UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
CROW BUTTE RESOURCES, INC. ,	)	Docket No. 40-8943
	)	ASLBP No. 08-867-02-OLA-BD01
(License Renewal for the	)	
In Situ Leach Facility, Crawford, Nebraska)	)	June 8, 2015

CONSOLIDATED INTERVENORS' REBUTTAL STATEMENT

Consolidated Intervenors[1] submit this Rebuttal Statement based on the Rebuttal Statement of Dr. David Kreamer (INT-069) and the Rebuttal Statement of Mikel Wireman (INT-070) which show that neither CBR nor the NRC Staff has complied with applicable NRC Regulations or NEPA which require understandable, adequate descriptions of the affected environment, irretrievable commitment of resources, including surface water and groundwater resources, adequate confinement of mining fluids, effective and meaningful monitoring that is designed to discover excursions, leaks and contamination, effective groundwater restoration, accuracy in modeling, and reasonableness and support for assumptions made.

A. Dr. Kraemer Rebuttal. Dr. Kreamer's Rebuttal Statement clearly demonstrates that there has been inadequate descriptions of water sources, impacts, and mitigation, a failure to deal with inconvenient or inconsistent data, cherry picking of data to including results favorable to CBR and to exclude unfavorable results, and the use of practices that while common in the

[1] Western Nebraska Resources Council ("WNRC"), Owe Aku/Bring Back the Way, Debra White Plume, Beatrice Long Visitor Holy Dance, Joe American Horse & Tiospaye, Thomas Cook, Loretta Afraid-of-Bear Cook & Tiwahe. Debra White Plume, Beatrice Long Visitor Holy Dance, Joe American Horse and Loretta Afraid-of Bear Cook are members of the Oglala Sioux Tribe (the "Tribe") at Pine Ridge Indian Reservation.

uranium mining ISL industry are substandard when compared to common practices in other similar environmental industries:

1. There has been inadequate characterization of surface water sources near the facility. No limnologic information is provided on these reservoirs, nor is water quality or sediment analysis provided in the LRA. The progressive changes in the nearby reservoirs are unexplained in the LRA. Noticeable discoloration in a small reservoir close to the CBR operation is unexplained. No information is provided on the location, flow or water quality of springs in the LRA. The LRA does not identify White Clay Creek or Saw Log Creek which run through or adjacent to the property, although it identifies a reservoirs associated with these creeks. There are additional unnamed southern tributaries to the White River in close proximity to the CBR property.

2. There is inadequate information provided on the existence or methods of sediment retention on the CBR site, such as silt fences, which would inhibit offsite movement. There is inadequate information provided on local springs, incomplete analyses of reservoirs, and inadequate reporting of creek sediment quality when dry, and creek water quality when flowing. There is no accounting for impacts on wildlife and livestock which use water resources down gradient of the CBR site.

3. There is an incorrect assumption of lack of vertical communication of water between aquifers in the Chamberlain Formation (Basal Chadron) and the Overlying Brule Formation. Attempts to characterize the vertical hydraulic connectivity at the CBR site as "low" or essentially "impermeable" have generally been inadequate. Analysis of aquifer tests have in

many cases relied on inappropriate assumptions, and the design of the many field tests at CBR are deficient, resulting in an inability to confirm that they reliably test vertical communication.

4. In some cases, only selected data were used in evaluating aquifer tests, effectively ignoring contradictory data which could indicate vertical communication of groundwater.

5. The basic assumptions about the site that were used to complete aquifer test analysis are not acceptable. CBR and NRC generally make the case that the geology at the site can be considered "layer cake", that is, horizontal strata of uniform thickness, with each layer being homogeneous and isotropic or slightly anisotropic in the Chamberlain Formation (Basal Chadron). NRC reports that this assumption can be supported by examinations of the site's geologic cross-sections. The reported analyses of the hydraulic properties of these formations, from aquifer testing, has utilized simplified equations that assume, *a priori* "layer-cake" geology. Specifically, aquifer test equations in the LRA, used to analyze hydrogeologic properties, contain presumptions about the geological setting that include: all the geologic layers are horizontal, of uniform thickness, of infinite horizontal extent, these layers contain homogeneous and isotropic material, and the geological setting contains no fractures or secondary porosity that would affect analysis of vertical groundwater movement. The 'layer-cake' geology is very clearly not present in the licensed area, as Dr. Kreamer states that :

> Geologic cross-sections show layers with tilted contacts, varying thicknesses, and profound heterogeneity is reported in some strata. Where hydraulically tested, some anisotropy is reported in the production zone. Particularly, the Chamberlain Pass Formation varies in thickness throughout the site and is reported as pinching out to the northwest, while the Brule Formation is reported to have significant heterogeneity. Regionally, the contact between the Chamberlain Pass and the underlying Pierre Shale varies many hundreds of feet, and the thickness of many formations more than doubles.

The foregoing means that there was no legitimate basis for CBR to base its geologic conclusions on the now-discredited layer-cake theories and there was no legitimate basis for NRC staff to accept CBR's geologic conclusions based on 'layer-cake' theories.

6. Secondary Porosity: The LRA largely ignores the possibility of secondary porosity, faults, fractures, heterogeneity, or preferential pathways. The Chamberlain formation is referred to, in different parts of CBR documentation, as both as "sandstone" (consolidated) and "sand" (unconsolidated). It is difficult to tell if the descriptive differences in the reported consolidation of the Chamberlain ("sand" or "sandstone") is a reporting error in CBR documentation, but if the reported variability is real, and the sandstones are fissile in some locations but not others, this would support the existence of secondary porosity and heterogeneity. Accordingly, CBR contradicts itself and the NRC Staff has accepted CBR's contradictions in violation of the 'hard look' requirement of NEPA. Dr. Kreamer states that:

> Further, the *a priori* assumption, that the "sand" or "sandstone" in the Chamberlain Pass (Basal Chadron) has no secondary porosity (fractures), is inconsistent with its reported directional anisotropy.
>
> Aquifer test analysis in the Chamberlain has reported permeability variations of approximately 3 times, which is inconsistent with assumptions of homogeneity in the production zone; rather it supports the idea of preferred pathways for groundwater flow. Further, restoration efforts from mining activities in the Chamberlain Pass Formation have been difficult, with a reported need for localized "spot treatment". This uneven distribution of contamination is also an indicator of heterogeneity, secondary porosity, and preferred groundwater pathways. The existence of secondary porosity and heterogeneity is supported on a large scale by observed areal changes in hydraulic gradient as well. A homogeneous system as assumed by CBR and NRC should show constant regional groundwater gradients. The overlying Brule Formation is reported to

> have even greater heterogeneity than the Chamberlain Pass formation, but is treated in mathematical analysis as being homogeneous.

7. CBR's old aquifer tests are inadequate and based on bad assumptions. These tests used analyses based on simplified and inappropriate assumptions, and were not set up optimally to yield usable results. Reported aquifer testing in the CBR and Crawford area include tests in 1982, 1987, 1992, 2002, throughout 2004 and 2005 (five tests), and 2006. The aquifer tests are entirely insufficient and potentially misleading, as typically only one observation well was placed in the overlying Brule Formation to determine vertical migration. Dr. Kreamer further states that:

> The Brule is documented to be extremely heterogeneous, making the selection and placement of only a single well not advantageous for producing usable results, and embodying a nonstandard and questionable practice. If the sole observation well in the heterogeneous Brule Formation happened to be in placed in a localized low permeability zone, the responses of this well would not be representative of the Brule aquifer, and would artificially and inaccurately show a lack of or reduced vertical connectivity. Somewhat surprisingly, not all aquifer test information was reported and some entire tests were entirely invalidated.

It further appears that CBR has been selecting data that is favorable to it and invalidating data that is unfavorable to it in order to create a misleading representation of the geologic conditions. Dr. Kreamer notes that:

> The five aquifer tests in 2004 and 2005 were invalidated on the basis reported as follows: "*Results from the initial testing activities conducted in 2004 to 2005 (Tests #1 through #5) were not definitive as a result of such problems including improperly abandoned old exploration holes, equipment problems, insufficient stress (drawdown) to provide usable data and infiltration of surface water into observation wells*." The data from these tests which were "*not definitive"* were not widely reported or available for this external analysis. Many of the reasons given, for labeling these tests as not definitive, actually support the idea of vertical communication of water. For example, the mention of

> "*improperly old abandoned explorations holes"* implies vertical groundwater movement. Hundreds of exploratory holes have been drilled in the region, with 686 exploration/ development boreholes reported in the NTEA alone, and hundreds of wells of several types in the CBR region. Importantly, no supportive information is supplied to assess whether this implied vertical groundwater movement was indeed from improperly abandoned wells, or adjacent secondary porosity and fractures/ faults. Further, one potential cause of the reported lack of a definitive aquifer test was: "*insufficient stress (drawdown) to provide usable data*". Insufficient stress could be symptom of unexpected vertical groundwater replenishment and subsequent reduction in the drawdown of piezometric surfaces. Reasons are not specified why drawdown was considered insufficient, or if vertical groundwater replenishment was a suspected cause. Finally, the reasoning to draw the conclusion, that the tests were not definitive, because there might have been vertical flow of "*surface water into observation wells"* in the 2004 and 2005 tests, was not supported. Accompanying supporting data, demonstrating temporal variation in observation well water levels, was not available for this external review.

8. Then CBR misinterprets the data after cherry picking the most favorable results.

Dr. Kreamer observes that:

> Some analysis and discussion of aquifer test data is potentially misleading. For example, Petrotek's analysis of the 2002 aquifer testing is insufficient, in that only the first 700 or 800 minutes of a 3,780 minute drawdown fully matched a Cooper-Jacob straight line approach for several observation wells, and observation well response beyond that time was not fully discussed. As mentioned above, the data analysis was based on equations that assume grossly simplified assumptions of the geologic strata, specifically, that the geologic media is homogeneous, isotropic, of uniform thickness, and there is infinite horizontal extent of geologic strata. A fuller analysis of the Petrotek data, even using these inappropriate assumptions, shows that drawdown rates in several wells significantly slowed or momentarily stopped at times in several wells after 700 minutes, reflecting increased groundwater inflow into the Chamberlain Pass Formation, and the potential existence of a recharge boundary. Likely recharge boundaries would include vertical influx of water into the Chamberlain Pass (Basal Chadron).

9. Monitoring efforts are inadequate. A monitoring period that is restricted to only six months after restoration and stabilization does not account for rebound effects, common at many contaminated sites. Uneven distribution of subsurface contamination found at CBR lends

credence to the existence of low permeability zones in the Chamberlain Pass Formation (Basal Chadron) and the potential for delayed release, and the planned addition of reductants for stabilization opens up the same possibility. The exhibited heterogeneity of the Chamberlain Pass Formation makes addition of reductants for stabilization potentially ineffective, as there may only be treatment of the well bore and immediate surrounding environment and not the larger aquifer. Monitoring for selected parameters only, (e.g. excluding uranium), profoundly inhibits discovery of rebound effects, as the release of sequestered contaminant and indicator parameters would not be expected to occur simultaneously. Monitoring locations and well screened intervals at CBR are not optimally located and could miss contaminant excursion. Monitoring in geologic strata overlying the Chamberlain Pass Formation is deficient. Additionally, screened intervals of monitoring wells are not optimally protective of human and ecosystem health. NUREG 1569 does not prohibit many short vertically displaced screened intervals.

10. Restorations efforts are inadequate and based on badly designed models based on poor, incorrect or unsupported assumptions. Dr. Kreamer states that:

> Restoration at CBR is now guided by a new, Model-based Restoration Plan (MBRP) instituted in 2009. The modeling approach is based on MODFLOW2000, which is a USGS model that was developed for flow in porous, unfractured media. Documentation states that the MBRP model is derived from a generalized lumped parameter ground-water model, which was developed based on simultaneous water and solute balances for a phreatic aquifer. It is stated that this model is based on the batch mixing model of Gelhar and Wilson (1974) which was designed for unconfined aquifers, not confined systems such as the Chamberlain. Also referenced is Zheng et al. (1991, 1992) who used the simplifying concept of the mixed linear reservoir (MLR). Particle tracking along the lines of Zheng et al.'s work with PATH3D is shown in the WorleyParsons (2009) documentation, but the detailed model parameter estimations and conditions which justify these particle tracks are not fully detailed. Several more recent models claim significant improvements in PATH3D. Likewise, Zheng et al.'s work on MT3D has been

> updated since the early 1990s but their second-generation work MT3D MS (1998) and later work is not fully referenced in the LRA.

Further, Dr. Kreamer notes that the MBRP has been "*continually updated and improved since it was originally developed*", indicating that initial use of the MBRP, as originally conceived and on which restoration procedures were based, was not optimal and required continual updating. Dr. Kreamer further notes that " The changes and updates of the model, central to the MBRP, are not well documented in the LRA and supporting materials."

11. Vertical hydraulic connectivity is shown by Petrotek's data. Dr. Kreamer states that:

> Petrotek's data show another possible relationship that supports vertical hydraulic connectivity between the Chamberlain Pass Formation and the overlying Brule Formation. The first figure in Appendix A shows background water levels of wells, before pumping, in the Chamberlain Pass and Brule Formations, CPW2002 and SM9-10, respectively, along with barometric pressure changes. This figure shows a response of water levels in the Brule observation well to barometric pressure changes, indicating a connection between the Brule and the land surface. Importantly, what is not articulated in the report, is that there is also is apparently a muted and lagged response in the Chamberlain to pressure changes in the Brule. This would indicate a hydraulic response of piezometric level changes in the Chamberlain to water level fluctuations in the Brule, and suggest a level of vertical communication between the two, even if the well in the Brule were not optimally placed to show complete, representative response. Additionally, no groundwater age dating is presented to support that these two aquifers are in different and distinct hydrologic systems.

12. CBR uses non-standard practices that are inconsistent with the standards of the environmental industry. Dr. Kreamer states that:

Screening entire thicknesses of aquifers is not standard practice in the environmental industry, and is highly non-optimal in the CBR situation where there is an apparent uneven distribution of contamination. Wells that are screened throughout the entire aquifer thickness have a great propensity for diluting contaminant events, causing false negatives, inducing vertical spread of contamination, and not allowing focused spot remediation and overall restoration, among other non-optimal consequences. Apparent heterogeneity in the Chamberlain Pass production zone also makes the pore volume calculations mute, as preferential flow paths could bypass lower permeability areas that need to be remediated. Further, basing cleanup requirements on mine-based averages is also non standard in the environmental industry, and is not a conservative practice for protecting human or ecosystem health. This non-standard practice adds another possibility of concealing a contaminant excursion, particularly from a thin plume.

13. The water balance for the region is not well reported and insufficient to justify the consumptive use of groundwater by CBR. Dr. Kreamer states that:

(d) Complete water balance for the region is not well reported to substantiate that consumptive use of groundwater by CBR will not impact the surrounding regions long-term. In the absence of a detailed regional water balance evaluation, the short term justification, that the impact will be SMALL because "*the aquifer is expected to recover relatively quickly once restoration is complete and natural flow patterns are re-established*", does not adequately address the complete long-term picture and impact on surrounding communities and ecosystems. Some presented documentation indicates that at a minimum, flowing wells in surrounding area would cease to flow to the surface by some CBR activities. The stated impact of this is minimized in the documentation, indicating that shallow submersible pumps could installed, despite the added energy costs associated with this change.

14. CBR's system of monitoring its pipes is designed in such a way as to minimize the discovery of small, long-term chronic leaks of large volumes of lixiviant and/or well development water and/or mining fluids into the ground and, therefore, into contaminant pathways. Dr. Kreamer states that:

(e) The monitoring of pipes would only account for large leaks. Regarding the possibility of leaking pipes, pressure monitoring is the primary monitoring technique. The documentation states, "*Accordingly, as described in the LRA (Exh. CBR-011), Section 3.3, Crow Butte maintains continuous real-time monitoring and control systems to detect and mitigate potential spills and leaks that would impact groundwater."* Also, **"***As previously discussed, all piping is leak checked prior to operation. Piping from the wellfields is generally buried, minimizing the possibility of an accident. Large leaks in the pipe would quickly become apparent to the plant operators due to a decrease in flow and pressure, thus any release could be mitigated rapidly*." With this system, chronic leaks in pipes would not be caught. These could be quite sizable in the long term.

B. **Mikel Wireman Rebuttal.** Mr. Wireman's Rebuttal Statement demonstrates that CBR and the NRC Staff have failed to accurately describe the White River structural feature, have failed to adequately characterize the upper confining unit in a way that demonstrates confinement, and the pump tests would not have been sufficient to demonstrate confinement based on the results provided in the LRA and EA, there is insufficient information concerning the water and groundwater flows of the Brule aquifer (direction of flow unknown), the Brule aquifer is connected to the White River, English Creek and Squaw Creek which has an unexplained presence of daughter Lead-210, the monitoring program is inadequate because, among other things, uranium is not monitored, there is great uncertainty as to the quantity of water that will be consumed in the restoration process and CBR has historically underestimated the amounts used:

1. The characterization of the White River structural feature (fold/fault) presented by CBR and NRC is not adequate to satisfy the Atomic Energy Act, NRC Regulations or NEPA. Mr. Wireman states that:

(a) In my opinion there is still too much uncertainty about the White River structural feature (fold /fault) and how it may affect groundwater flow in the Basal Chadron. The characterization presented by CBR and NRC is not sufficient to clearly identify this

feature and conclude that there will be no unwanted migration of contaminated groundwater into the overlying upper Chadron and / or lower Brule. The modelling effort used by the NRC to analyze risk associated with this structure is too qualitative and lacks sufficient data to adequately characterize groundwater flow in the vicinity of the structure. More work needs to be completed to clearly identify and characterize the structure (fault or fold?) and evaluate the potential for preferential groundwater flow paths. The work needs to generate empirical data based on drilling or geophysical techniques.

2. The hydraulic characterization of the upper confining unit is inadequate. Mr. Wireman states that:

(b) The hydraulic characterization of the upper confining unit is inadequate. Only two of the aquifer tests performed between 1982 and 2006 included a monitoring well in the upper confining unit. Given the size of the mined area, the spatial heterogeneity of lithologies and the presence of extensive fracturing and significant faulting in the rocks which comprise the upper confining unit, the tests were not adequate for characterizing the potential for unwanted movement of ground water from the Basal Chadron upward into the upper confining unit. The aquifer test data were not appropriately analyzed and no data analysis methods were used that are appropriate for non-Darcy flow in fractured rock settings. During the 1987 pump test, water level changes were measured in the only monitoring well completed in the upper confining unit. CBR concludes that this was due to barometric pressure changes during the test, however this change in water level could have been due to pumping the Basal Chadron. In addition, there is insufficient characterization / description of the hydrology of the upper confining unit. Characterization should include determination of recharge and discharge areas, identification of high permeability lithologies and zones of enhanced secondary permeability and determination of water types and isotopic chemistry. Locations of monitoring wells in rocks overlying the Basal Chadron should be justified based on hydrogeologic criteria.

3. The description of the hydraulic properties and groundwater flow in the Brule aquifer in the LRA and in the EA is not adequate and fails to comply with NRC Regulations or NEPA. Mr. Wireman states that:

(c) The hydraulic properties and groundwater flow in the Brule aquifer is not adequately characterized. There is no water table/ potentiometric map for this aquifer.

> The direction of groundwater flow is apparently not known with a certainty as it reported to flow in numerous directions in the various reports ad technical documents. Groundwater in the aquifer is hydraulically connected to the White River and likely to Squaw Creek and English Creek. It is important to identify the location of gaining and losing reaches of the White River and the temporal nature of base flow and stream loss to the shallow aquifer. To better estimate hydraulic properties of the Brule aquifer, a series of time-drawdown / distance drawdown aquifer tests should be conducted in areas where well yield is known to be high and in areas that have been mapped as having significant fracturing / faulting.

4. The water resource monitoring program conducted by CBR is inadequate to protect water resources. Mr. Wireman states:

> (d) The water resource monitoring program currently being conducted by CBR is inadequate. There should be established monitoring sites for the alluvial aquifer along the White River, sampling of the White River should be included and, uranium should be included as an indicator parameter for excursion monitoring in addition to chloride, total alkalinity and conductivity. There should be a Basal Chadron monitoring well located near Crawford to monitor the decline in the potentiometric surface as a lowering of the potentiometric surface will affect well yields. This is especially important to monitor changes in the Basal Chadron potentiometric surface that may result during groundwater restoration activities.

5. There is great uncertainty concerning CBR's groundwater restoration and the vast quantities of water in pore volumes required to meet applicable standards and this uncertainty means that the actual amount of water being used is much greater than the amount projected and stated in the LRA and in the EA. Mr. Wireman states:

> (e) Groundwater restoration efforts at the CBR facility have been problematic and inadequate. The time required to meet applicable standards has been significantly longer than anticipated and, in my opinion, ACLs have been approved for too many parameters. In 2009 CBR adopted a modeling based groundwater restoration (MBRP) method to help achieve better restoration. However there still seems to be significant uncertainty regarding the number of pore volumes that need to be removed /replaced for a given mine unit; how /where to best deliver treated water within the mine unit being restored and

how much groundwater needs to be treated to assure stabilization. The unexpected problems encountered in achieving adequate restoration could be due to an inadequate understanding of groundwater flow in the Basal Chadron and may indicate that groundwater flow is controlled by significant heterogeneity within the Basal Chadron. The MODFLOW model used in the MBRP was used to better characterize groundwater flow conditions. To help understand why previous restoration effort have not been fully successful, more information should be provided regarding the restoration efforts at mine units 1 and 2. In my opinion compliance should not be determined based on mine unit average. Instead compliance should be based on achieving applicable standards at key compliance wells.

C. Conclusion

The Rebuttal Statements of Dr. Kraemer and Mr. Wireman demonstrate that the NRC Staff failed to comply with the Atomic Energy Act, NEPA and applicable NRC Regulations, and that CBR failed to comply with the Atomic Energy Act and applicable NRC Regulations, which violations support the admitted Contentions A, C, D, F, EA6, EA9 and EA 14.

Dated this 8th day of June, 2015.

Respectfully submitted,

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In Situ Leach Facility, Crawford, Nebraska)	)	June 8, 2015

CERTIFICATE OF SERVICE

I hereby certify that copies of the foregoing '**CONSOLIDATED INTERVENORS' REBUTTAL STATEMENT**', in the captioned proceeding were served via email on the 8th day of June 2015, which to the best of my knowledge resulted in transmittal of same to those on the EIE Service List for the captioned proceeding.

Respectfully submitted,

_____/s/_____

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