


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)
	ASLBP #: 08-867-02-OLA-BD01
	Docket #: 04008943
	Exhibit #: INT-071-00-BD01
	Admitted: 8/18/2015
	Rejected:
	Identified: 8/18/2015
	Withdrawn:
	Stricken:
	Other:

INT-071

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)	)	July 31, 2015

**REBUTTAL STATEMENT OF LINSEY McLEAN**

The following points comprise my statement:

**With regard to:**

*Moreover, Dr. McLean has not established that a pathway exists by which the land application of treated process wastewater under dry conditions will cause the significant adverse impacts to human beings and wildlife that she describes (land application after wet weather events is not allowed under CBR's NDEQ permit) (Ex. NRC 010 at 12).* In fact, Dr. McLean identifies other pathways by which the heavy metals she discusses have been known to cause impacts to the environment, including impacts from uranium acting in concert with calcium ions generated by ISR mining generally "as well as in runoff waters of the Rocky Mountains over old uranium open pit mines" (Ex. INT-048 at 10) and "legal dumping" of arsenic "into commercial fertilizers from mining and ore smelting waste since 1976" (Ex. INT-048 at 14). "

**My Response:**

Application of metals in solution as ionic compounds and also as endemic organic compounds found by other researchers in remediation of old ISL sites, that are not able to be recovered by ion exchange, (1) (2) can be diluted ad infinitum with clean water and applied to land with the false premise that these metals are somehow rendered less toxic, when such is not the case. It does not matter how much you dilute the metals before applying the wastewater, the water portion of the solution will invariably evaporate into the atmosphere or go deep towards the aquifers, as that is Mother Nature's method of recharging aquifers for the most part, leaving the metals, which are highly ionic and

chemically “sticky” and attractive towards elements in soils because of their electrochemical nature, to concentrate in the surface soils over time.

The inorganic forms of the metals, can be taken up by micro organisms in the soil once they are in solution again, at any following rain or snow, as chemical salts of all kinds become readily soluble again after drying and crystallization. Inevitably, there will be rain or snow in amounts that would cause the metal salts to go back into solution again. Think of the drying of seawater to make table salt, and how easily that salt dissolves again in your soup. There are many metals salts in seawater, and they all dissolve after drying. By definition, chemical salts/ionic forms of metallic salts share this crystallization/solubility characteristic. So the fact that the wastewater is diluted ad infinitum, makes no difference in the toxicity and future hazards to wildlife and humans. It is actually a waste of clean water. In fact, over time, with the increasing buildup of metal salts in the soil, and the saturation of attracting elements in the soil to keep the metals in the surface soils, the dissolved metal salts could feasibly travel downward into the groundwater below, contaminating aquifers below.

Addressing the inorganic salt forms of the metals: These have been shown in numerous studies to be able to be uptaken by micro organisms and primitive life forms and converted to organic forms that are then able to be bioaccumulated up the food chain. Indeed, since more advanced organisms, including animals and humans lack the ability to efficiently convert inorganic minerals and metals to organic forms that are more bioavailable, Nature relies on these primitive forms of life to do that job for us. There are sterile soils at Crow Butte. The metallic waste water is not going to be applied to sterile soil. And, as stated in my prior testimony, organic forms of metals and minerals are far more bioavailable to living organisms than inorganic forms which have to be converted to organics. This organification also makes the toxic heavy metals even more toxic and more bioavailable to bioaccumulate up the food chain. Organification and increased bioavailability and increased ability to enter into biochemical reactions in the living body is why we chelate/organify essential minerals in the laboratory for use in nutrition. These organically chelated minerals are successfully used in humans and animals whom show inborn errors of metabolism where one or more minerals are not able to be successfully and routinely uptaken from foods and actively carried through the gut wall, as they are in a “predigested” form. For this reason, it is not a reliable assessment of the true toxicity of any toxic metal to evaluate and test for inorganic forms alone. Organic forms may be orders of magnitude in toxicity above an inorganic form in the living body, animal or human.

Additionally, ruminants like deer, sheep, cows, and other animals with a biologically active cecum, such as horses, have a much higher population of microorganisms in their digestive tracts than humans do, with our nearly extinct appendix, the evolutionary counterpart. These animals depend on the microbiological activity of the cecum and rumen to complete their digestion, maintain immune status and provide essential amino acids for protein needs as well as B complex vitamins and intermediary factors for healthy biochemistry. This is how they can live in a healthy state as true vegetarians, and be supplied all the missing amino acids not found in plants. These higher numbers of

“probiotics” in the intestines of these animals will also convert higher levels of inorganic metals and minerals to organification than humans, making the same levels of inorganic metals that would be tolerable to humans, highly toxic to ruminants and cecates. That same difference in toxicity is well known for nitrates in water too. So, the land areas (in and around) application of wastewater will be found, for this reason, to be more toxic for grazing animals in the future, than simple inorganic testing [comparable to human tolerable limits] compromising the ability of the land to be reclaimed after mining stops.

Further, land application during wet weather vs dry weather was deemed necessary to prevent further migration of the metals from flooding and runoff, and has nothing to do with the actual toxic bioavailability of the metals, only the spread of their territories.

(1) [Arabian Journal of Chemistry](#)

[Volume 4, Issue 4](#), October 2011, Pages 361–377

(2) (Kurniawan et al., 2006).

**(3) Chelated Minerals in Animal Nutrition**

Rajendran, C.Kathirvelan and V.Balakrishnan, Madras Veterinary College,  
Chennai, INDIA

(4) find references to nitrates and ruminants and organification about the rumen

(5) find references to the differences in toxicity of organified heavy metals

(6) Differences in Uptake of Organic vs Inorganic Forms of Selenium.

<http://www.efsa.europa.eu/en/scdocs/doc/348.pdf>

(7) How Inorganic Forms of Metals Become Organic Forms in Nature-Arsenic

<http://medicalassessmentonline.com/terms.php?R=255>

(8) How Inorganic Forms of Metals Become Organic Forms in Nature-Selenium

<https://dl.sciencesocieties.org/publications/jeq/abstracts/31/4/1146?show-t-%20%20f=tables&wrapper=no?access=0&view=article>

(9) Organification of Mercury by River Algae

Kate L. Buckman, Mark Marvin-DiPasquale, Vivien F. Taylor, Ann Chalmers, Hannah J. Broadley, Jennifer Agee, Brian P. Jackson, Celia Y. Chen. Influence of a chlor-alkali Superfund site on mercury bioaccumulation in periphyton and Low-trophic level fauna. Environmental Toxicology and Chemistry, 2015; DOI: 10.1002/etc.2964

(10) The Chemistry of Selenium, Oxidation/Reduction/Volatilization

Shows how selenium changes inorganic speciation until it volatilizes into an organic form

<http://www.intechopen.com/books/antioxidant-enzyme/selenium-an-important-antioxidant-in-crops-biofortification>

(11) The Difference in Uptake in Humans of Inorganic vs. Organic Forms of Selenium to Different Tissues

<http://www.efsa.europa.eu/en/scdocs/doc/348.pdf>

**With regard to:**

**Q9. Ms. McLean also asserts that the liner is made of everyday plastics that are easily degraded. Can you respond?**

A9. Yes. Her characterization of the pond liner is incorrect. The HDPE plastic that is used is designed specifically for use in evaporation ponds, not for use in the food and bottled water industry. Moreover, the seams in the pond liner are fusion welded and are re-welded if they are found to have failed. In December 2013, an evaluation of the liners was performed by a third party. The liners were in satisfactory condition for continued operation.

**My Response:**

First: I misspoke with the term “leach” ponds. I should have said “containment” ponds as containment ponds were what I was describing.

Second: The oxidation and degradation of the plastics in the pond liners by the leachates and residues in the pond water is evident in that pinhole leaks were found just 6 yrs after installation. Pinhole leaks are classic for what you would expect to find in plastics degradation by oxidizing chemicals. The plastics used in pond liners are thicker, true, however still made of the **same kind** of plastic that is referred to in my testimony, HDPE, commonly used in industries of all kinds, including food industry and easily degraded, which is why it is so easy to recycle. The thickest geomembrane available is 80 mil HDPE resin designed specifically for flexible geomembrane applications and contains approximately 97.5% polyethylene, 2.5% carbon black and trace amounts of antioxidants and heat stabilizers; no other additives, fillers or extenders are used. This is the exact same chemical recipe that all HDPE products are made from, with exception of colorants. The only difference between all HDPE products is the thickness. Some geomembranes contain a dacron fabric inside of the applied plastics for better protection against tears and mechanical breaks, however the same HDPE plastic coats the fabric layer, subjected to the same chemical degradation fate, and that plastic is the sole protection from leaks. The interior fabric by itself is not leakproof. So there is nothing special about the pond liners that is inherently different from the common milk jugs.

The geomembranes typically come in 22.5 ft wide rolls, so there has to be several strips down the entire length of the ponds of fusion between strips, capable of forming leaks, since that fusion is done under the less than ideal “field conditions” and not at the factory in manufacture.

<http://cdn2.hubspot.net/hub/32796/file-2204650797-pdf/docs/chemical-resistance-xr-5-8130.pdf?t=1438130708147>

shows 28 day exposures to the best pond liner of different chemicals

The record speaks for itself:

**August 12, 1997: Discovery of Pinhole Leaks in Upper Liner of Process Water Evaporation Pond - this demonstrates the exact type of degradation you would expect from chemical exposure, and just 6 yrs after initial use**

**May 14, 2004: Leak detected at Pond 1**

**May 5, 2006: Leak detected at Pond 4**

**June 5, 2009: Evaporation Pond 1 liner leak detected**

**June 18, 2009: Evaporation Pond 4 liner leak detected**

**Dec. 31, 2009: Evaporation Pond 4 Liner Leak**

**June 11, 2010: Evaporation Pond 3 liner leak detected**

**June 1, 2011: Evaporation Pond 1 liner leak**

Three of 4 ponds have been found to leak.

**With regard to:**

Mr. Teahon acknowledges Ms. McLean’s discussion of potential impacts from selenium contamination, but notes that she provides no site-specific assessment of the impacts of hypothetical land application of wastewater at Crow Butte. Her generalized assertions provide no site-specific reason to question the conclusions of the LRA or EA regarding land application of wastewater. She does not acknowledge that Crow Butte has not performed land application at the site or that Crow Butte has no plans to conduct land application. She also does not account for the limitations on Crow Butte’s use of land application for wastewater — imposed by both

**My Response:**

The potential impacts for Crow Butte for selenium contamination are the same as have been recognized at all other ISL sites, when continuous application of even diluted wastewater are land applied. The water portion of the mix evaporates or goes down in the soils, leaving the electrostatic heavy metals, including selenium, to increase over time in the upper soils. I refer to the first response in this document regarding the dilution factor of wastewater, the ineffectiveness of such and wasting of clean water in the unnecessary dilution process.

**With regard to:**

Mr. Teahon also explains that, although outside the scope of the admitted contention, Ms. McLean provides testimony on evaporation ponds. Mr. Teahon then describes the design, operation, and decommissioning requirements for evaporation ponds at Crow Butte. He discusses the requirement to maintain a minimum “freeboard” to accommodate rain events, as well as the obligation to keep the sediments in the pond.

**My Response:**

Crow Butte has not included a description for their active air application of the liquid waste from the ponds. The ponds are supposed to be, by NRC description, strictly “solar” evaporation ponds. Aerosol sprayers can be clearly observed from both the ground and also satellite pictures provided by Google Maps. The technique seems to place a row of 11 aerosol sprayers in a line down the middle of the ponds. In fact, the satellite pictures clearly show the spray picked up and carried by the wind from those sprinklers.

fig.1

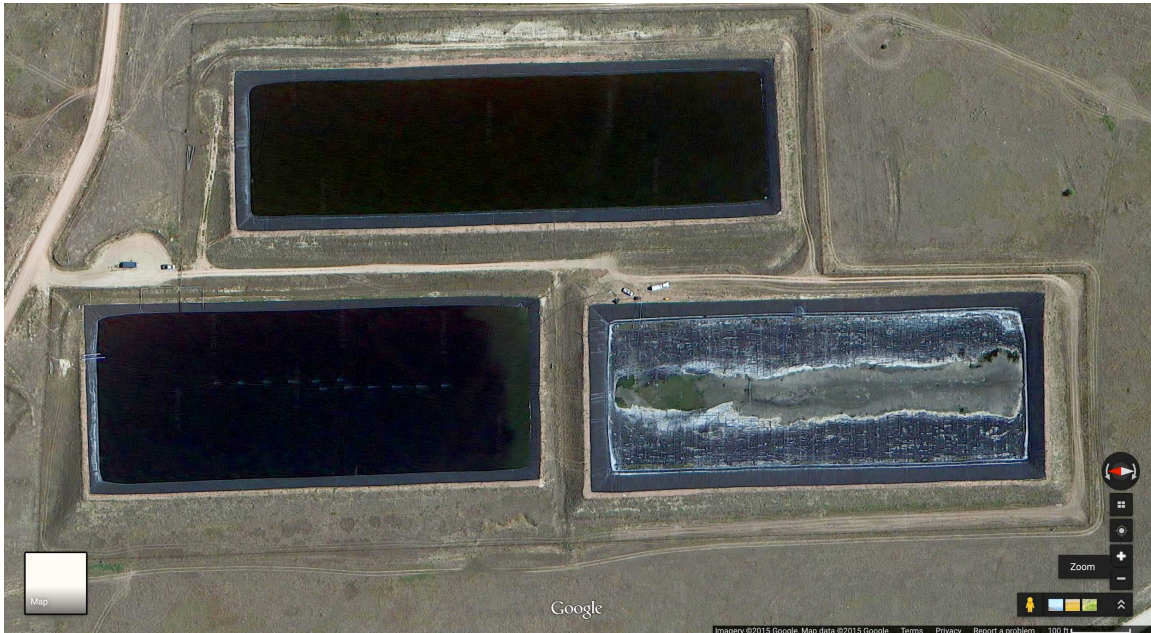


fig.2





fig.3



I am concerned that these aerosol sprayers are putting even more radiation and metals into the air to be spread by the wind, and this would also qualify as an air and/or land application of sorts. I have not found anywhere in NRC documents, the permit for an air application.

**With regard to:**

**A.12.3** (N. Goodman) Dr. McLean makes several claims regarding the impacts of selenium and other heavy metals on human health and wildlife. She states at times that these health impacts result from “low levels” of selenium and other heavy metals in the organism (Ex. INT-048 at 9, 15, 18, 19, 22), and at other times from “high levels” of these metals (Ex. INT-048 at 8, 9, 12, 14, 15, 19-20, 24), where levels are discussed at all. However, she does not address with any specificity the concentration of selenium that must be present in the land-applied treated process wastewater at the Crow Butte site to be expected to cause the impacts she describes.

**My Response:**

The actual toxicity and respective levels for toxicity of individual heavy metals including selenium will be dependent upon the chemical forms in which these metals exist. I have explained in depth, and shown by slides included, that different chemical forms of metals and minerals have different levels of toxicity in the living body and different destinations in the living body too. Bioaccumulation of organified metals that we know does exist as a

result of bacteria and algae upon the metals, has been demonstrated to occur. The organified metals are considerably more toxic than inorganic forms, so lower levels of these forms will show toxic manifestations. Speciation testing would be necessary to properly assess toxicity of the inorganic forms, and these numbers are typically not released to the public by mining companies. In fact, in researching ISL site testing, I could not find even one copy of such testing. I called the testing labs and spoke with two bench chemists from two different labs, they both told me that they could not release to me or publish any testing results, and that the reason that the numbers were not released by their clients is because those numbers were so characteristically bad that mining companies chose not to release them. So, to properly assess true toxicity to the living body, we would have to have speciation of inorganic metal compounds as well as an assessment of organic forms. These tests are not being done. Only very limited and sporadic speciation is done and then only for arsenic and selenium, when the other heavy metals are also active in toxicity, and also synergistic in their toxicity. The limited speciation testing of infrequent arsenic and selenium, without the other metals, and not published, is inadequate in assessing true potential toxicity. There is a side synergistic toxicity of the metals in that they oppose and interfere with nutritional metals as demonstrated by the mineral wheel slides, that is independent of the toxicity from the biochemical effects in biochemical pathways of the chemical forms, and this must also be considered in total toxicity. In closing on this subject, the toxicity of the actual levels of metals cannot be determined until proper testing is done. In place of this lack of testing, we can follow the toxicity by following the health consequences of populations living downstream of the source of contamination, where local wells are recharged by the White River which runs through/close to the site. Currently, and still in process, there is a canvassing of door to door communities in Crawford, Pine Ridge and Rosebud of a health survey that will compare statistical analyses of those living with wells that are in the recharge area of the White River, those who are on web water piped in from the Missouri River and not contaminated, and those who are on well water not in the recharge zone of the White River. Following that survey, there will be water chemistry studies done on these groups as well as hair mineral analysis to show uptake and exposure of 39 metals and minerals in the human and animal populations.

Pursuant to 10 C.F.R. § 22.304(d) and 28 U.S.C. § 1746, I declare, under penalty of perjury, that the foregoing is true and correct to the best of my knowledge and belief.

Dated this 31<sup>st</sup> day of July, 2015.

Respectfully submitted,



A handwritten signature in cursive script, reading "Linsey McLean", written in black ink. The signature is positioned above a horizontal line.

Linsey McLean