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Idaho To Miss Important Idaho Settlement Agreement Milestones

The State of Idaho has ignored the Department of Energy's lack of focus on meeting future milestones in the Idaho Settlement Agreement. Idaho now stands assured of missing every major settlement agreement milestone in the future involving removal of spent nuclear fuel (SNF) and high-level waste (HLW) from the state. [1]

[1] See more about Idaho's Settlement Agreement at https://www.deq.idaho.gov/inl-oversight/oversight-agreements/1995-settlement-agreement.aspx Selected highlights of the agreement are described below.

Section B(1) stipulates that all transuranic waste be shipped to WIPP or other facility "in no event later than December 31, 2018. Section B(1)c stipulates that the running average of no fewer than 2,000 cubic meters per year of transuranic waste be shipped out of Idaho. The 2006 litigation where a judge concluded that "all means all" was subsequently decided by Idaho's leaders to mean only the less than 7 acres of "targeted" exhumation of the 97-acre burial ground, with no reliable way to know how many curies of transuranics including americium-241 were exhumed or remained buried. Americium-241 is a dominant ingestion dose contributor for the burial ground's migration of contaminants into the aquifer. The americium-241 buried at the RWMC that they are not retrieving would require 6 Snake River Plain aquifers to dilute to drinking water standards.

In 2008 the Department of Energy, Idaho Department of Environmental Quality, and Environmental Protection Agency signed on to a plan the exhume a limited amount of buried waste at the Radioactive Waste Management Complex. Despite the "all means all" ruling regarding the 1995 Idaho Settlement Agreement to remove all transuranic waste at the Idaho National Laboratory, the tri-agency agreement specifies retrieval of at least 5.69 acres "determined to contain the highest density of "targeted waste" and shipment of at least 7,485 cubic meters of retrieved and packaged targeted waste out of the state of Idaho.

The "targeted waste" in the subsurface disposal area focused on the most chemically contaminated waste from the Rocky Flats nuclear weapons plant in Colorado because of contamination of the Snake River Plain aquifer already occurring due to the chemical contamination, mainly carbon tetrachloride. Of the acreage exhumed, much of the radioactive material will remain buried.

Section C(1) stipulates that DOE remove DOE SNF, the naval SNF and TMI SNF from Idaho by January 1, 2035. An addendum signed in 2008 allows certain amounts of SNF to remain in Idaho.

Section C(3) stipulates that DOE shall treat all HLW currently at INL so that it is ready to be moved out of Idaho for disposal by a target date of 2035. This includes the calcine, should include the treated liquid sodium-bearing waste to be treated by the IWTU, and waste from pyroprocessing at the Materials and Fuels Complex, formerly Argonne National Laboratory-West.

Section D(1)(e) stipulates that naval fuel be among the early shipments to the first permanent repository or interim storage facility.

Section E(8) DOE shall transfer all spent fuel at INEL out of wet storage facilities by December 31, 2023. (Apparently, the used or spent fuel at the Advanced Test Reactor is not deemed a "waste" while at the reactor facility.)

Section E(6) DOE shall issue a record of decision for the treatment of calcined waste not later than December 31, 2009 and apply for a RCRA permit by December 1, 2012. But the decision of how to treat the calcine was challenged by an independent report conducted for the DOE, US DOE-EM, "Independent Analysis of Alternatives for Disposition of the Idaho Calcined High-Level Waste Inventory, Volume 1 – Summary Report," April 2016.

The currently missed milestones are the slowed pace of shipments of transuranic waste to the Waste Isolation Pilot Plant (WIPP) in New Mexico, which resumed a year ago, and the failure to get the Integrated Waste Treatment Unit (IWTU) treating liquid radioactive waste it was supposed to have completed in 2012. [2] DOE is paying fines to the state for not emptying the waste tanks and calcine treatment is delayed by continued problems at the IWTU. [3] [4] [5] [6] [7] [8] [9] [10]

Section F(1) DOE shall designate the INL as the lead laboratory for DOE SNF to direct the research, development and testing of treatment, shipment and disposal technologies for all DOE spent fuel. This program was defunded in 2009 and the State of Idaho pretended that it didn't matter, after all, INL was the nation's premiere nuclear energy research laboratory.

[2] Bryan Clark, *The Idaho Falls Post Register*, "IWTU might begin this year – DOE gives progress report to LINE Commission," February 1, 2018. The Post Register reported that as of last June, the IWTU was more than $200 million over budget. The DOE faces daily fines while it's not in operation because of missing the 2012 milestones and subsequently missed renegotiated schedules for hazardous waste tanks regulated by the State of Idaho.

[3] In order to ship the calcine out of Idaho, it needs a repository to ship to. It needs to be packaged into canisters for shipping and disposal.

Calcine retrieval must be performed regardless of the choice of repository or choice of canister packaging method such as Hot Isostatic Press (HIP) (see our June 2017 newsletter). The Department of Energy had formally announced in 2009 the decision to use HIP as the method of repackaging the calcine for shipping and disposal. The 2009 decision was actually amending previous decisions. Now it appears that the 2009 decision may be changed again because the Department of Energy recently issued a report by an independent review panel describing the possible treatment options for the calcine.

Both the CAB and DOE-ID both agree in 2017 that calcine retrieval needed to continue uninterrupted. Environmental Defense Institute has previously submitted comments to the Idaho Department of Environmental Quality about the calcine. More background on the calcine can be found in the July 2017 EDI newsletter and in other reports listed.

Sec. Moniz: "At the Idaho National Laboratory, 4,400 cubic meters of calcine high-level waste, which exists as granular and powdered solids, is currently planned for treatment, but may be more safely and efficiently packaged without treatment and disposed in a borehole or in a defense waste repository. The same is true for granular solids resulting from fluidized bed stream reforming of 900,000 gallons of sodium-bearing liquid wastes that will be treated at the Idaho site."

DOE has suspended its two repository approach and its borehole research.

[4] Department of Energy Press Release, Amended Record of Decision: Idaho high-Level Waste Facilities Disposition Final Environmental Impact Statement REVISED BY STATE 12/21/09. http://www.id.doe.gov/NEWS/PressReleases/PR100104-HIP/Calcine%20ROD%20final_SIGNED_PDF.pdf In 2009 DOE had decided to select hot isostatic pressing (HIP) to treat the calcine.

[5] US DOE-EM, "Independent Analysis of Alternatives for Disposition of the Idaho Calcined High-Level Waste Inventory, Volume 1 – Summary Report," April 2016. https://energy.gov/sites/prod/files/2016/05/f31/Volume%201%20Calcine%20AoA%20Final%2004-19-16%20w_signatures.pdf

[6] See the Idaho National Laboratory Citizens Advisory Board meeting presentations for June 22, 2017, for the Idaho Cleanup Project at www.inlcab.energy.gov

[7] Chuck Broscious and David B. McCoy, "Preliminary Comments on Calcined Solids Storage Facility," Submitted to Idaho Department of Environmental Quality, May 9, 2017. http://www.environmental-defense-institute.org/publications/EDI-CSSF-Permit-S.pdf and pictures at http://www.environmental-defense-institute.org/publications/EDI-CSSF-Attach.pdf

[8] Calcined Solids Storage Comment Submittal (Docket No. 10W-1604), by Chuck Broscious and Tami Thatcher, July 11, 2016. http://www.environmental-defense-institute.org/publications/EDICalcineComments.pdf

[9] J. V. Crum and J. D. Vienna, Pacific Northwest National Laboratory and D. K. Peeler and I. A. Reamer, Savannah River Technology Center, for the US Department of Energy, "Formulation Effects for Direct Vitrification of INEEL Blend Calcine Waste Simulate: Fiscal year 2000. http://www.pnl.gov/main/publications/external/technical_reports/PNNL-13483.pdf

Even with the progress of shipping of above-ground stored transuranic waste and some buried transuranic waste, the "cleanup" will still leave plenty of transuranic waste over Idaho's aquifer. The americium-241 buried at the RWMC not being exhumed would require six Snake River Plain aquifers to dilute to drinking water standards. [11] [12] [13] [14] [15]

Largely because of the failure to treat liquid waste with the IWTU, the shipping of non-naval spent nuclear fuel to the Idaho National Laboratory was suspended, including research quantities of commercial nuclear power reactor SNF. [16]

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[10] http://energy.gov/articles/secretary-monizs-remarks-look-back-blue-ribbon-commission-america-s-nuclear-future

[11] See the CERCLA administrative record at www.ar.icp.doe.gov (previously at ar.inel.gov) and see also Parsons, Alva M., James M. McCarthy, M. Kay Adler Flitton, Renee Y. Bowser, and Dale A. Cresap, Annual Performance Assessment and Composite Analysis Review for the Active Low-Level Waste Disposal Facility at the RWMC FY 2013, RPT-1267, 2014, Idaho CleanupProject. And see Prepared for Department of Energy Idaho Operations Office, Phase 1 Interim Remedial Action Report for Operable Unit 7-13/14 Targeted Waste Retrievals, DOE/ID-11396, Revision 3, October 2014 https://ar.inl.gov/images/pdf/201411/20141103009608RU.pdf

[12] An often repeated contrived excuse for limiting RWMC cleanup comes from the Record of Decision fuzzy artwork of "worker" risk per acre of waste dug up. It references administrative record report RPT-188 at ar.inel.gov. or ar.icp.doe.gov. It is used to defend digging around in only about 6 acres and not the entire 35 acres of buried waste at RWMC. Radiation worker risks are higher than DOE acknowledges, but they claim that radiation protections for DOE contractor radiation workers limit health risks. But the case was not actually based on a monitored radiation worker. It was based on an unmonitored state employee who receives an unmonitored 47 rem dose throughout his career if the cleanup extends from 6 years to 25 years. This argument, however, is immediately forgotten when discussing extending operations at the AMWTP to outside waste. There is no estimate of the number of people who will be dosed from the polluted aquifer. The gross conservatism of this unmonitored "worker" dose estimate was used to argue that cleaning up the entire mess would yield incrementally high worker doses for each additional acre cleaned up.

[13] US Department of Energy, "Environmental Assessment for the Replacement Capability for Disposal of Remote-Handled Low-Level Radioactive Waste Generated at the Department of Energy's Idaho Site," Final, DOE/EA-1793, December 2011. http://energy.gov/sites/prod/files/EA-1793-FEA-2011.pdf

[14] U.S. Department of Energy, 2008. Composite Analysis for the RWMC Active Low-Level Waste Disposal Facility at the Idaho National Laboratory Site. DOE/NE-ID-11244. Idaho National Laboratory, Idaho Falls, ID and U.S. Department of Energy, 2007. Performance Assessment for the RWMC Active Low-Level Waste Disposal Facility at the Idaho National Laboratory Site. DOE/NE-ID-11243. Idaho National Laboratory, Idaho Falls, ID. Available at INL's DOE-ID Public Reading room electronic collection. (Newly released because of Environmental Defense Institute's Freedom of Information Act request.) See https://www.inl.gov/about-inl/general-information/doe-public-reading-room/

[15] Idaho National Laboratory, "Explanation of Significant Differences Between Models Used to Assess Groundwater Impacts for the Disposal of Greater-Than-Class C Low-Level Radioactive Waste and Greater-Than-Class-C-Like Waste Environmental Impact Statement (DOE/EIS-0375D) and the Environmental Assessment for the INL Remote-Handled Low-Level Waste Disposal Project (INL/EXT-10-19168)," INL/EXT-11-23102, August 2011. http://www.inl.gov/technicalpublications/documents/5144355.pdf and a report prepared for the US Department of Energy, DOE Idaho Operations Office, "Preliminary Review of Models, Assumptions, and Key Data Used in Performance Assessments and Composite Analysis at the Idaho National Laboratory," INL/EXT-09-16417, July 2009. See p. 11, Tables 3 and 4 for sorption coefficients.

[16] Department of Energy, Draft Supplement Analysis: Two Proposed Shipments of Commercial Spent Nuclear Fuel to Idaho National Laboratory for Research and Development Purposes, DOE/EIS-0203-SA-07DOE/EA-1148-

The environmental impact statements regarding DOE's SNF and HLW at INL, including the research quantities of SNF, all rely on the illusive Yucca Mountain repository for disposal. Even a Republican dominated congress is unable to revive the illusion of progress toward obtaining a license to construct the repository. [17]

The geology of Yucca Mountain does not prevent corrosion of the SNF or its containers and does not prevent the migration of radionuclides into nearby watersheds. Arguments that migration of the contaminants from the repository will be acceptably low hinge on the assumed protection of 11,500 5-ton titanium drip shields to be robotically installed after the waste is in place. [18] [19] [20] [21] [22] [23] [24] [25]

SA-01 DOE/EIS-0250F-S-1-SA-02, June 12, 2015. http://energy.gov/nepa/draft-supplement-analysis-two-proposed-shipments-commercial-spent-nuclear-fuel-idaho-national

[17] Recent news at https://www.rollcall.com/news/politics/judicial-cia-nominations-highlight-senates-may-agenda and https://titus.house.gov/press-releases/titus-statement-on-floor-consideration-of-nuclear-waste-policy-amendments-act regarding the bill to be considered by the House but expected to be rejected by the senate.

[18] State of Nevada, Office of the Governor, Agency for Nuclear Projects, "Report and Recommendations of the Nevada Commission on Nuclear Projects." December 10, 2010. https://www.leg.state.nv.us/Division/Research/Library/Documents/ReportsToLeg/2010/61-10.pdf

Excerpt: "For example, the current license application includes covering all the waste canisters with 11,500 titanium drip shields to protect them from rock fall and highly corrosive groundwater. But the drip shields themselves (estimate to cost $12 billion or more) are only proposed to be installed 80 to 100 years after the waste is put into the mountain, using yet-to-be developed robotics due to the extreme thermal and radiological environment that would exist within the emplacement tunnels. Despite this, potentially disqualifying conditions were reveal ed at the site (i.e., fast groundwater pathways, unacceptably high level potential for escaping radioactive gasses, recent volcanism, high levels of seismicity, etc.). To get around this, DOE petitioned Congress to exempt the site from health and safety regulations and then scrapped its own site evaluation guidelines altogether."

Another excerpt: "It posits the existence of titanium alloy 'drip shields', one 5-ton drip shield over each of the 11,500 waste packages, to ward off the corrosion-promoting water. However, these extremely expensive drip shields are not part of the current waste installation plan, but are intended to be installed by a yet-to-be-designed, remote-controlled robotic mechanism about one hundred years after the wastes have been emplaced."

[19] The Department of Energy was planning to use a consent-based approach for siting spent nuclear fuel and high-level waste storage and disposal facilities including: (1) a pilot interim storage facility, (2) consolidated interim storage facilities, and (3) permanent geologic disposal facilities, one for commercial spent nuclear fuel and the other for defense spent nuclear fuel and high-level waste.

A consent-based approach was recommended in the 2012 Blue Ribbon Commission report on the nation's problem of spent nuclear fuel disposal, but no one knows what a consent-based approach entails. What we do know that even with local support, state opposition effectively stymied efforts to obtain authorization to construct the geologic waste disposal at Yucca Mountain at Nevada and prevented a proposed interim storage site at Skull Valley, Utah. The DOE held meetings in 2016 around the country seeking public input on the consent-based process, including one in Boise, Idaho. The Department of Energy successfully disposed of the consent-based approach and the public comments collected following the appointment of Rick Perry as the Secretary of Energy in 2017.

The majority of the spent nuclear fuel is from commercial electricity generation from US nuclear power plants. As of 2013, there was 70,000 metric tons heavy metal, enough for the stymied Yucca Mountain repository. The inventory is expected to roughly double as the existing fleet of US nuclear reactors operates for its expected life. Utilities are winning billions in compensation from the DOE over the continuing costs of storing the spent nuclear fuel because of the DOE's failure to provide a disposal facility.

The rest of the spent nuclear fuel is from DOE research and defense reactors, including nuclear submarines and carriers. The DOE's high-level waste is in various forms ranging from liquid waste at Hanford awaiting vitrification, highly soluble powder-like calcine at Idaho and vitrified waste as other sites.

In the optimistic scenario that a repository is obtained, the spent nuclear fuel and high-level waste at the INL will likely be stored in Idaho decades longer than expected and certainly beyond the milestone dates. The only thing certain is the hubris of nuclear boosters who will try to dismiss the problem of dealing with the nuclear wastes which remains unsolved despite decades of trying and billions of dollars spent.

The settlement agreement date of January 1, 2035 to have the SNF shipped out of Idaho would require SNF repackaging to begin by 2020, but the DOE has not even decided whether to build a new facility or if it can use an existing one. [26]

According to a presentation at the Idaho Cleanup Project Citizens Advisory Board meeting held in April, the DOE has not completed the SNF fuel canister design, has not fully implemented fuel aging management programs for the SNF already at INL, is not addressing waste acceptance requirements affecting disposal of certain SNF/HLW and is not conducting the necessary research concerning degradation related to disposal. [27] [28]

The DOE is simultaneously pretending that a repository will be operating soon and using the lack of a repository is an excuse not to make progress on the repackaging facilities that are essential for the removal of SNF and HLW from Idaho.

And although the settlement agreement does not prevent new reactors such as the NuScale reactor from creating more SNF, this new commercial SNF would be at the back of the line

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[20] Before ending the consent-based siting effort, information found about the Department of Energy's consent-based siting at www.energy.gov/consentbasedsiting and its Integrated Waste Management and Consent-based Siting booklet at http://energy.gov/ne/downloads/integrated-waste-management-and-consent-based-siting-booklet

[21] Department of Energy Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste, January 2013. p. http://energy.gov/em/downloads/strategy-management-and-disposal-used-nuclear-fuel-and-high-level-radioactive-waste

[22] Blue Ribbon Commission on America's Nuclear Future, Report to the Secretary of Energy, January 2012. http://energy.gov/sites/prod/files/2013/04/f0/brc_finalreport_jan2012.pdf.

[23] State of Nevada's website reflecting its opposition to Yucca Mountain, see http://www.state.nv.us/nucwaste/

[24] Utah Department of Environmental Quality reflects state leaders views and offers this information on its opposition to storage of spent nuclear fuel at the facility proposed on the Skull Valley Goshute Indian Reservation at http://www.deq.utah.gov/Pollutants/H/highlevelnw/opposition/concerns/concerns.htm

[25] See Yucca Mountain Environmental Impact Statement, DOE/EIS-0250F-S1.

[26] Department of Energy, Idaho Operations Office, Mission Need Statement: Idaho Spent Fuel Facility Project, DOE/ID-11344, September 2007. http://www5vip.inl.gov/technicalpublications/Documents/3867685.pdf The mission need for a new facility to inspect, package or repackage DOE's non-naval spent nuclear fuel at INL states: "this capability does not exist at INL and is needed in order to meet the Idaho Settlement Agreement."

[27] U.S. Nuclear Waste Technical Review Board, "Management and Disposal of U.S. Department of Energy Spent Nuclear Fuel – Report to the United States Congress and the Secretary of Energy," December 2017. http://www.nwtrb.gov/our-work/reports/management-and-disposal-of-u.s.-department-of-energy-spent-nuclear-fuel-(december-2017) The NWTRB issued a new report summarizing a multi-year review in December 2017. The NWTRB report summarizes the issues of waste disposal and spent nuclear fuel with an emphasis on the storage at the Idaho National Laboratory, Hanford and Savannah River Site. The presentation by Bret Leslie of the NWTRB to the Idaho Cleanup Project Citizens Advisory Board at the April meeting focused on issues at the Idaho National Laboratory.

[28] Idaho Cleanup Project Citizens Advisory Board (formerly the Idaho National Laboratory Citizens Advisory Board) meeting schedules and presentations at https://energy.gov/em/icpcab/idaho-cleanup-project-citizens-advisory-board-icp-cab See presentations for the April 19, 2018 meeting at Fort Hall, Idaho.

should a repository open. Ask NuScale who will pay for extended storage decades after closure and the subsequent repackaging of the SNF it creates.

This editorial was printed in The Idaho Falls Post Register on May 19, 2018 with the headline "Missed clean up milestones."

Idaho LINE Commission Meeting Held in Arco, Idaho

The Idaho Leadership in Nuclear Energy Commission meeting was held in Arco, Idaho on May 24. Presentations given were by Naval Reactor Facilities which gave an overview of the history and current program of the naval nuclear submarine and air craft carrier program, by the Department of Energy regarding "cleanup," and by the Idaho Cleanup Project Citizens Advisory Board chair.

But the big issue that was barely mentioned in the context of a brochure the LINE Commission was developing on the Idaho National Laboratory's calcine waste.

Get ready for the Department of Energy to snuggle up to the LINE Commission and ICP Citizens Advisory Board to press for reclassification of the powdery, highly soluble radioactive calcine waste that resulted for spent nuclear fuel reprocessing at INL. This would open the door for DOE to back out of the Idaho Settlement Agreement milestone that has, since 1995, required DOE to repackage and ship the calcine out of Idaho. Read more about the calcine later in this newsletter.

DOE Seeking To Back Out of Calcine Cleanup Commitments

At the May 24 LINE Commission meeting, a presentation about the Idaho Cleanup Project Citizens Advisory Board said that the DOE would be seeking input by the CAB concerning changes to radiative waste reclassification efforts that mean the highly soluble radioactive calcine waste form would stay in Idaho. Most CAB members have no nuclear chemistry background and rely almost entirely on what the Department of Energy presents to them.

The LINE Commission is easy to fool about this and former LINE members working for the Department of Energy as former INL director John Grossenbacher had been pressing for delaying calcine treatment. The LINE Commission is full of people with self-interest in the nuclear industry and others eager to go along with anything the Department of Energy proposes.

While the overall radioactivity of the calcine declines with time, many of the very long-lived radionuclides in the highly soluble powdery waste will remain highly radiotoxic if inhaled or ingested.

Idaho leaders are being convinced that the U.S. cannot afford to deal with the calcine in a manner to protect Idaho's environment, but they don't worry about the money for a new test reactor and fast reactor research.

For more information about the high-level waste calcine at the Idaho National Laboratory, see our Environmental Defense Institute June 2017 and July 2017 newsletters and calcine comments including 2016 comments. [29]

In Table 1, the radionuclide inventory of the stored calcine is compared to the buried radioactive waste that is not being exhumed and to the new replacement for RWMC.

Table 1. Calcine bin set total radionuclide inventory comparison to the waste that will remain buried at RWMC and to the replacement for RWMC.

Radionuclide (half life)	Calcine Inventory (curies)	Buried (existing) RWMC Inventory (curies)	Buried (future) Replacement RH-LLW Inventory (curies)
Carbon-14 (5730 year)	0.038	731	432
Chlorine-36 (301,000 year)	0	1.66	260
Iodine-129 (17,000,000 year)	**1.6**	0.188	0.133
Technetium-99 (213,000 year)	**4600**	42.3	16.7
Neptunium-237 (2,144,000 year)	**470**	0.141	0.003
Uranium-232 (68.9 year)	1.6	10.6	0.00036
Uranium-233 (159,000 year) Product bred from U-235 and thorium, also decay of Np-237	0.057	2.12	0.0001
Uranium-234 (245,500 year) Pu-238 decay product	**130**	63.9	0.0012
Uranium-235 (703,800,000 year)	**3.2**	4.92	0.005
Uranium-236 (23,400,000 year) Pu-240 decay product	**11**	1.45	0.0001
Uranium-237 (0.0185 year to Np-237)	**1.5**	-	-

[29] Calcined Solids Storage Comment Submittal (Docket No. 10W-1604), by Chuck Broscious and Tami Thatcher, July 11, 2016. http://www.environmental-defense-institute.org/publications/EDICalcineComments.pdf

Uranium-238 (4,470,000,000 year)	3.1	148	16.2
Thorium-228 (1.92 year to radium-224) Natural thorium decay and Pu-240 decay product	1.6	10.5	-
Americium-241 (423 y decays to Np-237)	12,000	215,000	0.38
Plutonium-238 (87.7 year)	**110,000**	2080	-
Plutonum-239 (24,000 year)	**48,000**	64,100	-

* Calcine inventory from DOE/EIS-0287; RWMC buried waste inventory from DOE/NE-ID-11243/11244 (figures cited may not be the latest estimates); replacement remote-handled facility INL-EXT-11-23102.

****Bold** highlighting of calcine inventory indicates a similar or larger inventory than the buried RWMC waste. The RWMC buried waste is estimated by the DOE to yield 100 mrem/yr doses in drinking water for millennia unless a perfect soil cap limits the estimated doses to be 30 mrem/yr. Importantly, the inevitable spikes in contamination due to flooding have not been accounted for despite RWMC flooding in 1963 and 1969. The dose estimates are not conservative. The assumed dilution factors are not consistent with past INL aquifer contamination migration. Calcine migration Kd coefficients may be different than used for RWMC and may worsen the effect of calcine in the soil.

Table 2 provides some additional perspective on the large inventory of radioactive material in the calcine bin sets. It would require 1,975,000,000 billion liters of water (or over 800 Snake River Plain aquifers) to dilute the strontium-90/y-90 in calcine storage to federal drinking water standards. It would require 7,300,000 billion liters of water (or over 3 Snake River Plain aquifers) to dilute the Pu-238 stored in the calcine to federal drinking water standards. It should also be pointed out that these figures are presented as though only a single contaminant were present. In reality, the health detriment of the combination of all contaminants in the drinking water must be considered. This is a point often overlooked by the Idaho Department of Environmental Quality as IDEQ surveys the contamination in the aquifer, dismissing any result below federal drinking water standards which have, for tritium and hexavalent chromium been found to not be protective of human health, especially when consumed over a lifetime. [30]

[30] See www.environmental-defense-institute.org for discussion of more stringent tritium and hexavalent chromium regulations and public health goals that the current EPA federal drinking water standards.

Table 2. Perspective on the quantity of radionuclides in the stored calcine.

Radionuclide (half life)	Inventory (curie)	Maximum Contaminant Level	Dilution volume (Liter) [b]	Number of Aquifers to Dilute
Sr-90/Y-90 (Sr-90 29.1 year)	15,800,000	8 pCi/L	1.975E+18 1,975,000,000 billion	809
Cs-137/Ba-137m (30.2 year)	17,300,000	160 pCi/L	1.081E+17 108,000,000 billion	44
C-14 (5,730 yr)	0.038	2000 pCi/L	1.90E+7 0.019 billion	<<1
Cl-36 (301,000 yr)	0	700 pCi/L	0	0
I-129 (17,000,000 yr)	1.6	1 pCi/L	1.6E+12 1600 billion	<<1
Tc-99 (2213,000 yr)	4600	900 pCi/L	5.11E+12 5110 billion	0.002
Np-237 (2,144,000 yr)	470	15 pCi/L[a]	3.13E+13 31,300 billion	0.0128
U-234 (245,500 yr)	130	15 pCi/L[a]	8.67E+12 8,670 billion	0.00355
Am-241 (432 yr to Np-237)	12,000	15 pCi/L[a]	8.0E+14 800,000 billion	0.378
Plutonium-238 (87.7 year)	110,000	15 pCi/L[a]	7.3E+15 7,300,000 billion	3
Plutonum-239 (24,000 year)	48,000	15 pCi/L[a]	3.2E15 3,200,000 billion	1.3

a. The unit of 1 picoCurie/liter is 1.E-12 curie/liter. The limit is 15 pCi/L for total alpha (40 CFR 141). For uranium, total natural uranium limit of 30 microgram/liter for all combined uranium isotopes.

b. Aquifer volume of 2.44E+15 liters is assumed.

c. The dilution volume ignores soil adsorption and migration delay timing; it is provided to give some perspective on the amount of waste involved. It ignores that fact that the entire aquifer is not going to be involved with dilution, although waste in the aquifer can fan out and involve a considerable portion of the aquifer downstream.

The graph of the migration of the buried waste at RWMC that will remain at RWMC buried in soil is shown below in Figure 1. The contamination migration is not realistically modeled by the DOE nor is it conservatively modeled. Flooding and fast paths of contaminant migration are ignored. [31] The ingestion doses will undoubtedly exceed the 30 to 100 mrem/yr radiation doses shown, intermittently at least. The CERCLA cleanup ignored doses after 10,000 years. Check out how, even after 100,000 years, the long lived radioactive waste, including americium-241, various plutonium and uranium isotopes, iodine-129, neptunium-237 and technetium-99, remains an ingestion hazard, even with the modeling assumptions biased toward retention in the burial grounds.

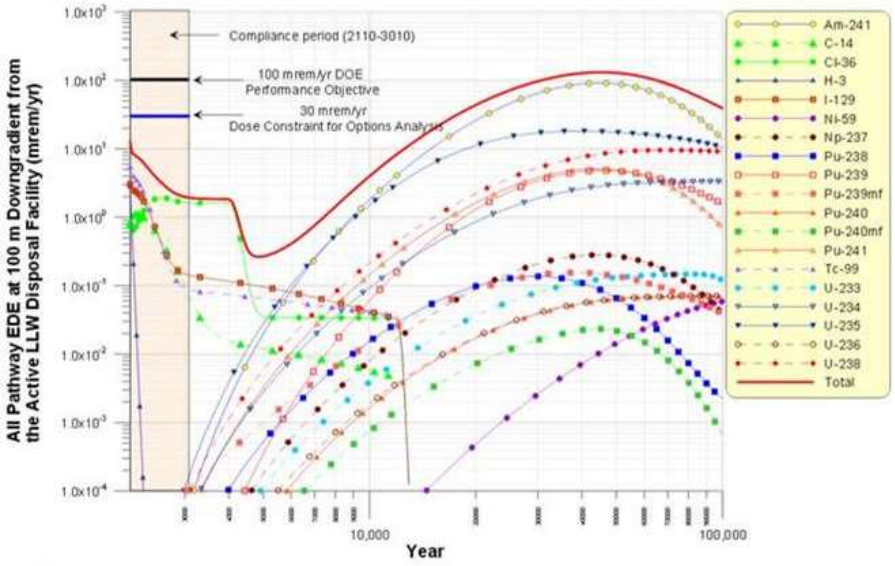

Figure 4-2. All-pathways effective dose equivalent 100 m downgradient from the Radioactive Waste Management Complex boundary from year 2110 to year 100,000 with cover infiltration rate equal to 1 cm/year.

Figure 1. All-pathways radiation dose for the Radioactive Waste Management Complex from DOE/NE-ID-11243 and DOE/NE-ID-11244. Americium-241, uranium-235, uranium-238, and plutonium-239 are top contributors to ingestion dose after 10,000 years. Beware, however, that contamination migration by the DOE appears to be modeled with a bias toward delaying the release timing to be after 10,000 years. The EPA ignores post-10,000 contamination in its INL CERLCA cleanup.

[31] Johnson TM et al., *Geology*, "Groundwater "fast paths" in the Snake River Plain aquifer: Radiogenic isotope ratios as natural groundwater tracers," v. 28; no. 10; p. 871-874, October 2000.

Naval Reactors Facilities Presentation to the Idaho LINE Commission

Excluded from the NRF presentation to the LINE Commission on April 24 was any mention of their continuing radioactive waste disposal on the Idaho National Laboratory's Radioactive Waste Management Complex and the replacement for the RWMC the Remote-Handled Low-Level Waste Disposal at the ATR Complex. Also, not mentioned in the presentation was NRF's longstanding travesty of exempting civilian NRF employees from the Energy Department's illness compensation program.

When I asked about changing the law so that NRF employees would be eligible for illness compensation, I was given the same excuses that NRF had always be careful with radiation exposures. Radiation monitoring and controls were superior and they had very few skin exposures. So NRF officials conclude that NRF workers didn't need to be eligible for illness compensation.

During a break, when I asked whether NRF could provide evidence of adequate internal alpha monitoring programs for all decades of operation, the response was "I'll get back to you."

NRF leadership is living in a fantasy if they actually believe what they are saying. There are too many workers younger than age 50 who have died of cancer after working at NRF. Radiation worker epidemiology is showing elevated cancer risk at annual doses far below the currently allowed 5 rem [32] and the external radiation limit used to be higher and had not included internal dose. The investigations of the Idaho National Laboratory for energy worker compensation have found wide spread inadequate monitoring of internal alpha emitters such as plutonium at the INL. There was plenty of fuel end cap chopping and chemical fuel and target separations and disposal to spread alpha contamination to workers breathing space at NRF.

Inhalation and ingestion of radionuclides is missed by film badge monitoring programs and needs a strong bioassay program of urine and fecal monitoring. The harm from internal radionuclides is also higher than official radiation health models predict. [33]

From US Geological Survey reports, americium-241 flows in the aquifer to the ATR Complex from the Naval Reactors Facility. This is just some of the evidence of transuranic

[32] Richardson, David B., et al., "Risk of cancer from occupational exposure to ionizing radiation: retrospective cohort study of workers in France, the United Kingdom, and the United States (INWORKS), BMJ, v. 351 (October 15, 2015), at http://www.bmj.com/content/351/bmj.h5359 Richardson et al 2015 . This epidemiology study that included a cohort of over 300,000 nuclear industry workers has found clear evidence of solid cancer risk increases despite the average exposure to workers being about 2 rem and the median exposure was just 410 millirem. Also see December 2015 EDI newsletter.

[33] Christopher Busby, *INTEC*, "Aspects of DNA Damage from Internal Radionuclides," 2013. http://dx.doi.org/10.5772/53942

separations processes have been conducted at NRF. Why would NRF have had adequate programs to monitor the transuranic ingestion and inhalation when the National Institute for Occupational Safety and Health (NIOSH) continues to find that the rest of the INL did not?

Special Exposure Cohorts for the INL have been added because of inadequate programs to monitor and control internal doses from transuranic radionuclides. Investigations conducted of historical INL operations for energy worker illness compensation during the last two years have found shattering revelations about inadequate worker protections at the INL especially regarding inhalation of alpha emitters such as americium and plutonium and the inability to estimate what doses these workers had received. The investigations partially include the early decades of INL operation until the 1980s but have not investigated all years of operation. [34] [35] [36] [37] [38] [39] [40] [41]

Yet, as these studies for radiation dose reconstruction by NOISH have begun to allow more workers to obtain compensation, many more studies need to be completed for various INL facilities and various years of operation. See more in Environmental Defense Institute's April 2018 newsletter about the wrongful exclusion of NRF workers from Energy Employee Occupational Illness Compensation Program Act (EEOICPA).

Even though compensation is currently excluded, I would urge all former NRF workers or their eligible survivors to apply for compensation from the EEOICPA so that there is a record of NRF employee illness.

[34] See the EDI September 2017 newsletter and the Advisory Board on Radiation and Worker health meetings webpage for August 2017 at https://www.cdc.gov/niosh/ocas/pubmtgs.html See the NIOSH/DCAS: Idaho Laboratory SEC Evaluation Report SEC-00238 from that page at https://www.cdc.gov/niosh/ocas/pdfs/abrwh/pres/2017/dc-inlsec238-082317.pdf

[35] See the July 20, 2017 presentation to the NIOSH radiation board (See August 14, 2017 board meeting) describing various problems at the Idaho National Laboratory's INTEC prior to 1981 at https://www.cdc.gov/niosh/ocas/pdfs/sec/inl/inler-238-r0.pdf

[36] INL May 2, 2016 NIOSH Radiation Advisory board recommended Special Exposure Cohort: https://www.cdc.gov/niosh/ocas/pdfs/abrwh/secrecs/bdrecinl-219.pdf

[37] ANL-West May 2, 2016 NIOSH Radiation Advisory board recommended Special Exposure Cohort: https://www.cdc.gov/niosh/ocas/pdfs/abrwh/secrecs/bdrecanlw-224.pdf

[38] See p. 19 of "INL SEC Proposed Class – Update SEC00219" at https://www.cdc.gov/niosh/ocas/pdfs/abrwh/pres/2015/dc-inlsec219-111015.pdf

[39] See EDI's June 2017 newsletter article "Why so wrong for so long?" at http://www.environmental-defense-institute.org/publications/News.17.June.pdf

[40] SC&A, Inc., "Draft Review of NIOSH's Evaluation Report for Petition SEC-00219, Idaho National Laboratory: Burial Ground, 1952-1970," SCA-TR-2017-SEC007, May 2017.

[41] Department of Labor presentation August 2017 https://www.cdc.gov/niosh/ocas/pdfs/abrwh/pres/2017/dol-update-082317.pdf p. 10-12.

Another Oversight by IDEQ at INL's HFEF RCRA Program?

On May 16, the Idaho National Laboratory sent a letter describing that a permit modification request was needed for its Hazardous Waste Management Act/Resource Conservation and Recovery Act Permit for the Hot Fuel Examination Facility (HFEF) at the Materials and Fuels Complex. It stated that the current permit does not describe a mezzanine in the High Bay Area at the HFEF. It stated that the permittee added language to clarify that storage on the mezzanine is allowed, and other changes.

The diagram of the floor layout and the areas where RCRA hazardous waste was allowed to be stored has been online at the Idaho Department of Environmental Quality. The mezzanine has not been delineated as a RCRA hazardous waste storage area. [42]

What I was told years ago was that RCRA hazardous waste was being stored at MFC in areas that did not allow RCRA hazardous waste. RCRA hazardous waste can included radioactive waste. In the past, I have asked IDEQ why there were no RCRA storage violations at MFC.

It appears that Battelle Energy Alliance is finally seeking a "clarification" to make its longstanding practice of unlawfully and knowingly storing RCRA waste where it was not permitted to do so.

Why isn't the Idaho Department of Environmental Quality's INL Oversight recognizing RCRA storage violations have been taking place at MFC?

New Fast Neutron Test Reactor Won't Be Paid For By Reactor Vendors and Would Likely Experience Significant Cost Overruns

The Nuclear Energy Advisory Committee (NEAC) Report regarding "Assessment of Missions and Requirements for a New U.S. Test Reactor," is available online. [43] The Department of Energy is considering the design, development, and deployment of a fast spectrum test reactor.

The materials test reactors in the U.S. are typically for slow neutron spectrum of light water reactors and can only provide about 5E+14 n/cm2/s which would provide about 6 displacements per atom (dpa) per year of irradiation. The fast reactor research is thought to need 100 dpa; hence, the existing capability in the U.S. is inadequate.

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[42] Idaho Department of Environmental Quality http://www.deq.idaho.gov/media/60177424/inl-mfc-hw-partial-permit-attachment1b-1017.pdf

[43] Nuclear Energy Advisory Committee (NEAC) Report "Assessment of Missions and Requirements for a New U.S. Test Reactor," report approved February 16, 2017. https://www.energy.gov/ne/downloads/neac-report-assessment-missions-and-requirements-new-us-test-reactor

Currently, there are a few materials test reactors outside the U.S. such as the BOR-60 materials testing reactor in the Russian Federation.

Some fast reactor researchers anticipate that the fuel used in advanced fast reactor concepts will attain higher peak burnups and neutron fluences and this will require materials testing for plant licensing. But, a number of venders did not believe that a test facility was essential to deployment of new fast reactor designs.

Responses in 2016 from TerraPower, Westinghouse and Areva regarding fast reactor research are interesting now in terms of the upheaval faced by some of these nuclear companies in recent years.

Areva said it had no pressing need for fast reactor test reactor capability. Areva has had to be bailed out by the government of France for its cost overruns building EPR reactors outside of France.

TerraPower's proposed Traveling Wave fast small modular reactor has partnered with China National Nuclear Corp. The TerraPower website states: "Currently, fuels are also being tested in the Advanced Test Reactor at Idaho National Laboratory. In partnership with AREVA Federal Services, TerraPower manufactured the first full-size test assembly for the TWR technology. **Additionally, the company is now receiving and analyzing results from its first irradiation experiments, conducted in partnership with the BOR-60 fast reactor in Russia.**" [44]

After the bankruptcy of Westinghouse because of its cost overruns in the AP1000 nuclear power plants in the U.S., it would appear to have little resources to invest in fast reactor research. [45]

A company called Advanced Reactor Concepts, of Chevy Chase, Maryland, has an ARC-100 small modular reactor fast reactor design concept wrote that they didn't need a test reactor. Advanced Reactor Concepts announced their collaboration with GE Hitachi Nuclear (GEH) to develop the ARC-100 advanced small modular reactor design. [46]

So, we have some vendors interested in materials test reactor capability but there is no indication that they plan on investing in building the test facility. And if current materials testing is any indication, they will expect to pay very little to use the facility. The U.S. taxpayer will be asked to fund a $1 billion plus facility and the cost can be expected to double several times, as have other recent nuclear industry and Department of Energy projects.

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[44] TerraPower.com, http://terrapower.com/technologies/progress

[45] Reuters Staff, Reuters, "Toshiba withdraws from South Texas nuclear power plant project," May 31, 2018. https://www.reuters.com/article/us-toshiba-nuclear-texas/toshiba-withdraws-from-south-texas-nuclear-power-plant-project-idUSKCN1IW35T Toshiba America Nuclear Energy (once Westinghouse Toshiba) has scrapped a plan to build third and fourth reactors for NRG Energy Inc's South Texas Project due to lack of investors.

[46] Press Release, GE Hitachi Nuclear Energy and ARC Nuclear Announce Steps to Further Collaboration to Commercialize Advanced Small Modular Reactor," August 28, 2017. http://www.powermag.com/press-releases/ge-hitachi-nuclear-energy-and-arc-nuclear-announce-steps-to-further-collaboration-to-commercialize-advanced-small-modular-reactor/

Two Westinghouse AP1000 reactors in South Carolina were partially built and then cancelled; the other two AP1000 reactors in Georgia are needing financial help.

The Department of Energy's vitrification plant in Hanford and Mixed Oxide (MOX) plant in South Carolina at the Savannah River Site have faced increasing cost estimates. The cost estimates to complete MOX plant that had been under construction at the Savannah River Site kept ballooning and this year the MOX Fuel Fabrication Plant has now been cancelled. [47] So far, $7 billion was spent on the now canceled MOX project. [48]

The Idaho National Laboratory is spending considerable effort to promote a light-water NuScale small modular reactor designed by NuScale. This old light-water reactor technology uses up a small fraction of the uranium in the fuel. Reprocessing pollutes air and water and the uranium it recovers has impurities that make problems in fuel fabrication and in operation. There is only roughly 80 years of uranium left for light water reactors if their use was to widen enough to be relevant to slowing carbon emissions.

The fast reactor research by TerraPower that is going on is already using a materials test reactor in Russia. GE Hitachi and Advanced Reactor Concepts don't see that a fast neutron test reactor is essential. So, why have the U.S. taxpayer pay for a fast materials test reactor that likely will cost far more than initially estimated and won't be operating until years after initially scheduled, given the track record of recent U.S. nuclear industry and Department of Energy projects? This is clearly a boondoggle in the making.

Department of Energy MOX Plant Canceled After Spending $7 Billion, Now Plans are to Dilute and Bury

The Department of Energy's Mixed Oxide (MOX) plant in South Carolina has faced increasing cost estimates. The MOX plant had been under construction at the Savannah River Site in South Carolina and would have been used to dispose of 34 metric tons of excess plutonium from the U.S. nuclear weapons program. The cost estimate to complete the project kept ballooning by billions of dollars above the original estimate. The MOX Fuel Fabrication Plant has now been cancelled. [49] So far, $7 billion was wasted on the now canceled project. [50]

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[47] Ed Lyman, *Union of Concerned Scientists*, "Another Nail in the Coffin of the Misguided MOX Program," March 23, 2018. https://allthingsnuclear.org/elyman/mox-program-coffin

[48] Andrew Brown, *The Post and Courier*, "Another SC nuclear boondoggle could soon meet its end. This time it's $7B in taxpayer money wasted," May 20, 2018. https://www.postandcourier.com/business/another-sc-nuclear-boondoggle-could-soon-meet-its-end-this/article_e7096912-590a-11e8-b88a-a76a2bf0e36e.html Shaw Group and Areva, a French-based nuclear company, were initially hired to build the one-of-a-kind facility for the Department of Energy. Shaw would later be taken over by Chicago Bridge & Iron – a move that put the company in charge of the MOX and the V.C. Summer AP1000 nuclear reactor projects. There is no agreement on how much of the MOX project is actually finished.

[49] Ed Lyman, *Union of Concerned Scientists*, "Another Nail in the Coffin of the Misguided MOX Program," March 23, 2018. https://allthingsnuclear.org/elyman/mox-program-coffin

Cost overruns on the MOX project have been blamed on construction problems that resulted from the construction proceeding when the design was only partially (20 to 25 percent) complete. Faulty construction has resulted in about twenty-five percent of the construction having to be reworked. [51]

Proposed 40 Year License for Interim Spent Nuclear Fuel Storage at Holtec Facility in New Mexico

If you live near stranded nuclear fuel, say perhaps near San Onofre's closed nuclear plant and its storage of spent nuclear fuel near the Pacific coast line in canisters that will be vulnerable to corrosion in perhaps less than 20 years because of corrosion issues due to the salty air, you are hoping for any place to send the spent nuclear fuel to.

Stranded spent nuclear fuel is piling up at closing nuclear plants around the U.S. After the SNF cools in a spent fuel pool, it can be transferred to dry storage canisters. While the fuel risks of an overcrowded spent fuel pool with hotter (radioactively and thermally) spent fuel are greater than for dry storage, leakage from canisters can be expected to blow in the wind. Not only that, the repackaging that may be needed to replace the cannister or for shipping may require an expensive facility to be built. There are numerous dry storage designs and the vulnerability of the various designs and the needed repackaging for transportation varies. As the fuel and canisters age, transportation issues may be more prone to problems.

Holtec is seeking a 40 Year License for an Interim Spent Nuclear Fuel Storage facility in New Mexico. [52] What will happen after 40 years, when some canisters are leaking and there is still no place for final disposal of the spent nuclear fuel? It will essentially blackmail the State of New Mexico into becoming the nation's spent fuel repository.

The Holtec facility would be the HI-STORE Consolidated Interim Storage Facility that would store the canisters underground. The canisters would be shipped by railroad.

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[50] Andrew Brown, *The Post and Courier*, "Another SC nuclear boondoggle could soon meet its end. This time it's $7B in taxpayer money wasted," May 20, 2018. https://www.postandcourier.com/business/another-sc-nuclear-boondoggle-could-soon-meet-its-end-this/article_e7096912-590a-11e8-b88a-a76a2bf0e36e.html Shaw Group and Areva, a French-based nuclear company, were initially hired to build the one-of-a-kind facility for the Department of Energy. Shaw would later be taken over by Chicago Bridge & Iron – a move that put the company in charge of the MOX and the V.C. Summer AP1000 nuclear reactor projects. There is no agreement on how much of the MOX project is actually finished.

[51] Plutonium Disposition and the MOX Project, Hearing before the Subcommittee on Strategic Forces of the Committee on Armed Services House of Representatives, Hearing Held October 7, 2015. John MacWilliams Testimony 2015 https://www.documentcloud.org/documents/4465476-John-MacWilliams-Testimony-2015.html

[52] Laura Paskus, *The NM Political Report*, "With no permanent repository for commercial nuclear waste, NM is in the spotlight," May 29, 2018. http://nmpoliticalreport.com/841916/with-no-permanent-repository-for-commercial-nuclear-waste-nm-is-in-the-spotlight-en/

Who would fund and operate the facility in the long term? No one knows. The spent nuclear fuel remains highly radiotoxic if released to the environment for over a million years.

For those who see the underground salt mine as the perfect disposal site, it makes sense. But for those who question to geology and the brine that seeps through the underground salt mine where the nation's defense generated transuranic waste is disposed of, there are questions that the Department of Energy did not answer. The Department of Energy never expected salt brine to enter the Waste Isolation Pilot Plant (WIPP) facility, but it does. The brine water can carry radioactive material with it. Where is the brine moving to? Geologists who question too much have their employment terminated.

There are those in New Mexico who understand the peril of accepting "interim" storage when there is no authorized permanent disposal site. [53] New Mexico Senator Tom Udall has said he won't support an interim disposal site without a plan for permanent disposal because the nuclear waste could be orphaned there indefinitely.

Transportation by rail is proposed, but the weight of a loaded transport cask will weigh at least 371,000 pounds (185.5 tons) according to Don Hancock, Southwest Research and Information Center. Hancock said that the not all existing railroads will be able to handle the weights of these loaded spent nuclear fuel transport casks.

The Albuquerque Journal also quoted Bob Alvarez, a former senior policy adviser to the Secretary of Energy that some of the spent fuel, which has been sitting around for decades in some cases, may not be appropriate for transport and may require repacking. The cost of repackaging the spent nuclear fuel for transport is unknown.

The U.S. Nuclear Regulatory Commission's public comment period for its scoping process on Holtec's license for the HI-STORE Consolidated Interim Storage Facility is open until July 30. Comments can be emailed to Holtec-CIFEIS@nrc.gov.

Articles are by Tami Thatcher for June 2018.

[53] Maddy Hayden, *Albuquerque Journal*, "Plan to store spent nuclear fuel rods in NM," March 16, 2018. https://www.abqjournal.com/1147077/proposed-nuclear-waste-facility-in-se-new-mexico-under-review.html?utm_source=abqjournal.com&utm_medium=related+posts+-+opinion&utm_campaign=related+posts