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Energy Northwest in Washington State still promoting X-energy reactor project that would leave ratepayers with spent nuclear fuel management expenses far beyond the 60-yr reactor design life

While a public utility district in central Washington, Grant County PUD, recently withdrew support for X-energy, Energy Northwest upped its support by receiving a $10 million investment from Puget Sound Energy to continue promoting the risky small modular reactor X-energy project in the Pacific Northwest. [1] X-energy has cancelled plans for a merger and initial public stock offering and also laid off some of its staff. So far, X-energy has received $242 million from the Department of Energy. [2]

Energy Northwest and X-energy have announced an agreement for up to 12 Xe-100 advanced SMRs in central Washington capable of generating up to 960 megawatts of electricity. The first Xe-100 high-temperature gas-cooled reactor 80-MW module is said to be scheduled to be online by 2030. [3] The Xe-100 is a pebble-bed helium-cooled high-temperature gas-cooled reactor that uses 15.5 percent enriched TRISO fuel.

X-energy claims that its Xe-100 reactors are "clean, safe, secure and affordable." [4] But no facts support these claims. The spent fuel remains radiotoxic for more than hundreds of thousands of years and there is no spent nuclear fuel disposal repository. The Department of Energy has no program to obtain one or more repositories. Enrichment in uranium-235 about 3 to 4 precent complicated disposal in a repository and no process has been developed for reprocessing of TRISO fuel.

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[1] Andrew Engelson, Columbia Insight, "Two planned nuclear power projects in Pac NW are scrapped," January 11, 2004. https://columbiainsight.org/two-planned-nuclear-power-projects-in-pac-nw-are-scrapped/

[2] Stephanie Cooke, *Energy Intelligence*, Opinion – The End of DOE's Flagship SMR – A Cautionary Tale, November 17, 2023. https://www.energyintel.com/0000018b-cf50-dbb5-a5ef-df7378750000

[3] Aaron Larson, *Powermag.com*, "Puget Sound Energy Company Commits $10M to Nuclear Power Feasibility Work, X-energy SMR Technology a Leading Contender for Project," January 11, 2024. https://www.powermag.com/puget-sound-energy-commits-10m-to-nuclear-power-feasibility-work-x-energy-smr-technology-a-leading-contender-for-project/

[4] X-energy, Letter from X-energy to U.S. Nuclear Regulatory Commission, "Submittal of X Energy, LLC (X-energy) Xe-100 White Paper Slide Deck, 'Spent Fuel Management White Paper,'" 2023-XE-NRC-002, January 10, 2023. https://www.nrc.gov/docs/ML2301/ML23011A324.pdf Project No. 99902071.

The TRISO fuel would be more difficult to reprocess than many other fuels because of various silicon impurities and high loadings of carbon fines, [5] and no process has been developed to reprocess TRISO fuel. The cost of reprocessing, the airborne polluting while reprocessing, the extra radioactive waste generated by reprocessing and the weapons material theft are problems with reprocessing spent fuel. **The use of high-assay low-enriched uranium (HALEU) inherently means enriched uranium-235 is more available for diversion to nuclear weapons and creates nuclear material security problems.** So much for being "secure."

Similar TRISO spent fuel languishes in the U.S. Fort St. Vrain spent nuclear fuel and also in Germany, and remains costly to store decades after the reactors were shuttered. So much for being "affordable." There may be safety advantages to the TRISO fueled Xe-100 reactor, but information isn't available to make much of an assessment.

The Department of Energy conducted a study completed in 2023 about Xe-100 reactor impacts on a repository, but that report, mentioned at the August 2023 Nuclear Waste Technical Review Board Meeting, still withheld from the public. [6]Apparently, the waste disposal characteristics of Xe-100's spent fuel are not something the public should be told about.

X-energy has not yet submitted a license application to the U.S. Nuclear Regulatory Commission for the Xe-100 reactor modules. [7] However, X-energy has submitted an application to the NRC to build a commercial-scale TRISO-X Fuel Fabrication Facility. [8] The TRISO-X fuel uses high-assay low-enriched uranium (HALEU) that is up to 20 percent enriched in uranium-235, far higher than the 2 to 5 percent enrichment of typical commercial nuclear power plants and poses weapons material proliferation risks.

There have been several gas-cooled reactors built. Germany operated the THTR, a 750 MW-thermal pebble-bed reactor (FRG) from 1985 to 1991. [9] In the U.S., the Department of Energy research included the Peach Bottom high temperature gas-cooled reactor (40 MWe) and the Fort St. Vrain (330 MWe) high-temperature gas-cooled reactor. [10] Fort St. Vrain was based on the

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[5] Charles W. Forsberg and David L. Moses, Oak Ridge National Laboratory, *Safeguards Challenges for Pebble-Bed Reactors Designed by People's Republic of China*, ORNL/TM-2008/229, November 2009.

[6] Brady Hanson, Pacific Northwest National Laboratory, Laura Price, Sandia National Laboratory and others, *Report of the Back-End Management of Advanced Reactors (BEMAR) IPT on the X-energy's Xe-100 Reactor,* April 25, 2023, Revision 1. CUI Categories: SP-EXPT-SP-PROPIN/PRIVILEGE. Report front cover only was provided at the August 2023 NWTRB meeting presentation by Ned Larson, Department of Energy.

[7] U.S. Nuclear Regulatory Commission webpage at https://www.nrc.gov/reactors/new-reactors/advanced/who-were-working-with/licensing-activities/pre-application-activities/xe-100.html

[8] U.S. Department of Energy webpage at https://www.energy.gov/ne/articles/x-energy-completes-40-million-project-further-develop-high-temperature-gas-reactor

[9] J. M. Beck and L. F. Pincock, Idaho National Laboratory, High Temperature Gas-cooled Reactors Lessons Learned Applicable to the next Generation Nuclear Plant, INL/EXT-10-19329, Revision 1, April 2011. https://inldigitallibrary.inl.gov/sites/sti/sti/5026001.pdf

[10] J. M. Beck and L. F. Pincock, Idaho National Laboratory, High Temperature Gas-cooled Reactors Lessons Learned Applicable to the next Generation Nuclear Plant, INL/EXT-10-19329, Revision 1, April 2011. https://inldigitallibrary.inl.gov/sites/sti/sti/5026001.pdf

Peach Bottom reactor design and used a fuel that was a mixture of carbides of uranium and thorium with TRISO coatings.

The Fort St. Vrain reactor was high-temperature gas-cooled reactor. It was helium-cooled, graphite-moderated, and *operated between unplanned repairs* between 1979 and 1989. The Fort St. Vrain reactor used TRISO fueled, using very high enriched in uranium-235 (93.5 percent enriched) and thorium-uranium carbide particles. The Fort St. Vrain reactor was plagued with problems related to helium leakage and material corrosion. [11]

The high-temperature gas-cooled reactor Fort St. Vrain nuclear reactor suffered cost overruns in construction and operation, continuous breakdowns and was a huge financial failure. It had corrosion problems and it was shut down for repairs most of the time, with average capacity of only 14 percent. [12] Moisture in-leakage into the helium-cooled reactor degraded the control rod drives and reserve shutdown systems. Six control rod pairs failed to scram during an event on June 23, 1984. This represented a significant safety hazard for the nuclear plant despite some claims to the contrary. Helium leaks were a challenge. Moisture in the helium coolant also degraded the nuclear fuel, caused by hydrolysis of the fuel particle coating of the TRISO fuel. [13]

The difficulty in disposal of TRISO fuel and reactor internals will depend on whether or not the graphite can be disposed of with the spent fuel and whether or not the graphite exceeds Class-C low-level radiative waste criteria. In addition, when the carbide in TRISO fuel is exposed to water, flammable gases are generated, which may be significant. Also, the more highly enriched the fuel, above 3 to 5 percent, additional measures may be needed to ensure criticality control after disposal, particularly if the fuel is separated from the graphite blocks. [14]

X-energy's design is for a 60-year reactor design life and for an 80-year spent fuel storage design. X-energy is stating that **"X-energy has engaged with the DOE to strategize their acceptance of all spent fuel within the 80-year period."** [15] **But this statement is no guarantee that there will be a permanent repository in 80 years.**

Because no money is collected for the Nuclear Waste Fund and because new reactors won't be able to sue the Department of Energy for not taking commercial spent nuclear fuel starting in 1998, ratepayers will be on the hook for more costs of spent managing the spent nuclear fuel that

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[11] U.S. Nuclear Waste Technical Review Board (NWTRB, Factsheet Fort St. Vrain. https://www.nwtrb.gov/docs/default-source/facts-sheets/doe-snf-fact-sheet---fort-st-vrain-rev-1.pdf?sfvrsn=14

[12] Cathy Proctor, *Business Journal*, "Fort St. Vrain power plant reborn after checkered past," June 10, 2001. https://www.bizjournals.com/denver/stories/2001/06/11/story3.html (converted from nuclear to fossil fuel)

[13] D. A. Coppinger and D. L. Moses, ORNL Prepared for U.S. NRC, "Fort Saint Vrain Gas Cooled Reactor Operational Experience," NUREG/CR-6839, September 2003. https://www.nrc.gov/docs/ML0403/ML040340070.pdf

[14] Laura Price, Sandia National Laboratories, *Using Past Experience to Inform Management of Waste from Advanced Reactors and Advanced Fuels*, SAND2022-10873C, 2022. https://www.osti.gov [2004321.pdf]

[15] X-energy, Letter from X-energy to U.S. Nuclear Regulatory Commission, "Submittal of X Energy, LLC (X-energy) Xe-100 White Paper Slide Deck, 'Spent Fuel Management White Paper,'" 2023-XE-NRC-002, January 10, 2023. https://www.nrc.gov/docs/ML2301/ML23011A324.pdf Project No. 99902071.

X-energy will generate than past consumers of earlier nuclear reactors in the U.S. Disposal of TRISO fuel is likely to complicate repository design and safety.

High construction costs ended the NuScale project, but construction costs are not the only unaffordable costs of nuclear energy

David Schlissel of Institute for Energy Economics and Financial Analyses (IEEFA), spoke at a virtual meeting held by the Montana Environmental Information Center on January 11. [16] Schlissel's evaluation of construction costs one year ago for the now-cancelled NuScale nuclear project that had been slated to be built at the Idaho National Laboratory, [17] clued many people paying attention, that the NuScale project, had it proceeded, would have been a financial disaster for electricity ratepayers. This is despite NuScale having received $583 million in Department of Energy funds since 2015. [18]

Cost overruns on construction and decommissioning nuclear plants are common. Operating costs can spiral up as unplanned repairs are needed or nuclear reactors must be prematurely shut down before their planned end-of-life.

While new nuclear projects may factor in some of the costs of spent nuclear fuel management, none of these projects is factoring in the ratepayer's and taxpayer's liability over the long-term. Nuclear plants who years ago entered into the "standard contract" with the Department of Energy to take the spent nuclear fuel by 1998, and who have sued DOE for the costs of dry storage of their stranded spent nuclear fuel, have been and continue to be reimbursed for the cost of dry storage of their spent nuclear fuel. But new nuclear reactors won't be able to be paid this way and will be putting ratepayers on the hook for untold decades and perhaps centuries of the cost of packaging and of repackaging the spent fuel while no repository exists.

Regarding a permanent disposal repository, as of 2014, fees are no longer being collected into the Nuclear Waste Fund from nuclear utilities. The U.S. taxpayer is on the hook for paying to attempt to license and construct now multiple spent nuclear fuel repositories. The Department of Energy's promotion of consolidated interim storage facilities is not a permanent solution at all and the DOE has no program to license and construct any repository for commercial spent nuclear fuel or the Department of Energy's SNF/HLW.

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[16] Montana Environmental Information Center, Webinar Recording – Moving Forward without Nuclear: Montana's Path to Clean, Reliable Electricity, webpage accessed January 26, 2024. https://meic.org/webinar-recording-moving-forward-without-nuclear-montanas-path-to-clean-reliable-electricity/

[17] David Schlissel, *Institute for Energy Economics and Financial Analysis*, "Eye-popping new cost estimates released for NuScale small modular reactor," January 11, 2023. at https://ieefa.org/resources/eye-popping-new-cost-estimates-released-nuscale-small-modular-reactor

[18] Andrew Engelson, Columbia Insight, "Two planned nuclear power projects in Pac NW are scrapped," January 11, 2004. https://columbiainsight.org/two-planned-nuclear-power-projects-in-pac-nw-are-scrapped/

The Department of Energy, what by law, is responsible for obtaining a permanent solution for spent nuclear fuel, has no program to obtain a repository. No one knows who will pay for continued storage of spent nuclear fuel that will likely require repackaging as containers and their contents degrade.

No one who is informed about the actual costs and liabilities of nuclear energy would ever support building more nuclear power plants.

Nuclear promoters continue to avoid realistic disclosure of the cost of spent nuclear fuel disposal or of reprocessing

Nuclear promoters pathologically repeat nonsense about the cost and the problem of spent nuclear fuel disposal. An example is from Oliver Stone who made a documentary promoting nuclear energy. In an interview, Stone when asked stated that "nuclear waste is 'not an issue' and is 'completely handleable.'" [19]

In 2009, the GAO reported its own estimate of the cost to dispose of 153,000 metric tons of spent nuclear fuel and high-level waste by 2055 being from $41 billion to $67 billion (in 2009 dollars). Adding in the already spent $14 billion on Yucca Mountain, this totaled a maximum of $81 billion, over a 143-year period until repository closure. **This estimate included both spent nuclear fuel generated by commercial power reactors, and DOE-managed spent fuel and high-level waste from power, research and navy reactors and high-level waste.** [20] A similar but even higher estimate came from the DOE's 2008 estimate for Yucca Mountain: $96 billion (in 2007 dollars) from 1983 through expected closure in 2133. [21] [22]

In 2010, the Yucca Mountain repository was defunded. And the Department of Energy announced that commercial spent nuclear fuel would go to a separate repository than the DOE-managed nuclear waste repository. Neither repository exists.

A more recent cost estimate was given in 2021 GAO-21-603 for the disposal of commercial spent nuclear fuel as $168 billion. **But this only includes the spent nuclear fuel generated by commercial nuclear reactors and excludes the separate disposal of DOE-managed spent nuclear fuel and high-level waste.** [23]

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[19] Cliff Conner, *Science for the People Magazine*, "Here We Go Again: Yet Another "Nuclear Renaissance," December 29, 2023. https://magazine.scienceforthepeople.org/online/here-we-go-again/ And also "Oliver Stone says nuclear power is 'the only option' for society," *Independent*, May 2, 2023.

[20] Government Accountability Office (GAO), "Report to Congressional Addresses, Nuclear Waste Management – Key Attributes, Challenges and Costs of the Yucca Mountain Repository and Two Potential Alternatives," GAO-10-48, November 2009. https://www.gao.gov

[21] World Nuclear News, "Yucca Mountain cost estimate rises to $96 billion," August 6, 2008. https://www.world-nuclear-news.org/wr-yucca_mountain_cost_estimate_rises_to_96_billion_dollars-0608085.html

[22] Department of Energy, "Analysis of the Total System Life Cycle Cost of the Civilian Radioactive Waste Management Program, Fiscal Year 2007, DOE/RW-0591, July 2008.

[23] Government Accountability Office (GAO), Report to Congressional Addresses, "Commercial Spent Nuclear Fuel – Congressional Action Needed to Break Impasse and Develop a Permanent Disposal Solution," GAO-21-603, September 2021. https://www.gao.gov/nuclear-waste-disposal The estimate for spent fuel disposal at YM is $75

GAO-21-6-3 cites a 2019 Sandia National Laboratory [24] estimate of the Yucca Mountain spent fuel disposal cost for 109,000 metric tons of spent fuel if the never-built Yucca Mountain repository licensing was restarted. The actual costs will be higher for a number of reasons.

The 2021 GAO report GAO-21-603 [25] states that there was then existing 86,000 metric tons of commercial spent nuclear fuel stored on-site at 75 operating or shutdown nuclear plants in 33 states, an amount that grows by about 2,000 metric tons each year. This depends upon the number of operating nuclear reactors and the number of hours they operate that year. The GAO report also states the estimated total accumulation of commercial spent nuclear fuel, by roughly 2035 (with no new nuclear plants), is 140,179 metric tons but depends on when existing plants permanently shut down and how many new nuclear reactors enter operation. The GAO report buries in a footnote on page 34 is the fact that the cost estimate is limited to only 109,300 metric tons of commercial SNF, not the already expected 140,179 metric tons.

GAO-21-603 cost estimate ignores the fact that the disposal cap of 70,000 metric tons heavy metal (MTHM) on the Yucca Mountain repository — as well as the small detail that there is no repository program at Yucca Mountain or for any other site.

The statutory limit on the amount of spent nuclear fuel Yucca Mountain was limited to is 70,000 metric tons — and so the amount of commercial spent nuclear fuel slated for disposal is already expected to be double the currently legal amount, even without the defense- and research-related government-owned SNF and HLW. The cost of another repository for the defense- and research-related government-owned SNF and HLW is not available and tracking of the increases in this waste, such as Advanced Test Reactor spent nuclear fuel and naval submarine and carrier spent nuclear fuel isn't being addressed by the GAO.

The technical challenges and the high costs and highly uncertain costs of addressing the technical challenges of licensing, building and operating a repository cannot be overstated.

The technical challenges of repackaging welded-closed canisters, of transporting spent nuclear fuel some of which is far larger in length and weight than previously transported, of preventing accidental criticalities in waste with high uranium-235 and/or plutonium content, and of the overall repository create tremendous cost and schedule uncertainty. These technical challenges are going to be costly, not by 20 or 40 percent, but by factors of 2 to 20 or more.

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billion to $117 billion is for repository operations beginning in 2031 and from $141 billion to $158 billion for repository operations beginning in 2117.

[24] Geoffrey A. Freeze et al., Sandia National Laboratory, "Comparative Cost Analysis of Spent Nuclear Fuel Management Alternatives," June 2019. https://www.osti.gov/biblio/1762633

[25] Government Accountability Office (GAO), Report to Congressional Addresses, "Commercial Spent Nuclear Fuel – Congressional Action Needed to Break Impasse and Develop a Permanent Disposal Solution," GAO-21-603, September 2021. https://www.gao.gov/nuclear-waste-disposal

The ability to achieve a successfully operating repository — ever — is questionable. The GAO continues to put an undeserved air of credibility to these highly speculative repository cost estimates.

The current lack of technical solutions to repackage spent nuclear fuel stored in welded-closed thin-walled canisters —which are not disposable — are another reason that the cost of spent nuclear fuel disposal presented in GAO-21-603 is a gross underestimate.

No one is accounting for the cost of spent nuclear fuel repackaging needed because of canister aging and degradation in the face of ongoing repository delays. The cost of repackaging **for disposal** of the spent fuel is supposedly included in the cost estimate, but not the cost of repackaging needed for continued safe storage at each nuclear site. **No one has decided who will pay for this likely inevitable repackaging for continued long-term storage.**

The Department of Energy's push for advanced reactors and small modular reactors (SMRs) has been going on for over a decade and the SMRs can greatly exacerbate the needed repository size. **The small modular reactors will require disproportionately more containers and more space in a repository, according to independent evaluations.** The nuclear waste from the variety of small modular reactors (water-, molten-salt-, and sodium-cooled SMR designs) has been evaluated and can be expected to "increase the volume of nuclear waste in need of management and disposal by factors of 2 to 30" for each megawatt produced. [26]

The Department of Energy and its nuclear boosters like to say that spent fuel reprocessing is the answer to the nuclear waste problem. But they don't like to discuss the unaffordable cost, the high radiological emissions, or the increased overall volumes of radioactive waste associated with reprocessing.

The Bill Gates' TerraPower Natrium fast neutron reactor slated for Kemmerer, Wyoming, will require costly and polluting reprocessing due to the sodium-bonded fuel and will exacerbate weapons material proliferation risks. It will also take so long to deploy Natrium as to be irrelevant to combating climate change.

In March 2023, the Department of Energy proposed to increase nuclear energy electricity production in the U.S. by a factor of three. [27] The 2021 GAO report does not include the spent nuclear fuel from any new nuclear plants and the proposed use of nuclear reactors for purposes other than electricity generation. With more than 140,000 metric tons of commercial spent fuel that is more than double the current statutory limit for Yucca Mountain and the need for a DOE-managed spent nuclear fuel and high-level waste repository, the promoted new nuclear energy

[26] Lindsay M. Krall, Allison M. Macfarlane, and Rodney C. Ewing, *PNAS*, "Nuclear waste from small modular reactors," Received June 26, 2021, Published May 31, 2022, https://doi.org/10.1073/pnas.2111833119.

[27] Department of Energy webpage, Pathways to Commercial Liftoff: Advanced Nuclear, March 2023. https://www.energy.gov/lpo/articles/sector-spotlight-advanced-nuclear DOE discusses deploying about 300 gigawatts (GW) by 2050, with current U.S. nuclear capacity of about 100 GW. See also the related COP28 announcement at https://www.energy.gov/articles/cop28-countries-launch-declaration-triple-nuclear-energy-capacity-2050-recognizing-key

would mean many more repositories the size and cost of a Yucca Mountain repository — that does not exist.

The reality is that the Yucca Mountain or any other repository is basically an experiment and one that when problems occur, is going to be even more expensive.

For far less technically challenging projects, costs have doubled within 10 years of commencing the project (think of the Savannah River MOX facility). Future generations will be stuck with needing billion dollar repackaging facilities at each of the 75 commercial power plant sites and will likely have to pay for continuous redesign of not just one repository.

History of Nuclear Waste Policy

The history of Department of Energy repository failure is relevant to understand. In 1983, the Nuclear Waste Policy Act of 1982 (NWPA) was enacted, making permanent disposal of commercial spent nuclear fuel a federal responsibility. From 1983 through 2010, $15 billion had already been spent on repository investigation of other sites and on the Yucca Mountain Repository research, design effort, and license application submittal. [28] After more than three decades and over $15 billion spent, Yucca Mountain is no closer to disposal of spent fuel than when it was designated to be the nation's repository for spent fuel in 1987. [29]

DOE's 1998 Yucca Mountain cost estimate [30] includes keeping the repository open for at least 100 years and monitoring the repository performance for up to 300 years. **Essentially, the Yucca Mountain repository is an experiment.** And the costs taking action if the repository does not perform well have never been included in the 1998 or any subsequent estimate.

See a timeline for management of spent nuclear fuel in Table 1.

Table 1. Timeline of key events in U.S. plans for managing spent nuclear fuel and high-level waste.

Date	Event
By 1940 to present	U.S. nuclear weapons program includes uranium enrichment at Oak Ridge, plutonium production reactors at Hanford, multiple research reactors and defense-related wastes continue to be generated. (The Waste Isolation Pilot Plant (WIPP) in New Mexico accepts transuranic defense waste but not spent nuclear fuel or high-level waste.)
1954	Congress passes Atomic Energy Act of 1954, promoting the peaceful use of atomic energy

[28] Government Accountability Office (GAO), Report to Congressional Addresses, "Commercial Nuclear Waste – Effects of the Yucca Mountain Repository Program and Lessons Learned," GAO-11-229, April 2011. See https://www.gao.gov.

[29] Brian Isom, The Center for Growth and Opportunity at Utah State University, "Waste storage or waste of money – It's time to move on from Yucca Mountain," February 20, 2020. https://www.thecgo.org/benchmark/waste-storage-or-waste-of-money/

[30] Department of Energy, *Analysis of the Total System Life Cycle Cost of the Civilian Radioactive Waste Management Program*, DOE/RW-0510, December 1998.

Date	Event
1955	U.S. begins using nuclear power to generate electricity
1957	National Academy of Sciences recommends geologic disposal as the permanent solution for spent nuclear fuel and high-level waste (HLW)
1970	U.S. begins search for potential repository sites
1970	Lyons, Kansas, site selected as the first national repository
1972	Lyons site withdrawn due to technical problems and public opposition
1983	Nuclear Waste Policy Act (NWPA) signed into law
1986	Department of Energy recommends three sites for further study: Yucca Mountain, Hanford in Washington and Deaf County in Texas
1987	Congress amends NWPA, directing DOE to study only Yucca Mountain
1988-2008	DOE studies Yucca Mountain and plans to dispose of both commercial spent nuclear fuel and DOE-owned defense SNF/HLW.
1994	Outside experts independently raise issues about criticality concerns for surplus plutonium disposal at Yucca Mountain. DOE did not provide technically defensible criticality studies for either surplus plutonium nor high-burnup fuel for the 2008 license submittal. Two scientists from Los Alamos National Laboratory would explain how the plutonium-239 posed a particularly high criticality risk at Yucca Mountain. [31] [32] The Department of Energy has continued to argue that while criticality is possible at Yucca Mountain, it is sufficiently unlikely and of unimportant consequence if it does occur. [33] In SNF, criticality risks remain after 10,000 years, yet there is no regulatory requirement to assess or limit the criticality risk after 10,000 years, either at Yucca Mountain or WIPP.
1998	The date DOE had contractually agreed to accept commercial spent nuclear fuel. This failure leads to lawsuits brought by commercial nuclear utilities who sought reimbursement for spent fuel management, specifically for dry spent fuel storage as spent fuel pools ran out of space.
1998	DOE ignores repository suitability criteria not met by Yucca Mountain. A presentation to the Nuclear Waste Technical Review Board acknowledges Yucca Mountain fails to meet suitability criteria. Water infiltration through YM is greater than expected and migration of contamination is as little as 50 years, far more rapid than the 1000 years for significant radionuclide travel. Other problems include high seismicity and volcanism. [34] [35]

[31] C. D. Bowman and F. Venneri, Los Alamos National Laboratory, *Underground Autocatalytic Criticality from Plutonium and Other Fissile Material*, LA-UR 94-4022, 1994.

[32] C. D. Bowman, Los Alamos National Laboratory, *Underground Supercriticality from Plutonium and Other Fissile Material*, LA-UR-94-4022A, 1994.

[33] Rob P. Rechard et al., Sandia National Laboratory, *Consideration of Criticality when Directly Disposing Highly Enriched Spent Nuclear Fuel in Unsaturated Tuff: Bounding Estimates*, May 1996.

[34] State of Nevada and related findings indicating that the proposed Yucca Mountain site is not suitable for development as a repository, webpage, https://www.yuccamountain.org/archive/nuctome2.htm

[35] Richard Burleson Stewart and Jane Bloom Stewart, Fuel Cycle to Nowhere – U.S. Law and Policy on Nuclear Waste, Vanderbilt University Press, 2011. ISBN 978-0-8265-1774-6

Date	Event
1998	DOE's 1998 Yucca Mountain cost estimate [36] includes keeping the repository open for at least 100 years and monitoring the repository performance for up to 300 years. **Essentially, the Yucca Mountain repository is an experiment.** And the costs taking action if the repository does not perform well have never been included in the 1998 or any subsequent estimate.
1998	Waste Isolation Pilot Plant (WIPP), a Department of Energy disposal facility in New Mexico for transuranic waste related to nuclear weapons production is certified by the U.S. Environmental Protection Agency. WIPP first waste shipment in 1999. WIPP excludes spent nuclear fuel and high-level waste. WIPP is not designed to handle the heavy and large sized commercial spent nuclear fuel canisters.
1998-present	U.S. taxpayers, rather than electricity rate payers, are funding the dry storage of commercial spent nuclear fuel. Commercial nuclear power plants with a contract that DOE take SNF by 1998, win lawsuits and are paid money for the cost of spent nuclear fuel management such as dry spent fuel canisters and facilities, now 75 facilities in 33 states. The money is the taxpayer funded "Judgment Fund" and DOE continues to pay with taxpayer money for the dry storage of spent fuel at commercial power plants who were able to sue to DOE's partial breach of contract because DOE did not take spent fuel beginning in 1998.
2002	DOE and President G.W. Bush designate Yucca Mountain as suitable for repository development and licensing
2008	DOE submits YM license application to the Nuclear Regulatory Commission
2009	The Obama presidential administration determines Yucca Mountain is not a workable solution. Lawsuits over the technical problems associated with YM would take years to litigate.
2009	NIRS letter to President Obama includes the finding that sound science has not been the basis of the plans for the Yucca Mountain Repository.[37]
2010	Blue Ribbon Commission established
2010	Yucca Mountain research is defunded. Despite having a much-photographed tunnel entrance, the repository above ground support facilities and the repository were never constructed and the design is largely an incomplete conceptual design.
2010	The U.S. Nuclear Waste Technical Review Board (NWTRB) recommended the "design and demonstration of dry-transfer fuel systems for removing fuel from casks and canisters following extended dry storage." It still hasn't happened as of January 2024.
2011	GAO-11-229 and -230 identify currently existing amounts of waste slated for Yucca Mountain as 65,000 metric tons of commercial spent nuclear fuel and

[36] Department of Energy, *Analysis of the Total System Life Cycle Cost of the Civilian Radioactive Waste Management Program*, DOE/RW-0510, December 1998.

[37] Nuclear Information & Resource Service (NIRS), Letter to President Obama Concerning Yucca Mountain and the Re-evaluation of U.S. Radioactive Waste Policy and Management, May 2009. : http://www.nirs.org/radwaste/hlw/obamaltrsigners.pdf

Date	Event
	13,000 metric tons of DOE SNF/HLW.
2011	GAO-11-810 states that from 1983 to 2010, $15 billion was spent on research and the license application for Yucca Mountain (but no facility constructed).
2012	Blue Ribbon Commission recommends DOE adopt a consent-based approach to siting nuclear waste facilities
2013	DOE releases *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste* and this calls for a separate DOE-waste repository
2014	"Zero-Day" requires DOE to stop collecting Nuclear Waste Fund money from electricity ratepayers because DOE has no spent nuclear fuel repository program
2014	Nuclear Regulatory Commission (NRC) completes *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel*, NUREG-2157, replacing the previous "waste confidence" rule. Essentially, both the "continued storage" and the "waste confidence" positions mandate ignoring spent nuclear fuel management costs and technical challenges.
2015	NRC review finds DOE's YM application meets regulatory requirements but lacks land withdrawal and water rights.
2016	NRC creates a report for the DOE yielding a very low radiation trickle-out from the YM repository, *Supplement to the U.S. Department of Energy's Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, NUREG-2184.
2018	A criticality analysis shows previous DOE assumptions were flawed regarding criticality of high burnup fuel, above 3 percent enriched, and that criticalities are credible. [38]
2010-present	DOE continues to assert in multiple National Environmental Policy Act (NEPA) documents that its solution to spent nuclear fuel is Yucca Mountain, despite defunding and no program for the Yucca Mountain repository.
2010-present	DOE continues to hint that spent fuel reprocessing is the solution despite this being contrary to the Blue-Ribbon Commission report recommendations because of the increased volume of nuclear waste and high cost
2010-present	DOE continues to promote the growth in nuclear energy despite having no program for a commercial spent fuel repository or for a DOE-owned SNF/HLW repository
Before 2010-present	DOE is promoting numerous new "advanced" reactor designs, many of which require many more canisters of spent nuclear fuel in a repository, from 2 to 30 times more, on an electricity generated basis, all without consideration of the adverse impact on any repository program
2019	2019 Gap Analysis admits DOE does not have an adequate technical basis for assuming decades of SNF storage is safe and may cause degradation affecting

[38] Allseed Abdelhalim, Enviro Nuclear Services, LLC, Spent Fuel and Waste Disposition, *Review of Criticality Evaluations for Direct Disposal of DPCs and Recommendations*, SFWD-SFWST-2018-000***, SAND2018-4415R, April 20, 2018. https://prod-ng.sandia.gov/techlib-noauth/access-control.cgi/2018/184415r.pdf

Date	Event
	transportation. No one knows who will pay for addressing replacement/repackaging from age-related degradation prior to obtaining a repository.
2019	DOE study by Sandia National Laboratory makes estimate of cost for disposal of commercial spent nuclear fuel, making multiple assumptions that are not compliant with existing laws or any technical study. For example, it assumes Yucca Mountain will be opened. It assumes that Yucca Mountain or an identical site can accept far more SNF than allowed by current law. It assumes basically no technical hurdles. And it assumes that past cost estimates are adequate and are simply converted to 2018 dollars. The cost of repackaging SNF for disposal is considered; however, the cost of any needed repackaging at 75 sites in 33 states to address corrosion and aging or other damage as decades of dry storage continue, is excluded.
2020	GAO-21-603 states that the Nuclear Waste Fund from fees collected from electricity generated by nuclear energy, and not previously spent, totals $43 billion, in 2020.
2021	GAO-21-603 identifies existing commercial spent nuclear fuel as 86,000 metric tons and has about 14,000 metric tons of DOE defense- and research-related SNF/HLW.
2023	DOE continues to admit that it does not have an adequate technical basis for existing SNF, for high-burnup SNF now used in commercial nuclear reactors, and the problem is greatly exacerbated by the growing number of varieties of new types of nuclear reactors.
2023	DOE is paying numerous universities, businesses and others, called "consortia," to look for communities to convince to host a consolidated interim storage facility
2024	DOE promotes tripling the amount of nuclear energy in the U.S. without any consideration of the lack a repository for SNF from existing plants and without any consideration of the technical and financial peril of more nuclear reactors, and the disproportionately higher amount of space required for many of the new fuels from small modular reactors.
2024	Commercial spent nuclear fuel continues to accumulate at roughly 2000 metric tons per year. Depending on premature shutdowns, by 2055, **without any new nuclear reactors**, over 140,000 metric tons of commercial spent nuclear fuel is expected. This exceeds the statutory limit of Yucca Mountain of 70,000 metric tons, and excludes the DOE-owned defense- and research-related SNF/HLW that will require a different repository.
2024	No alternative to Yucca Mountain has been identified. DOE has shifted to assuming that only commercial spent nuclear fuel would go to Yucca Mountain, if the Yucca Mountain repository existed. No repository for a DOE-owned defense- and research-related SNF/HLW repositories has been identified.
By 2090	Much of the spent nuclear fuel will be over or approaching 100 years in dry storage and may require repackaging due to corrosion or other age-related or incident-related issues, unrelated to disposal. Transportation requires an intact

Date	Event
	canister. DOE, according the GAO-21-603 has not included the cost of developing a method for canister repackaging and has not include the cost of canister repackaging. DOE has included estimates of repackaging costs as needed for disposal, which are likely gross underestimates.
2117	SAND2019-6999 study assumes 2117 repository opening date for a commercial-only spent nuclear fuel repository. Many assumptions are not in compliance with current regulations and have not been evaluated for ability to confine radionuclides. Cost estimate in 2018 dollars is $141 to $168 billion and assumed only 109,300 metric tons of commercial spent nuclear fuel even though over 140,000 metric tons of commercial SNF would be expected even with no new nuclear reactors. The $168 billion estimate is an underestimate that ignores the realities of the technical immaturity of many of the facilities needed. Also, with only $43 billion collected and remaining in the Nuclear Waste Fund, taxpayers are likely to be on the hook for enormous costs of attempting to obtain a permanent disposal path for commercial spent nuclear fuel.

Although the proposed Yucca Mountain repository license submittal was for 70,000 metric tons of storage, as limited by the Nuclear Waste Policy Act, it has been projected that for past and expected nuclear reactor operation in the U.S., by 2055 there will be roughly 10,000 canisters (or about 140,000 metric tons heavy metal) of spent nuclear fuel needing disposal, and a significant portion of them would be capable of going critical if water ingress occurs. [39]

The fact is that the Department of Energy was needing 41 miles of waste emplacement tunnels (or drifts) at the proposed Yucca Mountain repository as limited by law to 70,000 metric tons of spent nuclear fuel. And this assumed repackaging and positioning the waste to limit the thermal heat load. [40] Even so, the repository could heat up and invalidate the geological stability of the repository. The decision as to whether or not to plan for a hot repository (with higher decay heat) or a cold repository approach (less decay heat) was never decided.

The 2021 GAO report did a disservice by highlighting lower cost estimates of less than the total amount of expected commercial spent nuclear fuel and costs limits by funding source. GAO-21-603 gave a spent nuclear fuel disposal cost estimates in the text for only the amount to be paid from the Nuclear Waste Fund. Then, in a footnote, the total cost estimate for Yucca Mountain was presented which was to be paid by the Nuclear Waste Fund, the Judgement Fund and from "other resources." The Judgement Fund is the money paid by the U.S. taxpayer to

[39] Alsaed Abdelhalim, Enviro Nuclear Services, LLC, Spent Fuel and Waste Disposition, *Review of Criticality Evaluations for Direct Disposal of DPCs and Recommendations*, SFWD-SFWST-2018-000***, SAND2018-4415R, April 20, 2018. https://prod-ng.sandia.gov/techlib-noauth/access-control.cgi/2018/184415r.pdf

[40] U.S. Department of Energy, *Draft Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, DOE/EIS-0250F-S1D, October 2007. https://www.energy.gov/sites/prod/files/EIS-0250-S1-DEIS-Summary-2007_0.pdf

commercial nuclear power utilities for the cost of dry storage of spent nuclear fuel because the government failed to take ownership of the SNF by 1998, as per the "Standard Contract" that many utilities had. Costs remaining (not covered by the Nuclear Waste Fund and the Judgment Fund) will be paid by the U.S. taxpayer.

It should be noted that for new nuclear plants, the Judgment Fund isn't likely to apply and ratepayers will be paying more for spent nuclear fuel storage. **Ratepayers for new nuclear plants will be on the hook for more of the dry storage and continued storage costs that U.S. taxpayers now subsidize.** The stated nuclear plant costs typically exclude these ongoing perhaps decades or centuries of spent nuclear fuel storage costs, ignore the need for replacement of these facilities or repackaging of spent fuel (not repackaging for disposal) and exclude the cost of a spent nuclear fuel repository.

The Nuclear Waste Fund has not collected any funds since "Zero Day" in May 2014 because the Department of Energy has no spent nuclear fuel disposal program. The total amount in the Nuclear Waste Fund from the fee collected from ratepayers (and not already spent) is about $43 billion as of September 2020, but the low-balled cost of a repository for just the commercial spent nuclear fuel is already $168 billion.

The Nuclear Waste Policy Act of 1982 created a fee on electricity generated by nuclear power plants that would accumulate in the Nuclear Waste Fund for spent nuclear fuel disposal. That money had been collected into that fund and currently has $40 billion. [41]

No money has been collected for the Nuclear Waste Fund from nuclear utilities since the fee was set to zero on May 16, 2014, as a result of litigation in the U.S. Court of Appeals for the District of Columbia Circuit, because the Department of Energy had no spent fuel disposal program.

The Department of Energy had contractual obligations to begin disposing of spent nuclear fuel generated by electric utilities by 1998. Because DOE has not met its contractual obligations to begin disposing of the fuel, many utilities filed lawsuits. The utilities won and out of this came the Judgement Fund, financed by U.S. taxpayers. So far, about $8.6 billion has been paid to electric utilities for their costs of spent nuclear fuel management and storage and the total federal liability is expected to be $39.2 billion. [42]

It costs about half a billion per year for DOE payment to utilities for not taking the spent fuel in 1998 as promised.

When the 2021 GAO cost estimate for spent nuclear fuel disposal of only a portion of the commercial spent nuclear fuel is stated as $168 billion, it should be remembered that the U.S.

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[41] Nicole Feldman, Freeman Spogli Institute for International Studies, *Stanford University, School of Sustainability*, "The steep costs of nuclear waste in the U.S.," July 3, 2018. https://sustainability.stanford.edu/news/steep-costs-nuclear-waste-us

[42] Government Accountability Office (GAO), Report to Congressional Addresses, "Commercial Spent Nuclear Fuel – Congressional Action Needed to Break Impasse and Develop a Permanent Disposal Solution," GAO-21-603, September 2021. https://www.gao.gov/nuclear-waste-disposal (page 19)

already spent $15 billion on Yucca Mountain all without resulting in a license to construct that partially designed facility. It was never decided whether Yucca Mountain could withstand being a hot repository and many other crucial details. The plan included monitoring how the repository performed — yet did not include any estimate of the cost if the repository did not perform well. **There are several reasons why the 2021 GAO repository cost estimate is likely to far exceed $168 billion dollars.**

Still no repository identified for Department of Energy and Naval Spent Nuclear Fuel and High-Level Waste (or for Commercial Spent Nuclear Fuel)

The 2021 GAO report [43] made the assumption, unlike previous cost estimates regarding Yucca Mountain, that Department of Energy and Naval spent nuclear fuel and defense high-level waste would not go to Yucca Mountain.

The Department of Energy stores spent nuclear fuel (SNF) and/or high-level waste (HLW) in Idaho (Idaho National Laboratory), South Carolina (Savannah River Site), and Washington (Hanford) and high-level waste in New York (the West Valley shuttered SNF reprocessing facility), and a small amount of spent nuclear fuel in Colorado (the troubled gas-cooled Fort St. Vrain reactor's SNF). The DOE-Navy program stores spent nuclear fuel at the Idaho site.

The DOE does not know where commercial SNF or DOE-managed SNF/HLW will be disposed of. And DOE does not know how long the existing storage facilities will last. The U.S. Nuclear Waste Technical Review Board has pointed out that DOE has no research focusing on aging issues for its unique long-term waste storage needs. [44]

Now in 2024, the DOE has not made plans to address this waste, fourteen years after the 2010 end of the Yucca Mountain program. [45] In addition, previous plans had included reprocessing of highly enriched DOE-owned fuel at Savannah River Site's H-Canyon facility, but the decades-old facility poses cost and safety problems. Cessation or reduction of reprocessing at H-Canyon means the disposition of an unknown amount of DOE-owned spent nuclear fuel has not been included in prior disposal or disposition plans. [46]

A 2017 Nuclear Waste Technical Review Board report stated that the disposition path for Advanced Test Reactor aluminum-clad, highly enriched (93 percent uranium-235) fuel was not

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[43] Government Accountability Office (GAO), Report to Congressional Addresses, "Commercial Spent Nuclear Fuel – Congressional Action Needed to Break Impasse and Develop a Permanent Disposal Solution," GAO-21-603, September 2021. https://www.gao.gov/nuclear-waste-disposal

[44] U.S. Nuclear Waste Technical Review Board, *Management and Disposal of U.S. Department of Energy Spent Nuclear Fuel – A Report of the United States Congress and the Secretary of Energy*, December 2017..

[45] Government Accountability Office (GAO), Report to Congressional Addresses, GAO, "DOE Nuclear Waste – Better Information Needed on Waste Storage at DOE Sites as a Result of Yucca Mountain Shutdown," GAO-11-230, March 2011. https://www.gao.gov/products/gao-11-230

[46] Government Accountability Office (GAO), Report to Congressional Addresses, "Nuclear Materials: DOE Plans for Savannah River Site's H-Canyon Facility," December 2023. https://www.gao.gov/products/gao-24-106494

clear; however, the ATR SNF was being considered as a candidate for processing at the Savannah River Site's H Canyon. There was 4.8 MT of ATR SNF as of about 2017, requiring 290 canisters. [47] The ATR fuel requires nearly 300 times as many canisters per metric ton compared to commercial spent nuclear fuel of 2 to 3 percent enrichment.

The Department of Energy also owns certain commercial spent nuclear fuel, including Fort St. Vrain spent nuclear fuel. The Fort St. Vrain spent nuclear fuel from the failed gas-cooled reactor project for intermittent operation between 1979 and 1989, requires about 34 times as many canisters as commercial spent nuclear fuel of 2 to 3 percent enrichment. Two-thirds of the Fort St. Vrain spent fuel remains in Colorado and one-third is stored at the Idaho National Laboratory. The Fort St. Vrain high-temperature gas-cooled reactor built in Colorado was never profitable and storage of its spent nuclear fuel continues to cost several million dollars each year.

Department of Energy has no program for a permanent repository and it must be stressed that Consolidated Interim Storage Sites are not a solution for the growing nuclear waste problem

In 2021, the U.S. Nuclear Regulatory Commission issued a license for privately owned away-from-reactor consolidated interim storage facilities in Texas. The NRC also issued a license for a similar facility in New Mexico. Subsequently, both states have now passed legislation opposing these facilities.

Now, in August, a court of appeals ruled that the NRC license for the Texas consolidated interim storage facility be vacated because the NRC did not have the authority to authorize the private away-from-reactor facility. [48]

"The Nuclear Waste Policy Act creates a comprehensive statutory scheme for addressing spent nuclear fuel accumulation," the court said. "The scheme prioritizes construction of the permanent repository and limits temporary storage to private at-the-reactor storage or at federal sites. It plainly contemplates that, until there's a permanent repository, spent nuclear fuel is to be stored onsite at-the-reactor or in a federal facility.

"In sum, the Atomic Energy Act doesn't authorize the Commission to license a private, away-from-reactor storage facility for spent nuclear fuel. And the Nuclear Waste Policy Act doesn't

[47] U.S. Nuclear Waste Technical Review Board, *Management and Disposal of U.S. Department of Energy Spent Nuclear Fuel – A Report of the United States Congress and the Secretary of Energy*, December 2017. See nwtrb.gov. See Figure 5-3 on page 81 for the Group 16 Advanced Test Reactor spent nuclear fuel, metric tons and number of canisters. See page 86 regarding consideration of processing at H-Canyon.

[48] United States Court of Appeals for the Fifth Circuit, State of Texas; Greg Abbott, Governor of the State of Texas; Texas Commission on Environmental Quality; Fasken Land and Minerals, Limited; Permian Basin Land and Royalty Owners, versus Nuclear Regulatory Commission; United States of America, No. 21-60743. Filed August 25, 2023. The court found that the Atomic Energy Act did not delegate authority to the U.S. Nuclear Regulatory Commission to license a private, away-from-reactor storage facility for spent nuclear fuel. And the Nuclear Waste Policy Act doesn't permit the NRC to authorize an away-from-reactor spent fuel storage facility. The court found that the NRC does not have authority to issue the license to the Texas consolidated spent fuel facility. The court vacated the NRC's license of the proposed Texas consolidated interim storage facility.

permit it. Accordingly, we hold that the Commission doesn't have authority to issue the license challenged here."

New Mexico has a similar case pending in the US Court of Appeals for the 10th Circuit in regard to the proposed Holtec consolidated interim storage facility.

The U.S. Nuclear Waste Technical Review Board (NWTRB) held a summer meeting August 29 and 30, 2023. None of these recent experiences in siting a consolidated interim spent fuel storage facility was discussed at the August meeting regarding state opposition to private consolidated interim storage in New Mexico and Texas.

It is important to understand that consolidated interim storage of spent nuclear fuel is not a solution to the growing inventory of commercial spent nuclear fuel or the DOE-managed SNF/HLW.

Creating temporary "interim" consolidated storage of spent nuclear fuel does not solve the problem of finding a permanent disposal solution — it aims to put the problem out of sight and out of mind. It actually lulls people into thinking that the problem is solved. It puts off the day of reckoning of the challenges, costs and **perhaps the impossibility of siting, designing and building a successful repository (or actually several).**

Also, the issue of transportation of massive spent nuclear fuel casks over weakened roadways and railways will require transportation to the consolidated interim storage site and then to the repository.

The Department of Energy is seeking one or more communities to host consolidated interim storage of spent nuclear fuel and all without any consideration of where a permanent disposal facility would be. Native American tribes in particular are being targeted, especially given that multiple state legislatures have made laws against accepting consolidated interim storage. (See the September and October 2023 Environmental Defense newsletters.)

Department of Energy advised to strengthen public trust and confidence back in 1998 and again in 2021, as DOE hires social scientists and gives money to its 'consortia' but continues to make no progress on any repository for the nation's spent nuclear fuel

Back in 1993, a task force advised the Department of Energy to strengthen public trust and confidence with regard to spent nuclear fuel management. The 2012 Blue Ribbon Commission report also reminded DOE of the importance of sustaining public trust. In 2021, the Government Accountability Office (GAO) emphasized the need for DOE to implement a coordinated

outreach strategy for providing information to specific stakeholders and the public on federal activities related to managing spent nuclear fuel. [49]

The Department of Energy has hired staff with skills for public engagement, such as social scientists, as was evident at the U.S. Nuclear Waste Technical Review Board meeting held last August in Idaho Falls. Many presentations were given by social scientists who by-and-large had no comprehension of the safety and radiation health issues of managing spent nuclear fuel.

Furthermore, the Department of Energy admitted at the NWTRB meeting that it planned to give information to the newly forming "consortia" of universities, businesses and others and that citizens would not have access to the information given to the consortia. **Importantly, the communities being bribed and connived into hosting "temporary" interim consolidated storage sites would NOT have access to the information shared with the consortia.** The Department of Energy's approach to siting consolidated interim storage was to proceed with no planning for obtaining a permanent geological repository or for obtaining reprocessing capability. The DOE understands the imperative to withhold the truth about the risks and health harm of storing spent nuclear fuel for unknown decades to come.

Two days of presentations were given to the U.S. Nuclear Waste Technical Review Board. Congress created the U.S. Nuclear Technical Waste Review Board in the 1987 Nuclear Waste Policy Amendments Act (NWPA Act) to evaluate the technical and scientific validity of activities undertaken by the Secretary of Energy to manage and dispose of the nation's spent nuclear fuel and high-level radioactive waste.

Currently, the Department of Energy is not attempting to site a geologic repository but is seeking to figure out the messaging and the incentives to get a community to sign up to allow a consolidated interim spent fuel storage facility. The DOE emphasized that it will use a flexible, adaptive, but not yet defined approach to entice a community to sign up for consolidated interim storage. **The DOE stated that it would use carefully filtered messaging in order to persuade the community's leaders.**

On both August 29 and August 30, the DOE emphasized its outreach to states and tribes and its intention to have special consortia seeking to identify people and possible incentives that would be effective in gaining approval by a community to have consolidated interim storage of spent nuclear fuel. The DOE stated that consortia members will have ready access to DOE experts, special computerized tools and access to "unfiltered" information. **The non-tribal communities and tribes, it was stated, would not have access to DOE experts, special tools, or to "unfiltered" information.** The messaging and story-telling to attain siting that was most effective would be studied and applied by DOE.

[49] Government Accountability Office (GAO), Report to Congressional Addresses, "Commercial Spent Nuclear Fuel – Congressional Action Needed to Break Impasse and Develop a Permanent Disposal Solution," GAO-21-603, September 2021. https://www.gao.gov/nuclear-waste-disposal

With regard to transparency, the DOE also stated that the public would not be given or allowed access to information about its information gathering and discussions with consortia. The operation to convince and provide "incentives" to persuade a community into accepting a consolidated interim storage facility will be conducted in secrecy.

There remain significant gaps in the understanding of the performance characteristics in high burnup fuels now being used in U.S. commercial nuclear reactors, despite the high burnup fuels being approved by the U.S. Nuclear Regulatory Commission. These gaps mean that there is inadequate basis for concluding that spent fuel can be safely stored, transported and disposed of.

There are many variables that influence fuel cladding integrity: cladding composition and manufacturing processes, average and peak burnup while used in a reactor, primary coolant water chemistry, length of time stored in a pool, the drying process used for dry storage packaging and others. But the belated investigations of cladding are limited and may not address all cladding types, operating conditions, fuel burnups, and so on. The means that considerable uncertainty remains regarding fuel cladding performance during storage and transportation and is likely to remain even after additional but not exhaustive investigations have been conducted.

A presentation on August 30 concerning spent fuel performance during dry storage was very brief but did identify worse than unexpected performance of spent fuel cladding. Larger than expected reductions of cladding yield and ultimate strengths were found after heat treatment. The reduced material strengths can facilitate creep and may have significant implications for spent fuel performance during storage, transportation and disposal. **Reduced cladding yield and ultimate strengths may have significant implications for licensing (and relicensing) of current and future systems.**

This work is tardy, incomplete and also being conducted in ways that are prone to not produce reliable results for the wide variety of fuel burnups and conditions the fuel is exposed to. The implications of unresolved problems with continued storage of spent fuel, and especially the higher burnup fuels, in terms of accident risks and costs were not discussed. The thin-walled canisters prevalently in use are welded closed and cannot be opened to inspect the fuel. There is a wide variety of spent fuel cladding types and variable conditions that the fuel can be subjected to that may compromise its condition. **Furthermore, while the fuel can be inspected while in a storage pool, there is currently no way to inspect spent fuel stored in canisters prior to transportation.**

A presentation was also provided by the DOE on enormity of the needed investigations to evaluate the safety of spent fuel storage, transportation and disposal for the wide variety of advanced reactors being proposed. The presentation addressed the "Back-End Management of Advanced Reactors (BEMAR)." The DOE believes it must continue to accept any and all new fuel designs but it all depends on murky and inexplicable DOE's General Council for creating contracts with nuclear reactor developers.

The DOE acknowledged that it had insufficient information to assess the behavior of these proposed new or advanced reactor spent nuclear fuels. The DOE is apparently compelled to accept any and all possible new fuel designs and will not put in place research to understand the fuel characteristics needed to know the safety during storage, transportation or disposal. The DOE does not plan to commence any study of the spent fuel characteristics until the reactors are up and running and are more advanced than initial prototype reactors. The plan is to study, only belatedly, after these spent fuels are generated, the safety of the advanced fuels storage, transportation and disposal characteristics.

Safety of spent nuclear fuel during long-term storage still unknown

To date, the Department of Energy admits that studies to ponder how safe commercial spent nuclear fuel will remain during long term storage are inadequate. And the Department of Energy admits that the variety of new reactor fuels will only complicate such studies. Note that the costs of the research and the research backlog for assessing the long-term safety of spent nuclear fuel and for studying the effects on a repository design are not included in repository cost estimates.

A conference paper by the Department of Energy in 2019 asserts that "a general assessment can be made that the high burnup fuel can be safely stored for extended periods of time and subsequently transported." [50] Just how long are "extended periods of time"? Inside their own electronic document was an unresolved comment that highlighted the issue that the duration of extended periods of time may only be decades, but not centuries.

Spent nuclear fuel from a reactor is stored in a storage pool for several years until cooled long enough to be placed in dry storage. There are currently 164,840 spent fuel assemblies loaded in 3,879 dry casks at 93 different dry storage systems. [51] The push for away-from-reactor consolidated storage sites would involve the transportation of spent fuel to the consolidated storage site over long distances, by truck or rail.

Nuclear fuel enrichment has continued to increase and has allowed higher fuel burnup. The higher fuel enrichments and higher burnups increase the challenges of maintaining fuel integrity. The U.S. Nuclear Regulatory Commission has continued granting licenses for the high burnup fuels despite not knowing how these fuels will perform during storage or transportation.

The fuel cladding needs to maintain its integrity until final disposition. No one knows how long, and beyond 100 years, dry storage will be needed. The modeling of the fuel degradation in

[50] Ned Larson (Department of Energy), Sylvia Saltzstein (Sandia National Laboratories) and Brady Hanson (Pacific Northwest National Laboratory), "Making the Case: Demonstrating the Integrity of Spent Nuclear Fuel During Long-term Storage and Subsequent Transportation: SAND2019-8749C," PATRAM 2019 Conference. (File a1418_1.pdf)

[51] Ux Consulting, Roswell, GA, *StoreFUEL and Decommissioning Report*, StoreFUEL VOL 24, No. 287, July 2022. (See NUREG/CR-7302)

dry storage had little attention up to now and experimental efforts aimed at studying long time effects like cladding creep or hydrogen behavior are limited. [52]

The Department of Energy initiated a research program to investigate the feasibility of long-term dry storage and subsequent transportation of commercial spent fuel in 2009, states a paper in 2019. [53] Now, in 2023, there are still no answers and very little progress on key issues regarding safety of dry storage of spent nuclear fuel. [54]

Research priorities continue to change as unexpected findings emerge. A patchwork of research is conducted and so far, no conclusions can be drawn from the research that is needed to support the presumption that long-term storage of spent fuel and subsequent transportation is safe.

A Gap analysis updated in 2019 by the Department of Energy confirms that the NRC had no technically defensible documented evaluation of the consequences of spent nuclear fuel canister failure as it continued licensing dry storage of spent fuel. Regarding the lack of spent nuclear dry storage canister accident consequence research needs, a Gap acknowledging this was added identifying the need to assess radiological risk due to loss of confinement caused by stress corrosion cracking.

The hope was to develop technically defensible assessment of gaseous and particulates releases and radiological consequences through stress corrosion cracking of welded thin-walled canisters. As of 2019, and also now in 2023, this research still has not been done and there remains no technically defensible radiological consequence analysis for breach of a spent nuclear fuel canister.

No research has been conducted to validate assumptions about the radiological consequences during accident conditions such as having allowed oxygen ingress into a normally sealed and helium filled spent fuel container. The Department of Energy research that has been conducted so far has focused on a subset of fuels under normal conditions.

According to the 2021 NWTRB report, research efforts are still in the early stages of examining the potential for release of radioactive material, criticality, and radiation

[52] Piotr Konarski et al., "Spent nuclear fuel in dry storage conditions – current trends in fuel performance modeling," Elsevier, *Science Direct*, Volume 555, November 2021. https://doi.org/10.1016/j.jnucmat.2021.153138 or https://www.sciencedirect.com/science/article/pii/S0022311521003615

[53] Ned Larson (Department of Energy), Sylvia Saltzstein (Sandia National Laboratories) and Brady Hanson (Pacific Northwest National Laboratory), "Making the Case: Demonstrating the Integrity of Spent Nuclear Fuel During Long-term Storage and Subsequent Transportation: SAND2019-8749C," PATRAM 2019 Conference.

[54] U.S. Nuclear Waste Technical Review Board Public Meeting, August 30, 2023, Idaho Falls, Idaho, See various presentations including the Sibling Pin Test Campaign Phase I Summary and Draft Phase II Test Plan Overview by Scott Sanborn and John Bignell, Sandia National Laboratories; Advanced Reactor Fuel Gap and FEP Analyses, by Brady Hanson (PNNL-SA-189354); and others.

exposure to workers and the public from the gross breach of a dry storage spent fuel canister during dry storage or transportation. [55]

The NRC has prepared the draft Environmental Impact Statement for the proposed Holtec consolidated interim storage facility in New Mexico without having any documented basis for the consequences of an expected event, leakage of a spent nuclear fuel canister. [56] Even if a through-wall crack was not expected within 20 years of packaging into the canister, by the time the canister would be shipped to consolidated interim storage, likely at least 20 years would have already elapsed.

In addition to the Department of Energy's inadequate research regarding commercial spent nuclear fuel's long-term storage, DOE does not adequately assess the safety of the storage of its wide variety of research, defense-related and other spent fuel that it manages. [57]

Savannah River Watch concerns over DOE's Continually Evolving Surplus Plutonium Disposition Plans

Savannah River Watch has concerns over the Department of Energy's (DOE) National Nuclear Security Administration's (NNSA) Final Environmental Impact Statement on Surplus Plutonium Disposition, issued on January 19, 2024. [58] [59] The Record of Decision (ROD) has not been issued regarding which of the various alternatives put forth in the EIS will be selected.

The Surplus Plutonium EIS addresses alternatives for disposition of the 34 metric tons of surplus plutonium from nuclear weapons pits previously designated for the now-cancelled mixed oxide (MOX) plutonium and uranium fuel program and up to 7.1 metric tons of non-pit surplus plutonium. The 'dilute and dispose' processing would include converting to plutonium oxide and diluting the plutonium to inhibit plutonium recovery. The processed surplus plutonium would then be disposed of at the Waste Isolation Pilot Plant (WIPP) in New Mexico.

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[55] U.S. Nuclear Waste Technical Review Board, *Evaluation of the Department of Energy's Research Program to Examine the Performance of Commercial High Burnup Spent Nuclear Fuel During Extended Storage and Transportation - A Report to the U.S. Congress and the Secretary of Energy*, July 2021. See www.nwtrb.gov See page 29 which refers to the 2017 EPRI report.

[56] U.S. Department of Energy, Spent Fuel and Waste Science and Technology, *Gap Analysis to Guide DOE R&D in Supporting Extended Storage and Transportation of Spent Nuclear Fuel: An FY2019 Assessment*, SAND2019-15479R, December 23, 2019. https://www.osti.gov/servlets/purl/1592862

[57] U.S. Nuclear Waste Technical Review Board, *Management and Disposal of U.S. Department of Energy Spent Nuclear Fuel – A Report of the United States Congress and the Secretary of Energy*, December 2017..

[58] Savannah River Watch, https://srswatch.org/doe-issues-final-eis-on-surplus-plutonium-disposition-january-19-2024/ and Don Moniak, "'Appalling' and 'Abysmal' – How the Department of Energy addressed Governor McMaster's and Attorney General Alan Wilson's conflicting and sometimes harsh opinions regarding the future of surplus plutonium," January 22, 2024, https://srswatch.org/appalling-and-abysmal-how-the-department-of-energy-addressed-governor-mcmasters-and-attorney-general-alan-wilsons-conflicting-and-sometimes-harsh-opi/

[59] Department of Energy, Final Environmental Impact Statement for the Surplus Plutonium Disposition, DOE/EIS-0549, January 2024. https://www.energy.gov/nepa/articles/doeeis-0549-final-environmental-impact-statement (Federal Register Notice, Vol. 89, No. 13, January 19, 2024. https://www.govinfo.gov/content/pkg/FR-2024-01-19/pdf/2024-00890.pdf)

The surplus plutonium adds a tremendous burden to the already overcommitted WIPP disposal facility. The processing of the surplus plutonium would take place at the Los Alamos National Laboratory in New Mexico and/or the Savannah River Site in Georgia.

So far, new nuclear weapons production at LANL's plutonium facility, PF-4, is too busy making new nuclear warheads and its own legacy cleanup efforts have languished. Read more about radiological safety problems at LANL that put workers and the public at risk in the February 2023 Environmental Defense Institute newsletter. [60]

The NNSA in a November 2022 hearing conducted by the Defense Nuclear Facilities Safety Board [61] explained its tardy or cancelled safety upgrades at LANL by saying that in the U.S. it is difficult to get work done, and hiring and retaining workers is extremely difficult at LANL. [62] [63]

At the November hearing, the NNSA explained that it was accepting accident radiological doses to the public from an accident at LANL's PF-4 that far exceeded what Department of Energy requirements would normally allow. Normally, safety class systems would be required to assure that doses to the public remained below 25 rem. A 25-rem inhalation dose to the public would involve an obscenely high release of radioactivity that would remain in the environment basically, forever. **But the DOE and NNSA invoked the "exigent circumstances" processes to allow doses to the offsite public to exceed a whooping 3000 rem.** A radiation inhalation dose exceeding 400 rem is typically considered lethal.

While the DOE and NNSA make claims that processes will meet stringent safety standards, the reality is that shortcuts for convenience and cost-cutting often result is very unsafe practices at Department of Energy facilities. Another example is the two back-to-back accidents at WIPP in 2014 that were caused by multiple safety lapses by the DOE. WIPP first began accepting defense transuranic waste, usually packaged in barrels, in 1998.

At the Savannah River Site, billions of dollars were spent before the failed MOX fuel facility was cancelled by the Department of Energy. In addition to storing surplus plutonium, the

[60] Environmental Defense Institute, newsletter article "New Mexico's Los Alamos National Laboratory facing increased workload and increased accident risks to package surplus plutonium for WIPP disposal," February 2023. http://www.environmental-defense-institute.org/publications/News.23.Feb.pdf

[61] Defense Nuclear Facilities Safety Review Board website at dnfsb.gov, November 16, 2022 meeting on the Los Alamos National Laboratory, see meeting agenda, videos, exhibits for cleanup and increased pit production and other information on the dnfsb.gov webpage https://www.dnfsb.gov/public-hearings-meetings/november-16-2022-public-hearing.

[62] Environmental Defense Institute, newsletter article "Defense Nuclear Facilities Safety Board Public Hearing on cleanup, increased weapons pit production and heat source Pu-238 accident risks at the Los Alamos National Laboratory," December 2022. http://www.environmental-defense-institute.org/publications/News.22.Dec.pdf

[63] Environmental Defense Institute, newsletter article "Recap of the egregious safety shortcuts at the Los Alamos National Laboratory for heat source Pu-238 and weapons pit production," January 2023. http://www.environmental-defense-institute.org/publications/News.23.Jan.pdf

Savannah River Site continues to store various kinds of spent nuclear fuel [64] and high-level waste that there is no final repository for.

The Department of Energy has made major changes to plans for the surplus plutonium disposition at least five times in the past, and yet over the past three decades, less than five metric tons of surplus plutonium has been processed.

Idaho Capital Sun reports on former nuclear weapons testing harm to Montana and New Mexico, as Congress denies compensation

When the U.S. government detonated the first atomic bomb in New Mexico in 1945, citizens in New Mexico were not warned or evacuated. Fallout from the detonation blew in the wind, tracible by damaged Kodak film. The government as long denied the extent of the harm and the Radiation Exposure and Compensation Act has not been expanded to downwinders in New Mexico [65] or downwinders in Montana. [66]

I want to highlight that the article about the Trinity test downwinders includes that a health care provider in Roswell found a **surprisingly high number of infant deaths** one month after the Trinity test and the New Mexico Department of Health also found an unusually high rate of infant mortality in the counties downwind of the Trinity test.

Infant death rates downwind of the Trinity test steadily declined except for 1945, when the rate sharply increased, especially in the three months following the 1945 Trinity test. [67] The public was endangered by radioactive fallout and the government denied any harm had been caused.

The harm to an unborn child would occur not only from a passing radiological plume but also from fallout concentrated in cow's milk from cow's grazing on contaminated grass. The rapidly forming unborn child's body would be affected by radioactive iodine-131, cesium-137, strontium-90 and other radionuclides that would concentrate in cow's or goat's milk. Airborne radionuclides when inhaled can quickly enter the blood stream, also affecting the unborn child.

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[64] U.S. Nuclear Waste Technical Review Board (NWTRB), Management and Disposal of U.S. Department of Energy Spent Nuclear Fuel. Arlington, December 2017.

[65] Daneille Prokop and Marisa Demarco, *Idaho Capital Sun*, "'They scrapped us': The Trinity downwinders and New Mexico mine workers who remain unrecognized," January 16, 2024. https://idahocapitalsun.com/2024/01/16/they-scrapped-us-the-trinity-downwinders-and-new-mexico-mine-workers-who-remain-unrecognized/?emci=1009a06f-f5b3-ee11-bea1-0022482237da&emdi=a0a1c99b-77b4-ee11-bea1-0022482237da&ceid=112318

[66] Blair Miller, *Idaho Capital Sun*, "' What do we have to do?': Awareness of historic nuclear radiation grows in Montana neighborhood," January 12, 2024. https://idahocapitalsun.com/2024/01/12/what-do-we-have-to-do-awareness-of-historic-nuclear-radiation-grows-in-montana-neighborhoods/

[67] Kathleen M. Tucker and Robert Alvarez, *Bulletin of the Atomic Scientists*, "Trinity: 'The most significant hazard of the entire Manhattan Project," July 15, 2019. https://thebulletin.org/2019/07/trinity-the-most-significant-hazard-of-the-entire-manhattan-project/#:~:text=The%20Trinity%20bomb%20was%20detonated,over%20a%20very%20large%20area.

The Trinity test is the first time that fallout was noted to increase infant mortality, but certainly not the last. The finding of excess infant deaths near the Department of Energy Savannah River site around the 1970s and near the 1979 Three Mile Island nuclear accident are described in Jay Gould's book *Deadly Deceit*. [68]

Elevated rates of infant mortality and birth defects were found in communities near the Department of Energy's Hanford site, but workers were not told of these epidemiology results and newspapers did not report the findings. [69]

Following the 1986 Chernobyl nuclear disaster, a comprehensive study also found a spike in perinatal mortality (still-births plus early neonatal deaths) in several countries that received airborne radioactivity from Chernobyl. The amount of airborne radioactivity to cause this was far smaller than generally assumed. [70]

Despite the evidence brought to the U.S. government's attention in 1945 and despite the Department of Energy later engaging in manipulating infant mortality statistics, official health protection models used by the Department of Energy, the Nuclear Regulatory Commission and the Environmental Protection Agency still ignore elevated infant mortality from radiological releases in assessment of past releases and in assessments for Environmental Impact Statements.

Another must-read article is about a woman in New Mexico who was illegally autopsied and found to have a high amount of plutonium in her liver, 60 times the average New Mexico resident's. Her family was never told of the autopsy or of the high amount of plutonium in her liver. It is unknown whether the plutonium came from her exposure to the 1945 Trinity detonation, from contamination brought home from her husband's work as a janitor at the Los Alamos National Laboratory, 40 miles from their home, or some other radiological release. [71]

Common to all nuclear weapons testing and nuclear reactor operations — as well as uranium mining, milling and fuel enrichment and fabrication operations is that the industry's radiological monitoring is never adequate to protect workers or the pubic.

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[68] Jay M. Gould and Benjamin A. Goldman, *Deadly Deceit – Low Level Radiation High Level Cover-Up,* Four Walls Eight Windows New York, 1990. ISBN 0-941423-35-2.

[69] Kate Brown, *Plutopia – Nuclear Families, Atomic cities, and the Great Soviet and American Plutonium Disasters,* Oxford University Press, 2013. ISBN 978-0-19-985576-6. Note that many publications use spelling variation Mayak instead of Maiak. *Plutopia* documents the elevated percentage of deaths among infants in the Richland population in the 1950s. Elevated fetal deaths and birth defects in Richland were documented by the state health reports, yet Hanford's General Electric doctors and the Atomic Energy Commission that later became the Department of Energy failed to point these statistics out. The local newspapers failed to write of it. The Department of Energy has continued to fail to tell radiation workers and the public of the known risk of increased infant mortality and increased risk of birth defects that result from radiation exposure.

[70] Alfred Korblein, "Studies of Pregnancy Outcome Following the Chernobyl Accident," from *ECRR Chernobyl: 20 Years On – Health Effects of the Chernobyl Accident*, Editors C.C. Busby and A. V. Yablokov, 2006.

[71] Alicia Inez Guzman, *Searchlight New Mexico – Independent Investigative Journalism*, "Buried secrets, poisoned bodies," December 20, 2023. https://searchlightnm.org/buried-secrets-poisoned-bodies/?mc_cid=c42014a33e&mc_eid=4bcb612769

More misguided bills to advance nuclear energy: Atomic Energy Advancement Act HR 6544 and S.1111

Two bad bills have been introduced, H.R. 6544 in the House and S.1111 in the Senate [72] to reduce regulations and promote an unaffordable industry.

H.R.6544 – Atomic Energy Advancement Act is aiming to reduce the already low standards of the industry lapdog, the U.S. Nuclear Regulatory Commission and encouraging the use of categorical exclusions, shortened environmental assessments rather than full environmental impact statements and expanding the use of generic rather than specific environmental impact statements while not protecting American citizens from accidents and from crushingly high construction costs and from crushingly high spent nuclear fuel management and continued storage costs. [73]

And here's the biggest problem: HR 6544 would allow the Department of Energy to enter into long-term nuclear power purchase agreements. This will be an electricity ratepayer and a U.S. taxpayer debacle.

Please note that the Department of Energy has money bribe communities. The DOE also has boots on the ground, the "consortia" to search out who to bribe. And Indian tribes are being targeted especially after states like Utah, New Mexico, and Texas has used litigation and/or legislation to block consolidated interim storage in those states.

Senate bill S.1111, amended July 10, 2023, to strengthen the domestic nuclear energy fuel cycle and supply chain, and "improve" the regulation of nuclear energy, and for other purposes. [74] suggests that the fox guarding the hen house ought to suggest any mechanism for better accounting of liabilities for the lifecycle costs of the spent nuclear fuel and high-level radioactive waste inventory in the United States. Good luck with that! The Department of Energy and the nuclear industry in general work strenuously to avoid getting real about the costs of spent nuclear management and disposal. The bill even limits trying to look at the spent nuclear fuel inventory to currently existing nuclear plants, even as DOE has called for tripling nuclear energy in the U.S. all without consideration of the number of repositories that would require.

The football field analogy has perhaps become so ingrained that no one actually understands how much space it actually takes to dispose of spent nuclear fuel:

The fact is that the Department of Energy was needing 41 miles of waste emplacement tunnels (or drifts) at the proposed Yucca Mountain repository as limited by law to 70,000

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[72] Nico Portunondo, *E&E News*, "Is this the year for bipartisan action on advanced nuclear?" January 24, 2024. https://www.eenews.net/articles/is-this-the-year-for-bipartisan-action-on-advanced-nuclear/

[73] Congress.gov, H.R.6544 – Atomic Energy Advancement Act, Introduced in the House of Representatives December 1, 2023. Accessed January 26, 2024 at https://www.congress.gov/bill/118th-congress/house-bill/6544/text

[74] Congress.gov, S.1111, amended July 10, 2023, Accessed January 26, 2024 at https://www.congress.gov/bill/118th-congress/senate-bill/1111/text

metric tons of spent nuclear fuel. And this assumed repackaging and positioning the waste to limit the thermal heat load. [75] Even so, the repository could heat up and invalidate the geological stability of the repository. The decision as to whether or not to plan for a hot repository (with higher decay heat) or a cold repository approach (less decay heat) was never decided.

Another bill, HR 806, International Nuclear Energy Financing Act of 2023 was introduced again, now this January 17, [76] to push multilateral banks to make loans no prudent bank would make for reactor export projects. Such bills are needed because these loans are high risk and imprudent propositions. This bill requires the U.S. Executive Director at the International Bank for Reconstruction and Development (and the U.S. Executive Director at any other international financial institution deemed appropriate) to support financial assistance for the generation and distribution of nuclear energy, consistent with U.S. national security interests.

In December 2023, President Biden signed into law the Nuclear Fuel Security Act (NFSA) [77] to make money available for expanding highly radiologically polluting uranium enrichment capacity and domestic uranium mining.

If U.S. lawmakers want the most expensive and unaffordable way of generating electricity, want to risk catastrophic nuclear accidents further invited by weakening already lax nuclear regulatory oversight, want to promote radiological pollution that disproportionately harms the unborn, and children and women, and wants to increase nuclear weapons material proliferation, it should keep promoting radiologically polluting, unsafe, insecure and unaffordable nuclear energy.

Articles by Tami Thatcher for February 2024

[75] U.S. Department of Energy, *Draft Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, DOE/EIS-0250F-S1D, October 2007. https://www.energy.gov/sites/prod/files/EIS-0250-S1-DEIS-Summary-2007_0.pdf

[76] Congress.gov, H.R.806 – International Nuclear Energy Financing Act of 2023. Accessed January 26, 2024. https://www.congress.gov/bill/118th-congress/house-bill/806

[77] Zakary Sonntag, *Casper Star Tribune*, "What does the future old for Wyoming and nuclear energy"," December 29, 2023. https://trib.com/news/state-regional/business/nuclear-energy-terrapower-nuscale-reactors/article_cd4a801a-a4e5-11ee-9409-5f4e8db34a93.html