Proposed Legislative Framework for In Situ Coal Development

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Energy Resources Conservation Board

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Energy Resources Conservation Board
640 – 5 Avenue SW
Calgary, Alberta
T2P 3G4

Telephone: 403-297-8311
Fax: 403-297-7040
E-mail: infoservices@ercb.ca
Web site: www.ercb.ca

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Executive Summary

In situ coal gasification (ISCG) and in situ coal liquefaction (ISCL) are two emerging technologies that convert subsurface coal into synthetic gas and synthetic oil, respectively. Alberta is a prime candidate for these technologies because of the quality and quantity of its coal resources.

The ISCG industry has already shown interest in Alberta coals. The ERCB approved an ISCG scheme as an experimental gas scheme under the *Oil and Gas Conservation Act* (*OGCA*) in 2008 and the exploration necessary for a second ISCG scheme in 2009. Although the ERCB has issued approvals, the ERCB's legislative authority and requirements for in situ coal development are not clearly identified.

A multidisciplinary ERCB team was formed in January 2009 to develop a legislative framework for all aspects of in situ coal development, from coal exploration to abandonment and reclamation. This report details recommendations for the proposed legislative framework, which would involve amendments to the *Coal Conservation Act* (*CCA*), the *Coal Conservation Regulations* (*CCR*), the *OGCA*, the *Oil and Gas Conservation Regulations* (*OGCR*), the *Pipeline Act* (*PA*), the *Pipeline Regulations* (*PR*), and the *Security Management Regulations* (*SMR*).

Some of the key recommendations are as follows:

- In situ coal developments would be classified as schemes and approved under the *CCA* and *CCR* since they pertain to the development of coal. The wells, facilities, and pipelines required for an in situ coal scheme would be licensed under the *OGCA* and *OGCR* and the *PA* and *PR*. This approach is similar to the in situ oil sands regulatory model.
- The participant involvement program conducted for an in situ coal scheme would, as a minimum, satisfy the participant involvement requirements under the *Directive 056: Energy Development Applications and Schedules* process and, in accordance with *Directive 065: Resources Applications for Conventional Oil and Gas Reservoirs*, would include notification of offset mineral rights lessees and lessors within 1.6 kilometres of the applied-for scheme boundary.
- An applicant would obtain the coal rights prior to applying for a well licence for an evaluation well.
- An applicant would obtain the coal rights and the petroleum and natural gas rights for the coal and all lithologic units above the targeted coal seam prior to submitting an in situ coal scheme application.
- Abandonment and reclamation security deposits could be collected for in situ coal schemes.

1 Introduction

In January 2009, the ERCB formed a multidisciplinary team to develop a legislative framework to address all aspects of in situ coal gasification (ISCG) and in situ coal liquefaction (ISCL) development, from coal exploration to abandonment and reclamation. This report details the team's recommendations for the legislative framework and explains the basis for the proposed legislative and regulatory changes.

ISCG involves the conversion of coal in its original geological setting into a synthetic gas (syngas) comprising primarily carbon dioxide, methane, hydrogen (H), and carbon monoxide. Central to the ISCG process is the use of well pairs, consisting of an injector to introduce oxygen and water to the coal seam and a producer to flow the resultant syngas to surface for further processing. The gasification reaction is initiated by igniting the coal seam and is controlled by the injection fluids. During the ISCG process, a laterally and vertically expanding cavity forms in the coal seam. Coal char and ash fall from the combusted coal face to form a rubble pile in the cavity, exposing fresh coal to the process. ISCL converts coal in its original geological setting into a synthetic coal liquid by injecting fluids and catalysts into a coal seam, chemically liquefying the coal. The synthetic coal liquid can then be produced through a well and processed.

In 2007, the ERCB received an application for an ISCG project. After a review of the existing ERCB acts and regulations, it was clear that neither the *Coal Conservation Act* (*CCA*) nor the *Oil and Gas Conservation Act* (*OGCA*) had contemplated the recovery of coal through wells. The ERCB decided that the 2007 ISCG application would be handled as an experimental gas scheme under the *OGCA* since the project was based on the subsurface injection of fluids and the production of syngas through wells. At that time, the ERCB recognized the need to clarify how it would manage in situ coal development.

The ERCB expects that the in situ coal industry will continue to show interest in Alberta because of its quantity and type of coal. As a result, it is necessary to ensure that the ERCB has the legislative authority in place to address coal development.

2 Framework Development Process

ISCG legislation and regulatory processes in the United States, Australia, South Africa, Russia, and Europe were examined, but were not found to be useful precedents as the legislation was limited in scope and the regulatory processes were significantly different from that of Alberta. Instead, existing ERCB legislation was reviewed to determine how it could be amended to include in situ coal development.

The proposed legislative framework was developed through the discussion of project phases, including exploration, the application process, drilling, operations, surveillance, enforcement, monitoring, reporting, suspension, and abandonment, and the review of existing ERCB legislation. The recommendations derived from the discussion and review provided the basis for the proposed legislative and regulatory amendments.

Discussions focused on ISCG rather than ISCL because of the technologies' histories. ISCG has been occurring worldwide since the 1930s, and Alberta currently has its first experimental project. ISCL has yet to be demonstrated in any country, however, a demonstration ISCL project has been proposed in Victoria, Australia.

3 Proposed Legislative Framework

The proposed legislative framework was developed from recommendations regarding legislative development, application requirements, participant involvement, wells, geological data collection, experimental schemes, suspension and abandonment, liability management, environmental impacts, inspections, monitoring, and reporting.

3.1 Legislative Development

Presently, ERCB legislation comprises a number of acts, each focused on a specific resource (e.g., oil sands, coal, oil and gas). To be consistent with ERCB legislation, in situ coal developments would be regulated under the *CCA* and the *Coal Conservation Regulations* (*CCR*) as the resource being developed is coal. However, the *CCA* and *CCR* are specific to coal recovery through mining techniques, whereas in situ coal developments use wells for resource recovery and production of gas. It was noted that in situ coal development is similar to in situ oil sands development and thus a similar regulatory model can be used. Using this analogy, in situ coal developments would be regulated as schemes under the *CCA* and *CCR*. The associated components (wells, pipelines, facilities) would be regulated under the *OGCA, Oil and Gas Conservation Regulations* (*OGCR*), *Pipeline Act* (*PA*), and *Pipeline Regulations* (*PR*), and the associated applications would follow the *Directive 056: Energy Development Applications and Schedules* process. This recommended approach adopts existing well, facility, and pipeline legislation for in situ coal schemes and, as a result, relieves the *CCA* and *CCR* of significant amendments.

Alternative regulatory approaches were considered and dismissed. One option considered was regulating in situ coal schemes under the *OGCA* and *OGCR* without involving the *CCA* and *CCR*. For this option, the applicant would have been required to submit a scheme application and well, pipeline, and facility applications, which is consistent with the proposed application process. However, this approach would have required an amendment to the purpose of the *OGCA* to include conservation and development of coal resources, which would duplicate the purpose of the *CCA*. The other alternative approach considered was to issue scheme approvals through the *CCA* and *CCR* without involving the *OGCA, OGCR, PA,* and *PR*. The concern with this approach was that the *OGCA, OGCR, PA, PR*, and well, facility, and pipeline requirements would have to be duplicated in the *CCA* and *CCR* for regulation of in situ coal schemes.

3.2 Application Requirements

An in situ coal scheme application would contain detailed technical information relating to all aspects of the project including well, pipeline, and facility design details, thereby facilitating the routine filing of associated applications under the *Directive 056* process. If the technical information is not available at the time of the scheme application and a unique technical design is being considered, a nonroutine application could be made under *Directive 056* and a technical review conducted, or, alternatively, the application could be audited post-licensing. Unique designs for wells, pipelines, and facilities may be required due to the composition and temperature of the gases and liquids produced from in situ coal schemes.

Although there would be an upfront review of all technical information, including well completion and wellbore integrity information, all submissions relating to *Directive 051: Injection and Disposal Wells—Well Classifications, Completions, Logging, and Testing Requirements* would be sent to the Well Operations Group for final review and approval after an injection well was drilled and completed.

As part of an in situ coal scheme application, the applicant would be required to address the coalbed methane (CBM) potential of the targeted coal seam and demonstrate that this resource would not be sterilized or wasted by in situ coal development. The applicant would also be required to address any impacts to any potential resources above the targeted coal seam.

In order to eliminate conflict between holders of different resource rights within the proposed scheme area, an applicant would be required to obtain the coal rights and the petroleum and natural gas (PNG) rights for the coal and for all lithologic units above the targeted coal seam prior to submitting an in situ coal scheme application. Prior to the submission of an evaluation well application, the applicant would only need to obtain the coal rights.

With the exception of evaluation wells, in situ coal scheme approvals would always precede the granting of any licences through the *Directive 056* process.

In situ coal scheme application requirements would be incorporated into a revised *Directive 061: How to Apply for Government Approval of Coal Projects in Alberta.* In situ coal schemes would be required to comply with all relevant directives, in particular the following:

Directive 007: Volumetric and Infrastructure Requirements

Directive 008: Surface Casing Depth Minimum Requirements

Directive 009: Casing Cementing Minimum Requirements

Directive 010: Minimum Casing Design Requirements

Directive 017: Measurement Requirements for Upstream Oil and Gas Operations

Directive 019: ERCB Compliance Assurance—Enforcement

Directive 020: Well Abandonment Guide

Directive 036: Drilling Blowout Prevention Requirements and Procedures

Directive 038: Noise Control

Directive 051: Injection and Disposal Wells—Well Classifications, Completions, Logging, and Testing Requirements

Directive 055: Storage Requirements for Upstream Petroleum Industry

Directive 056: Energy Development Applications and Schedules

Directive 057: Fencing and Site Access Requirements for Oil and Gas Facilities

Directive 058: Oilfield Waste Management Requirements for the Upstream Petroleum Industry

Directive 059: Well Drilling and Completion Data Filing Requirements

Directive 060: Upstream Petroleum Industry Flaring, Incinerating, and Venting

Directive 067: Applying for Approval to Hold EUB Licences

Directive 068: ERCB Security Deposits

Directive 071: Emergency Preparedness and Response Requirements for the Petroleum Industry

Directive 072: Well Abandonment Notification Requirements

Interim Directive (ID) 2001-03: Sulphur Recovery Guidelines for the Province of Alberta

3.3 Participant Involvement

The participant involvement program conducted for an in situ coal scheme would, as a minimum, satisfy the participant involvement requirements under the *Directive 056* process and include notification of offset mineral rights lessees and lessors within 1.6 kilometres of the applied-for scheme boundary. This notification requirement is consistent with the notification area of contact for all disposal applications, including waste disposal (Class I) and acid gas disposal, and underground gas storage applications under *Directive 065: Resources Applications for Conventional Oil and Gas Reservoirs.* A participant involvement requirement would be included in a revised edition of *Directive 061.* Subject to the nature of the coal and the potential likelihood of the produced gas containing hydrogen sulphide, the applicant may also be required to meet *Directive 071.*

3.4 In Situ Coal Scheme Wells

Wells required for in situ coal schemes would be classified as evaluation, observation, production, or injection wells based on their purpose. All in situ coal scheme wells would be licensed under the *OGCA* and the *OGCR*. These wells would be expected to meet all associated requirements for wells except for the well spacing unit requirements. In situ coal scheme well spacing would be based on the recovery process and coal seam thickness and permeability, and therefore would be addressed in the scheme application.

Due to high operating temperatures involved in thermal processes, all wells would be completed and abandoned with thermal cement. In addition, all previously drilled exploratory coal holes penetrating the coal seam within the proposed scheme boundary would need to be re-abandoned with thermal cement to surface. Thermal completions could result in additional costs to industry, but would reduce the risk of uncontrolled releases during operation of an in situ coal scheme.

Evaluation wells would be used to explore for coal, determine geological constraints for in situ coal development, and evaluate the reserve potential. Existing coal exploration drilling and abandonment requirements in the *CCA* and *CCR* are minimal, requiring ERCB approval only when the hole is deeper than 150 metres. In situ coal evaluation wells would be drilled into and through the coal seam and would need to withstand the pressures and temperatures of the gasification chamber. To distinguish evaluation wells from mining exploratory holes and to meet the *OGCA* requirements and related directives, evaluation wells, like all in situ coal scheme wells, would be required to be licensed under the *OGCA*.

3.5 Geological Data Requirements

Geological data collection requirements under the *OGCR* were considered inadequate for in situ coal schemes. The *OGCR* sampling and logging requirements were designed for conventional oil and gas reservoir characterization and are not suitable for the characterization of coal resources. The existing *CCR* logging requirements are minimal, dated, and designed for coal mine exploration, and therefore would require enhancement and updating and would need to distinguish between coal mine exploration and in situ coal scheme geological data requirements.

The collection of geological information necessary to evaluate the feasibility of an in situ coal scheme application includes appropriate geophysical logging and core and rock chip sampling and testing to allow interpretation of

- geomechanical properties of the coal,
- geomechanical properties of the roof and floor rock,
- coal quality and composition,
- coal quantity and reserves, and
- surrounding strata, aquifers, and other potential energy resources.

Data from evaluation wells would be required to support a scheme approval. Evaluation wells would be drilled deeper than the target coal to allow for data collection for the scheme application. The proposed geophysical logging in evaluation wells would collect data on roof and floor rock composition. Geomechanical testing and measurement of geotechnical strength parameters of the cored roof rock would allow for assessment of the potential for roof rock sloughing into the chamber and subsidence of overlying strata. Production and injection wells are intended to penetrate the coal seam, but not be drilled through the base of the coal seam, and therefore would have different requirements for data collection.

In addition to geophysical logs, every evaluation well must be sampled in accordance with *Directive 061* requirements. One core of the coal seam roof and floor rock from an evaluation well per quarter section would provide sufficient information for the review of scheme applications (in the Plains Region for example) at this time.

Data collection, testing, and submission requirements would be referred to the *OGCR*. As additional information on in situ coal schemes becomes available, geological and engineering data requirements may evolve, and consequently the data collection requirements from evaluation wells would be updated in *Directive 061*.

3.6 Experimental Schemes

Provisions would be made to grant experimental status for in situ coal schemes since this technology is currently being developed in Alberta. This allows for confidentiality of specifically defined test data. The confidentiality period would be flexible to meet the particular needs of each in situ coal scheme. Applying experimental status criteria would be consistent with existing ERCB procedures.

3.7 Suspension and Abandonment

The wells, facilities, and pipelines associated with an in situ coal scheme would be suspended and abandoned in accordance with existing policy and procedures. *Directive 020* is being

revised and will include the requirement that any well associated with an in situ coal scheme must be classified as nonroutine and must receive ERCB approval before any work is started. *Directive 020* applications, similar to *Directive 051* submissions, are submitted to the Well Operations Group prior to abandonment but after drilling.

In situ coal scheme operators would be required to apply for approval to suspend or abandon the scheme. The intent is that broader issues, such as subsidence, fluid containment, and chamber abandonment, would be addressed as part of the scheme abandonment application. At this time, there is limited available information on suspension and abandonment procedures for in situ coal schemes, and therefore regulations and requirements will be developed in the future. General provisions regarding suspension and abandonment have been proposed for the *CCA*, which are consistent with the authorities and requirements regarding suspension and abandonment in the *OGCA*.

3.8 Environment

Alberta Environment (AENV) has amended the *Activities Designation Regulation* (*ADR*) to add a syngas plant as a new activity requiring *Environmental Protection and Enhancement Act* (*EPEA*) approval. The activity captures both underground and aboveground coal gasification, coke gasification and gasification of other types of biomass that were not already covered in the *ADR*. If AENV deemed it appropriate, it could request an environmental impact assessment and an *EPEA* approval for an ISCG development as a result of the *ADR* amendment.

Also, an in situ coal scheme may require approvals under the *Water Act*, administered by AENV, for water use and withdrawal. In some instances, an applicant may propose gasification of a coal seam above the base of groundwater protection, and AENV would need to decide if this is acceptable. While it would be desirable for an applicant to obtain a *Water Act* approval prior to submitting an in situ coal scheme application, the ERCB recognizes that this may not always be possible. At a minimum, the *Water Act* and ERCB in situ coal scheme applications would be submitted concurrently. As well, the applicant would be required to address groundwater protection issues within the ERCB application.

Concerns relating to abandonment of a scheme, such as groundwater contamination and ground subsidence, could be considered under both AENV and ERCB mandates. If in situ coal schemes are incorporated into the existing Liability Management Program or if the ERCB collects security deposits for abandonment and reclamation on a case-by-case basis, then the ERCB would take the lead role respecting abandonment of these schemes.

Since ISCG and ISCL are new technologies and both the ERCB and AENV are developing their regulatory processes for these technologies, it is important that they continue to work together to ensure a coordinated and consistent government approach.

3.9 Inspections

Field inspections would be conducted in accordance with existing policy and procedures established by the ERCB Field Surveillance and Operations Branch. If necessary, field inspection frequency could be altered to address specific issues with respect to in situ coal schemes.

3.10 Monitoring

Monitoring requirements would be determined on an individual project basis, but at a minimum would include monitoring of

- air and water,
- ground elevation to detect possible subsidence issues, and
- chamber location, size, and rate of growth.

3.11 Reporting

All in situ coal scheme well information and associated geological data collected would be submitted to the ERCB in accordance with the proposed *OGCR* and *Directive 061* amendments.

In situ coal schemes would be expected to measure production and injection volumes in accordance with the *OGCR* and to report volumes to the Petroleum Registry of Alberta in accordance with *Directive 007: Electronic Submission of Production, Disposition, and Transportation Volumetric Information and Well Status Changes*.

In situ coal scheme operators would be required to submit an annual report. The report would include information such as

- description of activities and operational issues for the past year,
- location and size of gasification chamber,
- changes to the operations,
- coal consumed,
- fluids injected and produced,
- overall energy efficiency,
- groundwater monitoring,
- ground elevation monitoring, and
- compiled observation well information.

Recommendations for regulations on reporting are limited. Instead, reporting requirements would be addressed through conditions on the scheme approval. Once these schemes are better understood, general requirements could be added to the existing regulations.

3.12 Conclusion

The proposed amendments to the *CCA*, *CCR*, *OGCA*, *OGCR*, *PA*, and *PR* would be consistent with existing ERCB authority and requirements. Changes proposed include new and amended definitions, extending the application and purposes of the *CCA* to include in situ coal development, and adding legislative authority to the ERCB to permit appropriate regulation of in situ coal development and allow further refining of requirements as experience with in situ coal technologies in Alberta continues.