

September 15, 2017

1260-4100-59240-09

Lynn Wood, P. Eng.
 Exploitation Engineer
 Canadian Natural Resources Limited
 2500, 855 2nd Street SW
 Calgary, AB T2P 4J8

Dear Mrs. Wood:

**RE: WATERFLOOD PRESSURE MAINTENANCE ORDER 09-09-002, AMENDMENT #4
 BIRCH FIELD – BALDONNEL ‘C’ POOL**

Commission staff have reviewed the application, dated July 5, 2017, to convert the well CNRL et al HZ Birch a-8-I/94-A-13 (WA # 8125) to injector service. Subsequent correspondence addressed Commission concerns regarding ongoing management of waterflood injection.

The Birch field Baldonnel “C” oil pool commenced production in February 1979. A waterflood pressure maintenance project was approved in September 2009 with injection starting in May 2010. A review of reservoir performance confirms earlier indications that the Baldonnel formation is highly compartmentalized, with significant pressure variation between wells. Waterflood operation has shown limited evidence of oil recovery enhancement from the pool. The Commission is highly concerned regarding current elevated reservoir pressures in the vicinity of several injector wells. Good reservoir management requires a limit on the ultimate reservoir pressure at the cessation of pool operation, with consideration of demonstrated potential for pool pressure equalization.

Recently submitted pressure tests show that all injectors except for well CNRL et al HZ Birch a-96-H/94-A-13 (WA 8157) are exceeding 120% of initial pool pressure, a reservoir pressure limit of 15.1 MPa. Based on performance to-date, the Commission sees limited potential for pressure equalization to achieve an average pressure that aligns with this value limit. Therefore, the Commission requires that these wells be suspended from injection service until the reservoir pressure in the vicinity of the injectors is below this pressure value. Table 1 lists wells suspended from injection service.

Table 1: Wells Suspended from Injection Operation

WA#	Well Name
8144	CNRL et al HZ Birch d-30-I/94-A-13
8246	CNRL HZ Birch a-19-I/94-A-13
8259	CNRL et al HZ Birch c-97-H/94-A-13

Table 2 lists wells that may be used on an intermittent bases for injection, when the capacity of preferential injection wells a-96-H (WA 8157) and a-8-I (WA 8125) is insufficient for the volume of produced water from the Birch Baldonnel “C” pool. This option terminates on February 1, 2018, after which these wells must cease injection.

Table 2: Wells to Cease Injection Operation by February 1, 2018

WA#	Well Name
8014	CNRL HZ Birch d-29-I/94-A-13
8244	CNRL Enermark HZ Birch d-A9-I/94-A-13

However, as noted, CNRL may continue injection into CNRL et al HZ Birch a-96-H/94-A-13 (WA 8157). The Commission approves the conversion of well CNRL et al HZ Birch a-8-I/94-A-13 (WA # 8125); this will allow the reallocation of injection volumes, into an area of reduced pressure due to production voidage.

The following Orders are attached;

- 1) Order 09-09-002 Amendment #4 designating Pressure Maintenance Waterflood within the Birch field – Baldonnel “C” pool, as a Special Project under section 75 of the *Oil and Gas Activities Act*, and
- 2) Order 09-09-002 Amendment #4 - OTN approving Other Than Normal Spacing under section 65.1 of the *Petroleum and Natural Gas Act* for the subject area and formation.

This amended approval includes a recalculated maximum wellhead injection pressure, an ultimate pool pressure limit, restriction of injection for the purpose of oil recovery, and a revised submission date for the annual progress report. Also included is a requirement for annual reservoir pressure tests on all injector wells. Casing vent flows, noted at various injection wells, must be monitored for any changes that may require immediate repair.

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

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

Sincerely,



Ron Stefik, EngL
Supervisor, Reservoir Engineering
Oil and Gas Commission

Attachments

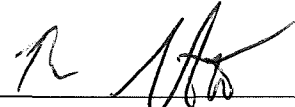
IN THE MATTER of an application from Canadian Natural Resources Limited (CNRL) to the Commission dated July 5, 2017 for the production of petroleum using pressure maintenance.

ORDER 09-09-002 AMENDMENT #4

- 1 Under Section 75(1)(a) of the *Oil and Gas Activities Act*, the Birch field – Baldonnel formation is designated as a special project for pressure maintenance for recovery of oil by water injection within the following area;
 - NTS 94-A-13 Block H - Units 52, 53, 62, 72-77, 82-88, 94-100
 - Block I - Units 4-10, 16-20, 28-30, 38-40, 48-50, 59, 60, 70, 80, 90
 - Block J - Units 1-3, 11, 12, 13, 21-23, 31-35, 41-45, 51-55, 61-64, 71, 81.
- 2 Under section 75(2) of the *Oil and Gas Activities Act*, I specify the following:
 - a) The daily oil allowable is waived.
 - b) All associated produced gas must be conserved.
 - c) Water may be injected into the wells, a-96-H/94-A-13 (WA# 8157), and a-8-I/94-A-13 (WA# 8125).
 - 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 14,500 kPa or the pressure required to fracture the formation, whichever is lesser.
 - iii) Not to exceed a formation pressure of 15,050 kPa measured at 1274 meters KB TVD.
 - d) Water may be injected intermittently into the wells, d-29-I/94-A-13 (WA# 8014), and d-A9-I/94-A-13 (WA# 8244).
 - 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 14,500 kPa or the pressure required to fracture the formation, whichever is lesser.
 - iii) Cease injection into wells listed in (d) prior to February 1st, 2018
 - e) Not exceed an average pool pressure of 12,600 kPa measured at 479 meters subsea.
 - f) The Permit Holder must conduct annual reservoir pressure (fall-off) tests on all injectors and two producers of the Baldonnel formation with a shut-in period of sufficient length to provide data for calculation of the reservoir pressure.
 - g) Cease injection into a well listed in (c) and (d) and notify the Commission immediately if hydraulic isolation is lost in the wellbore or formation
 - h) Submit the annual packer isolation test report to the Commission within 30 days of the completion of the test
 - i) Include the injection hours and the maximum injection pressure value on the monthly BC-S18 form.
 - j) Injection must cease upon termination of production from the pool.

Order 09-09-002 Amendment #4

- k) The permit holder must submit a Progress Report to the Commission for each 12 month period the project is in operation. The Progress Report must be filed by March 31st the following year and must contain the information specified in Pressure Maintenance Progress Report Requirements, attached to this Order.



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

DATED AT the City of Victoria, in the Province of British Columbia, this 15th day of September 2017.

Advisory Guidance for Order 09-09-002 Amendment #4

- 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.