Printed in U.S.A.
Vol. 117, No. 4

Note

DEFINING INTERIM STORAGE OF NUCLEAR WASTE

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ABSTRACT—Nuclear power may be humanity's best hope to curb climate-altering greenhouse gas emissions. But public fear of its dangers, including the toxicity of nuclear waste, undermines its expansion. To provide for more effective waste disposal, in 2021 and 2022 the Nuclear Regulatory Commission (NRC) recommended licensing two privately-owned nuclear waste storage facilities—called Consolidated Interim Storage Facilities (CISFs)—to be built in New Mexico and in Texas. Both states vehemently oppose the construction and operation of these facilities: legislators in both states have proposed state laws opposing them, and both states have sued the NRC challenging the legality of the facilities' licensure.

There is no doubt that an effective waste solution is sorely needed for nuclear power to reach its full potential. But while consolidated, above-ground storage may play an important role in the development of long-term nuclear waste disposal, establishing such a program at the cost of state and public enthusiasm is a long-term mistake. Informed by an analysis of the history of nuclear power and the difficulties inherent in nuclear waste disposal logistics, this Note argues that the NRC's licensure of the CISFs as "interim" storage facilities contradicts the meaning of that word, and therefore these licensing actions fall outside of the NRC's regulatory bounds. In doing so, this Note provides a legal argument that New Mexico and Texas—and future parties opposing similar facilities—may utilize in their suits against the NRC. This Note then proposes specific steps that a court may require to ensure that the NRC applies the word "interim" as it is defined.

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INTRODUCTION

Nuclear power is arguably the world's greatest tool to combat "the defining issue of our time": climate change.[1] There is overwhelming evidence that climate change is primarily caused by human activities, the most impactful of which is the burning of fossil fuels.[2] A vital portion of the

[1] *Climate Change*, UNITED NATIONS, https://www.un.org/en/global-issues/climate-change [https://perma.cc/5UKB-HWTH]; *see How Can Nuclear Combat Climate Change?*, WORLD NUCLEAR ASS'N, https://world-nuclear.org/nuclear-essentials/how-can-nuclear-combat-climate-change.aspx [https://perma.cc/DA4B-2ZJG] ("[N]uclear power is reliable and can be deployed on a large scale**,** it can directly replace fossil fuel plant[s], avoiding the combustion of fossil fuels for electricity generation . . . . Decarbonising the electricity supply, whilst providing affordable and reliable electricity to a growing global population, must be central to any climate change strategy."); Andrew I. Fillat & Henry I. Miller, *Nuclear Power Is the Best Climate-Change Solution by Far*, WALL ST. J. (Nov. 4, 2021, 6:09 PM), https://www.wsj.com/articles/nuclear-power-best-climate-change-solution-by-far-global-warming-emissions-cop26-11636056581 [https://perma.cc/C2TY-HRVH] (detailing the advantages of nuclear power over solar and wind and explaining the promise of emerging nuclear power technology); Don Howard, *The Moral Imperative of Green Nuclear Energy Production*, 1 NOTRE DAME J. EMERGING TECH. 64, 69 (2020) ("Nuclear power is the only option for preventing a climate catastrophe."); *Climate*, NUCLEAR ENERGY INST., https://www.nei.org/advantages/climate# [https://perma.cc/KF3Y-66C5] ("[]Nuclear generates more than half of [the United States'] carbon-free energy and is essential to any clean energy solution [to global warming].").

[2] *The Causes of Climate Change*, NAT'L AERONAUTICS & SPACE ADMIN., https://climate.nasa.gov/causes/ [https://perma.cc/GLJ3-J3RP].

response to climate change is mitigation, or the reduction of those harmful activities.[3]

That is where nuclear power comes in. The total lifecycle of a nuclear power plant, including construction, mining, and energy production, produces vastly fewer greenhouse gas emissions than coal and oil, yet requires a footprint considerably smaller than wind and solar.[4] Further, nuclear power is much safer than coal and oil. Coal kills over 800 times—and oil over 600 times—as many people as nuclear power per unit of electricity produced; nuclear power is essentially as minimally threatening to human life as solar and wind power are.[5] And as wind and solar energy have suffered supply chain disruptions, President Biden has turned to nuclear power to maintain the momentum of green energy growth.[6] Finally, nuclear power is primed for considerable technological advancement in the coming years, likely resulting in greater safety and power production efficiency.[7]

The upsides to the increased use of nuclear power in the United States and globally are tremendous. But for all of nuclear power's benefits, the waste produced by nuclear power presents significant challenges for its expansion into a viable replacement for fossil fuels. The radioactive hazards associated with nuclear waste raise national security concerns, while rising sea levels resulting from climate change threaten the stability of coastal waste storagFe sites.[8] Further, popular fear of nuclear waste dampens

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[3] *Responding to Climate Change*, NAT'L AERONAUTICS & SPACE ADMIN., https://climate.nasa.gov/solutions/adaptation-mitigation/ [https://perma.cc/537C-626Y].

[4] Fillat & Miller, *supra* note 1 (noting that the total lifecycle of a nuclear power plant produces just 0.14% of the total greenhouse gases of a coal plant and 0.25% of the greenhouse gasses of a gas plant, and its footprint is 0.05% that of wind and 0.25% of solar).

[5] Hannah Ritchie, *What Are the Safest and Cleanest Sources of Energy?*, OUR WORLD IN DATA (Feb. 10, 2020), https://ourworldindata.org/safest-sources-of-energy. [https://perma.cc/9JDE-BMVW] (ranking death rates per terawatt-hour of electricity produced from most to least: Coal (24.62), Oil (18.43), Wind (0.04), Nuclear (0.03), Solar (0.02)). Nuclear power's death rate is 0.12% that of coal. *Id.* (explaining that coal and oil death rates are calculated by adding deaths attributable to accidents and air pollution stemming from those methods of energy production); *see also* Fillat & Miller, *supra* note 1.

[6] Ivan Penn, *Nuclear Power Gets New Push in U.S., Winning Converts*, N.Y. TIMES (July 5, 2022), https://www.nytimes.com/2022/07/05/business/energy-environment/nuclear-energy-politics.html [https://perma.cc/KF6X-Q782].

[7] *See* Fillat & Miller, *supra* note 1 (discussing the several new versions of reactors on the horizon, each providing advances in reliability, scalability, and safety).

[8] *See* NAT'L RSCH. COUNCIL OF THE NAT'L ACADS., SAFETY AND SECURITY OF COMMERCIAL SPENT NUCLEAR FUEL STORAGE 25–37 (2006) ("Spent fuel storage facilities cannot be dismissed as targets for [terrorist] attacks . . . because of the attractiveness of spent fuel as a terrorist target given the well-known public dread of radiation."); YCC Team, *Sea-Level Rise Could Threaten Coastal Nuclear Waste Facilities*, YALE CLIMATE CONNECTIONS (Feb. 9, 2021), https://yaleclimateconnections.org/2021/02/sea-level-rise-could-threaten-coastal-nuclear-waste-facilities/ [https://perma.cc/2AEK-7X5F].

enthusiasm for nuclear energy.[9] The future of nuclear power in America depends largely on whether the problem of nuclear waste, including both its real and perceived dimensions, can be solved.[10]

In the 1950s and 1960s, the early years of nuclear energy, scientists were confident that the nuclear waste problem could be solved.[11] Those active in the field of nuclear science believed that the problem of nuclear waste was *temporary*. They relied on an optimistic assumption that the required technology and methodology for nuclear waste disposal would be developed in the near-enough future.[12]

The awaited solution never came. The federal government's long-anticipated permanent repository, Yucca Mountain, never materialized, due not to scientific or technological shortcomings but rather to political decisions resulting from sustained popular opposition.[13] Some sixty years later, the problem remains: nearly 90,000 metric tons of high-level nuclear waste is located at approximately eighty different locations across the country, stored in cooling pools or above-ground containment vessels.[14] Yucca Mountain's failure—alongside the absence of any subsequent legislative solution—has left the United States with no clear nuclear waste disposal plan.[15]

Private companies have stepped into this void by proposing consolidated "interim" nuclear waste storage. These companies hope to build

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[9] *See* J. SAMUEL WALKER, CONTAINING THE ATOM: NUCLEAR REGULATION IN A CHANGING ENVIRONMENT, 1963–1971, at 413 (Univ. of Cal. Press, 1992), *reprinted in* J. SAMUEL WALKER, U.S. NUCLEAR REGUL. COMM'N 413 (2010) ("[G]rowing concerns over [issues including] waste disposal . . . contributed to visibly increasing uneasiness about the technology.").

[10] *See* BLUE RIBBON COMM'N ON AM.'S NUCLEAR FUTURE, REPORT TO THE SECRETARY OF ENERGY, at vi (2012) [hereinafter BRC REPORT] ("Put simply, this nation's failure to come to grips with the nuclear waste issue has already proved damaging and costly and it will be more damaging and more costly the longer it continues: damaging to prospects for maintaining a potentially important energy supply option for the future . . . .").

[11] GEORGE T. MAZUZAN & J. SAMUEL WALKER, CONTROLLING THE ATOM: THE BEGINNING OF NUCLEAR REGULATION 1964–1962, at 371 (1997) ("The prevailing opinion within the [AEC] and among scientific experts in the late 1950s and early 1960s was that the problems of high-level wastes could be solved.").

[12] *See id.*

[13] *See* Hannah Northey, *GAO: Death of Yucca Mountain Caused by Political Maneuvering*, N.Y. TIMES (May 10, 2011), https://archive.nytimes.com/www.nytimes.com/gwire/2011/05/10/10greenwire-gao-death-of-yucca-mountain-caused-by-politica-36298.html?pagewanted=all [https://perma.cc/2THT-CCWG].

[14] *See Nuclear Waste Disposal*, U.S. GOV'T ACCOUNTABILITY OFF., https://www.gao.gov/nuclear-waste-disposal [https://perma.cc/VGL8-GG5E]; *see also* LANCE N. LARSON, CONG. RSCH. SERV., IF 11201, NUCLEAR WASTE STORAGE SITES IN THE UNITED STATES 1 (2020), https://sgp.fas.org/crs/nuke/IF11201.pdf [https://perma.cc/7KP3-GN52] (describing the ongoing challenge of nuclear waste storage).

[15] *See* BRC REPORT, *supra* note 10, at 33.

massive facilities utilizing modern containment and security technology to house the nation's waste.[16] Consolidated storage facilities could provide significant improvements to the safe and secure storage of nuclear waste, making these private facilities seem like an improvement over the disaggregated, tenuous status quo. For that reason, the Nuclear Regulatory Commission (NRC), the federal agency tasked with nuclear power regulation,[17] has licensed one and recommended licensing another of these private facilities to be built as interim storage installations.[18]

Both New Mexico and Texas, the states in which the interim storage facilities are planned to be built, fervently oppose the construction of those facilities.[19] But the NRC licensure process allows the states no negotiation power. Federal law—the Atomic Energy Act (AEA)—preempts state law in the realm of nuclear power. Under the Commerce and Supremacy clauses of the United States Constitution, states would likely be unable to prevent or regulate the development of nuclear waste storage facilities within their borders.[20] While states may regulate nuclear power within their borders on economic grounds, the federal government has sole regulatory power over issues touching on radioactive safety.[21] Given the rhetoric from New Mexico and Texas, those states may have a difficult time arguing that their objection to the CISFs is primarily economic rather than safety-oriented.

This unilateral federal action of licensure in the face of substantial local opposition has the potential to turn public perception and state involvement away from the ultimate goal: mitigating man-made contributions to climate

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[16] *Consolidated Interim Storage Facility (CISF)*, U.S. NUCLEAR REGUL. COMM'N (Dec. 8, 2020), https://www.nrc.gov/waste/spent-fuel-storage/cis.html [https://perma.cc/6NGH-7RJU]. For a helpful primer on the proposed consolidated interim storage facilities, see *Project Overview*, INTERIM STORAGE PARTNERS (Feb. 11, 2021), https://interimstoragepartners.com/project-overview/ [https://perma.cc/Q3XN-FF66], and *Hi-Store CISF*, HOLTEC INT'L, https://holtecinternational.com/products-and-services/hi-store-cis/ [https://perma.cc/KLP8-TDZA].

[17] *About NRC*, U.S. NUCLEAR REGUL. COMM'N (Jan. 25, 2022), https://www.nrc.gov/about-nrc.html [https://perma.cc/H8QN-NTTL].

[18] U.S. NUCLEAR REGUL. COMM'N OFF. PUB. AFFS., No. 22-027, NRC ISSUES FINAL ENVIRONMENTAL STUDY ON PROPOSED NEW MEXICO SPENT FUEL STORAGE FACILITY (2022); U.S. NUCLEAR REGUL. COMM'N OFF. PUB. AFFS., No. 21-036, NRC ISSUES LICENSE TO INTERIM STORAGE PARTNERS FOR CONSOLIDATED SPENT NUCLEAR FUEL INTERIM STORAGE FACILITY IN TEXAS (2021).

[19] *See infra* notes 68–70 and accompanying text.

[20] *See* BRC REPORT, *supra* note 10, at 144 n.147. States' attempts to block transportation of nuclear waste through their borders have been struck down on preemption grounds. *See, e.g.*, Illinois v. Gen. Elec. Co., 683 F.2d 206, 213–16 (7th Cir. 1982), *cert. denied*, 461 U.S. 913 (1983); Washington State Bldg. & Constr. Trades Council v. Spellman, 684 F.2d 627, 630 (9th Cir. 1982), *cert. denied*, 461 U.S. 913 (1983). Similarly, states' attempts to block power plants' releases of waste have also been invalidated based on preemption doctrine. *See, e.g.*, N. States Power Co. v. Minnesota, 447 F.2d 1143, 1152–54 (8th Cir. 1971).

[21] Pac. Gas & Elec. Co. v. State Energy Res. Conservation & Dev. Comm'n, 461 U.S. 190, 212, 222–23 (1983).

change. State-level support is essential to chipping away at this collective action problem. Licensure of interim facilities against states' wills must be contested to open up new avenues for long-term solutions.

This Note presents a novel litigation strategy that states and other interested parties may use to oppose licensure by the NRC of these facilities. This Note argues that designating these facilities as offering "interim" storage is inappropriate because no plan for ultimate removal exists. There is no end state, no concluding event, on which to base the temporariness required by the term "interim." Given the failure to develop a permanent disposal solution for the roughly eighty-year life of nuclear power in the United States, these new "temporary" facilities will likely become de facto permanent storage facilities. That outcome, where "temporary storage" becomes "permanent disposal," is unacceptable. Nuclear science has concluded that deep geologic burial—not above-ground storage—is the optimal solution for nuclear waste disposal. And perhaps more importantly, history teaches that forcing a state to accept the country's nuclear waste against popular will generates animosity against this vital source of energy.

The belief of the past seventy-five years that a permanent solution to the nuclear waste problem is just around the corner has been debunked. The federal government must eschew Band-Aid solutions and commit to finding that permanent solution. Keeping the NRC to its word by ensuring that any interim storage does not become indefinite is an important step. States will be more willing to host CISFs, as they may be enticed by the associated high-quality, high-paying jobs. Nuclear waste may begin to move out of unfit and stranded sites, reducing the danger of overfilled cooling pools. And progress in solving the nuclear waste conundrum may reinvigorate investment in nuclear power through good press and improved confidence in government. Nuclear power need not be mired in 1970s technology and Chernobyl-induced fear. Proper definition of an important word is a small step, but it works towards the broader goal of worldwide confidence in a method of energy production that solves significant climate change obstacles our world faces today.

In pursuit of this solution, Part I introduces relevant background information on nuclear waste generation. Part II outlines the safety concerns presented by current storage practices, the history of nuclear power and its political difficulties, and nuclear waste logistics realities. Part III provides the substance of the legal argument that the NRC's use of the word "interim" is inappropriate. And Part IV lays out two requirements which a court may require to ensure that such facilities remain temporary and, consequently, to maintain pressure on the federal government to produce a solution to this pressing issue of nuclear waste disposal. At bottom, a requirement of

progress on a federal repository may be sufficient to meet the definitional demands of the word "interim" such that the NRC may properly license CISFs under its regulatory framework.

I. NUCLEAR WASTE AND THE DISPOSAL PROBLEM

America is home to almost 90,000 metric tons of nuclear waste.[22] This waste is stored at eighty locations across the country: fifty-seven operating nuclear power plants and twenty-three "stranded sites."[23] Most of America's nuclear waste is still sitting in cooling pools at those locations—nearly 70% by one estimate.[24] This storage arrangement is economically inefficient: dispersed storage requires consumption of far greater resources than consolidated storage would.[25] Further, by 2048 the amount of nuclear waste in the United States may be closer to 150,000 metric tons.[26] The current status of nuclear waste storage is costly and untenable and therefore detrimental to the development of nuclear power.

The long-term success of nuclear power depends upon a permanent nuclear waste solution. And because nuclear power is such a powerful tool in the fight against climate change, humanity's ability to "go green" also largely depends on a permanent nuclear waste solution. Disposal in a geologic repository is the widely agreed-upon permanent solution towards which the federal government must continue to work. History has shown, however, that choosing, developing, gaining support for, and opening a repository is a difficult process.

This Part begins with a description of the physical problem: the production of nuclear waste, current methods of storage, and the plan for disposal. It next describes why the current state of nuclear waste storage poses a substantial safety threat. This Part then outlines the history of nuclear waste regulation and shows why nuclear waste is properly deemed to be a political problem. Finally, this Part discusses the slow-moving nature of nuclear waste disposal logistics.

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[22] *Nuclear Waste Disposal*, *supra* note 14.

[23] LARSON, *supra* note 14, at 1. The term "stranded sites" refers to shut-down nuclear power plants. *Id*.

[24] Robert Rosner & Rebecca Lordan, *Why America Should Move Toward Dry Cask Consolidated Interim Storage of Used Nuclear Fuel*, 70 BULL. ATOMIC SCIENTISTS 48, 51–52 (2014).

[25] *See id.* at 49.

[26] *See* LARSON, *supra* note 14, at 1; BRC REPORT, *supra* note 10, at 14. The number of tons is less important to note than is the fact that the amount of nuclear waste is increasing rapidly, and is expected to nearly double in twenty-five years.

A. The Physical Problem

Nuclear power produces clean energy but hazardous waste. The primary chemical element in nuclear power generation, uranium, is mined, isolated, and enriched to a level that makes it useable in power plants.[27] Then, the uranium is formed into pellets stacked inside a metal housing, creating fuel rods. The nuclear reactor is designed to facilitate the splitting of the enriched uranium atoms contained in fuel rods. This process is called nuclear fission.[28] Fission produces heat, which is used to boil water; the resulting steam spins a turbine that produces electricity.[29] Over time, the process of fission renders those fuel rods less efficient as a source of nuclear fuel because some of the uranium has decayed, or split, into other radioactive substances.[30] Once a fuel rod's usability drops below a certain level, power plant operators remove it from the reactor and replace it with a newer rod. The old one is dubbed a "spent" fuel rod.[31]

Just because a fuel rod is considered "spent" does not mean that it is any less radioactive than a freshly enriched fuel rod; in fact, the opposite is true. Spent fuel rods are significantly more radioactive than fresh rods because some of the byproducts of nuclear fission are themselves more radioactive than enriched uranium.[32] These highly radioactive byproducts emit dangerous radiation and cause the rods themselves to become thermally hot.[33] To illustrate the danger posed by these byproducts, ten years after a spent fuel rod is removed from a plant, the radiation level on the surface of

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[27] *Uranium Enrichment*, U.S. NUCLEAR REGUL. COMM'N (Dec. 2, 2020), https://www.nrc.gov/materials/fuel-cycle-fac/ur-enrichment.html [https://perma.cc/BHF8-QULX].

[28] Off. of Nuclear Energy, *NUCLEAR 101: How Does a Nuclear Reactor Work?*, U.S. DEP'T OF ENERGY (Mar. 29, 2021), https://www.energy.gov/ne/articles/nuclear-101-how-does-nuclear-reactor-work [https://perma.cc/JV7B-2LGB].

[29] *Id.* Fuel rods are submerged in water. The water serves three purposes. First, fission produces heat, which converts the surrounding water to steam, and this steam turns the turbine, generating electricity. Second, the water acts as a coolant for the rods, preventing excessive heat buildup and meltdown. Third, the water moderates the physical process of fission, which is necessary to sustain the chain reaction of nuclear fission. *Id.*

The mechanics of nuclear fission are complex. For a somewhat more thorough—though still generally accessible—explanation of the process, see generally *Nuclear Power Reactors*, WORLD NUCLEAR ASS'N (Aug. 2022), https://world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-power-reactors/nuclear-power-reactors.aspx [https://perma.cc/5FE6-GQ9T].

[30] *See High-Level Waste*, U.S. NUCLEAR REGUL. COMM'N (Mar. 12, 2020), https://www.nrc.gov/waste/high-level-waste.html [https://perma.cc/6A9V-CH42].

[31] *Id.*

[32] *Backgrounder on Radioactive Waste*, U.S. NUCLEAR REGUL. COMM'N (July 23, 2019), https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/radwaste.html [https://perma.cc/M5SW-Q6YN].

[33] Sebastian Wegel, Victoria Czempinski, Pao-Yu Oei & Ben Wealer, *Transporting and Storing High-Level Nuclear Waste in the U.S.—Insights from a Mathematical Model*, 9 APPLIED SCIS. 2437, 2437–38 (2019).

the rod is twenty times higher than a fatal dose of radiation.[34] So, these spent rods are initially submerged in large pools of water located near the plant to diffuse the thermal heat and provide radiation protection.[35] Cooling in pool storage normally takes about five years.[36]

Once the spent rods have sufficiently cooled, they are pulled out and placed into dry cask storage.[37] Dry casks are either metal or concrete cylinders that protect both the fuel inside from external influences and also the people outside from the hazardous radiation of the contained fuel.[38] All of America's commercial spent fuel rods are currently held either in cooling pools or dry casks, awaiting final disposal.[39]

The reason the nuclear waste problem is so difficult is that the byproducts of fission vary greatly in their radioactive effects.[40] Some fission byproducts are short-lived, extremely radioactive elements which generate the dangerous radiation and heat that drive power plant operators to submerge spent fuel rods in those cooling pools.[41] Other substances found in spent fuel rods are less "hot" but much longer-lasting. For instance, the half-life of Plutonium-239 is 24,100 years, which means it takes 24,100 years for the radioactivity of the plutonium within the fuel rod to reduce by *half*.[42] For some perspective: 24,100 years ago, humans probably had not yet entered the landmass that would become the Americas.[43] Further, if the highly radioactive contents of post-fission fuel rods enter the environment, either through improper handling or storage containment failure, these long-lived

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[34] *Backgrounder on Radioactive Waste*, *supra* note 32.

[35] *Id.*; *see also Spent Fuel Pools*, U.S. NUCLEAR REGUL. COMM'N (July 8, 2020), https://www.nrc.gov/waste/spent-fuel-storage/pools.html [https://perma.cc/9GJN-A4ZH] (discussing how water pools provide adequate shielding from radiation from spent fuel assemblies).

[36] Rosner & Lordan, *supra* note 24, at 51.

[37] *Id.* at 52.

[38] *Id.* at 52–53; BRC REPORT, *supra* note 10, at 34.

[39] Rosner & Lordan, *supra* note 24, at 49.

[40] Nuclear waste exists in many different forms other than spent fuel rods, including byproducts of reprocessing, contaminated clothing and equipment, and low-level radioactive waste (for instance, from medical equipment). *See* BRC REPORT, *supra* note 10, at 28; *Radioactive Waste*, U.S. NUCLEAR REGUL. COMM'N (June 5, 2020), https://www.nrc.gov/waste.html [https://perma.cc/RW6H-BXZX]. This Note focuses solely on disposal of spent fuel rods, so any reference to "waste" refers to that source alone.

[41] *See* U.S. NUCLEAR REGUL. COMM'N TECH. TRAINING CTR., 0703 USNRC, REACTOR CONCEPTS MANUAL: THE FISSION PROCESS AND HEAT PRODUCTION 2-1, 2-24, https://www.nrc.gov/reading-rm/basic-ref/students/for-educators/02.pdf [https://perma.cc/M3C5-2F4E].

[42] *Half-Life*, U.S. NUCLEAR REGUL. COMM'N (Mar. 9, 2021), https://www.nrc.gov/reading-rm/basic-ref/glossary/half-life.html [https://perma.cc/ZB4V-Y875]; *Backgrounder on Plutonium*, U.S. NUCLEAR REGUL. COMM'N (Jan. 7, 2021) https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/plutonium.html [https://perma.cc/L258-5H6A].

[43] *See* Guy Gugliotta, *When Did Humans Come to the Americas?*, SMITHSONIAN MAG. (Feb. 2013), https://www.smithsonianmag.com/science-nature/when-did-humans-come-to-the-americas-4209273/ [https://perma.cc/Q9DC-BETA].

byproducts may enter groundwater or poison food chains.[44] This means that, as our nuclear power technology and knowledge currently stand, nuclear waste must be isolated from human beings for hundreds of thousands of years.[45]

The combination of hot byproducts and long-lasting byproducts demands immediate, intricate cooling and shielding systems early and extraordinarily long-term isolation later.[46] The nuclear industry has developed effective short-term methods of dealing with those initial hot byproducts: cooling pools and on-site dry storage. It is the long-term isolation that has evaded solution.

B. Physical Solutions

Through the history of nuclear power, scientists have proposed several methods of isolation that could withstand the test of time.[47] Dumping under polar ice sheets is one idea (scientists hypothesized that the heat of the waste would melt the ice, dropping containers into the ice layer, with new ice freezing back over on top of it),[48] but scientists worry that the effects of climate change on polar ice masses could result in unpredictable release of the waste.[49] Disposal by shooting into space is feasible but unacceptably

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[44] *See Backgrounder on Radioactive Waste*, *supra* note 32. Ingestion of fission byproducts carries an increased risk of cancer. *See, e.g.*, *Radioisotope Brief: Uranium*, CTRS. FOR DISEASE CONTROL & PREVENTION (Jan. 21, 2022), https://www.cdc.gov/nceh/radiation/emergencies/isotopes/uranium.htm [https://perma.cc/3QBD-M6SKK] ("Ingestion of high concentrations of uranium . . . can cause severe health effects, such as cancer of the bone or liver.").

[45] *See* Wegel et al., *supra* note 33, at 2437–48.

[46] Wegel et al., *supra* note 33, at 2438. The longevity of nuclear waste radioactivity requires analysis in terms not of *human eras* but rather *geologic eras*. Jacob Darwin Hamblin, *Learning to Think Long-Term*, 370 SCIENCE 1043, 1043 (2020).

[47] Another option (not involving isolation), pursued in the United States at the beginning of the nuclear age but later rejected, is nuclear fuel reprocessing. Reprocessing separates the spent fuel into plutonium, uranium, and waste. The separated plutonium is mixed with new uranium to create new fuel rods, and the waste is packaged for disposal. The uranium can also be used to make new fuel, though the process of doing so is more difficult than simply using "fresh" uranium. BRC REPORT, *supra* note 10, at 11. Power plants built from the 1950s until the 1970s were organized with the assumption that the waste they generated would be disposed of—either reprocessed or taken off-site to a federal depository. *Id.* at 33. But, under President Carter, the United States ended the policy of reprocessing spent nuclear fuel due to concerns of nuclear proliferation: nuclear materials, most notably plutonium, ending up in the hands of bad actors. *Id.* at 20; J. SAMUEL WALKER, THE ROAD TO YUCCA MOUNTAIN: THE DEVELOPMENT OF RADIOACTIVE WASTE POLICY IN THE UNITED STATES 95 (2009).

This paper does not address the merits or dangers of reprocessing because the practice seems to have been taken off the table completely. BRC REPORT, *supra* note 10, at 20. Reprocessing can make the nuclear fuel cycle more efficient; at the same time, it still generates nuclear waste that requires permanent disposal. *Id.* at 28. So, the focus must remain on development of a permanent depository.

[48] K. Philberth, *The Disposal of Radioactive Waste in Ice Sheets*, 19 J. GLACIOLOGY 607, 607 (1977).

[49] U.S. DEP'T OF ENERGY, MANAGING NUCLEAR WASTE: OPTIONS CONSIDERED 2 (Dec. 2002), https://www.osti.gov/servlets/purl/808028 [https://perma.cc/NWN2-ZUTZ].

dangerous.[50] One company is developing a deep borehole burial capability drawing on fracking technology—though this option is scientifically controversial and requires further research and development.[51]

Despite all these creative proposals, disposal in a permanent geological repository holds the most promise for nuclear waste management.[52] The structure of a geological repository allows burial of containers (like dry casks) of nuclear waste within a complex of underground tunnels, utilizing both manmade barriers (the casks themselves, backfill, shaft and tunnel seals, and others) and natural barriers (surrounding geologic deposits) to contain the nuclear waste for an extraordinarily long time.[53] As a result, geologic disposal provides long-term protection from both human activity and environmental effects.[54] And it can be done.

Moreover, deep geologic isolation is not a uniquely American concept.[55] Finland has become the global leader in nuclear waste disposal: in

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[50] Ethan Siegel, *This Is Why We Don't Shoot Earth's Garbage into the Sun*, FORBES (Sept. 20, 2019, 2:00 AM), https://www.forbes.com/sites/startswithabang/2019/09/20/this-is-why-we-dont-shoot-earths-garbage-into-the-sun/?sh=2733afa15d63 [https://perma.cc/DKY4-YTSK] ("Even if we could reduce the launch failure rate [of rockets carrying nuclear waste into space] to an unprecedented 0.1% [down from the current 3% standard], it would cost approximately a trillion dollars and, with an estimated 9 launch failures to look forward to, would lead to over 60,000 pounds of hazardous waste being randomly redistributed across the Earth.").

[51] *Technology*, DEEP ISOLATION, https://www.deepisolation.com/technology/ [https://perma.cc/R3KF-9HPC]; Lindsay Krall, *Nuclear Waste Disposal: Why the Case for Deep Boreholes Is . . . Full of Holes*, BULL. OF THE ATOMIC SCIENTISTS (Mar. 26, 2020), https://thebulletin.org/2020/03/nuclear-waste-disposal-why-the-case-for-deep-boreholes-is-full-of-holes/ [https://perma.cc/VC8T-BK5W] (explaining that while the prospect of burying nuclear waste below the water table seems enticing, it would require compromises; for example, waste-canister thickness would have to be reduced by 80%, exposing workers to radiation); BRC REPORT, *supra* note 10, at 29.

[52] BRC REPORT, *supra* note 10, at 29 (noting that deep geologic disposal has been the "front-running disposal strategy in the United States for more than 50 years" and "is the most promising and accepted method currently available for safely isolating spent fuel and high-level radioactive wastes from the environment for very long periods of time") (emphasis omitted).

[53] *What Is the Yucca Mountain Repository?*, U.S. ENV'T PROT. AGENCY (Sept. 30, 2022) https://www.epa.gov/radiation/what-yucca-mountain-repository [https://perma.cc/SH2X-3HRU]; BRC REPORT, *supra* note 10, at 29.

[54] BRC REPORT, *supra* note 10, at 29. In fact, the United States already uses a deep geologic repository for contaminated material: the Waste Isolation Pilot Plant (WIPP). *About Us*, WASTE ISOLATION PILOT PLANT, https://wipp.energy.gov/about-us.asp [https://perma.cc/TQ6F-F2PB]. WIPP houses "clothing, tools, rags, residues, debris, soil and other items contaminated with . . . man-made radioactive elements." *Id.* WIPP stores these items in a salt formation 2,150 feet underground just outside of Carlsbad, New Mexico. *National Transuranic (TRU) Program*, WASTE ISOLATION PILOT PLANT, https://wipp.energy.gov/national-tru-programs.asp [https://perma.cc/5ADH-JJV8].

[55] *See id.* (noting that geologic disposal is "the approach being taken in other countries"); *Storage and Disposal of Radioactive Waste*, WORLD NUCLEAR ASS'N (May 2021), https://world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-waste/storage-and-disposal-of-radioactive-waste.aspx [https://perma.cc/5X33-NTS6] ("Deep geological disposal is the preferred option for nuclear

May 2021, the Finnish people began excavation on their own deep geologic nuclear waste repository, ONKALO.[56] The World Nuclear Association reports that Sweden and France also have "particularly well advanced" plans for development of deep geological disposal capabilities, with Canada and the United Kingdom also having started the site selection process.[57]

Though there is substantial agreement in the international nuclear energy community that deep geologic isolation is the preeminent nuclear waste disposal strategy, the U.S. nuclear industry is still prioritizing interim options.[58] Two companies, Holtec International (Holtec) and Interim Storage Partners (ISP), have submitted applications for licensure of massive off-site dry cask storage facilities called "Consolidated Interim Storage Facilities" (CISFs).[59] Holtec hopes to build its CISF in Lea County, New Mexico.[60] Holtec's proposed facility will be able to hold 8,680 metric tons of nuclear waste at the outset, but they plan on upgrading capacity over several phases to 173,000 metric tons;[61] ISP's facility in Andrews County, Texas, will eventually be able to hold 40,000 metric tons of waste.[62]

Holtec plans to provide semi-buried dry-cask storage capability with its CISF. The nuclear waste will be contained within stainless steel casks, semi-buried vertically in a grid of steel-lined holes surrounded by concrete.[63] Only the top two feet of the casks will protrude above the ground, which makes the facility less visible from the air but still provides ease of waste removal.[64]

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waste management in most countries, including Argentina, Australia, Belgium, Canada, Czech Republic, Finland, France, Japan, the Netherlands, Republic of Korea, Russia, Spain, Sweden, Switzerland, the UK, and the USA.").

[56] James Conca, *Finland Breaks Ground on World's First Deep Geologic Nuclear Waste Repository*, FORBES (May 31, 2021), https://www.forbes.com/sites/jamesconca/2021/05/31/finland-breaks-ground-on-its-deep-geologic-nuclear-waste-repository/?sh=35f3a6c36103 [https://perma.cc/FN6W-X6YE]; Laura Gil, *Finland's Spent Fuel Repository a "Game Changer" for the Nuclear Industry, Director General Grossi Says*, INT'L ATOMIC ENERGY AGENCY (Nov. 26, 2020), https://www.iaea.org/newscenter/news/finlands-spent-fuel-repository-a-game-changer-for-the-nuclear-industry-director-general-grossi-says [https://perma.cc/9Y2V-KCQX].

[57] *Storage and Disposal of Radioactive Waste*, *supra* note 55.

[58] These proposals provide the basis for this paper. This Section will address how the owners of these facilities plan to fit into the nuclear waste disposal process. Part III, *infra*, will discuss some problems with the NRC's licensure of these proposed facilities as "interim" storage facilities.

[59] *Consolidated Interim Storage Facility (CISF)*, *supra* note 16.

[60] *Id.*

[61] *See FAQ*, Holtec Int'l, https://holtecinternational.com/products-and-services/hi-store-cis/faqs/ [https://perma.cc/Z425-63MT]; U.S. NUCLEAR REGUL. COMM'N, INTRODUCTION TO THE PROPOSED CONSOLIDATED INTERIM STORAGE FACILITY FOR SPENT NUCLEAR FUEL IN LEA COUNTY, NEW MEXICO 1 (2018), https://www.nrc.gov/docs/ML2012/ML20122A147.pdf [https://perma.cc/TP55-W7E2].

[62] *Project Overview*, *supra* note 16.

[63] *Safety and Security Features*, HOLTEC INT'L, https://holtecinternational.com/products-and-services/hi-store-cis/features/ [https://perma.cc/W256-GNEN].

[64] *Id.*

ISP, on the other hand, will store its steel casks horizontally in above-ground storage buildings, and the company claims to be able to provide the same security and retrievability benefits as Holtec's facility will.[65]

CISFs—by name, *interim* storage facilities—are not equivalent to deep geologic *disposal* facilities because they are not designed for long-term isolation. The objective of geologic disposal is permanent isolation from both human and environmental interference; CISFs, though designed with some security in mind, do not reach that goal,[66] nor are they meant to.[67] Further, both New Mexico and Texas oppose the building of these CISFs within their states,[68] mainly due to popular fear that—in contrast to their stated intent—these CISFs will become de facto permanent storage sites.[69]

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[65] *See Used Fuel Storage*, ORANO USA, https://www.orano.group/usa/en/our-portfolio-expertise/used-fuel-management/used-fuel-storage [https://perma.cc/RQS5-N9WR].

[66] *FAQ*, *supra* note 61 (emphasizing that the CISF provides "safe, secure, temporary, retrievable" storage); *see* BRC REPORT, *supra* note 10, at 34 ("[I]t is clear that today's institutional arrangements and storage technologies [including dry cask storage] were not designed for the lengthy storage timescales that now appear inevitable . . . .").

[67] *Overview*, HOLTEC INT'L, https://holtecinternational.com/products-and-services/hi-store-cis/overview/ [https://perma.cc/CN8J-A7ZD] (explaining the role of the Holtec CISF as "a short-term storage facility" for the initial aging period of "several decades").

[68] New Mexico has sued the NRC to challenge licensure of Holtec's CISF. *See* Press Release, Matt Baca, Chief Couns., New Mexico Off. of the Att'y Gen., Attorney General Balderas Announces Lawsuit to Halt Holtec Nuclear Storage Facility (Mar. 29, 2021), https://www.nmag.gov/uploads/PressRelease/48737699ae174b30ac51a7eb286e661f/Attorney_General_Balderas_Announces_Lawsuit_to_Halt_Holtec_Nuclear_Storage_Facility.pdf [https://perma.cc/YWP7-WJGT]. New Mexico attacks NRC licensure of Holtec's CISF under both the NWPA and the Administrative Procedure Act; it also claims that licensure of the CISFs would create unfunded federal mandates. It does not, though, argue that the NRC's use of the word "interim" is inappropriate. *Id.*

Texas has passed state legislation banning CISFs. *See* Erin Douglas, *Texas Bans Storage of Highly Radioactive Waste, but a West Texas Facility May Get a License from the Feds Anyway*, TEX. TRIB. (Sep. 10, 2021), https://www.texastribune.org/2021/09/10/texas-nuclear-waste-ban [https://perma.cc/6WU5-5F6C] (detailing Texas state legislation banning nuclear waste storage and the uncertainty of its effectiveness against federal action). New Mexico is considering doing the same. *See* Adrian Hedden, *Nuclear Waste Storage Ban Gains Steam Among New Mexico Lawmakers, but Carlsbad Leaders Oppose It*, CARLSBAD CURRENT-ARGUS (Feb. 5, 2022), https://www.currentargus.com/story/news/local/2022/02/05/new-mexico-nuclear-waste-storage-ban-gains-steam-holtec-project-carlsbad-hobbs/9302663002/ [https://perma.cc/G434-SZLD] (discussing draft legislation in both bodies of New Mexico legislature).

[69] Letter from Michelle Lujan Grisham, Governor, State of N.M., to President Donald Trump (July 28, 2020), https://bloximages.newyork1.vip.townnews.com/santafenewmexican.com/content/tncms/assets/v3/editorial/c/13/c130d8a2-d11b-11ea-be5e-1b25fff8a207/5f209cdf1eef8.pdf.pdf [https://perma.cc/K9C2-LHRN] ("Given that a permanent repository for high-level waste does not exist in the United States and there is no existing plan to build one, any 'interim' storage facility will be an indefinite storage facility, and the risks for New Mexicans, our natural resources and our economy are too high."); Brief for State Petitioners at 25–27, Texas v. Nuclear Regul. Comm'n, No. 21-60743 (5th Cir. Feb. 2, 2022) ("If a permanent repository is not built in the next sixty years, why would the Commission allow ISP's facility to close down? Where would all that waste go? The inertia would all but guarantee that the ISP facility will transform into the *de facto* permanent repository for the Nation's nuclear waste.").

Given the history of nuclear waste policy,[70] the fears of New Mexico and Texas residents are justified.

II. NUCLEAR WASTE & REASONS FOR HASTE

One may understand the inherent danger posed by radioactive substances and agree that the current methods in storage are suboptimal for long-term isolation, and yet still wonder why the scientific community at-large calls for urgency in developing a permanent disposal system. The reasons for haste are threefold: security, historical political failure, and logistical difficulties. These justifications for swiftness are explored in the following Sections.

A. The Security Problem

Nuclear waste is inherently hazardous unless it is completely isolated from people for an incredibly long time. The current nuclear waste storage program—ad hoc storage in cooling pools or dry casks—does not meet that standard of isolation, and numerous studies similarly conclude that maintaining the current program requires permitting unacceptable risks.

One study, published on the NRC's website, discusses the devastation possible from a cooling pool fire—an incident that could occur even without any malicious act.[71] A fire at one of the cooling pools at the Indian Point nuclear reactors near New York City could result in over five thousand cancer deaths and $461 billion dollars' worth of damage.[72] Such a catastrophe would have long-term effects beyond the immediate cleanup, including a substantial depression in public enthusiasm for nuclear power.

Beyond science, the perception of nuclear power has been shaped by the incidents at Chernobyl, Three Mile Island, and Fukushima, leading to a popular—if not completely informed—conclusion that nuclear materials are

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[70] *See infra* Section II.B.

[71] Robert Alvarez, *Pushing the Storage Horse with a Nuclear Waste Cart: The Spent Fuel Pool Problem*, BULL. OF THE ATOMIC SCIENTISTS (Aug. 9, 2017), https://thebulletin.org/2017/08/pushing-the-storage-horse-with-a-nuclear-waste-cart-the-spent-fuel-pool-problem/ [https://perma.cc/CR6D-SNGV] ("[I]f a spent fuel cooling pool loses a significant amount of water [exposing the fuel assemblies to air and steam] . . . their zirconium cladding will react exothermically, after several hours or days catching fire in a burn front, ala a forest fire or a fireworks sparkler . . . . Such a fire would release a potpourri of radioisotopes . . . .").

[72] ROBERT ALVAREZ, SPENT NUCLEAR FUEL POOLS IN THE U.S.: REDUCING THE DEADLY RISKS OF STORAGE 1, 2 (2011), https://www.nrc.gov/docs/ML1209/ML120970249.pdf [https://perma.cc/J57K-9D6V].

bad.[73] Radioactivity is a complex phenomenon. It cannot be seen, heard, smelled, or detected without specialized tools, and exposure may not be readily apparent. These invisible and undetectable properties contribute to public fear of exposure.[74] This capacity to induce fear informed a National Academy of Sciences report from 2006, which noted the "attractiveness of spent fuel as a terrorist target given the well-known public dread of radiation."[75] That study then concluded that a terrorist attack on a cooling pool full of nuclear waste was plausible and that such an attack's resulting damage would be significant.[76]

These studies demonstrate the high cost of inaction in tackling the problem of nuclear waste.[77] But even more troublesome is the United States government's long history of *failed* action regarding nuclear waste disposal.

B. History and the Political Problem

Given the scientific feasibility of permanent options, nuclear waste disposal has a political—not a technological—problem.[78] Management of nuclear waste has posed a "complex and vexing question" for decades,[79] given the mismatch between short-term political costs and the seemingly nonimminent nature of the problem. In 1972, one commentator bitingly framed the general political issue posed by nuclear waste: politicians cannot be held accountable for a failure to secure safe, permanent nuclear waste disposal because by the time the dangers truly become irreversible, "they would all be safely dead."[80]

America began its quest to exploit the atom almost a century ago. In the 1940s, while the Manhattan Project sought to weaponize radioactivity,

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[73] BRC REPORT, *supra* note 10, at 14; *see also* Victoria Gill, *Chernobyl: The End of a Three-Decade Experiment*, BBC NEWS (Feb. 14, 2019), https://www.bbc.com/news/science-environment-47227767 [https://perma.cc/H5T3-QL4G] ("Fear of radiation could actually be hurting the people of Narodichi far more than the radiation itself."); Bill Hutchinson, *4 Decades After Three Mile Island Meltdown in Pennsylvania, Fear Lingers over Safety of Nuclear Energy*, ABC NEWS (Mar. 28, 2019, 9:21 AM), https://abcnews.go.com/US/decades-mile-island-meltdown-pennsylvania-fear-lingers-safety/story?id=61950753 [https://perma.cc/7J47-TNGY]; Geoff Brumfiel, *Fukushima: Fallout of Fear*, 493 NATURE 290, 293 (2013).

[74] *See* BRC REPORT, *supra* note 10, at 8.

[75] NAT'L RSCH. COUNCIL OF THE NAT'L ACADS., *supra* note 8, at 36.

[76] *Id.* at 6, 38.

[77] It should be noted that the NRC disagrees with this conclusion. *Backgrounder on Radioactive Waste*, *supra* note 32 ("The NRC believes spent fuel pools and dry casks both provide adequate protection for public health and safety and the environment.").

[78] *See Options for the Interim and Long-Term Storage of Nuclear Waste and S. 1234, The Nuclear Waste Administration Act: Hearing Before the Comm. on Energy and Nat. Res.*, 108th Cong. 12 (2019).

[79] Minnesota v. U.S. Nuclear Regul. Comm'n, 602 F.2d 412, 419 (D.C. Cir. 1979).

[80] WALKER, *supra* note 47, at 42.

nuclear physicists made breakthroughs in harnessing its power as a source of energy.[81] But almost immediately after establishing the first reliable means of generating power through nuclear fission, those scientists were forced to confront the hazards of nuclear waste. One member of the Safety and Industrial Health Advisory Board in 1948 expressed concern that "no concrete program exists at the present for waste disposal," urging that "this problem . . . be tackled at the earliest opportunity."[82] Nuclear scientists were confident they could solve the waste issue—after all, they had just established a new source of nearly unlimited power.

The federal government first passed legislation concerning nuclear power in 1946 in the Atomic Energy Act (AEA). The AEA created the Atomic Energy Commission (AEC) as the federal agency tasked with both promoting and regulating nuclear power.[83] The AEC, pursuant to its promotion responsibilities, provided assurances that a plan for "final disposal" of nuclear waste would emerge "in the foreseeable future."[84] This mindset was not unique in the nuclear power community: scientific experts at the time generally shared in the optimism.[85] The AEC recognized the need for a solution for nuclear disposal, but scientific confidence combined with the excitement, perceived importance, and rapid growth of the civilian nuclear power industry led to the AEC's focus on nuclear power promotion over nuclear waste management.[86]

The U.S. government first attempted to develop a permanent geologic repository to store nuclear waste in the 1960s. Project Salt Vault, located in Kansas, was a concerted effort to solve the nuclear waste disposal problem.[87] The AEC concluded that the deeply buried salt caves would be well-suited as a long-term home for high-level waste.[88] However, Project Salt Vault failed when new information arose that the proposed burial site might be susceptible to significant water intrusion as a result of earlier drilling, potentially resulting in contaminated water reservoirs.[89] Local geologists had

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[81] *See* MAZUZAN & WALKER, *supra* note 11, at 4, 9–10 (noting that physicist Enrico Fermi created the first human-made nuclear chain reaction in 1942).

[82] *See id.* at 12; *see also* MARK HOLT, CONG. RSCH. SERV., RL33461, CIVILIAN NUCLEAR WASTE DISPOSAL 2 (2020) (discussing how the beginning of the civilian nuclear power industry in the 1950s posed "difficult issues for Congress").

[83] *Summary of the Atomic Energy Act*, ENV'T PROT. AGENCY, https://www.epa.gov/laws-regulations/summary-atomic-energy-act [https://perma.cc/3UQQ-HSHA].

[84] *See* MAZUZAN & WALKER, *supra* note 11, at 345.

[85] *See id.* at 371.

[86] *See id.* at 418 (explaining that the AEC prioritized licensure of new civilian nuclear power facilities over development of a sufficient waste disposal plan).

[87] WALKER, *supra* note 47, at 54.

[88] *Id.* at 58.

[89] *Id.* at 72–73.

raised similar concerns prior to commencing excavation, but, much to the locals' frustration, AEC scientists had refused to listen.[90] Federal–state distrust was also heightened after the AEC made several decisions without consulting with, or sometimes outright ignoring, state leadership.[91]

Salt Vault's failure was an impactful event in nuclear power history. It indicated that development of a permanent repository would be harder than expected, and it turned public sentiment against the AEC.[92] Recognizing the fallacy of tasking a single agency with both nuclear energy promotion and nuclear energy regulation, subsequent legislation dissolved the AEC and split its responsibilities between the predecessor to what is now the Department of Energy (DOE) and the Nuclear Regulatory Commission (NRC);[93] the NRC was made responsible for developing and implementing nuclear regulations and licensing nuclear facilities, including nuclear waste storage facilities.[94]

After reorganizing the nuclear regulatory framework, Congress got back to work on nuclear waste legislation. In 1982, Congress passed the Nuclear Waste Policy Act (NWPA), "[a]n Act to provide for the development of repositories for the disposal of" nuclear waste.[95] The 1987 amendment to the NWPA named a site in Nevada, Yucca Mountain, as the sole future permanent site for America's nuclear waste.[96] The NWPA obligated the federal government to begin receipt of commercial nuclear waste for permanent disposal in 1998.[97] To meet this goal, the federal government poured $12 billion dollars into developing Yucca.[98]

But local opposition—as it had before—overpowered federal policymaking, and Nevadans mounted sustained political, legal, and

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[90] *See id.* at 61.

[91] *Id.* at 67.

[92] *Id.* at 75 ("The AEC paid a heavy price for its errors. The Lyons debacle received national attention that diminished confidence in the agency and made its search for a solution to the waste problem immeasurably more difficult.").

[93] *Id.* at 93. The Energy Research and Development Administration (ERDA), the agency that originally assumed some of the AEC's responsibilities after its dissolution, was superseded by the Department of Energy in 1977. *Records of the Energy Research and Development Administration*, NAT'L ARCHIVES, https://www.archives.gov/research/guide-fed-records/groups/430.html [https://perma.cc/8M62-J3Z5].

[94] Bullcreek v. Nuclear Regul. Comm'n, 359 F.3d 536, 538 (D.C. Cir. 2004).

[95] Nuclear Waste Policy Act, 42 U.S.C. §§ 10101–10225 (1982) (amended 1987).

[96] *Id.* § 10172.

[97] BRC REPORT, *supra* note 10, at 23.

[98] *Used Nuclear Fuel*, NUCLEAR ENERGY INST., https://www.nei.org/advocacy/make-regulations-smarter/used-nuclear-fuel [https://perma.cc/M6X8-CGGX].

scientific attacks on Yucca Mountain's siting, licensing, and funding.[99] President Obama decided to end funding and rescind the license application for Yucca Mountain in 2010.[100] President Trump attempted to revive Yucca Mountain, requesting funding allocation for the first three years of his presidency.[101] In his fourth year, however, President Trump reversed on Yucca, tweeting to Nevadans, "I hear you on Yucca Mountain and my Administration will RESPECT you!"[102] President Biden has also made it clear that his administration will not pursue development of Yucca Mountain.[103] Congress has not yet amended the NWPA, which lists Yucca Mountain as the only repository candidate site.[104] Therefore, "[a]t this time, there is not even a prospective site for a repository, let alone progress toward the actual construction of one."[105]

The United States has twice attempted and twice failed to construct a federal nuclear waste repository, and current leadership of both political parties oppose further development of Yucca Mountain. But the scientific consensus is clear: the United States government must continue to pursue development and operation of a national nuclear waste repository. Threats to security—both immediately from nuclear waste management shortcomings and long term from the broader threat of climate change—demand haste in constructing permanent solutions. The next Section will contextualize both needs by discussing a simple reality: nuclear waste logistics are complex.

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[99] BRC REPORT, *supra* note 10, at 48; *see also Nevada Sues to Block Nuclear Waste Dump*, N.Y. TIMES, (Dec. 28, 1989), https://www.nytimes.com/1989/12/28/us/nevada-sues-to-block-nuclear-waste-dump.html [https://perma.cc/WFM6-CP4D] (noting the efforts of Nevada's Attorney General and Governor in opposing the project).

[100] Catherine Clifford, *The Feds Have Collected More Than $44 Billion for a Permanent Nuclear Waste Dump—Here's Why We Still Don't Have One*, CNBC (Dec. 18, 2021, 9:00 AM), https://www.cnbc.com/2021/12/18/nuclear-waste-why-theres-no-permanent-nuclear-waste-dump-in-us.html (outlining the political actors that led to the demise of Yucca Mountain) [https://perma.cc/UB5Q-YZK5].

[101] Timothy Gardner, *Trump Halts Support for Yucca Mountain, Nevada Nuclear Waste Dump*, REUTERS (Feb. 6, 2020, 6:29 PM), https://www.reuters.com/article/us-usa-trump-nuclearpower-yucca/trump-halts-support-for-yucca-mountain-nevada-nuclear-waste-dump-idUSKBN20101J [https://perma.cc/4ZUH-99PT].

[102] *Id*.

[103] Geoff Dornan, *Sisolak: Biden Promises No Nukes to Yucca Mountain*, NEV. APPEAL (Aug. 4, 2021), https://www.nevadaappeal.com/news/2021/aug/04/sisolak-biden-promises-no-nukes-yucca-mountain/ [https://perma.cc/MS39-TFLH].

[104] *See* HOLT, *supra* note 82, at 1.

[105] New York v. Nuclear Regul. Comm'n, 824 F.3d 1012, 1015 (D.C. Cir. 2016) (quoting New York v. Nuclear Regul. Comm'n, 681 F.3d 471, 474 (D.C. Cir. 2012)).

C. The Logistics Problem

Disposal of nuclear waste takes time. Even if a nuclear repository opened for operation tomorrow, it would take an estimated forty-six years just to transport the nation's spent fuel from its current storage to the repository.[106] Yucca Mountain began development in 1987, and in 2009, the DOE estimated completion as early as 2020.[107] Using Yucca's development timeline, the combination of repository development and waste transport to the repository equals seventy-nine years. The federal government has not yet identified Yucca Mountain's successor, so an estimate of one hundred years from now until complete nuclear waste disposal in a federal repository is not implausible.[108] In short, there's no time left to lose.

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As shown above, America's seventy-five-year history with nuclear power operated against a backdrop assumption that a permanent repository would be developed. Early scientists were optimistic about long-term storage development; later scientists predicted nuclear process breakthroughs rendering waste a nonissue;[109] and nuclear power plant owners installed cooling pools as a means of temporary storage where spent fuel rods would await transportation to a permanent repository. The NWPA, the federal government's hallmark legislation on nuclear waste disposal, has failed. And finally, the collapse of Yucca Mountain signals political failure and the end of imminent permanent solutions.[110]

Perhaps the most important lesson from nuclear waste management history is the power of public perception. History teaches that forcing states to host nuclear waste generates a popular animosity that prohibits progress—Nevadans' sustained opposition to Yucca Mountain halted federal repository development for half a century. So, if CISF licensure and development goes ahead, the people and governments of Texas and New Mexico will very likely use every political tool in their power to fight back. Other states will likely join in on the fight, resulting in a significant chasm between the states and the federal government.

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[106] *See* RICHARD BURLESON STEWART & JANE BLOOM STEWART, FUEL CYCLE TO NOWHERE: U.S. LAW AND POLICY ON NUCLEAR WASTE 261 (2011).

[107] *NRC Adopts 1 Million Year Rule for Yucca Mountain*, REUTERS (Feb. 7, 2009), https://www.reuters.com/article/us-energy-nuclear-yucca/nrc-adopts-1-million-year-rule-for-yucca-mountain-idUSTRE51G6XN20090217 [https://perma.cc/QXR8-J4GZ].

[108] President Obama's Blue Ribbon Commission suggested that identifying and licensing a proposed federal repository site might take fifteen to twenty years. BRC REPORT, *supra* note 10, x.

[109] *See Technology*, *supra* note 51.

[110] BRC REPORT, *supra* note 10, at 40 (explaining the loss of confidence in the federal government's ability to establish a permanent repository).

Regardless of whether the states win this long political battle, the loser will be nuclear power—an unacceptable outcome considering its importance in developing a green future. The optimal solution to the current CISF conundrum is a loss in the courtroom rather than the streets; this will give the federal government an opportunity to take the next step in repository development while avoiding enhanced and sustained public opposition. This Note offers a litigation strategy to do so.

III. DETERMINING THE MEANING OF "INTERIM"

As discussed in Parts I and II, nuclear waste poses considerable challenges to the nuclear energy industry, the federal government, and communities that may be selected as nuclear waste storage sites. Numerous scholars have sought to bring legal concepts to bear in attempts to solve the nuclear waste problem from various angles.[111] This Note contributes to the legal discussion surrounding nuclear waste by focusing on a specific litigation strategy for states to combat development of private storage facilities against the state's will: attacking the NRC's use of the word "interim." This tactic is new, as CISF licensure is a recent development in nuclear waste policy.

As the agency that has been at the forefront of nuclear waste policy development for decades, the NRC has the difficult job of balancing the views and needs of various groups, including the nuclear industry and environmental groups.[112] In an attempt to improve the nuclear waste situation—by reducing security concerns, relieving the burden on communities holding nuclear waste, and restoring nuclear power enthusiasm—the NRC has embraced the emergence of private CISFs.[113] In considering licensure of these CISFs as interim facilities, the NRC has

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[111] *See, e.g.*, Richard B. Stewart & Jane B. Stewart, *Solving the Spent Nuclear Fuel Impasse*, 21 N.Y.U. ENV'T L.J. 1 (suggesting development of private consolidated storage, creation of a governmental nuclear waste entity, and other financing and research priorities); James M. Cavanagh, Note, *Fixing America's Nuclear Waste Policy: Hurdling Infinite Obstacles to an Interminable Problem*, 32 NOTRE DAME J.L. ETHICS & PUB. POL'Y 355 (calling for federal interim storage at the Yucca Mountain site); Annemarie Wall, *Going Nowhere in the Nuke of Time: Breach of the Yucca Contract, Nuclear Waste Policy Act Fallout and Shelter in Private Interim Storage*, 12 ALB. L. ENV'T OUTLOOK J. 138 (discussing how to complete Yucca Mountain and amend the NWPA to alleviate contractual obligations that burden the NRC); Charles de Saillan, *Disposal of Spent Nuclear Fuel in the United States and Europe: A Persistent Environmental Problem*, 34 HARV. ENV'T L. REV. 461, 507 (proposing creation of new politically insulated entities to determine important nuclear waste policy).

[112] *Industry Interactions*, U.S. NUCLEAR REGUL. COMM'N (Sept. 18, 2020) https://www.nrc.gov/reactors/atf/industry-interact.html [https://perma.cc/8ZLW-N2P8]; *see, e.g.*, Transcript of the Public Meeting on Assessment of Environmental Justice at the NRC (Sept. 27, 2021), https://www.nrc.gov/docs/ML2128/ML21280A350.pdf [https://perma.cc/6FPC-UA7Y] (providing an example of the NRC meeting with environmental groups to discuss environmental justice initiatives).

[113] *See supra* note 18 and accompanying text.

implied that nuclear waste storage in CISFs is temporary, ending when the stored waste is transferred to an operational, permanent repository. But as Part II concluded, the United States currently has no plan to develop a permanent repository. In effect, if waste is transferred to the CISFs, the duration of that interim storage is completely unknowable—and potentially permanent.

This Part argues that the NRC's use of the word "interim" is inappropriate given the uncertainty of CISF storage duration. Section III.A will analyze the word "interim" within the NRC CISF licensing regulation, utilizing common methods of statutory interpretation, and propose a definition of the word. Section III.B will discuss potential counterarguments the NRC may make should New Mexico or Texas challenge CISF licensure based on this proposed definition. Section III.C will conclude the argument with policy reasons for a court to adopt this proposed definition.

A. The Definition of "Interim"

The NRC has analyzed both CISFs license applications under its regulation, 10 C.F.R. Part 72,[114] as Independent Spent Fuel Storage Installations (ISFSIs).[115] ISFSIs are "complex[es] designed and constructed for the interim storage of spent nuclear fuel."[116] These licenses last forty years.[117] However, at the end of that term, the facilities' owners may apply for the licenses to be renewed for another forty years.[118] There is no statutory limit to the number of renewals available to an ISFSI owner.[119]

The term "interim" is not defined in 10 C.F.R. Part 72. To determine ordinary meaning absent definition, courts first consider whether the term has a specific meaning within a relevant field. Courts have also increasingly turned to dictionaries for help.[120] Finally, courts look to uses of the word elsewhere in federal legislation.[121] This Part's analysis tracks that

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[114] 10 C.F.R. Part 72 (2021).

[115] *Consolidated Interim Storage Facility (CISF)*, *supra* note 16.

[116] 10 C.F.R. § 72.3.

[117] 10 C.F.R. § 72.42.

[118] *Id.*

[119] *Id.* This problem—a lack of "bite" of the end of the licensure period—is discussed further in Section III.C, *infra*.

[120] *See, e.g.*, Nix v. Hedden, 149 U.S. 304, 306 (1893) ("There being no evidence that the words 'fruit' and 'vegetables' have acquired any special meaning in trade or commerce, they must receive their ordinary meaning."); Lawrence M. Solan, *The New Textualists' New Text*, 38 LOY. L.A. L. REV. 2027, 2055 (2005) ("[T]he biggest change in the search for word meaning in the past twenty years is the . . . attention courts now pay to dictionaries, including using them as authority for ordinary meaning.").

[121] *See* Babbitt v. Sweet Home Chapter of Cmtys. for a Great Or., 515 U.S. 687, 717 (1995) (Scalia, J., dissenting) (examining uses of the word "take" in other federal statutes to discern its meaning in the statute at issue).

methodology: it considers the use of the word in nuclear science, investigates dictionary definitions, and analyzes other governmental uses of the word. All three lead to this definition: "interim" means a temporary state of being, the initiation of which necessitates a reasonable expectation of some concluding event.

1. Use of "Interim" in Nuclear Science

This Section will analyze the use of the word "interim" in the context of nuclear waste legislation (the NWPA) and policy determinations by nuclear waste experts (the Blue Ribbon Commission Report). These two sources show that, within the nuclear power field, interim nuclear waste storage requires confidence in a concluding event that will result in removal of the waste from interim storage.

The NWPA, the federal government's comprehensive legislative solution to the nuclear waste dilemma, requires that "the generators and owners of . . . [nuclear waste] have the primary responsibility to provide for, and the responsibility to pay the costs of, the interim storage of such waste . . . until such waste . . . is accepted by the Secretary of Energy in accordance with the provisions of this chapter."[122] Here, interim storage ends when the Secretary of Energy "accept[s]" the waste. The interim state ends when the concluding event occurs—when the Energy Secretary removes the waste from storage.[123]

Next, the NWPA contains a provision for development of federally owned Monitored Retrievable Storage (MRS) facilities.[124] An MRS facility would serve as an intermediate step for nuclear waste storage between current storage systems and a permanent repository.[125] However, the NWPA restricts building and operating such a facility until significant progress has been made on a permanent repository.[126] This restriction of intermediate

[122] Nuclear Waste Policy Act, 42 U.S.C. § 10131(a)(5) (2006).

[123] One may argue that this provision—linking interim storage with removal by the federal government—is exactly what the NRC is proposing with the CISFs, albeit implicitly. The difference, though, is in the political climate. As discussed in Section II.B, *supra*, up until Yucca Mountain's demise, the prevailing opinion in the nuclear power realm was that one way or another, the solution to the nuclear waste problem was imminent. Especially because this requirement is couched *within* the NWPA, which was intended to establish this long-awaited solution, those "generators and owners" could be reasonably confident in the occurrence of the concluding event—acceptance by the Secretary of Energy.

[124] 42 U.S.C. § 10165.

[125] *Id.*

[126] BRC REPORT, *supra* note 10, at 40; 42 U.S.C. § 10168(d) ("Licensing conditions . . . Any license issued by the [NRC] for a monitored retrievable storage facility under this section shall provide that—(1) construction of such facility may not begin until the Commission has issued a license for the construction of a repository under section 10135(d) of this title; (2) construction of such facility or

storage development indicates congressional understanding of the consequences of consolidated storage without guaranteed divestment to a permanent repository: namely, that the intermediate storage would effectively be permanent.

Finally, the NWPA provides that "[a]ny spent nuclear fuel stored . . . [in a federal consolidated storage facility] shall be removed from the storage site or facility involved as soon as practicable, but in any event not later than 3 years following the date on which a repository or . . . [MRS] is available."[127] Here, again, Congress linked interim storage with its concluding event: removal of the stored waste. Waste removal is the concluding event that ends the interim state; Congress knew this and included provisions in its landmark nuclear waste legislation to ensure the timeliness of that event. The use of "interim" and other references to nonfinal storage in the NWPA indicate that this Note's proposed definition is the proper use of the term in nuclear waste law.

Nuclear energy experts use the word similarly. Shortly after terminating the Yucca Mountain project, President Obama established the Blue Ribbon Commission (BRC), a group of nuclear policy experts that included politicians, former NRC leadership, academics, industry leaders, and policy analysts.[128] The charter of the BRC was "to conduct a comprehensive review of policies for managing the back end of the nuclear fuel cycle . . . and make recommendations for a new plan."[129] The BRC traveled around the country, discussing the issues inherent in nuclear waste management and receiving input from concerned parties, including individuals, industry representatives, and interest groups.[130]

The BRC released a detailed report describing the history of the nuclear waste problem and laying out a path forward.[131] In multiple areas, the report used the term "interim," and each time it linked that term to some concluding event. One example: "As used in this report . . . . the term 'storage' is understood to mean storage for an interim period prior to disposal or other

acceptance of spent nuclear fuel or high-level radioactive waste shall be prohibited during such time as the repository license is revoked by the Commission or construction of the repository ceases; (3) the quantity of spent nuclear fuel or high-level radioactive waste at the site of such facility at any one time may not exceed 10,000 metric tons of heavy metal until a repository under this chapter first accepts spent nuclear fuel or solidified high-level radioactive waste . . . ."). Section 10168(d) also contains a limitation on MRS facility capacity which should be the basis for a strong policy argument against the massive scope of the CISFs; that argument is beyond the scope of this Note.

[127] 42 U.S.C. § 10155(e).

[128] *See* BRC REPORT, *supra* note 10, vi, 121.

[129] *Id.* at 122.

[130] *Id.* at Preamble.

[131] *See generally id.*

disposition."[132] Later, the report includes a graphic illustrating the nuclear fuel cycle, which shows nuclear fuel moving from the nuclear reactor to interim storage to final disposition.[133] In another section, the report explains that early nuclear waste was stored in underground steel tanks, which were "deemed adequate as an interim means of isolating" the waste, though at the time the AEC noted that "better means of isolating, concentrating, immobilizing, and controlling wastes [would] ultimately be required."[134] The BRC uses the word "interim" to describe situations that are not indefinite but rather that are known to be temporary.

Both Congress and the BRC, when discussing nuclear waste, utilize the word "interim" to mean a temporary state during which there is a reasonable expectation of some concluding event that will end the state. This usage within the field of nuclear science mirrors the dictionary definition of the word as well.

2. Dictionary Use of "Interim"

As stated above, courts often turn to dictionaries and other sources to interpret the proper use of a statutory term.[135] An influential argument popularized by Supreme Court Justice Antonin Scalia and like-minded jurists is that words should be given their public meaning at the time the law was passed.[136] 10 C.F.R. Part 72 was initially proposed in 1978;[137] the current 10 C.F.R. Part 72 was promulgated in 2015.[138] The *Webster*'s dictionary definition of "interim" from around 10 C.F.R. Part 72's initial proposal is: "[a] time intervening: meantime, interval," with example "between phases of the battle."[139] Next, a definition near the regulation's most recent revision: "[d]one, made, or occurring for an intervening time; temporary or provisional," with example "an interim director."[140] Stemming from their common use of the word "intervening," both definitions seem to indicate the existences of an initiating event, the interim state, and a concluding event. The example of "between phases of battle" emphasizes the imminence of the second event—the next phase of battle.

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[132] *Id.* vii n.2.

[133] *Id.* at 10 fig.1.

[134] *Id.* at 19.

[135] *See supra* notes 120–121 and accompanying text.

[136] Kevin P. Tobia, *Testing Ordinary Meaning*, 134 HARV. L. REV. 726, 740–41 (2020).

[137] Storage of Spent Fuel in an Independent Spent Fuel Storage Installation (ISFSI), 43 Fed. Reg. 46309 (Oct. 6, 1978) (to be codified at 10 C.F.R. pt. 72).

[138] 10 C.F.R. Part 72.

[139] *Interim*, WEBSTER'S THIRD NEW INTERNATIONAL DICTIONARY (3d ed. 1976).

[140] *Interim*, BLACK'S LAW DICTIONARY (11th ed. 2019).

3. Use of "Interim" in Other Areas of Federal Law

Considering those definitions, this Section assesses use of the word "interim" in other federal statutory contexts: appointment of interim directors and interim compensation of bankruptcy trustees. When Congress creates the hierarchy within agencies, it usually outlines a method of appointing and removing certain officers or directors, often including a procedure for designating interim officials to hold a position until the statute's appointment process properly names the successor.[141] Because Congress has outlined the position's replacement plan, the concluding event—replacement of the interim officer by somebody subject to the statute's appointments process—is reasonably concrete at initiation of the interim phase.

Next, a bankruptcy court may award compensation to a trustee for his or her services rendered during a bankruptcy proceeding.[142] A trustee may request and be granted "interim compensation" to be paid during the course of the proceedings.[143] In this case, the concluding event is the court's determination of total compensation allowed and, if necessary, further payment or collection. That concluding event is sufficiently concrete to initiate the interim state: bankruptcy proceedings are reasonably expected to end. Both of these examples in other areas of federal law support this Note's proposed definition of "interim."

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Synthesizing the use of the word "interim" in the nuclear waste realm, dictionary definitions, and other areas of federal law results in a uniform use of the word "interim": an interim phase is properly initiated only if a concluding event is reasonably certain to occur. Applying this analysis of "interim" to 10 C.F.R. Part 72 licensure: when the NRC licenses a facility to provide interim storage of nuclear waste, the depositing of waste into the facility is the initiating event that begins the interim state. The concluding event ending the interim state is removal of the nuclear waste. At present, there is no reasonable expectation of that concluding event because federal nuclear waste policy is in disarray, and therefore depositing waste into a CISF would not properly initiate an "interim" state of storage.

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[141] *See, e.g.*, Energy Reorganization Act of 1974, 42 U.S.C. §§ 5801–5891; Department of Energy Organization Act, 42 U.S.C. §§ 7101–7386.

[142] 11 U.S.C. § 330(a)(1).

[143] 11 U.S.C. § 331.

B. Counterarguments

Section III.A shows that the use of the word "interim" both in government and in industry requires a sufficiently probable concluding event in order to initiate an interim state. However, in a potential future lawsuit, the NRC could argue that that survey of uses of "interim" is underrepresentative in that it fails to include the usage of the word by the power player in nuclear waste policy: the NRC. As a government agency that works closely with industry leaders, the NRC may argue that it has the best grasp of both government and industry uses of particular terminology; therefore, its own use of the word should provide a strong indication of its proper use. So, the argument would go, if the NRC defines "interim storage" as "storage until a federal repository becomes available, whenever that may be," then that definition, relied upon by government and industry alike, should govern.

When a court reviews an agency's interpretation of its own regulation, it must determine whether and to what extent the agency's interpretation should be granted deference. The court applies a multifactor analysis, as outlined in *Kisor v. Wilkie*, which first asks whether the regulation is genuinely ambiguous, or whether there is only one reasonable interpretation of the regulation.[144] If the latter, that interpretation must govern. But if the former, the court assesses whether the agency's interpretation of the ambiguous language is reasonable.[145] An agency's reasonable interpretation of its own regulation normally prevails.[146]

Under this framework, the NRC may argue that 10 C.F.R. Part 72 can only be reasonably read to require that "interim" means "until a federal repository becomes available." Alternatively, if the court finds the regulation to be ambiguous, the NRC may argue that the NRC's interpretation is reasonable and therefore should govern.

But neither position is persuasive. As Section III.A showed, the word "interim" requires some certainty of the concluding event; it unambiguously prohibits initiation of "interim storage" given the substantial uncertainty currently surrounding the concluding event of that interim phase.

And even if a court finds the text to be ambiguous, it should find the NRC's possible interpretation to be unreasonable. The interpretation the NRC may adopt is unreasonable because it erodes the distinction between

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[144] 139 S. Ct. 2400, 2415 (2019). The *Chevron* doctrine governs judicial deference to administrative agencies when interpreting statutes; *Kisor* deference governs an agency's interpretation of its own regulation.

[145] *Id.*

[146] *Id.* at 2411 ("[W]e have often thought that a court should defer to the agency's construction of its own regulation."). *Kisor* outlined other factors for a court to consider, but none influence this analysis.

the words "interim" and "indefinite." Interim means an "intervening" period of time, while indefinite means "[u]ndefined, unlimited . . . indeterminate, vague."[147] The difference between these words is the level of confidence in the occurrence of some concluding event.

Perhaps when 10 C.F.R. Part 72 was initially promulgated in 1980, and especially after the passage of the NWPA in 1982 and the naming of Yucca Mountain in 1987, the concluding event was sufficiently concrete,[148] and therefore the term "interim" was proper because it was distinct from "indefinite." In the following years, Yucca Mountain was sited, funded, and developed; while the concluding event may not have been projected to occur at a specific time, storage in an ISFSI would not have been said to be "unlimited."

But times have changed. No repository exists, the NWPA requires substantial legislative overhaul, and public trust in federal nuclear waste policy has waned. Confidence in the occurrence of the concluding event is significantly lower now. The NRC's potential argument would fail to recognize this new reality.

In fact, the fear of confusing "interim storage" with "indefinite storage" is the central argument of the states opposing the development of CISFs. In a letter to President Trump combatting CISF development in her state, the governor of New Mexico wrote: "Given that a permanent repository for high-level waste does not exist in the United States and there is no existing plan to build one, any 'interim' storage facility will be an indefinite storage facility."[149] While the NRC's position as the sole federal agency tasked with nuclear power regulation should enable it to have a unique hold on current understanding of industry terms, in this case, the NRC's potential definition of the word is simply too far from the word's plain meaning to be granted deference by a court.

Next, the NRC may argue that this Note's proposed definition is in tension with a recent Supreme Court case, *Eldred v. Ashcroft*.[150] In that case, petitioners argued that Congress's repeated extensions of statutory copyright protections violated the Constitution. The Supreme Court held that the constitutional requirement that copyright protections be granted for a "limited time" did not restrict Congress from granting extensions to the

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[147] *Interim*, WEBSTER'S THIRD NEW INTERNATIONAL DICTIONARY (3d ed. 1976); *Interim*, BLACK'S LAW DICTIONARY (11th ed. 2019); *Indefinite*, OXFORD ENGLISH DICTIONARY ONLINE (2022), https://www.oed.com/view/Entry/94244 [https://perma.cc/ULY9-WLVX].

[148] Meaning, the NRC could have reasonably expected the concluding event to occur.

[149] Letter from Michelle Lujan Grisham, *supra* note 69.

[150] 537 U.S. 186 (2003).

initial protection timeframe so long as those extensions themselves were limited.[151]

At first glance, *Eldred* seems to apply when linking the regulatory term "interim" to the time-limited nature of the license granted. The AEA directs the NRC to license nuclear materials facilities. Those licenses "shall be issued for a specific period . . . not exceeding forty years,"[152] and such licenses "may be renewed upon the expiration of such period."[153] So, licensure of an ISFSI under 10 C.F.R. Part 72 for forty years complies with congressionally mandated statutory provisions, and so long as license extensions are granted for forty additional years (or some other "specific period"), the NRC would be operating within both AEA bounds and *Eldred* requirements. By that logic, interim requirements are sufficiently bounded by subsequent time-limited licensure actions much like "limited time" copyright requirements are met through successive bounded time extensions granted by Congress.

But the terms "interim" and "limited time" are different, and that difference becomes clear when viewed in context. A phase of interim storage of nuclear waste begins when the material is deposited into the facility (the initiating event), and that phase ends when the waste is removed (the concluding event). On the other hand, "limited time" copyright protections begin when Congress grants the protection (the initiating event), and protection ends when time runs out: at the end of the "limited time," the previously protected work *automatically* loses protection and enters the public domain. Therein lies the difference: at the end of the "specific period" of nuclear waste storage licensure, absolutely nothing happens to the nuclear waste—it remains exactly where it is. In other words, copyright protections disappear without any positive physical action by a party; interim nuclear waste storage only ends when one party physically removes the stored waste. Therefore, *Eldred* is unhelpful to the NRC and in fact highlights the importance of requiring a certain level of concreteness of a concluding event in order to deem storage to be truly "interim."

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[151] *Id.* at 194, 199.

[152] Atomic Energy Act of 1954, 42 U.S.C. § 2133(c) ("Each [commercial] license shall be issued for a specified period, as determined by the Commission, depending on the type of activity to be licensed, but not exceeding forty years from the authorization to commence operations, and may be renewed upon the expiration of such period."); *see also* 10 C.F.R. § 72.42 ("The license term for an ISFSI must not exceed 40 years from the date of issuance . . . . Licenses for either type of installation may be renewed by the Commission at the expiration of the license term upon application by the licensee for a period not to exceed 40 years.").

[153] 42 U.S.C. § 2133(c).

C. Policy Rationales

In addition to textual and legislative consistency concerns, a court should adopt the proposed definition of the word "interim" for two compelling policy reasons: maintaining public support for nuclear power and ensuring nuclear waste policy follows the scientific consensus.

First, forcing nuclear waste storage facilities onto nonconsenting states will lead to significant long-term damage to the country's nuclear power policy. A central conclusion of the BRC report was that federal development of consolidated storage facilities should begin immediately.[154] However, the BRC did not expect that long-term storage facilities[155] would be licensed to the private sector without substantial state and local involvement and consent, i.e., through NRC's 10 C.F.R. Part 72.[156] Discussing the nine nonoperational reactors at which nuclear waste remains, the BRC says:

> At all of these sites, which are formally known as [ISFSIs[157]], . . . the continued presence of spent fuel . . . is problematic and costly . . . . [T]hese communities were never asked about, and never contemplated or consented to, the conversion of these reactor sites into indefinite long-term storage facilities. As a result, they generally also did not have an opportunity to negotiate for rights of participation or incentives and benefits of the sort that would likely be available to the host community of a dedicated storage facility.[158]

This is the fundamental drawback of using 10 C.F.R. Part 72 to develop interim storage facilities—it completely disregards states' interests. The Blue Ribbon Commission focused on the importance of community consent to successful waste facility siting.[159] Discussing the history of Yucca Mountain, the BRC identified "the most important and most enduring problem of all—the fact that the project was strongly opposed . . . by the majority of Nevada residents and by the state's political leaders."[160] The BRC noted:

> To allay the concerns of states and communities that a consolidated storage facility might become a *de facto* disposal site, a program to establish

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[154] BRC REPORT, *supra* note 10, xii.

[155] The BRC distinguished "storage" from "disposal": "[T]he term 'disposal' is understood to mean permanent disposal; the term 'storage' is understood to mean storage for an interim period prior to disposal or other disposition." *Id.* vii n.2. Again, the use of "interim" is linked with a concluding event.

[156] *See id.* at 35.

[157] Recall that ISFSIs are governed by 10 C.F.R. Part 72. *See supra* notes 114–119 and accompanying text.

[158] BRC REPORT, *supra* note 10, at 35.

[159] In fact, "[a] new, consent-based approach to siting future nuclear waste management facilities" was the number one "key element[]" in the BRC's recommended strategy. *Id.* vii.

[160] *Id.* at 48.

> consolidated storage must be accompanied by a parallel disposal program that is effective, focused, and making discernible progress in the eyes of key stakeholders and the public.[161]

That proposed requirement is exactly the type of assurance in the concluding event that the word "interim" requires.

As the BRC noted, "[e]xperience in the United States and in other nations suggests that any attempt to force a top-down, federally mandated solution over the objections of a state or community—far from being more efficient—will take longer, cost more, and have lower odds of ultimate success."[162] Both proposed CISFs are opposed by the states' public and governing political parties.[163] Nuclear power history shows how disruptive losses in trust can be. A court should anticipate this issue and exercise its discretion to mitigate it.

A second policy consideration centers on the science. If licensure and development are allowed to proceed, these CISFs would likely become de facto permanent disposal facilities, possibly storing nuclear waste for a century or more. Because these facilities are relatively robust, legislators and agency regulators may feel comfortable leaving nuclear waste in them while dealing with other pressing matters.[164] However, above-ground dry cask storage is not the consensus view on optimal nuclear waste disposal; the consensus view is deep geologic repository disposal.[165] CISF operation is a Band-Aid on a gunshot wound: the remedy is suboptimal and short term. Politicians can declare victory to their constituents, hiding the fact that they actually just handed the problem to the next generation.

For these political and scientific reasons, a court should accept this Note's definition of "interim." How a court operates with that definition is the focus of the next Part.

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[161] *Id.* xii.

[162] *Id.* ix. Notably, the BRC "has heard testimony indicating that potential host communities, states and tribes would be willing to participate in an open process that engages affected constituencies from the outset and gives them actual bargaining power." *Id.* at 37.

[163] *See supra* notes 68–70 and accompanying text.

[164] Specifications of the CISFs themselves are insufficient to ensure any reasonable limit on the storage timeline. Holtec answers the question "How long will the Holtec dry storage system last?" with "[t]he life expectancy of the stainless-steel canister, which is the primary containment of the spent nuclear fuel, varies based on the environment. Conservative estimates put the life expectancy of the canister at hundreds of years," and even then, waste can be repackaged. *FAQ*, *supra* note 61. ISP says "The design life of the proposed . . . CISF storage system is 100+ years." *Project Overview*, *supra* note 16.

[165] *See supra* Section I.B.

IV. HOW TO PROTECT THE MEANING OF "INTERIM"

This Note has analyzed the nuclear waste dilemma from scientific, security-minded, historical, and political angles. It has also explained why the NRC's licensure of CISFs as interim facilities is inappropriate. This Note has also illuminated some of the downsides of transferring the nation's waste to CISFs—including generating animosity between states and the NRC[166] and passing the buck to future generations without solving the underlying problem. Of course, a court's rejection of CISF licensure under 10 C.F.R. Part 72 would not in itself solve the waste problem. But deficient "solutions" that unnecessarily generate tension between the states and the federal government may be more harmful than helpful.

Recognizing that other storage ideas may implicate the interim storage as regulated by 10 C.F.R. Part 72, this Part outlines a methodology for a court to determine whether a concluding event (removal of waste from the interim storage facility) is sufficiently concrete to allow for initiation of an interim state of storage. One way a court could allow the initiation of interim storage would be to require proof of substantial progress on the development of some appropriate federal facility to which stored nuclear waste may be removed. A provision for money damages, payable to the hosting state if waste is not transferred out of interim storage in a timely manner, would increase the reasonable expectation of the concluding event.

A. Proof of Progress

The simplest method of ensuring "interim" retains its meaning would be for a court to invalidate any state-opposed CISF licensure until a federal repository is fully operational and ready to accept (with established transportation plans and reserved capacity) the nuclear waste that would be stored in the CISF.[167] Because that concluding event would be concrete,

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[166] *See supra* Section II.B (explaining how Project Salt Vault's failure led to the Energy Reorganization Act and how Yucca Mountain's failure forced Congress back to the table to determine the future of permanent disposal). In a sense, this conflict is even more impactful because the popular backlash crosses partisan lines: Texas's governor is a Republican; New Mexico's governor is a Democrat.

[167] Another option would require amendment of 10 C.F.R. Part 72 to change ISFSI licensure time limits. Currently, ISFSIs may be licensed for forty years with the option of renewal. As discussed above, with the expected logistical timeline associated with nuclear waste transportation to a future federal repository, there is almost no possibility that nuclear waste stored in the proposed CISFs will be removed within its term of licensure; therefore, initial licensure essentially guarantees *at least* one renewal. This reality renders the forty-year time limit meaningless and certainly informs why both Texas and New Mexico argue that licensure of the CISFs in fact permits de facto indefinite storage. The difficulty in this approach is that the NRC may well say, based on the science and the current state of politics, that licensure should be for some incredibly long time, say 300 years. It is unclear whether such a number will be considered arbitrary or capricious and therefore deficient under principles of administrative law; that is

storage in a CISF would be properly interim. The problem with such a strict requirement is that any such repository is likely seventy-five years away. And if such a repository were operational, CISFs would be less needed. There must be some middle ground between the current status—complete uncertainty in federal repository development—and absolute certainty that would suffice.

That middle ground exists in proof of *progress*. A court may require substantial progress on the development of some federal storage program—either a substantially large, consolidated storage facility or set of facilities, or a permanent repository—in order to meet the demands of concreteness of the concluding event. This idea is not novel: the NWPA restricts development of federal consolidated storage facilities until substantial progress has been made on a federal repository.[168] Further, five states have passed legislation similarly requiring progress on waste disposal capabilities before they will allow construction of new power plants.[169] So, both the federal government and the states are aware of the risks associated with initiating temporary storage without a plan for final disposition. Therefore, this option may be the most palatable to all parties involved.[170]

A court implementing a requirement of progress for ISFSI licensure would still have the difficult task of determining how much progress is enough. For example, the Yucca Mountain program underwent $12 billion dollars' worth of "progress" before it closed—clearly that amount of "progress" was insufficient to concretely predict success.[171] To determine sufficient progress of development of a repository, this Note proposes a three-step questionnaire:

(1) Has Congress amended the NWPA to identify the new federal repository site?

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the effect of the considerable uncertainty surrounding America's nuclear waste policy. But to a person alive today, what is the difference between 300 years and permanence?

[168] *See* BRC REPORT, *supra* note 10, at 40; Nuclear Waste Policy Act, 42 U.S.C. § 10168(d).

[169] *States Restrictions on New Nuclear Power Facility Construction*, NAT'L CONF. OF STATE LEGISLATURES (Aug. 17, 2021), https://www.ncsl.org/research/environment-and-natural-resources/states-restrictions-on-new-nuclear-power-facility.aspx [https://perma.cc/8F79-LVTW] (listing California, Connecticut, Illinois, Maine, and Oregon).

[170] One consequence of requiring progress on CSF/repository development prior to issuing certain nuclear facility licenses may be a prohibition against licensure of new nuclear power plants. Because nuclear power plants must have cooling pools built on-site (for the good reasons outlined in Part I, *supra*), and those cooling pools are considered interim storage facilities, the plant itself may not be allowed. From a nuclear power development standpoint, this may pose an unfortunate consequence, especially to any energy companies working on building new plants. On the other hand, such a restriction may have the practical effect of sending the nuclear power lobby into overdrive—if logic, science, and the law are insufficient to urge Congress to action, perhaps the energy industry can apply the requisite muscle.

[171] *Used Nuclear Fuel*, *supra* note 98.

(2) Does the proposed repository have the strong support of state, local, and tribal governments *and* populations?[172]

(3) Has a sufficient amount of excavation and facility development occurred to sustain local scientists'—especially geologists'—determinations of adequacy of the site for long-term disposal?[173]

Favorable answers to these questions should indicate favorable conditions for successful repository development.

These proposed questions are admittedly vague; questions of what constitutes "strong support" (question 2) and "sufficient amount" (question 3) are valid. The difficulty lies in the dearth of attempts to build a repository and therefore the lack of lessons learned from doing so. A specific percentage of support, or a specific phase of repository development, cannot easily be identified. But history makes clear that a lack of public support will doom development, and that a certain amount of development may have to be completed before scientists agree that the site of the repository is geologically sound. A court would have to conduct a fact-intensive inquiry to determine the strength of public support and the sufficiency of development. Comparing public support to the support of other successful nuclear waste compromises—WIPP[174] or waste storage contracts with Idaho and Colorado, discussed next—may aid in this analysis.

Another difficulty with a judicial determination of sufficient progress is one of expertise. A central policy of administrative law is that generalist judges should be most deferential to agencies operating at the "frontier[] of science."[175] This proposed methodology to determine sufficient progress need not be executed in isolation. Rather, the NRC and other experts must play a central role in providing the court with ample data to make a well-reasoned decision. But it must be a court—not the NRC—that makes this determination; the NRC, through the CISF licensure, has already tipped its hand, indicating preference for early licensure.

Finally, because history shows that repository development is fraught with unexpected challenges, the federal government may also be able to meet a showing of substantial progress by following the BRC suggestion of developing federal consolidated storage. Doing so would still allow for

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[172] *See* BRC REPORT, *supra* note 10, at 48. At this step, the court should inquire into significant economic or historical factors at the site that may reasonably lead to a near-future reversal in political or popular support for the repository. Local consent at the time of siting is necessary to success, but factors that indicate a probability of enduring consent are just as important.

[173] Salt Vault failed in part because preliminary scientific determinations turned out to be incorrect. *See supra* Section II.B. This ties into question 2 as state governments will likely be informed by their own local experts of the viability of such a facility or repository.

[174] *See supra* note 54.

[175] Balt. Gas & Elec. Co. v. Nat. Res. Def. Couns., 462 U.S. 87, 103 (1983).

private ISFSIs to be licensed by the NRC as interim storage facilities because the concluding event is, simply, removal of the nuclear waste. If the federal government has the capacity (and sufficient incentive) to remove the waste from CISFs in a timely manner, the concluding event should still be found to be sufficiently concrete regardless of where the federal government takes it.

B. Incentives

A requirement of progress makes the concluding event—removal of the waste—more likely, but not necessarily certain. As discussed above, a requirement of absolute certainty of the concluding event is impractical. To move closer to certainty, and to make interim storage more palatable for states, a court may require a payment of money damages to the states and localities housing the waste for any delay in waste removal. In fact, the federal government already does this.

The nuclear waste discussed so far has been almost exclusively private waste, but the government generates its own nuclear waste from sources like nuclear-powered aircraft carriers and submarines, nuclear weapons production and maintenance, and nuclear energy. The DOE needs a place to store this waste, so the DOE contracts with multiple states, including Idaho and Colorado, to build nuclear waste storage facilities.[176] Those contracts include incentives for timely removal of the waste.[177] The parties to these contracts have incentives to keep up their ends of the bargain, and over the last twenty-five years, they have done so.[178]

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[176] *See* BRC REPORT, *supra* note 10, at 17 fig.10.

[177] "To address state concerns about the indefinite storage of . . . [nuclear waste] at existing federal facilities [within those states], DOE has entered into agreements with Idaho and Colorado to remove all . . . [waste] by 2035. Failure to meet this deadline will trigger monetary penalties and restrictions on further shipments of waste material into these states . . . ." *Id.* at 18. Under Idaho's agreement with the DOE, all spent fuel must be transferred from pool storage into dry storage by 2023, and the DOE must remove all naval spent fuel by 2035. If the DOE doesn't, it must pay $60,000 per day, and Idaho may ask a federal district court to enjoin any further shipments into Idaho. *Id.* at 58.

[178] *Idaho Site Continues Cleanup Progress Under 25-Year-Old Landmark Agreement*, OFF. OF ENV'T MGMT. (Nov. 3, 2020), https://www.energy.gov/em/articles/idaho-site-continues-cleanup-progress-under-25-year-old-landmark-agreement [https://perma.cc/L5PA-8AR2] ("In two and a half decades, [Department of Energy Office of Environmental Management (EM)] has met more than 90% of milestones outlined in the 1995 Idaho Settlement Agreement on or ahead of schedule. In other instances, EM and the state have renegotiated milestones. 'The Idaho Settlement Agreement has been extremely beneficial to the Department, the state of Idaho, and our stakeholders in that it provided the vision to safely dis[pose of] legacy wastes and spent nuclear fuel . . . . We've made monumental progress in meeting our commitments, which in turn has paved the way for a long and meaningful nuclear energy mission in Idaho.'"). These contracts and the parties' performance under them illustrate the possibility of amicable, mutually beneficial relationships between federal and state governments concerning nuclear waste.

The DOE recognized states' concerns regarding nuclear waste, and, responsibly, negotiated terms favorable to both sides: the DOE gets much-needed nuclear waste storage, and the states get concrete assurances that the waste will be removed or will receive damages ex post if the DOE fails to remove it.[179] The occurrence of the concluding event is legally binding and therefore publicly acceptable.[180] Of course, agency regulation (10 C.F.R. Part 72) is not subject to contract negotiation. NRC licensure of CISFs results in the states losing out on rightful benefits of negotiation *and* an opportunity to craft sufficient safeguards against indefinite storage. But a court could revive the role of contract negotiations. If the damages—and therefore deterrent effect—are high enough, this increases the likelihood of a concluding event.

Another potential option would be to require the federal government to take title to the nuclear waste upon expiration of CISF licensure.[181] This may provide some benefits to the states as the federal government would become responsible—and therefore liable—for the waste. If the federal government were required to take title to the waste upon license termination, it could be required to pay not only damages but also CISF operation costs, the cost of state emergency services responsible for nuclear waste emergencies, infrastructure maintenance and upgrade costs, and other related expenditures.

These ideas—a requirement of progress on federal storage and a provision for damages—may allow the NRC to properly license facilities under 10 C.F.R. Part 72. By increasing the probability that the stored nuclear waste would be removed within a reasonable, limited time, this framework should allow adherence to the limitations imposed by the word "interim."

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[179] *See* Nuclear Waste Policy Act, 42 U.S.C. § 10155(d)(2) ("Public participation in the negotiation of such an agreement [development of interim storage facility] shall be provided for and encouraged by the Secretary [of Energy] . . . .").

[180] There is a sociological argument here as well—that the state's power to negotiate is a benefit itself that confers public recognition of the legitimacy of the endeavor. An inability to bargain, as in the New Mexico and Texas cases, surely has a significant—though unquantifiable—effect on public opinion.

[181] This "take title" idea is not novel. Nuclear Waste Policy Act § 136 permitted the federal government to contract with nuclear waste producers providing, in return for payment into the Nuclear Waste Fund, the federal government take title to the waste and transport it to a federal facility by 1998. *See* 42 U.S.C. § 10156(a). Many contracts were formed, but, of course, the federal government has not yet developed a federal facility to dispose of such waste. Breach of contract suits have been brought and won by waste producers; damages have cost the government (really, taxpayers) two billion dollars. BRC REPORT, *supra* note 10, at 79. So, while breach of contract suits have provided a method of payment, and therefore, hopefully, persuasion, the "take title" provision of the NWPA has not yet led to the removal of nuclear waste from those facilities.

CONCLUSION

The state of America's nuclear waste disposal policy is abysmal. With the death of the Yucca Mountain federal depository, the next steps toward permanent disposal are uncertain. By conflating "interim" with "indefinite," the NRC will force states to store against their will vast amounts of nuclear waste for an indefinite time with minimal legal remedies available. As the history of nuclear waste disposal shows, this is the surest way for the federal government to lose its credibility and public support for nuclear power policy. But if a court requires proof of substantial progress on a federal repository and provides for money damages, truly interim storage may prove to be a useful tool in the country's disposal of its nuclear waste.

The growth of nuclear power—and therefore the fight against climate change—depends on an effective waste disposal plan. Properly defining "interim" is a necessary step towards that goal.