

December 22, 2017

7750-2800/2850-32640-02

Mr. David B. Holt, P. Eng
Vice-President, Production, West
Canadian Natural Resources Ltd.
2100, 855 – 2nd Street S.W.
Calgary, AB T2P 4J8

Dear Mr. Holt:

**RE: PRODUCED WATER DISPOSAL WELLS
CNRL SEPTIMUS A7-5-82-19; WA# 22061
CNRL HZ SEPTUMUS B2-8-82-19; WA# 24196
SEPTIMUS FIELD - CADOMIN AND NIKANASSIN FORMATIONS**

The Commission has reviewed the proposal from Canadian Natural Resources Limited (CNRL), letter dated December 14, 2017, regarding operation of the subject disposal wells. CNRL also met with OGC technical staff on December 19 and presented additional information regarding the interpretation of seismic events noted in this area.

Disposal operation of the subject wells has been coincident with a number of seismic events of varying magnitude and frequency. Induced seismicity (IS) has the potential of surface expression and affect wellbore integrity. Thrust faulting and casing deformation have been observed at this location. The varying hypocenters of IS events associated with sustained disposal fluid injection may indicate migration paths for fluids.

The Commission and CNRL have communicated on numerous dates regarding observation of these wells, supported by data from monitoring seismic arrays. The Commission has expressed concerns regarding the viability of continued disposal operation of these wells. Oil and Gas Activities Act section 75 Order 13-02-004 Amendment #1 (WA 22061) and Order 12-02-020 Amendment #1 (WA 24196) both contain a condition to cease injection if hydraulic isolation is lost in the wellbore or formation.

Regarding the action plan outlined in the December 14th correspondence, the following responses correspond in numbering sequence to the items;

1. The Commission is in agreement as to the requirement to reduce the maximum wellhead injection pressure stipulated in Order 12-02-020, from a value of 15,745 kPag to 10,000 kPag. This is supported by petrophysical data of the potential for fault failure. The Commission is of the understanding that CNRL has enacted this limit beginning December 13, 2017. Attached is Order 12-02-020 Amendment #2, modifying this value.
2. The Commission is not in agreement regarding the requested increase in wellhead injection pressure for the well A7-5. The trend of recent IS events, and reservoir pressure relationship to cumulative disposal volume, may indicate potential for fluid migration out of the approved formations should pressure increase. Limiting additional disposal and corresponding reservoir pressure increase by maintaining the current wellhead pressure value address this for the near term.
3. OGAA Section 75 Order 17-02-10, dated December 7, 2017, for the disposal operation of well CNRL Septimus 15-34-81-19 (WA 19411), will provide alternative disposal capacity.

4. The proposal to drill and operate a new disposal well in the Cadomin formation at location H5-23-81-19, subject to OGC approval, is anticipated to provide significant disposal capacity. However, the scheduled date of October 12th, 2018, to allow the cessation of disposal operation of wells A7-5 and B2-8 on that date, is not acceptable to the Commission. This is addressed the following portion of this letter.
5. The Commission concurs that additional disposal capacity development would be beneficial for continued operation, and cautions on reliance on a single well.

The Commission is cognizant of the requirement for disposal capacity to support continued responsible development of the Montney resource. However, due to the demonstrated potential for continued disposal to trigger additional events, potential for associated loss of wellbore integrity and fluid containment, the Commission hereby intends to terminate Order 13-02-004 Amendment #1 and Order 12-02-020 Amendment #1 effective April 1, 2018. Mitigation measures prior to this date may be required should there be a rise in related seismic activity or other information that does not support continued operation.

Should you have any questions, please contact the undersigned at (250) 419-4430.

Sincerely,



Ron Stefik, Eng. L.
Supervisor, Reservoir Engineering
Oil and Gas Commission

Attachment



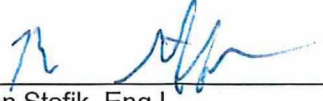
ORDER 12-02-020 Amendment #2

- 1 Under Section 75(1)(d) of the *Oil and Gas Activities Act*, the Commission designates the operation and use of a storage reservoir for the disposal of produced water, into the Cadomin formation – in the Septimus field as a special project in the following area:

DLS Twp 82 Rge 19 W6M Section 8 - Lsds 1, 2, 7 and 8.

- 2 Under section 75(2) of the *Oil and Gas Activities Act*, the special project designation in this Order is subject to the following conditions. The Permit Holder shall:

- a) Inject produced water only into the well CNRL Hz Septimus B2-8-82-19 W6M; WA# 24196 – Cadomin formation (disposal perforations 1057.5 – 1073.5 mKB MD).
- b) Not exceed an injection pressure, measured at the wellhead on the subject well, of 10,000 kPag or the pressure required to fracture the formation, whichever is lesser.
- c) Inject only through tubing with a packer set as near as is practical above the injection interval.
- d) Continually measure and record the wellhead casing and tubing pressures electronically.
- e) Cease injection and notify the Commission immediately if hydraulic isolation is lost in the wellbore or formation.
- f) Submit the annual packer isolation test report to the Commission within 30 days of the completion of the test.
- g) Include the disposal operating hours and the maximum injection pressure value on the monthly BC-S18 disposal statement.
- h) Conduct an annual reservoir pressure test on the formation in the subject well, with a shut-in period of sufficient length to provide data for calculation of the reservoir pressure, and submit a report of the test within 60 days of the end of the test.
- i) Cease injection upon reaching a maximum formation pressure of 11,365 kPaa, measured at 1065.5 mKB TVD.
- j) Maintain and manage the well head to prevent surface liquids from entering the well bore through the annulus outside or between casing strings.
- k) i) Perform a casing inspection log on the subject well and submit results to the Commission within 30 days of the completion of logging, at an interval of not more than every 10 years, commencing from the date of initial disposal.
ii) Perform a hydraulic isolation temperature log on the subject well and submit results to the Commission within 30 days of the completion of logging, at an interval of not more than every 5 years, commencing from the date of initial disposal.
- l) Not conduct a hydraulic fracture stimulation on any formation in the subject well without prior Commission approval.



Ron Stefik, Eng.L.
Supervisor, Reservoir Engineering
Oil and Gas Commission

DATED AT the City of Victoria, in the Province of British Columbia, this ^{22nd} day of December, 2017.

Advisory Guidance for Order 12-02-020 Amendment #2

- I. A production packer must be set above the injection interval and the space between the tubing and casing filled with corrosion and frost inhibiting fluids, as per section 16(2) of the Drilling and Production Regulation.
- II. Annual packer isolation tests are required to be submitted, as per section 16(3) of the Drilling and Production Regulation.
- III. Injected fluids must be metered and the injection pressure measured at the wellhead, as per section 74 of the Drilling and Production Regulation.
- IV. A monthly disposal statement must be submitted to the Commission not later than the 25th day of the month following the reported month, as per section 75 of the Drilling and Production Regulation.
- V. Seismic events must be reported and disposal operations suspended as per section 21.1 of the Drilling and Production Regulation.