BRITISH COLUMBIA ENERGY REGULATOR

March 25, 2024 8100-4900-59240-16

Matthew Elms, P. Eng.
Exploitation Engineer
Canadian Natural Resources Limited
2100, 855 – 2nd St. S.W.
Calgary, AB T2P 4J8

Dear Mr. Elms:

RE: ACID GAS DISPOSAL APPROVAL 17-16-002 AMENDMENT #2
CNRL HZ W STODDART 08-29-87-21W6M; WA# 10347
STODDART WEST FIELD – DOIG "E" POOL

The BCER has reviewed the request from Canadian Natural Resources Limited to discontinue the operation of an accelerometer at this wellsite, a condition of the approval Order.

The subject well was approved for acid gas disposal on March 20, 2017, with a requirement for ground motion monitoring to measure motion from potential induced seismic events.

Since commencing operation five years ago there have been no seismic events or ground motion detected as a result of injection, and no new geologic data to indicate a potential for events. Induced seismicity potential from hydraulic fracturing activity in the area is mitigated through assessments under existing protocols. The Regulator concurs that existing seismic arrays and monitoring diminish the need for ground motion detection and the accelerometer may be removed.

The attached Order, 17-16-002 Amendment #2, removes the prior condition requiring ground motion monitoring.

Should you have any questions, please contact Michelle Gaucher at (250) 419-4482 or Ron Stefik at (250) 419-4430.

Sincerely,

Ron Stefik, P.L. Eng.
Supervisor, Reservoir Engineering
BC Energy Regulator

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ORDER 17-16-002 AMENDMENT #2

1 Under Section 75(1)(d) of the *Energy Resources Activities Act*, the Regulator designates the Doig 'E' pool as a special project for the operation and use of a storage reservoir for the disposal of acid gas within the following area:

DLS TWP 87 RNG 21 Sec 29.

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

Well Details

a) Inject acid gas only into the well CNRL HZ W STODDART 08-29-87-21; WA 10347 – Doig 'E' pool (1691.0 – 2200 mKB MD).

Operating Limits

b) Limit the maximum H2S concentration of the injection fluid stream to 95%.

c) Not exceed an injection pressure, measured at the wellhead on the subject well, of 11,800 kPag or the pressure required to fracture the formation, whichever is lesser.

d) Inject only through tubing with a packer set as near as is practical above the injection interval.

e) Continually measure and record the wellhead casing and tubing pressures electronically, including when the disposal well is inactive or suspended.

f) Alarm the annulus pressure monitoring system to indicate when casing pressure varies outside a normal range of 1000 kPa.

g) Cease injection upon reaching a maximum pool pressure of 14,500 kPaa measured at MPP.

Monitoring

h) Sample gas from the observation well each 6 months and submit the analysis.

i) Sample the disposal fluid and e-submit composition analysis at least twice annually, indicating the disposal well as the sample source.

j) Submit the annual packer isolation test report to the Regulator within 30 days of the completion of the test.

k) Conduct and submit an annual Surface Casing Vent Flow test to the Regulator within 30 days of the completion of the test

l) Include the disposal operating hours, the maximum injection pressure and the minimum temperature values on the monthly Petrinex submission.

m) At each facility turn-around with a shut-in period of sufficient length to provide data for calculation of the reservoir pressure or at a period of no greater than 5 years, conduct a reservoir pressure test on the formation in the subject well, and submit a report of the test within 60 days of the end of the test.

n) Implement a groundwater monitoring program as detailed in Appendix A

Wellbore Integrity and Hydraulic Isolation

o) Ensure a Wellhead Emergency Shut-Off Device and Subsurface Safety Valve are installed to operate "fail-safe" and are linked to H_2S detector heads at the wellhead.

p) Implement appropriate corrosion and freeze protection measures in the casing-tubing annulus.

q) Conduct function testing of SSSV at least annually, or as recommended by API 14B or the manufacturers - whichever is more rigorous.

r) Conduct SSSV (or check valve) retrieval and inspection as per API 14B or the manufacturers recommended practice – whichever is more rigorous.

s) Annually confirm the Subsurface Safety Valve is capable of activation remote from the wellhead.

t) Immediately suspended all injection operations if any injection equipment, monitoring equipment or safety devices considered necessary for safe operation should fail.

u) Cease injection and notify the Regulator immediately if hydraulic isolation is lost in the wellbore or formation.

v) Perform casing inspection log on the subject well and submit results to the Regulator within 30 days of the completion of logging, at an interval of not more than 10 years, commencing from the date of initial disposal. Through tubing logging is acceptable.

w) Perform a hydraulic isolation log on the subject well and submit results to the Regulator within 30 days of the completion of logging, at an interval of not more than 5 years, commencing from the date of the previous log.

x) Install a barricade around the wellhead that is capable of withstanding vehicle collision.

y) Not conduct a hydraulic fracture stimulation on any formation in the subject well without prior Regulator approval.

z) Submit a Progress Report to the Regulator for each six month period the project is in operation. The Progress Report must be filed within 60 days after the end of each period and must contain the information specified in the Acid Gas Progress Report Requirements document found on the OGC website here: http://www.bcogc.ca/industry-zone/documentation/Subsurface-Disposal.

aa) Prior to abandonment of the disposal zone, conduct a reservoir pressure test on the zone 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.

Ron Stefik P.L.Eng.
Supervisor, Reservoir Engineering
BC Energy Regulator

DATED AT the City of Victoria, in the Province of British Columbia, this 25th day of March 2024.

BRITISH COLUMBIA ENERGY REGULATOR

Advisory Guidance for Order 17-16-002 AMENDMENT #2

I. A production packer must be set above the injection interval and the space between the tubing and casing filled with corrosion inhibiting fluids, as per section 16(2) of the Drilling and Production Regulation.

II. Annual packer isolation tests are required, as per section 16(3) of the Drilling and Production Regulation.

III. Injected fluids must be metered, as per section 74 of the Drilling and Production Regulation.

IV. A monthly disposal statement must be submitted to Petrinex as per section 75 of the Drilling and Production Regulation.

V. All fluid analyses must be submitted with 30 days of tests as per section 34 (5) (a) of the Drilling and Production Regulation.

Appendix A
Groundwater Monitoring Program Requirements

For Acid Gas Disposal Wells – WA 10743 and WA 10347

1. One groundwater monitoring well shall be installed by __June 30__ within 50 m of the disposal well. The monitoring well shall be installed to a depth within the saturated groundwater zone, below the water table, to enable the collection of representative samples of groundwater from the well, to a maximum depth of 30 m.
2. One groundwater monitoring well shall be installed by ___June 30___ within 50 m of the Observation Well WA 9971. The monitoring well shall be installed to a depth within the saturated groundwater zone, below the water table, to enable the collection of representative samples of groundwater from the well, to a maximum depth of 30 m.
3. During drilling of the monitoring wells, geological conditions shall be logged.
4. A minimum of one representative "reference" groundwater sample shall be collected from each monitoring well following installation and appropriate development/purging.
5. The samples shall be submitted for laboratory analysis for analytical parameters including:
    - Major Cations and Anions (HCO_3, CO_3, SO_4, NO_2, NO_3, Cl, Ca, Mg, K, Na, Fe, Mn)
    - Total Dissolved Solids (TDS)
    - Alkalinity
    - pH
    - Electrical Conductivity
    - Hardness
    - Dissolved Metals
    - Dissolved Hydrocarbon Gases (C1-C3)
    - Dissolved sulphides
    - Benzene, Ethylbenzene, Toluen, Xylenes (BETX)
    - Volatile Hydrocarbons (VH_w) (C6 to C10)
    - Volatile Petroleum Hydrocarbons (VPH_w) (C6 to C10 - BETX)
    - Extractable Petroleum Hydrocarbons C10-C19 (EPH_{w10-19})
    - Extractable Petroleum Hydrocarbons C19-C32 (EPH_{w19-32})
6. The static water level shall be measured following development/purging and prior to sampling.
7. A reference groundwater monitoring report shall be submitted to the Commission within 60 days of the date of groundwater sampling. The report, pdf format, shall include:
    - graphical monitoring well logs showing construction details and geological conditions;

- a site plan showing the locations of the monitoring wells relative to the disposal well and the observation well (WA 9971), and other well pad infrastructure;
- documentation of the UTM coordinates of the monitoring wells (NAD1983) and monitoring well top elevations;
- descriptions of the procedures used in drilling and installing the monitoring wells and procedures for sampling;
- data for the measured static water levels in the monitoring wells;
- tabulated analytical results; and
- the laboratory analytical reports.

One combined reference groundwater monitoring report may be submitted to satisfy requirements for both WA 10743 and WA 10347 .

8. Long term monitoring shall involve the collection of one representative groundwater sample from the monitoring well on an annual basis, and analysis for the following parameters:
   - Major Cations and Anions (HCO_3, CO_3, SO_4, NO_2, NO_3, Cl, Ca, Mg, K, Na, Fe, Mn)
   - Total Dissolved Solids (TDS)
   - Alkalinity
   - pH
   - Electrical Conductivity
   - Dissolved Metals
   - Dissolved Gases (C1-C3)
   - Dissolved sulphides
9. Annual sampling shall commence one year after the collection of the reference groundwater samples. The analytical results shall be submitted to the Commission annually within 60 days of sample collection by eSubmission, if available, or by Email to Hydrogeology@bc-er.ca. Long term groundwater monitoring shall be implemented over the period extending from the date of reference groundwater sampling until one year after ceasing disposal and until authorized by the Commission.
10. Monitoring well installation and groundwater sampling procedures for this program shall be consistent with standard practices for environmental investigations such as those outlined in the British Columbia Field Sampling Manual (2013) http://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/monitoring/emre/field_sample_man2013.pdf
11. At any time during this program, the Commission may require re-sampling to confirm a result or further investigation which may include additional sampling and/or additional analytical requirements.