

CHECKS, BALANCES, AND NUCLEAR WASTE

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ABSTRACT

Systems of political checks and balances, so prominently featured in the U.S. Constitution, are also commonly installed in statutory and regulatory regimes. Although such systems diffuse political authority and may facilitate participation and accountability, they come with a price. If exercised, political checks—even those that appear trivial—can obstruct statutory processes and saddle a policy system with an unintended default policy outcome. Policies that are neither debated nor chosen, but that emerge as unbidden defaults, exhibit the very democratic deficits that checks and balances are intended to remedy.

This is precisely the situation of nuclear waste policy in the United States. The Nuclear Waste Policy Act of 1982 established a process for siting and constructing repositories for nuclear waste. When Nevada's Yucca Mountain emerged as a likely repository site, that state's officials and allies exercised the numerous political and legal checks afforded by the Act and appear, at least for the time being, to have defeated the selection. But Nevada's victory may well be the nation's loss. In the absence of a national waste repository, nuclear power plant operators have no choice but to store spent nuclear fuel on site, where it presents a number of risks not contemplated by the 1982 legislation. This outcome was not chosen or anticipated by legislators, plant operators, state and local siting authorities, or host communities.

This Article argues that lawmakers must take more realistic stock of their own institutional behaviors. Although certain corrosive incentives are intractably embedded in our constitutional system, lawmakers can and should write statutes with full awareness of the risks of relying on statutory checks and balances. In particular, legislators should assess carefully the default policy that will dictate outcomes when statutory processes fail.

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I. INTRODUCTION

The United States Constitution famously imposes a system of checks and balances on the fundamental mechanisms and institutions of American governance.¹ This system, venerated in American political thought, maintains equilibrium between the branches of government, suppresses concentrations of political power, and protects political minorities.² Numerous regulatory schemes both exploit and mimic the separation of powers by implementing, through legislation, subsidiary systems of checks and balances to ensure that public authority is wielded judiciously and with the informed participation of the governed.³

These systems come with a price. For example, the fragmentation of political authority slows the lawmaking process, rendering it less efficient than parliamentary systems which conjoin executive and legislative power.⁴ Of greater relevance to this Article is a different pathology, namely, that a surfeit of “veto points” within a decision making system creates a “status quo bias,” a bias against policy change.⁵ In such systems, default policies and

1. Although the phrase “checks and balances” was undoubtedly used earlier, its first published appearances date to the era of the Constitutional Convention. *See THE FEDERALIST* No. 9, at 42 (Alexander Hamilton) (J. R. Pole ed., 2005) (writing of “balances and checks”); JOHN ADAMS, A DEFENSE OF THE CONSTITUTIONS OF GOVERNMENT OF THE UNITED STATES OF AMERICA, AGAINST THE ATTACK OF M. TURGOT IN HIS LETTER TO DR. PRICE (1797) (using the phrase “checks and balances” throughout).

2. *See generally* Wallace Mendelson, *Separation of Powers*, in *THE OXFORD COMPANION TO THE SUPREME COURT OF THE UNITED STATES* 905–11 (Kermit Hall et al eds., 2d ed. 2005). There are of course many other goods associated with the separation of powers. *See Bradford R. Clark, Separation of Powers as a Safeguard of Federalism*, 79 TEX. L. REV. 1321, 1324–27 (2001) (arguing that a formalist approach to the separation of powers protects the state-federal balance); Torsten Persson et al., *Separation of Powers and Political Accountability*, 112 Q.J. ECON. 1163, 1164–68 (1997) (arguing that constitutional schemes that rely on separation of powers reduce opportunities for rent-seeking and aid political accountability).

3. *See generally* Mathew D. McCubbins et al., *Administrative Procedures as Instruments of Political Control*, 3 J.L. ECON. & ORG. 243 (1987) (arguing that administrative procedures limit agencies and allow elected officials to maintain policymaking control); Mathew D. McCubbins et al., *Structure and Process, Politics and Policy: Administrative Arrangements and the Political Control of Agencies*, 75 VA. L. REV. 431 (1989) (discussing how legislatures form the structure and process of administrative agencies to achieve “policy outcomes [they] deem satisfactory”).

4. *See* Mendelson, *supra* note 2, at 905 (“[T]he founders favored inefficient government checked and balanced against itself because it seemed safer than the risk of tyranny in a more efficient system.”). *See generally* Michael Laver, *Legislatures and Parliaments in Comparative Context*, in *THE OXFORD HANDBOOK OF POLITICAL ECONOMY* 121, 121–40 (Barry R. Weingast & Donald A. Wittman eds., 2006) (contrasting parliamentary systems with U.S.-style presidential democracies).

5. *See* Gary W. Cox & Mathew D. McCubbins, *The Institutional Determinants of Economic Policy Outcomes*, in *PRESIDENTS, PARLIAMENTS AND POLICY* 21, 26–28 (S. Haggard &

practices matter greatly because they often become deeply embedded.⁶ Regulatory schemes reliant on political checks tend to exhibit long periods of stasis in which established political pathways and processes dominate.⁷ In some cases, default elements lead to outcomes neither predictable nor desirable.

The system of nuclear waste regulation in the United States is an example par excellence of such a circumstance. In the Nuclear Waste Policy Act of 1982 (“NWPA”), Congress created a complicated institutional process full of political checks, apparently intending to ensure that the siting of nuclear waste facilities would be conducted deliberatively and with full input from those most affected.⁸ But by introducing so many opportunities for challenge and delay, Congress inadvertently increased the likelihood that the law would fail to yield a waste solution.⁹ With no national waste repository in sight,

Matthew D. McCubbins eds., 2001) (noting the trade-off between political systems that are “resolute” (their decisions “stick”) and those that are “decisive” (they are able to make decisions in the first place)); William N. Eskridge, Jr., *Vetogates and American Public Law*, 31 J.L. ECON. & ORG. 756, 756–58 (2012) (describing, *inter alia*, the difficulty of passing or repealing legislation in a system containing numerous “vetogates”). In the political science literature, the flip side of the “status quo bias” coin is legislative gridlock. *See, e.g.*, Keith Krehbiel, *Institutional and Partisan Sources of Gridlock: A Theory of Divided and Unified Government*, 8 J. THEORETICAL POL. 7, 11–12 (1996). Although the veto gate literature focuses principally on formal institutional filters, Michael Sant’Ambrogio has noted that the President has various tools to prevent enactment of legislation even outside of formal legislative processes. *See* Michael Sant’Ambrogio, *The Extra-legislative Veto*, 102 GEO. L.J. 351, 353–59 (2014).

6. By “default,” I mean fall-back policies that take (or remain in) effect in the absence of affirmative change. The establishment and exploitation of such defaults can be an important part of a political agenda. For example, a decision to set a particular fee in nominal dollars, unadjusted for inflation, effects a fee decrease in real dollars over time, but does so without any further legislative action and without the appearance of having done so. *See generally* Jacob S. Hacker, *Privatizing Risk Without Privatizing the Welfare State: The Hidden Politics of Social Policy Retrenchment in the United States*, 98 AM. POL. SCI. REV. 243 (2004) (describing “subterranean” processes of policy change).

7. *See* FRANK M. BAUMGARTNER & BRYAN D. JONES, *AGENDAS AND INSTABILITY IN AMERICAN POLITICS* 3–4 (2d ed. 2009) (positing a model of “punctuated equilibria” in American politics, characterized by long periods of stability with rare but substantial disruptions, in contrast to conventional models which assume incremental change).

8. Nuclear Waste Policy Act of 1982, Pub. L. No. 97-425, 96 Stat. 2201 (1982) (codified at 42 U.S.C. §§ 10101–10270 (2012)); *see infra* Part III.

9. Some readers may wonder whether certain members of Congress deliberately neutered the law. Indeed, any honest observer of legislative behavior must acknowledge that Congress, in some instances, passes laws that cannot reasonably be expected to achieve their stated goals. Worse, legislators sometimes deliberately hamstring legal enactments. *See* Terry M. Moe, *Political Institutions: The Neglected Side of the Story*, 6 J.L. ECON. & ORG. 213, 226–35 (1990). In the case of the NWPA, however, the intervening years have not brought to light any evidence that losers in the congressional bargain deliberately sought to render the law ineffectual.

Americans are today saddled with a default policy that is distinctly undesirable: high-level nuclear waste simply remains where it is created, at power plants not designed for long-term waste storage.¹⁰

The NWPA emerged out of years of tumultuous conflict over the disposal of used nuclear fuel.¹¹ Under the Act, nuclear power plant operators were to contribute to a federal fund that would pay for one or several national nuclear waste repositories.¹² In return, the federal government was to select a site, construct a repository, and begin collecting waste from these utilities no later than January 31, 1998.¹³ Since roughly the late 1980s, the presumptive site for the first high-level waste repository was Yucca Mountain, Nevada.¹⁴ But Nevada skillfully and spectacularly exploited the checks offered by the NWPA.¹⁵ After twenty years and \$8 billion of work on the Yucca Mountain

10. See Jonathan Fahey & Ray Henry, *U.S. Storage Sites Overfilled with Spent Nuclear Fuel*, NBCNEWS.COM (Mar. 22, 2011, 6:24 PM), http://www.nbcnews.com/id/42219616/#.V-givCTY_Zs (“The nuclear crisis in Japan has laid bare an ever-growing problem for the United States—the enormous amounts of still-hot radioactive waste accumulating at commercial nuclear reactors in more than 30 states. . . . [T]he industry’s collective pile of waste is growing by about 2,200 tons a year; experts say some of the pools in the United States contain four times the amount of spent fuel that they were designed to handle.”); *Stop Wasting Time—Create a Long-Term Solution for Nuclear Waste*, SCI. AM. (Apr. 1, 2016) [hereinafter *Stop Wasting Time*], <http://www.scientificamerican.com/article/stop-wasting-time-create-a-long-term-solution-for-nuclear-waste> (noting that the United States faces a “danger that is in many ways more threatening than a meltdown: the steady accumulation of radioactive waste. . . . at 72 sites scattered across 39 states”).

11. See generally J. SAMUEL WALKER, *THE ROAD TO YUCCA MOUNTAIN: THE DEVELOPMENT OF RADIOACTIVE WASTE POLICY IN THE UNITED STATES* 1–181 (2009). For a thorough institutional analysis of the events that gave rise to the Act, see JOHN L. CAMPBELL, *COLLAPSE OF AN INDUSTRY: NUCLEAR POWER AND THE CONTRADICTIONS OF U.S. POLICY* (1988).

This Article will focus on spent nuclear fuel, which is by volume the largest category of high-level nuclear waste. The NWPA addressed other categories of nuclear waste as well, and some of the political dispute over the law focused on these other categories. For an overview of the various forms of nuclear waste, see Richard B. Stewart, *U.S. Nuclear Waste Law and Policy: Fixing a Bankrupt System*, 17 N.Y.U. ENVT. L.J. 783, 785–87 (2008). The label “nuclear waste” is somewhat controversial as applied to spent nuclear fuel; those who favor the reprocessing or “recycling” of spent fuel fear that the “waste” designation obscures the possibility of reprocessing. See, e.g., JOEL B. EISEN ET AL., *ENERGY, ECONOMICS AND THE ENVIRONMENT: CASES AND MATERIALS* 435 (4th ed. 2015).

12. 42 U.S.C. § 10222(a)(3) (2012).

13. *Id.* § 10222(a)(5).

14. See WALKER, *supra* note 11, at 174–86 (detailing the process by which Yucca Mountain was chosen).

15. For an analysis of Nevada’s efforts leading up to the congressional endorsement of the Yucca site in 2002, see Robert Ressetar, *The Yucca Mountain Nuclear Waste Repository from a Federalism Perspective*, 23 J. LAND, RESOURCES & ENVT. L. 219, 230–39 (2003). For a discussion of events subsequent to 2002, see *infra* Part III.

site, the Department of Energy abruptly abandoned its efforts there in 2009, making good on a campaign promise by then-candidate Barack Obama to terminate operations at the site.¹⁶

There are as yet no serious alternatives to Yucca Mountain, and the 1998 deadline has long since come and gone.¹⁷ With the failure of the site selection process, every other aspect of the NWPA regime has collapsed or been placed under enormous strain.¹⁸ Spent nuclear fuel continues to accumulate at the nation's commercial nuclear reactors. The spent fuel pools designed to hold this waste are either full or nearly full, so utilities have been forced to improvise alternative waste storage and management solutions.¹⁹ The Department of Energy has been in breach of its obligation to collect waste for well over fifteen years.²⁰ The federal government has already paid out billions in liability for this breach, with tens of billions more to come.²¹ And perhaps strangest of all is that federal courts are resolving difficult questions of

16. See David M. Herszenhorn, *Yucca Mountain Plan for Nuclear Waste Dies*, N.Y. TIMES (Mar. 31, 2009, 4:59 PM), http://theaucus.blogs.nytimes.com/2009/03/31/yucca-mountain-plan-for-nuclear-waste-dies/comment-page-2/?_r=1; see also Barack Obama, *Barack Obama Explains Yucca Mountain Stance*, L.V. REV.-J. (May 20, 2007, 10:00 PM), <http://www.reviewjournal.com/opinion/barack-obama-explains-yucca-mountain-stance>. Unsurprisingly, President Obama's handling of the Yucca Mountain matter provoked the ire of his political opponents. To quote John McCain: "And to say that after 20 years and nine billion dollars spent on Yucca Mountain that there's not an option, period, to me is a remarkable statement." *To Receive Testimony Regarding Draft Legislative Proposals on Energy Research and Development: Hearing Before the S. Comm. on Energy and Nat. Res.*, 111th Cong. (2009) (statement of Sen. John McCain); Kent Garber, *Lessons from the Yucca Mountain Nuclear Waste Storage Debate*, U.S. NEWS & WORLD REP. (Mar. 16, 2009, 3:04 PM), <http://www.usnews.com/news/energy/articles/2009/03/16/lessons-from-the-yucca-mountain-nuclear-waste-storage-debate>.

17. After the Obama administration pulled the plug on Yucca Mountain, it established a "Blue Ribbon Commission," chaired by Representative Lee H. Hamilton and General Brent Scowcroft and staffed with other leading nuclear experts and policy makers, to formulate recommendations about nuclear waste policy. In 2012 the Commission issued its final report, which opened with the tagline, "America's nuclear waste management program is at an impasse." BLUE RIBBON COMM'N ON AMERICA'S NUCLEAR FUTURE, REPORT TO THE SECRETARY OF ENERGY, at vi (2012), https://curie.ornl.gov/system/files/BlueRibbonCommission_FinalReport_Jan2012.pdf.

18. See generally MARK HOLT, CONG. RESEARCH SERV., NUCLEAR ENERGY POLICY 33–36 (2014), <https://www.fas.org/sgp/crs/misc/RL33558.pdf>.

19. See Fahey & Henry, *supra* note 10.

20. HOLT, *supra* note 18, at 34 (noting that the deadline "even under the most optimistic scenarios will be missed by more than 20 years").

21. *Id.* at 35 (stating "DOE estimates that liability payments would eventually exceed \$20 billion if DOE were to begin removing waste from reactor sites by 2020," a date which almost certainly misses the mark by decades).

nuclear waste management under doctrines of contract law, as utilities sue the Department of Energy to recover breach of contract damages.²²

This Article argues that the checks and balances embedded in federal nuclear waste law made this result quite likely, if not inevitable. By rendering site selection so difficult, the NWPA in effect fixed a default policy for waste storage. As a consequence, spent nuclear fuel will remain at commercial nuclear power plants for decades longer than first planned, much to the dismay of plant operators and, of course, their neighbors.²³ Nor is this situation easily reversible: a great deal of this spent fuel sits entombed within immense casks that the Department of Energy is unwilling to receive and that may be too heavy or too corroded for conventional rail transport in any event.²⁴

In addition, this Article suggests that the NWPA's remarkable failure hints at several broader questions. Why does Congress enact laws so unlikely to succeed?²⁵ Is Congress ignorant of its own pathologies? Such questions cannot be answered here conclusively, but this Article will contend that citizens may reasonably expect Congress to consider default policies more fully. At times, Congress seems to recognize that an undesirable default may serve as a prod to compromise; in recent budget controversies, for example, Congress deliberately imposed upon itself a "budget sequestration" of automatic spending cuts that would take effect in the absence of a deal

22. See *infra* Part III.C.

23. For example, the disjoint between local expectations and the reality of long-term on-site storage was evident in a dispute concerning the recently closed San Onofre nuclear plant near San Diego, California. The California Coastal Commission's decision in October 2015 to approve the continued storage of waste at the plant—a decision necessitated by the lack of a national repository—was met with lawsuits and sharp condemnation from local residents. See Morgan Lee, *Lawsuit Targets Nuclear Waste Permit at Beach*, SAN DIEGO UNION TRIB. (Nov. 3, 2015, 6:08 PM), <http://www.sandiegouniontribune.com/sdut-lawsuit-targets-nuclear-storage-2015nov03-story.html>; Teri Sforza, *San Onofre Nuclear Waste Storage Fight Hits Coastal Commission*, ORANGE CTY. REG., <http://www.ocregister.com/articles/nuclear-686166-isfsi-storage.html> (last updated Oct. 5, 2015, 2:20 PM).

24. Carolina Power & Light v. United States, 115 Fed. Cl. 57, 61 (Fed. Cl. 2014) ("DOE has taken the position that under the Standard Contract, DOE will only accept fuel out of the spent fuel pools [rather than in dry casks]."); AREVA FED. SERVS. LLC, TASK ORDER 12—STANDARDIZED TRANSPORTATION, AGING AND DISPOSAL CANISTER FEASIBILITY STUDY, at i (2013), https://curie.ornl.gov/system/files/documents/not%20yet%20assigned/STAD_Canister_Feasibility_Study_AREVA_Final_1.pdf ("Under the Standard Contract (10 CFR 961.11), DOE is obligated to accept only bare spent nuclear fuel. Acceptance of canistered spent nuclear fuel would require an amendment to the Standard Contract."). This document also explains that some waste is stored in "single-purpose" casks not designed for transport. *Id.* at 3.

25. For a comprehensive analysis of government failure, see generally PETER H. SCHUCK, *WHY GOVERNMENT FAILS SO OFTEN AND HOW IT CAN DO BETTER* (2014).

yielding a \$1.2 trillion ten-year deficit reduction.²⁶ In theory, the cuts were to be so painful to both political parties that a budget deal would be compelled.²⁷ Even in this instance, however, Congress appears to have misunderstood its own incentives, for the automatic cuts did take effect.²⁸

This line of inquiry is particularly timely at the present moment, a moment characterized by congressional dysfunction generally and by uncertainty about nuclear power specifically.²⁹ In the next few years, the United States must make important decisions about its systemic reliance on nuclear power. The United States presently derives roughly twenty percent of its electricity from nuclear plants,³⁰ but nearly all these plants came online in the 1970s and 80s.³¹ This first generation of nuclear reactors is approaching the end of its useful life.³² Either new nuclear power plants must be constructed to replace

26. See Suzy Khim, *The Sequester, Explained*, WASH. POST (Sept. 14, 2012), <https://www.washingtonpost.com/news/wonk/wp/2012/09/14/the-sequester-explained> (describing cuts to both defense and social programs, taking effect due to the congressional “super-committee’s” failure to agree to an adequate deficit reduction package). The cuts resulted from the Budget Control Act of 2011, Pub. L. No. 112-25, 125 Stat. 240 (2012).

27. Khim, *supra* note 26.

28. Ted Barrett et al., ‘*Super Committee’ Fails to Reach Agreement*, CNN (Nov. 21, 2011, 10:01 PM), <http://www.cnn.com/2011/11/21/politics/super-committee/index.html>. For a typical analysis—i.e., one that focuses on personal rather than institutional failure—see Molly Ball, *Here’s Who Is Really to Blame for Sequestration*, ATLANTIC (Feb. 28, 2013), <http://www.theatlantic.com/politics/archive/2013/02/heres-who-is-really-to-blame-for-sequestration/273587>.

29. For accounts of congressional dysfunction by leading political scientists, see generally WILLIAM G. HOWELL & TERRY M. MOE, *RELIC: HOW OUR CONSTITUTION UNDERMINES EFFECTIVE GOVERNMENT AND WHY WE NEED A MORE POWERFUL PRESIDENCY* (2016); THOMAS E. MANN & NORMAL J. ORNSTEIN, *IT’S EVEN WORSE THAN IT LOOKS: HOW THE AMERICAN CONSTITUTIONAL SYSTEM COLLIDED WITH THE NEW POLITICS OF EXTREMISM* (2013); SEAN M. THERIAULT, *THE GINGRICH SENATORS: THE ROOTS OF PARTISAN WARFARE IN CONGRESS* (2013).

30. See PAUL BOLTON, *NUCLEAR ENERGY STATISTICS* 7 (2013), <http://researchbriefings.files.parliament.uk/documents/SN03631/SN03631.pdf>; PIETRO S. NIVOLA, BROOKINGS INST., POLICY BRIEF NO. 138, *THE POLITICAL ECONOMY OF NUCLEAR ENERGY IN THE UNITED STATES* 12121–22 (2004), <https://www.brookings.edu/wp-content/uploads/2016/06/pb138.pdf>. The EIA forecasts that this share will decline through 2040. See U.S. ENERGY INFO. ADMIN., *ANNUAL ENERGY OUTLOOK 2015 WITH PROJECTIONS TO 2040*, at 24 (2015), <http://www.eia.gov/forecasts/aeo/pdf/0383%282015%29.pdf>.

31. See generally NIVOLA, *supra* note 30, at 1 (noting interest in nuclear power declined due to “basic economic considerations” after “the extraordinarily favorable conditions that prevailed before the energy crisis of the 1970s”).

32. The operating licenses for the vast majority of the existing fleet of nuclear power reactors in the United States will expire by roughly 2040. See U.S. ENERGY INFO. ADMIN., *ANNUAL ENERGY REVIEW 2010* 283 (2011). There is an ongoing debate about whether to allow nuclear plant operators to renew licenses a second time. See *Dominion First to Seek 80-Year Life for Nuclear Plant*, READING EAGLE (Nov. 6, 2015), <http://www.readingeagle.com/ap/article/dominion-first-to-seek-80-year-life-for-nuclear-plant>.

the old, the operating licenses for aging plants must be extended, or other sources of electricity must be constructed rapidly and on a grand scale to replace retired nuclear plants.³³ Enough nuclear waste to fill a Yucca Mountain-like repository already sits waiting at power plants, so the waste problem will require a solution whether or not new plants are constructed.³⁴ Thus lawmakers would be wise to ask whether the Nuclear Waste Policy Act is bearing the weight of responsibility for nuclear waste in ways that safeguard the interests of present and future generations.³⁵

This Article takes up these issues. Part II provides technical and historical background on nuclear power and the management of spent nuclear fuel. Part III describes the NWPA framework and the events that led to its failure. Part IV explains the default policy that has emerged in the wake of the NWPA's failure. Part V explores the institutional roots of the present situation, and concludes with lessons for legislative design.

II. NUCLEAR POWER: SOME TECHNICAL AND HISTORICAL BACKGROUND

The use of atomic bombs by the armed forces of the United States at Hiroshima and Nagasaki during World War II revealed to the world in horrifying fashion the enormous potential energy contained within the atom. Shortly after the war's conclusion, countries with nuclear capabilities began to explore peacetime applications for nuclear technology, including especially the generation of electricity.³⁶ In 1954, Congress authorized the federal government to share its nuclear technology with private utilities in order to explore the possibility of private sector nuclear power generation.³⁷ By the mid-1960s, commercial nuclear power was widely heralded as a

33. This is so not merely because the regulatory approval process for new nuclear power facilities runs roughly ten to twenty years; it is also because the pipeline of nuclear engineers and scientists is at risk of running dry unless a new generation of students sets out on the nuclear path. See, e.g., *New Nuke Plants Face Skilled Labor Shortage*, CBSNEWS (Apr. 30, 2010), www.cbsnews.com/news/new-nuke-plants-face-skilled-labor-shortage.

34. Fahey & Henry, *supra* note 10 ("Plans to store nuclear waste at Nevada's Yucca Mountain have been abandoned, but even if a facility had been built there, America already has more waste than it could have handled.").

35. An influential MIT study on nuclear power identifies nuclear waste management as one of four central challenges that nuclear power needs to overcome in order to establish viability in the future. MASS. INST. TECH., THE FUTURE OF NUCLEAR POWER: AN INTERDISCIPLINARY MIT STUDY, at ix (2003).

36. See generally BERTRAND GOLDSCHMIDT, ATOMIC COMPLEX: A WORLDWIDE POLITICAL HISTORY OF NUCLEAR ENERGY (1982).

37. The Atomic Energy Act of 1954, Pub. L. No. 83-703, 68 Stat. 919 (codified at 42 U.S.C. §§ 2011–21, 2022–2286i, 2296a–2297h-13).

breakthrough for domestic energy production. Thanks to nuclear power, electricity would soon be “too cheap to meter.”³⁸

Although the highest hopes for nuclear power have not been realized, nuclear energy has assumed an important role in the world’s electricity supply. Some seventeen percent of the world’s electricity is generated by nuclear reactors.³⁹ Several high-profile scares and disasters—Three Mile Island, Chernobyl, Fukushima—have caused some governments to reduce their reliance on nuclear energy, but global interest in nuclear power has persisted.⁴⁰ This Section will briefly describe how spent nuclear fuel is managed and then provide some general background on nuclear power: its risks, its benefits, and its setting within the broader energy system in the United States.

38. *Abundant Power from Atom Seen*, N.Y. TIMES, Sept. 17, 1954, at 5 (quoting Lewis L. Strauss, Chairman, Atomic Energy Comm’n, Address at the Twentieth Anniversary of the National Association of Science Writers (Sept. 16, 1954)). In a 1967 decision, the Supreme Court wrote, in an opinion about a hydropower proposal, that “[b]y 1980 nuclear energy ‘should represent a significant proportion of world power production’ By the end of the century ‘nuclear energy may account for about one-third of our total energy consumption’ ‘By the middle of the next century it seems likely that most of our energy needs will be satisfied by nuclear energy.’” Udall v. Fed. Power Comm’n, 387 U.S. 428, 447 (1967) (citations omitted) (citing HARRISON BROWN ET AL., THE NEXT HUNDRED YEARS: MAN’S NATURAL AND TECHNOLOGICAL RESOURCES 109–10 (1957)).

39. MASS. INST. TECH., *supra* note 35, at 17.

40. Germany, for example, declared in the wake of the Fukushima disaster that it would phase out its reliance on nuclear power, which previously accounted for nearly twenty percent of the country’s electricity supply. Tim Smedley, *Goodbye Nuclear Power: Germany’s Renewable Energy Revolution*, THE GUARDIAN (May 10, 2013), <http://www.theguardian.com/sustainable-business/nuclear-power-germany-reasonable-energy>. Japan’s forty-three reactors were taken offline after Fukushima but are slowly being restarted. Stephen Staczyński & Emi Urabe, *Japan on Track to Start 3rd Nuclear Reactor Under New Rules*, BLOOMBERG (Oct. 25, 2015), www.bloomberg.com/news/articles/2015-10-26/japan-on-track-to-start-3rd-post-fukushima-reactor-with-approval. The Nuclear Energy Institute (NEI) maintains a database on nuclear power installations worldwide. As of November 2015, NEI listed sixty-seven nuclear units under construction, led by twenty-four in China, eight in Russia, and six in India. See *Nuclear Units Under Construction Worldwide*, NUCLEAR ENERGY INST., <http://www.nei.org/Knowledge-Center/Nuclear-Statistics/World-Statistics/Nuclear-Units-Under-Construction-Worldwide> (last updated Mar. 2016). See generally Lincoln L. Davies, *Beyond Fukushima: Disasters, Nuclear Energy, and Energy Law*, 2011 BYU L. REV. 1937; Lincoln L. Davies & Alexis Jones, *Fukushima’s Shadow*, 48 VAND. J. TRANSNAT'L L. 1083 (2015).

A. Nuclear Power and Nuclear Waste

Most commercial power generation relies on the same physical process: a turbine is spun through a magnetic field to create electricity.⁴¹ Flowing water can be used to turn turbines, as occurs at hydroelectric dams. Many power plants burn coal, natural gas, or petroleum and use the resulting heat to create pressurized steam which in turn spins turbines. In nuclear power plants, turbines are also propelled by steam, but nothing is burned; instead, a nuclear reaction—atomic fission⁴²—creates the heat required to generate steam.⁴³

Nuclear power plants typically use uranium to fuel the fission reaction. Uranium ore, formed into pellets, is encased in long, narrow, metal tubes called fuel rods. These rods are then batched into assemblies roughly four meters tall and less than half a meter wide. Up to several hundred assemblies may be used in a single reactor at any given time. The fuel assemblies are used for five to six years; after this, they no longer generate enough heat to fuel the reactor and must be removed and cooled.⁴⁴

Every commercial nuclear power plant has on its site one or more cooling pools, deep enough to immerse the uranium fuel assemblies in water.⁴⁵ Water is circulated constantly through these pools in order to dissipate “waste” heat from the spent rods; hot water leaving the pool is cooled before it returns. The cooling pool is the first step in nuclear waste management, and of necessity it occurs on site. Fuel assemblies leaving a reactor must be cooled immediately and constantly in order to prevent meltdown of the fuel

41. The discovery of this process, electromagnetic induction, is commonly attributed to Michael Faraday. It is by far the leading, though certainly not the only, method for transforming other forms of energy into electric current. *See generally* MARK DENNY, LIGHTS ON! THE SCIENCE OF POWER GENERATION (2013).

42. In theory, nuclear fusion—the fusion of atoms, as occurs inside the sun—is also a possible source of energy, and one that would produce little to no radioactive waste. But creating and maintaining a controlled fusion reaction has thus far eluded scientists. *See* Dino Grandoni, *Start-Ups Take on Challenge of Nuclear Fusion*, N.Y. TIMES, Oct. 25, 2015, at B1.

43. *See Spent Fuel Generation and Storage After Use*, U.S. NUCLEAR REGULATORY COMM’N, <http://www.nrc.gov/images/waste/spent-fuel-storage/generation-storage.gif> (last updated July 21, 2016) [hereinafter *Spent Fuel*]. The two leading reactor types in the United States are the boiling water reactor (BWR) and the pressurized water reactor (PWR). In both types, steam drives a turbine, but in a BWR, the reactor core itself boils water which spins the turbine, whereas in a PWR, reactor water is kept from boiling and instead exchanges heat with another, self-enclosed water system. *Boiling Water Reactors*, U.S. NUCLEAR REGULATORY COMM’N, <http://www.nrc.gov/reactors/bwrs.html> (last updated Jan. 1, 2015); *Pressurized Water Reactors*, U.S. NUCLEAR REGULATORY COMM’N, <http://www.nrc.gov/reactors/pwrs.html> (last updated Jan. 1, 2015).

44. *Spent Fuel*, *supra* note 43.

45. *Id.* Cooling pools are typically at least forty feet in depth. *Id.*

assemblies and the potentially catastrophic release of radioactive material.⁴⁶ This initial cooling process requires a minimum of several years and can continue for decades.⁴⁷

But what then? Spent fuel rods remain dangerously radioactive for hundreds of thousands of years.⁴⁸ Governments and research institutions have spent decades and billions of dollars trying to establish the safest means of processing or storing radioactive waste.⁴⁹ When the first generation of nuclear power plants was constructed in the United States, it was widely assumed that spent nuclear fuel would be reprocessed in order to recover remaining nuclear materials.⁵⁰ Reprocessing substantially reduces the volume of waste requiring ultimate disposal.⁵¹ But reprocessing has serious downsides. Because reprocessing generates materials that can be used to make nuclear weapons,⁵²

46. Dan Nosowitz, *How Nuclear Reactors Work and How They Fail*, POPULAR SCI. (Mar. 14, 2011), <http://www.popsci.com/science/article/2011-03/whats-happening-japans-nuclear-power-plants>. Cooling is absolutely essential to the confinement of the fission reaction. “A full meltdown is a worst-case scenario: The zirconium alloy fuel rods and the fuel itself, along with whatever machinery is left in the nuclear core, will melt into a lava-like material known as corium. Corium is deeply nasty stuff, capable of burning right through the concrete containment vessel thanks to its prodigious heat and chemical force, and when all that supercharged nuclear matter gets together, it can actually restart the fission process, except at a totally uncontrollable rate. A breach of the containment vessel could lead to the release of all the awful radioactive junk the containment vessel was built to contain in the first place, which could lead to your basic Chernobyl-style destruction.” *Id.*

47. MASS. INST. TECH., THE FUTURE OF THE NUCLEAR FUEL CYCLE: AN INTERDISCIPLINARY MIT STUDY 43–44 (2011).

48. For a helpful graphic depicting the duration of radioactivity of various fission byproducts, see MASS. INST. TECH., *supra* note 35, at 58.

49. H. Josef Hebert, *Nuclear Waste Disposal Will Cost US \$96B*, USA TODAY (Aug. 5, 2008, 5:33 PM), http://usatoday30.usatoday.com/news/washington/2008-08-05-2263572427_x.htm.

50. RICHARD B. STEWART & JANE B. STEWART, FUEL CYCLE TO NOWHERE: U.S. LAW AND POLICY ON NUCLEAR WASTE 22 (2011). “Back in the 1960s, when most of today’s reactors were designed, the consensus was that fuel would emerge from the reactors, cool for a few years in the pools, and then go to a factory where it would be chopped up. That process would take the unused uranium and plutonium created during the reactor’s operation, purify them and fashion them into new fuel.” Matthew L. Wald, *A Safer Nuclear Crypt*, N.Y. TIMES, July 5, 2011, at B1.

51. The volume of waste produced from various nuclear fuel cycles is discussed in MASS. INST. TECH., *supra* note 35, at 29–35, and graphically depicted at 30–31.

52. William C. Sailor, *Why the US Should Not Reprocess Spent Nuclear Fuel*, 14 F. APPLIED RES. & PUB. POL’Y 1, 6 (1999), <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.417.8076&rep=rep1&type=pdf> (“It has long been feared . . . that clandestine diversion of plutonium from a commercial reprocessing stream could allow a sub-national or terrorist groups [sic] access to nuclear weapons.”). The level of enrichment required to make uranium usable as a fuel for nuclear power generation is far lower than the level required to make a nuclear weapon. Sarah Zielinski, *What is Enriched Uranium?*, SMITHSONIAN.COM (Jan. 10, 2012), <http://www.smithsonianmag.com/science-nature/what-is-enriched-uranium-17091828/?no-ist>.

many policy makers have opposed it on the basis of national security; some even have taken the view that reprocessing would violate U.S. nonproliferation commitments.⁵³ It is also far more expensive to derive usable nuclear fuel from reprocessing than it is simply to mine new uranium, so utilities have urged against reprocessing on economic grounds.⁵⁴ For these and other reasons, reprocessing never became the primary strategy for spent fuel management.⁵⁵ Although reprocessing proposals still surface from time to time,⁵⁶ spent fuel reprocessing is unlikely to solve pressing short-term problems of waste management.⁵⁷

Without reprocessing, nuclear waste must be quarantined for many thousands of years so as to prevent radioactive contamination.⁵⁸ This presents an enormous engineering challenge because fission byproducts, over long time periods, tend to degrade and destroy engineered storage containments.⁵⁹ Given this likelihood, some have proposed ejecting nuclear waste into space; others, depositing it at the bottom of the ocean.⁶⁰ A loose global consensus rejects these approaches and favors instead “geologic” disposal: the placement of waste into an engineered repository that is itself situated in a favorable geologic context.⁶¹ Viable sites are those located within geologic formations that are likely to be very stable for long geologic periods, that

53. For a brief policy history of reprocessing, see generally ANTHONY ANDREWS, CONG. RES. SERV., RS22542, NUCLEAR FUEL REPROCESSING: U.S. POLICY DEVELOPMENT (2008). For a general discussion of the proliferation risks, see MASS. INST. TECH., *supra* note 35, at 65–69.

54. See Sailor, *supra* note 52, at 1–3. Neither are natural uranium supplies likely to run out in the near term. MASS. INST. TECH., *supra* note 35, at 34. “Based upon a review of published information and analyses, and the present modeling of the cost/resource relationship, there is a high degree of confidence that natural uranium can be provided at affordable costs well into the future.” MASS. INST. TECH., *supra* note 47, at 41.

55. See generally ANDREWS, *supra* note 52.

56. See, e.g., William F. Shughart II, *Why Doesn’t U.S. Recycle Nuclear Fuel?*, FORBES (Oct. 1, 2014), <http://www.forbes.com/sites/realspin/2014/10/01/why-doesnt-u-s-recycle-nuclear-fuel/#3034b38b7db4> (“What we ought to do is what other countries do: recycle [spent nuclear fuel]. Doing so would provide a huge amount of zero-carbon energy that would help us reduce greenhouse-gas emissions.”).

57. For example, an influential research team at the Massachusetts Institute of Technology concluded that reprocessing remains an important option to consider in the long-term, but at present, “enriched uranium is likely to remain less expensive than plutonium from [light water reactor spent nuclear fuel].” MASS. INST. TECH., *supra* note 47, at 13.

58. See *Stop Wasting Time*, *supra* note 10.

59. MASS. INST. TECH., *supra* note 47, at 45.

60. See generally, e.g., THOMAS C. JACKSON, NUCLEAR WASTE MANAGEMENT: THE OCEAN ALTERNATIVE (1981).

61. MASS. INST. TECH., *supra* note 47, at 58–59.

present no opportunity for the seepage of radioactive materials away from the repository site, and that are far from population centers.⁶²

Federal policy makers in the United States have joined the consensus in favor of geologic disposal but, for reasons that will be explained in the remainder of the Article, have been unable to implement a geologic repository.⁶³ Instead, spent nuclear fuel has simply accumulated at nuclear power plants across the country.⁶⁴ Much of this fuel sits in cooling pools that were designed to hold only several decades' worth of it. As these pools fill, plant operators have shifted increasingly to so-called "dry cask" storage.⁶⁵ Dry casks are enormous concrete and steel containment devices, cylindrical in shape, that entomb spent fuel assemblies.⁶⁶ One important benefit of dry cask storage is that it does not rely on cooling water or, indeed, on any active cooling process. No electricity is required at all; the process is entirely passive, and thereby eliminates the possibility of a Fukushima-style fuel pool failure.⁶⁷ Some analysts applaud dry cask storage for this reason, but others, especially in the wake of 9/11, decry the security risks inherent in placing

62. See MASS. INST. TECH., *supra* note 47, at 59 ("Today, geologic disposal is considered the preferred option for the disposal of long-lived wastes that must be isolated from the biosphere for protection of human health and the environment."). "The concept of deep geologic disposal has been studied extensively for several decades, and there is a high level of confidence within the expert scientific and technical community that this approach is capable of safely isolating the waste from the biosphere for as long as it poses significant risks." MASS. INST. TECH., *supra* note 35, at 54. This consensus masks significant disagreement about the degree of confidence that decision makers may reasonably have about the long-term safety of such repositories. This disagreement runs roughly along disciplinary lines, between geologists on one hand and engineers on the other, and involves the ability to predict the performance of engineered waste containment systems on geologic time scales. For examples of this disagreement, see the chapters collected in UNCERTAINTY UNDERGROUND: YUCCA MOUNTAIN AND THE NATION'S HIGH-LEVEL NUCLEAR WASTE (Allison M. Macfarlane & Rodney C. Ewing eds., 2006).

63. The international community has not fared much better in the quest to site and construct such a repository. See generally NUCLEAR WASTE GOVERNANCE: AN INTERNATIONAL COMPARISON (Achim Brunnengräber et al. eds., 2015).

64. See *Stop Wasting Time*, *supra* note 10.

65. See generally *Dry Cask Storage*, U.S. NUCLEAR REGULATORY COMM'N, <http://www.nrc.gov/waste/spent-fuel-storage/dry-cask-storage.html> (last updated Oct. 12, 2016).

66. *Id.*

67. During the disaster at Fukushima, the power plant was cut off from both the national power grid and all forms of backup power. The all-important pumps that circulate cooling water therefore failed, leading to the meltdown of the spent fuel assemblies. See Davies, *Beyond Fukushima*, *supra* note 40, at 1940–47; *Backgrounder on NRC Response to Lessons Learned from Fukushima*, U.S. NUCLEAR REGULATORY COMM'N, <http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/japan-events.html> (last updated Apr. 8, 2016).

radioactive waste in exposed casks outside the most secure containment areas at nuclear power plants.⁶⁸ More on this later in the Article.

B. *The Place of Nuclear Power Today*

As a matter of public policy, nuclear power's standing is mixed. For the last several decades, most leading environmental interest groups have opposed the expansion of nuclear power.⁶⁹ Radioactive substances pose extraordinary risks. Exposure to radiation causes illness and death, and materials emitting radiation can remain dangerous for tens of thousands of years. The risks associated with nuclear radiation play into deep public fears about hidden or invisible harms.⁷⁰ For these reasons, the public—and especially the environmental community—has generally opposed the expansion of nuclear power.⁷¹

Proponents of nuclear power, however, assert that nuclear power has achieved an almost impeccable record of safety and that it has proven remarkably benign to human health.⁷² In the wake of the Fukushima disaster, George Monbiot, a notable British environmentalist famous for his ambivalence about nuclear power, abandoned his “nuclear-neutrality” because, in his words:

A crappy old plant with inadequate safety features was hit by a monster earthquake and a vast tsunami. The electricity supply failed, knocking out the cooling system. The reactors began to explode and melt down. The disaster exposed a familiar legacy of

68. For a brief discussion of these risks, see NAT'L RES. COUNCIL OF THE NAT'L ACADS., SAFETY AND SECURITY OF COMMERCIAL SPENT NUCLEAR FUEL STORAGE: PUBLIC REPORT 64–68 (2006).

69. Ben Geman, *Greens Still See Red on Nuclear Power*, ATLANTIC (Feb. 2, 2014), <http://www.theatlantic.com/politics/archive/2014/02/greens-still-see-red-on-nuclear-power/447408/>. The case against nuclear power is summarized in Benjamin J. Sovacool & Christopher Cooper, *Nuclear Nonsense: Why Nuclear Power Is No Answer to Climate Change and the World's Post-Kyoto Energy Challenges*, 33 WM. & MARY ENVTL. L. & POL'Y REV. 1, 1–2 (2008).

70. See, e.g., MARY DOUGLAS & AARON WILDAVSKY, RISK AND CULTURE: AN ESSAY ON THE SELECTION OF TECHNOLOGICAL AND ENVIRONMENTAL DANGERS 16–28 (1983).

71. The dramatic 1970s–80s shift in public opinion from support to opposition of nuclear power is described and analyzed in BAUMGARTNER & JONES, *supra* note 7, at 26.

72. Pushker A. Kharecha & James E. Hansen, *Prevented Mortality and Greenhouse Gas Emissions from Historical and Projected Nuclear Power*, 47 ENVTL. SCI. & TECH. 4889, 4892 (2013).

poor design and corner-cutting. Yet, as far as we know, no one has yet received a lethal dose of radiation.⁷³

Indeed, one wonders why nuclear power has been so vilified by many environmentalists for so long when the burning of coal has quietly killed tens of thousands over the past several decades.⁷⁴ On a per-unit basis, nuclear energy has led to far fewer fatalities than any other major source of energy.⁷⁵

In addition, many regard nuclear power as a leading source of carbon-free energy and therefore a readily available solution to the problem of climate change.⁷⁶ The energy sector is the principal contributor to global carbon emissions, and nuclear power creates carbon-free power in massive quantities. Not only is the process of nuclear power generation itself virtually carbon-free, but other lifecycle emissions, associated with uranium mining and plant operation, are very small in relation to nearly all other large-scale sources of energy.⁷⁷

Thus nuclear power has substantial upsides and downsides. American policy towards nuclear power has been correspondingly bipolar. In the 1950s, Congress manifested its support for the nuclear power industry by erecting limitations on liability for nuclear power entities.⁷⁸ The Price-Anderson Act, signed into law by President Eisenhower in 1957, created a tiered liability scheme to partially indemnify nuclear power generators from liability arising

73. George Monbiot, *Why Fukushima Made Me Stop Worrying and Love Nuclear Power*, GUARDIAN, (Mar. 21, 2011), <https://www.theguardian.com/commentisfree/2011/mar/21/pro-nuclear-japan-fukushima>.

74. Robert B. Finkelman et al., *Health Impacts of Coal and Coal Use: Possible Solutions*, 50 INT'L J. COAL GEOLOGY 425, 426–31 (2002).

75. Kharecha & Hansen, *supra* note 72; see also ORG. FOR ECON. CO-OPERATION & DEV., COMPARING NUCLEAR ACCIDENT RISKS WITH THOSE FROM OTHER ENERGY SOURCES 37 (2010), <http://www.oecd-nea.org/ndd/reports/2010/nea6862-comparing-risks.pdf> (concluding that “[n]uclear energy in OECD countries is very safe in comparison with fossil chains”); James Conca, *How Deadly Is Your Kilowatt? We Rank the Killer Energy Sources*, FORBES (June 10, 2012, 1:08 AM), <http://www.forbes.com/sites/jamesconca/2012/06/10/energys-deathprint-a-price-always-paid/#1713bfa749d2>.

76. Kojo Menyah & Yemane Wolde-Rufael, *CO₂ Emissions, Nuclear Energy, Renewable Energy and Economic Growth in the US*, 38 ENERGY POL'Y 2911, 2911 (2010) (positing that nuclear energy reduces societal CO₂ emissions more readily than renewable energy).

77. Manfred Lenzen, *Life Cycle Energy and Greenhouse Gas Emissions of Nuclear Energy: A Review*, 49 ENERGY CONVERSION & MGMT. 2178, 2195–96 (2008).

78. *Id.*

from nuclear accidents.⁷⁹ Without such limitations, private investors were unlikely to take on the risks associated with nuclear power.⁸⁰

But in the 1970s, public concern over these risks increased.⁸¹ Nuclear regulators imposed additional safety requirements.⁸² As energy demand projections declined during the 1970s energy crises, nuclear power no longer looked like a sure bet from an economic standpoint.⁸³ The Three Mile Island incident in 1979 put public opinion into freefall.⁸⁴ Utilities cancelled orders for new reactors, sometimes even abandoning plants in the middle of construction.⁸⁵ Some state utility commissions refused to allow utilities to recover the costs of cancelled plants from ratepayers, further spooking investors.⁸⁶ And sixteen states simply banned the construction of new nuclear power plants.⁸⁷ The first wave of nuclear power investment in the United States was decidedly over, and the resulting chill—deep freeze, really—in nuclear power investment lasted decades.

Only in the early 2000s was interest in new nuclear power plants rekindled.⁸⁸ Several prominent institutions and advocacy organizations argued forcefully that nuclear power represents a critical tool in climate change policy.⁸⁹ During the George W. Bush administration, Congress authorized new economic stimuli for nuclear power development.⁹⁰ Utilities took advantage of these measures and submitted a number of new reactor applications.⁹¹ The economic fallout from the Fukushima Daiichi disaster of

79. Pub. L. No. 85-256, 71 Stat. 576 (codified as amended at 42 U.S.C. § 2210 (2012)).

80. See generally Harold P. Green, *Nuclear Power: Risk, Liability, and Indemnity*, 71 MICH. L. REV. 479, 480 (1973); Daniel W. Meek, *Nuclear Power and the Price-Anderson Act: Promotion Over Public Protection*, 30 STAN. L. REV. 393, 393 (1978).

81. See WALKER, *supra* note 11, at 88–93, 114–17.

82. See CAMPBELL, *supra* note 11, at 50–72.

83. *Id.* at 92–109.

84. See WALKER, *supra* note 11, at 124.

85. See generally Richard J. Pierce, Jr., *The Regulatory Treatment of Mistakes in Retrospect: Canceled Plants and Excess Capacity*, 132 U. PA. L. REV. 497, 497–98 (1984).

86. *Id.*

87. Rod Kuckro, *States Consider Lifting Bans on New Nuclear Power Plants*, ENERGYWIRE (Feb. 8, 2016), <http://www.eenews.net/stories/1060031955>.

88. Matthew L. Wald, *Edging Back to Nuclear Power*, N.Y. TIMES (Apr. 21, 2010), <http://www.nytimes.com/2010/04/22/business/energy-environment/22NUKE.html>.

89. See, e.g., MASS. INST. TECH., *supra* note 35, at 17–18.

90. Edmund L. Andrews & Matthew L. Wald, *Energy Bill Aids Expansion of Atomic Power*, N.Y. TIMES (July 31, 2007), <http://www.nytimes.com/2007/07/31/washington/31nuclear.html> (referring to § 1306 of the Energy Policy Act of 2005, Pub. L. No. 109-58, providing a tax credit for electricity production from nuclear power facilities).

91. Wald, *supra* note 88.

2011 killed off many of these applications.⁹² Nonetheless, five new nuclear reactors are slated to come online in the United States over the upcoming few years.⁹³ They will be the first new commercial power reactors to be completed since the mid-1990s.⁹⁴

Overall, the role of and forecast for nuclear power in the United States remains mixed. On one hand, the commercial nuclear plant fleet is aging.⁹⁵ If present policy holds, nearly all currently active reactors' licenses will expire by 2050, even with the license renewals allowed by current law.⁹⁶ The NRC may soon revise its policy to allow an additional twenty year license renewal,⁹⁷ but barring the imposition of a carbon tax or a similar policy device, new nuclear plants face severe economic headwinds in the form of very inexpensive fossil fuel alternatives.⁹⁸

But on the other hand, nuclear reactors provide abundant, low-carbon, baseload power in a number of areas.⁹⁹ The Paris climate agreement highlights the importance of independent national contributions to

92. Amy Harder, *Can the U.S. Government Revive Nuclear Power?*, WALL ST. J. (Nov. 23, 2014), <http://www.wsj.com/articles/can-the-u-s-government-revive-nuclear-power-1416777789>.

93. Ayesha Rascoe, *U.S. Approves First New Nuclear Plant in a Generation*, REUTERS (Feb. 9, 2012, 5:51 PM), <http://www.reuters.com/article/us-usa-nuclear-nrc-idUSTRE8182J720120209>

94. See, e.g., Rebecca Smith, *TVA Cleared to Start First New U.S. Nuclear Power Plant in Nearly 20 Years*, WALL ST. J. (Oct. 22, 2015), <http://www.wsj.com/articles/tva-cleared-to-start-first-new-u-s-nuclear-power-plant-in-nearly-20-years-1445551025>.

95. Matthew L. Wald, *As Reactors Age, Funds to Close Them Lag*, N.Y. TIMES (Mar. 20, 2012), <http://www.nytimes.com/2012/03/21/science/earth/as-nuclear-reactors-age-funds-to-close-them-lag.html>.

96. Nancy Slater-Thompson, *Almost All U.S. Nuclear Plants Require Life Extension Past 60 Years to Operate Beyond 2050*, U.S. ENERGY INFO. ADMIN. (Dec. 8, 2014), <http://www.eia.gov/todayinenergy/detail.cfm?id=19091>.

97. See Paul Voosen, *As Nuclear Reactor Fleet Ages, Engineers Ask, 'Is 80 the New 40?'*, N.Y. TIMES (Nov. 20, 2009), <http://www.nytimes.com/gwire/2009/11/20/20greenwire-as-nuclear-reactor-fleet-ages-engineers-ask-is-94897.html?pagewanted=all> (describing the NRC and DOE's approaches to the analysis of extended plant operation).

98. The principal driver at present is the low price of natural gas. See, e.g., Rebecca Smith, *Cheap Natural Gas Unplugs U.S. Nuclear-Power Revival*, WALL ST. J. (Mar. 15, 2012), <http://www.wsj.com/articles/SB10001424052702304459804577281490129153610>; see also Nathan E. Hultman et al., *What History Can Teach Us About the Future Costs of U.S. Nuclear Power*, 41 ENVTL. SCI. & TECH. 2088, 2088 (2007) (arguing that "[p]ast experience suggests that high-cost surprises should be included in the [nuclear] planning process"); Ioannis N. Kessides, *Nuclear Power: Understanding the Economic Risks and Uncertainties*, 38 ENERGY POL'Y 3849, 3850 (2010).

99. "Baseload" power sources are those typified by low marginal costs of operation, continuous operation, and high reliability. These attributes make such sources the first to be dispatched to satisfy demand, as opposed to "peaking" power plants activated only when demand increases. See generally EISEN ET AL., *supra* note 11, at 67.

greenhouse gas reduction, and it is difficult to envision serious emissions reductions from the all-important energy sector without a sizeable role for nuclear power.¹⁰⁰ Nuclear power is likely to remain an important part of the national energy outlook for many decades to come. Its viability, however, is seriously handicapped by the absence of a waste management solution. Without such a solution, public support for nuclear power has been tepid.¹⁰¹ Let us turn, then, to examine directly the issue of nuclear waste management.

III. THE NUCLEAR WASTE POLICY ACT REGIME

Specialists in fields related to nuclear energy broadly agree that the legislated nuclear waste policy of the United States, established by the Nuclear Waste Policy Act (“NWPA” or, in this Section, “the Act”), is in disrepair.¹⁰² This Section describes some of the more acute problems. There are several well-written and comprehensive texts that narrate the history of nuclear waste management in the United States;¹⁰³ I make no effort here to add to those accounts. Instead, this Section distills that history, describes more recent events, and draws attention to certain patterns. Later, the Article will examine whether Congress can meaningfully improve the law of nuclear waste management given current political and institutional realities.

A. *How It Was Supposed to Work*

We may begin by describing the nuclear waste management regime established by the NWPA in 1982.¹⁰⁴ First and foremost, the Act set forth a process for siting a nuclear waste repository.¹⁰⁵ The process was based on Congress’ findings that spent nuclear fuel had created “a national problem”,¹⁰⁶ that “[f]ederal efforts during the past 30 years to devise a

100. Framework Convention on Climate Change, Adoption of the Paris Agreement, U.N. Doc. CP.21 (Dec. 11, 2015), <https://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf>. See generally Robinson Meyer, *A Reader’s Guide to the Paris Agreement*, ATLANTIC (Dec. 16, 2015), <http://www.theatlantic.com/science/archive/2015/12/a-readers-guide-to-the-paris-agreement/420345/>.

101. See, e.g., MASS. INST. TECH., *supra* note 47, at 127–32.

102. See STEWART & STEWART, *supra* note 50, at 201; WALKER, *supra* note 11, at 181–82; David R. Hill, *The NWPA and the Realities of Our Current Situation*, 40 ENVTL. L. REP. 10795, 10795–96 (2010).

103. See generally STEWART & STEWART, *supra* note 50; WALKER, *supra* note 11.

104. Nuclear Waste Policy Act of 1982, 42 U.S.C. §§ 10101–270 (1982).

105. *Id.* §§ 10121–45.

106. *Id.* § 10131(a)(2).

permanent solution to the problems of civilian radioactive waste disposal have not been adequate”¹⁰⁷ and that “[s]tate and public participation in the planning and development of repositories is essential” to the program’s success.¹⁰⁸ Secondly, the Act established a way to pay for the repository. Congress required the recently-created Department of Energy (DOE) to enter into contracts with nuclear power plant owners regarding nuclear waste.¹⁰⁹ In return for a small tax on the energy generated by these plants, the DOE would begin accepting spent nuclear fuel from them by January 31, 1998.¹¹⁰ Tax payments would enter a Nuclear Waste Fund which would in turn be used for the spent fuel repository.¹¹¹

Although these objectives may seem straightforward, the path to their achievement was anything but. The statute contained myriad checks and balances, each designed to ensure that affected constituencies and relevant experts would have their voices heard. Congress assigned the central role in the siting process to the DOE.¹¹² The DOE was ordered first to “issue general guidelines for the recommendation of sites for repositories[,]” with input from various agency heads and from “interested Governors.”¹¹³ These guidelines were to include considerations of geology, hydrology, proximity to populated areas, and other matters related to public safety and environmental protection.¹¹⁴

Following issuance of these guidelines and consultation with the Governors of “affected [s]tates,” as well as public hearings in “the vicinity of . . . [proposed] site[s],” the Secretary was to nominate at least five sites and later cull the list to three.¹¹⁵ Nominations would receive a thorough environmental review, which was to be made available to the public and subject to judicial review.¹¹⁶ The President was to review these site candidates and, within sixty days, to make a decision on each.¹¹⁷

107. *Id.* § 10131(a)(3).

108. *Id.* § 10131(a)(6).

109. *Id.* § 10222(a)(1).

110. *Id.* § 10222(a)(5). The standard contract required by the NWPA, which implements these requirements, is at 10 C.F.R. § 961.11 (1983).

111. 42 U.S.C. § 10222(a)(3).

112. *Id.* § 10132. The various institutional tasks and responsibilities created by the Act are described in CHRISTOPHER W. MYERS, HISTORY, STRUCTURE AND INSTITUTIONAL OVERVIEW OF THE NUCLEAR WASTE POLICY ACT OF 1982, at 14–20 (1986).

113. 42 U.S.C. § 10132(a).

114. *Id.*

115. *Id.* § 10132(b)(1).

116. *Id.* § 10132(b)(1)(D)–(E)(i).

117. *Id.* § 10132(c)(1).

Once the President had selected a site from among the candidates, the DOE was ordered to proceed with a “site characterization”¹¹⁸ process after yet again consulting with affected states and tribes¹¹⁹ and holding public hearings.¹²⁰ Upon completion of this process, the Secretary of Energy was to issue a site recommendation to the President.¹²¹ If the President sought to move forward with a recommended site, the Act required him to formally recommend the site to Congress.¹²² If Congress also approved, the Secretary had to submit to the Nuclear Regulatory Commission (NRC) an application for construction authorization within ninety days.¹²³ The Act gave the NRC three years in which to approve or disapprove the application,¹²⁴ and in the meantime the Commission was to provide an annual report to Congress describing the proceedings undertaken.¹²⁵ If the NRC approved the application, only then, after the completion of this grueling regulatory process, could construction actually begin.¹²⁶

The NWPA process, then, was shot through with checks. Site selection would require multiple approvals by the DOE, two approvals by the President, one approval by Congress, and further approval by an independent agency, the NRC. To be sure, some of these checks were largely ministerial and would be satisfied without incident. But viewed as a whole, the NWPA created a perilous institutional obstacle course. The path to a completed repository would be an exceedingly difficult one.

B. Yucca Mountain

In the first few years following the NWPA’s enactment, the DOE intensively evaluated potential repository sites in Mississippi, Texas, Utah, Washington, and Nevada.¹²⁷ By 1986, the Department had narrowed its list to three locations: Deaf Smith County, Texas; Hanford, Washington; and

118. “Site characterization” is defined in the Act as “activities . . . undertaken to establish the geologic condition and the ranges of the parameters of a candidate site relevant to the location of a repository” *Id.* § 10101(21).

119. *Id.* § 10121(a).

120. *Id.* § 10132(b)(2).

121. *Id.* § 10132(b)(1)(B).

122. *Id.* § 10134(a)(2).

123. *Id.* § 10134(b).

124. *Id.* § 10134(d).

125. *Id.* § 10134(c).

126. *Id.* § 10134(d).

127. WALKER, *supra* note 11, at 181.

Yucca Mountain, Nevada.¹²⁸ Amidst opposition from all three states, Congress in 1987 passed further legislation—nicknamed by some “the Screw Nevada bill”—that singled out Yucca Mountain for site characterization.¹²⁹

Aided by opponents of nuclear power and geologic waste storage, Nevada engaged in a lengthy campaign of lawsuits and political action intended to derail the Yucca Mountain selection.¹³⁰ The suits attacked, among other things, the environmental standards applied to the repository site¹³¹ and the validity and constitutionality of the site selection procedure.¹³² Administratively, the Clinton administration temporized on Yucca,¹³³ but the George W. Bush administration pushed the approval process forward.¹³⁴ On June 3, 2008, just months before President Bush left the White House, the DOE submitted to the Atomic Safety and Licensing Board (ASLB) of the NRC its 8,000page license application to operate the Yucca Mountain repository.¹³⁵

As a legal matter, the submission of the license application was the culmination of the lengthy process established by the 1982 legislation. It was a crucial step that set in motion certain statutory duties at the NRC; the Commission would now have three years to decide whether to issue a

128. *Id.* at 182.

129. John J. Fialka, *The ‘Screw Nevada Bill’ and How It Stymied U.S. Nuclear Waste Policy*, N.Y. TIMES (May 11, 2009), <http://www.nytimes.com/cwire/2009/05/11/1climatewire-the-screw-nevada-bill-and-how-it-stymied-us-12208.html?pagewanted=all>. The legislation was contained in the Omnibus Budget Reconciliation Act of 1987, 42 U.S.C. § 10172 (1987).

130. For a nice summary of Nevada’s efforts in this regard, see Marta Adams, *Yucca Mountain—Nevada’s Perspective*, 46 IDAHO L. REV. 423, 438–42 (2010); Ressetar, *supra* note 15, at 233–39; see also Jon Christensen, *Can Nevada Bury Yucca Mountain?*, HIGH COUNTRY NEWS (July 2, 2001), <https://www.hcn.org/issues/206/10604>. Nevada officials argued that Congress short-circuited the NWPA process and stole the selection decision from the DOE. To varying degrees, Congress’ intervention in 1987 has caused allies of Nevada to regard further engagement in NWPA processes as illegitimate. In the words of Nevada’s Deputy Attorney General, “there is a history of institutional misconduct on the part of federal government agents which has so pervaded the controversial project that it has undermined whatever public confidence may have once existed in the program.” Adams, *supra*, at 425.

131. See, e.g., Nuclear Energy Inst., Inc. v. EPA, 373 F.3d 1251, 1261–62 (D.C. Cir. 2004); Nat’l Res. Def. Council, Inc. v. EPA, 824 F.2d 1258, 1261–62 (1st Cir. 1987).

132. See, e.g., Nevada v. Watkins, 943 F.2d 1080, 1083 (9th Cir. 1991); Nevada v. Watkins, 939 F.2d 710, 713 (9th Cir. 1991); Nevada v. Watkins, 914 F.2d 1545, 1549 (9th Cir. 1990).

133. Ressetar, *supra* note 15, at 233.

134. Matthew L. Wald, *Bury the Nation’s Nuclear Waste in Nevada, Bush Says*, N.Y. TIMES (Feb. 16, 2002), www.nytimes.com/2002/02/16/us/bury-the-nation-s-nuclear-waste-in-nevada-bush-says.html.

135. See generally U.S. DEPT. OF ENERGY, DOE’S LICENSE APPLICATION FOR A HIGH-LEVEL WASTE GEOLOGIC REPOSITORY AT YUCCA MOUNTAIN (2008). The documents associated with this application are available at <http://www.nrc.gov/waste/hlw-disposal/yucca-lic-app.html>.

construction authorization for the repository.¹³⁶ But as a political matter, the battle was merely intensified. Harry Reid of Nevada, who as a junior senator in 1987 had been helpless to stop the “Screw Nevada Bill,” was now the Senate Majority Leader and the most powerful political figure in a crucial swing state. During the campaign season for the 2008 presidential election, the leading Democratic candidates worked hard to secure Reid’s support. Both Barack Obama and Hillary Clinton vowed to terminate the Yucca Mountain project if elected.¹³⁷

True to his promise, President Obama soon after assuming office took a handful of actions intended to bring an end to the Yucca Mountain repository. First, he moved to eliminate all funding for Yucca in the Department of Energy.¹³⁸ Thousands of federal employees and contractors working on the Yucca project in Nevada were laid off or reassigned.¹³⁹ Next, under Obama’s direction the new Secretary of Energy, Steven Chu, attempted to withdraw the DOE’s license application before the NRC.¹⁴⁰ Finally, and just as importantly, Obama designated Gregory Jaczko as the head of the NRC.¹⁴¹ Jaczko, formerly a member of Reid’s staff, served Nevada’s interests admirably and would play an important role in the review of the Yucca Mountain application.

136. According to the Nuclear Waste Policy Act, the NRC is required to “issue a final decision approving or disapproving the issuance of a construction authorization not later than the expiration of 3 years after the date of the submission of such application,” subject to a possible one-year extension. 42 U.S.C. § 10134(d) (1982).

137. Molly Ball, *Clinton Declares Yucca Mountain “Will Be Off the Table Forever”*, L.V. REV.-J. (Jan. 17, 2008), <http://www.reviewjournal.com/news/elections/clinton-declares-yucca-mountain-will-be-table-forever>; Sarah Wheaton, *Obama Ad Attacks McCain on Yucca Mountain*, N.Y. TIMES (Aug. 9, 2008), http://thecaucus.blogs.nytimes.com/2008/08/09/obama-ad-attacks-mccain-on-yucca-mountain/?_r=0.

138. Chris Good, *No Yucca in Obama’s Budget; Reid Rejoices*, ATLANTIC (Feb. 1, 2010), <http://www.theatlantic.com/politics/archive/2010/02/no-yucca-in-obamas-budget-reid-rejoices/35092/>.

139. See Hannah Northey, *DOE’s Trash Is Nev. Town’s Treasure*, GREENWIRE (Sept. 3, 2015), <http://www.eenews.net/stories/1060024222> (“Throughout the fall and winter of 2010, DOE let go of all federal workers focused on Yucca, terminated activities carried out by contractors, canceled leases for offices and closed most of its 500 contracts and subcontracts. Eventually, more than 1,000 office suites in Las Vegas would be left empty.”); see also Valerie Miller, *Yucca’s Nuclear Fallout Opponents Cheer Demise, but Jobs Vanish with Site’s Closure*, L.V. REV.-J. 1, 3 (June 20, 2010), http://www.yuccamountain.org/pdf-news/yucca_06202010.pdf.

140. Katherine Ling, *DOE Moves to Withdraw Yucca License Application*, E&E NEWS (Mar. 3, 2010), <http://www.eenews.net/stories/88207>.

141. Mary Manning, *Obama Names Ex-Reid Aide to Lead Nuclear Commission*, L.V. SUN, <http://lasvegassun.com/news/2009/may/13/former-reid-aide-likely-lead-nuclear-commission/> (last updated May 13, 2009, 5:21 PM).

Secretary Chu's effort to withdraw the Yucca license application was not a sure thing. In ordinary contexts, an application withdrawal is simple and straightforward. But an 8,000 page application, submitted pursuant to a tortuous statutory process, is not so easily set aside.¹⁴² The DOE's Motion to Withdraw is itself a ten-page document, and within those pages the Secretary acknowledged that others could "argue that dismissing this application is contrary to the [Nuclear Waste Policy Act]."¹⁴³ Further complicating the matter, the DOE pursued an interesting legal innovation in its motion. Noting that the NRC's regulations "empower [the Atomic Safety and Licensing Board] to regulate the terms and conditions of [application] withdrawal," the DOE asked the Board to "prescribe only one term of withdrawal—that the pending application for a permanent geologic repository at the Yucca Mountain site shall be dismissed with prejudice."¹⁴⁴

With prejudice? Dismissal with prejudice is generally invoked by courts in disposing of suits without legal merit.¹⁴⁵ In some circumstances it is employed by parties to a settlement to preclude subsequent lawsuits on points resolved by the settlement.¹⁴⁶ But a dismissal of a license application with prejudice? The motion explained:

DOE seeks this form of dismissal because it does not intend ever to refile an application to construct a permanent geologic repository for spent nuclear fuel and high-level radioactive waste at Yucca Mountain The Board should defer to the Secretary's judgment that dismissal with prejudice is appropriate here.¹⁴⁷

Clearly the administration was using all means available not only to shutter Yucca Mountain, but to prevent it from ever being resurrected. This maneuver was a unilateral attempt to end the Yucca Mountain story once and for all by binding even future administrations.

142. See Rob Pavey, *U.S. Court of Appeals says Yucca Mountain Licensing Can Resume*, AUGUSTA CHRON., <http://m.chronicle.augusta.com/news/metro/2013-08-13/us-court-appeals-says-yucca-mountain-licensing-can-resume#> (last updated Aug. 13, 2013, 8:57 PM).

143. U.S. Dep't of Energy's Motion to Withdraw at 4, *In re U.S. Dep't of Energy (High-Level Waste Repository)*, 71 N.R.C 609 (2010) (No. 63-001), 2010 WL 9105479 [hereinafter Motion to Withdraw].

144. *Id.* at 3.

145. *Dismissal with Prejudice*, BLACK'S LAW DICTIONARY 502 (8th ed. 2004) (defining "dismissal with prejudice" as "a dismissal, usu. after an adjudication on the merits, barring the plaintiff from prosecuting any later lawsuit on the same claim").

146. See, e.g., Robert R. Salman & Suzanne A. Salman, *The Art of Settlement*, PRAC. LITIGATOR, July 2000, 43, 45 (providing advice for settlement negotiations regarding the use of dismissal with prejudice).

147. Motion to Withdraw, *supra* note 143, at 3–4 (including material from 3 n.3).

The ASLB bypassed this matter by deciding, on June 29, 2010, that it lacked any authority to withdraw the DOE's application—with or without prejudice.¹⁴⁸ The ASLB's argument was based on the plain text of the Nuclear Waste Policy Act, which mandated that the NRC “shall” review the application, as well as the Act's broader context, which reflected that Congress had intended the Yucca Mountain deliberations to “be removed from the political process.”¹⁴⁹ Unsurprisingly, the DOE appealed this ruling to the full, five-member NRC.¹⁵⁰ The recusal of one of the NRC commissioners, however, yielded a tied vote of 2-2 on the DOE's motion.¹⁵¹

A tie would normally result in the affirmance of the decision under review. Enter Gregory Jaczko. Rather than report the deadlocked decision, Jaczko simply sat on it—for well over a year.¹⁵² Some surmised that Jaczko was awaiting a new appointee to the NRC, whose vote might break the tie in his favor.¹⁵³ Ultimately, Jaczko's prevarication led to several official investigations of his performance, a virtually unending stream of public criticism, scathing rebukes from two federal appellate court panels, and later his resignation.¹⁵⁴ The Inspector General of the NRC, in June of 2011, released an unflattering report that revealed, among other things, that Jaczko

148. *In re U.S. Dep't of Energy*, 71 N.R.C. 609, 617 (N.R.C. 2010). The decision stated the following on the matter of dismissal with prejudice: “The Board is not aware, in previous NRC practice, of any applicant voluntarily seeking dismissal with prejudice of its own application While the current Secretary may have no intention of refiling, his judgment should not tie the hands of future Administrations for all time.” *Id.* at 630.

149. *Id.* at 621.

150. Katherine Ling, *NRC Panel Blocks Obama Admin Effort to Withdraw Yucca License*, E&E NEWS, June 29, 2010.

151. Steve Tetreault, *Yucca May Yet Have Pulse After Ruling*, L.V. REV.-J. (Sept. 9, 2011, 11:17 AM), <http://www.reviewjournal.com/news/yucca-mountain/yucca-may-yet-have-pulse-after-ruling>.

152. Jaczko did not release the NRC's decision until September 9, 2011, nearly a year after the votes were entered. See Hannah Northey, *Nuclear Waste: Confusion Reigns in Wake of Deadlocked NRC's Yucca Vote*, E&E NEWS (Sept. 9, 2011), <http://www.energyxxi.org/ee-news-nuclear-waste-confusion-reigns-wake-deadlocked-nrcs-yucca-vote>.

153. Peter Behr, *Brewing Yucca Mountain Controversy Puts NRC Commissioner in Crossfire*, CLIMATEWIRE, May 11, 2011.

154. Hannah Northey, *Jaczko's Departure, a Scalp for the GOP, Won't Resolve Yucca Debate*, E&E DAILY (May 22, 2012), <http://www.eenews.net/stories/1059964746>. Judge Randolph of the D.C. Circuit Court of Appeals, concurring in a judgment ordering the NRC to proceed with the Yucca review, wrote that “former Chairman Gregory Jaczko orchestrated a systematic campaign of noncompliance.” *In re Aiken Cty.*, 725 F.3d 255, 267 (D.C. Cir. 2013) (Randolph, J., concurring); Steve Tetreault, *Final Report Mixed for NRC Chairman Jaczko*, L.V. REV.-J. (June 26, 2012, 5:53 PM), <http://www.reviewjournal.com/news/yucca-mountain/final-report-mixed-nrc-chairman-jaczko>.

had withheld pertinent information from fellow commissioners.¹⁵⁵ A subsequent report by the Inspector General addressed charges that Jaczko had issued inconsistent testimony before Congress and bullied colleagues at the NRC.¹⁵⁶ The Government Accountability Office characterized Jaczko's actions as politically motivated, a serious criticism for the chairperson of an independent body charged with maintaining nuclear safety and security.¹⁵⁷

When the NRC process stalled, proponents of the Yucca Mountain repository took to the courts. They sued the DOE for abandoning its construction application, but the D.C. Circuit Court of Appeals at first deemed the claim unripe.¹⁵⁸ These parties then petitioned the federal courts for a writ of mandamus against the NRC, hoping that the courts would compel the Commission to move forward with the Yucca review, a process that they argued was required by the NWPA.¹⁵⁹ After holding the order in abeyance in 2012, the D.C. Circuit issued the requested writ in August of 2013.¹⁶⁰ The order was accompanied by some strong language from the court:

This case has serious implications for our constitutional structure. It is no overstatement to say that our constitutional system of separation of powers would be significantly altered if we were to allow executive and independent agencies to disregard federal law in the manner asserted in this case by the Nuclear Regulatory Commission.¹⁶¹

Pursuant to the writ, the NRC has moved forward, albeit reluctantly, with its review of the Yucca Mountain license application, first submitted in 2008.¹⁶² The funds that remain available for this review are dwindling, and congressional negotiations to restore funding are bound up with broader

155. Memorandum from Hubert Bell, NRC Inspector General to Gregory Jaczko, NRC Chairman 40 (June 6, 2011) (Chairman's Unilateral Decision to Terminate NRC's Review of DOE Yucca Mountain Repository Licensing Application (OIG Case No. 11-05)); *see also* Hannah Northey, *NRC Chief Shielded Information to Sway Yucca Decision – IG*, GREENWIRE, June 10, 2011.

156. *See* Hannah Northey, *IG Report Critical of Jaczko's Management Style, Hill Testimony*, E&E NEWS, June 26, 2012.

157. Hannah Northey, *Death of Yucca Mountain Caused By Political Maneuvering—GAO*, GREENWIRE, May 10, 2011.

158. *In re Aiken Cty*, 645 F.3d 428, 434 (D.C. Cir. 2011).

159. *In re Aiken Cty.*, 725 F.3d 255, 258 (D.C. Cir. 2013).

160. *Id.* at 266.

161. *Id.* at 267.

162. U.S. NUCLEAR REGULATORY COMM'N, LICENSING YUCCA MOUNTAIN 1 (2015), <http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/yucca-license-review.pdf>.

discord over the federal budgeting process.¹⁶³ Little in that process is predictable, though it may be worth noting that Harry Reid is no longer in office, having retired in 2016.¹⁶⁴

C. *The Act in Terminal Decline*

With Yucca Mountain on life support, the Nuclear Waste Policy Act's core provisions sit moribund. The process it established to site and construct a waste repository has stalled. Nuclear power plant operators, despairing that a repository will ever be constructed, have won a judgment in federal court terminating their obligation to pay into the Nuclear Waste Fund.¹⁶⁵ As this section will explain, the most recent Executive Branch directive on nuclear waste implored Congress to go back to the drawing board and to initiate a new siting process based on the consent of host sites.¹⁶⁶

Shortly after terminating the Nevada program, President Obama formed a special, high-level task force and directed it to create a set of recommendations for the future of nuclear waste policy in the United States.¹⁶⁷ The Blue Ribbon Commission on America's Nuclear Future, an assemblage of politicians and technical experts, worked for a number of months and issued its final report in January of 2012.¹⁶⁸ Although the Commission formally took no position on the Yucca Mountain proceedings, its report urged substantial changes to the national waste management

163. See, e.g., Kate Schimel, *Is Yucca Mountain Back on the Table?*, HIGH COUNTRY NEWS (Aug. 30, 2015), <http://www.hcn.org/articles/is-yucca-mountain-back-on-the-table>.

164. Carl Hulse, *Harry Reid to Retire from Senate in 2016*, N.Y. TIMES (Mar. 27, 2015), <http://www.nytimes.com/2015/03/28/us/politics/senator-harry-reid-retire.html>.

165. Nat'l Ass'n of Regulatory Util. Comm'r's v. DOE, 680 F.3d 819, 825 (D.C. Cir. 2012) (holding that the Department of Energy failed to provide a legal basis for continuing fee collection in the absence of an identifiable strategy for waste management); see also Hannah Northey, *U.S. Ends Fee Collections with \$31B on Hand and No Disposal Option in Sight*, GREENWIRE (May 16, 2014), <http://www.eenews.net/stories/1059999730>.

166. U.S. DEP'T OF ENERGY, STRATEGY FOR THE MANAGEMENT AND DISPOSAL OF USED NUCLEAR FUEL AND HIGH-LEVEL RADIOACTIVE WASTE 13–14 (2013).

167. The initial proposal for the establishment of a special commission was floated early in 2009, just as Congress was slashing funding for Yucca Mountain. Katherine Ling, *Obama Budget Means Nev. Repository is 'History'*—Reid, E&E DAILY, May 7, 2009. It took a number of months for the administration to assemble the commission. See Peter Behr, *The Administration Puts Its Own Stamp on a Possible Nuclear Revival*, CLIMATEWIRE, Feb. 2, 2010.

168. BLUE RIBBON COMM'N ON AMERICA'S NUCLEAR FUTURE, REPORT TO THE SECRETARY OF ENERGY pml. (2012).

program.¹⁶⁹ This was no mere tinkering with the NWPA or changes in its administration. Instead, the report called for new legislation to replace or substantially amend the NWPA.¹⁷⁰ The Commission advised Congress to scrap the NWPA's siting procedures entirely—Yucca Mountain and all—and to focus on interim waste “storage” alongside permanent waste “disposal.”¹⁷¹ Storage, in the parlance of the Report, is “isolation that permits managed access” to nuclear waste, while disposal is the “final stage of waste management” that “does not require continued human control and maintenance.”¹⁷² In other words, storage is temporary while disposal is permanent.¹⁷³ For both interim storage facilities and long-term repositories, the report proposed a “consent-based” siting process.¹⁷⁴ Finally, the Commission called for the creation of a brand new federally-chartered organization to assume responsibility for waste management and siting activities, taking over these roles from the DOE.¹⁷⁵

A full year after the report’s release, the Obama Administration issued an official strategy document, which remains the most recent presidential pronouncement on the issue.¹⁷⁶ The fourteen-page document did little more than affirm the basic findings of the Blue Ribbon Commission and adopt many of its recommendations.¹⁷⁷ Specifically, the Administration declared that it would prioritize the construction of a “pilot interim storage facility” focused initially on accepting waste from retired nuclear power plants.¹⁷⁸ This pilot facility would be followed by a larger interim facility.¹⁷⁹ As for the goal

169. *Id.* “The Commission takes no position on the Administration’s request to withdraw the license application. We simply note that the U.S. inventory of SNF will soon exceed the amount that can be legally emplaced at Yucca Mountain until a second repository is in operation. So under current law, the United States will need to find a new repository site even if Yucca Mountain were to go forward. We believe the approach set forth here provides the best strategy for assuring continued progress, regardless of the fate of Yucca Mountain.” *Id.* at 48–49.

170. *Id.* at viii.

171. *Id.* at 32–46.

172. *See id.* at xi.

173. *See id.* at xi.

174. *Id.* at 47–59. The report blamed the failure of the Yucca Mountain process in part on the “short-circuiting of the initial site selection process,” but also noted that the “most important and most enduring problem” was the opposition of the majority of the state’s residents and political leaders. *Id.* at 48.

175. *Id.* at 60–69.

176. U.S. DEP’T OF ENERGY, *supra* note 166.

177. *Id.* at 1 (“The [Obama] Administration endores the key principles that underpin the BRC’s recommendations.”).

178. “This system would initially be focused on acceptance of used nuclear fuel from shutdown reactors.” *Id.* at 5.

179. *Id.* at 6.

of building a geologic repository, however, the strategy took a less urgent tone. “The Administration’s goal is to have a repository sited by 2026; the site characterized, and the repository designed and licensed by 2042; and the repository constructed and its operations started by 2048.”¹⁸⁰

The 2048 target date must be evaluated in context: no official targets for nuclear waste storage development have been met.¹⁸¹ The acknowledgement that a permanent waste solution is not likely to be completed before mid-century must be appreciated for its candor, but it also has been regarded as “kicking the can” far down the road.¹⁸² In the years since the strategy document was released, progress has remained slow. Only in late 2015 did the DOE take serious steps towards locating sites for the interim storage facilities at the heart of the new strategy.¹⁸³ Members of Congress have complained about mounting federal liability for nuclear waste, but there is no new legislation on the horizon.¹⁸⁴

In sum, nuclear waste policy is not taking the shape of the Nuclear Waste Policy Act. The core provisions of that legislation are in disuse. Yet nuclear power plants continue to generate waste, and federal agencies continue to oversee their operations. There is, then, a de facto national policy in regard to nuclear waste, but it is being set, in essence, by default.

180. *Id.* at 7.

181. For example, the 1982 legislation clearly envisioned a repository ready for waste collection by 1998. In a 1984 rulemaking, the Nuclear Regulatory Commission published its estimate that a repository would be ready by 2007–2009. Waste Confidence Decision, 49 Fed. Reg. 34,658, 34,659–60 (Aug. 31, 1984). By 1990, the Commission estimated the repository’s readiness by 2025. Waste Confidence Decision Review, 55 Fed. Reg. 38,474, 38,505 (Sept. 18, 1990). In 2010, the Commission withdrew its 2025 estimate and declined to suggest any date at all. Waste Confidence Decision Update, 75 Fed. Reg. 81,037, 81,038–62 (Dec. 23, 2010). For its part, the Government Accountability Office (GAO) estimated in 2009—just before the events described above—that Yucca Mountain could be ready by 2020. U.S. GOV’T ACCOUNTABILITY OFFICE, GAO-12-797, SPENT NUCLEAR FUEL: ACCUMULATING QUANTITIES AT COMMERCIAL REACTORS PRESENT STORAGE AND OTHER CHALLENGES 23 (2012) [hereinafter GAO, SPENT NUCLEAR FUEL QUANTITIES]. Its current assessment is that a minimum of fifteen years will be required to open an off-site storage location once a site has been chosen. *Id.*

182. See *Stop Wasting Time*, *supra* note 10.

183. Hannah Northey, *DOE Takes First Steps Toward a Post-Yucca Future*, GREENWIRE (Sept. 9, 2015), <http://www.eenews.net/stories/1060024406>; Hannah Northey, *DOE Team Crafting Strategy for Moving, Storing Reactor Waste*, E&E NEWS (Dec. 21, 2015), <http://www.eenews.net/stories/1060026610>.

184. Hannah Northey, *Escalating Legal Fees Alarm House Members*, E&E DAILY (Dec. 4, 2015), <http://www.eenews.net/eedaily/stories/1060028959>.

IV. NUCLEAR WASTE POLICY BY DEFAULT

The previous Section described how the scheme established by the Nuclear Waste Policy Act has gone awry. This Section examines how nuclear waste policy has been forged in its abeyance. It first explores how and where nuclear waste is stored in the absence of a repository and the problems associated with the accumulation of used nuclear fuel. It then turns to examine the federal government's ongoing liability for nuclear waste management in light of the breach of its contractual obligations to accept nuclear waste. Finally, it analyzes the possible effects of judicial determinations of such liability.

1. On-Site Waste Storage

Recall that when spent uranium exits a nuclear reactor, it is first stored in a cooling pool adjacent to the reactor and within the containment area of the power plant.¹⁸⁵ Most U.S. nuclear power plants were constructed with sufficient pool capacity to hold several decades' worth of used nuclear fuel.¹⁸⁶ After Congress passed the NWPA, power plant operators entered into contracts with the DOE, as required by the legislation, pursuant to which the DOE would collect waste from power plants after it had cooled enough to be removed from cooling pools. Underlying these contracts, of course, was the premise that a nuclear waste repository would be sited and completed on a reasonable time scale after the Act's passage. Hence the standard contracts provided that the agency would begin accepting spent nuclear fuel by January 31, 1998.¹⁸⁷

That 1998 deadline, of course, is long past and the DOE has not made good on its contractual commitment. As might well be expected, the cooling

185. See generally INT'L ATOMIC ENERGY AGENCY, SURVEY OF WET AND DRY SPENT FUEL STORAGE (1999) [hereinafter IAEA SURVEY]. The containment area is the portion of a nuclear power facility that is designed to completely secure radioactive materials and prevent leakage into adjacent soil and groundwater. See INT'L ATOMIC ENERGY AGENCY, DESIGN OF REACTOR CONTAINMENT SYSTEMS FOR NUCLEAR POWER PLANTS 3 (2004). Central containment areas are typically built with reinforced steel. See *Containment Structure*, U.S. NUCLEAR REGULATORY COMM'N, <http://www.nrc.gov/reading-rm/basic-ref/glossary/containment-structure.html> (last updated Jan. 18, 2017).

186. "The capacity of [at-reactor] wet storage pools varies between countries and is a function of the overall fuel management strategy at the time the facility was built . . . [Large storage capacity] is generally the result of the deferral by a country on decisions for reprocessing or disposal." See IAEA SURVEY, *supra* note 185, at 8.

187. 42 U.S.C. § 10222(a)(5) (2012); see also 10 C.F.R. § 961.11 (2016) (the standard contract).

pools at nuclear power plants are reaching, and in most cases have now surpassed, their storage capacity.¹⁸⁸ As these pools have filled, nuclear power plant operators have been forced to find alternative ways to safely store spent nuclear fuel.¹⁸⁹

They have not had many options. In the absence of a national repository, plants were more or less compelled to retain their spent fuel on site. Constructing additional cooling pools was not often possible due to space and design constraints within the containment area.¹⁹⁰ The most common initial step, then, was simply to increase the density of pool usage—to cram more fuel assemblies into the same cooling pools.¹⁹¹ But this was only a short-term fix, and long-term solutions would soon be required.

1. Dry Cask Storage

Nearly all plant operators, therefore, have been forced to employ dry cask storage. As the name implies, and as discussed earlier, this option involves the encasement of spent fuel rods within immense, steel-reinforced, concrete casks.¹⁹² Cask storage becomes feasible only after used fuel assemblies have

188. See generally GAO, SPENT NUCLEAR FUEL QUANTITIES, *supra* note 181. Aggregate storage within cooling pools has plateaued as they have reached their capacity; space in pools is generally now reserved for recently exhausted fuel, which must cool for several years before dry cask storage becomes viable. In addition, some pool space is always kept available for the fuel currently within the reactor so that it may be transferred into the cooling pool in the event of an unexpected shutdown. *See id.* at 511–14.

189. Additionally, as a legal matter, nuclear power plant operators have had to seek amendments to their operating licenses from the Nuclear Regulatory Commission in order to permit expansion of their on-site storage capacity. Without such permission, plants would be forced to shut down. *See, e.g.*, Minnesota v. NRC, 602 F.2d 412, 414 (D.C. Cir. 1979) (“Operators of nuclear plants have sought from the Nuclear Regulatory Commission license amendments permitting expansion of on-site spent fuel storage capacity. Otherwise, as is evident from the foregoing description, these nuclear plants, which were designed in contemplation of off-site shipment of spent fuel, would be forced to shut down when the limited on-site storage capacity was filled.”).

190. *See, e.g.*, IAEA SURVEY, *supra* note 185, at 4 (providing statistics on away-from-reactor wet spent fuel storage).

191. This process is referred to as “reracking.” At the Wolf Creek nuclear generating station in Kansas, for example, reracking allowed the storage of 2,368 fuel assemblies in a storage pool that was initially designed to hold 1,340 assemblies. Kan. Gas & Elec. Co. v. United States, 95 Fed. Cl. 257, 262, 266 (Fed. Cl. 2010). Based on scenarios of this sort, one analyst concludes that reactor pools will hold “enormous amounts of radioactivity, well more than original designs for decades to come.” ROBERT ALVAREZ, INST. POL’Y STUDS., SPENT NUCLEAR FUEL POOLS IN THE U.S.: REDUCING THE DEADLY RISKS OF STORAGE 21 (2011); *see also* IAEA SURVEY, *supra* note 185, at 2.

192. *See supra* text accompanying notes 61–63.

cooled for several years within a cooling pool.¹⁹³ Once enough heat has dissipated, the assemblies may safely be transferred into casks cooled not by circulated water but by convection.¹⁹⁴ The overwhelming majority of such casks are housed at the nuclear plants where the waste contained within them was generated, because the challenges associated with their transport and relocation are formidable.¹⁹⁵

Dry cask storage did not initially disrupt the regulatory framework in place at the time. U.S. nuclear waste policy has always envisioned limited on-site storage of fission byproducts, and the Nuclear Regulatory Commission began licensing dry-cask storage in 1985.¹⁹⁶ Since 1990, operating licenses for nuclear plants have by regulation included terms and conditions related to dry cask storage operations.¹⁹⁷ Furthermore, dry cask storage presents a number of advantages in comparison to “wet” storage inside cooling pools. First and foremost, it is “passive” in that it does not require active cooling.¹⁹⁸ The water within cooling pools must be circulated constantly to prevent meltdown; failure of pumping systems poses a catastrophic risk. In the Fukushima

193. Fuel assemblies may be transferred into casks as early as three years after their removal from the reactor core, but it is far more economical to wait longer. After ten years, for example, the amount of radioactive shielding required is much smaller, and casks designed for such use are substantially less expensive. *See MASS. INST. TECH.*, *supra* note 47, at 43–45. According to the Congressional Research Service, “the industry norm is about 10 years.” JAMES D. WERNER, CONG. RESEARCH SERV., R42513, U.S. SPENT NUCLEAR FUEL STORAGE 29 (2012).

194. *See IAEA SURVEY*, *supra* note 185, at 5 (“Heat removal is normally accomplished by forced or natural convection of air or gas over the exterior of the fuel containing units or storage cavities, and subsequently exhausting this air directly to the outside atmosphere or dissipating the heat via a secondary heat removal system.”).

195. Not all casks are transportable, and in any event, transportation away from power plant sites typically costs more, not less, than on-site storage. *See generally* U.S. NUCLEAR REGULATORY COMM’N, NUREG-2125, SPENT FUEL TRANSPORTATION RISK ASSESSMENT: FINAL REPORT (2014). Moreover, the transportation of spent nuclear fuel is itself a highly controversial matter. Just as communities adjacent to potential repository sites often mount “not-in-my-backyard” campaigns, those along likely waste transport routes have often lobbied hard for alternative routes. *See generally* PIERRE SALIK, RADIOACTIVE ROADS AND RAILS: HAULING NUCLEAR WASTE THROUGH OUR NEIGHBORHOODS 1 (2002) (finding that “the transportation component of the Yucca Mountain project poses serious risks to the health and safety of a large cross-section of Americans, as well as to the environment”); Allison Macfarlane, *Interim Storage of Spent Fuel in the United States*, 26 ANN. REV. ENERGY ENV’T 201, 224 (2001) (noting that transportation costs may amount to 40–50% of the cost of a centralized waste facility).

196. *See* Macfarlane, *supra* note 195, at 210.

197. *Id.* at 207; *see also* Spent Fuel Storage Licensing, U.S. NUCLEAR REGULATORY COMM’N, <http://www.nrc.gov/waste/spent-fuel-storage/licensing.html> (last updated Oct. 12, 2016) (“A general license authorizes a nuclear power plant licensee to store spent fuel in NRC-approved casks at a site that is licensed to operate a power reactor under 10 CFR Part 50”).

198. *See* Macfarlane, *supra* note 195, at 210–211.

disaster, for example, the diesel generators that backed up the electric power supplied to the pumps for the cooling pools were inundated by the waters of the tsunami. When these generators failed, the pumps stopped functioning, the cooling water evaporated, and the spent fuel melted down.¹⁹⁹ Dry cask storage, by contrast, does not require electric power or even human supervision. Dry casks are commonly placed on concrete slabs located outside the innermost containment areas of the nuclear power plant, thus eliminating the need for scarce square footage within the containment area.²⁰⁰

But as dry cask storage has increased, serious concerns have arisen. Many have argued that dry casks are vulnerable to sabotage or terrorist attack, or perhaps even theft during transportation.²⁰¹ These threats have been the focus of substantial inquiry at the NRC, and the Commission has taken a number of steps to minimize them.²⁰² A much more vexing challenge, however, arises from the simple fact that when a dry cask is loaded with spent fuel, no one knows whether, when, how, or where that cask will be emptied. This reality presents cask designers and plant operators with a serious burden, because there is a great deal of uncertainty about what happens to nuclear fuel assemblies, and the casks that contain them, over long time periods.

These concerns have intensified as more and more nuclear power plants switch to so-called high burnup fuel (HBF),²⁰³ which has been found to corrode the cladding around fuel assemblies much more rapidly than conventional fuels.²⁰⁴ The U.S. Department of Energy is proceeding with tests

199. ALVAREZ, *supra* note 191, at 4–8.

200. NAT'L RESEARCH COUNCIL, SAFETY AND SECURITY OF COMMERCIAL SPENT NUCLEAR FUEL STORAGE: PUBLIC REPORT 63 (2006). Much of the public concern regarding dry cask storage results from the fact that casks are generally stored outdoors in plain sight, on open concrete pads, sometimes just meters away from the edge of a nuclear power facility. *Id.*

201. *Id.* at 25–37; Macfarlane, *supra* note 195, at 218–19.

202. Concern about extraordinary disasters spiked after both the attacks of September 11, 2001, and the Fukushima tsunami and ensuing nuclear disaster. See Peter Behr, *The ‘Fukushima Effect’ Promises More Safety Scrutiny for U.S. Reactors*, CLIMATEWIRE (May 12, 2011), <http://www.eenews.net/climatewire/stories/1059948922>. For an essay describing the regulatory response to Fukushima in the United States, see Emily Hammond, *Nuclear Power, Risk, and Retroactivity*, 48 VAND. J. TRANSNAT'L L. 1059, 1060–64 (2015); see also Davies, *supra* note 40, at 1937–40.

203. MASS. INST. TECH., *supra* note 47, at 68.

204. “High burnup fuel rods stay hotter longer, emit more radioactivity, and may become brittle, scientists suspect, as the cladding that holds them together endures greater stresses.” Jeff McMahon, *Fancy New Lids for Nuclear Waste Casks, As Contents Get Hotter*, FORBES (May 2, 2013, 1:02 PM), <http://www.forbes.com/sites/jeffmcmahon/2013/05/02/fancy-new-lids-for-nuclear-waste-casks-as-contents-get-hotter/>; see also MICHAEL BILLONE ET AL., ARGONNE NAT'L LAB., CLADDING EMBRITTLEMENT DURING POSTULATED LOSS-OF-COOLANT ACCIDENTS, at v (2007).

to evaluate how dry casks perform when loaded with HBF, but it is exceedingly difficult to monitor the interior condition of dry casks.²⁰⁵ Thus far, testing has shown that the risks associated with corrosion remain elevated for at least 20–25 years.²⁰⁶ But tests conducted over relatively short time frames can only yield guesses as to the degree of cask degradation that may occur over longer periods.

In short, despite ongoing doubts, almost all spent fuel currently being loaded into dry casks is HBF, elevating the risk that fuel assemblies will deteriorate significantly while in the cask.²⁰⁷ The magnitude of the risk is difficult to assess, but obviously it increases as casks age. The mere possibility of fuel assembly degradation substantially increases the risks and expenses associated with transporting casks and with reloading, repackaging, or permanently disposing of their contents.²⁰⁸ Even without these added risks, dry casks are exceedingly heavy and therefore very difficult to transport; at present, no standard mode of long-distance cask transport yet exists. Yet nuclear power plant operators continue to load dry casks with HBF because they have no other real choice. And since there is no national waste management facility ready to receive dry casks, experts simply do not know how long casks will need to retain their integrity.²⁰⁹ For all its benefits, then, dry cask storage represents a stark acknowledgement that the DOE will not begin collecting waste anytime soon.

2. Waste Confidence

This fundamental uncertainty about the ultimate duration of on-site storage of spent nuclear fuel has plagued the NWPA regime since its

205. McMahon, *supra* note 204.

206. O.K. CHOPRA ET AL., ARGONNE NAT'L LAB., MANAGING AGING EFFECTS ON DRY CASK STORAGE SYSTEMS FOR EXTENDED LONG-TERM STORAGE AND TRANSPORTATION OF USED FUEL, at iv (2014) (“The possibility of hydride reprecipitation diminishes only after the cladding temperature has dropped below 200° C (392° F) because of the decrease of fission-product decay heat during prolonged cooling, which may occur 20–25 years after the high-burnup used-fuel assemblies are placed in dry storage. Information on operating experience with long-term storage of high-burnup used fuel assemblies is needed to better understand this phenomenon.”).

207. ELEC. POWER RESEARCH INST., HIGH BURNUP DRY STORAGE CASK RESEARCH AND DEVELOPMENT PROJECT ES-1 (2014).

208. As to the difficulties associated with transportation, see generally CHOPRA ET AL., *supra* note 206.

209. Rodney C. Ewing & Frank N. von Hippel, *Nuclear Waste Management in the United States—Starting Over*, 325 SCI. 151, 151 (2009) (“Few are comfortable . . . with the idea of indefinite storage of [spent nuclear fuel] and [high level waste] on the surface at about 80 locations.”).

inception. The Act's central provisions mandate the removal of waste from power plants and waste entombment at a federally owned and operated repository. In the absence of this repository, the Nuclear Regulatory Commission for decades has worked to establish that nuclear power plants are safe interim storage sites, and can remain so until a repository is completed. Even before the NWPA's enactment, federal courts required the NRC to articulate the basis for its confidence that nuclear plant licensing could continue safely without a completed repository.²¹⁰ In an important 1979 decision, *Minnesota v. NRC*, the Federal Court of Appeals for the District of Columbia Circuit remanded several licensing decisions to the Commission and directed it to consider "whether there is reasonable assurance that an off-site storage solution [for spent nuclear fuel] will be available by . . . the expiration of the plants' operating licenses, and if not, whether there is reasonable assurance that the fuel can be stored safely at the sites beyond those dates."²¹¹ The basis of this obligation is the National Environmental Policy Act, which requires federal agencies to conduct robust environmental analyses of "major federal actions significantly affecting the quality of the human environment."²¹²

Since the 1979 decision, the NRC has chosen to satisfy its NEPA obligation in regards to on-site storage not by issuing individual environmental impact statements, but by way of a generic rulemaking known as the "Waste Confidence Decision."²¹³ Its first rule, issued in 1984, assumed that a repository would be ready by 2007–2009.²¹⁴ In 1990, the NRC updated its rule in light of delays in the Yucca Mountain process; its new estimate was that the repository would be open by 2025.²¹⁵ After the Yucca Mountain process stalled in 2009, the NRC had to go back to the drawing board once more, this time faced squarely with the reality that the siting process appeared to be indefinitely halted. In its 2010 update of the Waste Confidence Decision, the Commission abandoned its effort to divine the date of

210. See *Minnesota v. NRC*, 602 F.2d 412, 418 (D.C. Cir. 1979). Those arguing on the side of caution wanted licensing activities to cease until a repository had been completed. See CAMPBELL, *supra* note 11, at 120–35.

211. *Minnesota v. NRC*, 602 F.2d at 418.

212. National Environmental Policy Act, 42 U.S.C. § 4332(2)(c) (2012). The output of the NEPA process is the environmental impact statement (EIS). *See id.* The legal sufficiency of an EIS is often litigated. *See, e.g.*, Nat'l Parks & Conservation Ass'n v. Bureau of Land Mgmt., 606 F.3d 1058, 1069–75 (9th Cir. 2010).

213. Hillary H. Harnett, Comment, *New York v. NRC*, 37 HARV. ENVTL. L. REV. 589, 592–94 (2013).

214. Waste Confidence Decision, 49 Fed. Reg. 34,658, 34,658 (Aug. 31, 1984).

215. Waste Confidence Decision Review, 55 Fed. Reg. 38,474, 38,474 (Sept. 18, 1990).

completion of a repository and instead declared that a repository would be ready “when necessary.”²¹⁶ This was too much for New York and several other states, which sued the NRC for its failure to consider the environmental implications of de facto permanent storage of nuclear waste at nuclear power plants.²¹⁷

Yet again, the D.C. Circuit Court of Appeals agreed that the NRC had failed to meet its obligations under NEPA.²¹⁸ In essence, the court found that the NRC did not adequately address the possibility that temporary, on-site storage facilities would become permanent due to the failure of the repository siting process.²¹⁹ Weeks later, the Commission imposed a moratorium on licensing decisions in order to confront the matters raised by the court’s opinion.²²⁰ Although the NRC approved an updated waste rule several years later,²²¹ there remained doubts among the commissioners about the rule’s environmental analysis,²²² and after its promulgation more lawsuits poured in.²²³

Although most Americans are relatively unaware of the risks associated with on-site storage of nuclear waste, there is one constituency that has consistently taken notice. Neighbors of nuclear plants, awakening to the reality that those plants will themselves serve as de facto waste repositories, have begun to resist the on-site storage regime.²²⁴ For example, when San

216. See Waste Confidence Decision Update, 75 Fed. Reg. 81,037, 81,038 (Dec. 23, 2010).

217. Jenny Mandel, *3 States Sue NRC Over Extended Storage*, E&E News (Feb. 15, 2011), <http://www.eenews.net/eenewspm/stories/1059945312>.

218. *New York v. U.S. Nuclear Regulatory Comm’n*, 681 F.3d 471, 473 (D.C. Cir. 2012); see also Katherine A. Trisolini, *Decisions, Disasters, and Deference: Rethinking Agency Expertise After Fukushima*, 33 YALE L. & POL’Y REV. 323, 373–78 (2015) (discussing failures in the NRC’s Waste Confidence rulemaking process).

219. *New York v. U.S. Nuclear Regulatory Comm’n*, 681 F.3d at 479.

220. Hannah Northey, *NRC Halts Licensing Decisions Amid Storage Debate*, GREENWIRE (Aug. 7, 2012), <http://www.eenews.net/stories/1059968492>.

221. *Continued Storage of Spent Nuclear Fuel*, 79 Fed. Reg. 56,238 (Sept. 19, 2014); see also Hannah Northey, *NRC Finalizes Waste Rule, Lets Licensing Decisions Resume*, GREENWIRE (Aug. 26, 2014), <http://www.eenews.net/stories/1060004936>.

222. Northey, *supra* note 221 (“[NRC Chairwoman Allison] Macfarlane took issue with the staff’s conclusion in [its] ‘general environmental impact statement’ that adverse environmental effects of storing waste for any period of time is ‘small,’ adding that such an assertion would indicate a deep geological repository is not necessary—when in fact it is.”).

223. Hannah Northey, *Green Groups Join States’ Fight Against NRC Waste Rule*, E&E NEWS, Oct. 29, 2014.

224. Most circuits have held that the Price-Anderson Act preempts state law causes of action for claims arising from nuclear incidents. See *In re Berg Litig.*, 293 F.3d 1127, 1132 (9th Cir. 2002); Roberts v. Fla. Power & Light Co., 146 F.3d 1305, 1306 (11th Cir. 1998); O’Conner v. Commonwealth Edison Co., 13 F.3d 1090, 1100 (7th Cir. 1994). But see Cook v. Rockwell Int’l

Diego's San Onofre Nuclear Generating Station was shut down after the discovery of a small radiation leak in 2012, community members began a long, contentious debate with plant operators and regulators about where its waste stockpile would go.²²⁵ Despite enormous community opposition, Southern California Edison, the utility that operates the plant, has secured regulatory approval to keep the waste on-site indefinitely.²²⁶

Long-term, on-site storage was not part of the initial NWPA bargain. But as efforts to site a repository have run aground, national waste policy is being made by default. As nuclear neighbors have learned, the lack of a national waste facility means that large quantities of radioactive waste will be stored indefinitely at nuclear power plants not designed for that purpose.

D. Federal Liability for Breach of Contract

The NWPA required the DOE to begin accepting spent nuclear fuel from nuclear power plants by early 1998.²²⁷ That deadline unmet, the DOE has been in breach of its contractual obligation ever since.²²⁸ As this section will explain, the Department has paid out vast sums in liability for breach and will continue to do so for many years to come.²²⁹ In other words, the failure to build a repository has shifted the financial burden of nuclear waste management from nuclear power plants to federal taxpayers. This shift is inconsistent with the NWPA, which provided that the expenses associated with the national repository would be borne exclusively by nuclear power plants themselves (and thus their ratepayers) under the Nuclear Waste Fund.

Utility companies began filing breach of contract actions against the federal government shortly after the 1998 deadline passed. In 2000, the Court of Appeals for the Federal Circuit ruled for the first time that the DOE's delay

Corp., 790 F.3d 1088, 1099 (10th Cir. 2015) (holding that the Price-Anderson Act does not supplant state law nuisance claims).

225. *See supra* note 23.

226. Morgan Lee, *State OKs Burying Nuclear Waste at Beach*, SAN DIEGO UNION-TRIB., (Oct. 6, 2015, 9:38 PM), <http://www.sandiegouniontribune.com/sdut-nuclear-waste-permit-approved-2015oct06-story.html> (noting site approval by the California Coastal Commission).

227. 42 U.S.C. § 10222(a)(5) (2012); *see also* 10 C.F.R. § 961.11 (the standard contract).

228. *See generally* TODD GARVEY, CONG. RESEARCH SERV., CONTRACT LIABILITY ARISING FROM THE NUCLEAR WASTE POLICY ACT (NWPA) OF 1982 (2012), <http://www.thenwsc.org/ym/YM%20CRS%20Report.%20Litigations%20122209.pdf>.

229. *Id.* at 16–17; *see also* MARK HOLT, CONG. RESEARCH SERV., RL 33461, CIVILIAN NUCLEAR WASTE DISPOSAL 10–11 (2015), <https://fas.org/sgp/crs/misc/RL33461.pdf>. (noting that the Department of Energy “estimates that its potential liabilities for waste program delays could total as much as \$27.1 billion”).

in accepting spent nuclear fuel did, in fact, constitute a partial breach of contract for which damages would be required.²³⁰ Since then, nuclear plant operators have filed many dozens of suits to recover costs incurred as a result of the delay.²³¹ These suits involve the expenses that operators have incurred to store spent nuclear fuel which, had DOE performed its contractual obligations in a timely manner, would have been accepted by DOE and removed from the operators' premises.

The amount of federal liability is staggering. Already damage payments for nuclear waste management have totaled roughly \$5.3 billion,²³² but the overwhelming majority of utilities' claims remain outstanding. DOE itself now estimates its total liability at \$29 billion—and that estimate is premised on the federal government's readiness to accept waste by 2025.²³³ The nuclear power industry projects damages in excess of \$50 billion.²³⁴ Although the DOE disputes the industry's estimate, the DOE's official estimates have risen substantially in recent years and will continue to do so as long as no progress is made towards waste collection.²³⁵ The ultimate extent of federal liability, of course, will depend on how long nuclear power plants must manage their

230. *Me. Yankee Atomic Power Co. v. United States*, 225 F.3d 1336, 1341–42 (Fed. Cir. 2000). The DOE had long disavowed any contractual obligation to accept waste if it did not have an operational repository. *See, e.g.*, Final Interpretation of Nuclear Waste Acceptance Issues, 60 Fed. Reg. 21,793 (May 3, 1995). The Department “interpreted the NWPA to mean that the statutory deadline did not apply if DOE did not have a facility available to accept nuclear waste by that date.” *Neb. Pub. Power Dist. v. United States*, 590 F.3d 1357, 1361 (Fed. Cir. 2010).

231. Because the Federal Circuit deemed the breach to be partial rather than total, and because courts have been reluctant to speculate as to when the DOE might begin collecting waste, operators must bring new actions at least every six years in order to fully recoup their costs. *See Ind. Mich. Power Co. v. United States*, 422 F.3d 1369, 1376–78 (Fed. Cir. 2005); Michael F. Hertz, Deputy Asst. Atty. Gen., Dept. of Justice, Statement Before the Blue Ribbon Commission on America’s Nuclear Future, 2–3 (Feb. 2, 2011); *see also* Marcia Coyle, *Nuclear-Fuel Lawsuits Spawn Damage Award Fallout*, NAT’L L.J. (Aug. 23, 2006), http://www.yuccamountain.org/pdf-news/lawsuits_082306.pdf (quoting a litigant as commenting that “[s]ince there is the possibility of performance tomorrow, the courts said, ‘If we award damages for the next 10 years and then DOE actually performs in five years, you might end up with a windfall. Let’s not speculate about when they will perform’”).

232. KIM CAWLEY & MEGAN CARROLL, THE FEDERAL GOVERNMENT’S RESPONSIBILITIES AND LIABILITIES UNDER THE NUCLEAR WASTE POLICY ACT 1 (Bo Peery ed., 2015), https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/reports/51035-NuclearWaste_Testimony.pdf.

233. *Id.* at 2.

234. Mark Fahey, *How the Department of Energy Became a Major Taxpayer Liability*, CNBC (Jul. 6, 2016, 8:00 AM), <http://www.cnbc.com/2016/07/05/how-the-department-of-energy-became-a-major-taxpayer-liability.html>.

235. Northey, *supra* note 184.

own waste on-site; each additional year of delay adds to the government's tab.²³⁶

The enormous federal liability is somewhat ironic in light of the fact that the Nuclear Waste Fund, the Fund created by the NWPA to cover the cost of a national repository, still contains over \$34 billion.²³⁷ Numerous regulators and legislators have made the case that federal liability payments for breach of contract should be paid out of the Fund,²³⁸ but in 2002 a federal court held that the NWPA did not permit this use of the Fund.²³⁹ Adding yet further irony, a federal court recently suspended the collection of fees into the Fund, citing the federal government's failure to justify the fee in the absence of an identifiable plan for waste management.²⁴⁰ If those payments are not restarted soon, the federal government could well lose entirely the opportunity to compel nuclear power plants to complete their payment for an eventual repository—leaving the remainder of that expense, too, with federal taxpayers.²⁴¹

To summarize: because of the federal government's failure to complete a nuclear waste solution, federal taxpayers—rather than ratepayers who buy electricity from nuclear power plants—will have to pay tens of billions of dollars to pay for nuclear waste management. This too is a facet of nuclear waste policy made by default. To be sure, taxpayers have underwritten the civilian nuclear power industry to some degree since its very inception. When the development of nuclear technology became a shared private-public enterprise in the 1950s, many argued that government, in order to encourage the commercialization of nuclear energy, needed to partially indemnify private enterprises from the incredible liabilities that could arise from a

236. CAWLEY & CARROLL, *supra* note 232, at 6 (“[Without] programmatic changes or appropriations for DOE to pursue a waste management strategy consistent with the NWPA . . . spending from the Judgment Fund—through which taxpayers effectively pay utilities for on-site storage of nuclear waste—will probably exceed DOE’s current \$29 billion estimate of the government’s aggregate liability and result in continued substantial outlays over many decades.”).

237. *Id.* at 3.

238. See, e.g., Ala. Power Co. v. United States, 307 F.3d 1300, 1306 (11th Cir. 2002) (noting that DOE tried to settle claims by using the Fund).

239. *Id.* at 1312–13.

240. Nat’l Ass’n of Regulatory Util. Comm’rs v. U.S. Dept. of Energy, 736 F.3d 517, 521 (D.C. Cir. 2013).

241. CAWLEY & CARROLL, *supra* note 232, at 6 (“The opportunity to collect fees for waste generated by existing nuclear power plants will end when they reach the end of their NRC license extension (or the end of their economically useful life) and cease operations—probably in the 2030s and 2040s.”).

nuclear accident.²⁴² This principle was enacted into law by the Price-Anderson Nuclear Industries Indemnity Act of 1957.²⁴³ The Price-Anderson Act's objective was to foster the development of nuclear energy by, in essence, providing a public indemnification arrangement for private firms. Private investors were unwilling to shoulder the enormous risks inherent in nuclear technology; the public, via this act of Congress, agreed to take on the risks above the threshold defined by the Act.²⁴⁴

But nuclear policy by default has no such democratic pedigree. The public's representatives in Congress made no affirmative decision to pay for nuclear waste management. The shift of the cost burdens of nuclear waste that has taken place since 1998 received no vote in Congress. And because federal payments are legally characterized as breach of contract liabilities, there is no simple way for Congress to legislate its way around the problem.²⁴⁵

242. See Philip R. Yeany, *Under Fire: The Price-Anderson Act*, 4 ENVTL. POL'Y & L. 115, 115–16 (1978).

243. Pub. L. No. 85-256, 71 Stat. 576 (codified as amended at 42 U.S.C. § 2210 (2012)).

244. 42 U.S.C. § 2210(b)(1) (2006). Under the statute, firms pay annual premiums for the current maximum private insurance coverage of \$375 million per reactor. (Technically, all facilities must purchase the maximum private insurance available at a "reasonable cost"—a number which will vary if the facility is smaller than a typical energy producing plant. At present, \$375 million is the maximum amount—per reactor—available from private insurers.) Companies pay a premium for each reactor facility, based upon the number of reactors present. Currently, the average premium of a single-unit facility is \$860,000; after an incident, the premium amount a single company pays cannot be more than \$95,800,000. In addition, all firms are liable collectively for what the Act calls "excess loss"—loss in excess of that covered by private insurance. This liability essentially creates a shared risk fund—a second tier of coverage that takes effect if the damages arising in connection with a nuclear accident exceed \$375 million. Under such circumstances, all companies paying into the risk fund will essentially pay a prorated amount to cover the excess. Every operator would be charged a retrospective premium equal to its proportionate share of the excess loss (proportionality is based on the number of covered nuclear reactors), up to a maximum of \$121.3 million per reactor, and to be paid in annual installments no greater than \$17.5 million per year. At present, the fund would provide over \$13.6 billion in total. *Need for Nuclear Liability Insurance*, AM. NUCLEAR INS., <http://www.annucins.com/download/need-for-nuclear-liability-insurance/> (last updated May 7, 2015).

As a hypothetical, imagine a major nuclear accident on the scale of the Fukushima incident in 2011. Suppose that damages totaled \$50 billion. Assuming the company that owned the facility had only that single reactor, the first \$375 million in damages would be paid by that company's private insurance from ANI. All other nuclear operators in the United States would then satisfy their obligations to the ANI-managed second tier fund up to its current limit of \$13.6 billion. As to the remaining \$36 billion in damages? These damages would be paid by taxpayers via the general fund.

245. Any legislative attempt to redirect this liability towards nuclear utilities would almost certainly invite challenge under the Contracts and Takings Clauses. See Richard B. Stewart &

E. The Federal Circuit and Waste Management

The Department of Energy's breach of contract has led to enormous taxpayer liability. But it has also entailed another interesting and important development. The steady line of lawsuits in the Federal Court of Claims and the Federal Circuit Court of Appeals, suits which plumb the precise contours of federal liability, raise the possibility that the federal courts are making de facto nuclear waste management decisions under breach of contract doctrine.

To understand why, we must examine briefly the lawsuits that nuclear plant operators have brought against the Department of Energy. The bulk of these cost recovery actions against the DOE seek reimbursement for costs associated with dry cask storage.²⁴⁶ Nuclear power plant operators have had to purchase dry casks, build storage platforms for these casks, develop safe ways to load the casks and move them to the storage platforms, and so forth.²⁴⁷ For example, in *Energy Northwest v. United States*, the plant operator sued the DOE to recover some \$3 million in "loading" fees—expenses incurred in repositioning some dry storage casks due to a lack of space.²⁴⁸ The DOE has settled some claims but has actively challenged others, including some that involve fundamental operating decisions at nuclear facilities.²⁴⁹

Federal courts are thus placed in an unusual position. On one side are nuclear operators seeking to recover costs associated with safety and storage measures that they deem necessary. On the other side is the federal government trying to limit its liability. In this context, judicial determinations of liability may well feed back into operational decisions. Suppose that a plant operator, in an abundance of caution, incurs costs associated with the safest possible means of packing nuclear waste into dry casks. Suppose that the federal government takes the position that a cheaper but less secure method was available. The court would have to decide whether the plant operator had appropriately mitigated the damages attributable to the government's breach, and in so doing would likely affect similar decisions subsequently faced by operators of other plants.

The unintended consequences that may be invited by this sort of litigation are not hard to see. Let us examine, by way of example, a recent suit brought

Jane B. Stewart, *Solving the Spent Nuclear Fuel Impasse*, 21 N.Y.U. ENVTL. L.J. 1, 128–38 (2014).

246. Hertz, *supra* note 231, at 3–4.

247. *Id.* at 4 ("The [litigated] costs include the capital costs to construct dry storage facilities or additional wet storage racks, costs to purchase and load casks and canisters and costs of utility personnel necessary to design, license and maintain these storage facilities.").

248. Energy Nw. v. United States, 115 Fed. Cl. 69, 70 (Fed. Cl. 2014).

249. Hertz, *supra* note 231, at 6 (charting the status of spent nuclear fuel litigation).

by Carolina Power & Light (CP&L) in the Court of Federal Claims.²⁵⁰ CP&L and its affiliates (all now owned by Duke Energy) operate four nuclear power plants in Florida and North Carolina (the Harris, Brunswick, Robinson, and Crystal River plants) and brought suit against the United States, claiming damages in excess of \$104 million for costs incurred between 2006 and 2010.²⁵¹ The damages claimed were described by the court this way:

- (1) \$66,375,235 to complete construction of an Independent Spent Fuel Storage Installation at Brunswick; (2) \$7,760,680 to expand and load spent fuel onto the dry storage facility at Robinson; (3) \$21,143,250 to design, engineer, and develop a dry storage facility at Crystal River; (4) \$4,291,417 for the procurement and installation of additional racks in the Harris C spent fuel pool; and (5) \$5,420,926 to conduct transshipments of spent fuel from the Brunswick to Harris plant.²⁵²

The court awarded nearly all of the claimed damages, but disallowed several elements:

The Court has disallowed three elements of Plaintiffs' damages claims. For these items: the Brunswick computer system replacement; the Brunswick crane studies; and the Crystal River 3 mobile BRE, the Court concludes that Plaintiffs would have incurred these expenses for other reasons absent DOE's partial breach.²⁵³

Notice what is going on here. The court is deciding which of these expenses would have been incurred by CP&L even if the DOE had performed its contractual obligations. The court concludes, for example, that the DOE is not obligated to reimburse CP&L for costs incurred to study the adequacy of its cranes at the Brunswick Nuclear Plant.²⁵⁴ Here is the court's description of that expense:

250. Carolina Power & Light Co. v. United States, 115 Fed. Cl. 57, 59 (Fed. Cl. 2014).

251. *Id.* This is so-called "round 2" litigation in that federal liability for breach was already established in earlier litigation. See generally Carolina Power & Light Co. v. United States, 98 Fed. Cl. 785 (Fed. Cl. 2011); Carolina Power & Light Co. v. United States, 82 Fed. Cl. 23 (Fed. Cl. 2008). The earlier litigation covered damages claimed through 2005. *Carolina Power & Light*, 115 Fed. Cl. at 59. A "round 3" suit has already been filed for costs incurred from 2011–2013. Carolina Bolado, *Duke Units File 3rd Spent Nuclear Fuel Suit Against DOE*, LAW360 (Oct. 17, 2014), <http://www.law360.com/articles/587860/duke-units-file-3rd-spent-nuclear-fuel-suit-against-doe>.

252. *Carolina Power & Light*, 115 Fed. Cl. at 59–60.

253. *Id.* at 60.

254. *Id.*

Prior to DOE's partial breach, Progress Energy used two 125-ton Brunswick cranes to load 75-ton casks for shipment to the Harris site. As part of the Brunswick dry storage project, Progress Energy concluded that it would be prudent to determine if its existing cranes were qualified to lift the heavier 110-ton dry-storage casks. The crane review revealed problems with the structural design of the Units 1 and 2 cranes—conditions that existed since the plant began operations. As a result of the Brunswick crane studies, Progress Energy temporarily downgraded the cranes to 40 tons and made modifications addressing newly discovered issues, such as seismic and wind loads, to restore the cranes to their original capacity. Based on the studies, Progress Energy also found it necessary to replace the wire ropes to prepare for lifting the 110-ton dry-storage casks.²⁵⁵

The court ultimately concluded that CP&L would have needed to study its cranes even if the DOE had not breached the contract, and that therefore the DOE was not liable for this expense.²⁵⁶

There is nothing particularly out of the ordinary in the court's conclusion or its analysis, but it is somewhat disquieting to find a federal court determining whether or not taxpayers must pay for a nuclear plant operator's study of its cranes. Determinations of this sort will inevitably bear on subsequent decision making by plant operators. To be sure, CP&L can, in all likelihood, recover the cost of its crane studies from its ratepayers.²⁵⁷ But CP&L operates in states that still have traditional utility regulation.²⁵⁸ Many states have restructured their energy sectors; in these jurisdictions, electricity generators are no longer assured that they will recover their costs through a regulatory process but must instead compete on the open market.²⁵⁹ A nuclear

255. *Id.* at 62.

256. *Id.* at 60.

257. Traditionally, state utility commissions set the rates that utilities may charge for electricity, taking into account the costs that the utilities incur and allowing a reasonable return. *See generally* CHARLES F. PHILLIPS, JR., THE REGULATION OF PUBLIC UTILITIES (1993).

258. The nuclear power plants involved in the CP&L litigation are located in Florida and North Carolina. Neither state has taken legislative action with regards to restructuring since 2001. *See Status of Electricity Restructuring by State*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/electricity/policies/restructuring/restructure_elect.html (last updated Sept. 2010).

259. In the 1980s and 90s, FERC took steps to open wholesale power markets to competition. *See generally* RICHARD F. HIRSH, POWER LOSS: THE ORIGINS OF DEREGULATION AND RESTRUCTURING IN THE AMERICAN UTILITY SYSTEM (1999). A number of states followed FERC's lead and moved to restructure retail markets within the state as well. In these states, electric utilities were generally required to divest some or all of their power generating facilities. These facilities were thus compelled to sell power into competitive wholesale markets overseen by

plant operator in a restructured state faces cost pressures that CP&L may escape. One would hope that a nuclear plant's operators would always make decisions they deem necessary from the standpoint of public safety, whatever the costs. But especially for nuclear plants in competitive energy markets, the fact remains that judicial determinations in this space may apply some downward pressure on safety-related expenditures.²⁶⁰

V. ANALYSIS: CHECKS, BALANCES, AND NUCLEAR WASTE

The NWPA process is at a standstill. Very few wish for it to be revived. With the NWPA in disuse, nuclear waste policy has been made by default. It is the product of a series of ad hoc decisions made by industry actors, federal regulators, and federal courts. At the heart of the default regime is long-term nuclear waste storage at nuclear power plants, with the costs covered by federal taxpayers under the supervisory authority of the courts of the Federal Circuit.

The situation is troubling in a variety of respects: nine billion dollars spent on a repository in the Nevada desert with nothing to show for it; a federal government in breach of contract for nearly twenty years, resulting in tens of billions of dollars of taxpayer liability; mounting stockpiles of radioactive waste at power plants all around the country; federal courts making determinations about financial liability that may inadvertently make nuclear plants less safe. And perhaps worst of all is that the resulting scenario, though emerging out of duly-adopted legislation forged by the peoples' elected representatives, bears none of the marks of that legislation but instead has arisen by default. This section explores the causes and implications of the legislation's failure.

One of the primary reasons that the Nuclear Waste Policy Act has failed to achieve its objectives is that the Act includes a number of mechanisms that can cut short the Act's siting processes. As we have seen, the Act establishes

FERC, rather than provide power only to captive customers in service areas assigned by the state utility commissions. For a general description of restructuring in the electricity sector, see generally CAPTURING THE POWER OF ELECTRIC RESTRUCTURING (Joey Lee Miranda ed., 12th ed. 2009). Nuclear power plants have found it difficult to compete in these wholesale markets, and several have closed as a result. See, e.g., Diane Cardwell, *Exelon to Close 2 Nuclear Plants in Illinois*, N.Y. TIMES (June 2, 2016), http://www.nytimes.com/2016/06/03/business/exelon-to-close-2-nuclear-plants-in-illinois.html?_r=0.

260. The Nuclear Regulatory Commission promulgates rules that cover many aspects of nuclear power plant operation. The bulk of these rules can be found in Title 10 of the Code of Federal Regulation. Nevertheless, many operating decisions, including many that impact the safety of the plant's operation, remain within the discretion of the plant operator.

a lengthy bureaucratic process for siting a geologic repository. Before construction can begin, a site requires several iterations of formal approval by the President, the Congress, the Nuclear Regulatory Commission, and the Department of Energy.²⁶¹ Although the acquiescence of the host state is not a formal requirement, we have seen that the Act opens many avenues, both legal and political, by which a site opponent might object.

These requirements resemble the checks and balances that drive the legislative process, and they serve similar purposes. The Constitution creates “[a] political system where statutes must pass through a variety of institutional filters, each motivated by somewhat different incentives and interests.”²⁶² These filters, in the founders’ vision, ensured that national legislation represented the agreement of a wide range of constituencies.²⁶³ Similarly, the NWPA’s siting process was geared towards achieving broad social and technical support for site candidates in order to overcome public concerns about nuclear waste.²⁶⁴

The fundamental problem with a sequence of institutional filters is that each filter multiplies the opportunities for interference with a legally prescribed process, making it much more likely that policy is made by default processes—that is, by whatever background processes of law and administration operate when the prescribed process fails. In the broader constitutional context, political scientists refer to this as a “status quo bias”: a systemic bias in favor of the existing state of affairs, arising from the fact that changing the law is, in the American legal system, very difficult to accomplish.²⁶⁵ This bias is created by the Article I legislative process and the

261. *See supra* Part III.A.

262. Eskridge, *supra* note 5, at 757. These filters include the bicameralism and presentment requirements of Article I, Section 7, as well as the chamber-specific rules adopted pursuant to Article I, Section 5, Clause 2. Under these rules, Eskridge counts “at least nine major points where bills can be vetoed, usually without the need to secure a majority vote against the bill.” *Id.* at 758.

263. *Id.* at 762 (explaining the rationale behind veto gates under various political theories).

264. Myers, *supra* note 112, at 20.

265. The importance of such filters has been illuminated by a line of work in political science, which takes as its point of departure the observation that policy systems in the United States display a great deal of stability, to a degree seemingly incommensurate with the rapid changes in political mood and personnel reflected in popular elections. *See generally* WILLIAM H. RIKER, LIBERALISM AGAINST POPULISM: A CONFRONTATION BETWEEN THE THEORY OF DEMOCRACY AND THE THEORY OF SOCIAL CHOICE (1982). What is responsible for the stability that we actually observe, i.e., the difficulty in changing law? The answer: political institutions. (In the parlance of political science, “institution” is not synonymous with organization; rather, an institution is any formal “rule of the game” that structures how political authority works, such as the president’s veto power or the Senate’s filibuster rule.) Institutions embody compromises and deals cut by prior actors, and come with a certain amount of inertia. Each point of action formally required by

rules adopted by each chamber of Congress. Scholars have long recognized that the many “veto gates” in the legislative process allow a number of political actors the opportunity to thwart legislative proposals.²⁶⁶ It is far easier to block legislation than to pass it. In this institutional environment, the status quo reigns.

But there is a crucial distinction between the constitutionally ordained checks and balances of Article I and the statutorily imposed checks and balances of the sort that plague the NWPA. In the first case, checks and balances ensure democratic legitimacy. Successful legislation must gain the approval of a broad coalition of political actors representing a diverse group of states, voters, interests, and political institutions. But in the second case, excessive opportunities for interference may have nearly the opposite effect. They can render useless a legislated compromise, leaving policy to be forged instead by the free play of background processes of law and administration. Default policy of this sort suffers from a democratic deficit. It is not the carefully considered product of legislative deliberation. It may be, as in the case of nuclear waste policy, a detrimental policy that appeals to virtually no one.

There are several important rejoinders to this sort of claim. First, some might point out that when political checks are exercised, the system is working exactly as designed. When Nevada finally seized the political opportunity to terminate the Yucca Mountain project, it did so by making use of the legal and political tools available—and indeed, the NWPA provided numerous mechanisms to truncate its own core processes.²⁶⁷ Second, and relatedly, one might argue that the inclusion of these many mechanisms in the NWPA was itself the manifestation of democratic will.²⁶⁸ Perhaps the political compromise represented by the Act was the only sort of legislation capable of achieving majority support in Congress at the time. Finally, the background processes that have taken hold are themselves appropriate, lawful, and democratically selected. These rejoinders seek to salvage or

the law represents a political check—a “veto gate”—and thus a possible point of intervention for an opponent. Veto gates are central to positive political models of legislative behavior. See generally James G. March & Johan P. Olson, *Elaborating the New Institutionalism*, in THE OXFORD HANDBOOK OF POLITICAL INSTITUTIONS (Sarah A. Binder et al. eds., 2008).

266. “Not all coalition members are equally important in determining the content of legislation; positive political theory points to the members who control the various veto gates as crucial” McNollgast, *Positive Canons: The Role of Legislative Bargains in Statutory Interpretation*, 80 GEO. L.J. 705, 707 (1992).

267. See generally Adams, *supra* note 130.

268. See generally Ressetar, *supra* note 15.

reclaim the credibility and legitimacy of the current state of affairs. They cast the situation as normal politics rather than a failure of the legislative process.

It is indisputable that the NWPA was the product of a hard-fought political battle. It was a compromise solution. It is also true that the NRC's efforts to regulate on-site waste storage fall within its regulatory purview under pre-existing law.²⁶⁹ But these facts are beside the point. This Article does not argue that Congress ought not to employ formal checkpoints, institutional filters, or veto points in its legislation. Rather, it argues that when Congress legislates in this fashion, it is incumbent upon lawmakers to consider fully the default policies that will carry the day if such checkpoints or veto gates are exercised, precisely because the inclusion of these devices make it that much more likely that policy will be made by default.

Political scientist Jacob Hacker has explored how substantive policy shifts can occur even in the absence of affirmative legislative or regulatory action.²⁷⁰ In his influential analysis of welfare state retrenchment in the United States, Hacker notes that “subterranean” processes can effect change just as surely as the “observable decisions” of government bodies.²⁷¹ In many cases, politicians are well aware of these processes. They can be skillful in exploiting changed circumstances and outmoded policies for tactical or electoral benefit. This Article goes one step further, asking legislators not only to examine subterranean policy changes retrospectively, but also to anticipate them—to analyze, prospectively, the policies and processes likely to take hold if legislation should fail.

Of course, legislators cannot be expected to predict the future. But in the case of the NWPA, even modest foresight may well have militated for

269. The bulk of the NRC's governing legislation was passed as the Energy Reorganization Act of 1974, Pub. L. No. 93-438, 88 Stat. 1233 (codified at 42 U.S.C. § 5801 (2012)).

270. See Hacker, *supra* note 6.

271. *Id.* at 245. Hacker had in mind, *inter alia*, the reduction in welfare provision during the 1990s attributable to declining workplace protections. In his useful and influential typology, Hacker identifies three modes of policy change apart from formal policy revision. *Id.* at 248 fig.1. There is *drift*, defined as “transformation of stable policy due to changing circumstances;” *layering*, “the creation of new policy without [the] elimination of [the] old;” and *conversion*, the “internal adaptation of existing policy.” *Id.* The mode most evident in the present NWPA case is drift, in that established nuclear waste practices and protocols took on a drastically different cast in light of the increasing inventories of spent nuclear fuel and the year-after-year failure to construct a waste repository. This is no surprise from the standpoint of Hacker’s analysis; as he notes, drift is most likely when a policy poses high hurdles to internal conversion (meaning a policy is hard to adapt to new ends) and when the status-quo bias of the external political context is also high (meaning it is hard to eliminate or supplant existing policies). *Id.* at 248. “Drift, as noted, may be inadvertent. Or it may be the result of active attempts to block adaptation of institutions to changing circumstances.” *Id.*

different congressional choices. By 1982, the process of searching for a repository site had already been controversial for many years; finding a state and community willing to host permanently a facility capable of housing thousands of tons of radioactive waste had proven an extraordinary challenge. The experience of other countries would have lent no additional encouragement.²⁷² At the least, legislators could have considered contingency plans in the event that difficulties arose. Recall that prior to 1982, federal courts had challenged federal agencies to account for the safety of on-site waste storage, given the extraordinary problems posed by locating a permanent waste site; some had gone so far as to recommend a moratorium on nuclear plant licensing until a repository was complete. There were, in other words, ample indications that the road ahead would not be straightforward. It ought not to have taken a rocket scientist—or a nuclear engineer—to predict that spent nuclear fuel might be housed at nuclear power plants for timeframes that would strain the capacity of cooling pools.

It is fair to ask what, exactly, Congress might have done differently. There are two basic steps that Congress could have taken that could have ameliorated the present situation. First, it could have limited the federal government's financial liability for missed contractual deadlines. Even optimistic participants could have recognized the possibility that the repository process would experience delays. Second, Congress could have insisted that on-site storage of spent fuel remain limited to the amount allowable within existing spent fuel pools. These two straightforward steps would have eliminated the possibility that accumulating spent fuel would spiral out of control, reaching quantities that would surpass existing fuel pools' capacities and incurring massive federal liability. It is these aspects of the default regime—on-site storage and enormous public liability—that represent the most egregious departures from the statutory scheme, which focused emphatically on centralized waste storage and operator liability. Perhaps these changes would have met with some opposition, but the final NWPA legislation passed the houses of Congress with many votes to spare.²⁷³

Ultimately, in exercising its legislative functions, it is incumbent upon members of Congress to pay attention to the foreseeable consequences of legislation, even and perhaps especially if they are undesirable. No doubt this statement smacks of academic idealism, and there is ample cause for

272. See generally NUCLEAR WASTE GOVERNANCE: AN INTERNATIONAL COMPARISON (Achim Brunnengräber et al. eds., 2015) (offering a collection of case studies on various countries' experiences with civilian nuclear waste management).

273. The Senate passed the final bill by voice vote, and the vote in the House was 256–32. WALKER, *supra* note 11, at 181.

skepticism. Indeed, although legislators use the language of the public interest, a great deal of legislative behavior can be explained in terms of electoral self-interest.²⁷⁴ And the self-interested legislator may actually invite policy failure if it is likely to lead to his or her electoral advantage.²⁷⁵ But it is not obvious that the actual provisions of the NWPA, as compared with the alterations proposed above, offered obvious political safety. It is quite likely that Congress could have passed better legislation than the NWPA without serious electoral repercussions.

VI. CONCLUSION

A long-term solution to the nuclear waste crisis will certainly require additional congressional action, but the current climate in the United States Congress is marked by impasse. Session after legislative session passes without legislation on important matters of the day.²⁷⁶ Countless observers of American politics, whether of the left or the right, have grown deeply frustrated with the legislative process.²⁷⁷ With little in the way of major new legislative initiatives, agencies are increasingly forced to meet new policy demands under aging and often ill-fitting statutory provisions. The agonizing saga of nuclear waste policy in the United States exemplifies a number of the sources of this frustration. It offers an example of a major policy area, one with enormous implications for public safety and welfare, in which the

274. Private interest or “public choice” theories of regulation posit that small sets of special-interest groups are able systematically to distort regulation for their own private benefit. Few regulatory theorists today would hold unwaveringly to a “public interest” view of regulation. An important departure from the public interest ideal has to do with the time horizon of legislative decision makers. In a body of work beginning with David Mayhew’s famous 1974 book *Congress: The Electoral Connection*, political scientists have explored the proposition that legislators’ decisional time horizon is limited by their terms of office. *See generally* DAVID MAYHEW, CONGRESS: THE ELECTORAL CONNECTION (1974). A long line of research now supports that proposition: many areas of public policy display a presentist bias and a corresponding neglect for the interests of the future. The logic is straightforward. Elected politicians have a clear incentive to benefit current, not future, constituencies. Although there are electoral demands for policies that are future-regarding, these demands can often be satisfied by symbolic provisions or provisions that are otherwise capable of subsequent manipulation.

275. *See* MORRIS P. FIORINA, CONGRESS: KEYSTONE OF THE WASHINGTON ESTABLISHMENT 67 (2d ed. 1989) (describing legislators’ tendencies to claim credit for solving impossible policy problems by assigning them to federal agencies, and then scoring further political points for lambasting those agencies when their solutions fail, as is inevitable).

276. *See, e.g.*, David Welna, *As Congress Breaks, Inaction Remains Most Notable Action*, NPR (Aug. 2, 2014, 8:29 AM), <http://www.npr.org/sections/itsallpolitics/2014/08/02/33718119/8/as-congress-breaks-inaction-remains-most-notable-action>; *see also supra* note 29.

277. *See, e.g.*, MANN & ORNSTEIN, *supra* note 29, at XII.

statutory “solution” sits in total disrepair. Not only has the executive branch failed to designate a long-term repository for nuclear waste, but it has incurred billions of dollars in financial liability for nuclear waste management. Congress has left American taxpayers on the hook for these many billions, and saddled them with a waste storage regime that appears ad hoc and untrustworthy.

Perhaps some of this condemnation is undeserved. After all, the United States is not the only country to struggle with nuclear waste. Only one country, Finland, has approved a site and authorized the construction of a permanent geologic waste repository.²⁷⁸ Many other countries reliant on nuclear power have had experiences not altogether dissimilar to that of the U.S. Perhaps it is unfair, then, to criticize American political institutions for this failure.

But Congress can and should do better, and to this end, the story of the NWPA contains important lessons. Further decisions about nuclear power must be made with the awareness that legislative checks may create opportunities to circumvent the statutory regime. If these checks are exercised, important matters of public policy may well be made by default and in ways that contradict the legislated scheme. And the stakes are high: in a system so heavily biased towards the status quo, legislated outcomes are sticky.²⁷⁹ If Congress wishes to maintain its commitment to nuclear power, it must develop a new approach. It must take stock of the likely consequences of its legislation, and move forward with its eyes wide open and in full knowledge of the possibilities that lie ahead.

278. *Nation OKs World's First Underground Nuclear Waste Dump*, GREENWIRE, Nov. 13, 2015. The Finnish waste site is slated for completion by 2023. Its planned capacity is 6,500 metric tons, or less than ten percent of the amount of waste already in need of disposal in the United States. *Id.* By contrast, the Yucca Mountain site’s planned capacity was roughly 70,000 tons. JAMES D. WERNER, CONG. RESEARCH SERV., R42513, U.S. SPENT NUCLEAR FUEL STORAGE 5–6 (2012), <http://www.fas.org/sgp/mis/R42513.pdf>.

279. On the status quo bias of American political institutions, see *supra* note 265. The phenomenon of path dependence—the effects of which are widespread—is particularly acute in legislative institutions. See generally PAUL PIERSON, POLITICS IN TIME: HISTORY, INSTITUTIONS, AND SOCIAL ANALYSIS (2004).