UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD PANEL

Before the Licensing Board:

G. Paul Bollwerk, III, Chairman
Dr. Richard E. Wardwell
Dr. Thomas J. Hirons

In the Matter of	Docket No. 40-8943-MLA-2
CROW BUTTE RESOURCES, INC.	ASLBP No. 13-926-01-MLA-BD01
(Marsland Expansion Area)	March 1, 2019

MEMORANDUM AND ORDER
(Providing Parties' Proposed Questions for the Official Record)

The attached documents are the proposed witness questions submitted to the Licensing Board by the NRC staff, applicant Crow Butte Resources, Inc. (CBR), and intervenor Oglala Sioux Tribe prior to or during the evidentiary hearing in this proceeding held on October 30–November 1, 2018, in Crawford, Nebraska.[*] With the issuance of the Board's initial decision in this proceeding on February 28, 2019, see LBP-19-2, 89 NRC __ (Feb. 28, 2019), in

[*] CBR did not propose any questions at the hearing. See Tr. at 558, 841, 932, 1017.

accord with 10 C.F.R. § 2.1207(a)(3)(iii) these questions are being provided to the Office of the Secretary and are to be included in the official record of this proceeding.

It is so ORDERED.

FOR THE ATOMIC SAFETY
AND LICENSING BOARD

/RA/

G. Paul Bollwerk, III, Chairman
ADMINISTRATIVE JUDGE

Rockville, Maryland

March 1, 2019

ATTACHMENT 1

NRC Staff Proposed Questions

October 1, 2018

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NUCLEAR REGULATORY COMMISSION

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NRC STAFF'S PROPOSED QUESTIONS

Pursuant to 10 C.F.R. § 2.1207(a)(3) and the Board's scheduling order in this proceeding,[1] the NRC Staff submits, *in camera*, its proposed cross-examination questions on Contention 2 for the Board's consideration. The Staff's proposed questions are directed to the prefiled direct and rebuttal testimony of the witnesses appearing on behalf of the Oglala Sioux Tribe (OST). The answers to these questions will help the Board build a sound record and will further demonstrate that the NRC Staff complied with the National Environmental Policy Act (NEPA) and other laws when preparing the final Environmental Assessment (EA) for the proposed Crow Butte Resources (CBR) Marsland Expansion Area (MEA).

[1] Memorandum and Order (License Amendment Effectiveness Stay Application, In Limine Motions, and Site Visit/Limited Appearance Session/Evidentiary Hearing Scheduling), Appendix A at 3 (May 21, 2018) (unpublished).

NRC STAFF'S PROPOSED QUESTIONS FOR CONTENTION 2

I. GEOLOGIC SETTING AND HYDROLOGY

A. Issue/Objective: The OST claims that information related to geologic setting and hydrology is missing from the MEA application and/or the NRC Staff's Environmental Assessment (EA). The objective of the following questions is to establish that the topics identified were discussed in the application and EA, and/or are not relevant to the contention.

B. Proposed Questions for Mr. Wireman

Recharge and discharge of the Basal Chadron Sandstone Aquifer

1. Do you dispute the statements in Section 2.7.2.3 of the Technical Report (TR) and Section 3.3.2.1 of the EA identifying the recharge and discharge areas for the Basal Chadron Sandstone aquifer? If so, what evidence have you provided to support your position?

2. Do you dispute CBR's conclusion that the recharge area for the Basal Chadron Sandstone aquifer is to the west or southwest of the MEA where the potentiometric surface is above 3715 feet? If so, what evidence have you provided to support your position?

3. Do you dispute that the recharge and discharge areas identified in the TR and EA are located at significant distances from the MEA? If so, what evidence have you provided to support your position?

4. Given that the recharge and discharge areas are at considerable distances from the MEA, how are the locations of recharge and discharge areas relevant to any of the concerns raised in Contention 2?

Groundwater flow in the Basal Chadron Sandstone Aquifer

1. Do you agree that License Condition 10.1.6 requires that CBR maintain an inward hydraulic gradient within the Basal Chadron Sandstone aquifer during operations?

2. Do you dispute that under License Condition 11.1.5, CBR is required to install a ring of monitoring wells in the Basal Chadron Sandstone aquifer for each MEA wellfield, and to conduct biweekly testing on samples from those wells?

3. Do you dispute the results of CBR's well use survey, which indicated (see Ex. CBR006 at 2-11) that there are no private water supply wells drawing from the Basal Chadron Sandstone aquifer within the MEA area of review (which consists of the MEA license area plus a 2.25 mile buffer zone)? If so, what evidence do you have to support your position?

4. On page 2 of Ex. OST004, you question the statement in Section 3.3.2.1 of the EA (Ex. NRC006) that groundwater flow in the Basal Chadron Sandstone is not affected by the Pine Ridge Escarpment. What evidence have you provided to support the

statement that groundwater flow in the Basal Chadron Sandstone aquifer is affected by the Pine Ridge Escarpment?

Surface water features at the MEA

1. On page 3 of Ex. OST004, you claim that "no data/information on surface water hydrology at MEA is included in the TR or the EA." In A.7 of its rebuttal testimony (Ex. NRC014), the Staff addressed your claim that "no data/information on surface water hydrology at MEA is included in the TR or the EA," identifying several sections of the EA that provide information on surface water hydrology. Do you dispute that Sections 3.3.1, 3.4.2, and 3.11.3 of the EA (identified in Ex. NRC014 at A.7) address that topic?

Baseline Restoration Wells

1. On page 3 of Ex. OST004, you claim that no background concentration data has been provided for applicable constituents. Do you dispute that the data in Tables 2.9-10 and 2.9-11 (Ex. CBR009 at 130-141) of the TR provided four quarterly sets of water quality data from 11 wells in the Basal Chadron Sandstone aquifer to establish preoperational water quality?

2. Given the data referred to in the previous question, what is the basis for your claim (Ex. OST004 at 3) that no background concentration data has been provided for applicable constituents?

3. You assert (Ex. OST004 at 4) that lithologic and hydraulic data for the Brule and Arikaree in the TR indicate "significant heterogeneity." Which specific lithologic and hydraulic data are you referring to?

Heterogeneity in the Brule and Arikaree Aquifers

1. In A.10 of its rebuttal testimony (Ex. NRC014), the Staff states that any heterogeneity in the overlying aquifers is not germane to the confinement of the Basal Chadron Sandstone aquifer. Do you dispute that statement?

2. How is heterogeneity in the Brule and Arikaree aquifers relevant to determining that the Basal Chadron Sandstone aquifer is adequately confined (to prevent vertical migration of ISR production fluids from the Basal Chadron Sandstone aquifer to overlying aquifers)? Specifically, why is the heterogeneity of the Brule and Arikaree relevant to confinement of the Basal Chadron Sandstone aquifer given the undisputed presence of 360-450 feet of low-permeability Upper and Middle Chadron confining layers between the Basal Chadron Sandstone and the Brule aquifers?

3. How is heterogeneity in the Brule and Arikaree aquifers relevant to determining that ISR production fluids cannot migrate laterally within the Basal Chadron Sandstone aquifer outside of the MEA wellfields and the exempt portion of the aquifer?

4. With respect to your concern that contaminated groundwater migrating into the Brule aquifer could be pumped from the Arikaree (Ex. OST004 at 4), given the multiple lines of evidence indicating that the Basal Chadron Sandstone aquifer is vertically confined, including the evidence of a strong downward gradient from the Brule

aquifer to the Basal Chadron Sandstone aquifer, how would contaminated groundwater reach the Brule aquifer from the Basal Chadron Sandstone aquifer in the first place?

Deep Disposal Wells

1. On page 6 of Ex. OST004, you assert that the TR did not include any information on the geologic formations to be used for deep disposal wells (DDWs) and, specifically, their status as underground sources of drinking water. Do you dispute that the EA, the TR, and the Environmental Report (ER) identify the relevant formations (Lower Dakota, Morrison and Sundance) to be used for DDWs?

2. Do you dispute the statement on page 3-99 of the ER (Ex. CBR005-R) that the proposed formations for the DDWs have been demonstrated to be located below the lowermost underground source of drinking water in the vicinity of the MEA? If so, what evidence have you provided to support your position?

3. Do you dispute the statement on page 3-99 of the ER (Ex. CBR005-R) that, based on the quality of the water in these proposed formations (specifically, total dissolved solids (TDS) concentrations), they are not considered to be underground sources of drinking water? If so, what evidence have you provided to support your position?

4. The TR (Ex. CBR006 at 7-20) states that the proposed DDW formations are separated from the Basal Chadron Sandstone aquifer by several thousand feet of low-permeability units. This includes at least 750 feet of Pierre Shale. Do you dispute those statements? If so, what evidence have you provided to support your position?

5. CBR has stated that these DDWs will be Class I underground injection control (UIC) wells. Do you dispute that Class I UIC wells are adequately regulated by the Nebraska Department of Environmental Quality (NDEQ) under delegated authority from the U.S. Environmental Protection Agency (EPA)?

II. FAULTS, JOINTS, OR FRACTURES AS POTENTIAL PATHWAYS

A. Issue/Objective: The OST asserts that faults, joints or fractures may provide a pathway for contaminants to migrate upward from the production zone aquifer to overlying aquifers, and that further analysis of fractures is needed. The objective of the following questions is to establish that there is ample evidence that there are no continuous pathways through faults, joints or fractures at the MEA, and no further analysis or investigation is needed.

B. Questions for Mr. Wireman

1. In the Section 2.3.3.2.2 of the TR and Section 3.3.2.5 of the EA, CBR and the Staff described in detail the reasons for concluding that there is no evidence of significant offsets associated with the reported Pine Ridge and Niobrara River faults at or near the MEA. Do you dispute the Staff's and CBR's reasons? If so, what evidence have you provided to support your position?

2. Although the Staff concluded there was no evidence of significant offsets associated with these reported faults at the MEA, in Section 3.3.2.5 of the EA (Ex NRC006 at 3-14), the NRC Staff provided several reasons why, even if such offsets were present, they would not lead to significant adverse environmental impacts. Do you dispute those reasons? If so, what evidence have you provided to support your position?

C. Questions for Dr. LaGarry

1. In A.23 of Ex. NRC001, the Staff pointed out that the cross-section shown in Figure 1 of Ex. OST010 is based on cross-section A-A' in Swinehart 1985 (Ex. NRC012). Do you dispute this?

2. Do you agree that Swinehart's cross-section A-A' is located in Sioux County, about 25 miles west of the MEA?

   - If so, how does this cross-section support your assertion that this figure shows a "known" fault near the MEA?

   - If not, what evidence have you provided to support your position?

3. In A.25 of Ex. NRC001, and in section 3.3.2.5 of the EA, the Staff notes that cross-section B-B' in Swinehart 1985 (Ex. NRC012) is closer to the MEA (approximately 7-8 miles east) and shows no evidence of faulting. Do you dispute that?

4. Do you dispute that Figure 2 in Swinehart 1985 (Ex. NRC012) confirms that the fault identified in cross-section A-A' has limited areal extent and is considerably west of the MEA?

5. Isn't it correct that subsurface exploration is necessary to determine the extent of faults and their possible impacts on confinement?

6. What evidence do you have that there are joints, fractures or faults at the MEA in the Upper and Middle Chadron confining layers that could act as pathways to transmit ISR production fluids from the Basal Chadron Sandstone aquifer to the overlying aquifers at the MEA?

7. Don't the multiple lines of evidence of confinement cited by CBR and the Staff refute the assertion that such pathways through joints, fractures or faults exist at the MEA? If not, what evidence have you provided to support your position?

8. You state that various surface geophysical techniques, such as electrical resistivity, seismic reflection, and ground penetrating radar, would be better for identifying faults than geophysical logging from boreholes. What evidence have you provided that these surface techniques are superior to borehole logging, which has demonstrated the presence of thick, continuous Middle and Upper Chadron confining units throughout the MEA?

9. In OST010 you cite work by Diffendal. Do you agree that Diffendal's work involved identification of lineaments from large-scale topo maps and aerial imagery that was not verified by fieldwork?

10. Isn't it true that you have not provided any field-verified evidence of faults, joints, or fractures capable of transmitting ISR production fluids from the Basal Chadron Sandstone aquifer through the Upper and Middle Chadron confining layers in or near the MEA?

D. Questions for Dr. Kreamer

1. In your rebuttal testimony (Ex. OST014), you take issue with CBR's core sample test results showing composition and hydraulic conductivity indicative of confinement. You claim that CBR and the Staff did not consider the possibility of fracture flow.

   - What geophysical evidence have you provided to support your claim that fracture flow or secondary porosity could provide a continuous pathway through 360 to 450 feet of siltstones and clays that comprise the Upper and Middle Chadron confining units?

   - Don't the multiple lines of evidence supporting confinement refute your assertion that secondary porosity and fracture flow provide pathways for ISR production fluids to migrate upward through the Middle and Upper Chadron confining layers to the Brule aquifer?

   - What evidence, other than your assertions that the aquifer test data suggest leakage, have you provided to support your assertion that fracture flow may be occurring?

2. Do you dispute that the site-specific cross-sections and structure contour maps show no evidence of significant offsets associated with faults over the entire MEA? If so, what is your evidence?

III. BASES FOR CONFINEMENT

A. Issue/Objective: The OST asserts that the hydrological conceptual model at the MEA is inadequate to demonstrate confinement and the ability to contain fluid migration. The objective of these questions is to establish that there is substantial evidence of confinement and ability to contain fluid migration at the MEA.

B. Questions for Dr. LaGarry and Mr. Wireman

1. The TR, EA and Safety Evaluation Report (SER) describe the upper confining layers at the MEA as consisting of 360 to 450 feet of clay and siltstones with very low vertical conductivities. Do you dispute this description of the upper confining layers?

2. Isn't it true that the presence of over 360 feet of low-conductivity clay and siltstones provides significant evidence of confinement between the Basal Chadron Sandstone aquifer and the first overlying aquifer (Brule)?

3. The MEA application describes the lower confining layer (Pierre Shale) as being at least 750 feet of marine shale with extremely low vertical conductivity that is considered a regional aquiclude (Ex. CBR006 at 2-85). Do you dispute this description?

4. The results of CBR's X-ray diffraction testing (Ex. CBR006 at 2-48 to 2-49) indicates that the upper confinement contains substantial amounts of smectite clay (e.g., montmorillonite), as well as other clays. Do you dispute these results? If yes, what evidence have you provided to support your position?

5. Considering that smectite clay along any vertical water-filled fractures in the upper confining layers would become saturated, do you dispute that swelling of these saturated clays would prevent any localized fractures and joints from creating permeable pathways that could connect the Basal Chadron Sandstone aquifer to the overlying aquifer?

6. Do you agree that the cross-sections provided in the MEA application (Figures 2.6-3a through 2.6-3n of Ex. CBR008-R) illustrate the continuity of the upper confining units throughout the MEA site? If not, what evidence have you provided to support your position?

7. The potentiometric surface maps provided in the MEA application (Figures 2.9-5a through 2.9-5d; 2.9-6a through 2.9-6d), and discussed in the SER and EA, indicate that the potentiometric surface of the Brule aquifer is several hundred feet higher than that of the Basal Chadron Sandstone aquifer. Do you dispute this information? If so, what evidence have you provided to support your position?

8. According to Figure 2.9-6a through 2.9-6d in Ex. CBR008-R (the potentiometric surface map of the Basal Chadron Sandstone aquifer) and Figure 2.6-11 of Ex. CBR008-R (the structure contour map showing the top elevation of the Basal Chadron Sandstone), the potentiometric surface of the Basal Chadron Sandstone aquifer rises several hundred feet above the top elevation of the formation.

    - Do you dispute this interpretation? If so, what evidence have you provided to support your position?

    - Isn't the fact that the elevation of the potentiometric surface of the Basal Chadron Sandstone aquifer is several hundred feet higher than the top elevation of the Basal Chadron Sandstone an indication that the Basal Chadron Sandstone aquifer is confined?

C. <u>Questions for Dr. Kreamer</u>

1. In your rebuttal testimony you question CBR's use of the WinFLOW model. Do you dispute that CBR's use of the WinFLOW model solely addressed lateral containment of ISR production fluids? If so, what is your basis?

    - If the WinFLOW model solely addressed lateral containment of production fluids, how is the modeling relevant to the demonstration of adequate vertical confinement at the MEA?

    - Do you dispute that the WinFLOW model demonstrated that CBR can maintain hydraulic control? If so, what is your basis?

- Do you dispute that CBR is required by license condition to maintain an overall inward hydraulic gradient, and that CBR will have to demonstrate the inward hydraulic gradient during operations based on water level data from monitoring wells?

IV. AQUIFER PUMPING TEST

A. Issue/Objective: The OST has criticized several aspects of the design and analysis of CBR's aquifer pumping test performed at the MEA. The objective of these questions is to establish that those criticisms are invalid; that the aquifer pumping test was conducted and analyzed appropriately; and that the aquifer pumping test, along with several other lines of evidence, establishes that there is adequate vertical confinement of the Basal Chadron Sandstone aquifer at the MEA.

B. Questions for Dr. Kreamer and Mr. Wireman

1. In its rebuttal testimony (Ex. NRC014 at A.21) the Staff states that based on the reported radius of influence, the MEA aquifer test covered approximately 3 miles of the 7.5 mile length of the site. Do you dispute that statement?

2. Do you dispute that the aquifer pumping test is only one of six lines of evidence cited by CBR and the Staff to support their conclusions concerning confinement?

3. As stated in Section 3.3.2.5 of the EA (Ex. NRC006) and shown in Figures 2.9-6d and 2.6-11 of the TR (Ex. CBR008-R) the potentiometric surface in the Brule aquifer is several hundred feet higher than that of the Basal Chadron Sandstone aquifer. Do you agree, therefore, that there is a strong downward gradient between the Brule and the Basal Chadron Sandstone aquifers? If not, what evidence have you provided to support your position?

4. As shown in Figures 2.6-11 (structure contour map of Basal Chadron Sandstone) and 2.9-6d (potentiometric surface map of Basal Chadron Sandstone aquifer) of the TR (Ex. CBR008-R), the potentiometric surface of the Basal Chadron Sandstone aquifer rises several hundred feet above the top elevation of the Basal Chadron Sandstone formation. Section 3.3.2.5 of the EA (Ex. NRC006) states that this would not occur if the overlying strata were not effective confining units.

   - Do you dispute this statement? If so, what evidence have you provided to support your position?

   - Given the several-hundred foot difference in potentiometric surface between the Brule and the Basal Chadron Sandstone aquifer over the entire MEA, do you dispute that a strong downward gradient exists at the site?

   - Do you dispute that a downward gradient at the MEA would prevent upward migration of ISR production fluids from the Basal Chadron Sandstone aquifer?

   - Do you dispute that the downward gradient at the MEA would increase once operations begin?

5. According to Section 2.7.2.3 of the MEA application (Ex. CBR006), the upper confining units at the MEA consist of 360 to 450 feet of low-permeability smectite-rich mudstones and siltstones that are continuous over the MEA and have chemical compositions that are highly similar to the Pierre Shale. In addition, the Pierre Shale acts as a regional lower confining unit for the Basal Chadron Sandstone aquifer. Given these undisputed facts, do you agree with CBR and the NRC Staff that the presence of these thick and continuous confining units is a basis for concluding that there is adequate upper and lower vertical confinement of the Basal Chadron Sandstone at the MEA? If not, what evidence have you provided to support your position?

6. Given the other lines of evidence that strongly demonstrate confinement across the entire MEA, what evidence have you provided to support your position that it is necessary to conduct additional aquifer pumping tests to demonstrate confinement?

C. Questions for Mr. Wireman

1. You assert in your initial testimony (Ex. OST004 at 4) that "the aquifer test data indicate that hydraulic conductivity and transmissivity of the Basal Chadron near the pumping well is an order of magnitude lower than at the outlying monitor wells." Do you acknowledge that near-wellbore effects may explain these results?

2. License Condition 10.1.6 requires that CBR maintain an overall inward hydraulic gradient within the Basal Chadron Sandstone aquifer during operations. Given that, how is heterogeneity in the Basal Chadron Sandston aquifer relevant to determining that the aquifer is adequately confined or that ISR production fluids cannot migrate laterally within the aquifer outside of the MEA license area and the exempt portion of the aquifer?

D. Questions for Dr. Kreamer

1. Do you agree that CBR conducted the MEA aquifer pumping test for several purposes—not only to assess confinement, but also to determine the degree of connectivity in and hydraulic properties of the Basal Chadron Sandstone aquifer? If not, why not?

2. Do you agree that the hydraulic properties and degree of connectivity of the production zone aquifer are important for selection of injection and extraction rates and maintenance of an inward lateral hydraulic gradient? If not, why not?

3. Do you dispute that a drawdown response at observation wells located at long distances (e.g. 8800 feet) from the aquifer test pumping well which was operated at a relatively low rate over a short time period is an indicator of vertical confinement? If so, what evidence have you provided to support your position?

4. Do you dispute that the NDEQ approved the MEA aquifer pumping test plan, including changes made after the first failed test?

5. In your initial testimony (Ex. OST003) you refer to reports on aquifer pumping tests conducted at the existing CBR facility in 1982, 1987 and 1996 (Exs. OST006 to

OST008). How are the results of tests conducted at the existing CBR ISR facility, which is 11 miles away, relevant to the assessment of confinement at the MEA?

6. On page 3 of Ex. OST003, you assert that the MEA aquifer pumping test data shows departures from classic Theis type curves consistent with leakage, and you refer to graphs in Appendix C of the MEA aquifer test report. Why, then, is it necessary to discuss aquifer pumping tests performed at the existing CBR facility to point out asserted departures in the MEA data?

7. You claim that a statement in the MEA aquifer pumping test report (Ex. CBR016 at 6) mischaracterizes results of previous testing because it states that the Basal Chadron Sandstone aquifer at the existing CBR ISR facility site is "relatively homogeneous and isotropic." How does this description of the Basal Chadron Sandstone aquifer at the existing site have any bearing on the conduct or evaluation of the MEA aquifer pumping test?

8. Do you dispute that CBR's aquifer pumping test report for the MEA (Ex. CBR016 at 11) acknowledges that the Basal Chadron Sandstone aquifer is not homogeneous and isotropic on a local scale, but that "over the scale of the pumping test the Basal Chadron Sandstone aquifer can be treated as homogeneous and isotropic for analytical purposes"?

9. Isn't it true that the MEA pumping test results showed no response in the three overlying aquifer (Brule) wells?

10. Isn't it true that lack of response in overlying aquifer wells during an aquifer pumping test supports a finding that the lower (pumped) aquifer is confined?

11. In A.15 of the Staff's rebuttal testimony, the Staff pointed to two other observations from the MEA aquifer pumping test that indicate confinement: (1) the observation of drawdown responses at long distances (8800 feet) over short time periods at a relatively low pumping rate, and (2) storativity values typical of a confined aquifer (citing Todd 1980 (Ex. NRC015)). Do you dispute that those observations signify confinement? If so, what evidence have you provided to support your position?

12. You claim that CBR only analyzed "selective portions" of the data from the MEA aquifer pumping test instead of the complete data set.

    - What data are you referring to?

    - Do you dispute that the plots in Appendix C of the aquifer pumping test report (Ex. CBR016 at 79-95) show all data points for all of the observation wells used in the MEA aquifer pumping test?

13. In the Crow Butte License Renewal proceeding, you argued that the aquifer pumping tests conducted at the existing CBR facility were deficient because they did not consider early time data. The licensing board in that proceeding disagreed, finding that "relying upon early-time drawdown data is inconsistent with aquifer testing guidance, and that the use of later-time drawdown data is superior for estimating aquifer parameters and detecting leakage." LBP-16-13, 84 NRC 271, 330 (2016).

Why is the license renewal board's finding in LBP-16-13 not applicable to the MEA as well?

14. Do you dispute the explanation from Kruseman and de Ridder (Ex. CBR029 at 16) cited in A.17 of the Staff's rebuttal testimony (Ex. NRC014) regarding the inappropriateness of using early time data in analyzing the aquifer pumping tests? If so, what evidence have you provided to support your position?

15. On page 6 of Ex. OST003, you acknowledge that CBR's aquifer pumping test report (Ex. CBR016) provides an explanation for the flattening of data, but you claim that they did not discuss the possibility of lack of confinement. In A.18 of its rebuttal testimony (Ex. NRC-014), the Staff identified three plausible explanations for deviations of late time data in the Theis curves other than leakage: increased transmissivity (CBR's explanation), release of water from storage, and wellbore storage or near-wellbore effects. Do you dispute that the explanations identified by the Staff are plausible? If so, what evidence have you provided to support your position?

16. You claim throughout your initial testimony in Ex. OST003 that the methods used by CBR to analyze the aquifer pumping test are inappropriate because assumptions are not met.

    - Although you claim that the analysis methods are inappropriate, haven't you relied on analysis of Theis curves to support your testimony that the aquifer pumping test data are consistent with lack of confinement and show potential leakage?

    - Do you dispute the explanation in Driscoll 1986 (Ex. NRC016, cited in A.23 of the Staff's rebuttal testimony (Ex. NRC014)) regarding the extent to which analytical assumptions must be satisfied? If so, what evidence have you provided to support your position?

    - Do you dispute that in the case of an ISR facility, the homogeneity and isotropy of the production zone aquifer is not relevant for demonstrating vertical confinement, but is used to mainly to assess the licensee's ability to maintain an inward gradient?

    - Do you dispute that the potentiometric surface maps of the Basal Chadron Sandstone aquifer within the MEA, which are smooth, flat, and show relatively constant hydraulic gradients, signify a lack of significant heterogeneity in that aquifer?

    - Do you dispute that if the potentiometric surface of an aquifer, measured in a well, rises above the elevation of the top of the aquifer, then the aquifer is confined?

    - With regard to the assumption of infinite extent, do you dispute that the site-specific and regional cross-sections provided in the MEA TR (Figures 2.6-3a through 2.6-3n, Ex. CBR008-R) demonstrate that the Basal Chadron Sandstone

is present within and beyond the MEA site? If so, what evidence have you provided to support your position?

- Do you agree with the description on page 3-10 of the EA (Ex. NRC006) that the Basal Chadron Sandstone has been altered relatively little since it was deposited as a stream deposit, and that "[t]he sands are relatively uncemented, with calcite and silica cement present in only minor amounts"? If not, why not?

17. Don't the multiple lines of evidence for confinement that were identified by CBR and the NRC Staff refute your interpretation that late time deviations in the Theis curves are due to leakage?

18. According to License Condition 10.1.6 (Ex. NRC009 at 11), Crow Butte is required to maintain an inward hydraulic gradient during operations. Do you dispute that there is sufficient transmissivity and connectivity in the Basal Chadron Sandstone Aquifer, as demonstrated by the MEA aquifer pumping test, to maintain hydraulic control (i.e., inward gradient) during operations? If yes, what evidence do you have to support your position?

Respectfully submitted,

/Signed (electronically) by/
Marcia J. Simon
Emily Monteith
Robert Carpenter
Counsel for the NRC Staff

Dated at Rockville, Maryland
This 1st day of October 2018.

NRC Staff 10-30-2018

Additional questions for Dr. Kreamer

You mentioned use of ModFlow as a numerical approach. Does ModFlow simulate groundwater flow and contaminant transport through fractures?

Please clarify how heterogeneity and anisotropy in the Basal Chadron Sandstone have any bearing on confinement.

How do the variability in aquifer thickness and transmissivity values affect CBR's ability to maintain inward hydraulic gradient as required by license condition 10.1.6?

In A.18 of its rebuttal testimony (Ex. NRC-014), the NRC Staff identified three plausible explanations for deviations of late time data in the Theis curves other than leakage: increased transmissivity (CBR's explanation), release of water from storage, and wellbore storage or near-wellbore effects. Do you dispute that the explanations identified by the Staff are plausible? If so, why?

Do you agree that the pumping well in an aquifer test can affect drawdown in close observation wells – ~~such as Monitor well 3 at the MEA?~~

Do you agree that such pumping well effects on drawdown in close observation wells must be accounted for in selection of the portion of the drawdown curve to be evaluated – ~~e.g., the evaluation of Monitor Well 3 at the MEA?~~

How do you reconcile the large observed drawdown distances (e.g. 8800 feet) in conjunction with low pumping rates and short time intervals with your assertions of significant leakage?

You have extensively referred to late flattening in the Theis curve and stated that it indicates significant recharge. The NRC Staff and CBR offered several alternative explanations for the flattening. Given the alternative explanations and the multiple lines of evidence indicating confinement, how do you defend your assertion that the flattening signifies recharge?

What evidence other than the deviations in the Theis curves do you have that indicates there is significant leakage in the upper confining layers that would lead to inability to control fluid migration at the MEA?

Given that the confining layers (Upper and Middle Chadron) are at least 400 feet below the ground surface, wouldn't the significant weight of overlying strata cause any fractures, should they exist, to narrow or close?

Proposed additional question for Crow Butte

CBR has drilled and logged over 1600 boreholes at the MEA site. Have you encountered any evidence of fractures in the Upper or Middle Chadron formations in drill cuttings from those boreholes?

NRC Staff additional questions for Dr. LaGarry (10-31-2018):

You testified that the downward gradient at the MEA would cause contaminants from spills or leaks to migrate down from the surface to the aquifer below. But the downward gradient is from the Brule aquifer to the Basal Chadron Sandstone aquifer, not from the surface to the Brule aquifer. Given that fact, do you stand by your original statement, and if so, what is the basis for your statement?

You testified today that cross-section A-A' in Ex. OST010 is based on 12,500 boreholes. But you stated in Ex. OST010 that the figure is from Swinehart's work, which is based on approximately 12,500 boreholes. According to Ex. NRC012 (pages 214 and 215), there are five cross-sections provided in that paper. Do you agree that the borehole data would have been used to construct all of those cross-sections? If so, what is your basis for stating that all 12,500 boreholes were used for a single cross-section?

Isn't it true that your Ex. OST019 (Haeni and Lewis) states (top of page 2 of the document) that "surface and borehole geophysical methods both have been successfully used to locate and characterize fractures in bedrock"?

Do any of the advantages of surface geophysical methods discussed on page 2 of Ex. OST019 state that surface methods give superior results in terms of ability to detect fractures?

How does Ex. OST017 provide support for your assertions that there are faults, fracture and joints at the MEA, when the locations in which Maher and Shuster did their work (Slim Buttes and Pine Hills in NW South Dakota, Badlands Nat'l Park, the White Clay fault, Toadstool Park, and the North Platte River) are all at significant distances from the MEA?

You testified earlier that the headwaters of the White River are east of the MEA. Referring to Figure 2.3-1 of Ex. CBR008-R, the White River flows northeast from a point east of Harrison, Nebraska, just south of Fort Robinson, through Crawford, and then to the northeast. The MEA is shown to the southeast of the river. Given this, what basis do you have for stating that the headwaters of the White River, or any other part of it, are east of the MEA as you testified earlier?

What evidence in the record of this proceeding can you point to that is contrary to the explanation given by CBR and the Staff regarding the flatness of the Basal Chadron Sandstone aquifer from the existing CBR facility to the Niobrara River, as shown in Fig. 2.6-23 of Ex. CBR008-R?

What documentary evidence have you provided in this proceeding that indicate the existence of any faults, fractures or joints <u>at the MEA site</u>?

NRC Staff follow up question for Crow Butte (10-31-2018):

Did Crow Butte find evidence of the Ogallala Formation within the MEA site based on the borehole logging and drill cuttings?

NRC Staff additional questions for Mr. Wireman (10-31-2018)

You mentioned Trump Butte as an outcrop of the Basal Chadron Sandstone – how far from the MEA, and in what direction, is that outcrop located?

In the EA, the Staff estimated the travel time from the MEA to the reported Pine Ridge Fault to be approximately 500 years (Ex. NRC006 at Section 3.3.2.1), and that any contaminants in water traveling through the Basal Chadron Sandstone will be attenuated by dilution and other processes? Given those facts, what is your basis for asserting that there could be impacts from water reaching distant outcrops of the Basal Chadron Sandstone?

In Opinion 2 of page 3 in OST004-R, and in your oral testimony, you stated that there is "significant disagreement" about geologic structures. What evidence <u>in the record</u> can you point to that demonstrates this "significant disagreement"?

What site-specific evidence or analysis of site-specific data have you provided in your written or oral testimony to support your statements?

CBR

When discussing Figure B-1 in Appendix AA-3 (CBR012), you stated that if operations were shut down the potentiometric surface contours would return to the pre-mining gradient that is SW to NE. Did you mean to say SE to NW?

Kreamer

Do you dispute that CBR has demonstrated the ability to maintain an inward gradient to prevent fluid migration during operations?

Do you believe that contamination from within the production zone can move against the hydraulic gradient?

Do you dispute that CBR is required by a performance-based requirement to return groundwater quality to an acceptable level (i.e., 10 CFR Part 40 Appendix A, Criterion 5B(5) standards)?

Staff

Is CBR required to undertake the types of transport analysis Dr. Kreamer has repeatedly referred to in his testimony?

In your opinion, is such analysis necessary?

ATTACHMENT 2

Crow Butte Resources, Inc., Proposed Questions

Confidential Pending Release by the Licensing Board
Pursuant to 10 C.F.R. § 2.1207(a)(3)(iii)

October 1, 2018

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 40-8943-MLA-2
CROW BUTTE RESOURCES, INC.	)	
	)	ASLBP No. 13-926-01-MLA-BD01
(Marsland Expansion Area)	)	

CROW BUTTE RESOURCES'
PROPOSED QUESTIONS ON CONTENTION 2

Pursuant to the Licensing Board's Memorandum and Order (License Amendment Effectiveness Stay Application, In Limine Motions, and Site Visit/Limited Appearance Session/Evidentiary Hearing Scheduling), dated May 21, 2018, and in accordance with 10 C.F.R. § 2.1207(a)(3), Crow Butte Resources, Inc. ("Crow Butte") hereby submits proposed questions for the Board for the NRC Staff and intervenor witnesses. These questions are based on the parties' direct and rebuttal testimony and associated exhibits.

I. QUESTIONS FOR NRC STAFF WITNESSES

1. Do you agree that there are multiple lines of evidence demonstrating adequate confinement of the Basal Chadron Sandstone?

2. Do you agree that there are no known faults or fractures within the license area that call into question Crow Butte's ability to control mining fluids?

3. Do any of the issues raised by intervenors' witnesses in their testimony call into question your conclusions in the SER or EA for Crow Butte on confinement?

II. QUESTIONS FOR INTERVENORS' WITNESSES

A. Dr. Kreamer

1. Have you reviewed the site-specific data (other than the aquifer pumping test) provided by Crow Butte to the NRC in support of confinement?

a. If so, why does your testimony not refer to that available site-specific data to support your position?

b. If not, how can you reach a conclusion on the fundamental issues without having considered the available site-specific data?

2. How do you explain the site-specific data and evidence provided by Crow Butte (apart from the aquifer pumping test data) and that the NRC Staff and Crow Butte claim show confinement, including water level data, water quality data, particle size analyses, and geophysical borehole logs? How can each type of data be explained in your view?

3. Having read the rebuttal testimony, do you now acknowledge that Crow Butte did evaluate aquifer pumping test data using the Cooper-Jacob method (see CBR016 at 12-13, Figure 18)?

4. Why did you not prepare a drawing similar to one you prepared in the license renewal proceeding? In that case, the Licensing Board rejected your interpretation of the data. What is different here?

5. Were you aware of the concerns relating to the use of early-time drawdown highlighted by both Crow Butte and the NRC Staff (*e.g.*, Kruseman and di Ridder, CBR029)?

a. If so, why didn't you address it in your testimony.

b. If not, do you think you are qualified to opine on the adequacy of the aquifer pump tests?

6. Did your analysis account for the quantity of water in the well casing?

7. What basis is there for suggesting the mining fluids will flow upward from the Basal Chadron Sandstone into other aquifers in light of the strongly downward vertical hydraulic gradient in the permit area?

8. Were you aware that Crow Butte's aquifer pump tests were reviewed and approved by NDEQ beforehand?

B. Mr. Wireman

9. Have you reviewed the site-specific data (other than the aquifer pumping test) provided by Crow Butte to the NRC in support of confinement?

a. If so, why does your testimony not refer to that available site-specific data to support your position?

b. If not, how can reach a conclusion on the fundamental issues without having considered the available site-specific data?

10. How do you explain the site-specific data and evidence provided by Crow Butte (apart from aquifer pumping test data) and that the NRC Staff and Crow Butte claim show confinement, including water level data, water quality data, particle size analyses, and geophysical borehole logs? How can each type of data be explained in your view?

11. Having read the parties' rebuttal testimony, do you continue to maintain that there is no information on sources of recharge? *See, e.g.*, TR at Section 2.7.2.3, *Hydrologic Conditions* (CBR006); *see also* EA Section 3.3.2.1 (NRC006 at 3-27 to 3-29).

12. Having read the parties' rebuttal testimony, do you continue to maintain that there is "uncertainty" regarding groundwater flow in the Basal Chadron downgradient of Marsland? *See, e.g.*, CBR021; *see also* TR Figures 2.9-4a through 2.9-4d, 2.9-5a through 2.9-5d, and 2.9-6a through 2.9-6d (CBR008).

13. What basis is there for suggesting the mining fluids will flow upward from the Basal Chadron Sandstone into other aquifers in light of the strongly downward vertical hydraulic gradient in the permit area?

C. <u>Dr. LaGarry</u>

14. Your testimony only mentions regional data and investigations. Have you reviewed the site-specific data provided by Crow Butte to the NRC as the basis for their conclusions on confinement?

    a. <u>If so</u>, why does your testimony not refer to the available site-specific data to support your position?

    b. <u>If not</u>, how can reach a conclusion on the fundamental issues in this proceeding without having considered the available site-specific data?

15. Do you dispute *all* of the lines of evidence for confinement presented by Crow Butte and the NRC Staff? If so, please address each one.

16. How do you explain the site-specific data and evidence provided by Crow Butte and that the NRC Staff and Crow Butte claim show confinement, including water level data, water quality data, particle size analyses, and geophysical borehole logs?

17. What basis is there for suggesting the mining fluids will flow upward from the Basal Chadron Sandstone into other aquifers in light of the strongly downward vertical hydraulic gradient in the permit area?

18. What site-specific basis do you have for suggesting that there are faults or fractures at Marsland (as opposed to the region generally)? Are you aware of any specific data showing faulting or fracturing within the license area?

19. Do you agree that, hypothetically speaking, the presence of a fault or joint does not necessarily mean there is a hydraulic connection created?

    c. If so, then wouldn't that suggest that site-specific data demonstrating a lack of a hydraulic connection would be more indicative of actual conditions than your speculation?

ATTACHMENT 3

Oglala Sioux Tribe Proposed Questions

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD
(IN CAMERA)

In the Matter of	)	
	)	
CROW BUTTE RESOURCES, INC. ,	)	Docket No. 40-8943-MLA-2
	)	ASLBP No. 13-926-1-MLA-BD01
(Marsland Expansion Project)	)	
	)	October 1, 2018

OGLALA SIOUX TRIBE'S
PROPOSED CROSS EXAMINATION QUESIONS

The Oglala Sioux Tribe hereby submit the following Proposed Cross Examination Questions for the Board to pose to witnesses for the NRC Staff and CBR.

Issues Needing Further Clarification

1. Whether the gradient and discharge of the Basal Chadron aquifer are understood in sufficient detail to allow accurate characterization.

2. Whether the Basal Chadron is homogeneous and isotropic or heterogenous and anisotropic.

3. Whether there exists sufficient understanding of the target aquifer to adequately predict mining and restoration performance.

Objective of Examination

To establish that the characterization of the subsurface at the MEA is oversimplified and likely to result in inaccurate assumptions regarding hydraulic connectivity and aquifer performance during mining and restoration leading to unidentified and unexamined uncertainty regarding the stability of the long-term

conditions in the post mining aquifer.

PROPOSED QUESTIONS

1. Describe, in detail, the groundwater flow system in the Basal Chadron aquifer downgradient of the MEA.

2. In order to help evaluate degradation of the Basal Chadron aquifer from potentially inadequate restoration, describe the groundwater use and groundwater discharge from the aquifer downgradient of the MEA.

3. Discuss the data from which you derive your understanding/opinion.

4. Is the restoration monitoring protocol in use by CBR, and approved by the NRC Staff, rigorous enough to characterize the actual conditions in the post-mining aquifer?

5. What is the degree of uncertainty related to the pump test results?

6. What are the assumptions for the analytical Theis equation?

7. What does a recharge boundary look like on a Theis-type curve?

8. What did the Cooper-Jacob semi-logarithmic evaluation of the pump test reveal?

9. Was the actual or average aquifer thickness used to calculate transmissivity?

10. Do you consider the Basal Chadron to be homogeneous and isotropic?

11. What is the likelihood that CBR will employ numerical modeling during restoration?

12. Does the numerical modeling assume a homogeneous and isotropic aquifer?

13. If the optimal numerical model deviates from the assumptions of the analytical models used to evaluate aquifer properties in surrounding aquifers and aquitards, are the impacts of pumping and injection in the Basal Chadron evaluated by simplified analytic models alone incomplete and deficient?

Dated this 1st day of October, 2018.

Respectfully submitted,

____/s/_____
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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
BEFORE THE ATOMIC SAFETY AND LICENSING BOARD
(IN CAMERA)

In the Matter of	)	Docket No. 40-8943-MLA-2
	)	
CROW BUTTE RESOURCES INC.	)	ASLBP No. 13-926-01-MLA-BD01
	)	
(Marsland Expansion Project)	)	October 1, 2018

CERTIFICATE OF SERVICE

I hereby certify that copies of the foregoing '**OGLALA SIOUX TRIBE'S PROPOSED CROSS EXAMINATION QUESTIONS**', in the captioned proceeding were served In Camera to Board Members and the Board Clerk via email on the 1st day of October, 2018.

Respectfully submitted,

signed electronically

_____/s/_____

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OST Proposed Cross-Examination Questions for 10/30/18

1. For NRC Staff + CBR:
   Does demonstrated containment in the BC/CP mean that contaminated fluids cannot migrate to unwanted places?

2. For CBR:
   How is Aquifer Test data used to prevent excursions or control excursions if they occur?

3. For CBR:
   Have you investigated likely flow patterns and/or preferential pathways along which contaminants may move based on the results of the Aquifer Pumping Test?

4. For NRC:
   Does NRC Staff evaluate preferential pathways based on Aquifer characteristics demonstrated by the Aquifer Pumping Test?

5. For CBR:
   How Do the results of the Aquifer Pumping Test effect the design of your Scope of Work to collect the

data necessary to evaluate the risk of unwanted migration of contaminated groundwater?

5a How does recharge and discharge of the Target aquifer effect this design?

5b How is recharge and discharge evaluated and identified?

Submitted

Thomas J. Ballanco
OST Course

OST Proposed Cross Examination Questions 10/31/18

1. For CBR:
   How does CBR determine that there is no USDW aquifer below the injection zone for the MEA deep disposal well?

Submitted,

Thomas J. Ballanco
OST Counsel

OST Proposed Questions
11/1/18

1.) For NRC/CBR: Why are the Troughs in the contact between the Top of the Pierre Shale and the Top of the BC/CPF coincident in orientation and location when the layers were formed millions of years apart?

2.) For Dr. Kreamer: Is there supporting data that demonstrates the validity of the data in Pump Test Graph C-3 and that show leakage? If so, what is that information?

3) For NRC: Does the inertial analysis that Dr. Stritz conducted appear in the Record?

4) For NRC: Is NRC Staff satisfied with Restoration performance leading to rapid + effective closure of ISR mine units given

that it does not require transport analysis?

Submitted,

Thomas J. Ballanco
OST Counsel

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of	)	
	)	
CROW BUTTE RESOURCES, INC.	)	Docket No. 40-8943-MLA-2
	)	
In-Situ Leach Uranium Recovery Facility, Crawford, Nebraska	)	ASLBP No. 13-926-01-MLA-BD01
	)	
(License Amendment – Marsland Expansion Area)	)	

CERTIFICATE OF SERVICE

I hereby certify that copies of the foregoing **MEMORANDUM AND ORDER (Providing Parties' Proposed Questions for the Official Record)** have been served upon the following persons by Electronic Information Exchange.

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[Original signed by Clara Sola]
Office of the Secretary of the Commission

Dated at Rockville, Maryland
this 1st day of March, 2019