UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
POWERTECH (USA) INC.,	)	Docket No. 40-9075-MLA
	)	
(Dewey-Burdock In Situ Uranium Recovery	)	
Facility)	)	

DECLARATION OF DR. ROBERT E. MORAN

I, Dr. Robert E. Moran, do hereby swear that the following is true to the best of my knowledge:

Professional Qualifications and Introduction

1. I am a hydrogeologist/geochemist with more than 38 years of domestic and international experience in conducting and managing water quality, geochemical, and hydrogeologic work for private investors, industrial clients, tribal and citizens groups, NGO's, law firms, and governmental agencies at all levels. Much of this technical expertise involves the quality and geochemistry of natural and contaminated waters and sediments as related to mining, nuclear fuel cycle sites, industrial development, geothermal resources, hazardous wastes, and water supply development. Much of this experience has involved uranium mining, processing, and related environmental impacts. I have significant experience in the application of remote sensing to natural resource issues, development of resource policy, and litigation support. I have often taught courses to technical and general audiences, and have given expert testimony on numerous occasions. Countries worked in include: Australia, Greece, Mali, Senegal, Guinea, Gambia, Ghana, South Africa, Iraqi Kurdistan, Oman, Pakistan, Kazakhstan, Kyrgyzstan,

Mongolia, Romania, Russia (Buryatia), Papua New Guinea, Argentina, Bolivia, Chile, Colombia, Guatemala, Honduras, Mexico, Peru, El Salvador, Canada, Great Britain, United States.

2. My services have been contracted to supply comments on the Powertech (USA) Inc. Dewey-Burdock (D-B) In Situ Recovery NRC License Application for the express purpose of aiding the Oglala Sioux Tribe, and others, in the drafting of contentions to be submitted to the NRC. My CV is attached.

Literature Reviewed

3. In addition to my professional experience, the opinions and comments that follow are based on review of all, or significant portions of the following documents:

Powertech Application for NRC Uranium Recovery License, Dewey-Burdock Project, Feb. 2009:

- Technical Report (TR)
- Environmental report (ER)
- Supplement to Application, Aug. 2009

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Summary of Comments.

4. As discussed in detail below, the Powertech application is technically deficient and not well organized. The application fails to include and analyze sufficient data to justify the conclusions asserted that the proposed mine will protect water quality, the environment, and human health. In particular, the application is deficient with respect to the baseline ground water, surface water, and hydrogeological characterizations. These aspects are critical to providing a defensible demonstration that mining fluids and mobilized constituents can be contained within the mine production zone and that impacted ground water can be restored to acceptable standards. The application fails to provide an adequate presentation of the potential impacts associated with waste disposal from the proposed mining operations, whether disposal by deep well injection or surface land application. Lastly, the application neglects to provide sufficient discussion of financial assurance calculations or amounts, a critical component for protection of natural and human resources.

Specific Comments

Powertech's Application is Technically-deficient and Disorganized

5. Powertech D-B Application is so disorganized and technically-deficient that it does not comply with the terms of NUREG-1569 and other relevant NRC regulations and should be revised. The various portions of the D-B Application total almost 6000 pages and are composed of:

- Technical Report (TR)-- 3103 pages;

- Environmental Report (ER)-- 2615 pages;
- Supplement to Application-- 66 pages.

The relevant information, if compiled in a direct, transparent manner using predominantly maps, tables and graphs, could easily have been summarized in 150 pages for the main volume. Instead, the Application is so duplicative and poorly-organized that it makes informed review by both the regulators and general public largely impossible. The Table of Contents for both the TR and ER provide no page numbers for the masses of information presented in the Appendices. The Appendices, in places, seem to have been thrown together with little or no logic to the organization. The authors of the main portions of the ER and TR, whoever they are, have made the review process unnecessarily convoluted, for both the NRC and the public. To that point, for numerous sections of the Application, it is not possible to discern whose opinions are being stated – Powertech's, one of their consultants, or some other source.

6. What follows in paragraphs (6-10) are a few examples of the disorganized nature of these documents: For both the ER and TR, the tables of contents present basic titles, but no page numbers for the thousands of pages of appendices. As it is the Appendices that contain much of the corroborating data, such careless organization makes document review and substantiation of claims written in the text unnecessarily difficult. The headings of the appendices, figures, and tables often are far too vague to be useful. For example, regarding ER Append. 3.4-A, the title simply says: WELL LOCATION DATA. This is an inadequate presentation and several questions are evident. Data complied by whom? When was the data compiled? For what types of wells (domestic? agricultural?)? Are those wells still in use? Are those wells monitored?

7. There are several other similar examples. One title says: Wells in Dewey-Burdock Database. Was this database originally compiled by Powertech? TVA?

8. Surface water sites discussed on pg. 2-192 through 2-194 of the TR have no specific names; they are simply labeled BVC01, BVC04, CHR01, CHR05. The field data for these sites are not integrated with the lab data from the same samples.

9. Application documents fail to provide summary tables and figures where they are most necessary. For example, the ER, pg. 3-39-40 provides no summary of the wells discussed, their uses, water-bearing units / formations, etc.; such tables should be included in the text where the discussions are taking place.

10. Water-related discussions / data are scattered throughout the ER and present inconsistent findings. For example, a reviewer (NRC or public) of water-related issues must search through the following sections:

3.4 Affected Environment [WQ and Q discussions not integrated];

4.6 Potential WR Impacts

6.1.8 GW Sampling

6.2 Physiocehmical GW Monitoring

7.4.3 Potential GW Impacts

8.1 Summary of Env. Consequences

Appendices:

3.3A, D

3.4A, B, C, D, E

3.5I

6.1B, C, D, E, F, G

Given the need for the applicant to submit supplemental information, these deficiencies should have been resolved at that time.

An Independent Review of the Application Is Necessary

11. Given the inherent conflict of interest in having the Application preparation directed, partially-prepared, and paid for by the project proponent, some independent party needs to take a more assertive oversight role, including in oversight of actual monitoring methods in the field. This is especially evident in the biased decisions made throughout these Application documents regarding baseline water quality and quantity decisions, as discussed below.

Water Use: The D-B Project will use and contaminate tremendous volumes of ground water

12**.** The D-B project area is semi-arid, having an average yearly precipitation of about 12 to 13 inches. While the application documents fail to report yearly evapotranspiration (ET), estimates of ET are roughly 70 inches per year, about 5 times the yearly precipitation (ER, pg. 3-176 and 177; Fig. 3.6-27). Because the project is presently expected to operate for between 7 and 20 years, it will require the use of tremendous volumes of local ground water.

13. Unfortunately, the Application documents present conflicting estimates of the volumes of water actually needed to operate the project. The ER, pg. 4-25, section 4.6.2.7.2 Water Requirements for the Proposed Action Facilities states:

“Water requirements of the CPP and other facilities are estimated to have a maximum requirement of **65 gpm**. As this requirement is relatively large, it is expected that most of this water will be derived from a water supply well in the Madison formation. Some of this water may be withdrawn from the Inyan Kara formation, but if so, it will not occur in a fashion to affect any well field operations."

While the last sentence is totally unclear as to specific details, the greater problem comes on reading ER pg. 8-2 (Table 8.1-1), which states that ground water consumption will be **320 gpm.** Aside from the obvious lack of consistency, both of the estimates translate into massive amounts of ground water when considered over the full life of the project.

The water usage data for the conflicting water usage numbers referenced in the Application result in total water consumption over the life of the project as follows:

65 gpm = 34.2 Million gpy (gals / yr).

After 7 yrs = 239,148,000 gallons, or 239.15 Million gals.

After 17 yrs = 580,788,000 gals or 580.8 Million gals.

320 gpm = 168.2 Million gpy (gals. / yr).

After 7 yrs = 1,177,344,000 = 1.2 Billion gallons

After 17 years = 2,859,264,000 gallons = 2.86 Billion gallons.

14. The TR, pg. 2-181, also says water requirements will be 65 gpm, but the subsequent discussion (pg. 2-181 and 2-182) indicates great uncertainty. These inconsistencies need to be rectified to enable effective public and NRC staff review. Clearly, both of these estimates indicate that vast quantities of ground water will be extracted from these aquifers over the long-term, and it seems overly-optimistic to simply state that no significant impacts will occur. At a minimum, Powertech should be required to construct a credible project water balance and to more seriously investigate the potential that such large-volume water use might impact local / regional ground water levels. At present, I see no evidence that the Application contains a reliable compilation of baseline water

level data for the surrounding domestic and agricultural wells (see discussion below). Without such reliable, summarized data, there will be no viable method to demonstrate that ground water levels (and related pumping costs) have not been impacted by project-related activities.

15. The public must assume that Powertech will pay no cost for the actual water (the commodity) used during operations---while numerous other users do. The specifics of this issue should be addressed by Powertech in writing.

Baseline Water Quality

16. The Powertech Application fails to define pre-operational baseline water quality and quantity—both in the ore zones and peripheral zones, both vertically and horizontally. Without adequate baseline water quality data (both ground water and surface water), there is no reasonable method for either the public or the NRC to evaluate the success or failure of either fluid containment or aquifer restoration. The Powertech Application documents repeatedly attempt to convey the impression that the D-B ground water quality is already degraded, rather than compile statistically-defensible data from both the ore zones and non-mineralized zones. This approach contradicts NRC guidance, which requires that pre-mining baseline conditions be defined before licensing (NRC, 2003, pg. 2-24).

17. Clearly the Powertech ground water baseline data should include, as a minimum, the chemical constituents listed in Table 2.7.3.1 of the NRC's Standard Review Plan (NRC, 2003, pg. 2-25). It seems only logical that the actual list of baseline constituents should be based on analyses of pregnant solutions resulting from leach testing of the D-B ores and lixiviants—not on theoretical assumptions about what might be the chemical

composition.

18. Frequently, uranium roll-front ores will also mobilize significant concentrations of additional constituents, such as antimony, lithium, and strontium (Moran, 1976). In addition, it is common to detect elevated concentrations of aluminum, sometimes as the result of well-drilling and completion techniques. Thus, it is recommended that these constituents be included in routine determinations of baseline water quality. In fact, standard lab analytical scans, such as ICP (inductively-coupled plasma spectroscopy) routinely report all (or most) of these metals and metalloids at the same cost. It should be noted that almost all of these constituents were included in the data in Appendix 3.4-C of the ER. I suggest that ammonia determinations be included to preclude future disputes regarding impacts (ammonia may enter the aquifer via numerous agricultural or industrial activities) along with ion balances, to assist in evaluating the reliability of the analytical data (Hem, 1985).

19. Section 2.7 of NRC (2003) is unclear whether applicants shall provide water quality data from unfiltered (Total concentrations) or 0.45-micrometer-filtered samples ("dissolved"). Much of the D-B data in the Application Appendices include both. It is recommended that unfiltered samples be collected and analyzed, as a minimum, for baseline ground water evaluation. These provide more *conservative* characterization of the ground waters, and waters used in rural areas (human and livestock consumption from wells; other agricultural uses; irrigation; fisheries) are not filtered. Furthermore, contaminants carried in particulate form are ingested by humans and other organisms when consuming unfiltered waters. These particles / colloids are dissolved by the extreme biochemical conditions found in the guts of such organisms, mobilizing the contaminants

into the blood and other tissues. In addition, many trace constituents are mobile in ground waters as colloidal particles (McCarthy, 1989; Ramsey, 2000), which would be removed by filtration, generating unreasonably-low concentrations.

20. The D-B baseline data should include statistical comparisons of the field and lab determinations of pH, and S.C. for the same samples. See section….below for further discussion.

21. The D-B project area has been historically mined and thousands of exploration holes have been drilled within the properties. Hence, it is imperative that high-quality baseline data be supplied to evaluate the actual extent of past impacts to water resources, and the success of future containment or aquifer restoration.

22. No coordinated, statistically-sound data set for **all** Baseline Water Quality data (both surface and ground water) is presented in these documents—as is required in NUREG--1569. For example, on pg. 2-14 and 2-15 of the Technical Report (TR), Sect. 2.2.3.2.2., Powertech states: "At the project site, baseline groundwater sampling was conducted in general (sic) accordance with NRC Regulatory Guide 4.14 (NRC, 1980). ... A summary of the results and methods for the groundwater quality monitoring program, as well as the historical TVA data, is presented in Section 2.7." However, when the reader goes to TR Section 2.7, there are no tables that actually statistically summarize complete baseline field and lab water quality data for the complete data sets—both historic and recent. Instead, for ground waters, Powertech presents statistics for field data from individual wells or selected aquifers, but fails to statistically-summarize the laboratory data and leaves out the historic TVA data. Powertech then states (TR, pg. 2-203): "Complete groundwater quality data results are available in Appendix 2.7-G." However, on TR, pg.

2-205 (Sect. 2.7.3.2.2.2, Results for Laboratory Parameters) Powertech then states: "Summary statistics for baseline monitoring program laboratory samples are contained in Appendices 2.7-H and 2.7-I. Appendix 2.7-H gives statistics for all groundwater constituents detected at or above PQL by constituent." Thus, it appears that Powertech has not included "qualified values," that is data reported as "less than" some concentration. By deleting the "less than" values, Powertech has severely biased the data set, rendering it useless as a reliable source for evaluating baseline conditions.

23. Furthermore, Powertech states (TR, pg. 2-217-218) that they have arbitrarily selected some analyses from the voluminous historic TVA data, but the reviewer is never allowed to see a statistical summary of the total original data set. Portions of the relevant data are scattered throughout the Appendices of the various documents, and disingenuously organized to leave out all baseline data that had concentrations reported below the detection limits (i.e. "less than" values). Obviously, this approach biases the data. Powertech must statistically summarize all historic water quality data and all recently collected data in separate tables, including all "less than values." Both historic and recent baseline data should be segregated by water-bearing unit. Even should averaging of water quality data over a portion of the aquifer be acceptable, the methodology employed in the Application of discounting relevant data points is untenable.

24. To further confuse the baseline issues, Powertech's Supplement to the Application (August 2009) states on pg. 3-3: "A minimum of eight baseline water quality wells will be installed in the ore zone in the planned well field area." Thus it appears that the Applicant intends that the massive amounts of water quality data (historic and recent) presented in both the TR and ER (Environmental Report) will not actually be used to

determine baseline. More importantly, it is unclear whether Powertech has baseline (pre-operational) ground water quality data that describes the **non-ore zone regions of the relevant aquifers.** It is imperative that baseline data for the non-ore zone ground waters be collected and summarized separate from those of the ore zones. Lastly, the Application should already contain a statistically-reliable database of baseline ground water quality data from all known wells within at least a one-kilometer radius of the project boundary.

Surface Water Quality Baseline Data: Application fails to include statistically-reliable summaries of detailed data.

25. The D-B Application casually dismisses the possibility of any significant impacts to surface water resources [ER, Pg. 4-14: 4.6 Potential Water Resource Impacts.] Page 4-16 of the ER states: “ISL operations do not involve the consumption of surface waters. Nor do the operations proposed require a long- term discharge to surface waters. For these reasons, no significant impacts to surface water quantity and use are anticipated.”

26. On ER, pg. 4-16 (Section 4.6.1.2 Potential Surface Water Impacts from Operations) it further states: “Potential impacts from accidental spills or permitted temporary discharge to surface water may include the release of process materials into the environment or a release or spill from the operation or well field (e.g., handling of fuels, lubricant, oily wastes, chemical wastes, sanitary wastes, herbicides, and pesticides). Surface water monitoring and spill response procedures will limit the impact of potential spills to surficial aquifers.”

These statements are far too simplistic and self-serving. They fail to mention that all such operations generate short-term discharges to surface waters, as a minimum. More importantly, the Application fails to provide a summarized, statistically-reliable surface water quality baseline database. As such, there will be no defensible method for verifying whether impacts to surface water quality have or have not occurred.

27. ER pg. 4-16 also states: "Most ISL operations extract slightly more groundwater than they re-inject into the uranium bearing formation. ***The groundwater extracted from the formation could result in a depletion of flow in nearby streams and springs if the ore-bearing aquifer is hydraulically connected to such features.*** However, because most, if not all ISL operations are expected to occur where the ore- bearing aquifers are confined, local depletion of streams and springs is unlikely, and potential impacts would be anticipated to be SMALL (NUREG-1910, 2008)."

28. As stated above, there is ample evidence to suggest that portions of the impacted water-bearing zones are, in fact, in hydraulic connection with each other and are also likely to be hydraulically-connected with local surface waters, springs, and seeps, especially when **long-term operating conditions** are considered. More importantly, Powertech has failed to provide a reliable baseline spring and seep survey. Hence there would be no way to verify whether future impacts were the result of the D-B operations. The Application provides no support for such statements. Thus, it is imperative that reliable surface water quality baseline data be made public and that a viable seep and spring survey be performed, prior to the issuance of any licenses.

The presence of high-quality ground waters within the D-B Project boundary have not been adequately defined.

29. Much of the Application discussion concerning ground water quality seems focused on showing that the site waters are already contaminated. This would not be surprising given the presence of the uranium mineralization and the past mining and exploration activities---all of which would have caused increased concentrations of numerous

chemical constituents above true pre-mining baseline. However, based on statements made in the ER, pg 1-16, Powertech has not adequately defined whether zones peripheral to the D-B ore-bearing geologic formations and bounding formations (above and below) also contain zones of high-quality, possibly potable ground water. Such zones should already have been defined as part of the Application documents.

The Application documents fail to present an adequate database and summary of Baseline Ground Water Levels, both within the project boundary or outside.

30. ER, pg. 4-18: states that "Background water levels will be monitored in regional wells." Such monitoring of water levels should already have been completed for numerous episodes over at least a one-year period prior to issuance of any permits. The Application also fails to provide a map and detailed program describing which wells will be included in such water-level monitoring.

31. Rather than presenting actual water level data, the Application (ER, pg. 4-21 through 4-23: Drawdown Estimates) attempts to substitute predictions of future water levels, all of which are based on unrealistic, theoretical assumptions. The public and regulators need to see actual baseline water-level data.

32. Also, the public and regulators should note the great range of uncertainty the ER presents for predictions of water level declines after 8 years of continuous pumping:

- at the nearest domestic well in the Fall River Aquifer, located 15,075 feet from the approximate center of pumping is **9.9 to 42.8 feet** (Pg 4-23);
- at the nearest domestic well in the **Lakota Aquifer**, located 10,915 feet from the approximate center of pumping is **4.9 to 12.6 feet.**

With such uncertainty, it is quite possible that some neighboring wells will be negatively impacted.

A Baseline Spring and Seep Survey is not presented in the Application.

33. The Application ER, pg 3-58 states that the region surrounding the D-B project contains numerous springs in both the Madison and Minnelusa formations.

Baseline surveys of springs and seeps are crucial in studies where large volumes of ground water are to be extracted. The flows of such seeps and springs often decline or stop after large-scale, long-term ground water extraction begins, especially in arid or semi-arid regions, such as the D-B area. If such impacts begin to occur, disputes will arise as to the possible roles of the project water extraction and overall climate change, for example. Hence, it is imperative that such a survey be performed prior to issuance of any licenses, and such a survey should include, as a minimum:

-locate and survey all springs and seeps within some reasonable radius of the project boundary;

-measure and record flow / discharge quarterly for at least one year prior to issuance of any licenses;

-during all field episodes, make field measurements of in-situ pH, water temperature, and S.C.(specific conductance) and collect samples for laboratory analysis. Samples should be analyzed for the same list of constituents noted in the Baseline water Quality comments above. Spring and seep water quality data should be interpreted as representative of local ground water quality (Freeze and Cherry, 1979; Hem, 1985).

Chemical Analyses (Detailed) of Ores, Pregnant Leach Solutions, Liquid Wastes are not presented in the Application.

34**.** The Application fails to provide actual, detailed chemical analyses (numerous) of representative pregnant leach solutions (ore reacted with lixiviant), both before and after undergoing ion exchange treatment. Such data would routinely include both in-situ measurements of fluid temperature, pH, specific conductance, possibly D.O. (dissolved oxygen) and Eh (redox). Similar representative, detailed data should also have been included for the detailed chemical composition of liquid wastes to be disposed of via deep-well injection or land application.

35. Because most mining projects at a similar stage of advancement have already conducted extensive laboratory testing and prepared Feasibility Studies to present to potential investors, such detailed chemical composition data would be available. It is not sufficient to present theoretical / expected chemical compositions, as has been done on ER, pg. 4-83. Smith & Assoc. (2005), pg. 5, reports that TVA, one of the previous mineral right holders, had a "pre-mine feasibility study" prepared, probably in the late 1970's or 1980's. If TVA had obtained such detailed data in earlier decades, certainly Powertech would have / should have also. Clearly some information in Feasibility Studies is considered proprietary, but detailed chemical composition data on the pregnant solutions and liquids / wastes described above should be included in any complete Application.

The D-B water-bearing units are hydrogeologically interconnected.

36. The application presents overly-optimistic conclusions about the isolation of the ore-bearing zones, aquifers, and the lack of fluid excursions that will occur, both vertically and horizontally. Powertech's description and evaluation of possible water-related impacts [ER pg. 8-2 (Table 8.1-1)] are unreasonably optimistic. It is unlikely that the process waters can be contained within the project boundaries given the following sources of the evidence.

37. The D-B uranium deposits occur in subsurface, fluvial channel, sandstone deposits in the Lakota and Fall River formations (Smith, 2005). These sandstones inter-finger with finer-grained silts and shales, often associated with lignites and coals, which form the typical lithologic sequences often seen in classic sedimentary uranium deposits (Abitz, 2005; Gott, 1974; Henry, 1982; Galloway, 1982; Henry, 1980; Harshman, 1972).

38. Hydraulically, such sedimentary packages typically allow ground waters to flow between the inter-fingering facies, both vertically and horizontally, when the coarser-grained sediments are stressed by long-term pumping. The hydraulic inter-connections are verified by conducting long-term aquifer tests integrated with sequential water quality sampling and in-situ measurement of field parameters (Henry, 1982; Galloway, 1982; Moran, R.E.—hydrogeochemical research activities, U.S.G.S., Water Resources Div., 1973—1978).

39. Thus, ore-bearing sandstones in typical sedimentary packages associated with roll-front uranium deposits do not routinely behave as hydraulically-isolated bodies. Numerous specific lines of evidence from the D-B Application documents indicate that the project sediments possess various pathways for the migration of water and contaminants from the ore zones into neighboring sediments, both vertically and laterally. For example, thousands of exploration boreholes have been drilled since the 1950's at the D-B site (Smith, 2005; TR, ER), many of which were not correctly plugged and abandoned (TR, Pg. 2-157; Append. 2.7-B, sub-Appendix D, pg. 1484; TR, Append. 2.6-A, pg. 972-1111). In addition, several sources (Smith, 2005, pg. 9; ER, pg. 3-106) report that the area contains historic shallow mine workings, both open pits and short tunnels that would provide additional flow pathways.

40. There are numerous old and existing water wells and old oil test wells in the D-B area, many with rusty and leaky casings, often unplugged or partially-plugged, drilled through several formations which act as potential pathways for flow between water-bearing units (ER, pg.3-40; TR, Append. 2.2-A, pg. 740-779; 2.2-B, especially pg. 864-902).

41. The TR, pg. 2-153-154, states that hydraulic connections between local D-B aquifers often result because confining units thin or are absent in many areas (ER, pg.3-56-57). In addition, Gott (1974) and others have mentioned the presence of breccia / evaporite pipes (collapse structures), which create vertical permeability pathways between aquifers. Gott (1974, pg. 27-29) and others discuss the common presence of faults and joints throughout the region, which could easily act as flow pathways.

42. Vertical and lateral hydraulic connectivity between the ore zones and the neighboring facies / formations are also indicated by the aquifer test results conducted in both 1979 and 2008 (ER, pg.3-56-57; TR, pg. 2-170 & 2-180, for example; TR Append. 2.7-B, Knight-Piesold Pumping Test Report, pg. 1290).

43. It seems obvious that the aquifer testing already performed demonstrates leakage between the various formations / facies bounding the ore zone. However, it seems equally likely that longer-duration aquifer tests conducted at even higher pumping rates would demonstrate even more clearly the leaky nature of these site sediments.

44. Repeatedly throughout the Application, Powertech states that the project will bleed 0.5 to 3% of leachate to maintain a cone of depression, which will prevent flow of leachate outwards (i.e. ER, pg. 1-14). Rather than supporting this allegation with long-term, technical data from other operating sites, Powertech has inserted a public relations

statement from the mining industries' lobbying group, the National Mining Association (NMA, 2007).

45. D-B Application Supplement, pg. 5-5 describes an aquifer exemption boundary, which acts as an additional buffer zone outside the monitor well rings **"to provide protection to adjacent water from the excursions that occur in the normal course of operations."** Page 5-6 of the Supplement further states that the aquifer exemption boundary is proposed to be up to 1200 ft. outside the monitor well ring, and **would be considered the point of regulatory compliance. Apparently simply pumping to create an inward flow direction is not adequate to control "excursions."** It appears this aquifer exemption boundary is actually an expanded ground water sacrifice zone.

Potential hydrogeologic pathways to nearby wells have not been adequately investigated and documented.

46. The discussion above presents ample evidence that the D-B area sediments contain numerous possible subsurface pathways for project leach fluids to migrate vertically between water-bearing units and outside the project boundaries. Unfortunately, as noted above, Powertech has not adequately defined the baseline water levels or water quality conditions of neighboring wells within a 1 to 2 mile radius of the D-B project. In addition, the TR, pg. 2-180, states that no public data are available on the use of aquifers in Fall River or Custer counties. Such data should have been compiled by Powertech as part of the Application, and should be required before any licenses are given.

Potential impacts to ground waters have been unrealistically minimized and inadequately characterized.

47. Powertech has failed to provide adequate baseline data to demonstrate that portions of the ore-bearing zones do not contain high quality ground water. On pg. 4-18 of the ER

they misleadingly state that all D-B ore zone ground water quality is degraded by natural mineralization processes. They have failed to provide the data to support this allegation and in many similar situations it is simply not true. Furthermore, many ground water-bearing zones in mineralized areas do not contain elevated concentrations of metals, non-metals, etc. until they have been exposed to air and bacteria---often as the result of previous mining or exploration drilling—as has occurred here. Even following exploration and mining activities, some portions of ore-bearing formations continue to contain high-quality ground water.

48. Hence, it is not defensible for Powertech to state, as they do in Sect. 4.6.2.2 (Potential Impacts of Production on Ore Zone Groundwater Quality) that: "Potential environmental impacts to groundwater are changes to water quality in well fields within the exempted aquifer**.** The impact, in and of itself, it is of limited significance, due to the fact that the groundwater quality is very poor prior to ISL operations; due to the presence naturally occurring radionuclides, heavy metals, and other constituents that exceed EPA and/or state drinking water limits. Accordingly, the exempted aquifer is not and can never serve as a USDW (HRI, 1997; NMA, 2007)." The citations provided here by Powertech do not pertain to the specific D-B situation and one, the NMA citation, is simply a routine public relations statement made by the industry's lobbying group.

49. The public relations statements continue on ER, pg 4-18, where they state: "Powertech (USA) has proposed to use gaseous oxygen and carbon dioxide lixiviant. The interaction of the lixiviant with the mineral constituents of the exempted ore zone results in a slight increase in trace elements and primary constituents of sulfate, chloride, cations and TDS above pre production levels. There is no introduction of non-naturally occurring

constituents from the leach fluids into the ore body."

50. To support these unsubstantiated statements, Powertech needs to supply actual, detailed chemical analyses of the pregnant leach solutions (multiple analyses)--solutions resulting from the chemical interaction of the proposed lixiviant and the ore zone rocks. All responsible parties knowledgeable about ISL operations are aware that the introduction of these lixiviants drastically changes the local ground water chemistry, routinely producing significantly-elevated concentrations of many major and trace metals and metalloids, plus other constituents: i.e. arsenic, antimony, molybdenum, selenium, vanadium, uranium, strontium, iron, manganese, lead, lithium, nickel, chromium, sulfate, chloride, etc. It is a total "red-herring" to claim that: "There is no introduction of non-naturally occurring constituents….."

51. In addition, there is ample evidence in the technical and regulatory literature to show that the leached aquifers at most, if not all ISL operations, have never truly been restored to their pre-operational, baseline water quality.

Land application is not an approved method of radioactive liquid waste disposal.

52. Powertech has proposed that various liquid wastes may be disposed via land application. However, US EPA (2008) guidance states that such land application is not an approved method for disposal of such wastes. Equally importantly, Powertech has failed to supply detailed chemical analyses of these proposed wastes (see discussion above) to clarify the chemical nature of the materials being disposed.

53. It is ironic that the Supplement to the Application states on pg. 4-7 that irrigation pivots have been used to dispose of non-hazardous wastes via surface application " with no deleterious effect on the environment" at Hobson, Mount Lucas, and Highland. In

2008, the operators of the Highland and Smith ISL mines in Wyoming were forced into a settlement agreement with the WY Dept. of Environ. Quality, because land application of liquid wastes containing elevated concentrations of selenium had contaminated soils. Part of the settlement agreement required the operators of Highland to immediately pay $8 million to accelerate reclamation activities and to increase their financial assurance bonds for these two sites to $80 million (WY DEQ, 2008). Furthermore, Faillace and others (1997) report that release of such waters will contaminate the soil at the land application areas. Radionuclides adsorbed by the soil will become a source term for radioactive release through wind erosion processes.

Deep Well Injection of Liquid Wastes. The Application fails to provide necessary details on the chemical composition of the wastes and water treatment specifics.

54**.** ER, Pg 4-21 (4.6.2.6 Potential Impacts of Groundwater Consumption During Operations and Restoration) states: "The majority of groundwater used in the ISL process will be treated and injected." However, no details are provided on the (actual) chemical composition of either the untreated or treated liquid wastes. Instead, ER, Pg 4-83 states: "The physical and chemical properties of the wastes will be similar to the estimated quality of wastes provided in **Table 4.15-1 for land application**. The process waters for deep well injection will meet the regulatory provisions in 10 CFR 20.2002 and be within the dose limits in 10 CFR 20.1301." Table 4.15-1 lacks many of the constituents for which water quality standards / criteria exist. Powertech should be required to provide actual, detailed analyses for such wastes.

55. In addition, the Application presents no details on the specific methods of water treatment that would be used prior to injection. As discussed above, such details are routinely known at this stage of a project.

Ground water sampling results presented in ER, section 6.1.8 (Groundwater Sampling, pg 6-62) should be combined and integrated with those in ER, Chapter 3.

56**.** ER, pg 6-69 states: "A groundwater quality constituent list was developed based on NUREG-1569 groundwater parameters, NRC 4.14 parameters, and added parameters from a constituent-list review with SD DENR." It is recommended that the constituent list be expanded to include all constituents for which any water quality standards or use criteria exist.

57. Which specific personnel performed the actual field activities (sampling and measurement)? Do field sheets exist to demonstrate that samples were preserved in the field?

The technical and regulatory literature amply documents the numerous failures to restore aquifer water quality at other ISL sites. Thus, it is reasonable to assume that portions of the D-B ground water surrounding the leached zones will have degraded water quality and may be unfit for future uses.

59**.** Powertech repeatedly makes optimistic statements about aquifer restoration such as: "Powertech (USA) will restore GW in each depleted well field consistent with pre-operational or baseline WQ conditions…….." ER, pg. 1-1. However, there is no demonstration as to other in-situ operations that have been able to do so. Indeed, the historical reality from other operating or closed ISL sites demonstrates an inability to restore to pre-operational or baseline WQ conditions for all constituents. (Otton, 2009; Hall, 2009).

The Application fails to adequately describe the common names (in addition to commercial names) and quantities of chemicals, fuels and explosives to be used and stored per year at the D-B site.

60. The ER, pg. 1-32, presents some information on the chemicals to be used, but no quantities are given. ER, pg. 1-34, Sect. 1.4.7.9 presents a very limited mention of the

fuels to be used, but again no details on the quantities. All categories of chemicals, explosives, fuels, and any other potential environmental contaminants need to be summarized in a simple table including estimated quantities to be used per year. *Equally importantly, all categories of baseline monitoring should determine chemical constituents that will indicate the possible presence of these compounds (organic and inorganic) in the environment.*

What Commercial Products will be Extracted?

61**.** Does Powertech intend to produce only uranium yellowcake as a commercial product or will other products be generated? [Any molybdenum, selenium, etc. products anticipated?]

Improper Technical Conclusions.

62. The Application is inadequate in its attempt to demonstrate that the ground water quality data are of suitable quality, as on ER pg. 3-61, 62. Here they state that a comparison of field and lab pH and specific conductance data "are within reasonable limits." Despite the vagueness of the language, this statement / section demonstrates a failure to understand the basics of applied water quality. Ground water chemistry routinely changes between the time a water sample is lifted from a well--where field pH and S.C. measurements should be made immediately--and much later when investigated in a laboratory. Hence, it is inappropriate to argue that, for example, the highest measured field pH was 12.67 and it "was verified by the contracting laboratory which reported a pH of 12.4 in the sample" (p. 3-62). Of course the chemistry changed as the temperature and pressure of the sample changed, the sample de-gassed, and various chemical reactions occurred. However, the authors failed to comment on the significance of the actual

reported pH of 12.67. In such a hydrogeologic setting, a site that had been previously drilled by thousands of exploration boreholes, and possibly previously mined, the logical conclusion is that such a pH represents evidence of some form of contamination -- possibly from the incorrect completion of a well with cement and / or bentonite grout, a spill of some alkaline chemicals, or from some past attempts to test the leachability of these ores using an alkaline lixiviant. The same is true for the insufficient discussion of the field versus lab specific conductance values at well 677, which were reported to be 12,220 µS/cm versus 11,000 µS/cm (pg. 3-62). The authors ignore the more reasonable conclusions that some form of contamination has occurred.

63**.** However, someone preparing the Powertech ER knows that water quality data should be summarized statistically, as is evidenced by the format of ER Table 3.4-4, for all Powertech field parameters. Unfortunately, the Powertech documents fail to summarize the *laboratory data* in the same fashion. Nowhere else in the body of the ER is a similarly-detailed, statistical summary of water quality data presented. Also, they fail to include the previous water quality data from the historic TVA and other data in these summaries. Worse, they have chosen to leave out of their water quality summaries all lab data that have *qualified values* -- that is, values reported as “less than” some concentration. This approach totally biases the various data sets, because it neglects to include all determinations that had very low concentrations.

Compliance: The actual regulatory role of US EPA here is unclear.

64. Application Supplement, pg. 5-6 states: “EPA Region 8 has stated that they want to limit the distance outside the monitor well ring to minimize potential environmental impact. There is an idea that if there is an excursion out to the aquifer exemption

boundary, operations will be shut down." This description does not provide a sufficient description of the EPA's regulatory program. The application should define these specifics, including a full description of "the idea that if there is an excursion out to the aquifer exemption boundary, operations will be shut down."

UCL Parameters should be approved by NRC.

65. Application Supplement, pg. 5-6, Sect. 5.2.7 states: "Powertech management has always used Chlorides, Sulfate, and Uranium as Upper Control Limit (UCL) Parameters. Sometimes Total dissolved Solids is used." This statement seems disingenuous as Powertech has never operated an ISL mine. Once a reliable baseline ground water database has been approved (for the various zones described above, not simply the ore-bearing zone), the NRC should approve the constituents designated as UCL parameters.

Powertech's proposed ALARA goal for limiting uranium concentrations in site soils

66. The ER, Pg 4-80 states: "Powertech (USA) Uranium USA proposes an ALARA goal of limiting the natural uranium concentration in the top 15 cm soil layer to 150 pCi/g averaged over the impacted areas. Subsurface soil (greater than 15 cm) natural uranium concentrations should be limited to 230 pCi/g averaged over the impacted area based on chemical toxicity." NRC should make public its opinion on this proposed goal prior to the issuance of any licenses.

Soil contamination (radiation and metals / metalloids) from past mining and exploration should be incorporated into determining baseline

67. ER, pg. 6-13 (Monitoring Programs--Surface Mine Area) states: "In the surface mine area, the gamma-ray count rates ranged from 5,550 to 460,485 cpm and the median was 12,717 cpm. In general, clusters of higher readings are associated with un-reclaimed open pit uranium mines, waste rock, rocky outcrops, and drainages in the surface mine area."

"It is clear that the surface mine area in the eastern quarter of the site exhibits radiological impacts from historic and/or current anthropogenic activities within the area. In addition, gamma-ray count rates in the anomalous north area also are clearly distinct from those in the wider main PAA. **The precise sources of the differences are not relevant in the context of this investigation since they are part of the baseline or background radiological characteristics of the site."**

68. The site is clearly contaminated from past activities, and no reclamation has been required. Powertech has a conflict of interest if allowed to determine which data are relevant here. The NRC should make public its opinions on these matters prior to issuance of any licenses.

Baseline soil and stream sediment databases should include data for a broad suite of other chemical constituents (metals, organics, etc.) besides simply selected radiochemical constituents.

69. The ER, pg 6-21and 22 (6.1.3 Soil Sampling) states: Soil samples were analyzed for radium-226 while two were also analyzed for natural uranium, thorium-230, and lead-210. Baseline soil data should include data for a many additional chemical constituents, especially those that are routinely considered to be potentially toxic at hazardous waste sites. Similar comments pertain to stream sediment samples, which are described on ER, pg 6-41.

Financial Assurance.

70. The NRC and the general public know several general facts about the usefulness of most company-generated financial assurance estimates:

1-They generally are based on overly-optimistic assumptions about future water quality, thereby under-estimating costs. Kuipers (2000) conducted a survey of bonding practices at metal mines throughout the western U.S. and found that the bond amounts available were hundreds of millions of dollars below that necessary to conduct actual clean-ups. Many of the "problem" sites have been foreign-owned entities, especially those with their corporate headquarters and assets based in Canada.

2-Aquifer restoration at most, if not all previously-licensed and operated ISL sites fail to actually return ground water quality to baseline conditions [Hall (2009); Otton and Hall (2009);

3-Predictions of future aquifer restoration success made by the project proponents seldom use truly conservative assumptions. Calculation of financial assurance amounts made by representatives of the party that stands to profit from project licensing represent an extreme conflict of interest.

4-The technical literature is filled with documentation that quantitative predictions of future water quality at specific sites cannot be done reliably [Sarewitz, et. al. (2000); Moran (2000); Pilkey & Pilkey-Jarvis(2007); Kuipers & Maest (2006)], and the general failure to restore aquifers back to pre-operational baseline concentrations supports this. At an academic level, this approach must be totally rejected because it assumes one can make accurate and precise *deterministic* predictions.

71. For these reasons, the financial assurance calculations should be made by some independent party, not paid or directed by the project proponents. These calculations should also consider the actual reclamation and restoration costs incurred, long-term, from a statistical sampling of the previously-licensed ISL sites. Furthermore, these

financial assurance amounts and mechanisms should be made public prior to award of any licenses.

72. To ensure protection of the general public, such financial assurance vehicles (bonds, etc.) should be made with the parent corporation, not simply the local operating entity.

Pursuant to 10 C.R.F. § 2.304(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.

Signed on the 4th day of April, 2010,

Robert E. Moran

Robert E. Moran, PhD.