

**CAMECO RESOURCES
CROW BUTTE OPERATION**



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February 23, 2018

**USPS PRIORITY MAIL
SIGNATURE CONFIRMATION**

Marty Link, Water Quality Division Administrator
Nebraska Department of Environmental Quality
P.O. Box 98922
Lincoln, NE 68509-8922

Class I UIC Permit NE0211670
Deep Disposal Well #1 (DDW #1) Well Workover

Dear Ms. Link:

In accordance with Part II, F (1) of Class I UIC Permit NE0211670, Crow Butte (CBO) is submitting for approval, a well workover procedure to be performed on DDW #1. Since July, 2017, CBO has experienced three incidents of significant annulus pressure loss in this well. These incidents were recently described in a letter dated January 24, 2018.

The most recent annulus pressure loss occurred on January 1, 2018, at 2:20 p.m. when the well was operating at an annulus pressure of 385 psi and a seal pot reading of 27.0". On January 1, 2018 at 2:25 p.m. the annulus pressure had decreased to 282 psi and the seal pot had declined to 0". As a result of these decreases the well was shut in at 3:15 p.m. and the NDEQ and NRC were notified by phone the following morning. During this time period, although the annulus pressure decreased it remained at least 150 psi above the injection pressure until the well was shut in. CBO contracted with Integrated Petroleum Technologies (IPT) to oversee the diagnostic work to identify the reason for the pressure loss and the ultimate workover to repair the well.

January 12, 2018: Northern Lights wire line unit tested the tubing. The test was unsuccessful because they were unable to attain a seal in the profile nipple. A work over rig was ordered.

January 17, 2018: The packer was tested to see if it was set. The test was successful.

January 18, 2018: All 4.5" injection tubing was pulled, laid down and visually inspected. There was no evidence of exterior damage. Twelve joints were removed from the string due to thread damage on the couplings. The packer was also visually inspected and no visual damage was evident, but it was suspected to be the source of the leak because of the three sealing elements, only the center sealing



element showed expansion. With only one sealing element engaging with the casing wall, it is suspected that the packer was able to slip.

January 19, 2018: The 2 7/8" work string was picked up and tripped into the hole with a bit and scraper to 3585'. No drag was encountered, indicating there was no scale or corrosion inside the well casing. The bit and scraper were tripped out and the packer and bridge plug were tripped in. The bridge plug was set at 3455'. The hole was loaded and pressure tested to 850 psi on the annulus. The pressure of 850 psi was held for 20 minutes, and dropped to 790 psi at 30 minutes.

January 22, 2018: Two attempts were made to pressure test the casing. The tests were unsuccessful due to equipment issues with the pressure test equipment. The decision was made to install a new style packer in hopes that the new packer would better engage the inside of the well casing.

The failed packer was a Baker Hornet. The rubber seating elements in this style packer have a hardness of 80-90 durometers. The new packer was an Aero ASX 1. The hardness of the seating elements is 70 durometers, and the three seating elements are thicker than the elements in the Baker Hornet. Based on the advice of IPT, CBO believed that the increased surface area would more fully contact the inside of the well casing and hold the packer in place.

January 25, 2018: The Aero ASX 1 style packer was installed at 3420'. The packer was set with 40,000 lbs. of down pressure and 30,000 lbs. of upward force to ensure the seating elements fully engaged the casing wall. Fluid was added to the annulus to prepare for MIT.

January 26-February 3, 2018: A series of pressure tests (>15) were attempted over this period. Most of the pressure tests were unsuccessful, but several passed, showing slight pressure increases over the duration of the test. On February 3, 2018, IPT advised that the new packer was likely still not sealing against the inside of the well casing because of degradation of the casing wall, and recommended testing the application of an inflatable packer to maximize contact of the seating elements with the casing wall. A multi set TAM-J packer was ordered for testing. This packer engages the inside casing wall for a length of several feet.

February 13, 2018: The new packer is set at a depth of 3420'. The well is pressured up four times, and significant pressure declines, consistent with a casing leak, are observed each time.

February 14-22, 2018: Subsequent pressure tests confirm and isolate a casing failure. On February 22, the failure is confirmed and isolated to the interval between a depth of 2994' and 3000'. The leak results in a loss of .2 gpm at a pressure of 1000 psi. A leak of this size is too small to be repaired by a conventional squeeze patch. It should be noted that no loss of waste water has occurred, only annulus fluid would have escaped from the casing.

Two factors have been taken into consideration in devising a plan to repair the well:

1. There is an interval of damaged casing (inside surface of the casing is not smooth) from 3400' to at least 3434', making it difficult to get a successful packer seat in this interval. This fact has been a significant contributing factor in the amount of time that has been required in identifying the casing failure, because the packer seat was not trustworthy. The packer may



set and not seal, as occurred on February 15, 2018 with a Graco test packer, or it may move down while attempting to set and then seal, as the Graco bridge plug did on the same day. This would indicate that the casing is either rough or eroded or both over this interval. On the advice of IPT, CBO proposes installation of a 40' Weatherford Metal Skin Patch in this area (the top of the patch would begin at 3400' and extend down to 3440'). The patch would provide an appropriate surface for the installation of the packer following repair of the well.

2. There is a .2 gpm @ 1000 psi leak located in the interval between 2994' and 3000'. CBO proposes installation of a 20' Weatherford Homco Patch in this interval to repair the leak.

The Weatherford Metal Skin Patch that will be installed in the 3400'-3440' interval has an ID equivalent to 5 1/2" 17 lbs/ft casing, or a 1.47" restriction. The Baker Hornet packer that was originally installed in the well is too large to be installed with this patch. CBO is planning to install a 5 1/2" Aero packer. The original 4 1/2" injection tubing will be installed for most of the length from the wellhead to the packer, but installation of a crossover to 3 1/2" tubing will be required immediately above the packer. This will result in a nominal friction pressure increase of 15 psi.

The Weatherford Homco Patch that will be installed to repair the leak has an ID restriction of .300", resulting in an internal diameter equivalent to 7", 35 lbs/ft casing. This patch will accommodate the original 4 1/2" injection tubing. The patch will be centered over the 2994'-3000' interval where the leak has been isolated (the top of the patch will be located at approximately 2987').

Following completion of the repairs and installation of the packer and the injection tubing, a successful MIT of the well will be completed before the well is returned to service. The repair work is anticipated to begin on Monday, February 26, 2018. It is anticipated that the repair work may take up to a week to complete before the well will be ready for MIT.

If you have any questions regarding this submittal, please feel free to contact me at (308) 665-2215, ext. 122.

Sincerely,
Cameco Resources
Crow Butte Operation

Bob Tiensvold
Restoration Manager

cc: Ron Burrows - NRC
CBO - File
cc: CR - Electronic File
Dave Miesbach - NDEQ Groundwater Unit Supervisor
Kory Winters - NDEQ Field Office
Amanda Jones - NDEQ Program Coordinator