

## ACTION PLAN FOR AER DECISION 2012-008

### SHELL CANADA LIMITED

#### APPLICATION FOR THE QUEST CARBON CAPTURE AND STORAGE PROJECT, RADWAY

ACTION ITEM	REQUIRED ACTION/COMMENTS	DECISION: 2012-008	AER PROCESS TO ENSURE FOLLOW-UP	STATUS & EVIDENCE
1 MBHIP	The Board therefore approves a MBHIP of 30 MPa for the BCS in the 8-19 injection well.	Section: Paragraph 210 P. 29	Place on Approval No. 11837, Table 1, Resource Compliance Audit	Completed - August 24, 2012
2 Mercaptans	[T]he Board requires Shell to submit, before building the pipeline, additional detailed information on the technical, operational, cost, and public safety considerations of adding mercaptans. The Board could at that time determine that Shell be required to add mercaptans to the CO <sub>2</sub> .	Section: Paragraph 241 P. 34	ERCB will review and determine if the additional information is adequate. Information is due by January 31, 2013.	Ongoing - Report received February 7, 2013.  Review completed December 2, 2013 with ongoing review requirement as described in December 3, 2013 letter to Shell, Carbon Dioxide Disposal and Containment Approval No. 11837A (clause 11b), and ERCB Decision 2012-008, (paragraph 241). Next follow-up due on December 2, 2018.
3 Pre-baseline MMV Plan	[T]he Board requires that Shell submit a complete pre-baseline MMV plan by October 15, 2012.	Section: Paragraph 332 P. 46	ERCB will review the plan for acceptability. Plan is now due November 2, 2012.	Ongoing - Plan received on November 2, 2012.  Review completed and conditionally approved December 3, 2013 with January 31, 2014 deadline for updated MMV plan.  Updated MMV plan received February 14, 2014, January 31, 2015, and on February 23, 2017.
4 Annual Report	The Board requires Shell to submit an annual report of operational performance, MMV results, associated analyses that describe how the operational performance of the scheme conforms with the modelling and predictions, and discussion of the need for further MMV changes.	Section: Paragraph 333 P. 46	The ERCB will review this report and based on that review, additional monitoring and/or modelling studies could be required. First annual report due January 31, 2013.	Ongoing - Annual reports were submitted by Shell to the AER by the deadline: - January 7, 2013 - January 31, 2014 - January 30, 2015 - March 30, 2016  5th annual report was submitted by Shell to the AER on March 31, 2017.  Subsequent annual reports due March 31, 2018 to March 31, 2040.

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5 MMV Plan Updates	Shell must submit MMV plan updates as required by the ERCB; at a minimum Shell must submit updates at critical milestones such as commencement of injection, closure, and post closure.	Section: Paragraph 334 P. 47	Shell will submit the required information to ResourceCompliance@ercb.ca. The ERCB will review the plan updates for acceptability.	<p>Ongoing - First MMV plan received November 2, 2012 and conditionally approved December 2, 2013.</p> <p>Commencement of injection MMV plan received by the AER on January 31, 2015 and approved on March 20, 2015.</p> <p>Approval holder is required to submit MMV plan updates as required by AER, at minimum at critical milestones: commencement of injection, closure, and post closure.</p> <p>On March 11, 2016 approval holder proposed changes to current MMV plan and MMV plan update during 2016 that were approved by the AER.</p> <p>Updated MMV plan received by the AER on:</p> <ul style="list-style-type: none"> <li>- February 14, 2014</li> <li>- January 31, 2015</li> <li>- February 23, 2017</li> </ul>
6 Deep Monitoring Wells	[T]he Board requires Shell to evaluate the need for adding a Winnipegosis formation deep monitoring well at either the 15-16 or 15-29 location. The Board requires Shell to include its analysis in the report to be provided by October 15, 2012.	Section: Paragraph 339 P. 47	Based on the information provided the Board might require Shell to drill one or more such deep monitoring wells. Plan is now due November 2, 2012.	<p>Ongoing - Special Report #1 analysis submitted by Shell to the AER on November 2, 2012.</p> <p>AER follow-up requirement to update the plan was completed by Shell with the submission of updated MMV plan to the AER on February 14, 2014.</p> <p>This is an ongoing review requirement.</p>
7 Additional Deep Monitoring Wells	[T]he Board requires Shell, in its annual reporting, to evaluate the need for additional deep monitoring wells adjacent to the four legacy wells in the AOI.	Section: Paragraph 340 P. 47	Based on the information provided the Board may require Shell to drill one or more such deep monitoring wells. First annual report due January 31, 2013.	<p>Ongoing - Addressed in February 7, 2013, January 31, 2014, January 31, 2015, and March 31, 2017 annual reports.</p> <p>Ongoing review requirement.</p>

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8 Hydraulic Isolation Logging	<p>The Board therefore requires that hydraulic isolation logging be conducted after two years of injection, and that the need for further hydraulic isolation logging over the life of the well will be determined through the annual reporting process.</p> <p>The need for further hydraulic isolation logging is included in the Jan 31, 2015 updated MMV plan. Approved injection wells:  For 02/05-35-059-21W4/0 well - within 3 months of start of injection, then annually for 2 years, then as required.  For 03/07-11-059-20W4/0 and 00/08-19-059-20W4/0 wells - within 6 months of start of injection, then annually for 2 years, then as required.</p>	Section: Paragraph 342 P. 48	The ERCB will review the annual report for acceptability.	<p>Ongoing - As described in January 31, 2015 updated MMV plan (pre-injection plan).</p> <p>Request for extension of logging submission deadlines in 03/07-11-059-20W4/0 and 00/08-19-059-20W4/0 wells approved March 11, 2016. Deadline for logging submission for 03/7-11 well is May 23, 2016 and for 00/08-19 well is May 24, 2016.</p> <p>Shell has completed isolation logging. Future logging information will be included in annual reports.</p> <p>Ongoing review required based on performance.</p>
9 Fracturing	[T]he Board requires Shell to immediately report any anomalies that indicate fracturing out-of-zone.	Section: Paragraph 343 P. 48	<p>The Approval Holder must provide a written incident report within 90 days to ResourceCompliance@ercb.ca and WellOperations@ercb.ca for an event that raises any immediate risk to public safety or environment including</p> <ul style="list-style-type: none"> <li>a) any anomalies that indicate fracturing out of zone,</li> <li>b) any indications of loss of containment,</li> <li>c) unexpected surface heave, and</li> <li>d) appropriate mitigative measures taken.</li> </ul> <p>If monitoring shows loss of containment or unexpected surface heave the approval holder is required to conduct and submit results of more comprehensive project modeling using site specific parameters to re-evaluate the issue of deformations caused by pressure changes.</p>	Pending -

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10 Core Testing	Regarding geomechanical testing of the MCS, the Board understands the difficulty sampling, preserving, and testing shale. The Board acknowledges that the core testing has not been completed, and that Shell is required to submit the final results to the ERCB.	Section: Paragraph 345 P. 48	ERCB will review the core testing report. Placed on Approval No. 11837. Plan is now due November 2, 2012.  As per MMV plan, on annual basis and in the event of monitoring showing loss of containment or unexpected surface heave, the approval holder must address the feasibility and need of additional geo mechanical testing of remaining preserved MES core.	Ongoing - To be reviewed in annual report and all MMV plan updates. MMV plan and report received November 2, 2012.  Included in February 14, 2014 and January 31, 2015 updated MMV plan.
11 Loss of Containment	Immediately report evidence of loss of containment.	Section: Paragraph 346 P. 48	See Approval No. 11837. Report immediately to WellOperations@ercb.ca, ResourceCompliance@ercb.ca, and Bonnyville.fieldcentre@ercb.ca	Pending -
12 Site-specific Project Modelling	[I]f monitoring shows loss of containment or unexpected surface heave, Shell is required to conduct, and submit the results of, more comprehensive project modelling using site-specific parameters to re-evaluate the issue of deformations caused by pressure changes.	Section: Paragraph 346 P. 48	Submit results to ResourceCompliance@ercb.ca and WellOperations@ercb.ca. The ERCB will review the report.	Pending -
13 Microseismic Arrays	The Board agrees with the need to install a microseismic array in the deep monitoring well to be located on the 8-19 well pad to identify potential formation fracturing. Recognizing the size of the injection area, the Board believes that microseismic arrays might be needed at other injection well pads. Therefore, the Board requires Shell to also address this issue in the October 15, 2012 report.	Section: Paragraph 347 P. 48	Plan is now due November 2, 2012. Based on the report, the Board could require Shell to install more microseismic arrays.	Ongoing - Addressed by Shell in October 15, 2012 Special Report #1 and proposed MMV plan.  Included in February 14, 2014, January 31, 2015, and February 23, 2017 updated MMV plans as a contingency requirement.  Ongoing as contingency in MMV plans.
14 The Need to Rerun Models	[T]he Board requires that after each injection well is drilled and the data collected Shell address the need to rerun CO2 plume and pressure front models in its annual reporting.	Section: Paragraph 350 P. 49	Shell will submit an annual report for review and acceptance by the ERCB.	Ongoing - 1st, 2nd and 3rd annual reports received and models updated.  Ongoing requirement.

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15 Additional Fall-off Test	Following an initial baseline pressure analysis of the fall-off data from the 8-19 well, the Board requires an additional fall-off test with pressure-gradient analysis, after two years of injection in all injection wells, for comparison with the baseline data.	Section: Paragraph 351 P. 49	These data will provide stabilized shut-in reservoir pressures and information on any indication of fracture flow. Based on the results of each fall-off test the Board may require Shell to conduct further fall-off tests in order to better understand plume movement.	Ongoing - Annual reports received February 7, 2013 and January 31, 2014.  Updated MMV plans received February 14, 2014, January 31, 2015, February 23, 2017, and included these requirements as part of the plan.
16 InSAR Corner Reflectors	[T]he Board requires Shell to include the preliminary InSAR results showing the distribution of likely natural targets in the October 15, 2012 reporting. If corner reflectors are deemed necessary by the ERCB after reviewing the updated MMV plan, they must be installed near each injection site at least 15 months before injection.	Section: Paragraph 353 P. 49	See Approval No. 11837. Plan is now due November 2, 2012. The ERCB will review the results, and based on the report will make a decision on the need for InSAR corner reflectors.	Ongoing - Report received January 31, 2013.  Review completed October 4, 2013 with ongoing review requirements, which were included in February 14, 2014 updated MMV plan as a contingency item.
17 InSAR Baseline Data	The Board requires that Shell provide a preliminary report two years before commencing injection, on the InSAR baseline data, that addresses the suitability of the data for the pressure front and geomechanical modelling and analysis recommended in its MMV plan.	Section: Paragraph 354 P. 50	See Approval No. 11837. Report is due by January 31, 2013.	Ongoing - Report received January 31, 2013.  Review completed October 4, 2013 with ongoing review requirements, which were included in February 14, 2014, January 31, 2015, and February 23, 2017 updated MMV plans.
18 InSAR Program Efficacy	The Board also requires some early indication of the efficacy of the InSAR program and directs that Shell provide a report to the ERCB six months after injection begins.	Section: Paragraph 354 P. 50	See Approval No. 11837 (Clause 16). Report is due by July 31, 2015.	Pending - Due date extended to July 31, 2016 as per letter dated May 27, 2015, due to delay in commencement of injection.  Due date further extended to March 31, 2017 as per AER email dated February 8, 2016. The report was received by the AER on March 31, 2017.
19 Participation in Water Well Program	The Board therefore finds that additional water well owners should be given the opportunity to participate in the landowner water well portion of the MMV program at any time, and requires Shell to include such wells in the MMV plan and associated reports.	Section: Paragraph 357 P. 50	Placed in Approval No. 11837. The ERCB will review the MMV plan and determine if additional information is required. Plan is now due November 2, 2012.	Ongoing - MMV plan received November 2, 2012.  Review completed October 4, 2013 with ongoing review requirements, which were included in February 14, 2014, January 31, 2015, and February 23, 2017 updated MMV plans.

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20 Water Well Monitoring Program	The Board notes that Shell's water well monitoring program is based on wells within a 3.2 km radius around each injection well. The Board requires clarification of the process through which Shell determined the statistical significance of the number of wells. This information must be included in the October 15, 2012 report.	Section: Paragraph 358 P. 50	The ERCB will review and determine if additional information is required. Plan is now due November 2, 2012.	Ongoing - Plan and additional information received November 2, 2012.  Review completed December 3, 2013 with ongoing review requirements, which were included in February 14, 2014, January 31, 2015, and February 23, 2017 updated MMV plans.
21 Phased Assessment of Natural Variability	The Board therefore requires Shell to address a phased assessment of natural variability in its October 15, 2012, pre-baseline reporting of the MMV plan, including the need for more frequent sampling during both the baseline data collection and early operational monitoring periods.	Section: Paragraph 360 P. 50	The ERCB will review and determine if additional information is required. Plan is now due November 2, 2012.	Ongoing - MMV Plan and additional information received November 2, 2012.  Review completed December 3, 2013 with ongoing review requirements, which were included in February 14, 2014 and January 31, 2015 updated MMV plans.
22 Additional Monitoring Wells	[T]he Board believes there might be value in installing additional monitoring wells in the Winnipegosis and BCS toward the periphery of the pressure build-up zone in the BCS later in the project life. The Board therefore requires Shell to address this potential need for additional monitoring wells in its annual reports and presentations.	Section: Paragraph 361 P. 51	The ERCB will review and determine if additional information is required. First annual report due January 31, 2013.	Ongoing - Report received February 7, 2013.  Covered in February 14, 2014 and January 31, 2015 updated MMV plans as contingency.  Ongoing review requirement.
23 Surface Leak Monitoring	The Board agrees that the use of satellite or air-borne spectral image analysis is an appropriate method of detecting changes in vegetation health over an area the size of the AOI. The Board notes that Shell is currently testing and evaluating other measurement and monitoring technologies and that some of those technologies would become part of the updated MMV plan to be submitted to the ERCB before the start of baseline monitoring.	Section: Paragraph 362 P. 51	The ERCB will review and determine if additional information is required. Plan is now due November 2, 2012.	Ongoing - Plan received November 2, 2012.  Review completed December 3, 2013 with ongoing review requirements, which were included in February 14, 2014 updated MMV plan.  Review requirement completed and reported in January 31, 2015 third annual report.

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24 Tracer Feasibility Study	The Board notes the importance of Shell's tracer feasibility study and requires Shell to complete and submit the results of its study one year before injection starts. If a tracer is deemed not technically feasible, Shell is required to provide a discussion of the baseline data and the methods by which anthropogenic CO2 will be distinguished from naturally occurring CO2. For this purpose, the Board recognizes the need for baseline data and requires Shell to take and analyze measurements of biogenic flux of CO2 in different soil types throughout the AOI, and to report on the results before injection begins.	Section: Paragraph 363 P. 51	The ERCB will review and determine if additional information is required.	Completed - Study received on June 16, 2014 and accepted March 23, 2015. Results included in January 31, 2015 MMV plan.  Ongoing: need for monitoring during closure period to be determined based on outcome of monitoring during injection period.

*The conditions imposed in approvals/licence(s) are monitored by the Alberta Energy Regulator (AER). The AER has developed a process whereby an action plan is developed internally to ensure that AER staff monitor conditions arising from decision reports for compliance. The conditions are managed in an action plan that is updated quarterly with statuses of conditions. The action plan defines the action required, timeframes for completion, and a summary of the evidence provided to confirm a condition was met. For more information, please contact the Action Plan Administrator at (403) 297-4289.*