Base Protocol Plan – Acid Gas Injection Base Protocol

PART I: IDENTIFICATION OF THE PROTOCOL DEVELOPER

1.1 Title of Base Protocol

Acid Gas Injection Base Protocol (adapted from the *Quantification Protocol for Acid Gas Injection*, May 2008, Version 1. Alberta Environment; Specified Gas Emitters Regulation)

1.2 Lead Protocol Developer

1.3 Initiating Entity

PART II: BASE PROTOCOL APPLICABILITY AND DEVELOPMENT APPROACH

2.1 Description of the Project Type

Acid gas is produced from the processing of raw natural gas to produce saleable natural gas product. The acid gas stream may contain hydrogen sulphide (H_2S), carbon dioxide (CO_2) and other contaminants. The processing of natural gas — including sulphur removal, incineration and acid-gas injection — is included in Canada's inventory of GHG emissions.[1] This protocol applies specifically to acid gas injection projects and is not applicable to other forms of CO_2 geosequestration.

Potential users of this protocol include any natural gas processing entities that process sour natural gas. Those natural gas processing facilities that initiated AGI or transitioned to AGI from conventional processing prior to January 1, 2000 are not be eligible under this protocol. Credits will only be granted for processing that occurs after January 1, 2008.[2] Only projects that involve the handling of acid gas are eligible under this protocol.

Processing a raw gas stream for the purpose of producing a saleable natural gas product results in an acid gas waste stream by-product. The acid gas stream may contain significant amounts of both hydrogen sulphide (H_2S), carbon dioxide (CO_2) and other contaminants.

In the baseline condition for projects applying this protocol, the acid gas stream would be processed in a sulphur recovery unit or incinerated to destroy any hydrogen sulphide. The most likely baseline scenarios would therefore be the processing of acid gas in one of the following units:

- Liquid Redox Process,
- Multi-Stage Claus Unit, or
- Directly combusted in an incinerator.

Where, in any case, the CO_2 contained in the acid gas stream would be released to the atmosphere from the tail (exit) gas stream of the sulphur recovery and/or incineration process. Under the project condition, the capture and permanent containment of the entire acid gas stream reduces the quantity of CO_2 released to the atmosphere.

Further, the process of compression, transportation, and sequestration of acid gas reduces the quantity of GHG released to the atmosphere as it is less energy intensive than the baseline processes required for safe disposal of the acid gas stream.

Where the waste acid gas stream is injected into an active reservoir (where raw natural gas is actively being withdrawn) there is the opportunity for the CO_2 to be "recycled"; that is, the same CO_2 molecule could be withdrawn with the extracted raw gas, separated and re-injected over and over. This could result in an over estimation of the baseline condition and thus the resulting offset. To be conservative in those cases where CO_2 is captured and injected into an active gas producing reservoir, all of the CO_2 that is contained in raw natural gas extracted from producing wells in the reservoir will be considered recycled and no credit will be claimed.

[1] Section 3.3.2 Oil and Natural Gas (CRF Category 1.B.2) National Inventory Report, 1990-2005: Greenhouse Gas Sources and Sinks in Canada. Environment Canada, April 2007. In addition, the National Inventory Report states, in regard to CO_2 sequestration, that '…current inventory procedures are designed to estimate the net CO_2 emitted to the atmosphere…'

[2] Section III. Registration of Offset Projects. Turning the Corner: Canada's Offset System for Greenhouse Gases.

The offsets resulting from Acid Gas Injection projects implemented in conformance with this protocol should be considered inherently permanent as a result of the project monitoring and robustness of the injection reservoir mandated by the regulator in the permitting phase. This protocol does not intend nor attempt to address the issue of how offset credits are earned or granted.

2.2 Description of any project-specific technology (if applicable)

Sour gas is natural gas that contains hydrogen sulphide (H_2S). Hydrogen sulphide is flammable, has a strong rotten-egg odour, and at higher concentrations is poisonous to humans and animals.

Various means are available to process sour gas, dispose of H_2S and deliver sweet (H_2S-free) natural gas to transmission pipelines and end-use customers.

Physical and chemical processes in the presence of catalysts (such as Multi-Stage Claus or Liquid-Redox), can be employed to remove H_2S and other byproducts from the natural gas. Alternatively, the H_2S in sour gas production can also be combusted in flares or incinerators, where the H_2S is converted into water and sulphur dioxide.

Acid gas injection is the process whereby the H_2S, along with CO_2 and salt water removed from the natural gas, is injected into underground rock formations. This process is known as acid gas injection because H_2S and CO_2 are both gases that can form acids when combined with water. Acid gas injection disposes of H_2S safely, and sequesters CO_2. The gas mixture can be injected into either saltwater aquifers or depleted oil and gas fields. It can also be used to enhance the recovery of oil or natural gas. Acid gas injection may reduce the expense associated with the storage and disposal costs associated with conventional sulphur recovery processes. In Western Canada, about four per cent of the recovered H_2S is injected into underground rock formations.[3]

In acid gas injection processes, sour gas is normally sweetened using an amine solution or solid desiccants such as iron sponges to remove the hydrogen sulphide and carbon dioxide. The sour gas is passed through a processing tower which contains the solid desiccant or amine solution. The effluent gas is virtually free of sulfur compounds, and thus loses its sour gas status. The solid desiccant or amine solution can then be regenerated (the absorbed sulfur is removed), allowing it to be reused to treat more sour gas.[4]

The H_2S and CO_2 captured during the process is then compressed and transported to a suitable injection site via pipeline. Generally, the acid gas is not transported a significant distance prior to injection.

2.3 Greenhouse gases that will be reduced

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)

2.4 Description of how real reductions will be achieved

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[3] Bott, Robert D. Sour Gas Questions and Answers, Second Edition. Canadian Centre for Energy Information. 2006.
[4] http://www.naturalgas.org/naturalgas/processing_ng.asp#sulphur

The baseline condition for projects applying this protocol would require the acid gas stream to be processed in a sulphur recovery unit or incinerated to destroy any hydrogen sulphide. The baseline calculation may be based upon a pre-existing sulphur treatment unit or a theoretical engineering design that takes into account the properties of the acid gas stream. In any case, the CO_2 contained in the acid gas stream would be released to the atmosphere from the exhaust of the sulphur recovery or incineration process.

Under the project condition, the capture and permanent containment of the greenhouse gases (GHG) present in the acid gas stream reduces the quantity of GHG released to the atmosphere. Furthermore, the processes of compression, transportation, and sequestration of acid gas reduce the quantity of GHG released to the atmosphere as together they are less energy intensive than the baseline processes required for safe disposal of the acid gas stream. The offsets resulting from Acid Gas Injection projects implemented in conformance with this protocol should be considered inherently permanent.

Where the acid gas stream is injected into an active reservoir (from which raw natural gas is actively being withdrawn), under certain circumstances, the CO_2 may be “recycled”; that is, the same CO_2 molecule could be withdrawn with the extracted raw gas — separated and re-injected over and over — resulting in an over estimation of the baseline condition and thus the resulting offset. To account for those cases where CO_2 is captured and injected into an active gas producing reservoir, appropriate metering will need to be put into place to measure the proportion of produced gas that is recycled.

The most significant net reduction of the GHGs identified in section 2.3 would be achieved through the capture and permanent containment of the GHGs contained in the acid gas stream. Under the baseline condition, these GHGs would be released to the atmosphere; under the project condition, these GHGs are permanently sequestered deep underground.

The peripheral processes associated with the treatment and/or containment and storage of the acid gas — dehydration, compression, transportation, injection, etc. — may be more or less energy intensive than in the base case, depending on specific project conditions. Generally, the processes related to the containment of the acid gas (including compression, transportation, and sequestration) are less energy intensive than the available baseline processes required for safe disposal of the acid gas stream.

Under certain baseline conditions, exothermic energy from acid-gas treatment systems may be used to supply other processes with heat. The generation of heat through the combustion of fossil fuels may occur in the absence of the exothermic baseline activity. Therefore, it is possible that emissions will actually increase under the project condition, especially in projects with a high volume, high concentration stream of acid gas.

In most cases however, the emissions associated with avoided fossil fuel consumption and peripheral processes are less than the total GHG contained and stored; therefore, net GHG reductions are achieved.

The offsets resulting from acid gas injection projects implemented in conformance with this protocol will be considered inherently permanent as a result of the project monitoring and robustness of the injection reservoir mandated by the regulator in the permitting phase. A project that undertakes this activity does not require a testing period prior to full implementation as acid gas injection activities are highly regulated.

2.5 Base Protocol Flexibility

Flexibility in applying the quantification protocol is provided to project developers in the following ways:

1. Project developers may use alternative monitoring methodologies and/or equipment rather than the methodologies and/or equipment described in this protocol. The developer must justify that the chosen methodology and/or equipment provides equivalent or more conservative data than the specified equipment;

2. Project developers may use an alternative sulphur recovery technology than the Claus and Liquid Redox technologies described in this protocol to quantify the baseline. The use of an alternate technology would be acceptable if a different type of sulphur recovery technology is assessed as the preferred baseline scenario or is already installed and operational at the project site. The developer must justify that the chosen methodology for calculating emissions from the alternate technology is based on engineering designs or one year or more of operational data and provides an equivalent or more conservative estimate of baseline emissions;

3. Site specific emission factors may be substituted for the generic emission factors indicated in this protocol document. The methodology for generation of these emission factors must be sufficiently robust as to ensure reasonable accuracy;

4. Where a significant volume of the raw gas is produced from the same reservoir as the acid gas injection well, an alternate methodology for calculating the volume of recycled gas may be used. The proponent must justify that the chosen methodology provides verifiable data;

5. Projects may be developed where existing Claus units will remain in place. The baseline condition in this case should be redefined to exclude emissions resulting from the operation of the existing Claus unit;

6. The thermal energy credit produced by a Multi-Stage Claus unit may be calculated by relating the sulphur content of the acid gas input stream to the exothermic energy produced in the Claus process;

7. Where the thermal energy credit produced by a Claus unit is relatively small, the related emissions may be excluded as it is conservative to do so. The proponent must justify the decision to exclude these emissions by demonstrating the relative quantity;

8. For existing acid gas injection facilities that do not collect project data pertaining to the percentage of methane contained in the injected acid gas (data that is used in calculations for SS P8 Upset Flaring and SS B6 Incineration), this component of the calculation can be excluded as it is conservative to exclude these emissions. It is expected that new facilities would have the means to account for methane concentrations in the raw gas streams; and

If applicable, the project developer must indicate and justify why flexibility provisions have been used.

2.6 Federal, Provincial/Territorial Legal Requirements & Climate Change Incentives

List of potentially relevant legal requirements:

Federal:

- *Turning the Corner: Regulatory Framework for Industrial Greenhouse Gas Emissions* announced (Note: to date, these stated requirements have yet to be enshrined in legislation).

Provincial/Territorial:

Alberta

- *Climate Change and Emissions Management Act,* R.S.A. 2003, c. C-16.7 & *Specified Gas Emitters Regulation*, Alta. Reg. 139/2007

British Columbia

- *Greenhouse Gas Reduction (Cap and Trade) Act*, S.B.C. 2008, c. 32. Note this Act was given Royal assent on May 29, 2008, but is not yet in force.

Manitoba

- *Climate Change and Emissions Reductions Act*, C.C.S.M. c. C135

Nova Scotia

- *Environmental Goals and Sustainable Prosperity Act,* S.N.S. 2007, c. 7

List of potentially relevant climate change incentives:

Federal:

- Funding is available under the EcoTrust program.

Provincial/Territorial

- On July 8, 2008 the Alberta Government announced a $2-billion fund to advance carbon capture and storage projects through an estimated four or five large demonstration projects.

- New Brunswick launched a $34-million Climate Change Action Fund in October 2007 to support projects to reduce GHG emissions.

Ontario's intention to adopt a low-carbon fuel standard.

2.7 Building on existing protocols or proprietary information

Registered name of protocol:	*Quantification Protocol for Acid Gas Injection*

System for which protocol was developed: Specified Gas Emitters Regulation, Alberta Environment

Date protocol was completed and approved: May 2008, Version 1

Developer of the protocol: Alberta Environment[5]

Explanation of how the existing protocol will be adapted

The *Quantification Protocol for Acid Gas Injection* will be adapted to conform to *Turning the Corner: Regulatory Framework for Industrial Greenhouse Gas Emissions* and other relevant government publications. More specifically, the Geological Sequestration Working Group, facilitated by the Industry Provincial Offset Group (IPOG), will closely inform and participate in the development process, increasing transparency and consistency between protocol types.

Explanation of the nature of the proprietary information and how it might be used in the Base Protocol

The protocol is based upon the publicly available *Quantification Protocol for Acid Gas Injection*, Specified Gas Emitters Regulation, Alberta Environment.

[5] The *Quantification Protocol for Acid Gas Injection* is based upon work performed by ICF Consulting Canada Inc.

PART III: DECLARATION/CONSENT/SIGNATURE

The undersigned acknowledges that the undersigned has read, understood and that the undersigned agrees to abide by all the terms, conditions, instructions, and notices set out in the Guide for Protocol Development.

The undersigned acknowledges that the review of, and comments regarding, this base protocol plan or portions thereof does not ensure that the base protocol plan or portions thereof will be used in an Offset System Quantification Protocol by Canada's Offset System for Greenhouse Gases.

The undersigned is legally authorized to use any and all proprietary (or protected) information found in and submitted with the base protocol plan.

The undersigned is duly authorized to sign this application.

The undersigned declares that the base protocol plan submitted for Canada's Offset System for Greenhouse Gases and the information provided on, with or pursuant to this application is true, accurate and complete.

The undersigned consents to the public disclosure, in any manner including, without limitation, posting on Offset System website, of all the information in the base protocol plan and the information submitted with the base protocol plan.

Signature:

By protocol developer (individual, or an organization's or a corporation's duly authorized representative, date, name, title)

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Name

By: __________________________
(print name)

Title: _________________________

Signature:___________________________

Signed this ____day of _______, 2008