UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of NUFUELS, INC. (Crownpoint Uranium Project In-Situ Recovery Facility)	Docket No. 40-8968-LR; NRC-2026-1882 License No. SUA-1580 July 27, 2026

Exhibit 2

Declaration of Dr. Richard J. Abitz, PhD

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Declaration of Richard J. Abitz, PhD

1. My name is Richard J. Abitz. The opinions expressed herein are my own and are held to a reasonable degree of scientific certainty. My education and experience as a professional geologist are described in my vita, attached to this declaration as **Exhibit A**. I have a Doctor of Philosophy in geology (emphasis in geochemistry) from the University of New Mexico and over 38 years of experience as an environmental consultant dealing with problems associated with the solubility and mobility of hazardous and radioactive elements in the sediment/water environment of major aquifers. My declaration is given in support of several of the contentions raised by the State of New Mexico's petition (EC-1, EC-2, EC-7, SC-1, SC-2, and SC-3) on the inability of the mining industry to restore groundwater quality in an aquifer that has been subject to uranium ISR mining. I have reviewed the petition and the facts and opinions attributed to me are my own.

2. I presently serve as the principal scientist/owner of Geochemical Consulting Services, LLC (GCS). GCS provides technical services to government contractors and confidential clients in the areas of document preparation and review associated with groundwater restoration and human health risk and dose assessments.

3. Previously, I served as the director of the Environmental Restoration Group for the Idaho Closure Project contract at the Department of Energy's (DOE) Idaho National Laboratory Site. My experience also includes years of work with uranium contamination in the surface environment and groundwater at the DOE Portsmouth and Fernald Sites. At the Portsmouth Site, which produced low enriched uranium for commercial power plants and highly enriched uranium for weapon components and Navy ship reactors, I served as the senior scientist responsible for dose calculations to assess the risk to human health associated with exposure to

EXHIBIT 2

uranium and other radionuclide isotopes under present conditions and a future condition where all contamination was buried in an on-site disposal facility. At the Fernald Site, which processed uranium ores and yellow cake for over 30 years (1952 to 1985) to produce uranium metal for plutonium production reactors at the Hanford and Savannah River Sites, I managed the Environmental Services Division for the Fernald Closure Project. Our division was responsible for 1) installation and development of monitoring, extraction, and injection wells, 2) air, water and soil sampling activities, 3) analytical facilities for the measurement of radionuclides, metals, and organic compounds in soil and water samples, 4) *in situ* measurements of ^{226}Ra, ^{232}Th, and ^{238}U activities in soil using sodium-iodide and high-purity germanium detectors, 5) data verification, validation, and reporting, and 6) data analysis, modeling, and reporting.

4. In addition to my experience at DOE sites, I have served as a subcontractor to the Environmental Protection Agency (EPA) in support of groundwater remediation at the Homestake uranium tailings site north of Milan, NM. For the Navajo Nation (New Mexico), Sioux Nation (Nebraska), Goliad County Groundwater Conservation District (Texas), and National Resources Defense Council, I served as a technical expert and witness to evaluate the impact of proposed uranium in situ recovery (ISR) mining on community groundwater supplies. I have also provided technical input to the Wyoming Powder River Basin Resource Council's comment responses to EPA's proposed Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192).

5. Based on my geology education and environmental work experience, I have extensive theoretical, laboratory, and field knowledge on 1) the solid forms of uranium in aquifer sediments; 2) the chemical reactions that are responsible for the mobilization and/or adsorption/precipitation of uranium from groundwater systems; 3) well fields and ion-exchange operations associated with recovering groundwater that is contaminated with uranium; and 4) the rocks and structures of the southern San Juan Basin, which includes the Westwater Canyon Member of the Morrison Formation that hosts the Church Rock and Crownpoint uranium deposits.

6. In preparation of this declaration, I have reviewed the following documents:

Cameco Resources, 2018, Application for Alternate Concentration Limits, Mine Unit 1, Smith Ranch-Highland Uranium Project, SUA-1548 (ML18065A233 (application letter)); (ML18186A337 (Appendix C)), (ML18186A328)

Gallegos, T.J. et al, 2015, Persistent U(IV) and U(VI) following In Situ Recovery (ISR) Mining of a Sandstone Uranium Deposit, Wyoming, USA, Applied Geochemistry, v. 63

Gallegos, T.J. et al, 2022, A Methodology to Assess the Historical Environmental Footprint of In Situ Recovery (ISR) of Uranium: A Demonstration in the Goliad Sand in the Texas Coastal Plain, USA, Minerals, v.12

Hall, S., 2009, Groundwater Restoration at Uranium ISR mines , South Texas Coastal Plain; USGS open-file report 2009-1143

Lasaga, A.C., 1981, Rate Laws of Chemical Reactions, in Kinetics of Geochemical Processes, American Mineralogical Society, v.8

Lucas, S.G., 2005, Declaration of Dr. Spencer G. Lucas in the Matter of Hydro Resources, Inc., (Docket No. 40-8968-ML, ASLBP No. 95-706-01-ML)

NRC, 1988, In consideration of the release of Source Material License SUA-1479 for Mobil Oil Corporation, Crownpoint, Section 9 In Situ Pilot Test Project, McKinley County, New Mexico (Docket No. 40-8911, ACN 8802230437) (ML071350629)

NRC, 2009, Data on Groundwater Impacts at Existing ISR Facilities (ML091770385)

NRC, 2012, Technical Evaluation Report, Review of Christensen Ranch Mine Units 2-6 Groundwater Restoration Report, Willow Creek Project, SUA-1341 (ML12174A048)

NRC, 2025, Request for Supplemental Information for the Acceptance Review of the License Renewal Application, NuFuels, Inc. Crownpoint Uranium Project, McKinley County, New Mexico (SUA-1580 NRC Docket No. 040-08968) (ML25080A079)

NRC, 2026, Request for Additional Information to Support the Review of the NuFuels License Renewal Application for the Crownpoint Uranium Project, McKinley County, New Mexico (SUA-1580 NRC Docket No. 040-08968) (ML26191A309)

NuFuels, Inc. and Los Alamos National Laboratory, 2023, Project Narrative File: Laboratory-Scale In-Situ Recovery and Restoration Demonstration Using Uranium Deposit Core Materials, DE-FOA-0002491 (ML23304A114)

NuFuels, 2025, Environmental Report for the Crownpoint Uranium Project, NRC License SUA-1580 Renewal, McKinley County, New Mexico (ML25022A292)

NuFuels, 2025, Consolidated Operations Plan for the Crownpoint Uranium Project, NRC License SUA-1580 Renewal, McKinley County, New Mexico (ML25022A293)

NuFuels, 2025, Response to Request for Supplemental Information for the Acceptance Review of the License Renewal Application, NuFuels, Inc. Crownpoint Uranium Project, McKinley County, New Mexico (SUA-1580 NRC Docket No. 040-08968) (ML25182A330, ML25350C307)

NUREG-1508, 1997, Final Environmental Impact Statement to Construct and Operate the Crownpoint Uranium Solution Mining Project, Crownpoint, New Mexico

NUREG-1569, 2003, Standard Review Plan for In Situ Leach Uranium Extraction License Operations

Overpeck, J.T. and B. Udall, 2020, Climate change and the aridification of North America, Proceedings of the National Academy of Sciences, V. 117, no. 22

Power Resources, Inc. (Cameco Resources), 2009, Alternate Schedule for Groundwater Restoration, Smith Ranch-Highland Uranium Project, SUA-1548 (ML092330083)

Reimus, P. et al, 2022, Restoration Insights Gained from a Field Deployment of Dithionite and Acetate at a Uranium In Situ Recovery Mine, Minerals, v. 12

Ruiz, O. et al, 2019, Groundwater Restoration Following ISR Mining of Uranium, Applied Geochemistry, v. 109

Saunders, J.L. et al, 2016, Potential Aquifer Vulnerability in Regions Down Gradient from Uranium In Situ Recovery Sites, Journal of Environmental Management, v. 183

United Nuclear Corporation (UNC), 2004, Northeast Church Rock Site Mine Closeout Plan

Uranium One Americas, 2016 Semi-Annual Report, Willow Creek Project, SUA-1341 (ML17090A256)

U.S. Department of Energy (DOE), 2026, Sixth Five-Year Review Report for the Fernald Preserve, Ohio

U.S. Government Accountability Office (GAO), 2012, Uranium Mining: Opportunities Exist to Improve Oversight of Financial Assurances, GAO-12-544

USGS, National Ground-Water Monitoring Network, monitoring location 35423510817073, https://www.usgs.gov/apps/ngwmn/index.jsp (accessed July 25, 2026)

Wallace, M.G., 2005, Declaration of Michael G. Wallace in the Matter of Hydro Resources, Inc., (Docket No. 40-8968-ML, ASLBP No. 95-706-01-ML)

Wentworth, D.W. et al, 1980, Geology of Crownpoint Section 29 Uranium Deposit, McKinley County, New Mexico, New Mexico Bureau of Mines and Mineral Resources, Memoir 38

CONTENTION [EC-1]: FAILURE TO DEMONSTRATE THE FEASIBILITY OF AQUIFER RESTORATION

Contention: The Environmental Report fails to demonstrate that groundwater in the Westwater Canyon aquifer production zones can be restored to the primary restoration standards of 10 C.F.R. Part 40, Appendix A, Criterion 5B(5) (background or MCL), fails to analyze the environmental impacts that will result if restoration achieves only the ER's fallback secondary standards, derives its restoration baseline from non-representative ore-zone sampling without analyzing the consequences, and rests its groundwater impact conclusions on a 2009 NRC staff data compilation that does not reflect seventeen years of subsequent commercial ISR restoration experience, in violation of 10 C.F.R. §§ 51.45(b), (c), and (e) and 51.60(a).

7. Overall, the Environmental Report (ER) is misleading by implying contamination will be contained by excursion monitoring (ER § 2.1.3.4.3 at 27) and groundwater restoration will achieve pre-mining contaminant concentrations in groundwater (ER § 2.1.3.5 at 30), while NRC concedes that excursions and unsuccessful restoration will likely result in uranium contamination at the Crownpoint drinking water wells and NuFuels must replace the drinking water wells prior to mining in Unit 1 and Crownpoint (ER § 4.4.2.1.1.3 at 227).

8. Excursion monitoring will be unsuccessful because the spacing of wells in the monitoring ring (generally 400 ft apart) will not detect contaminated groundwater flowing along preferential pathways that are commonly no wider than 100 ft (Lucas, 2005, para 45 & 46). Fluvial sediments that comprise the Westwater Canyon aquifer are interlayered, lithified clay, silt, sand, and gravel deposits that form preferential flow paths associated with paleochannels (Lucas, 2005, para 40 - 51). The complex stratigraphy and preferential flow paths in the Westwater Canyon aquifer were acknowledged by NRC during the post-restoration analysis to understand the failure to restore the Westwater Canyon aquifer after the Mobil Section 9 in situ pilot test: "The analysis has been extremely difficult due to the hydrogeology of the site, complexities imposed by operational difficulties encountered during leaching and restoration, a high degree of natural variability and the small area of previous mining activity." NRC, 1988, p. 2.

9. The proposed CUP schedule for operations and aquifer restoration at Church Rock Section 8 (6 and 4.6 yrs), Church Rock Section 17 (4 and 2.5 yrs), Unit 1 (6 and 5.4 yrs), and Crownpoint (14 and 13.3 yrs) (ER § 2.1.3.1 at 18) does not consider the timeframes used for the Mobile Section 9 pilot test performed in the Westwater Canyon aquifer one mile north of Unit 1 between 1979 and 1986. At the Mobil Section 9 pilot test site, one year of mining was followed by six years of restoration activities [groundwater sweep, lime treatment, reverse osmosis, and injection of sodium sulfide (Na_2S) and hydrogen sulfide (H_2S)] that failed to restore the groundwater to pre-mining contaminant levels (NRC, 1988, Appendices B & C). Given that the aquifer restoration at the Mobil Section 9 site was 6 times longer than production time and failed to restore the aquifer, the proposed CUP restoration schedule is unsupported where the restoration times are less than the production times. The never-performed commercial-scale

restoration demonstration at Church Rock Section 8 is necessary to support the questionable restoration times in the CUP schedule, and it is technically material to the feasibility of restoration at the other proposed project areas.

10. The ER proposes to restore the aquifer in the noted timeframes using the standard methods of groundwater sweep, reverse osmosis, and brine concentration (ER § 2.1.3.5.2 at 31-32). A search of the ER for other groundwater restoration techniques to support the short timeframe of the restoration schedules was conducted, though nothing was found. However, it was noted in the ER that an estimated 9 pore volumes will be needed to achieve aquifer restoration in each area (ER § 4.4.2.1.1.3 at 227). This estimate has no valid basis for restoration of the Westwater Canyon aquifer because the Mobil Section 9 in situ pilot test used over 16 pore volumes of groundwater and did not restore the aquifer to baseline values (NRC, 1988, Appendix C).

11. Therefore, it is inconsistent that NuFuels states without basis that: "During operation and aquifer restoration, modern techniques will make it highly unlikely that any adjacent, non-exempt portions of this aquifer will be affected adversely." ER § 2.2.3.5.1 at 49.

12. The ER simply proposes standard groundwater restoration methods and shorter restoration times, relative to production time, to achieve groundwater restoration; despite the historic record of restoration failure at the Mobil Section 9 pilot site north of their proposed Unit 1 operations. Restoration methods proposed in the ER will not succeed in restoring the aquifer to pre-mining levels because groundwater sweep treats only the preferential flow paths in the aquifer, as noted above, and contamination remains in less permeable portions of the contaminated aquifer.

13. Since the conclusion of the initial litigation on the CUP project, there have been multiple investigations and reports on the restoration of groundwater at uranium ISR sites. The USGS compiled data on south Texas uranium ISR sites and showed that none of the ISR operations were able to restore the mined aquifer to pre-mining baseline[1] levels for all

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[1] The uranium ISR industry does not establish statistically valid baseline values. Baseline values for the ISR industry are established using samples taken from the ore zone after well drilling and development. The ore zone occupies an insignificant volume in most aquifers, and a representative sample should be collected through the entire sand thickness as opposed to the biased samples collected from the disturbed ore zone. Well drilling mechanically grinds the ore into finer particles and introduces oxygen-rich water, and well development introduces

contaminants (Hall 2009). In 2009, the NRC reviewed aquifer restoration at the only three licensed facilities that were operating (two in WY and 1 in NE) and found that none of the well fields at those ISR sites were able to restore all contaminants to baseline levels (NRC 2009).

14. At the Smith Ranch-Highland Uranium Project in Wyoming (NRC Source Material License SUA-1548), the operator requested an alternate schedule for completion of groundwater restoration in August 2009, reporting that restoration at seven wellfields would be delayed for several years, in one case to 2025 (ML092330083). At Mine Unit 1 of that same project, uranium production ran from 1997 to September 2006; restoration activities then continued until stability sampling began in September 2014 — a restoration period nearly as long as the production period — and post-restoration concentrations of uranium, arsenic, selenium, and radium-226 still exceeded restoration target values and primary drinking water standards in stability monitoring samples (ML18065A233 (application letter); ML18186A337 (App. C)). In February 2018, the operator applied for alternate concentration limits for Mine Unit 1 of 51 mg/L for dissolved uranium, 0.18 mg/L for dissolved arsenic, and 0.2 mg/L for dissolved selenium (ML18065A233; ML18186A328) — a requested uranium limit approximately 1,700 times the 0.03 mg/L standard of 20.6.2.3103(A)(1)(p) NMAC — while acknowledging that dissolved uranium in portions of the mine unit will increase in concentration over a time scale of centuries (ML18186A328 at i).

15. At the Christensen Ranch mine units of the Willow Creek project in Wyoming (SUA-1341), restoration of Mine Units 2 through 6 concluded in 2005 and the restoration report was submitted in April 2008; on October 23, 2012, the NRC staff's Technical Evaluation Report set out its basis for denying restoration completeness (ML12174A048 (NRC Staff TER); ML17090A256 (operator semi-annual report).

atmospheric oxygen during airlift procedures to clear the well of sediment. An increase in surface area of the ore particles and higher levels of oxygen increase the dissolution rate of the uranium ore minerals and contaminate the water within the ore zone. Prior to drilling, the uranium ore minerals are in a reduced zone of the aquifer and their low solubility under reducing conditions is the basis for the ore deposit. Uranium groundwater concentrations in an undisturbed, reduced ore zone do not exceed the EPA MCL for uranium (0.03 mg/L). Therefore, true baseline for uranium and other contaminants in the aquifer would be much lower than the invalid baseline established by the ISR industry, which implies restoration of groundwater to true baseline is impossible after the aquifer is contaminated by uranium ISR mining.

16. These are the same facilities whose data comprise the 2009 NRC compilation on which the ER relies (NRC 2009): the record for these sites after 2009 — the schedule extensions, a denial of restoration completeness, and alternate concentration limit requests at multiples of the groundwater standards — demonstrates that the restoration difficulties the NRC documented in 2009 were not subsequently overcome, and that the ER's reliance on the 2009 compilation understates rather than overstates the restoration record as it now stands.

17. Other studies have looked at geochemical, mineralogical, and microbiological techniques to improve the efficacy of aquifer restoration (see Ruiz et al, 2019, and references therein). Though the techniques did provide short-term decreases in some of the contaminants, none of the methods deployed resulted in long-term compliance with pre-mining baseline values. Investigators cited the inability to treat all areas of the aquifer due to the complexity of fluvial stratigraphy and preferential flow paths (Saunders et al, 2016), the remobilization of uranium when injected reducing agents dissolved iron-oxide phases that contained adsorbed uranium (Gallegos et al, 2015; Reimus et al, 2022), and the overall absence of production records for processing reagents to assess the overall destruction of the reducing capacity of the aquifer by decades of lixiviant injection (Gallegos et al, 2022). Therefore, aquifer restoration techniques implemented after uranium ISR mining are unlikely to permanently reverse the contamination created by mining in groundwater aquifers and long-term treatment and monitoring will be needed to protect human health and the environment.

18. NuFuels recognized that restoring groundwater to pre-mining contaminant levels would require decades of treatment and monitoring due to the inability to remove uranium from less permeable areas of the aquifer. In 2023, NuFuels entered into a joint agreement with Los Alamos National Laboratory to perform lixiviant leaching tests on crushed uranium ore placed in leach columns (NuFuels/LANL, 2023, ML23304A114). The scope of work outlined on page 20 of the referenced work plan was "to demonstrate the capacity of an optimized groundwater restoration strategy that relies on active sweep operations using reverse osmosis treatment, injection of amendments, and natural attenuation to restore geochemical conditions in situ to background levels at uranium recovery operations." A test report of the results for this work could not be found.

19. Long-term treatment and monitoring are also driven by the improper derivation of baseline values for contaminants in groundwater. The ER's restoration program states "If the

restoration activities are unable to achieve the background or MCL, whichever is greater, the secondary goal will be to return water quality to the maximum concentration limits as specified in Section 20.6.2.3103 NMAC or 40 CFR § 141.62 or 143.3." (ER § 2.1.3.5.1 at 30). The corresponding secondary-goal MCL concentrations under both federal and state requirements are arsenic 0.01, selenium 0.05, uranium 0.03 mg/L, radium 5 pCi/L. 20.6.2.3103(A)(1)(b), (m), (p), and (q) NMAC; 40 C.F.R. §§ 141.62(b)(10), (16), 141.66(b), (e). Because the ISR industry commonly uses non-representative samples to establish baseline (i.e., background) values for contaminants in groundwater, the baseline is likely to be greater than MCLs (secondary goal) for many contaminants.

20. For the Crownpoint and Church Rock areas, the ER reports pre-mining mean values (presumably baseline) in Tables 3.4-7 (Crownpoint), 3.4-8 (Unit 1), and 3.4-14 (Church Rock Sections 8 and 17) for the proposed ISR mining areas. The radium-226 mean value exceeds the MCL in all areas, and the uranium mean value exceeds the MCL at Unit 1 and Church Rock. As I explain in footnote 1, it is common in the ISR industry to develop baseline in the production area by screening the well only through the ore zone, which has been disturbed and oxidized by well drilling and development. The dissolution of reduced uranium ore minerals is enhanced when mechanical grinding of the drilling increases the surface area of the uranium ore minerals and oxygen is introduced by both the drilling fluid and air lifting to develop the well. Lasaga has shown that a higher surface area and increased oxygen activity will increase the rate of mineral dissolution (Lasaga, 1981).

21. The degradation of groundwater by the use of non-representative samples to establish values for baseline concentrations used in restoration targets ensures contamination will remain in the aquifer far above true baseline values. The impact will be contamination of groundwater outside the monitor-well ring, including wells completed in the Westwater Canyon member that supply drinking water to people in and around Crownpoint. An exempted-aquifer boundary is a regulatory line; it is not a hydraulic barrier.

22. In my opinion, when restoration cannot achieve true pre-mining conditions — whether because of the restoration-technology limitations described above or because baseline values were derived from non-representative samples — the realistic physical endpoints are limited to three. First, restoration operations continue beyond the scheduled timeframes: additional pore volumes of groundwater sweep and reverse osmosis treatment, with the

associated consumptive water use, brine generation and disposal demand, and energy consumption extending over a horizon the ER does not estimate. The Mobil Section 9 pilot test, in which six years of restoration followed one year of mining without achieving pre-mining values (NRC, 1988, Appendices B & C), indicates that time frame can substantially exceed the ER's estimates. Second, active restoration is discontinued and the site transitions to long-term monitoring and treatment. My direct experience managing groundwater programs at the DOE Fernald and Idaho sites is that where aquifer contamination cannot be fully removed, monitoring and treatment continues for decades: the uranium plume at the DOE Fernald site has required monitoring and treatment for over 30 years at an annual cost of 2 to 3 million dollars (DOE, 2026, Table 3). Although those are not ISR wellfield restorations, the cost and duration driver — indefinite operation of extraction, treatment, and monitoring systems for a groundwater plume that cannot be eliminated — is the same. Third, contamination above pre-mining values remains in place in the aquifer, continues to migrate along the preferential pathways described above and requires institutional controls on groundwater use for an indefinite period. Each of these endpoints has environmental impacts of its own — water consumption, waste streams, disposal capacity, land use, and constrained use of a drinking-water aquifer — that are distinct from, and additional to, the impacts of the restoration program that the ER describes.

23. I searched the ER for any analysis of the consequences of using non-representative samples for establishing baseline values in groundwater, and for any analysis of the three endpoints described in ¶22 above, including the groundwater impact analysis (ER § 4.4.2 at 223–28), the cumulative impacts discussion (ER § 2.2.3.5 at 48–49), the mitigation discussion (ER § 5.4.2 at 277-282), and the restoration program description (ER § 2.1.3.5 at 30–32). No such analysis appears. The ER's impact conclusions assume that restoration succeeds; the ER contains no assessment of the exempted-zone boundary, the adjacent non-exempt portions of the Westwater Canyon aquifer, or the Crownpoint-area drinking water wells under a scenario where groundwater restoration fails and monitoring and treatment must be performed for decades.

24. In summary, the ER's approach to groundwater restoration and impact analysis is inadequate because it assumes successful aquifer restoration despite the failure at the Mobil Section 9 pilot site, it does not assess the complexity of the stratigraphy and preferred flow paths within the Westwater Canyon aquifer, and it lacks a discussion on how to collect representative

samples for establishing true baseline values. Moreover, the restoration strategy invokes using the higher value of a non-representative background concentration over the drinking water MCL (ER § 2.1.3.5.1 at 30). Lastly, the ER mitigation strategy to replace Crownpoint drinking-water wells before production begins (ER § 4.4.2.1.1.3 at 227) indicates that the NRC and NuFuels know they cannot restore the aquifer, and a large volume of drinking water will be lost to the people in and around Crownpoint.

CONTENTION [EC-2]: RELIANCE ON OUTDATED HYDROGEOLOGIC DATA AND MODELING

Contention: The Environmental Report's description of the affected groundwater environment and its groundwater impact analyses rest on water level data ending in 2011, water quality characterization largely predating the 1997 FEIS, and drawdown modeling performed in 1993 and baseline studies from 1996 — deficiencies the NRC staff itself identified in its acceptance review and that the applicant has conceded it cannot yet cure for lack of site access — in violation of 10 C.F.R. §§ 51.45(b), 51.60(a), and 40.9.

25. The hydrogeology and water-quality data presented for Crownpoint and Unit 1 (ER § 3.4.3.2) and Church Rock Sections 8 and 17 (ER § 3.4.3.3) are outdated and cannot be relied upon to sustain the decision to move forward on reissuing the license for the CUP project. NRC recognized this and requested additional information from NuFuels (NRC 2026), though NuFuels has not responded as of the date of this narrative.

26. Specifically, NUREG-1569, Section 2.7.1 requires the following:

> A description of site hydrogeology, including (i) identification of aquifer and aquitard formations that may affect or be affected by the in situ leach operations; (ii) a description of aquifer properties, including material type, formation thickness, effective porosity, hydraulic conductivity, and hydraulic gradient; (iii) estimated thickness and lateral extent of aquitards, and other information relative to the control and prevention of excursions; and (iv) data to support conclusions concerning the local ground-water flow system, based on well borings, core samples, water-level measurements, pumping tests, laboratory tests, soil surveys, and other methods.

27. Of prime concern is item (iv), data to support conclusions. The ER (ER § 3.4.3.2 & 3.4.3.3) points to Sections 3.3.1.2, 3.3.1.3, and 3.3.1.4 of the CUP FEIS for hydrological and groundwater quality data that were collected decades ago. Extreme drought and aridification conditions remain in the southwest (Overpeck and Udall, 2020) and aquifer data presented in the CUP FEIS, and referenced in the ER, do not reflect present conditions in the aquifer. Groundwater levels have likely decreased in wells installed at Unit 1 and Crownpoint[2], and pump tests and drawdown models based on higher groundwater levels decades ago will not provide a reasonable picture of present conditions. General assumptions on Figure 3-10 of the CUP FEIS for thickness (201 ft) and porosity (0.251) of the Westwater Canyon member do not reflect the fluvial stratigraphy of sandstone, siltstone, and mudstone discussed in the ER (ER § 3.3.1.2).

28. Water-quality data collected decades ago from wells installed for the Unit 1 and Crownpoint areas will not represent present water quality because those wells were sampled only from the narrow ore zone after drilling and development disturbed and oxidized the ore zone (see ¶ 20 above). A representative groundwater sample should be obtained from a well screened across the entire thickness of the sandstone layer impacted by ISR lixiviant. As mining was not performed at Unit 1 and Crownpoint, it is likely that reducing conditions have returned to the wells previously sampled for the baseline values and redox sensitive elements (e.g., arsenic, selenium, and uranium) are likely to be at lower concentrations. This is important because it means the decades-old baseline values overstate current concentrations, which matters because baseline drives both restoration targets and excursion upper control limits. The NRC understands that redox sensitive elements will have lower concentrations under reducing conditions because they noted in a 2009 ISR data review that restoration "is not attainable for other constituents, in particular, the major and trace cations with solubilities most susceptible to the oxidation state of the aquifer water (i.e., iron, manganese, arsenic, selenium, uranium, vanadium and radium-226)" (NRC 2009).

[2] At USGS monitoring location 35423510817073, approximately 5 mi northwest of Crownpoint, the water level in an unidentified aquifer above the Westwater Canyon aquifer decreased over 100 ft between 2009 and the present (www.usgs.gov/apps/ngwmn/index.jsp), indicating it is probable that water in the Westwater Canyon aquifer also decreased.

29. As noted in the ER, drawdown models used to assess the impact to the Crownpoint wells were run in 1993 and 1996 (ER § 4.4.2.1.1.2.1 at 224), and the NRC requested a review and update of the hydrogeological data (NRC 2026) because:

> "Current and projected water-use conditions may differ from the conditions assumed in older modeling, including changes associated with municipal pumping, replacement municipal wells, and the Navajo-Gallup Water Supply Project."

30. An update to the models should also address the preferred flow paths along paleochannels in the Westwater Canyon aquifer. A significant deficiency in the old models was the assumption that the Westwater Canyon aquifer resided in homogenous, isotropic sandstone over a vast areal extent (Wallace, 2005, para 13). An electric well log from an exploration hole drilled in the Crownpoint area showed five different sand layers ranging from 20 feet to 75 feet in thickness, separated by four mudstone/siltstone layers measuring 10 to 20 feet in thickness (Wentworth et al., 1980). This picture of the Westwater Canyon aquifer residing in a series of ancient, buried streambeds with sandstones stacked one on top of another and separated by discontinuous mudstones and siltstones is consistent with the geological mapping done by Lucas on outcrops near the Unit 1 and Crownpoint sites (Lucas, 2005, para 25 & 26). Drawdown and transport modeling using the realistic, heterogenous model with preferred flow paths showed greater drawdown in the Crownpoint wells and uranium contamination reaching the wells in under 10 years (Wallace, 2005, para 20).

31. Therefore, data collection efforts should be executed to obtain current static water levels across the monitoring wells, updated potentiometric surface maps and interpretation; current pumping records for the municipal and NTUA wells and the Navajo-Gallup Water Supply Project's effects on regional use; re-sampling of baseline wells under protocols that account for collecting representative samples under reducing conditions from the entire sand thickness of individual or coalesced sandstone units; updated aquifer testing; and revised drawdown/transport modeling based on the heterogeneous structure of the fluvial deposits (i.e., paleochannels). The opinions stated above apply equally to the ER's municipal-well impact analysis challenged in EC-7.

32. With respect to EC-7, the ER's conclusion that impacts to the Crownpoint municipal water supply will be SMALL is not supported by any current analysis. The conclusion rests on drawdown and transport modeling from 1993 and 1996 that does not account for current

municipal pumping, the replacement municipal wells, or the Navajo-Gallup Water Supply Project, and the heterogeneous-aquifer modeling described in ¶ 30 indicates greater drawdown and shorter contaminant travel times to the town wells than the homogeneous models the ER relies on. The commitment to replace the town's water supply wells under License Condition 10.27 is a mitigation measure adopted because of the recognized risk of contamination; it is not an analysis of the impacts of the proposed operations on the municipal supply. A supportable impact conclusion would require the updated characterization elements identified in ¶ 31.

CONTENTION [SC-1]: INADEQUATE CHARACTERIZATION OF, AND MONITORING DESIGN FOR, THE OLD CHURCH ROCK MINE WORKINGS

Contention: The application fails to demonstrate adequate confinement and excursion detection at the Church Rock project areas because it does not adequately characterize the flooded underground workings of the Old Church Rock Mine and because its monitoring design treats those workings as though they were discrete wells — placing monitor wells "no more than 122 m [400 ft]" from the workings and asserting without analysis that excursion detection "will not be influenced by the presence of the mine workings" — contrary to the requirements of 10 C.F.R. Part 40, Appendix A, Criteria 5B(2) and 7, and without the reasonable assurance the Atomic Energy Act requires.

33. The COP is inconsistent in the presentation of information on the intersection of the Dakota aquifer with the old Church Rock mine workings. NuFuels states that they have records of all mine workings (COP 8.7.3.1) and the mine workings could be open to the Dakota sandstone (COP 8.3), though to the best of NuFuels knowledge they do not extend up into the Dakota sandstone (COP 8.3). If NuFuels has all records for the mine workings, there should be detailed stratigraphic columns for mine shafts and drifts that lead down to the workings that will definitively establish where the Dakota sandstone intersects the flooded mine workings. This information is not included in the COP or ER, and it is important because NuFuels proposes one monitoring well per 8 acres in the Dakota sandstone (COP 8.1.1), presumably on the basis of no communication between the mine workings and Dakota sandstone.

34. The basis for treating mine workings as a well field (COP 6.3.1) is absent in the COP. Flooded mine workings are equivalent to a channel of contaminated water as opposed to

contaminated pore fluid in a well field. Flooded mine workings can intersect preferred flow paths in the aquifer sands they intersect and flow past monitor wells spaced 400 feet from the edge of flooded workings and 400 feet apart (COP 6.3.1). As noted above in the response to contention EC-1, excursion monitoring will be unsuccessful because the spacing of monitoring wells (400 ft apart) will not detect contaminated groundwater flowing along preferential pathways that are commonly no wider than 100 ft (Lucas, 2005, para 45 & 46). NuFuels argues that the angle formed by lines drawn from mine workings to the two nearest monitor wells will not be greater than 75 degrees and this means that the detection of horizontal excursion will not be influenced by the presence of mine workings (COP 6.3.1), which is puzzling and completely without basis.

35. The COP strategy for excursion detection will be ineffective because a monitor well spacing of 400 ft will miss preferential flow paths in contact with the flooded mine workings. Migration of mining fluids along east/southeast-trending paleochannels from the Church Rock NECR-2 shaft to the old Church Rock Mill well (approximately 1,000 feet) occurred between October 1984 and April 1992 (after mine closure). Arsenic, selenium, and uranium values increased as follows: As, <0.001 to 0.004 mg/L; Se, <0.001 to 0.218 mg/L; and U, 0.065 to 0.565 mg/L (UNC, 2004, Table 1). This observation shows that contaminated mining fluids in the Church Rock mine workings have migrated into the Westwater Canyon aquifer along paleochannels that are generally no wider than 100 feet (Lucas, 2005, para 45). Therefore, monitoring wells spaced 400 feet apart will inevitably miss excursions moving along narrow preferential flow paths.

36. NuFuels proposes to screen a monitor well through the full thickness of the stacked ore horizons when there is no substantial confining layer between the sands (COP 6.3.1). In this geometry, an excursion from a single ore horizon will be diluted by the water from other ore horizons that are not experiencing an excursion. In other words, an excursion will be contaminating the non-exempt portion of the aquifer yet not be detected due to dilution of the excursion from ore horizons that contain non-contaminated groundwater. Wells with multiple sampling ports at distinct aquifer horizons are commonly used to monitor groundwater plumes at DOE sites, and this technology is the appropriate application when discrete levels of the aquifer need to be monitored for contaminant migration.

37. Of interest is that NuFuels states that confining layers between the Westwater Canyon sands are not continuous (COP 6.3.1), implying lixiviant will be present throughout the Westwater Canyon member. As Lucas has pointed out, the Westwater Canyon member is unconfined in areas of Section 17: Dakota sandstone is above and Cow Springs sandstone is below the Westwater Canyon member (Lucas, 2005, para 20). Thus, the lixiviant has a direct vertical path to reach an overlying and underlying aquifer.

38. At the Church Rock units, the COPs proposed monitoring in the Dakota sandstone is one well per 8 acres (COP 8.1.1), which equates to essentially no monitoring, because one well per 8 acres has a very low probability of detecting an excursion when the lixiviant is in direct contact with the overlying sand. For the underlying Cow Springs sandstone, the COP states there is little site-specific data on the Recapture; but, because it is a suitable aquitard elsewhere, no monitoring of the Cow Springs aquifer is necessary (COP 8.2). The omission of monitoring in the Cow Springs sandstone fails to protect a groundwater aquifer in direct contact with lixiviant.

CONTENTION [SC-2]: UNVERIFIED INTEGRITY OF LEGACY/HISTORIC EXPLORATION BOREHOLES

Contention: The application fails to provide reasonable assurance of production-zone confinement because it relies on surveyed borehole locations and after-the-fact corrective plugging — undertaking to locate and plug legacy exploration holes only "[i]f during operational testing individual holes become suspect" — rather than pre-operational verification of the plugging and integrity of the extensive legacy/historic exploration drilling that penetrates the confining units, contrary to 10 C.F.R. Part 40, Appendix A, Criteria 5B(2) and 7, and NUREG-1569 § 2.7.

39. The NRC standard review plan for ISR license applications, NUREG-1569, describes the information about historic drill holes and wells needed to make the confinement findings required by 10 C.F.R. Part 40, Appendix A. Three provisions are relevant here. First, the site-characterization acceptance criteria require, for each abandoned well or drill hole within the site area and within 0.25 mile of the wellfield boundary, its location and depth, type of use, condition of closing, the plugging procedure used, and its date of completion (NUREG-1569 § 2.2.3(1)(e) at 2-5). Second, the geology acceptance criteria require that, to allow evaluation of connections between the mineralized zone and underground sources of drinking water, the

applicant provide plugging and abandonment records from state, federal, and local sources — and, for all wells that *cannot* be documented in this manner, "evidence that action has been undertaken to properly plug and abandon" (NUREG-1569 § 2.6.3(5) at 2-18). The structure of this criterion is significant: it offers two paths, documentation or demonstrated plugging action, and it contemplates that one or the other be satisfied for every known penetration before the staff makes its findings — not after operations begin. Third, the hydrology acceptance criteria require characterization of the thickness, lateral extent, and vertical hydraulic conductivity of the confining units, supported by pumping tests investigating vertical confinement between the production zone and the overlying and underlying aquifers (NUREG-1569 §§ 2.7.1(3), 2.7.2(3), 2.7.3(3) at 2-20 to 2-24). Unverified plugging of boreholes that penetrate a confining unit are uncharacterized vertical pathways that do not meet the NRC confinement demonstration, and NuFuels has not accounted for this in the COP.

40. The record of historic penetrations at the CUP project areas is extensive. The ER identifies multiple exploration and pilot-project drilling campaigns from the 1970s and 1980s within and near the project areas, 195 registered groundwater rights of which 154 are *recorded as* plugged and abandoned, and additional unregistered wells (ER § 3.4.3.2.2 at 109-10). Additionally, the ER notes the early phase (1958-1962) of exploration in the Church Rock area was essentially unregulated and activities related to borehole plugging, as well as the location of the boreholes, are unknown (ER 3.13.1 at 201).

41. Against this record, the COP's approach is to survey coordinates for exploration holes, with plugging performed only "[i]f during operational testing individual holes become suspect" (COP § 8.4-8.4.1 at COP-83-84). This approach satisfies neither requirement of NUREG-1569 § 2.6.3(5) for a substantial portion of the borehole inventory and fails to address the consequences of penetrations made by early exploration boreholes. A notation that a well is "recorded as" plugged is a record of a filing, not of the condition of closing or the plugging procedure used and provides no basis to assess whether the plug remains competent decades later. For the unregistered wells and early exploration boreholes the ER acknowledges, the records path is unavailable by definition, and the COP identifies no plugging action taken or planned for them before operations. The COP's approach thus provides, at the time the license would issue, neither documented integrity nor demonstrated plugging for the penetrations of the confining units on which its confinement conclusions depend.

42. In my opinion, reasonable assurance of production-zone confinement requires pre-operational field verification of the legacy penetrations, not surveyed locations plus after-the-fact correction. Standard verification practice, which I have implemented and overseen at DOE environmental restoration sites, proceeds from the inventory to the field: locating each mapped penetration on the ground and reconciling the field inventory against the records to identify unmapped holes. If unmapped holes are discovered, the surface condition of each located penetration is inspected to determine the potential actions for an open or closed hole (e.g., evaluating the integrity of the hole using methods such as downhole geophysical or camera logging, re-drilling of the plug interval, and plugging/replugging as necessary).

43. Because inspecting every historic exploration hole is generally impracticable, a random sample of the surveyed population in each project area, distinguished by drilling campaign and vintage, is the appropriate means of estimating the frequency of bridging — a plugged interval overlying an open borehole — and other plug failures in the population as a whole. This is particularly important at Church Rock Sections 8 and 17, where the Westwater Canyon member may be in direct contact with the overlying Dakota and underlying Cow Springs sandstones (Lucas, 2005, para 20), so that a single failed penetration provides a direct vertical pathway between the production zone and an unexempted aquifer. Statements on the formation clays self-sealing the boreholes (COP 8.4.1.2) are not applicable when there are no confining layers between the Westwater Canyon member and overlying Dakota sandstone and underlying Cow Springs sandstone. Verification of borehole integrity should be performed before operations because the alternative — detection of borehole leakage through the monitoring network after lixiviant injection begins — presumes the adequacy of the monitoring network whose design is at issue, and remediates contamination rather than preventing it.

44. The speculation of detecting communication with open boreholes via pump tests and pressure changes in overlying and underlying aquifer monitor wells (COP 8.4.1.2) is presumptuous at best. NuFuels has presented no basis to support how one well per 4 acres in overlying aquifers (COP 8.1) will detect leakage from a borehole in a preferential flow path that does not intersect the well. For the underlying Cow Springs aquifer in the Church Rock area, NuFuels states it will not monitor the Cow Springs aquifer because the Recapture member is an adequate aquitard (COP 8.2) between the Westwater Canyon member and the Cow Springs

aquifer. This omission ignores the geology in Section 17 discussed by Lucas, where the Westwater Canyon member directly overlies the Cow Springs aquifer (Lucas, 2005, para 20).

CONTENTION [SC-3]: INADEQUATE FINANCIAL ASSURANCE

Contention: The application fails to demonstrate compliance with 10 C.F.R. Part 40, Appendix A, Criterion 9 because it contains no current decommissioning and aquifer restoration cost estimate — stating only that NRC approved revised Restoration Action Plans in 2011 and that annual surety updates will be submitted — and because the surety framework it references omits identifiable cost categories, including the contractually required NNCERCLA remediation of Church Rock Section 17 and the costs of 11e.(2) byproduct disposal under an agreement that does not yet exist, in violation of Criterion 9 and 10 C.F.R. § 40.9.

45. NuFuels has not developed a current aquifer restoration cost estimate that considers the failed restoration record of the ISR industry, as discussed under my response to EC-1. Specifically, NuFuels states that aquifer restoration costs for each area will be based on 9 pore volumes to achieve restoration goals (COP 10.4.3 at 171), yet the Mobil Section 9 pilot test did not achieve restoration after processing 16 pore volumes over a period of 6 years. My experience with restoring contaminated groundwater at DOE sites (in Ohio, South Carolina, and Idaho) over the past 35 years shows that long-term monitoring and treatment costs for financial assurance needs to consider monitoring and treatment for decades, rather than years.

46. Of relevant interest to uranium ISR sites are the DOE records for the Fernald, Ohio site, which show present aquifer restoration and monitoring for the uranium groundwater plume (at roughly $2-3 million per year) has not restored the aquifer to baseline values after 30 years (DOE 2026, Section 2.4, Table 3). Similar restoration and treatment time frames have been encountered for a TCE plume at the DOE Idaho site at a rough cost of $1.5 million a year. Though TCE is not a contaminant of concern to ISR mining, the relevant point is any contaminant that exists in an aquifer at levels far above baseline values will take decades of monitoring and treatment to restore the aquifer.

47. In the GAO review of financial assurance accounts for the Smith Ranch and Highland operations in Wyoming (GAO-12-544 at 27), they report that required financial assurance increased from June 2011 through December 2011 -- from about $80 million to $120 million for the Smith Ranch and from about $80 million to $93 million for Highland. NRC and

Wyoming officials indicated the increase was largely due to the increase in extraction and treatment when the number of pore volumes to treat increased from 6 to 9. These 2011 values suggest that about $40 million dollars was needed to process an additional 3 pore volumes at Smith Ranch. As aquifer restoration is commonly extended at ISR sites due to the inability to restore the contaminants to pre-mining levels, contingency costs for extending the monitoring and restoration should be considered in financial assurance estimates.

48. The COP fails to address NRC's Criterion 9 requirements for developing a cost estimate for financial assurance and is also silent on costs for the Section 17 NNCERCLA remediation. In addition to the absence of these costs, additional costs for the extension of monitoring and restoration beyond the proposed schedule for remediation, along with additional 11e.(2) disposal costs during the extended restoration period, are material to the evaluation of adequate financial assurance.

I declare under penalty of perjury that the foregoing is true and correct. Executed on July 27, 2026.

Richard J. Abitz, PhD

Exhibit A – Curriculum Vitae

Richard J. Abitz

Professional Qualifications

Dr. Abitz is a geologist and former project director with over thirty-eight years of experience in the environmental services sector of private and government organizations. His broad experience encompasses project and personnel management, analysis of chemical and radiological data, modeling of soil/water systems and radioactive waste streams with experimental methods and computer codes, human-health risk assessment, dose assessment for low-level waste disposal facilities, and development and review of scientific studies and regulatory documents for CERCLA, RCRA, and uranium in situ recovery (ISR) sites.

Presently, Dr. Abitz performs limited consulting services for private and government clients as the principal scientist and owner of Geochemical Consulting Services, LLC. These tasks include technical reviews and preparation of documents for environmental response actions at CERCLA/RCRA sites and evaluation of NRC license applications for uranium ISR from potable groundwater aquifers.

Prior to June 2024, Dr Abitz served as the director of the Environmental Restoration (ER) organization at the DOE Idaho National Laboratory (INL) site. In this capacity, he was responsible for mentoring personnel and the safe and efficient management of ER contract work scope for the Idaho Cleanup Project (ICP). The ER organization is tasked with groundwater monitoring, risk assessment, and reporting requirements associated with CERCLA remedial actions executed across the INL site.

In his previous position as senior technical consultant for the Environmental Remediation project at the DOE Portsmouth site, he was responsible for preparation and oversight of documents associated with CERCLA and DOE Order 435.1 regulations; and was the control account manager for the analytical laboratory and soil projects. Dr. Abitz prepared the DOE Order 435.1 Performance Assessment and Composite Analysis for the Portsmouth on-site waste disposal facility (OSWDF) and was a key player in obtaining the Disposal Authorization from DOE HQ for the design and construction of the OSWDF.

Dr Abitz also has extensive experience at other DOE sites, including Savannah River, Fernald, Los Alamos National Laboratory, and the Waste Isolation Pilot Plant. Dr. Abitz served with the Savannah River National Laboratory as the DOE EM13 program manager for the development of technologies to support the in situ decommissioning of highly contaminated nuclear facilities. At the Fernald site, Dr. Abitz managed the Environmental Services Group and was a senior consultant to the DOE Technology Development Program. For Los Alamos National Laboratory, he developed waste analysis and radioactive material management plans for transuranic and low-level mixed wastes generated, treated, and stored on site. At the Waste Isolation Pilot Plant, Dr. Abitz directed geochemical studies that evaluated the composition and origin of brine and saline groundwater in the repository and overlying strata.

In addition to work performed at DOE sites, Dr. Abitz served as an EPA subcontractor supporting groundwater remediation at the Homestake uranium tailings site north of Milan, NM. For the Navajo Nation (New Mexico), Sioux Nation (Nebraska), Goliad County Groundwater Conservation District (Texas), and National Resources Defense Council he served as a technical expert and witness to evaluate the impact of proposed uranium ISR mining on community groundwater supplies. Dr. Abitz also provided technical input to the Powder River Basin Resource Council's comment responses to EPA's proposed Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192).

Education and Training

B.A., Geology, Humboldt State University, Arcata, California; 1981

M.S., Geology, University of New Mexico, Albuquerque; 1984

Ph.D., Geology, University of New Mexico, Albuquerque; 1989

EQ3/6 Geochemical Modeling Short Course, San Diego, CA; 1991

Environmental Risk Assessment Communication and Application Workshop,

INEL Oversight Program, Boise, ID; 1992

OSHA HAZWOP Training, 29 CFR 1910.120 (40 hours), 1994

RAD WORKER II Training, 10 CFR 835, 1998

Practical Models Supporting Remediation of Chlorinated Solvents, Aiken, SC; 2010

Experience and Background

2024 – present — ***Principal Scientist/Owner, Geochemical Consulting Services, LLC***

- Dr. Abitz performs data analysis and review of technical and regulatory documents prepared by consultants performing environmental work for the DOE, EPA, and NRC. He also prepares documents and declarations for confidential clients on the adequacy of environmental and groundwater protection data within NRC license applications for in situ recovery of uranium.

2020 – 2024 — ***Director, Environmental Restoration, Idaho Cleanup Project, INL site***

- Dr. Abitz led a group of scientists, engineers, and technicians tasked with executing monitoring tasks, risk assessments, and reports for CERCLA remedial actions across the INL site. Under his leadership, the ER group maintained their perfect safety record (no first aids or recordables), achieved cumulative cost and schedule performance indices greater than one, and received recognition from Region 10 EPA on the "high quality, well organized" Five-Year Review of CERCLA Response Actions at the INL Site (February 2021).

2016 - 2020 — ***Deputy Director, Environmental Restoration, Idaho Cleanup Project, INL site***

- Dr. Abitz led communication and planning activities to integrate ER work scope with organizations performing work across the INL site. He performed personnel reviews and management assessments to ensure planned and executed work was in accordance with ISMS principles and established work controls; observe safety behavior of personnel performing the work; and identify project risks and opportunities. His responsibilities also included succession planning, execution of Fluor's remediation process optimization to reduce ER project costs, and oversight of technical documents.

Dr Abitz played a key role in earning the maximum fee (~$1M) for early completion of the design for an evapotranspiration barrier at the INL subsurface disposal area.

2012 - 2016

Senior Technical Consultant, Fluor Government Group, DOE Portsmouth site

- Dr. Abitz was responsible for preparation, review, and oversight of DOE, CERCLA, and RCRA work plans and reports in the areas of groundwater quality, statistical development of background values for groundwater and soil, groundwater and soil geochemistry, human-health risk and radiation dose assessment (performance assessment for DOE Order 435.1), and hazard analysis for disposition of enriched uranium. Dr. Abitz also served as a control account manager and was responsible for monthly cost and schedule variance reports and the assessment of project risks and opportunities.

2009 - 2012

Program Manager, Savannah River National Laboratory, Aiken, SC

- Dr. Abitz was the primary SRNL lead for the DOE EM13 program to investigate and develop technologies for the *in situ* decommissioning of highly contaminated nuclear facilities and he supported EM13 technology development for the remediation of contaminated groundwater and soil across the DOE complex. He served on a DOE EM international team as a technical member to participate in workshops on the decommissioning and dismantlement of nuclear facilities in the United Kingdom and Japan.

2006 - 2009

Principal Scientist/Owner, Geochemical Consulting Services, LLC

Expert Scientist for the Navajo & Sioux Nations, Coloradoans Against Resource Destruction, the Goliad County Groundwater Conservation District, South Texans Opposing Pollution, and the National Resources Defense Council, Inc.

- Dr. Abitz provided legal testimony, technical review, geochemical modeling, and geological analysis of permit applications associated with proposed uranium ISR mines in the vicinity of Church Rock and Crownpoint, New Mexico (Navajo Nation), the Centennial Project in Weld County, Colorado, the Goliad Project near Goliad, Texas; expansion of ISR operations at the Crow Butte mine in Nebraska and the Ross Project in Crook County, Wyoming; and restoration operations at the Kingsville Dome ISR mine in Texas.

Technical Support to the Savannah River Site; Aiken, SC

- Dr. Abitz supported the contract transition team for Savannah River Nuclear Solutions (SRNS). He reviewed RCRA and CERCLA groundwater remedial systems (electrical resistivity heating with soil vapor extraction, chemical reactive barrier, and tritium phytoremediation), project controls and management systems used to status the remediation work, and regulatory milestones to assess the status of the Area Closure Projects and SRNS readiness to perform the work scope. He also supported SRNS in the preparation of the ARRA baseline estimate.

NESHAP Report for the Fernald Preserve; Cincinnati, OH

- For the Fernald Annual Sitewide Environmental Report, Dr. Abitz prepared the chapters on air emissions (particulate with uranium, thorium and radium isotopes, and radon), population dose, and the NESHAP annual report.

Risk Assessment for the Fernald Closure Project (FCP); Cincinnati, OH

- Tasked with the responsibility to develop and author the Interim Residual Risk Assessment for the Fernald site, Dr. Abitz evaluated the risk to visitors and workers exposed to residual contaminants in air, soil, and surface-water pathways. Risk scenarios showed the incremental lifetime cancer risk to the receptors was below the recommended EPA maximum of 0.0001.

2003 – 2006

Manager of the Environmental Services Group and Senior Consultant, Fluor Fernald, Inc.; Cincinnati, OH

- As the manager for the Environmental Services Group (ESG), Dr. Abitz oversaw the work of over 50 scientists and technicians. Personnel in the ESG performed water, soil and air sampling and monitoring; analytical services for radionuclides, metals and organic compounds; data verification, validation, reduction and reporting; and *in situ* soil activity measurements for ^{226}Ra, ^{232}Th, and ^{238}U via the site's real-time instrument measurement program (RTIMP).

- As the site geochemist, he prepared an estimate of the curie inventory for the on-site disposal facility (OSDF) to provide baseline values to DOE legacy management. The scope of this task was to develop the estimate using information from the Ohio Field Office Recycled Uranium Project Report, OU3 and OU5 RI/FS documents, the Fernald Dosimetry Reconstruction Project, remedial operation records, historic records, active monitoring data, interviews with technical personnel who supervised plant operations from the early 1960's through production shut down in 1989, and analytical results on soil placed in the OSDF.

- Dr. Abitz also served as senior consultant to the Fernald Closure Project on the long-term remediation strategy for the Great Miami aquifer. In this capacity, he coordinated laboratory and microscopy studies on the form of uranium present on aquifer sediments. The laboratory and microscopy studies examined the amount of uranium that is fixed to the sediments via chemical adsorption and overgrowth rims versus the mobile fraction that is readily desorbed from the aquifer matrix. These key studies identified and addressed the kinetics of uranium reactions to determine the time constraints associated with achieving the EPA's drinking water standard for uranium.

1998 - 2003

Environmental Science Manager/Project Manager/Senior Consultant, Fluor Fernald, Inc.; Cincinnati, OH.

- In his role as environmental science manager, Dr. Abitz directed the Real Time Instrument Measurement Program (RTIMP), which provided in situ soil activity measurements for ^{226}Ra, ^{232}Th, and ^{238}U in live time. This program supported excavation and D&D work by scanning soil to confirm U contamination was below the waste acceptance criteria for Fernald's OSDF. Prior to the release of remediated land, the RTIMP performs in situ activity measurements to demonstrate that the soil is below the final remediation levels established for ^{226}Ra, ^{232}Th, and ^{238}U.

- As a project manager, Dr. Abitz managed a remediation budget of six million dollars for Title I/II design work for D&D of structures and removal of all contaminated soil and subgrade structures within the former Production Area. Dr. Abitz led a team of engineers and scientists who integrated the remedial design with regulatory issues, sampling and analysis plans, waste management operations, demolition and construction activities, health and safety issues, radiological controls, and quality assurance protocols.

- Dr. Abitz served as a senior consultant to the DOE Technology Development Program, where he performed technical oversight of several university studies dealing with the mobilization of uranium and its removal from groundwater. He was active with laboratory investigations that examine the distribution of uranium phases in soil and aquifer sediment, the leaching behavior of the uranium phases, the treatment of contaminated soil with phosphate, and the geochemical properties of aggregate materials used to construct liners in the OSDF. The research established important baseline information on the distribution of uranium in the aquifer and in OSDF construction materials, while treatment studies evaluated the effectiveness of phosphate in reducing the solubility and mobility of uranium in the disposal cell.

- As a participant in research that evaluated the natural attenuation of uranium using a combination of passive inorganic and organic systems, Dr. Abitz was involved with work groups from industry, academia, and DOE laboratories. The inorganic systems that were investigated include rip-rap channels constructed with rock containing iron oxyhydroxide phases (e.g., goethite and hematite) or phosphate minerals (e.g., apatite) and flow-through cells using zero-valent iron. Organic systems that showed potential promise include sulfate-reducing bacteria, microbial mats, lichen, and phytoextraction.

Principal Scientist/Owner, Geochemical Consulting Services, LLC; Albuquerque, NM.

1997 - 1998

- Dr. Abitz performed confidential work for the Navajo Nation on the proposed *in situ* uranium leach mines in the vicinity of Church Rock and Crownpoint, New Mexico.

- At FEMP, he evaluated the efficiency of selected alternatives for soil and groundwater remediation, including soil washing and *in situ* uranium leaching methods. This effort involved supervising the technical team, assisting in the negotiation of clean-up levels with DOE and EPA, developing soil-treatment protocols, and interacting with public-interest groups.

- At the WIPP site, Dr. Abitz supported the operating contractor in the area of brine geochemistry. He was responsible for oversight of laboratory analyses and QA/QC, data analysis, and geochemical interpretation of the composition and origin of fluids in the vicinity of underground operations. Dr. Abitz also evaluated the solubility of transuranic elements in sodium-chloride brine and in brine containing organic-complexing agents such as citric acid, oxalic acid, and EDTA.

1994 - 1997 ***Project Manager/Senior Staff Consultant, IT Corporation; Albuquerque, NM***.

- Conducted a rerun of the chemical compatibility analysis of contact-handled and remote-handled TRU waste forms and container materials, as reported in the 1995 WIPP Transuranic Waste Baseline Inventory Report (WTWBIR), for Appendix C1 of the WIPP RCRA Part B permit. Chemicals reported by the generator sites were classified into reaction groups as defined by the U.S. Environmental Protection Agency (EPA) document "A Method for Determining the Compatibility of Hazardous Wastes."

- Assisted in evaluating the geochemical performance of backfill configurations proposed in the WIPP Compliance Certification Application. Modeled the interaction of Salado Formation brine with MgO placed in the backfill to estimate the quantity of MgO required to buffer the pH of the indigenous brine between 8 and 9, which minimizes the solubility of uranium and TRU nuclides relative to lower pH values found in Salado Formation brine.

- Project scientist responsible for developing the background radionuclide groundwater report for Norton AFB, which provided a robust scientific model to explain the presence of elevated levels of naturally-occurring uranium. The task required coordination of scientific and support staff to produce a principal milestone document that was delivered to the client one week ahead of schedule.

- Project manager and scientist on the FEMP OU5 FS task to evaluate aqueous reactions of metal and radionuclide complexes in proposed injection zones of the Great Miami Aquifer. Responsible for oversight of technical tasks, budget, schedule, and final technical report.

- Project scientist tasked with supporting the Navajo EPA on the evaluation of groundwater contamination from the mill tailings at the UNC Church Rock, New Mexico site. Radionuclide, sulfate, and nitrate concentrations were evaluated to discriminate between contamination originating from the mill tailings and natural salts present in the valley alluvium.

- Project manager and scientist on the FEMP OU3 RI/FS task to evaluate the release of radionuclides and metals from the proposed on-site disposal facility. Responsible for oversight of technical tasks, budget, schedule, and final technical report.

1988 - 1994 ***Senior Geochemist, IT Corporation; Albuquerque, NM***

- Developed database for the WIPP EATF to evaluate the solubility of thorium, uranium, neptunium, plutonium, and americium in sodium-chloride brine and in the presence of organic complexing agents, such as EDTA and citric acid.
- Authored white paper for OU 5 RI/FS at FEMP that discusses leaching, dissolution, and desorption processes for uranium and progeny, adsorption and aqueous complexation of the uranium and progeny with subsurface soils and groundwater, and secondary uranium phases that may form in the soils.
- Conducted site-surveys and interviewed LANL personnel on radiation practices associated with the handling, packaging, labeling, storage, transport, and disposal of transuranic materials. Information was used to support safe operation of LANL RMMAs and account for radioactive materials that enter and exit the area.
- Developed waste analysis plans for transuranic and low-level mixed wastes present at LANL. This activity was conducted to complete RCRA Part B permits and ensure compliance to DOE orders for all LANL mixed waste facilities.
- Managed and had technical oversight on geochemical program associated with FEMP RI/FS. Program tasks include the characterization of soil mineralogy by polarized light microscopy and x-ray diffraction studies, design and implementation of laboratory tests to characterize the composition of leachate derived from cemented and vitrified waste samples, evaluation of contaminant adsorption ratios, data validation, and tracking of labor and material costs.
- Designed laboratory experiments for FEMP RI/FS to measure adsorption ratios of radionuclides and metals and implemented ANSI/ANS-16.1 leach tests to evaluate the performance of cemented waste forms. Results were used to evaluate the most effective alternative for immobilizing radionuclides and metals from a near surface disposal cell.
- Led waste characterization program on INEL calcined solid waste. Responsible for evaluating radiochemistry data on uranium fission products and transuranic elements in aqueous and calcined waste forms. Assisted in the development of EPA approved sampling and analytical plans to support a draft no migration variance petition for the radioactive calcined waste stored at the ICPP.

Professional Affiliations

Geological Society of America

New Mexico Geological Society

Presentations & Publications

Abitz, R., Farfan, E., and Coleman, R., 2011, Gamma-Ray Mapping and Waste Segregation, *presentation at the Japan Ministry of Economy, Trade and Industry/USDOE workshop on Remediation at the Fukushima Daiichi Nuclear Plant Site*, Tokyo, Japan, October 26 and 27.

Abitz, R.J., 2011, Pre- and Post-Mining Water Quality at ISL Sites: Emphasis on Kingsville Dome, *presentation to representatives from EPA Region VI, Kleberg County, Texas and South Texans Opposing Pollution*, Victoria, Texas, August 5.

Abitz, R.J., 2010, Decommissioning Highly Contaminated Nuclear Facilities at the Department of Energy Sites, *presentation at the United Kingdom Decommissioning and Waste Management Conference*, Penrith, Cumbria, UK, November 2, 3 and 4.

Abitz, R. J. and B. Darling, 2010, Anthropogenic Induced Redox Disequilibrium in Uranium Ore Zones, *Geological Society of America Abstracts w/Programs*, Vol. 42.

Abitz, R.J., 2010, Technical Basis for Approval of Decon Gel as an Acceptable Component of WIPP Waste Streams, *Proceedings of the American Nuclear Society Meeting on Decommissioning, Decontamination and Reutilization*, Idaho Falls, ID.

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