

January 4, 2018

6230-4535-59240-09

Brittany Jorgensen, P.Eng.
Exploitation Engineer
Canadian Natural Resources Lim.
2500, 855 – 2nd Street S.W.
CALGARY, AB T2P 4J8

Dear Mrs. Jorgensen:

**RE: PRESSURE MAINTENANCE WATERFLOOD SPECIAL PROJECT –
AMENDMENT #3
OTHER THAN NORMAL SPACING ORDER – AMENDMENT #3
MUSKRAT FIELD – BOUNDARY LAKE “A” POOL**

The Commission has reviewed the application dated November 20, 2017, requesting the approval of an additional injection well in the Muskrat Boundary Lake 'A' oil pool, by converting well CNRL et al Muskrat B7-13 - 87-18 (WA 15459), a Lower Halfway 'A' injector last active in October 2015.

The Commission agrees that conversion of well B7-13 to injector service will offset the noted pressure decline in the area, increase sweep efficiency, and ultimately increase oil recovery. Prior to injection start; the Commission requires CNRL to submit hydraulic isolation log interpretation for the above well to establish that there is no communication to other formations. The approval is contingent on a pass of the wellbore integrity evaluation as per condition 2(e) and (f) of the Order.

The following Orders are attached;

- 1) Order 01-09-005 Amendment #3 designating Pressure Maintenance Waterflood within the Muskrat field – Boundary Lake “A” pool, as a Special Project under section 75 of the *Oil and Gas Activities Act*, and
- 2) Order 01-09-005 Amendment #3 - OTN approving Other Than Normal Spacing under section 65.1 of the *Petroleum and Natural Gas Act* for the subject area and formation.

Please note that, as per section 75 of the *Drilling and Production Regulation*, a record of the volume of water injected for each well must be included on a Monthly Injection or Disposal Statement (BC-S18), which must be submitted to the Commission no later than the 25th day of the month in which activity occurred.

Reviewing the history of monthly reported wellhead injection pressure (WHIP) for each of the injectors, the Commission notes that the values are constant. This is unusual performance for injectors. Please ensure that actual values are measured and recorded. The MWHIP on the monthly BC-S18 form is the maximum wellhead tubing pressure sustained for a period of 5 minutes or more. Well CNRL et al Muskrat A3-13-87-18 (WA 9446) WHIP exceeded the MWHIP of 12,400 kPa by 45 percent (October 2017); its rate must be reduced to meet the approved MWHIP. Further, the Commission requests that a reservoir pressure must be taken on well A3-13 within the next three months to ensure that there are no high pressure pockets building around the injection well.

The Muskrat field – Boundary Lake 'A' pool is not pressure exempt, CNRL must take yearly reservoir pressures from a minimum of 25 percent of the wells in the pool.

Should you have any questions, please contact Petra Kriescher-Trudgeon at (250) 419-4415 or the undersigned at (250) 419-4430.

Sincerely,



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

Attachments

IN THE MATTER of an application from Canadian Natural Resources Limited to the Commission dated November 20, 2017 for the production of oil using pressure maintenance (water injection).

ORDER 01-09-005 Amendment #3

- 1 Under section 75(1)(a) of the *Oil and Gas Activities Act*, the Muskrat field – Boundary Lake “A” pool is designated as a Special Project for the recovery of oil utilizing pressure maintenance waterflood within the following area;
Twp 87 Rge 18 W6M NE/4 Section 12, Sections 13, 14 and NE/4 Section 15.
- 2 Under section 75(2) of the *Oil and Gas Activities Act*, I specify the following:
 - a) The project daily oil allowable is 166.0 m³
 - b) All associated produced gas must be conserved.
 - c) Water may be injected into the wells CNRL et al Muskrat A3-13-87-18 (WA 9446), CNRL et al HZ Muskrat A7-14-87-18 (WA 10801), and CNRL et al Muskrat B7-13-87-18 (WA 15459)
 - i. For wells injecting other than fresh water, inject only through tubing with a packer set as near as is practical above the injection interval.
 - ii. Not exceed an injection pressure, measured at the wellhead of 12,400 kPa or the pressure required to fracture the formation, whichever is lesser.
 - d) Not exceed an average pool pressure of 11,588 kPa measured at 565 meters subsea.
 - i. The reservoir pressure must be measured at well CNRL et al Muskrat A3-13-87-18 (WA 9446) by March 31, 2018.
 - e) Prior to injection start, hydraulic isolation log must be run for well CNRL et al Muskrat B7-13-87-18 (WA 15459) and interpretations send to the Commission
 - f) Cease injection into a well listed in (c) and notify the Commission immediately if hydraulic isolation is lost in the wellbore or formation.
 - g) Submit the annual packer isolation test report for wells listed in (c) to the Commission within 30 days of the completion of the test.
 - h) Include the injection hours and the maximum injection pressure value for wells listed in (c) on the monthly BC-S18 form.
 - i) Injection must cease upon termination of production from the pool.



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

DATED AT the City of Victoria, in the Province of British Columbia, this 4th day of January 2018.

Advisory Guidance for Order 01-09-005 Amendment #3

- 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 injection 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 injection operations suspended as per section 21.1 of the Drilling and Production Regulation.

IN THE MATTER of an application from Canadian Natural Resources Limited to the Oil and Gas Commission dated November 20, 2017 for Other Than Normal Spacing.

ORDER 01-09-005 Amendment #3 - OTN

- 1 Under Section 65.1(2) of the *Petroleum and Natural Gas Act*, Other Than Normal Spacing is approved within the Muskrat field – Boundary Lake “A” pool within the following area;
Twp 87 Rge 18 W6M NE/4 Section 12, Sections 13, 14 and NE/4 Section 15.

- 2 Under section 65.1(3) of the *Petroleum and Natural Gas Act*, I specify the following:
 - a) the target area for an oil well completed within the project area is not nearer than 100 m to the sides of the Other Than Normal Spacing area,
 - b) an oil well completed outside the target area specified in paragraph (a) may be subject to an off-target production penalty,
 - c) oil wells drilled within the specified project area are not subject to spacing requirements.



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

DATED AT the City of Victoria, in the Province of British Columbia, this 4th day of January 2018.