



October 2, 2017

5500-6200-32640-02

Stephen Penner
Exploitation Engineering Technologist
Canadian Natural Resources Limited
2100, 855 – 2nd Street SW
Calgary AB, T2P 4J8

Dear Mr Penner,

**RE: PRODUCED WATER DISPOSAL SPECIAL PROJECT APPROVAL; AMENDMENT #1
CNRL SHELL LADYFERN b-17-I/94-H-01; WA# 12431
LADYFERN FIELD – BELLOY FORMATION**

Approval for disposal of produced water was issued for the subject well, Belloy formation, on December 22, 2000. The Commission is presently amending disposal well approvals to conform to current requirements.

The subject well was originally drilled down to Slave Point depth (TD 2931 mKB MD), but when a logging tool became stuck in the hole the lower portion of the well was abandoned. Following this, the well was planned to be used for disposal into the uphole Debolt or Belloy zones. Each zone was granted disposal approval; Order 00-02-011 for the Belloy in December 2000, and Order 01-02-004 for the Debolt in January 2001. Both zones were completed in January 2001, and the Debolt was subsequently abandoned with a bridge plug and cement, without disposal use. The Belloy zone has been used for disposal since December 2004. In 2016, a casing inspection log and temperature log were performed on the well. Both showed that hydraulic isolation of disposal fluids is maintained. However, it was noted from the March 2000 cement bond log that there is a lack of substantial bonded cement from 1985 mKB to surface.

Attached please find **Order 00-02-011 Amendment #1**, designating an area in the Ladyfern field – Belloy formation as a Special Project under section 75 of the *Oil and Gas Activities Act*, for the operation and use of a storage reservoir for the disposal of produced water. This Order contains a number of detailed operational conditions, including continuous tubing and casing pressure monitoring requirements, reservoir pressure fill-up limit, and a maximum wellhead injection pressure. Additional general information regarding disposal wells is available on the Commission's website at <http://www.bcogc.ca/industry-zone/documentation/Subsurface-Disposal>.

Conditions are included to address cement integrity concerns for this well. As outlined in condition 2e), casing and tubing alarms are to be set to ensure that abnormal wellhead pressures are immediately identified and investigated. Since only a hydraulic isolation temperature log can detect loss of integrity outside of the casing, an annual temperature log is required in condition 2k)ii). Because of lack of confidence in the cement bond above the disposal zone, the maximum reservoir pressure prescribed in condition 2j) is marginally higher than current pressure. Annual reservoir pressure tests, required under condition 2i), will ensure that pressure remains below this maximum value. Since reservoir pressure has not increased significantly since disposal start, there may be substantial disposal capacity remaining. In addition, condition 2m) requires that the cement condition be evaluated at the time of abandonment, to ensure long-term containment.

The Debolt zone has been abandoned in the wellbore. **Order 01-02-004 for Debolt disposal is hereby terminated.**

In certain circumstances, disposal well operation may induce seismicity of values that require modification of operations to mitigate.

Disposal of fluid with high total dissolved solids content requires adjustment of the wellhead injection pressure to remain below formation fracture pressure

Should you have any questions, please contact Michelle Harding at (250) 419-4493 or the undersigned at (250) 419-4430.

Sincerely,




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

Attachment



ORDER 00-02-011 Amendment #1

- 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, including flowback from fracturing operations, into the Belloy formation – Ladyfern field as a special project in the following area:
NTS 94-H-01 Block I Unit 17
- 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 Shell Ladyfern b-17-l/94-H-01; WA# 12431 – Belloy formation (disposal perforations 1260.5 – 1273.5 mKB).
 - b) Not exceed an injection pressure, measured at the wellhead on the subject well, of 2,210 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) i) Install electronic equipment to continually measure and record wellhead casing and tubing pressures by October 31, 2017, and from this date onwards;
ii) Continually measure and record the wellhead casing and tubing pressures electronically.
 - e) Set casing and tubing pressure alarms for values at endpoints of normal operating range, and notify the Commission if significant changes occur.
 - f) Cease injection and notify the Commission immediately if hydraulic isolation is lost in the wellbore or formation.
 - g) Submit the annual packer isolation test report to the Commission within 30 days of the completion of the test.
 - h) Include the disposal operating hours and the maximum injection pressure value on the monthly BC-S18 disposal statement.
 - i) 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.
 - j) Cease injection upon reaching a maximum formation pressure of 9,900 kPaa, measured at 1267 mKB.
 - 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.
ii) Perform an annual hydraulic isolation temperature log on the subject well and submit results to the Commission within 30 days of the completion of logging.
 - l) Not conduct a hydraulic fracture stimulation on any formation in the subject well without prior Commission approval.
 - m) Prior to abandonment, evaluate the production casing cement integrity and prepare an appropriate abandonment program, to be reviewed by the Commission.



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

DATED AT the City of Victoria, in the Province of British Columbia, this 2nd day of October 2017.



Advisory Guidance for Order 00-02-011 Amendment #1

- 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.