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
	)	ASLBP No. 10-898-02-MLA-BD01
(Dewey-Burdock In Situ Uranium Recovery	)	
Facility)	)	

WRITTEN REBUTTAL TESTIMONY OF DR. ROBERT E. MORAN

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

The opinions and testimony below are based on my review of the materials in the hearing record, including written testimony, and those materials referenced in my previous declarations, my opening written testimony, and in the testimony below. My qualifications as an expert in hydrogeology and geochemistry are set out in my opening written testimony.

Rebuttal Testimony: Contentions 2 & 3

The opening written testimony provided by Powertech's consultants regarding Contentions 2 and 3 provides further support for my opening testimony regarding the inadequacy of baseline characterizations and resulting errors in characterization of the interrelated hydrogeology, water quality, and water quantity of the project area and region.

Based on my review of the written testimony of Powertech's consultants, Mr. Lawrence (APP-037), Mr. Demuth (APP-013), and Mr. Fritz (APP-046), it is my further opinion that adequate hydrogeological analysis and data gathering can be conducted without construction and operation of the Nuclear Regulatory Commission (NRC)-approved well field and is necessary for a scientifically competent, interdisciplinary analysis of baseline water quality, water quantity, and hydrogeology. Examples of such sources of information are contained in and include published reports (e.g. TVA, 1979; Boggs & Jenkins, 1980; Boggs, 1983; Knight Piesold, 2008).

Contention 2: Baseline Characterizations are Inadequate

A. Past Uranium Mining and Other Contamination.

1. *Expert Opinion*: Analysis of impacts from past mining and other contamination are critical to assessing the baseline water quality, and potential impacts of future mining activity at the proposed site.

2. *Response to Powertech Testimony:*

I have reviewed the opening written testimony of Mr. Lawrence (APP-037), Mr. Demuth (APP-013), and Mr. Fritz (APP-046) and it appears each confirms that the license conditions approved by NRC Staff allow a delay in the gathering of detailed hydrogeological data and water quality testing until after NRC license approval and National Environmental Policy Act (NEPA) analysis is complete. The confirmation of delayed gathering provides further support for my opinion that the data are inadequate to establish a hydrogeological and water quality baseline for the aquifers that would be impacted by the Dewey-Burdock Project.

Powertech's consultants confirm that the information that may be gathered in the future is critical to a baseline characterization and in turn, a reasonably complete analysis of the environmental impacts of the project. There is no doubt that this information was unavailable for review by expert agencies such as USGS and EPA, and experts such as myself who assisted persons participating in the NEPA process. The lack of data during the NEPA process and during the licensing process prevents an adequate disclosure and analysis of the impacts of the D-B Project, and prevents the analysis, comparison, and choice of adequate mitigation measures.

Powertech consultants are incorrect in asserting that the individual well fields must be constructed and put in operation before the requisite level of hydrogeologic testing, sampling and analysis can be performed. For example, Mr. Demuth (APP-013) answers a misleading question posed by Powertech:

> Q.29. Can Powertech conduct pumping tests for each wellfield prior to license issuance?
>
> A.29 No. Powertech cannot conduct the aquifer pumping tests for each wellfield prior to license issuance, since it cannot construct the wellfield monitoring network for any wellfield until the license is granted (see A.22 of this written testimony). [...]

Mr. Demuth's response and the original question are misleading in that the question implies that a licensed, operating wellfield is necessary to create a reliable baseline.

In my opinion, pumping tests designed to establish the baseline site characteristics can be designed and carried out without constructing the ultimate wellfield monitoring network. For example, both Tennessee Valley Authority (TVA) and Knight Piesold conducted pump tests within the Dewey-Burdock area prior to NRC permit approval. Also, Mr. Demuth confuses hydrogeological testing that is needed to establish, analyze, and disclose the hydrogeological setting as part of the NEPA-based NRC permit-approval with the more specialized production tests Powertech will conduct on constructed wellfields.

Mr. Demuth's answer at APP-13 A.29 also claims, without support, that the admitted delay in gathering baseline data "does not mean that information needed to assess potential groundwater impacts is lacking at this stage of the licensing process." It is my expert testimony that the information is lacking. The specific information lacking is listed in my Opening Written Testimony (OST-1) at C.2. Based on my experience and training, it is my opinion that it is standard hydrogeological practice to collect and interpret such data (see OST-1 at C.2) in order to define ground water flow pathways and possible future impacts. Such data are also needed to provide reliable inputs for any computer modeling that may be employed. The present Powertech modeling is based on incorrect hydrogeological assumptions and inadequate data and therefore generates unreliable predictions. In my opinion, Mr. Demuth's answer at APP-13 A.29 contradicts standard hydrogeological practices.

Powertech's consultants now assert that the data relied upon in its application materials and the NEPA analysis are not useful. For example, Mr. Lawrence asserts at APP-037 A.56 and A.57 that the D-B exploration boreholes are closed through natural processes and in other testimony that they are open. Mr. Lawrence also concludes at APP-037 A.80 and A.85 that these borehole problems have rendered the pump test results useless. Mr. Lawrence further testifies that some of the leakage was due to an improperly completed well, but he supplies no proof of the improperly completed well, and none of the earlier consultant's reports mentioned this limitation.

I agree that the Dewey-Burdock pump tests alone are inadequate to establish a hydrogeological and water quality baseline. Further, the previously undisclosed irregularities in the data provided by Powertech provide further support for my testimony that Powertech and the NEPA analysis both failed to adequately define the detailed hydrogeologic conditions of the Dewey-Burdock aquifers and confining zones, or likely impacts.

Throughout the written testimony of Powertech's consultants, each selects only information and sources that support their preferred conclusions and fail to analyze information or analyses that disclose difficult problems —which means they failed to include some of the most important, relevant hydrogeological studies. In my opinion, Mr. Lawrence and the other Powertech consultants simply ignore difficult problems, effectively sweeping them under the rug and out of view of persons reviewing the NEPA analysis and license materials. The unreliable hydrogeological and water quality baselines presented by Powertech and the NEPA analysis are confirmed where Powertech consultants' assertions contradict their own previous assertions regarding the reliability of existing data.

For example, Demuth testifies at APP-013 A.29: "NRC staff **reviewed** Powertech's procedures for locating and installing monitor wells and for conducting the pumping tests and determined those procedures meet regulatory requirements (see below). The results of those pumping tests **will be provided** to NRC and EPA staff for review and will have to demonstrate adequacy of the monitoring network prior to operating each wellfield." (emphasis added). Mr.

Demuth confirms that the hydrogeological information provided in the Dewey-Burdock documents is inadequate to reliably characterize hydrogeological conditions and evaluate future changes and impacts to water resources.

Mr. Demuth's statement at APP-013 A.32 goes on to argue that the NRC-approved pump tests were flawed (TVA & 2008) and do not confirm whether or not the site involves leaky aquifers. This inconsistent statement supports my contention that the FSEIS failed to adequately define the hydrogeologic behavior of the Dewey-Burdock aquifers, confining zones and likely impacts.

Mr. Demuth testifies at APP-013 A.12: "It is also my testimony that, according to NUREG-1569 and federal regulations in 10 CFR Section 40.32(e), a **license applicant is not permitted** until after license issuance to install a complete wellfield monitor well network that is used to establish Commission-approved background (CAB) groundwater quality within the production zone of each wellfield and upper control limits (UCLs) that are used for excursion monitoring in underlying, overlying and perimeter monitor wells." Similar to Mr. Demuth's misleading testimony at APP-013 A.29, the explanation at A.12 confuses testing and analysis that is routinely performed by hydrogeologists in order to understand numerous hydrogeologic processes in almost any project and before NRC permit approval, with requirements after NRC-permit approval.

Mr. Demuth at APP-013 A.53 states that industry "success" at historic ISL sites has been confirmed by studies partially-summarized at 3 ISL sites out of possibly 35 to 40 sites that have long-term operational histories. In my experience, no ISL site has ever been returned to baseline. Mr. Demuth's statements confirm that the FSEIS has not adequately summarized the industry aquifer restoration successes and failures. Mr. Demuth's assertions help explain that the failure to timely restore aquifers to baseline conditions after cessation of ISL operations is partly a result of delaying the collection of necessary hydrogeological and water quality data until after NRC Staff approval, which avoids scrutiny of expert agencies and the public. Thus, license conditions that delay collection of these necessary hydrogeologic and water quality data / information until after NRC permit approval ensures that much of the detailed information will never become public or face careful review by other agencies and the public in a NEPA process.

Last, at APP-013 A.33 Mr. Demuth cites the ground water samples collected by Johnson, but fails to mention that these USGS data contain many more chemical constituents than are included in the Powertech water quality data. In my opinion, many of the constituents identified by the USGS should have been included as part of the "baseline" monitoring data, but were not. Mr. Demuth also fails to note that these USGS samples, although useful for other purposes, were not collected after long-term pumping, and do not represent long-term conditions. These USGS water quality / geochemistry samples were not collected as part of an integrated hydrogeology / water quality study. As stated in my written testimony, reliable conclusions about leakage between geologic

units and ground water-surface water interactions require more detailed, integrated testing.

B. Inadequate Baseline Concept and Baseline Data.

1. *Expert Opinion*: The Application and Final Supplemental Environmental Impact Statement (FSEIS) are inadequate to establish a hydrogeological baseline for the aquifers that would be impacted by the Dewey-Burdock Project.

2. *Response to Powertech Testimony:* See response in A.2.

C. Fundamental Hydrogeologic Information is Lacking.

1. *Expert Opinion*: The FSEIS and Application lack necessary scientifically-defensible hydrological and hydrogeological information.

2. *Response to Powertech Testimony:* See response in A.2

D. Data Provided Entirely by the Applicant is not an Accepted or Reliable Basis for Analysis.

1. *Expert Opinion*: Analytical results that rely entirely on data provided by the project proponent are not considered reliable by professional hydrogeologists and other water experts.

2. *Response to Powertech Testimony*: See response in A.2

Powerech has split the water-related testimony among three consultants, none of whom claim to have preformed any of the original hydrogeological testing or water quality sampling. None of Powertech's testifying consultants claim to be familiar with the actual details that influence the larger interpretations. The result of this disconnect between data gathering and analysis/interpretation is to confirm the inadequacy of the data obtained and the lack of interdisciplinary analysis in the NEPA analysis.

Contention 3: The Targeted Production Zones are Unable to Contain Fluids.

My response to Powertech testimony provided by Mr. Lawrence (APP-037), Mr. Demuth (APP-013), and Mr. Fritz (APP-046) affecting Contention 3 applies across all my opinions. Further, Powertech consultant's written testimony is based on the false assumption that the targeted production zones are able to contain fluids and do not leak horizontally or vertically into other water-bearing zones. It is my opinion that the targeted production zones involve "leaky aquifers."

The written testimony of Powertech's consultants, like the application and NEPA documents, select only information and sources that support their preferred conclusions and fail to cite those in opposition—which means they failed to look at or cite some of

the most important, relevant hydrogeological studies. In my opinion, such a methodology is not scientifically defensible and not up to the industry standard. Powertech consultants' written testimony are based on assertions that contradict opinions of all the other investigators who actually conducted and interpreted the D-B pump tests (Boggs & Jenkins, 1980; Boggs, 1983; KP, 2008), who state that there is leakage between the Fall River and the Lakota through the Fuson, and leakage within the facies of the Lakota. Mr. Lawrence totally disregards the same and related inconvenient opinions within, for example, Gott, et. al. 1974; Keene, 1973; TVA Envir. Statement, 1979; Butz, et. al., 1980; Boggs, 1983; Bredehoeft, Neuzil & Milly, 1983; SRK, 2012.

Leakage between geologic facies was not addressed, even though the overall hydrogeological literature and my experience indicate that leakage occurs (between the mined aquifers and the "confining" units) at most ISL sites operated in similar fluvial sedimentary uranium hydrogeologic settings during long-term pumping. *However, because the detailed hydrogeologic and water quality testing are delayed until after NRC permit approval, most of this information never becomes available to the public.*

Mr. Demuth's testimony at APP-013 Q.7 provides an inadequate description and conceptual diagram as a basis for his further assertion: "Within an aquifer water flows by porous media flow in interstitial spaces between the sand grains that make up the aquifer. This is depicted in the enlargement on the right of the conceptual diagram." Mr. Demuth's simplistic approach is inapplicable and misleading when applied to the majority of inter-bedded sediment packages in the project area. Instead, much of the water in leaky aquifers is actually supplied via leakage from confining units after long-term pumping.

The erroneous picture presented by Mr. Demuth's simplistic approach is confirmed by basic hydrogeological principles discussed in my opening written testimony: For example, **Freeze & Cherry, 1979, Groundwater at** p. 320 discuss the dangers of calculations that assume any aquifer is confined. "The assumption inherent in the Theis solution that geologic formations overlying and underlying a confined aquifer are completely impermeable is seldom satisfied. Even when production wells are screened only in a single aquifer, it is **quite usual for the aquifer to receive significant inflow from adjacent beds. Such an aquifer is called a *leaky aquifer,* although in reality it is the aquitard that is leaky."** (emphasis added).

Freeze and Cherry go on to explain at p. 332 that "The most common geological occurrence of exploitable confined aquifers is in sedimentary systems of interbedded aquifers and aquitards. In many cases the aquitards are much thicker than the aquifers and although their permeabilities are low, their storage capacities can be very high. In the very early pumping history of a production well, most of the water comes from the depressurization of the aquifer in which the well is completed. **As time proceeds the leakage properties of the aquitards are brought into play and at later times the majority of the water being produced by the well is aquitard leakage. In many aquifer-aquitard systems, the aquitards *provide* the water and the aquifers *transmit* it to the wells." (emphasis added).**

It is my expert opinion that both quantity and quality must be addressed in an interdisciplinary manner because as the leakage progresses, the chemical quality of the water being pumped changes. Powertech failed to conduct hydrogeological testing that was integrated with water quality sampling and analysis.

It is my expert opinion that the Powertech consultants' testimony relies on oversimplified and conceptual assumptions to assert that the aquifer is totally confined. In my opinion, the limited data provided, read consistently with accepted hydrogeological principles, confirm that the D-B project involves leaky aquifers, which require additional data to adequately characterize.

Contention 4: Failure to Adequately Analyze Ground Water Quantity Impacts.

A. Water Consumption

1. *Expert Opinion:* The applicant will use and contaminate tremendous quantities of ground water, thereby preventing / restricting the use of these waters by others.

2. *Response to Powertech Testimony*:

Mr. Demuth answers Q.27 by stating at A.27 that "**The latter [hydrogeologic] information is not required to assess potential impacts to groundwater** but instead to confirm that proper operational and monitoring procedures are followed to prevent groundwater contamination." It is my opinion that Mr. Demuth's conclusion confirms that hydrogeologal information was ignored by Powertech and the NEPA documents. In my opinion, defining the hydrogeological setting is critical to analyzing potential ground water quantity impacts.

At A.45, Mr. Demuth wrongly asserts that water lost via evaporation from the waste ponds has no effect on the volumes of water used by the D-B project. Mr. Demuth wrongly asserts that my expert opinion was "based on a false premise – that water loss through evaporation would somehow increase the overall water consumption rate." My testimony is not based on the increase in consumption rate. My testimony is based on the conclusion that such evaporation and any other categories of water loss not accounted for in the FSEIS estimate will increase the total volumes of water used by the D-B project.

B. Water Balance

1. *Expert Opinion*: The FSEIS relied on an inadequate and unreliable analysis of water use, and failed to provide a water balance.

2. *Response to Powertech Testimony:*

Mr. Fritz does not indicate that he conducted any of the data collection or initial analysis. Instead, Mr. Fritz' written testimony appears to attempt to identify materials in the hearing record that could be construed as part of a water balance. The comments of Mr.

Fritz do not change my opinions or the basis of my opinion that the FSEIS does not contain a water balance.

For example, at APP-046 A.6, Mr. Fritz points out that "Groundwater use was a primary focus of the June 2011 TR RAI responses (Exhibit APP- 016-A through 016-BB), including providing a project-wide **water balance** in support of the discussion on handling liquid waste (P&R-14(c), Exhibit APP-016-B at 68-73). This RAI response provides a detailed description of the quantity of **water anticipated to be used from the production zone aquifer (Inyan Kara) and from the Madison aquifer** (primarily for groundwater restoration) during production and groundwater restoration operations. Much of this information has been incorporated into the FSEIS (i.e., Sec. 2.1.1.1.3.3)."

The question posed to Fritz at APP-013 Q.7 mischaracterizes my testimony. Mr. Fritz is asked: "How do you respond to the allegation that the FSEIS provides conflicting information on the volumes of water to be used such that the water consumption impacts of the project cannot be accurately evaluated (CI 2013 at 27, CI 2014a at 25, **Moran 2013 at 12**, OST 2013 at 19, OST 2014a at 19)?" The response at Moran 2013 at 12 is not related to volumes of water. It appears, from this and other examples, that Mr. Fritz and other Powertech consultants have simply inserted random supporting citations that are unrelated to my expert opinion that the FSEIS does not contain a water balance.

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.

Signed on the 15th day of July, 2014

Robert E. Moran

Dr. Robert E. Moran, Ph.D.