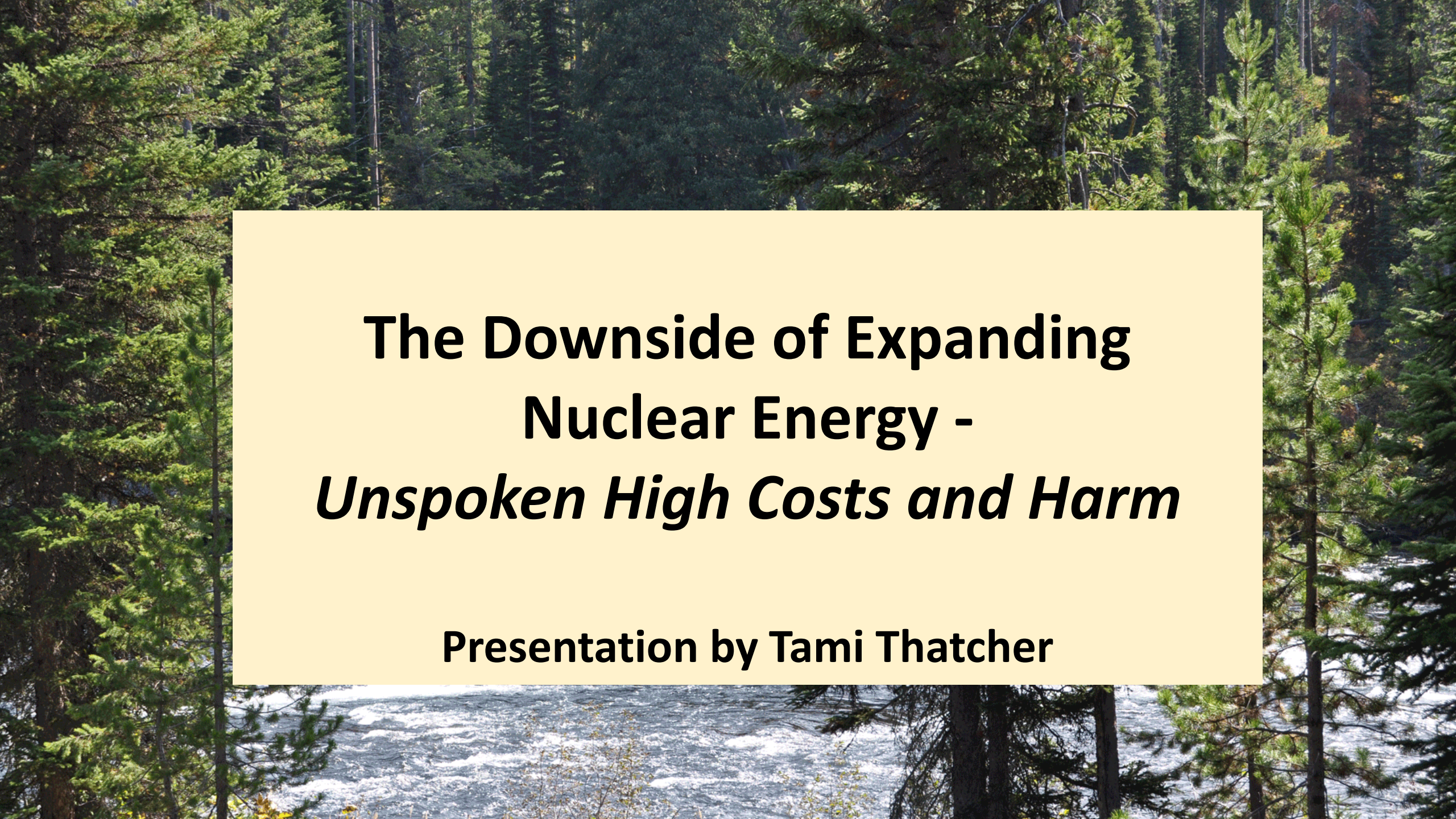


The Downside of Expanding Nuclear Energy - *Unspoken High Costs and Harm*

Presentation by Tami Thatcher

The Downside of Expanding Nuclear Energy –

Unspoken High Costs and Harm

By Tami Thatcher

June 27, 2024

The Department of Energy is aggressively promoting expansion of nuclear energy

- DOE proposes increasing nuclear energy electricity production in the U.S. by a factor of three (2023).

- DOE issued its Draft High-Enriched Low-Assay Uranium (HALEU) Environmental Impact Statement (March 2024)

Let’s talk about what the nuclear boosters don’t tell you

- Congress and communities are not being adequately informed of the costs and risks.
- The existing problem of spent nuclear fuel storage and disposal is already enormous and would be vastly worsened by increasing nuclear energy
- Radiological emissions from the Uranium fuel cycle, including reactors, cause harm, even without an accident

The Department of Energy claims that nuclear energy is -

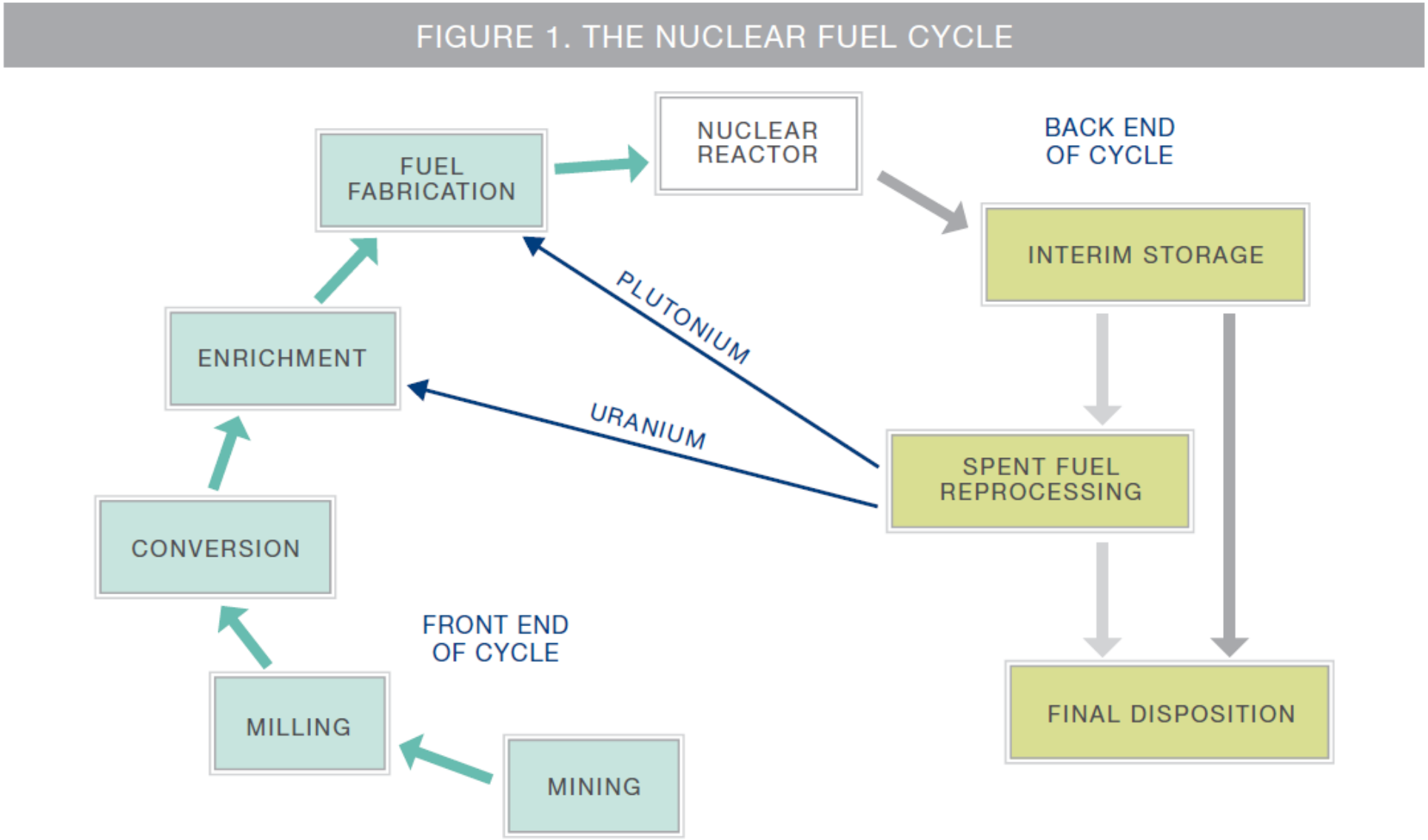
- Needed to combat climate change
- Affordable
- Provides reliable base-load power
- Clean
- Has a small footprint
- Safe

Draft HALEU EIS – DOE Misinformation

- Myth: *Nuclear energy is needed to combat climate change*. In fact, nuclear energy is too slow to deploy despite rosy and wrong estimated reactor startup dates.
- Myth: *Nuclear energy is affordable*. In fact, just the construction costs make nuclear energy unaffordable. But the actual costs are far higher and must include disposal. If “recycling” pursued, reprocessing costs must be included.
- Myth: *Nuclear energy is needed for reliable base-load power.* In fact, slow-to-deploy nuclear is keeping fossil fueled plants online. Nuclear energy’s reliability, esp. for proposed reactors is dismal.

Draft HALEU EIS – DOE Misinformation – NOT CLEAN

- Myth: *Nuclear energy is clean*. In fact, with routine activities from mining, milling, fuel fabrication, nuclear reactor operation, fuel reprocessing, and radioactive waste disposal – even without an accident- nuclear energy has created countless radiologically contaminated sites across the U.S.
- Myth: *Nuclear energy has a small footprint*. Include mining, milling, fuel fabrication, nuclear reactor operation, fuel reprocessing, transportation, and radioactive waste disposal – even without an accident- nuclear energy has created countless radiologically contaminated sites across the U.S.
  - Airborne radiological releases generously shared by many aspects of the uranium fuel cycle.



Source: Blue Ribbon Commission Report

DOE Misinformation – NOT SAFE

- Myth: *Nuclear energy is safe*. Decades of reactor experience has shown that severe reactor accidents impacting the public happen about every decade, can impact many countries and create health and economic peril.
  - Chernobyl and Fukushima “cleanups” are ongoing endeavors.
  - Permanent evacuation may be needed due to accidents or terrorism/war.

The Department of Energy also claims that Spent Nuclear Fuel -

- *SNF isn't a problem because the volume of spent nuclear fuel "is quite small" and "could fit on a single football field at a depth of less than 10 yards"*
- *"Recycling" or reprocessing will solve the spent nuclear fuel (waste) problem*
- *Yucca Mountain issues only political, not technical*
- *Some new reactors will "burn the waste"*

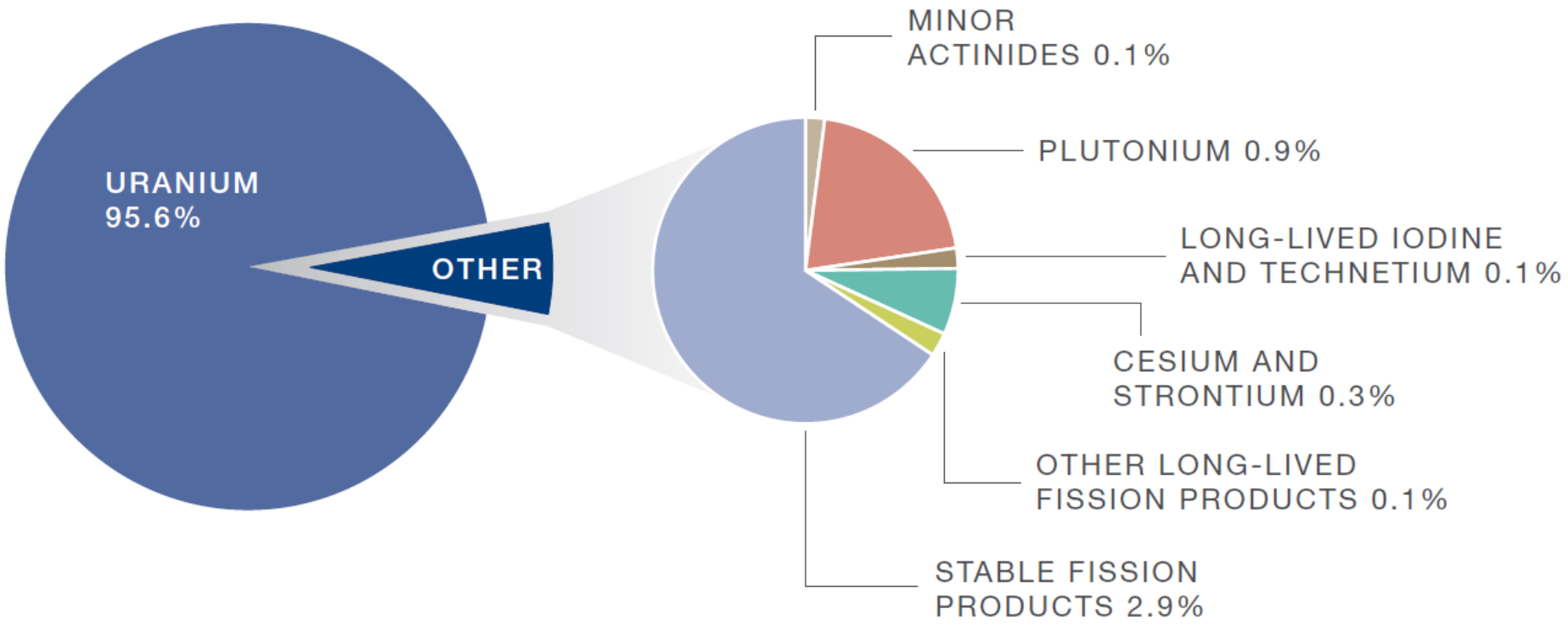
But Department of Energy claims about SNF aren't true:

- Spent nuclear fuel "could fit on a single football field at a depth of less than 10 yards." – **But YM needed 41 miles of drifts for 70,000 MT SNF. DOE's statement ignores the realities of heat load of the radioactive waste, criticality issues which increase with increasing fuel enrichment, and perhaps insurmountable technical challenges of limiting the spread of radionuclides to groundwater, soil and air over time.**
- Spent nuclear fuel isn't a problem? – ***But the reality is that commercial nuclear utilities don't want the cost of long-term storage or repackaging the spent fuel; don't want the liability of transporting spent fuel; refused to package the spent fuel for disposal as DOE wanted; there is no repository; AND the costs of repackaging, transporting and disposing of spent fuel will be astronomical.***
- Yucca Mountain issues political, not technical? – **But YM was not a dry repository as initially assumed; serious technical issues were not resolved including corrosion of containers; hot vs cold repository; impossible to install titanium drip shields; estimated rate of migration of radionuclides.**

Claims by the Department of Energy about SNF (or "used fuel") aren't true:

- "Recycling" or reprocessing will solve the waste problem? – **But this would more than double the cost of nuclear energy which is already unaffordable. And is highly polluting & creates more waste**
  - **Chemical-aqueous reprocessing is highly polluting to air and groundwater**
  - **Pyro-chemical or pyroprocessing is highly polluting to air**
- Some new reactors will "burn the waste"? – **All nuclear reactors can fission plutonium; fast reactors are better at fissioning plutonium. But fission of Pu or U creates more radwaste. Reducing the volume of waste by reducing disposal of uranium-238 does little to simplify disposal.**

FIGURE 6. COMPOSITION OF SPENT NUCLEAR FUEL AFTER 10 YEARS OF COOLING[10]

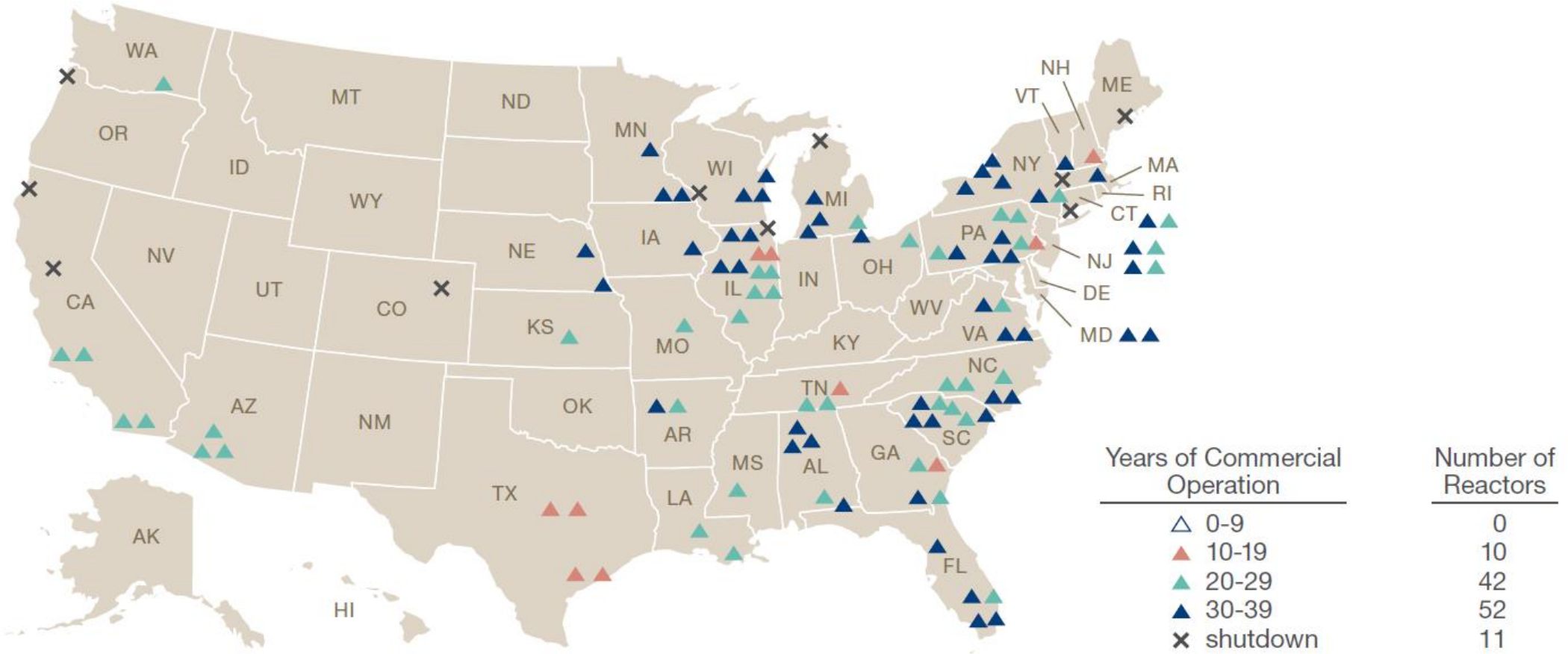


Source: Blue Ribbon Commission report. (Percent by weight.)

Nuclear Energy in the U.S. has provided only about 20 percent of electrical energy

- In 2020, 94 commercial nuclear power nuclear power plants provided about 96,557 mega-watts-electric, 18 % of US electricity
- Any given year, some reactors operate >90 percent of the time, some operate zero percent of the time, and some in between.
- Shutdown a 1000 MWe reactor and 1000 MWe is needed for replacement power.
- To recoup high construction/operating costs, nuclear plants need to operate at full power, squeezing out lower cost electricity
- Recovery of construction costs assumes operation at full power, maximum capacity, and no premature permanent shutdown.

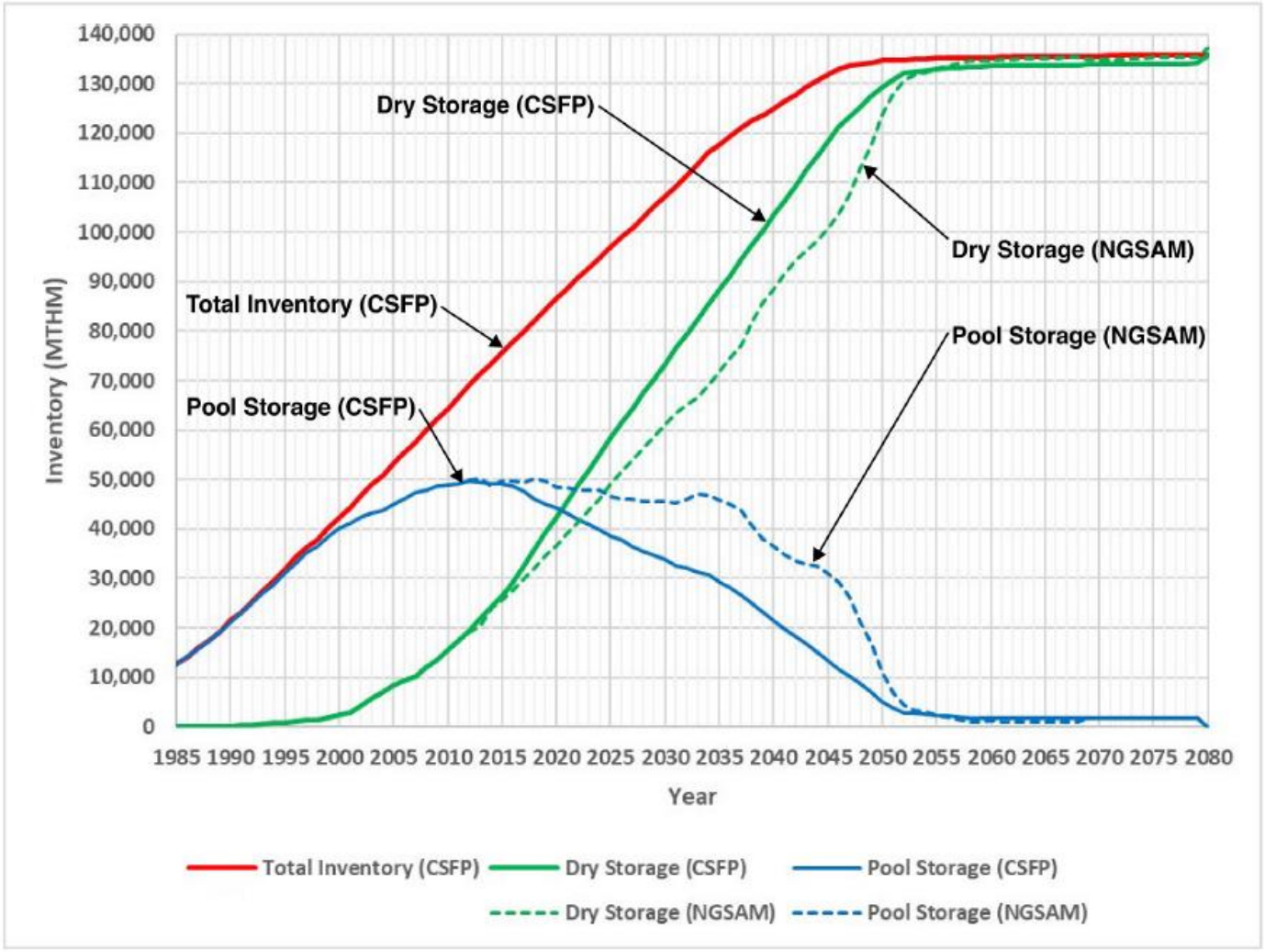
FIGURE 9. OPERATING AND SHUTDOWN COMMERCIAL NUCLEAR POWER REACTORS IN THE UNITED STATES



Source: U.S. Nuclear Regulatory Commission

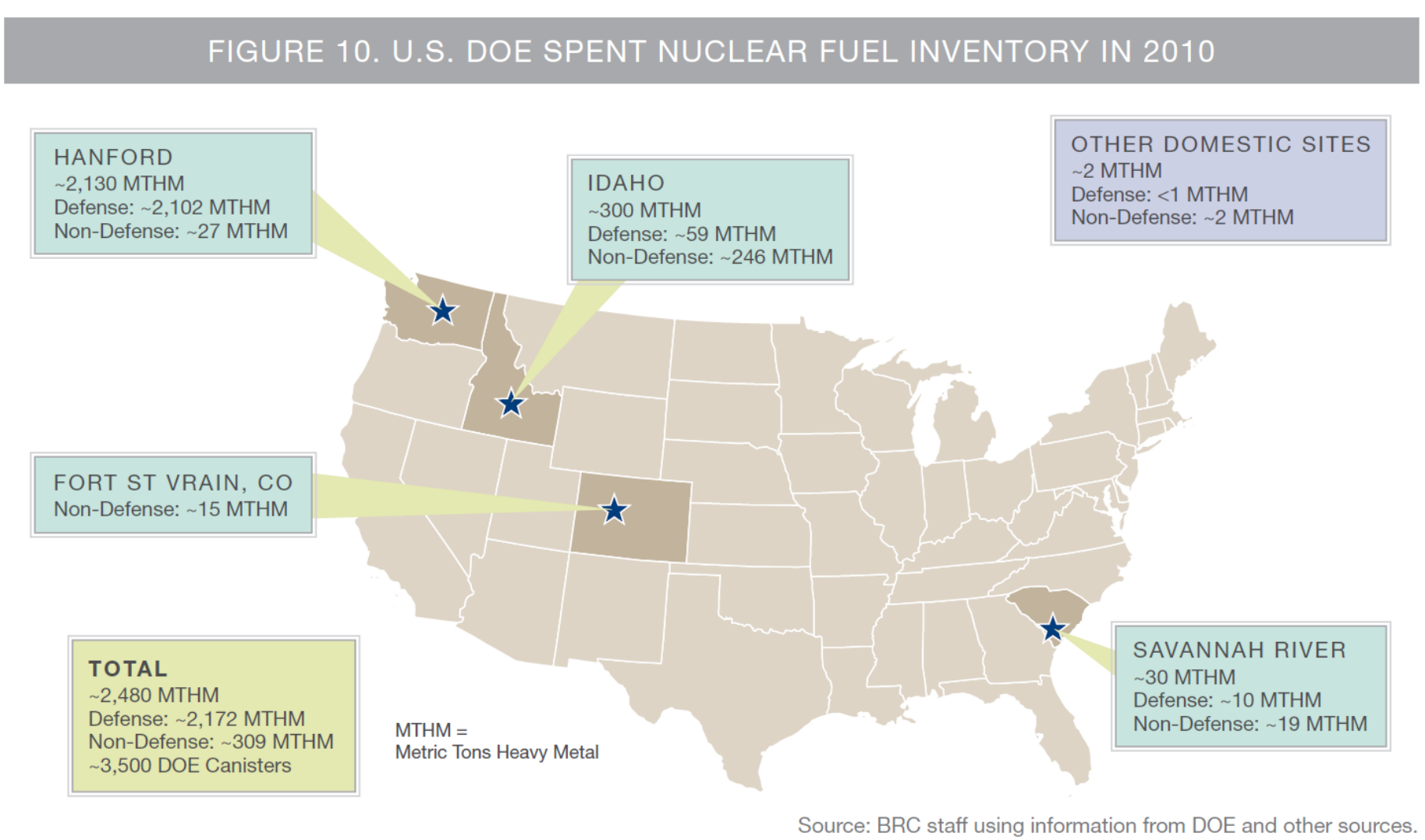
Source: Blue Ribbon Commission report

Figure 1. Projected inventory of U.S. commercial spent nuclear fuel in storage. (Source: Nuclear Waste Technical Review Board, February 2024 report.)



140,000 metric tons commercial SNF expected – without new nuclear plants

- Yucca Mountain repository had 70,000 MT limit.
- Yucca Mountain license submittal was for both
  - Commercial nuclear power plant SNF
  - DOE-owned, research, military SNF and high-level waste
- DOE's more recent cost estimates for an unknown, un-sited, undesigned repository were only for existing commercial SNF
- Recent est. $168 billion for disposal of 109,000 MT commercial SNF only (is low-balled)



Source: Blue Ribbon Commission report

140,000 metric tons commercial SNF expected – but no repository program

- DOE is responsible for both
  - Commercial nuclear power plant SNF
  - DOE-owned, research and military SNF and high-level waste
- DOE has the responsibility but has no repository program
- “Zero day” in 2014, DOE stopped collecting repository fees from rate payers because DOE has no repository program
- Industry successfully sued DOE for failure to take SNF in 1998. Money coming from tax-payer funded “Judgement Fund” is subsidizing SNF storage costs

140,000 metric tons commercial SNF expected – dry storage canisters licensed by the NRC are not designed for disposal

- DOE asked utilities to package SNF in disposable TADS – but the industry chose cheaper canisters.
- U.S. Nuclear Regulatory Commission (NRC) licensed various SNF storage systems.
- DOE contends welded-closed canisters are not an acceptable waste form.
- Electric utilities with nuclear power plants do not want the cost of repackaging spent nuclear fuel, for shipping or continued storage
- DOE studies “direct disposal” of existing canistered SNF, but denies the full extent of technical difficulty of near-term and long-term problems.
- DOE not disclosing how soon problems in existing dry canister systems will occur, affecting human safety and costs

Spent nuclear fuel is ‘safely stored’ BUT for how long?

- The U.S. Nuclear Regulatory Commission licensed dry storage canisters for 20 years, expecting DOE to open Yucca Mountain
- Canister aging or corrosion mechanisms depend on canister design, fuel burnup, chloride concentration in atmosphere, humidity, etc. Time to canister breach is canister and location dependent. Hoping for 80 years?
- DOE admits there is inadequate technical basis for assuming that spent nuclear fuel can be safely stored and transported after “long term storage”
- Technical basis for estimating radionuclide releases from a breached canister are lacking
- DOE research is tardy, not comprehensive, and unreliable

DOE is presenting consolidated storage of SNF as a "solution"

- Siting consolidated "interim" – forever – storage without siting a permanent repository is beyond irresponsible
- Repackaging facilities needed at 70+ sites? $ 1 billion each?
- Consolidated storage and stranded fuel sites will all likely need repackaging facilities, but cost and emissions not stated
- Hinting at reprocessing allows DOE to avoid stating costs and pollution of reprocessing
- DOE is planning to not worry about SNF management for proposed new reactors – See NWTRB.gov August 2023 mtg.

DOE is using Consortia to pursue consolidated “interim” storage

- DOE is seeking communities to accept a CIS via a growing paid consortia of universities, businesses, and non-profits
- DOE has admitted it will actively withhold information from communities about the problems of consolidated storage
- DOE plans to design the messaging and omit unfavorable information (See NWTRB.gov, August 2023 meeting)
- DOE’s HALEU EIS meetings prohibited access to tribal meetings by non-tribal citizens

Plethora of Proposed Reactors to use HALEU

- Sodium-cooled fast reactor by TerraPower/GE Hitachi, Natrium, 345 MWe (Kemmerrer, Wyoming)
- High-temperature gas-cooled (HTGR) reactor, X-Energy's Xe-100, 80 MWe, TRISO fueled.
- Project Pele, Micro – mobile Army HTGR fueled reactor, 1 to 5 MWe, TRISO fueled.
- Molten Chloride Reactor, research on << 1 MWe
- Many others
- NuScale small modular reactor, <4.95 % enriched, 60 MWe, UAMPs project cancelled November 2023 due to rising estimated costs. (Some HALEU research was planned)

Plethora of Proposed Reactors means a plethora of SNF disposal challenges

- Each new fuel type, cladding type, enrichment, burnup and reactor coolant type requires additional research for –
  - Spent nuclear fuel storage containers
  - Spent nuclear fuel long-term aging effects
  - Spent nuclear fuel repository behavior
  - Option: reprocessing technology development
- Higher enriched fuels, smaller reactors have bigger disposal problems

Fast reactor history proves these are unreliable baseload nuclear reactors

- Experimental breeder reactor – I (EBR-I) Idaho. Core melted.
- Experimental breeder reactor – II (EBR-II) Idaho. (intermittent 20 MWe)
- Fast Flux Test Reactor – Hanford
- Fermi-1, Detroit. Early operations, core melted due to flow blockage.
- France's Phoenix. Managed to operate only 8 percent of the time.
- Japan's Monju. Years of repairs and failures until closure.
- Navy's sodium-cooled reactor experience was not favorable.

Fast reactor hype has never materialized

- After wasting precious years on a non-existent “traveling wave reactor” TerraPower (Bill Gates) settled on a scale up of EBR-II.
- TerraPower and the Department of Energy have claimed that Natrium (sodium-cooled reactor) will “burn the waste.”
- All reactors can fission plutonium and fast reactors do fission plutonium effectively. But implying that the existing spent nuclear fuel problem will be reduced by creating more waste in Natrium is without merit.
- Vast stockpiles of separated plutonium exist – and yet Natrium requires HALEU and does not burn any significant existing SNF or existing surplus Pu.
- Natrium reactor slated for Kemmerrer, Wyoming but coal being converted to gas plants in order to provide reliable electricity
- New legislation allows reactors to be sold to foreign countries?

High-temperature gas-cooled reactors – History of premature SD

- Several HTGRs have been built in US and abroad.
- All were economic failures and shutdown (SD) early
- Various contamination problems although inadequately documented.
- TRISO fuel difficult, costly and likely impractical to reprocess.
- Plan on difficult maintenance, “forever” storage and “forever” terrorism target

M. V. Ramana, *Bulletin of the Atomic Scientists*, “The checkered operational history of high-temperature gas-cooled reactors,” 72:3, 171-179, 2016. See nuclearfreenw.org or http://dx.doi.org/10.1080/00963402.2016.1170395

Nuclear Regulatory Commission Licensing of New Nuclear Reactors

The NuScale Example:

- NRC's review for the SDA ended prematurely but on schedule
- NuScale's standard design approval for the 50 MWe modules had left important unresolved open issues (unique heat exchanger, density oscillation waves).
- Despite NRC stating that the standard design approval **did not constitute a commitment to issue a permit or design certification,** DOE loudly heralding "approved design."
- NuScale later claimed it had design approval for proposed higher 77-MWe modules, which it didn't
- NRC does not address spent nuclear fuel disposition (disposal) when licensing new reactors or affordability. Often fails to meet its own regs.

NRC's risk-informed regulation - can mean presenting favorable low risk estimates AND withholding unfavorable risk or safety information

- NRC omitted NuScale total-module risk estimates, whether 6 reactor or 12 reactor modules, risk of only 1 module provided
- NRC kept the public in the dark if a safety design problem seemed sensitive to the vendor
- NRC already doing everything it can to save nuclear reactor operators money – Congress is making a bad situation worse.
- I fully support conducting probabilistic risk assessment to find vulnerabilities, but PRA can be garbage in – garbage out.

Price Anderson Act protects nuclear plant owners but not citizens, especially regarding less than 100 MWe reactors and SNF storage and transportation

- Compensation in the event of a nuclear accident is far less likely to be provided to citizens harmed by <100 MWe “small” nuclear reactor accidents, even if several small nuclear reactors are involved (utilities v. DOE ownership affects compensation)
- Compensation in the event of a nuclear accident involving storage or transportation of spent nuclear fuel may be far less likely to be provided to citizens harmed

H. Arceneaux et al., U.S. Nuclear Regulatory Commission, *The Price-Anderson Act: 2021 Report to Congress – Public Liability Insurance and Indemnity Requirements for an Evolving Commercial Nuclear Industry*, NUREG/CR-7293, December 2021. https://www.nrc.gov/docs/ML2335/ML21335A064.pdf

U.S. Department of Energy, *The Price-Anderson Act Report to Congress*, January 2023.

Recap: DOE all but ignores SNF Disposal

- The DOE is promoting an increase in nuclear energy with advanced reactors
- Instead of “cradle-to-grave” planning, DOE is downplaying, ignoring or actively misinforming people about the increased and unsustainable spent nuclear fuel waste problem
- DOE is admitting that the Yucca Mountain project was defunded but to DOE, YM is not dead
- DOE is not admitting the enormous costs and technical challenges of ATTEMPTING to confine the radioactive waste at YM or other location
- Cost estimates available for SNF disposal are for only a PORTION of the EXISTING waste, low-balling the cost
- DOE is not admitting how the fuels using U-235 enrichment above 2 or 3 percent require more space in a repository and increase the difficulty (criticality, thermal heat and repository heat up, etc.)
- DOE hinting that the solution is simply reprocessing or “burning the waste” is a con

SNF Disposal – Broken Promises

- DOE promised to open YM and take SNF by 1998
- DOE and/or its contractor apply scientific fraud to waste container corrosion times, water infiltration rates, etc. (Nevada notices fraud.)
- NRC, the “regulator” performs migration analysis for dry shields that cannot be installed, but this lowers the predicted radiation dose
- DOE promises to take ownership of the SNF by 2010, then by 2048
- DOE stops giving any date for taking SNF or opening a repository
- DOE’s HALEU EIS claims DOE remains committed to providing a repository
- In 2024, DOE admits that there is no repository site and no design

SNF Disposal – Back to Square One

- DOE has a small amount of repository research for a variety of rock types: clay, shale, salt.
- DOE has conducted criticality studies confirm that some of the higher enriched high burnup fuels are capable of criticality if water introduced.
- In 2024, DOE's Paul Murray, Deputy Assistant Secretary for Spent Fuel and Waste, DOE Nuclear Energy, formerly of Orano, admits that there is no repository site, design or program. Higher enrichment of SNF problematic. So emphasis is on messaging with help from Social Scientists to convince the public that disposal (and transportation of SNF) will be safe.
- DOE's Paul Murray stated: "Transportation of SNF may be one of the safest endeavors in the history of the world." See https://www.ans.org/webinars/view-snfdoe/

June 27, 2024, train derailment.

Freight train derails outside Chicago, evacuations underway

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Dry storage of SNF

- As spent nuclear fuel pools approached capacity, spent nuclear fuel was placed in a variety of dry storage systems
- Pools re-racked for more dense packing of SNF and pose greater hazard to the public
- Dry storage of SNF at more than 70 sites in the U.S.
- As reactors have been permanently shut down, pools are removed
- Pools cannot be used for repackaging dry storage fuels in all cases
- **No dry transfer system has been designed**
- Hotter, high burnup fuels pose increased challenges

SNF dry storage based on flawed assumptions

- Regarding long-term storage of SNF, the DOE made gross technical errors in the previous spent nuclear fuel EIS for Yucca Mountain, as it ignored key corrosion mechanisms (Appendix K)
- The Nuclear Regulatory Commission licensed existing dry storage systems for SNF, expecting disposal within about 20 years (by 1998).
- The NRC did not formally admit SNF canisters susceptible to chloride-induced stress corrosion problem until 2012.
- DOE and NRC have refused to admit how soon existing SNF canisters may breach due to aging mechanisms such as chloride-induced stress corrosion cracking

SNF dry storage WILL need repackaging

- The NRC in its generic “continued storage” EIS simply assumes repackaging capability will take place as needed, wherever needed.
- Utilities do not want to pay for repackaging the spent nuclear fuel; neither does DOE
- Who pays for SNF repackaging?
- No canister repair or repackaging capability exists. Who pays to develop it?

Storage of existing SNF is safe?

- SNF in storage pools is safe unless the pool drains or other accident
- For Dry Storage, DOE has admitted that there is a lack of technical basis for understanding:
  - Whether SNF will be safe in dry storage, as time goes on
  - What the radiological consequences will be as canisters fail
- The NRC focuses its efforts on helping utilities avoid paying for SNF management
- How soon will existing SNF canisters breach due to aging mechanisms? Chloride-induced stress corrosion cracking can occur within 20 or 30 years.
- A repository will not become available by 2050, 2070? 2090?

Radionuclides in a single SNF canister

Nuclide [a]	Inventory per Assembly (Ci) [b]	Number of Assemblies	Release Fraction [c]	Release (Ci)	Eff DCF [d] (mrem/uCi)	Inhalation Dose at 500 m for 30 days (rem)
Hydrogen-3	5.0E2	36	0.15 (gases)	2700	6.40E-2	0.11
Iodine-129	3.6E-2	36	0.15 (gases)	0.1944	1.74E2	0.02
Krypton-85	5.8E3	36	0.15 (gases)	31320	0	0
Cobalt-60	3.3E1	36	1 (crud)	1188	2.19E2	166.51
Strontium-90	6.5E4	36	3E-5 (volatiles)	70	1.3E3	58.24
Ruthenium-106	1.3E4	36	3E-5 (volatiles)	14	4.77E2	4.27
Cesium-134	4.1E4	36	3E-5 (volatiles)	44	4.6E1	1.29
Cesium-137	1.1E5	36	3E-5 (volatiles)	119	3.19E1	2.43
Barium-137m	9.9E4	36	3E-3 (fines)	10692	?	?
Plutonium-241	8.0E4	36	3E-3 (fines)	8640	8.25E3	45,619
Yttrium-90	6.5E4	36	3E-3 (fines)	7020	8.44	37.9
Promethium-147	2.3E4	36	3E-3 (fines)	2484	39.2E1	623
Europium-154	6.2E3	36	3E-3 (fines)	669.6	2.86E2	122.5
Curium-244	1.4E4	36	3E-3 (fines)	1512	2.48E5	239,985
Plutonium-238	6.8E3	36	3E-3 (fines)	734	3.92E5	184,146
Antimony-125	1.9E3	36	3E-3 (fines)	205.2	1.22E1	1.6
Europium-155	1.8E3	36	3E-3 (fines)	194.4	4.14E1	5.15
Americium-241	8.8E2	36	3E-3 (fines)	95.04	4.44E5	27,007
Plutonium-240	4.0E2	36	3E-3 (fines)	43.2	4.29E5	11,861
Plutonium-239	1.8E2	36	3E-3 (fines)	19.44	4.29E5	5337
					Total (rem) At 500 m for 30 days, Inhalation dose	~400,000 rem

From Public comment submittal on the Draft Environmental Impact Statement for Department of Energy Activities in Support of Commercial Production of High-Assay Low-Enriched Uranium (HALEU), DOE/EIS-0559, by Tami Thatcher, April 22, 2024. www.environmental-defense-institute.org/Publications/CommentDOEhaleu2024.pdf

Consolidated “interim” storage is NOT a solution

- The DOE points to proposed consolidated interim storage facilities in New Mexico and Texas
- But DOE does not admit (in the Draft HALEU EIS) that:
  - Both New Mexico and Texas have state legislation to prohibit CISs
  - Texas has a court ruling that NRC does not have the authority to “authorize” away-from reactor storage
- DOE seeks the illusion of a solution with consolidated storage

DOE promotes ‘recycling’ and looks to the MOX program in France – but DOE’s MOX program in the U.S. failed

- DOE promoted mixed oxide fuel (plutonium mixed with uranium) used in U.S. conventional light-water
- DOE began construction on a MOX fuel facility at Savannah River Site that was to use surplus plutonium
- DOE’s enormous cost and schedule overruns led to cancellation of MOX fuel facility; also, no nuclear plant wanted the MOX fuel
- Reprocessing by France, UK and others have created vast surplus plutonium which is a liability to store or dispose of

Reprocessing amid vast amounts of surplus Pu

- The viability of reprocessing depends on the fuel type.
- With the U.S. awash is surplus plutonium, who would think reprocessing to extract plutonium from SNF is beneficial?
- If HALEU fuel is used for high-temperature gas-cooled reactors, their TRISO-based fuel may not be practical to reprocess and then will require more space in a repository.
- Sodium-bonded fuels such as for liquid-metal cooled fast reactors (Natrium) may require treatment by pyro-processing to remove chemically reactive sodium – and yet the costs and environmental effects are being ignored in DOE's Draft HALEU EIS.

Weapons Proliferation Threat

- **Higher enriched (about 5 and up to almost 20 percent) such as HALEU increases the likelihood of weapons-material theft**
- A repository, depending on design, may require remaining open for decades, for cooling, etc. and is not protected from theft
- Nuclear weapons use plutonium-239, uranium-235 or uranium-233.
- With the U.S. awash is surplus plutonium, who would think reprocessing to extract plutonium from SNF is beneficial?
- Reprocessing adds proliferation threat - Sodium-bonded fuels such as for liquid-metal cooled fast reactors (Natrium) that may require pyro-processing

HALEU will contribute to nuclear weapons proliferation threat

- Enrichment above 10 percent in uranium-235 is nuclear weapons useable
- HALEU is 10 to almost 20 percent enriched in uranium-235
- Despite DOE claims, HALEU is a proliferation threat.
- About 1 metric ton (1000 kg) of HALEU, 19.75 % enriched would make a nuclear weapon. (15 kg of high enriched uranium under ideal conditions)
- Over 10 proposed reactor concepts with cores containing the nearly 1 metric tons of HALEU (or more) with each core enough to make one or more nuclear weapons

R. Scott Kemp, Edwin S. Lyman, Mark R. Deinert, Richard L. Garwin, and Frank N. Von Hippel, *Science*, "The weapons potential of high-assay low-enriched uranium," June 6, 2024. https://www.science.org/doi/10.1126/science.ado8693

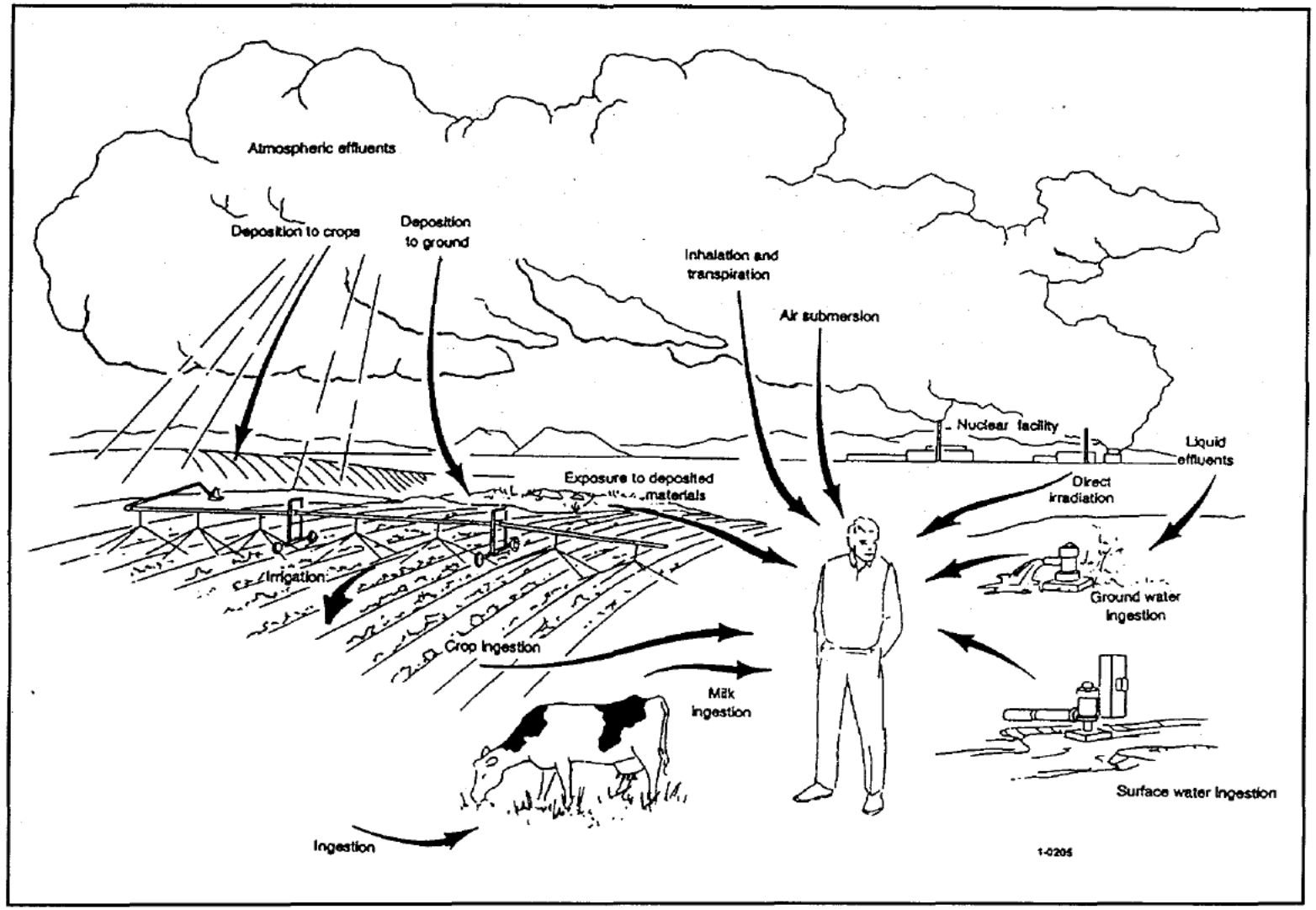
HALEU will contribute to nuclear weapons proliferation threat

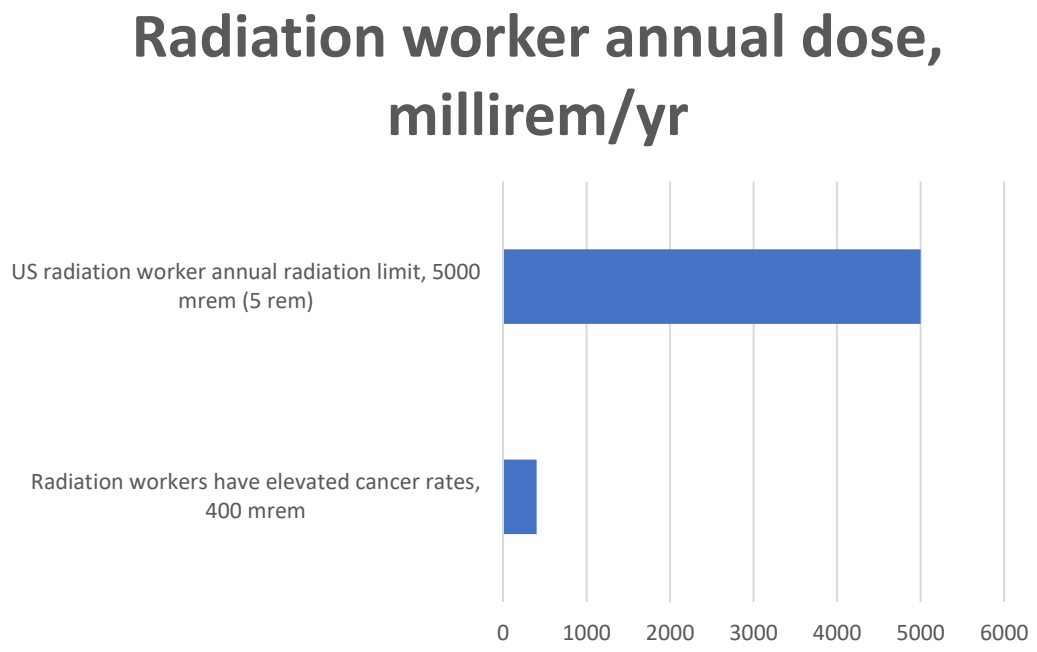
- In typical DOE behavior, DOE responded to concerns about HALEU proliferation concerns in DOE's NEPA response – with empty words.
- HALEU-fueled reactors create a proliferation threat.
- Uranium enrichment plants create a proliferation threat.
- Fuel fabrication facilities create proliferation threat.
- Reprocessing capability (to extract plutonium or HEU) also creates a proliferation threat.
- Loopholes for small research reactor fuel quantities should never have been applied. Each very small research reactor core far less than 1 metric ton of fuel. (TRIGA research fuel, 12 to 70 percent enriched.)

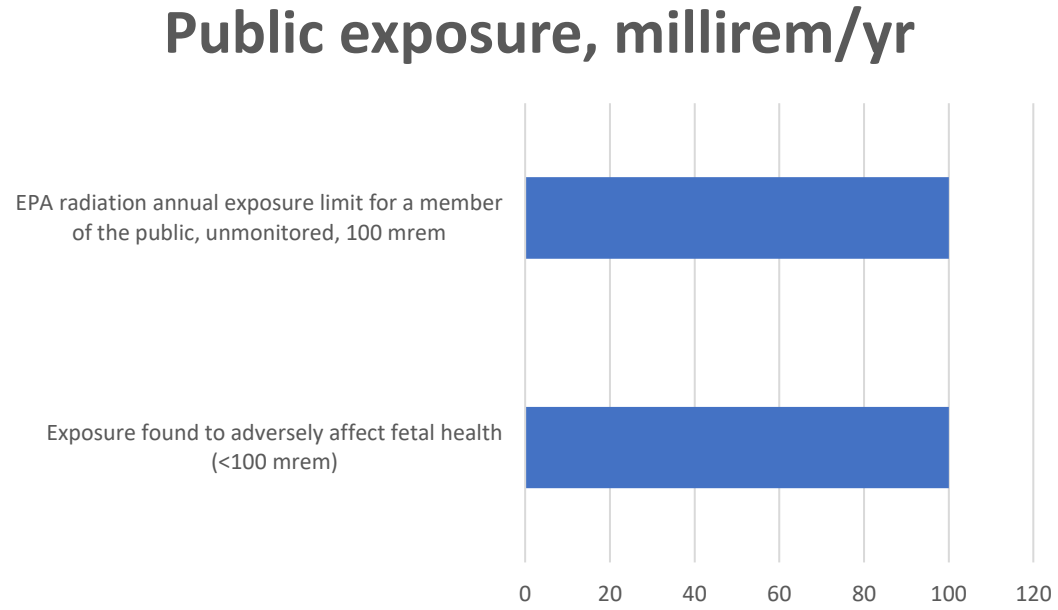
What's the harm?

- Mining, milling, enrichment, fuel fabrication radiological, nuclear reactor, SNF storage, reprocessing radiological releases often unmonitored and unreported.
- Nuclear reactor airborne releases often unmonitored and unreported.
- PWR steam generator tube ruptures meant far higher radiological airborne releases during operation.
- Nuclear reactor airborne releases may be higher during outages as systems are opened up, i.e. BWRs.
- Nuclear reactor releases to groundwater or oceans significant for BWR/PWRs.
- Accident releases such as Three Mile Island have not been adequately estimated or monitored.
- Dry storage of SNF creates radioactive carbon-14 and others, by neutron capture

Direct exposure and radionuclide releases







DOE, NRC and nuclear industry actively ignoring diverse, compelling evidence of greater health harm than their models suggest.

Outcomes other than death by cancer often ignored.

Neither rad workers nor public actually protected by existing standards.

The vulnerability of the unborn child often ignored. The nuclear industry ignores, still, increased infant mortality from radiological releases.

Operators/DOE/NRC have disincentive to monitor and report radionuclide releases from routine operations or accidents

- Accident releases such as Three Mile Island have not been adequately estimated or monitored. Radiation levels off the scale of TMI instruments.
- Certain radionuclides are easy to monitor due to high energy gamma rays, such as iodine-131. But, monitoring may be infrequent. MCLs too permissive.
- Other radionuclides are difficult to monitor due to low energy beta emissions, such as tritium, iodine-129, carbon-14 – and so these radionuclides are often not monitored, yet cause health harm.
- Strontium-90 beta requires analytical samples and isn't detected from gamma spectrometry and so may be reported less often.
- Alpha emitters may be ignored or falsely attributed to former weapons tests.
- Plutonium-239, Pu-241 -> Am-241, Np-237, like U-238 have long decay series.

NRC cancelled the only appropriately designed proposed epidemiology study

- The U.S. NRC cancelled what would have been the first meaningful epidemiology study of health effects near US nuclear reactors in 2012.
- Airborne radiological releases from nuclear power plants affect downwind residents but contaminated foods are distributed unevenly.
- The inhalation and ingestion of radionuclides varies according to location as well as diet.
- The harm depends on gender and the age of exposure and it is known that women are more vulnerable than men, and children are more vulnerable than adults.
- The unborn, developing child, in utero, is most at risk.

Diverse evidence show inadequacy of existing radiation protection standards

- The evidence is there that chronic low doses of radiation especially from ingestion of contaminated food is especially harmful to the child developing in utero and to children.
- Following nuclear power plant closures, decreases in the radioactivity of milk has been noted and reductions in infant deaths and incidence of childhood cancer.

- Jay M. Gould with members of the Radiation and Public Health Project, Ernest J. Sternglass, Joseph U. Mangano, and William McDonnell, *The Enemy Within – The High Cost of Living Near Nuclear Reactors – Breast Cancer, Aids, Low Birthweights, and Other Radiation-Induced Immune Deficiency Effects*, Four Walls Eight Windows, 1996. ISBN 1-56858-066-5. See pages 131 and 281.
- Joseph J. Mangano, Jay M. Gould, Ernest J. Sternglass, Janette D. Sherman, Jerry Brown and William McDonnell, Radiation and Public Health Project, "Infant Death and Childhood Cancer Reductions after Nuclear Plant Closings in the United States," *Archives of Environmental Health*, Vol. 57 (No.1), January/February 2002.

Congress is passing legislation that won't combat climate but create costly harm

- Congress is not being adequately informed as to the true cost of spent nuclear fuel (SNF) management and disposal
- Congress and communities are not being adequately informed as to upcoming crisis need for repackaging of spent nuclear fuel – as canisters breach or reach significant partially through-wall cracking
- DOE has not completed/disclosed studies of radiological consequences of high-burnup fuel canister breach
  - GAPS for safety of existing SNF
  - Unstated/unevaluated added difficulty of advanced reactor SNF

Congress is misinformed by DOE and nuclear industry

- Congress has passed legislation without being adequately informed
- DOE and the industry/laboratories often present a distorted picture
- The costs of SNF management, whether disposal or reprocessing or continued storage are not being disclosed
- Who will pay – is not being disclosed. GAO reports not helping.
- Recently passed S.870, in weak language asks DOE to report SNF disposal costs will not improve matters
- S.870 weakens NRC

Disastrous Legislation to enable DOE's dysfunction

- 2020 Energy Act, directing DOE to share HALEU with private companies
- October 202, DOE announced a 50% cost-sharing program for 2 demo reactors
- Inflation Reduction Act of 2022 appropriated $700 million to develop civilian supplies of HALEU.
- Consolidated Appropriations Act, 2024, added $2.72 billion more for LEU and HALEU
- Nuclear giveaways stealthily added to a Fire fighters bill, passed June 18, 2024 by House and Senate, called the "ADVANCED Act" S.870, reduce NRC oversight and allow foreign countries to own U.S. nuclear facilities.

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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 See also GAO-21-603. ($168 billion for 109,000 MT commercial SNF, $15 billion already spent)

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Thank you

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