NWT OFFICE OF THE REGULATOR OF OIL AND GAS OPERATIONS
Office of the Regulator of Oil and Gas Operations
P.O. Box 1320, Yellowknife, NT X1A 2L9
Tel: 867-767-9097 • Fax: 867-920-0798 • Web: www.orogo.gov.nt.ca
Courier Address: 4th floor, 5201 – 50th Avenue, Yellowknife, NT X1A 3S9

Angie Stastook
Specialist Asset Liability & ESG
Prairie Provident Resources Canada Ltd.
1100, 640 – 5 AVE SW
CALGARY AB T2P 3G4

July 6, 2023

Dear Angie Stastook:

Decision: Request for Variation to ACW-2021-PPR-L-68-WID1207 Denied

On April 28, 2023, the Office of the Regulator of Oil and Gas Operations (OROGO) received an application from Prairie Provident Resources Canada Ltd. (PPR) to vary its well approval (ACW-2021-PPR-L-68-WID1207) for the abandonment of the South Pointed Mountain L-68 well (WID1207), issued on January 11, 2022.

OROGO also received responses to the following information requests:

- Information Request No. 1 – received on June 2, 2023; and
- Information Request No. 2 - received on June 13, 2023.

This decision:

1. Provides context for PPR's request;
2. Considers each of PPR's arguments in support of its request; and
3. Concludes with my decision on the request.

Context

The South Pointed Mountain L-68 well is a non-compliant suspended well because the barriers in place for suspension of the Lower and Upper Muskwa formations and Exshaw formation do not meet the requirements of the *Well Suspension and Abandonment Guidelines and Interpretation Notes* (Guidelines). The well has a non-serious Surface Casing Vent Flow (SCVF) producing muds and fluids as well as gas and has shut in pressures on the casing and the tubing indicating a possible leaking barrier downhole.

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Bureau de l'organisme de réglementation des opérations pétrolières et gazières
B.P. 1320, Yellowknife, TNO X1A 2L9
Tél : 867-767-9097 • Téléc : 867-920-0798 • Site web : www.orogo.gov.nt.ca
Adresse de messagerie : 4e étage, 5201 – 50e Avenue, Yellowknife TNO X1A 3S9
BUREAU DE L'ORGANISME DE RÉGLEMENTATION DES OPERATIONS PÉTROLIÈRES ET GAZIÈRES DES TN-O

Section 56 of the *Oil and Gas Drilling and Production Regulations* (OGDPR) states that abandoned wells must be left in a state that "provides for isolation of all oil and gas bearing zones and discrete pressure zones". Section 6A of the Guidelines describes the various methods that are acceptable for achieving the isolation required under the OGDPR. Section 1 of the Guidelines states that "applicants may suggest alternative approaches, where those approaches are demonstrated to meet or exceed the same standards for the protection of human safety and the environment".

The abandonment program for the South Pointed Mountain L-68 well approved on January 11, 2022, includes:

- Separate cement squeezes coupled with the placement of retainers capped with cement to isolate the Upper and Lower Muskwa formations from the Exshaw formation.
- Abandonment of the liner top in accordance with the requirements of the Guidelines.
- An exemption from the Guidelines to allow the existing frac string to remain in place and then be plugged and cemented.

The proposed abandonment program, submitted on April 28, 2023, includes:

- One cement squeeze into the perforations for the Upper and Lower Muskwa formation and the Exshaw formation.
- No permanent barrier between the Muskwa and Exshaw formations in the wellbore.
- No abandonment of the liner top.
- Continued exemption from the Guidelines to allow the existing frac string to remain in place and then be plugged and cemented.

The program steps to abandon the liner top, in accordance with the requirements of the Guidelines, were added to the proposed program in response to Information Request No. 1, resolving that issue.

This decision focuses on the remaining issue: isolation of the Upper and Lower Muskwa formations from the Exshaw formation.

Consideration of PPR's arguments

In Information Request No. 1, I asked PPR to submit an updated well abandonment program that complied with section 6A of the Guidelines, including independent isolation of the Exshaw and Muskwa formations. PPR's response provided additional information on the proposed single cement squeeze but did not demonstrate how individual feed rates would be determined for each of the intervals, leading to uncertainty about the degree of isolation achieved through this method.

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In Information Request No. 2, I asked PPR again to submit an updated well abandonment program that complied with the requirement to independently isolate the Exshaw and Muskwa formations. I also pointed out that the source of the well's SCVF is unknown, and that isolating each completed interval independently would have the additional benefit of allowing PPR to observe the impact of the zonal isolation on the SCVF as it moves up hole.

PPR's response to Information Request No. 2 makes the following arguments in support of its proposal to conduct one cement squeeze across all perforations in the well:

1. The composition of the SCVF gas suggests it is coming from behind the production casing, above the perforated liner. Therefore, the method for abandoning the perforations should not affect the SCVF repair.
2. The volume of cement, coupled with the properties of the Muskwa and Exshaw formations, should appropriately isolate the formations with a single squeeze.
3. The additional time and equipment required to conduct two separate cement squeezes increases the safety risk of the operation in comparison with one cement squeeze.
4. Conducting two separate cement squeezes will cost more than one cement squeeze.

I consider each argument separately as follows.

Composition of SCVF gas

In response to Information Request No. 2, PPR provided the following information on the composition of the gas coming from the SCVF:

- The extended gas analysis and carbon isotope analysis shows the gas sample from the South Pointed Mountain L-68 well is a deep overmature thermogenic gas (C_1 = -28.04), typical of the Nahanni (the deepest formation intersected by the South Pointed Mountain L-68 well, zonally abandoned in 1982). PPR's geologist notes that shallower zones can also contain dry gas with similar C_1 readings and Vitrinite Reflectance (R_O) values around 1.2% to 1.4%.
- R_O values for the Exshaw formation are between 1.39% and 2.50% and for the Horn River formation (including the Muskwa formation) are between 1.53% and 2.66%.
- At 2255m, the Vitrinite Reflectance Analysis for gas from the well shows an R_O of 1.44%. R_O values decrease above this point and increase below it.

PPR concludes the SCVF gas originates above 2255m, which seems reasonable based on the data and analysis provided. Therefore, it is reasonable to suggest that the method used to abandon the Muskwa and Exshaw perforations (between 3351m and 3953m) will not affect PPR's efforts to repair the SCVF.

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Isolation of formations with a single squeeze

In response to Information Request No. 2, PPR provided the following information on the ability of a single squeeze to isolate the Muskwa and Exshaw formations:

- The calculated volume of cement required to fill the tubing, the casing, and the perforations (depending on their ability to accept cement) from the base to above the Exshaw formation is 16.6 T.
- The cement bond log for the liner portion (containing the Exshaw and Muskwa perforations) shows a very competent cement bond, isolating both formations on the annular side of the liner.
- PPR will perform one injectivity test over the three sets of perforations prior to cementing to determine the injection rate across all perforations.
- A production spinner log run while the well was flowing showed that most of the production came from the Upper Muskwa perforations, indicating that this zone has higher porosity and permeability.

PPR concludes the bulk of the fluid and cement will flow into the Upper Muskwa formation, isolating it from the Exshaw formation.

A single injectivity test over all perforations in the well cannot determine the individual injectivity rate for each set of perforations. Therefore, it cannot confirm the extent to which each set of perforations will be plugged and how much cement will be required to do so.

The program approved on January 11, 2022, for this abandonment mitigates this risk by placing retainers in the tubing between the Muskwa and Exshaw formations and above the Exshaw formations, allowing for independent squeezes of the Muskwa and Exshaw perforations.

Although PPR believes the fluid and cement from the single squeeze will flow into the Upper Muskwa formation to isolate it from the Exshaw formation in its proposed program, there is no way to confirm this before continuing with the abandonment operation. PPR's proposed program also does not include a permanent barrier in the wellbore between the Muskwa and Exshaw formations. Altogether, the proposed program results in a lower level of confidence in the isolation of the oil and gas bearing zones in this well compared to the approved program.

Furthermore, the approved program already includes an exception to the Guidelines to allow the well to be abandoned with the frac string in place, rather than pulling the frac string and placing permanent barriers across the entire wellbore.

Therefore, it is not reasonable to suggest that the proposed program is as likely or more likely to meet the objective of isolation of oil and gas bearing zones than the approved approach.

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Increased safety risks

In response to Information Request No. 2, PPR states that the proposed single squeeze program is safer than the approved program because:

- The approved program will take longer, which represents “an increase in operational exposure to the rig crew and support vendors”.
- The power swivel required to conduct the approved program represents “an increase in safety exposure”, although PPR also states that “power swivels are fairly common pieces of equipment”.
- The depth and temperature of the well “can make operations more challenging and the chances of having operational issues increase”. Operational issues would increase the time required to complete the operations and, therefore, the “safety exposure” to personnel.

I recognize that the risk of incident or injury increases with time spent on site and the use of additional equipment. However, in its Operations Authorization application for its abandonments in the Liard area (OA-2021-001-PPR), PPR submitted a Safety Plan and Emergency Response Plan which were reviewed by OROGO and found to be sufficient to identify and address any safety concerns associated with the approved well abandonment program, including the time spent on site and the use of the power swivel.

With respect to the operational challenges associated with the depth and temperature of the well, these apply to both the approved and proposed programs.

Given that the slight increase in safety risk associated with the approved program is mitigated by PPR’s existing Safety and Emergency Response Plans, it is not reasonable to suggest that the proposed program should be preferred based on safety considerations.

Cost

In response to Information Request No. 2, PPR states that conducting two cement squeezes (the approved program) will cost $287,000. It is not clear whether this is the difference between the cost of the approved and proposed programs or simply the cost of the approved program, but I infer that one of the reasons PPR is requesting a variation is to reduce cost.

While it is understandable that PPR wishes to minimize the cost of this operation, the Regulator’s mandate is primarily to promote human safety and protection of the environment. Therefore, cost is not a factor in my decision.

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Decision

Based on my consideration of PPR's arguments, I find that PPR has not made a reasonable case for its proposed variation to the abandonment program for the South Pointed Mountain L-68 well.

Therefore, PPR's request for a variation is denied.

Sincerely,

Pauline de Jong
Regulator

c. Jeremy Sadleir, Completions Engineer, Yellowstone Resources