirements for the project technology, resulting changes due to project activities, existing operation conditions prior to project activities, project industry sector, and project geography are all defined clearly and properly. The eligibility criteria were defined in the document and are summarized below: /1/:

- Project type:
  Projects implemented on coal seams or where exposed coalbed outcroppings exist having documented coalbed methane seeps. The baseline is the partial or total atmospheric release of the methane
- Extraction techniques:
  - The use of gas drainage wells and monitoring wells, serving as gas interception wells, drilled near locations where methane gas seeps are present. Gas interception wells must be located between documented methane gas seeps at coal seam outcroppings and down dip traditional CBM wells. In other words, traditional CBM wells themselves cannot qualify as interception wells.
  - The use of a gas membranes, surface covers or underground horizontal well fields to capture fugitive methane emissions at or just below the ground surface level.
- Destruction:
  - Captured methane is destroyed through flaring; and/or
  - Captured methane is destroyed through utilization on-site to produce electricity, and/or thermal energy; and/or
  - Captured methane is destroyed off-site through utilization by end users following injection into natural gas distribution grids.

This methodology does not apply to the following project activities:

- Methane captured at active traditional CBM extraction wells;
- Methane captured at active, closed or abandoned coal mines;
- Degasification of methane from coal seams prior to coal mining activities.
- Injection of any fluid/gas “down-dip” of the location of methane interception in order to enhance methane capture;
- Removal of water from coal seams where gas interception systems are constructed in order to enhance gas recovery. If suitable and eligible wells which lie on the path from down-dip traditional CBM wells to up-dip exposed outcroppings and having documented methane gas seeps are flooded, they may be dewatered in order to be operated as interception wells.

4.2 Baseline Approach

CDM “Combined tool to identify the baseline scenario and demonstrate additionality” is to be applied for baseline scenario identification. Specific guidance is given for identification of project alternatives. The approach for determining the project baseline is deemed by DNV appropriate and adequate.

4.3 Additionality

The project test option defined in the VCS 2007.1 is to be applied for additionality assessment. The additionality assessment should review all of the three steps in the project test option; CDM "Combined tool to identify the baseline scenario and demonstrate additionality" is required to be used in the assessment of the implementation barrier and common practice, which are respectively the second and third step of the project test option. DNV is of the opinion that the additionality requirement in the MED is appropriate.

4.4 Project Boundary

Project boundary including emission sources and spatial extent is defined properly as described below.

The emission sources for baseline and project activity are properly defined to include all the relevant emission sources as shown below:

- Project emissions: All CO_2 emissions resulting from the combustion of methane in the project activities, all CO_2 emissions from energy consumed in project activities, and fugitive emissions from unburned methane and from gas treatment equipment.
- Baseline emissions: Fugitive methane emissions from coalbed methane seeps, CO_2 emissions from the destruction of methane in the baseline scenario, and CO_2 emissions from the production of heat and power (motive and electrical) that is replaced by the project activity.

Spatial extent includes all equipment installed and used as part of the project activity, power plants connected to the electricity grid, to which the project activity exports power, and combustion of methane by end users connected to natural gas grids into which gas has been injected. The defined spatial extent is proper.

4.5 Emissions Reductions

Baseline emissions

As described in Section 4.4, baseline emissions include the following three parts of emissions:

- Fugitive methane emissions from coalbed methane seeps ($BE_{MR,y}$),
- CO_2 emissions from the destruction of methane in the baseline scenario ($BE_{MD,y}$), and
- CO_2 emissions from the production of heat and power (motive and electrical) that is replaced by the project activity ($BE_{USE,y}$).

For $BE_{MD,y}$, the emission calculations follow the approach taken in CDM methodology ACM0008 /5/. The ACM0008 methodology is accepted by VCSA. DNV can confirm the approach is acceptable.

For $BE_{USE,y}$, the emission calculations also follow the approach taken in the CDM methodology ACM0008 /5/, except the equation for determining the emission factor for gas grid fuel displaced by the project activity is given by the MED. DNV can confirm that the equation is suitable and clarifies the calculation of $BE_{USE,y}$ in this instance.

For $BE_{MR,y}$, the project participant needs to first demonstrate that the CBM gas seeps are present up-dip of where gas interception systems are placed, through submitting documented evidence in either of the following two forms:

- Aerial LIDAR mappings showing the coal outcropping, the location of the proposed gas interception system and ground level methane concentration at the outcropping
- Field surveys of the coal seam outcropping located up-dip of the interception systems using a methane flux chamber to establish ground level methane flux in mol/m^2-day

Then, the following equation is used to calculate $BE_{MR,y}$.

$$BE_{MR} = GWP_{CH4} * \sum_{i} (CM_{PJ,i,y} - CM_{BL,i,y}) \quad (1)$$

Where:

BE_{MR} = Baseline emissions from release of methane into the atmosphere that is avoided by the project activity (t CO_2e)

$CM_{PJ,i,y}$ = Captured methane that is destroyed by use *i* of the project activity in year *y* (tCH_4)

$CM_{BL,i}$ = Captured methane that would have been destroyed by use *i* in the baseline scenario in year *y* (t CH_4)

In ex-post determination of BE_{MR}, the measured captured methane will be used. DNV can confirm that the approach to calculate BE_{MR} is proper as justified below.

- Background information: Fugitive methane emissions generated at down-dip traditional coal bed methane operations are freely flowing gases that migrate from up-dip and are emitted at coal seam outcroppings at the ground surface. The gas captured by interception system is freely flowing up the coal seam, and the effect of applying vacuum pressure to the wellhead will increase the volume of free flowing gas that can be evacuated by each well, thus increasing the methane interception rate and decreasing fugitive emissions at the outcropping.
- Justification: Vacuum pumps do not act to liberate adsorbed methane or drain underground gas reservoirs, but rather act to increase the area of drainage for each interception well. Due to the depth of the inception systems, the gas contents are low; vacuum applied to the inception system needs to be low, otherwise the gas production would be uneconomically low. With low vacuum applied, the gas collected through gas interception

wells should be from migrating methane from down-dip areas where typical "CBM production" wells are continuously desorbing methane through the production of formation water. Thus, all of the methane captured during a given monitoring period can be said to have been emitted at the outcropping in the absence of the project activity during the same monitoring period.

Project emissions

As described in Section 4.4, project emissions include:

- All CO_2 emissions resulting from the combustion of methane in the project activities,
- All CO_2 emissions from energy consumed in project activities, and
- Fugitive emissions from unburned methane and from gas treatment equipment.

All the project emission calculations follow the CDM methodology ACM0008 /5/, based on which the proposed MED is prepared. The CDM methodology is accepted by VCSA. DNV can confirm the project emission calculations are acceptable.

Emission reductions

No leakage is identified in the MED. DNV confirmed this is reasonable. Therefore, the emission reductions are calculated as baseline emissions minus project emissions.

4.6 Monitoring

The activity parameters to be monitored for emission reduction calculations are defined appropriately and listed in the MED clearly, to ensure the emission reductions from the project activity to be estimated properly. Other monitoring requirements, such as measurement procedures, QA/QC procedures, monitoring frequency, and records retention are also properly established in the MED. As described in Section III, the monitoring approaches taken are also same as in ACM0008. DNV can confirm the monitoring requirements in the MED are proper.

4.7 Data and Parameters

Both monitored and not monitored data and parameters used in emissions calculations are defined in the MED clearly and appropriately to make it possible for the emissions reductions to be estimated and verified.

4.8 Data Quality Management

Requirements for data sources and estimations are properly defined in the MED; these requirements will reasonably reduce the uncertainties related to the emission reduction estimates.

4.9 Adherence to the project-level principles of the VCS Program

The MED was developed in line with the project-level principles of VCS 2007.1 as elaborated in the above. It is also deemed by DNV that the principles of relevance, completeness, consistency, accuracy, transparency, and conservativeness are properly addressed in the MED.

4.10 Comments by Stakeholders

DNV reviewed the methodology developer's responses to the received public comments as described in the following, and is of the opinion that the responses appropriately addressed or clarified all the comments.

Comments:

To: Voluntary Carbon Standard Association (secretariat@v-c-s.org)
From: Verdeo Group, Inc.
Date: July 14, 2010
Re: Stakeholder Comments on "Methodology for interception, recovery and use of methane from CBM Seeps that would otherwise be vented to the atmosphere"

Thank you for the opportunity to provide comments on the proposed methodology "Methodology for interception, recovery and use of methane from CBM Seeps that would otherwise be vented to the atmosphere" submitted to the Voluntary Carbon Standard (VCS) Association by Southern Ute Alternative Energy. This proposed methodology will be a valuable addition to the suite of methodologies available for use in the international and U.S. carbon markets under the VCS.
Our comments on and recommendations to this proposed new methodology are directed to the following issues outlined below.

1. Page 1 – Provide more bibliographical information on the tools (e.g., "CDM") so that they may be readily located.
2. Page 2 – Add "monitoring wells" to the definition section so that the use of the term is understood throughout the methodology.
3. Page 3 – Clarify if it is permissible to extract residual water from eligible wells if the process is not intended to enhance methane recovery.
4. Page 3 – Allow emissions from fuel consumption from the transport of fuel to be considered on a case-by-case basis for inclusion in the Project Boundary. These should be excluded for simplification in cases where they are insignificant.
5. Page 5 – Clarify language in the cell "Baseline, Grid electricity generation (electricity provided to grid)", Justification/Explanation.
6. Page 8 – In Figure 2, clarify if methane extracted through "PRODUCING WELL" would be included in the project boundary. Indicate if this is a CBM well (as it extends beyond the ground water level) and whether it is eligible or ineligible. Perhaps provide a visual example of an eligible and ineligible well to provide clarity on what type of extraction well is eligible under the methodology.
7. Page 8 – Provide further guidance on the spatial extent of eligible wells (e.g., distance to

coal outcroppings or other factors that should be used to define eligibility).
8. Page 9 – Clarify the term “annually-averaged baseline emission rate” and application of this value.
9. Page 21 – State that the use of U.S. EPA eGRID carbon emissions factors are acceptable for projects that are developed in the U.S.; eGRID is the primary source of air emissions data for the electric power sector and is used by the EPA, federal government agencies, and states.
10. Global – Confirm the units of density used throughout the methodology (kg/Nm^3)

Thank you for the opportunity to submit these comments in response to the proposed new methodology. For further questions, please contact:

Ben Apple, Director
Verdeo Group, Inc.

Marisa Buchanan, Manager
Verdeo Group, Inc.

WSP’s Responses to the comments:

. A reference to the CDM Executive Board has been added
2. Definition for “monitoring well” has been added
3. Although it is not permissible to use hydraulic lift to remove produced water from a well in order to enhance methane production, it is permissible to dewater eligible wells so that they may be used as interception wells. This has been clarified in the applicability conditions.
4. This has been clarified in the methodology. Emissions from fuel consumption during the transport of captured CBM gas are not included in the project boundary.
5. Clarified
6. Traditional CBM wells, or “producing wells” are not included in the project boundary
7. Clarifying language has been added, but the general intent is to keep the methodology applicable for a range of configurations and not to strictly limit the placement of interception wells.
8. This has been corrected. The metered flow should be extrapolated to an annual equivalent emission rate.
9. Yes, EPA eGRID factors are preferred for US projects. Clarifying language added to parameters section.
10. This has been clarified in the parameters section

APPENDIX A

RESOLUTION OF CORRECTIVE ACTION AND CLARIFICATION REQUESTS

Draft report clarifications and corrective action requests by assessment team	Summary of methodology element developer response	Assessment team conclusion
CAR 1 On page 14 of the proposed methodology element, Eff in the equation (9) should be dividing, instead of multiplying.	This has been corrected.	The MED was revised on this point. The CAR is closed.
CL 1 The versions for CDM methodologies (ACM0008 and AM0009) referenced in the proposed methodology elements (ME) need to be described.	We have added a description of each methodology and an assessment of how they are similar to and differ from the proposed methodology.	The MED was revised on this point. The CL is closed.
CL 2 On page 2 of the ME, there are the following descriptions: "The methodology does not apply to methane captured at CBM extraction operations, but will apply to mitigation projects located between coal seam outcroppings and ***CBM operations***."	We intend to exclude the possibility of developing projects in absence of down dip CBM production, so this criterion is eliminated.	The elimination is reasonable and makes the description clearer. The CL is closed.

Draft report clarifications and corrective action requests by assessment team	Summary of methodology element developer response	Assessment team conclusion
"If active traditional ***CBM wells are not present*** in the down dip direction from where CBM gas seeps are observed, interception wells must be located within 300 meters of the coal seam outcropping." The following need to be clarified: • Whether CBM operation is a requirement for the applicability of the ME. Please provide justification if appropriate. • Please provide justification for selection of the above-mentioned 300 meters.		
CL 3 On page 2 of the ME, two extraction techniques are described – interception wells and gas membranes or surface covers. The description in the ME focuses on the technique "interception wells". Need to describe if all the description applies to the project activity using the technique "membranes or surface covers".	Yes, all descriptions of interception systems throughout the methodology should apply to either vertical interception wells or surface gas collection membranes or to subsurface horizontal gas collection wells. We have attempted to clarify language in the document.	The clarification in the ME is proper. The CL is closed.
CL 4 On page 3 of the PME, there are following descriptions: "This methodology applies to methane capture, utilization and destruction project activities ***at or near*** known locations of methane gas seeps… …"	We have clarified that the utilization and destruction could occur both on-site or off-site. The "project site" is always considered to be the location of the methane interception system, although the "project boundary" may include emissions from off-	The clarification in the ME is proper. The CL is closed.

Draft report clarifications and corrective action requests by assessment team	Summary of methodology element developer response	Assessment team conclusion
"Captured methane is destroyed through utilization by end users following ***injection into natural gas distribution grids***." Please clarify the inconsistency about the project site (one is on-site, another is off-site).	site gas utilization.	
CL 5 On page 3 of the ME, there are the following descriptions: "This methodology applies to methane capture, utilization and destruction project activities at or near known locations of methane gas seeps, where the baseline is the ***partial*** or total atmospheric release of the methane". The emission reduction calculations and parameters monitored or not monitored that are related to the "partial atmospheric release" need to be defined.	The methodology allows for the partial or total release of methane in the baseline scenario. Equation 4, baseline emissions from methane release, has been modified to reflect this.	The reviewed Equation 4 is proper to include situation of partial release. The CL is closed.
CL 6 On page 5 of the ME, there are the following descriptions: **"**Figure 2: Hypothetical project schematic showing a gas interception system consisting of 7 wellheads connected to three compression and metering systems to deliver raw gas to a common pipeline booster compressor station and gas treatment plant shared by an	We have changed 7 wellheads to 9.	The change is correct. The CL is closed.

Draft report clarifications and corrective action requests by assessment team	Summary of methodology element developer response	Assessment team conclusion
existing CBM operation" The above description is not consistent with the Figure 2 provided.		
CL 7 Table 1 on page 6 of the ME needs to be corrected for editorial errors.	This has been corrected.	The correction is proper. The CL is closed.
CL 8 For "Identification of the baseline scenario" (page 7 of the ME), proper procedure, including definition of plausible alternative scenarios, needs to be defined, in order to facilitate the consistent use of the ME.	We direct proponents to the combined tool but have added specific guidance for formulating alternatives to the ME.	The specific guidance is added in the ME. DNV can confirm that the guidance is proper. The CL is closed.
CL 9 On page 8 of the ME, the follow descriptions are not consistent with the equation (1) on the same page (three sources are included in the equation): "Baseline emissions included in this methodology are: • CH_4 from free flowing gas seeps at locations where exposed coal outcroppings exist • CO_2 emissions from the generation of heat and / or power replaced by the project activity using recovered methane"	This has been corrected.	The correction includes all the emission sources. The CL is closed.
CL 10 On page 9 of the ME, there are the	Refer to the explanation in the below "Response to the CL 10".	Vacuum pumps do not act to

Draft report clarifications and corrective action requests by assessment team	Summary of methodology element developer response	Assessment team conclusion
follow descriptions: "***Since vacuum pumps do not act to liberate adsorbed methane or drain underground gas reservoirs,*** but rather act to increase the area of drainage for each interception well, all of the methane captured during a given monitoring period can be said to have been emitted at the outcropping in the absence of the project activity during the same monitoring period." The above description needs to be justified.		liberate adsorbed methane or drain underground gas reservoirs, but rather act to increase the area of drainage for each interception well. Due to the depth of the inception systems, the gas contents are low; vacuum applied to the inception system needs to be low, otherwise the gas production would be uneconomically low. With low vacuum applied, the gas collected through gas interception wells should be from migrating methane from down-dip areas where typical "CBM production" wells are continuously desorbing methane through the production of formation water. Thus, all of the

Draft report clarifications and corrective action requests by assessment team	Summary of methodology element developer response	Assessment team conclusion
		methane captured during a given monitoring period can be said to have been emitted at the outcropping in the absence of the project activity during the same monitoring period.
CL 11 On page 11 of the ME, the equation (4) is not consistent with the following descriptions for the equation, e.g. FM_{IS} does not appear in the equation.	This has been eliminated, erroneous.	The ME is revised to correct the error. The CL is closed.
CL 12 On page 17 of the ME, the determination of Eff in the equation (15) needs to be provided.	ACM0008 uses carbon oxidation factors in the equation for project emissions from methane destruction, and the emissions from un-combusted methane. This methodology refers to the oxidation factors from IPCC's 2006 inventory guidance where common fossil fuel oxidation factors are 98% to 99.5%. In IPCC's 2006 update, oxidation factors have all been assumed at 100%, so consequently we do not have Effi used in the calculation of project emissions or emissions from un-combusted methane in this methodology. PE_{MD} and PE_{UM} have been	The revision is based on the ACM008 and IPCC. The revision can be confirmed proper. The CL is closed.

Draft report clarifications and corrective action requests by assessment team	Summary of methodology element developer response	Assessment team conclusion
	modified accordingly Therefore, the equation for PEum has been corrected and changed to $PE_{UM} = PE_{Flare.}$	

Draft report clarifications and corrective action requests by assessment team	Summary of methodology element developer response	Assessment team conclusion
CL 13 On page 23 of the ME, for parameter "CEF_{ELEC}", the "source of data" is described as "EPA eGRID; National GHG Inventory". This is not consistent with the following description on page 15 and 16. "In other words, if the source of power for the process equipment is the grid, then the formulae from "Tool to calculate the emission factor for an electricity system" for calculating the combined margin emissions factor are used." This needs to be clarified and proper references provided.	This has been corrected.	The correction makes the ME consistent. The CL is closed.
CL 14 All the parameters under the Section "Data and parameters monitored", whose "Monitoring frequency" were defined as "Ex ante", should be put under the Section "Data and parameters not monitored".	This has been restructured.	The correction makes the ME to be easily applied. The CL is closed.
CL 15 On page 25 of the ME, the monitoring frequency for parameter CEF_{NMHC} is defined as "continuously". This needs to be clarified, considering the same is defined as "yearly" in ACM0008.	This has been changed to annually.	The change is proper for the measured parameter. The CL is closed.
CL 16 For parameters "captured methane delivered" to different	We have added that flow meters record gas volumes, temperature and pressure and that flows are converted to mass using the	The correction makes the measurement more specific.

Draft report clarifications and corrective action requests by assessment team	Summary of methodology element developer response	Assessment team conclusion
destruction/utilization facilities (page 25 and 26 of the ME), the "data unit" and "monitoring frequency" are respectively defined as "t CH_4" and "continuously". As the concentration of captured methane is not 100%, the parameters "captured methane delivered" to different destruction/utilization facilities need to be further defined as flow rate and concentration of captured methane. The corresponding "data unit" and "monitoring frequency" need to be defined accordingly.	density of methane.	The CL is closed.

Response to CL 10

Supporting evidence on claim that vacuum pumps do not cause methane desorption from "up-dip" coals

This memo clarifies and provides supporting evidence to the claim that:

- Methane collected from coal seams at shallow depths or "up-dip" has not been desorbed as a result of the low vacuum pressures applied by the gas interception system used to aggregate and transport methane to treatment plants, but rather are fugitive emissions which result from down dip CBM operations, and;
- Gas interception systems are not able to "produce" methane from the coal seams in which they are drilled and intercept methane from, but can only aggregate and redirect methane flowing across the wells and up the coal seam to the outcroppings.

This argument is formulated using the following key points:

1. Desorption of methane at a typical "CBM production" well is achieved though de-watering of the coal formation and vacuum pumps associated with gas interception systems do not produce formation water;
2. Gas-in-place volumes (scf of adsorbed methane per ton of coal) at "up-dip" locations or shallow depths are low enough that gas "production" from these locations is not technically feasible or economically attractive;

4.10.1.1 Point #1

Typical CBM production requires the de-watering of the coal formation in order to reduce reservoir pressure and subsequently stimulate the desorption of methane from the coal surface (USGS Fact Sheet FS-156-00, 2000). This fundamental principle of CBM production is based on the fact that methane is adsorbed to the surface of the coal through hydrostatic pressure and this pressure must be reduced in order to liberate the methane. Gas interception systems are located in areas where the coal formation is largely unsaturated, formation pressures are low, and significant quantities of methane are not adsorbed to the coal (see "gas-in-place" discussion in Point #2). In areas where formation water does exist, vacuum pumps associated with interception systems do not create a sufficient amount of vacuum to produce the formation water. Therefore, the sustained production observed in gas interception wells must be the result of migrating methane from down-dip areas where typical "CBM production" wells are continuously desorbing methane through the production of formation water. Up-dip coals near the surface are well above the water table and as such, there is no potential to rapidly drop the hydrostatic pressure in the seam through dewatering to produce gas. More likely, these shallow seems lost the bulk of their adsorbed methane millions of years ago during the gradual upheaval of coal seam.

4.10.1.2 Point #2

Shallow coal seams generally store low amounts of methane; they are not methane rich environments. Coal at shallow depths have low values for "gas in place" (SCF of CH4/ton of coal) and as a result are not regarded as feasible locations for typical "CBM production" from a technical or economic perspective. At depths above 246 to 262 feet methane readily escapes from the coal seam, and at depths lower than 656 feet below the surface, gas will be more easily retained (Das, Nikols, Das, & Hucka, 1991). This is why CBM production wells are typically drilled to depths of several thousand feet where gas-in-place values are much higher. Gas interception systems are located at shallow depths near coal seam outcroppings and therefore, do not have access to sufficient volumes of adsorbed methane to justify a "CBM production" well. This supports the claim that methane collected from gas interception systems does not originate from the immediately surrounding strata by desorption but rather originates from down dip production.

Furthermore, even if vacuum pumps associated with gas interception systems did generate sufficient pressure drops to liberate adsorbed methane, they would only be capable of desorbing gas in the immediate vicinity of the well bore due to the relatively low vacuum pressures applied. In other words, if the pumps did liberate methane, the gas production would be uneconomically low due to the low coal gas contents associated with shallow coal seams. Therefore, the main purpose of the vacuum pumps is to create enough pressure to inject the gas into a gathering line for transport to gas treatment plants and is not intended to desorb methane and increase gas production from the gas interception wells.