


United States Nuclear Regulatory Commission Official Hearing Exhibit	
In the Matter of:	CROW BUTTE RESOURCES, INC. (License Renewal for the In Situ Leach Facility, Crawford, Nebraska)
	<b>ASLBP #:</b> 08-867-02-OLA-BD01
	<b>Docket #:</b> 04008943
	<b>Exhibit #:</b> CBR-052-00-BD01
	<b>Admitted:</b> 8/18/2015
	<b>Rejected:</b>
<b>Other:</b>	<b>Identified:</b> 8/18/2015
	<b>Withdrawn:</b>
	<b>Stricken:</b>

**CBR-052**

June 8, 2015

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	Docket No. 40-8943
CROW BUTTE RESOURCES, INC.	)	
	)	ASLBP No. 08-867-02-OLA-BD01
(License Renewal)	)	

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REBUTTAL TESTIMONY OF CROW BUTTE RESOURCES WITNESSES DOUG  
PAVLICK, LARRY TEAHON, AND ROBERT LEWIS ON CONTENTIONS 6 AND 9

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**EXPERT WITNESSES**

**A. Doug Pavlick**

**Q1. Please state your full name, your employer, and your position.**

A1. Doug Pavlick (DP). I am employed by Cameco Resources as the General Manager for U.S. Operations. A copy of my qualifications statement was provided previously as Exh. CBR-009.

**Q2. What is the purpose of your testimony?**

A2. (DP) The purpose of my testimony is to respond to the issues raised in the NRC Staff and intervenors' testimony on Contentions 6 and 9.

**Q3. What documents have you reviewed to prepare your testimony?**

A3. (DP) I am familiar with the Crow Butte License Renewal Application ("LRA") as well as the NRC Staff review documents, including the Environmental Assessment ("EA") and the final Safety Evaluation Report ("SER"). I also have reviewed the testimony and exhibits submitted in this proceeding.

**B. Larry Teahon**

**Q4. Please state your full name, your employer, and your position.**

A4. Larry Teahon (LT). I am employed by Crow Butte Resources as the Safety, Health, Environment, and Quality (SHEQ) Manager at the Crow Butte in-situ recovery (“ISR”) facility. A copy of my professional qualifications statement was previously provided as Exhibit CBR-006.

**Q5. What is the purpose of your testimony?**

A5. (LT) The purpose of my testimony is to respond to the issues raised in the NRC Staff and intervenors’ testimony on Contentions 6 and 9.

**Q6. What documents have you reviewed to prepare your testimony?**

A6. (LT) I am familiar with the Crow Butte LRA as well as the NRC Staff’s EA and the final SER. I also have reviewed the testimony and exhibits submitted in this proceeding.

**C. Robert Lewis**

**Q7. Please state your full name, your employer, and your position.**

A7. Robert Lewis (RL). I am the owner and Principal Hydrogeologist of AquiferTek LLC, providing specialized hydrogeologic and environmental consulting services. A copy of my professional qualifications statement was previously provided as Exhibit CBR-003.

**Q8. What is the purpose of your testimony?**

A8. (RL) The purpose of my testimony is to respond to the issues raised in the NRC Staff and intervenors’ testimony on Contentions 6 and 9.

**Q9. What documents have you reviewed to prepare your testimony?**

A9. (RL) I am familiar with the Crow Butte LRA as well as the NRC Staff’s EA and the final SER. I also have reviewed the testimony and exhibits submitted in this proceeding.

## **BACKGROUND**

**Q10. What is your understanding of Contention 6?**

A10. (All) Contention 6 is entitled “[t]he EA violates NEPA in concluding that the short-term impacts from consumptive ground water use during aquifer restoration are MODERATE.” According to the intervenors, the short-term impact of mine restoration is greater than MODERATE. The NRC Staff also concluded that water levels would eventually recover after aquifer restoration, resulting in an overall SMALL impact from consumptive water use. It appears that the contention challenges that conclusion as well.

**Q11. What is your understanding of Contention 9?**

A11. (All) Contention 9 is entitled “the EA violates 10 C.F.R. §§ 51.10, 51.70 and 51.71, and NEPA and implementing regulations by failing to include the required discussion of ground water restoration mitigation measures.” The Board admitted Contention 9 to the extent it alleges that the EA’s discussion of ground water restoration mitigation measures is inadequate. The intervenors specifically allege that the NRC Staff has not justified its assumption that aquifer levels will eventually be restored naturally. I read the contention as asserting the need for more explanation and analysis related to restoration of water quality in the aquifer, the relationship to consumptive water use, and monitoring activities.

## **ASSESSMENT OF INITIAL RESTORATION TESTIMONY**

**Q12. Can you briefly summarize your approach to responding to the issues raised in the contentions in your initial testimony?**

A12. (All) Yes. In my initial testimony on Contention 6 and consumptive water use (Exh. CBR-008), I explained that Crow Butte has implemented a model-based

restoration plan (“MBRP”) since May 2009 that has achieved increased efficiency in the groundwater treatment and restoration process. The consumptive water use in restoration has been much lower than was achieved prior to May 2009. The results show that going forward Crow Butte can complete restoration that meets the restoration plan within the total of eleven pore volumes assumed in the EA. I also concurred with the EA conclusion that the longer term impact on the aquifer will be SMALL because water levels in the confined aquifer will recover.

With respect to Contention 9, Crow Butte explained that it is committed to restoration in accordance with the quality standard in 10 C.F.R. Part 40, Appendix A. This assures restoration to appropriate levels while also not unnecessarily increasing consumptive use of groundwater. There will also be monitoring to assure that the restoration has been successful.

**Q13. Can you briefly summarize your approach to responding to the initial testimony filed by the intervenors in this proceeding?**

A13. (All) In my rebuttal testimony, I will address the testimony of the intervenors’ witnesses, David Kreamer and Michael Wireman, and respond to their points. But, before doing so, I wanted to make a few general comments. First, the testimony of the intervenors’ experts does not address the admitted issue in Contention 6. There is no discussion in either witness’s testimony regarding impacts associated with groundwater consumption during restoration. With respect to Contention 9, much of the witnesses testimony surrounds the restoration standards, which are established by regulation. Moreover, as the Board noted in denying a contention challenging the use of alternate

concentration limits (“ACLs”), NRC regulations explicitly allow the use of ACLs. And, specific ACLs for mine units 7-11 would need to be approved in a license amendment if (and when) necessary. Nevertheless, to ensure a complete record and to provide contextual information for the Board, I will address the points made by the intervenors’ witnesses.

**A. Kreamer Testimony**

**Q14. Can you briefly describe the testimony of David K. Kreamer (Exh. INT-046)?**

A14. (All) Yes. Dr. Kreamer provides his views on the application and the NRC’s review and identifies a number of areas where he believes more work or discussion is needed to address an issue. However, Dr. Kreamer’s testimony fails to directly challenge (or even acknowledge) the site-specific information available at Crow Butte. Many of his concerns are generic in nature and do not account for the specific practices used or data collected at Crow Butte. The testimony is, in large part, conjecture that is inapplicable to Crow Butte. The portions of Dr. Kreamer’s testimony involving hydrogeology were addressed in the rebuttal testimony on Contentions A, C, D, F, and 14.

**Q15. Can you please respond to Dr. Kreamer’s claim that Crow Butte has conducted limited groundwater modeling and data analysis?**

A15. (All) I disagree with his claim. Numerical groundwater modeling has been extensively and nearly continuously applied for purposes of restoration support at the mine site. As noted in my initial testimony (Exh. CBR-008 at ¶32), Crow Butte has developed a very robust numerical groundwater model that accounts for site-specific hydrological conditions. Specifically, Crow Butte retained Worley

Parsons to develop a site groundwater flow model to optimize flow rates and patterns (Exh. CBR-041). This work was continued by Aqui-Ver and now AquiferTek. The model takes into account heterogeneity, non-uniform thickness, and other conditions as directly incorporated from thousands of boreholes and wells at the site. The calibrated model has been refined and expanded as restoration has progressed.

This flow and transport model, which is part of the Model Based Restoration Plan (“MBRP”), greatly improved restoration efficiency by strategically focusing on water that needs to be treated and minimizing water that is treated multiple times. This has led to significant improvements in restoration efficiency for Mine Units 2, 3, 4, and 5 to date. Aqui-Ver documented the results for restoration activities completed in Mine Units 2 and 3 in April 2013 (Exh. CBR-038). The analytic results for Mine Units 2 and 3 were submitted to the NRC in separate correspondence dated May 9, 2013 (Exhs. CBR-039 and CBR-040).

**Q16. Can you respond to Dr. Kraemer’s claim that sampling during restoration is “very restricted and artificially constrained” compared to monitoring that is more typical of industry elsewhere?**

A16. (All) Although Dr. Kraemer claims that the monitoring at Crow Butte is atypical, the monitoring is in fact standard for the ISR industry. Crow Butte is following NRC requirements (*e.g.*, the Crow Butte license) and State regulations and guidelines (*e.g.*, NDEQ Restoration Standards Title 118) for conducting monitoring during both pre-operation sampling and restoration. The location and spacing of monitoring wells are set by NDEQ. Dr. Kreamer does not provide any



information or examples to support his claim, nor has he demonstrated that additional monitoring is necessary to perform restoration or assure its effectiveness.

**Q17. Can you respond to Dr. Kreamer's claims that use of averaged values for each parameter is inappropriate?**

A17. (All) Dr. Kreamer claims that "demonstrable and verifiable regional background concentrations are a more accepted remediation goal than artificially contrived and averaged 'baseline' restoration standards." However, in doing so, he ignores the fact that pre-mining conditions in the ore zone differ significantly from regional values. The LRA explains (at 2-214) that the license area ore body is a zone of distinct water quality characteristics primarily due to the presence of relatively concentrated uranium and radium in the zone when compared to the concentration of these parameters outside of the zone. As a result, a baseline well drilled outside of the ore zone may contain water that is suitable for drinking, whereas a well drilled in the ore zone would not. Indeed, some offsite wells screened in the same interval meet drinking water standards, while wells in the permit area do not.

**Q18. Dr. Kraemer claims that Crow Butte's proposed restoration strategy is the "short-term sequestration (stabilization) of contaminants by the addition of reductants" and claims that the effects are temporary. Can you respond?**

A18. (All) This is incorrect. Groundwater stabilization is described in Section 6.1.5 of the LRA. Once restoration is completed for a mine unit, Crow Butte must conduct restoration stability monitoring to ensure that chemical species of concern

(i.e., hazardous constituents) do not increase in concentration above the Criterion 5B(5) restoration standards subsequent to restoration. Crow Butte committed in Section 6.1.5 of the LRA (Exh. CBR-011) that once the restoration standards are met for a mine unit, a stability monitoring period of at least six months will be initiated in which monthly samples will be collected from specified ore zone aquifer wells to demonstrate that restoration is stable and that there are no significant increasing trends in any of the constituents of concern. As discussed in the SER (Exh. NRC-009), Section 6.1.4(3), the NRC Staff increased the stability monitoring requirements during the license renewal period. Monitoring must continue until at least the most recent four consecutive quarters of data indicate that constituent concentrations do not demonstrate any statistically significant increasing trend. The NRC Staff imposed a license condition that requires quarterly monitoring of all constituents of concern at the specified ore zone aquifer wells until stability for all constituents of concern is established over at least four quarters.

**Q19. Regardless, are Dr. Kreamer’s concerns with baseline calculations relevant to Crow Butte given the current status of permitted mine units?**

A19. (All) No. Crow Butte has already collected all of the baseline data at the site and there are no plans to develop additional wellfields in the current permit area. There is no more “baseline” data to be collected. Therefore, Dr. Kreamer’s concerns, even if valid (and they are not), would be of no consequence at Crow Butte.

**Q20. Is there any basis for Dr. Kreamer’s claim that there is a “high probability” that baseline values of individual parameters are non-representative of background conditions?**

A20. (All) No, there is not. Crow Butte followed the requirements of its NDEQ permit and NRC license in collecting baseline data and developing baseline values for use in restoration. Moreover, there is no indication that mining activities in one mine unit adversely affected the background concentrations in an adjacent unit. For example, the table in Exhibit CBR-057 shows the baseline concentrations per analyte for each successive mine unit. There is no trend to suggest a bias in the baselines for later mining units. In fact, if you graph radium-226, the concentration actually is lower in the later mine units. And, as noted above, conditions outside the ore zone can be significantly different than those within the ore zone. Dr. Kreamer’s concern is unsupported conjecture.

**Q21. Do you agree with Dr. Kreamer that Crow Butte must provide reductant lifecycle and distribution-efficiency calculations, and detailed descriptions of reductant and stabilization chemistry, or discuss potential side effects such as biocidal impact on groundwater microbiology?**

A21. (All) The analyses referenced by Dr. Kreamer are not necessary to demonstrate the effectiveness of restoration at Crow Butte, particularly in light of recent restoration performance. Further, neither the LRA nor the EA are intended to be research documents. Instead, the objective is to identify reasonably foreseeable impacts, governed by a rule of reason in terms of the necessary detail. Dr. Kreamer’s speculation that reducing conditions can be reversed with time fails to

account for the fact that the mine units contain naturally reduced conditions, which led to the uranium deposition in the first place. As a result, the mine unit would be expected to revert, if anything, to the natural reduced state over time as the natural flow conditions resume following restoration.

**Q22. According to Dr. Kreamer, EPA monitoring well guidelines emphasize short screened intervals and several adjacent, nested monitoring wells with screens at different and restricted vertical depths to reduce the common problem of concentration dilution. Can you respond?**

A22. (All) Dr. Kreamer does not identify what monitoring well guidelines he is referring to in his testimony. But, it is nevertheless safe to say that monitoring wells at an ISR facility serve different purposes than wells used in a generic groundwater monitoring campaign or those used to establish regional water quality conditions. For example, at ISR facilities, including Crow Butte, the mining only occurs in a relatively thin stratigraphic unit that is bounded above and below by relatively impermeable units. Nesting of monitoring wells in hydraulically isolated stratigraphic units that are unaffected by mining would serve no practical purpose. Moreover, Crow Butte has followed applicable regulatory requirements regarding monitoring wells, including the location and separation of monitoring wells established by NDEQ.

**Q23. Do you agree with Dr. Kreamer that groundwater sampling during restoration has a likelihood of “false negatives” through dilution in monitoring well bores?**

A23. (All) No. As I described in my initial testimony (Exh. CBR-001 at ¶95) and in the LRA, during sampling, three casing volumes of water are purged from the well prior to collecting the sample. Also, pH and conductivity are measured to insure that the sample is formation water. Dr. Kreamer's allegation is based on nothing but conjecture.

**Q24. Do you have any overall conclusions regarding Kraemer testimony?**

A24. (All) Nothing in Dr. Kreamer's testimony undermines the conclusions in the LRA, the SER, or the EA. His concerns either lack specific relevance to Crow Butte or challenge established NRC requirements.

***B. Wireman Testimony***

**Q25. Can you briefly describe the testimony of Michael Wireman (Exh. INT-047)?**

A25. (All) Yes. Mr. Wireman's testimony is primarily a challenge to established regulatory requirements, such as restoration standards in 10 C.F.R. Part 40 and in NDEQ regulations. His knowledge of site activities is limited, and he fails to recognize site-specific data and conditions. The portions of Mr. Wireman's testimony involving hydrogeology were addressed in the rebuttal testimony on Contentions A, C, D, F, and 14.

**Q26. Can you address Mr. Wireman's assertion that "[r]estoration of groundwater in mine units where mining is complete is inadequate"?**

A26. (All) As an initial matter, Mr. Wireman identifies no specific deficiency related to Crow Butte's restoration to date. He does not refer to the LRA discussion of restoration, any specific restoration plans, or the documents demonstrating successful completion of restoration that has already occurred at Crow Butte. Instead, his concerns appear to be directed at ISR mining in general, rather than a

site-specific evaluation of Crow Butte's operations relative to applicable requirements. For example, he alleges generally that "mining companies do not conduct restoration activities for a long enough time period." But, he provides no data regarding restoration conducted at Crow Butte (or other ISR operations) to show that is the case. As noted above, Crow Butte conducts stability monitoring consistent with NRC and NDEQ requirements. And, Crow Butte performs substantial groundwater treatment as part of the restoration activities. Mr. Wireman's desire for Crow Butte to do more, without demonstrating a need for additional restoration, does not indicate a deficiency in Crow Butte's restoration plans.

**Q27. Mr. Wireman says that Table 6.1-12 of the LRA shows that CBR failed to achieve the restoration standards for seven parameters at MU 1 (radium 226, uranium, cadmium, chloride, manganese, sulfate and TDS). Is this true?**

A27. (All) No. Crow Butte successfully restored Mine Unit 1 to NDEQ's Class of Use restoration standards. Mr. Wireman also wrongly assumes that Crow Butte requested Alternate Concentration Limits ("ACLs") for these parameters. ACLs were not used.

**Q28. What about his references to the status of Mine Units 2-5?**

A28. (All) His references to the status of restoration of Mine Units 2-5 are also out of date. For MU-2 through MU-6, the restoration quality standards for ground water at Crow Butte were set by NDEQ. The NDEQ values are established for each mine unit in connection with the Notice of Intent to Operate ("NOI"). As explained in Section 6.1.3 of the LRA (Exh. CBR-011), Crow Butte set a primary

restoration goal as returning the quality to the pre-operational baseline values on a parameter-by-parameter basis for each mine unit. Baseline data are used to establish this goal for restoration on a mine unit average. If this baseline cannot be achieved after diligent application of the best practicable technology (“BPT”), Crow Butte committed to NDEQ to returning the ground water to secondary values set by NDEQ in the Class III Underground Injection Control (“UIC”) Permit. The secondary restoration values were approved by the NDEQ in the NOI for each mine unit. By letters dated June 10, 2013 (Exh. CBR-060), NDEQ indicated that the restoration data submitted by Crow Butte on May 9, 2013, had been reviewed for MU-2 and MU-3 and that stability monitoring could begin. MU-2 through MU-6 were put into restoration under the prior NRC license which allows them to be restored under the same class-of-use criteria as MU-1.

**Q29. What standards will be applied for Mine Units 7-11?**

A29. MU-7 through MU-11 will be restored to the Criterion 5B(5) standard. Under 10 C.F.R. Part 40, Appendix A, Criterion 5B(5), after termination of production activities the concentration of each hazardous constituent must be restored to not exceed (a) the background concentration, (b) the maximum values in the Criterion 5C Table, if the constituent is listed in the table and the background level is lower than the value in the table, or (c) an ACL proposed by the licensee and established in accordance with Criterion 5B(6) of Part 40, Appendix A.

**C. NRC Staff Testimony**

**Q30. Do you agree with the NRC Staff testimony on Contention 6?**

A30. (All) Yes, I agree with the NRC Staff testimony on Contention 6 (Exh. NRC-001 at A.6.1 to A.6.11).

**Q31. Do you agree with the NRC Staff testimony on Contention 9?**

A31. (All) Yes, I agree with the NRC Staff testimony on Contention 9 (Exh. NRC-001 at A.9.1 to A.9.8).

### **CONCLUSIONS**

**Q32. What are your overall conclusions regarding Contentions 6 and 9?**

A32. (All) Neither of the intervenors' witnesses present a valid reason that the NRC Staff's EA is inadequate. They provide no information regarding the impacts associated with consumptive use of groundwater during operations or during restoration and decommissioning. The EA addresses consumptive water use during restoration in both the short term and the long term. The EA describes the former as MODERATE and the latter as SMALL. I believe that, based on current and future practices, these characterizations are bounding. The EA, as supplemented by my discussion in testimony, also describes the restoration standards, the restoration process, and reasonable measures to mitigate the impacts of consumptive water use (*e.g.*, the MBRP) and to control and to mitigate impacts on groundwater water quality (*e.g.*, monitoring, treatment, and standards).