

Technical Review Session Meeting Minutes

Carbon Capture & Storage GHG Emission Reduction Quantification Methodology

March 18, 2009 Meeting/Teleconference (1:00 PM MST)

| Meeting Attendees: | |
|----------------------------------------------|------------------------------------------|
| Name | Affiliation |
| Jamie Callendar (JC) (Protocol Developer) | Blue Source Canada ULC |
| J.P Jepp (Organizer) (J.P) | Shell Canada Energy / ICO ₂ N |
| Arsheel Hirji (Secretary) (AH) | Blue Source Canada ULC |
| Herb Longworth (HL) | Energy and Resources Conservation Board |
| Robert Mitchell (RM) | Schlumberger Carbon Services |
| Rob Lavoie (RL) | CalPtera Research and Consulting |
| Micah Mah (MM) | CalPtera Research and Consulting |
| David Chadder (DC) | RWDI |
| Russ Lewis (Russ L.) | RWDI |
| Doug Miller (DM) | TransCanada |
| James Beckie (JB) | Husky |
| Mark Bohm (MB) | Suncor Energy Services Inc. |
| Bruce Herdman (BH) | IMC |
| Frank Mourits (FM) | Natural Resources Canada |
| Dr. Ben Rostron (DBR) | The University of Alberta |
| Stephanie Trottier (ST) | Alberta Research Council |
| Dr. Surindar Singh (DSS) | Alberta Energy Research Institute |
| Justin Wheler (JW) | Alberta Environment |
| Robyn Kuhn (RK) | Alberta Environment |
| Amanda Stuparyk (AS) | Climate Change Central |
| Karen Haugen-Kozyra (KHK) | Climate Change Central |

| Meeting Invitees Not in Attendance: | |
|-------------------------------------|-----------------------------------------|
| Name | Affiliation |
| Dr. R. J. Chalaturnyk | University of Alberta |
| Dr. Raphael Idem | University of Regina |
| Dr. Bernhard Mayer | University of Calgary |
| Mondher BenHassine | Natural Resources Canada |
| Nancy Barnes | Energy and Resources Conservation Board |
| Tom Byrnes | Energy and Resources Conservation Board |
| Christeen Finzel | Alberta Environment |

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| Stefan Bachu | Alberta Research Council |
| Steve Smith | Energy & Environment Research Centre |
| Richard Luhning | Enbridge |
| Farid Remtulla | Enhance Energy |
| Kristian Tang | PennWest |
| Carolyn Preston | Petroleum Tech Research Centre |

Meeting Agenda:

1. Introductions and Role Call: Jamie Callendar, Blue Source
2. Introduction to Protocol Approach: J.P. Jepp, Shell Canada Energy
3. Why we are here, Alberta Policy Context : Karen Haugen-Kozyra, Climate Change Central
4. Introduction to Quantification Methodology: Jamie Callendar, Blue Source
5. Review of Quantification Methodology: Jamie Callendar, Blue Source
6. Next Steps: Jamie Callendar, Blue Source

Meeting Minutes:

Introduction to Protocol Approach

JP: The document we are reviewing today was originally intended to be an offset protocol to be submitted to Alberta Environment for consideration under the Alberta Offset System; however, the definitions of regulated entities under the Specified Gas Emitters Regulation may not make it possible to create offsets per se. The GHG emission reductions may be credited as performance credits (e.g. from exceeding GHG reduction targets) or other types of credits depending on the Alberta Government's approach to CCS projects. For this reason, the document is referred to as an emission reduction quantification methodology, rather than an offset quantification protocol. The structure of this document is the same as that of a protocol and the review process will follow the usual format.

The policies that impact or incent CCS projects will be evolving over the coming months through the Carbon Capture and Storage Development Council, and as such, the document is focused on the technical elements of GHG quantification as these elements should remain the same regardless of policies decisions. This document will still be submitted to Alberta Environment in the same manner as if it were an offset quantification protocol; however, the path forward may change depending on relevant policy decisions. Nonetheless, the quantification methodology will require expert review, and today's review session will be an important step in its development.

In the upcoming months, we will also be looking to submit a similar version of this document under the Federal regulatory system as well.

Question - RL: is there a group looking at offsets from CCS (where does the OSQP sit under the Alberta Offset System?)

Comment - JP: some of the definitions in the existing specified regulations are not conducive for defining emission reductions from CCS as an offset. This is mainly a terminology issue, as this document, if it moves forward, could be used by any CCS project proponent to quantify the GHG emission reduction benefits from his/her project, whatever the GHG benefits may be called.

Comment – KHK: regardless of the end result of policy, a quantification methodology is going to be needed.

Comment – RK: AB ENV is currently fleshing out the ideas and will be coordinating with the Ministry of Energy.

Comment – JP: Where the document is going to go after April 1st is still uncertain.

Introduction to Quantification Methodology

JC: The scope of the methodology was intentionally kept quite broad

There are a number of options for the sources of CO₂ that can be captured and the types of reservoirs that can be injected into. This presents some significant challenges in ensuring broad applicability of the methodology.

We are trying to link capture, transport, compression, and injection together in one methodology. A number of project proponents may be involved, but each individual proponent can identify with a specific component of the quantification methodology. There is some redundancy in the protocol to allow each component of the project to be quantified.

The approach is based on the structure of the Specified Gas Emitters Regulation (SGER), which defines broad emission categories, such as: flaring, venting, fuel combustion etc. The use of these broad categories for defining sources, sinks and removals (SSRs) of emissions (rather than specific unit operations) helps to be inclusive for the various combinations of CCS technologies that could be implemented.

Comment - HL: ERCB perspective – it is their understanding that the methodology is geared towards the SGER and not the ERCB regulatory process. It must be made clear that this methodology will not be able to address the ERCB regulatory requirements.

Review of Quantification Methodology

JC: We will start the document review by going through each section. Please flip to Section 1.0

Comment - DSS: The wording in Section 1.0 speaks of abandoned reservoirs, which is limited in scope. It is recommended that it use the term 'depleted reservoirs' as this is a broader term that fits Enhanced Oil Recovery (EOR) projects.

Response – JC: The wording will be changed to 'depleted'.

Comment- BH: Do we need to have the word compression? The word transport should cover the compression. We should footnote all the examples of the project type and facilities.

Comment- DSS: There is currently no definition of “saline formations”

Comment- HL: It would be useful to include acronyms and abbreviations in the definitions section.

Response – JC: These changes are reasonable and will be made.

Question – DSS: Where does ownership lie?

Response – JC: The methodology purposefully remains silent on the issue of ownership as it would be dealt with under commercial agreements above and beyond the scope of this document. This approach is consistent with that used in approved protocols.

Question – JW: – Should we add other non-CO₂ gases to the quantification equations due to potential overlap with acid gas injection projects that could be addressed under this methodology?

Response – JC: We purposefully removed the non-CO₂ GHGs from the sources and sinks of emissions downstream from the capture site, such as transportation and injection. This was a simplification, but we are open to discussion on this point. The protocol currently overlaps with the approved Alberta EOR protocol, but the overlap with the Acid Gas Injection Protocol may not be necessary, unless proponents expect to source CO₂ from sour gas processing plants.

Comment - DSS: Sequestration and storage are two terms which are used interchangeably in the document, as such, one term should be selected.

Comment - JB - Sequestration should be used as it denotes something that is permanently stored.

Response – JC – We will use the term Sequestration throughout

Question – DSS: The wording states that the baseline approach is based on direct measurement. Is this actually the case for CCS projects?

Response – JC: The emissions which are being avoided were quantified using a projection based approach, meaning that the baseline emissions are determined from the amount of CO₂ that is captured and injected underground as measured under the project condition.

Question – BH: How are you quantifying the emissions associated with decreased power output from a power plant that is capturing CO₂?

Response - JC: When you are dealing with a regulated site, the CO₂ which is attributed to the parasitic load is reported under the SGER. We are not accounting for it because the capture site is already reporting it to Alberta Environment, and paying a compliance fee on the incremental emissions.

When you are dealing with an unregulated site (that is not required to report under the SGER), then any incremental fossil fuel consumption due to the CO₂ capture processes will be accounted for under the appropriate SSR. It will be important for the group to review the wording of this under the quantification section when we get there.

Comment - JW: A facility with a cogeneration unit would report its power output differently than a standalone power plant. How have you addressed this issue in the methodology?

Response – JC: Indirect emissions from facilities which are coming from 3rd party combined heat and power facilities are addressed under a specific SSR (P6). Alberta Protocols tend to attribute the emissions from electricity consumption to regulated facilities upstream, therefore, the quantification of these emissions in the project condition are excluded.

Comment - DSS: Page 3 appears to incorrectly reference the SGER facility compliance date

Comment - JW: it is a one-time 12% reduction not 12% per annum

Question - HL: Does it make any difference where compression takes place?

Response – JC: If your compression occurs at a regulated site, it is already taken care of and reported to Alberta Environment.

If it occurs off-site, then you would account for the emissions associated with fossil fuel consumption under the SSR with that label.

Discussion on permanence and the role of the ERCB

Comment – ST: Use Caution – the mandate of the ERCB is health and safety and proper management. As such, the accuracy and rigor of the ERCB directives may differ from that required by the methodology.

Response – JC: For all the above ground components, prescription on monitoring is provided in the methodology, but the below ground component has been left out deliberately as this is expected to be covered by ERCB through existing Directives or future regulations. This was the convention for the acid gas injection and EOR protocols. It is assumed that much of the assessment of permanence is undertaken during the injection well approval process.

We are expecting further guidance on the regulations on belowground measurements.

Response – HL: ERCB role also includes resource conservation. The ERCB currently oversees EOR projects and acid gas injection projects and it will likely oversee CCS projects down the road.

Comment-DSS: Permanence (1000 years) timeline does not fit in with the ERCB timeline. It should be said that the time period is for only 8 years. This is a consistent issue in the methodology that the time horizon is not defined

Response – JC: The methodology is only designed to account for leakage during the project crediting period and the recycling of CO₂ (i.e. in EOR or enhanced gas recovery). It is expected

that government will have to play an active role in regulating the long term liability of carbon sequestration and that any leakage issues would ultimately be resolved through the purchase of offsets from other projects, or through other penalties/ payments to the government.

Comment – RL: The longer term hope is that some of the aspects will be covered by decisions made by the ERCB. The ERCB decision making and review process should be good enough to guarantee permanence.

Response - HL: Current ERCB jurisdiction beyond the life of a project is currently only applicable to abandoned wells and not to entire reservoirs.

Comment – RL: The three directives are not time dependent and time is not addressed under any ERCB directive other than for abandoned wells.

Response – HL: The ERCB is looking at the definition of time and jurisdiction.

Comment - JW: Page 6 – The way project proponents are defined seems to be inconsistent with the way we define the SSRs as controlled, related or affected.

Response – JC: We defined the controlled SSRs as those that occur within the boundaries of the project site (dotted line on the process flow diagram), but you are right that it would make more sense to note that several proponents would be involved in the project and many SSRs would be ‘controlled’, although the entities may be different.

Comment - DSS: It seems the process flow diagram is geared towards oil sands operations and not power plants.

Question - DSS: Where would I have the concept of renewable electricity (biomass)?

Response - JC: If you are capturing biogenic CO₂ from biomass combustion/gasification or ethanol production, then that would be covered under P10f for the unregulated sites only.

Comment - JW: We should include biogenic emission sources under the regulated condition by creating an SSR P8f.

Response - JC: We maybe oversimplified things here, but to be generic we will add that SSR.

Comment – JW: In Table 2.4, there should be a justification for those SSRs which were included and not just the ones which were excluded.

Response - JC: We followed convention in AB protocols, but we can certainly add those justifications.

Comment – DSS: The definitions for CO₂ equivalence could be improved in the quantification section.

Response – JC: In the quantification table, there are Global Warming Potentials (GWP) identified for each of the GHGs. In Table 2.5, the equations are listed separately for each gas and no

summation is shown, so we added the GWP equation to clarify this, however, Alberta Quantification Protocols have typically not been very clear on this matter.

Comment – DSS: CO₂ recycling (there should be some discussion around the time delay between when something is injected and when the molecule is re-injected).

Comment - RL: Breakthrough gas in EOR could be recycled, could be vented, or it could be sold as sales gas.

Response - JC: As it stands the methodology acknowledges recycled CO₂ and downstream emissions from venting or flaring that release CO₂ (i.e. the CO₂ that isn't recycled). The CO₂ contained in produced gas may not be explicitly referenced in the document, but the total quantity of raw gas extracted from producing wells in the injection reservoir is required to be measured. I will look into this to check that the equations are correct.

Response - JC: The time delay could be an issue in that some years would have much lower credits (or negative credits) if the amount of recycled gas is large in that year. However, you would always have one meter for the 'new carbon' coming from the capture process and one meter for the recycled CO₂, so the amount of gas injected accounts for that recycled component so that you wouldn't get negative credits provided that you were recycling the CO₂ and not venting it. You would not get any additional credits for the recycled CO₂ since the metering is separate from the main stream of captured CO₂.

Comment - DC: Why are we accounting for other trace emissions from combustion?

Response - JC: The methodology includes non-CO₂ GHGs from combustion sources following the requirements in the Alberta Offset System. Usually these GHGs are not significant.

Comment - JB: The quantification of venting emissions could be problematic when the meters are not sales meters. Usually the measurement standards are high when a commodity is being transferred, but not as high when measuring process inputs. If the metering is not sufficiently accurate, then you could have discrepancies between inputs and outputs of CO₂.

Response - JC: The good thing is that in most cases, an input for one proponent will be an output for someone else, so that may prevent these discrepancies. We may be able to prescribe a minimum standard for measurement for the volumes of CO₂ so that we prevent discrepancies between inputs and outputs. We probably don't want to prescribe the type of meter, but we may need to specify minimum accuracies and calibration frequencies.

Comment JC: We would like the groups input on the SSR P17 Leakage from Reservoirs. Is this something that is practical to measure if it occurs within the project crediting period? This SSR is a bit of a placeholder in case there is a leakage event.

Comment – RM: you need to be leery about leaks from one formation to another. You may not know what is lost. This is likely not something practical to quantify.

Comment – RL: There is a lot of great information on this issue. There are really four steps, with the first being to detect the leak with pressure monitoring, observation wells, etc. After leakage is detected, then you have to locate the leak. When you find the leakage, then you verify the source and quantify it. In the end you have to fix the leak (i.e. cap a faulty well).

This is likely not something that needs to be quantified as there will eventually be a regulatory system to ensure permanence in the long-run and payments would have to be made on those lost emissions.

Question - JW: For enhanced oil recovery protocol, how is formation CO₂ dealt with?

Response – JC: As long as it's a closed loop then the volume which is not recycled is what you quantify a debit for.

Question - JW: If the CCS project is enabling additional production, does it really matter that it is the actual molecules injected which are making it out, or should any incremental CO₂ released be accounted for?

Response – JC: The approach as it stands, treats formation CO₂ emissions (the naturally occurring CO₂ contained in raw natural gas) as something that would have been emitted in the business as usual scenario. So the % of the CO₂ that is naturally from the formation is deducted from the total quantity of recycled gas using a ratio.

The assessment of the baseline formation CO₂ would be based on a 3 year historic benchmark approach from measurements of the % CO₂ in the produced gas before the CO₂ injection started.

Comment – DSS: An example in the protocol of a power plant would be helpful.

Next Steps:

-A summary of the meeting minutes will be circulated.

-All comments are to be received by Tuesday March 24th end of day.

-All comments received will be documented, summarized and addressed in a summary, which will be circulated to the reviewers.

-Submission of the draft methodology will be by April 1st.