New York University

Environmental Law Journal

Article

Richard B. Stewart and Jane B. Stewart
Solving the Spent Nuclear Fuel Impasse

Student Article

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The Efficiency and Management of the International Trade in Electronic Waste: Is There a Better Plan Than a Ban?

Volume 21 2014 Number 1

NEW YORK UNIVERSITY ENVIRONMENTAL LAW JOURNAL
110 West Third Street
New York, New York 10012-2411
TEL: (212) 998-6560; FAX: (212) 995-4032
WEBSITE: http://www.law.nyu.edu/journals/envtllaw/

Cite as: N.Y.U. ENVTL. L.J.
ISSN: 1061-8651

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New York University

Environmental Law Journal

Volume 21 2014 Number 1

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New York University

Environmental Law Journal

2012–2013

SOLVING THE SPENT NUCLEAR FUEL IMPASSE

RICHARD B. STEWART*

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INTRODUCTION

This article analyzes and offers solutions to the protracted legal and policy impasse in dealing with the United States' large and growing inventory of spent fuel from nuclear power plants. Nuclear power plants in the United States have been producing spent nuclear fuel (SNF) for about 60 pools at 65 nuclear power plant sites with 104 operating reactors, and at 9 sites where reactors have been shut down. Most of this SNF is stored in cooling pools, with the balance in dry cask containers. The federal government has been in partial default on its NWPA obligation to take this SNF from utilities since 1998, and is being repeatedly sued by the utilities to recover damages for this breach.[1]

[1] BLUE RIBBON COMM'N ON AMERICA'S NUCLEAR FUTURE, REPORT TO THE SEC'Y OF ENERGY, 17, 79–80 (2012) [hereinafter BRC REPORT].

Three recent decisions by the D.C. Circuit express sharp judicial impatience with the current SNF policy logjam. The first decision overturned the Nuclear Regulatory Commission's (NRC's) Waste Confidence Decision (WCD), which had found that SNF could be safely stored at reactors for up to sixty years past the end of their operating life. The court held that NRC had failed to address the implications for storage safety of indefinite delay in development of a repository for disposal as a result of Yucca's cancellation.[2] The second decision halted collection of the fees on nuclear electricity generation that NWPA authorizes for financing of SNF disposal.[3] The court directed the Department of Energy (DOE) to stop collecting fees until it either revived the Yucca repository or Congress amended the NWPA to authorize other arrangements for SNF management and disposal. In the third decision, involving a challenge to NRC's failure to process the license application for Yucca that had been filed in 2008 by the Bush administration, the court issued mandamus to NRC requiring it to decide the matter, despite the Obama administration's attempt to withdraw the application.[4] These decisions have created additional pressures on the administration and Congress to fundamentally change existing law and policy for SNF.

In light of the Fukushima Daiichi nuclear incident in Japan and continued threats of terrorism, there is growing sentiment that current arrangements for at-reactor storage in cooling pools pose unacceptable safety and security risks. The failure to make progress on developing a repository for disposal of SNF has exacerbated the problem of what to do with SNF until such a repository is constructed and opened—a process which will take several decades at best. The Obama administration has abandoned Yucca, although most Republicans in Congress support its revival. Nuclear power critics invoke the failure to "solve" the nuclear waste problem in opposing new plants; nine states have laws prohibiting new plants until there is at least demonstrable progress on the issue of disposal. Accelerated transfer of SNF from pool to dry cask storage at reactor sites, and dry cask storage at new, consolidated, away-from-reactor facilities, are increasingly being

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[2] New York v. Nuclear Regulatory Comm'n [hereinafter NRC], 681 F.3d 471, 478 (D.C. Cir. 2012).

[3] Nat'l Ass'n of Regulatory Util. Comm'rs v. U.S. Dep't of Energy [hereinafter DOE], 736 F.3d 517 (D.C. Cir. 2013).

[4] *In re* Aiken Cnty., 725 F.3d 255 (D.C. Cir. 2013).

considered as interim measures.[5] The question of transferring SNF to dry casks poses the familiar, but always complex, tradeoff between cost and reduction in risk. Developing consolidated storage facilities also poses cost-risk balancing issues, but the most difficult obstacles to developing such facilities and a new repository are political, financial, and institutional. As discussed in the following sections of this article, the U.S. experience shows that these obstacles are formidable, but also provides lessons for surmounting them.

NRC recently issued consolidated licenses for four new nuclear power reactors, the first to be approved in the U.S. since 1978.[6] Fourteen license applications for new reactors are pending,[7] yet surging talk of a nuclear renaissance in the U.S., stimulated in part by climate change concerns, has abated. Ten additional license applications filed by utilities have been dropped.[8] The falloff is due in part to Fukushima, but primarily to economics. The price of natural gas has fallen dramatically with the use of hydraulic fracturing and other technologies to tap new supplies, while the very high capital costs and long development times of nuclear plants remain substantial impediments. Concern over waste disposal from new plants is also a factor. Nonetheless, even if a large fleet of new reactors is not built, the nation still needs to find a way to deal with the existing stockpiles of SNF and the large additional amounts of waste that will be produced by existing reactors during their operating lifetimes. The D.C. Circuit's decision setting aside NRC's WCD[9] has forced NRC to suspend issuance of new or renewal licenses for at least two years while it addresses the court's ruling.[10]

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[5] *See infra* Sections II.B, II.C, and III.

[6] *See* Gretchen Gavett, *NRC Licenses First Nuclear Reactors in Decades*, FRONTLINE (Feb. 10, 2012, 12:46 PM), http://www.pbs.org/wgbh/pages/frontline/health-science-technology/nuclear-aftershocks/nrc-licenses-first-new-nuclear-reactors-in-decades/. The four reactors, all licensed in 2012, are: two AP1000 advanced passive pressurized-water reactors for the Virgil C. Summer Nuclear Station (VCSNS) Units 2 and 3; and two AP1000 advanced passive pressurized-water reactors for Vogtle Electric Generating Plant (VEGP) Units 3 and 4.

[7] *Combined License Applications for New Reactors*, NRC, http://www.nrc.gov/reactors/new-reactors/col.html (last visited Nov. 12, 2013).

[8] *See id*.

[9] *See* New York v. NRC, 681 F.3d 471 (D.C. Cir. 2012).

[10] Memorandum and Order, NRC, In the Matter of Calvert Cliffs Nuclear Project, CLI-12-16 (Aug. 7, 2012), *available at* http://www.nrc.gov/reading-

Congress and the Obama administration have abdicated their responsibilities to deal with SNF. This article argues that they must undertake four initiatives in order to break the current impasse and deal with nuclear waste. First, Congress and the administration should establish and support private development of several consolidated SNF storage facilities, with priority for storage of SNF located at decommissioned reactor sites. At the same time, they must initiate development of a new repository other than Yucca Mountain (whose fate is legally unresolved and politically precarious) for permanent burial of SNF. These two efforts must proceed in tandem. Further, the government must follow a new approach to siting both of these types of nuclear waste facilities, based not on federal unilateralism, but on obtaining the assent of host communities and states. This approach must reflect the lessons learned from the successful development by the federal government of the Waste Isolation Pilot Plant (WIPP) repository for certain defense nuclear wastes in New Mexico, and from its failures with Yucca and other unsuccessful efforts to site facilities for disposal or storage of high-level nuclear waste. This approach should be step-by-step, preserving options and permitting adaptive learning from experience.

Second, Congress must establish a new single-purpose entity, in lieu of DOE, to manage and dispose of SNF, develop the new facilities, and arrange for transportation of SNF to them. Preferably this new entity would be a federal corporation jointly owned by the government and the nuclear utilities.

Third, Congress must establish entirely new, comprehensive financing arrangements for waste management and disposal, and simultaneously settle the federal government's ever-accumulating liabilities to utilities arising out of its failure to take SNF since 1998, by passing legislation that deals with the problem in a holistic manner.

Fourth, in view of the important questions and safety concerns raised by terrorism and the Fukushima nuclear incident in Japan, Congress should direct NRC and DOE (and its successor) to establish a joint mechanism of coordination to study and determine whether transfer of SNF from pool to dry storage should be accelerated. This coordinating body should also determine what

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rm/doc-collections/commission/orders/2012/2012-16cli.pdf [hereinafter NRC Order].

other steps should be taken to address the safety issues posed by long-term SNF storage and SNF disposal, including the implications of high-burn-up SNF, the integrity of fuel rod cladding and casks, and development of integrated cask designs for storage, transport, and disposal. A new coordination mechanism is required because NRC and DOE have overlapping, but independent, responsibilities for the management and safety of SNF, and different but complementary areas of experience and expertise. Congressional legislation in the 1970s divided the responsibilities of the former Atomic Energy Commission (AEC) between its successor, DOE, and the then-newly-formed NRC. DOE, despite its lead role under NWPA for disposition of SNF, has not been appropriately engaged as a partner with NRC in key SNF-related policymaking and implementation. The lack of coordination presents particularly nettlesome issues for SNF storage. Although DOE manages planning of consolidated storage, transportation, and repository disposal of SNF, it lacks access to NRC's analysis and decision-making regarding key SNF storage safety issues and practices, including whether to accelerate movement of SNF from pools to dry casks. The two agencies should develop a joint plan to implement their determinations, which should be subject to review by the National Academy of Sciences (NAS) or a similar independent body. Coordination should be carried out in a way that does not undermine NRC's ultimate independent regulatory authority over nuclear safety.

The first three recommendations, for new waste storage and disposal facilities, a new waste management entity, and new financing arrangements, were outlined in our 2011 book, *Fuel Cycle to Nowhere: U.S. Law and Policy for Nuclear Waste*.[11] Somewhat similar recommendations were later made by President Obama's Blue Ribbon Commission on America's Nuclear Future (BRC) in its 2012 final report[12] and DOE's 2013 Strategy for the Management and Disposal of Used Nuclear Fuel and High Level Radioactive Waste (DOE Strategy).[13] This article develops our

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[11] RICHARD B. STEWART & JANE B. STEWART, FUEL CYCLE TO NOWHERE? LAW AND POLICY ON NUCLEAR WASTE (2011) [hereinafter FUEL CYCLE TO NOWHERE]. These recommendations are also made in Richard B. Stewart, *U.S. Nuclear Waste Law and Policy: Fixing a Bankrupt System*, 16 N.Y.U. ENVTL. L.J. 783 (2008).

[12] BRC REPORT, *supra* note 1.

[13] DOE, STRATEGY FOR THE MANAGEMENT AND DISPOSAL OF USED NUCLEAR FUEL AND HIGH LEVEL RADIOACTIVE WASTE (2013) [hereinafter DOE

earlier recommendations in ways that are more specific, going beyond those of BRC and the DOE Strategy, and adds a fourth proposal addressing SNF storage safety.

Section I of this article briefly introduces the current SNF impasse and its historical background. Section II provides an overview of NRC regulation of SNF storage safety and security and post-Fukushima critiques of NRC regulatory policies and practices. In Section III, the article examines the debate between continued at-reactor storage of SNF and development of consolidated storage facilities. Section IV examines the potential for DOE development of consolidated storage facilities, recommending a fresh approach to siting that the government should also follow in developing a new repository for permanent disposal of SNF. Section V considers the option of development of consolidated interim storage facilities by private firms, and discusses a recent initiative by local government bodies in New Mexico to develop a consolidated storage facility on private land with the participation of Areva, the French nuclear firm, and others. Section VI examines the possibility of creating a new, single-purpose SNF management entity in place of DOE, and the potential for a "grand bargain" that reforms how SNF storage and disposal is funded while simultaneously resolving the federal government's mounting SNF liabilities to utilities.

The bulk of this article is devoted to addressing the safety, economic, and equity issues associated with SNF storage, specifically through prompt development of consolidated interim storage facilities. This focus, however, should not be taken as slighting the vital task of promptly taking steps to develop a new repository for permanent burial of highly radioactive wastes. Since Yucca lies in political limbo and seems likely to remain there for some time, a search for a new repository site must begin immediately. As BRC has reminded us,[14] continued neglect of the waste disposal imperative is a grave abdication of our duty to those who will follow us.

I. THE SNF CHALLENGE

When civilian nuclear power generation was developed beginning in the 1950s, it was assumed that SNF would be

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STRATEGY].

[14] BRC REPORT, *supra* note 1, at 6.

reprocessed in order to extract plutonium and uranium to make new fuel. This solution was abandoned in the 1970s because of concerns over proliferation, and the serious economic and environmental problems posed by reprocessing. Federal policy shifted to burial of power plant SNF together with highly radioactive defense wastes in a deep geologic repository. Congress, in the NWPA, directed DOE to site and develop two such repositories.[15] It also authorized DOE to develop facilities for consolidated interim storage, known as Monitored Retrievable Storage (MRS), to store SNF in the interim, pending repository development.

DOE encountered enormous resistance at the state level in its efforts to site repositories and MRS facilities. Congress amended NWPA in 1987 to short-circuit the repository siting process, mandating that a single repository be located on federal lands at Yucca Mountain in Nevada. Concerned that the availability of MRS facilities would undermine the push for Yucca's development, and that these facilities would threaten to become de facto permanent disposal facilities, Congress also limited the MRS program to a single facility, with tight restrictions on the timing of its development and its storage capacity.[16]

In 2009, following protracted resistance by Nevada to Yucca's construction through litigation and other means, the Obama administration, driven by local Nevada politics, abruptly abandoned Yucca, leaving the nation without any plan or legal authority to develop a repository for SNF and highly-radioactive defense wastes. Meanwhile, ever since the federal government defaulted on its NWPA obligations to begin taking utilities' SNF in 1998, liabilities to the utilities have been steadily mounting, running into the tens of billions of dollars in damages.[17] In January 2010, President Obama established BRC, composed of distinguished outside experts and former government officials, to produce recommendations for dealing with the nuclear waste impasse. BRC issued its final report in January 2012.[18] Since then, no significant steps have been taken to implement its

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[15] *See* Nuclear Waste Policy Act of 1982 [NWPA], 42 U.S.C. §§ 10101 *et seq.* (2006).

[16] *See* 42 U.S.C §§ 10162, 10165–66, 10168; FUEL CYCLE TO NOWHERE, *supra* note 11, at 235–37.

[17] BRC REPORT, *supra* note 1, at 79–80.

[18] *See id.*

recommendations.

Host communities have grown increasingly resistant to indefinite SNF storage at reactor sites, most acutely at sites with decommissioned reactors storing so-called "stranded" fuel.[19] This incident, along with continuing concern about potential terrorist attacks on nuclear facilities, has stimulated public and congressional concern with the safety and security of indefinite at-reactor storage, especially storage in cooling pools. While SNF must be cooled in pools for several years following withdrawal from a reactor, thereafter it can be transferred to storage in dry casks. Dry cask storage is widely regarded as safer than storage in cooling pools, because storage pools may—as a result of natural disasters, accidents, or terrorist attacks—suffer loss of cooling water or circulation that could lead to dangerous releases of radioactivity.[20] But utilities prefer to leave SNF in existing cooling pools rather than develop more costly dry storage casks and facilities. In response to rising SNF inventories, utilities have packed SNF more tightly into their pools, and have generally used dry cask storage only when pools approach full capacity. Former DOE Secretary Chu stated that dry cask storage could be relied upon for half a century, perhaps longer, while alternatives to Yucca are explored and developed.[21]

There have been intensifying demands from nuclear safety watchdog organizations and influential members of Congress that NRC require utilities to accelerate use of dry cask storage. Thus far, the utilities and NRC have resisted these demands, arguing that pool storage is adequately safe. Based on its initial post-Fukushima review of U.S. SNF storage safety, in July 2011, a NRC Task

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[19] "Stranded" spent fuel generally refers to SNF remaining in storage at a site where the operating reactor that produced the waste has been shut down and at least partly decommissioned. Sites with stranded waste that are of greatest concern are those where there is no operating sister reactor; at such sites the costs of SNF storage represent most or all of the expenses associated with the facility and no revenues are being generated to offset the costs of SNF storage. *See* JAMES D. WERNER, CRS, R42513, U.S. SPENT NUCLEAR FUEL STORAGE 19–21 (May 2012), *available at* http://www.fas.org/sgp/crs/misc/R42513.pdf.

[20] *See, e.g.*, Jason Hardin, *Tipping the Scales: Why Congress and the President Should Create a Federal Interim Storage Facility for High-Level Radioactive Waste*, 19 J. LAND RESOURCES & ENVTL. L. 293, 301 (1999) ("'NRC has determined that dry storage of spent fuel at reactor sites is safe for at least 100 years, and generally considers dry storage safer than pool storage.'").

[21] Peter Behr, *The Administration Puts Its Own Stamp on a Possible Nuclear Revival*, N.Y. TIMES (Feb. 2, 2010).

Force issued a report finding that "continued [reactor] operation and continued licensing activities do not pose an imminent risk to public health and safety." At the same time, it made twelve sets of recommendations to improve safety and to enhance the capability of reactor operators to react in the event of an emergency. These recommendations did not include accelerated transfer of SNF from pools to dry storage casks.[22] BRC and the DOE Strategy also made no recommendations regarding accelerated transfer of SNF from pools to dry cask storage or managing the safety of high-burn-up SNF. NRC staff is now studying the issues surrounding accelerated transfer of SNF from pool to dry storage.

As noted above and discussed in detail in Section II, in 2012, the D.C. Circuit overturned NRC's updated WCD, finding that NRC had failed to provide adequate grounds for its assurances that SNF can be safely stored for long periods and that a repository will be available in a timely fashion, and that NRC had also failed to comply with the National Environmental Policy Act (NEPA).[23] As a result, NRC has been conducting a generic EIS (GEIS) on SNF storage and disposal issues, while at the same time suspending issuance of new reactor or storage licenses pending completion of the GEIS and the remanded Waste Confidence proceedings, which NRC intends to finish by Fall 2014.[24] Although NRC has continued with ongoing licensing proceedings short of issuing final licenses, the court's decision represents a substantial setback for NRC and the Obama administration's plans for nuclear expansion, and underscores the serious consequences of terminating Yucca without an alternative plan for dealing with SNF.

In September 2013, based on materials in a draft GEIS,[25] NRC proposed for public comment a revised Waste Confidence

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[22] NRC, RECOMMENDATIONS FOR ENHANCING REACTOR SAFETY IN THE 21ST CENTURY: THE NEAR-TERM TASK FORCE REVIEW OF INSIGHTS FROM THE FUKUSHIMA DAI-ICHI ACCIDENT 43 (2011), *available at* http://pbadupws.nrc.gov/docs/ML1118/ML111861807.pdf [hereinafter NRC NEAR-TERM TASK FORCE, RECOMMENDATIONS POST-FUKUSHIMA].

[23] Nat'l Ass'n of Regulatory Util. Comm'rs v. DOE, 680 F.3d 819 (D.C. Cir. 2012).

[24] See NRC Waste Confidence Update Schedule, NRC, http://www.nrc.gov/waste/spent-fuel-storage/wcd/schedule.html (last visited Mar. 18, 2014).

[25] NRC, WASTE CONFIDENCE GENERIC ENVIRONMENTAL IMPACT STATEMENT: DRAFT REPORT FOR COMMENT (2013), *available at* http://pbadupws.nrc.gov/docs/ML1315/ML13150A347.pdf.

Rule.[26] The proposed rule makes a generic determination that SNF can be safely stored in reactor pools or in dry casks at storage facilities for up to sixty years after the end of a reactor's licensed operating life, and that by the end of that period a deep geologic repository will be available to dispose of the waste. Accordingly, the proposed rule determines that the environmental effects of SNF storage need not be considered in a site-specific environmental impact statement (EIS) in connection with licensing new or relicensing existing nuclear power reactors or SNF storage facilities. The proposed rule is substantially similar to the one overturned by the D.C. Circuit and accordingly, if finalized, will (along with the GEIS) almost certainly be challenged in court.

As they did in the 1970s and '80s, opponents of nuclear power are again raising the federal government's failure to deal with SNF to challenge development of new nuclear power plants. Natural Resources Defense Council (NRDC) has cited the lack of any repository to dispose of SNF as one of the reasons that it opposes the current construction of new nuclear power plants.[27] Additionally, California, Connecticut, Illinois, Kentucky, Maine, New Jersey, Oregon, West Virginia, and Wisconsin all have moratorium legislation forbidding development of new nuclear power plants until there is demonstrable progress on the waste disposal issue.[28] The nuclear utilities and other proponents of nuclear power fear a repeat of the experience in the 1970s, when environmental and community groups used litigation based on nuclear waste issues to delay construction of new nuclear power plants. This tactic and the states' moratoria on new nuclear plants were among the several factors that led to a slowdown, and then a complete halt by the end of the 1970s, in development of new commercial nuclear power plants in the United States.

Any solution to the SNF impasse must include development of a deep geologic repository for permanent disposal, an unachieved objective of federal policy for forty-five years. The alternative of reprocessing SNF to extract plutonium and uranium for reuse in reactors failed for economic and environmental reasons in the 1970s. Although the nuclear industry favors and the

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[26] Waste Confidence—Continued Storage of Spent Fuel, 78 Fed. Reg. 56,776 (proposed Sept. 13, 2013).

[27] NATURAL RESOURCES DEFENSE COUNCIL, NUCLEAR FACTS (2007), *available at* http://www.nrdc.org/nuclear/plants/plants.pdf.

[28] BRC REPORT, *supra* note 1, at 25.

federal government supports R&D on advanced reprocessing and other fuel cycle technologies, serious cost and technical issues remain, and developing these at scale would in any event take decades. BRC correctly concluded that steps to dispose of accumulating SNF inventories should not be postponed. Both BRC and the DOE Strategy call for prompt steps to develop a repository.[29]

At this point there are three basic options for a repository: revive Yucca (an issue not within BRC's mandate and not mentioned in the DOE Strategy); develop a repository for SNF at or near the existing WIPP repository in New Mexico that now disposes of only defense transuranic (TRU) nuclear wastes; or develop a brand-new repository elsewhere. The Yucca Mountain repository was cancelled by the Obama administration, which withdrew all funding and dismantled the infrastructure that had been built at the site.[30] DOE also petitioned NRC to withdraw the Yucca license application that had been submitted in 2008 by the Bush administration.[31] In 2010, the NRC Atomic Safety and Licensing Board Panel (ATSLBP) denied the petition, ruling that NWPA bars withdrawal of the Yucca license application once DOE has submitted it.[32] Due to internal deadlocks, NRC did not review ATSLBP's decision, and ATSLBP suspended the licensing proceeding.[33] It has been reported that NRC staff has found, based on the license application materials, that Yucca meets applicable safety criteria for licensing; NRC has not made the staff's evaluation public.[34] In *Aiken v. NRC*,[35] South Carolina, Washington, and other petitioners sought review of the licensing suspension, asking the D.C. Circuit to issue a writ of mandamus

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[29] *See id.* at 27; DOE STRATEGY, *supra* note 13, at 7–8.

[30] TODD GARVEY, CONG. RESEARCH SERV. [hereinafter CRS], CLOSING YUCCA MOUNTAIN: LITIGATION ASSOCIATED WITH ATTEMPTS TO ABANDON THE PLANNED NUCLEAR WASTE REPOSITORY 3–4 (2012); Emily Yehle, *Yucca Project's Last 600 Employees Scramble for New Jobs*, N.Y. TIMES, Aug 4, 2010.

[31] In the Matter of U.S. Dep't of Energy (High-Level Waste Repository), 71 N.R.C. 609, 615–617, 2010 WL 9105479 at *5–6 (N.R.C. 2010).

[32] *Id.* at 629, *13.

[33] *See* Fact Sheet on Yucca Licensing, NRC, http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/fs-yucca-license-review.html (last visited Mar. 18, 2014).

[34] Steve Tretault, *Tabled NRC Report Calls Yucca Project Safe*, LAS VEGAS REVIEW-JOURNAL (June 8, 2011), *available at* http://www.lvrj.com/news/tabled-nrc-report-gives-thumbs-up-to-yucca-project-123509214.html.

[35] 725 F.3d 255 (D.C. Cir. 2013).

obligating NRC to decide the Yucca license application. NRC has asserted that it lacks sufficient funding to process the application, and that Congress's continuing failure to fund license processing indicates that processing it is not mandatory. The court entered an order without opinion in August 2012 ordering the parties to file updates on the status of fiscal year 2013 congressional appropriations with respect to the issues presented.[36] In August 2013, after Congress had failed to provide further funding, the court issued mandamus requiring NRC to process the application.[37] The court found that NWPA required NRC to decide the application once submitted, noted that NRC had $11.1 million in appropriated funds that would enable it to begin processing the application, and stated that the failure of Congress in recent years to fund such processing or the development of Yucca did not establish that Congress would refuse to do so in the future or amount to an implied repeal of NWPA's requirement that NRC decide the Yucca license application. NRC has since restarted preliminary licensing proceedings.[38] The ruling is a significant but nonetheless limited step towards restarting the Yucca repository project. Even if NRC were eventually to grant the Yucca construction license application, Congress would have to appropriate funds for the repository's construction. Although Republicans, who control the House, have generally supported Yucca, the Obama administration and the Senate majority leader, Nevada Democrat Senator Harry Reid, collaborated in the project's demise and have adamantly resisted all efforts to revive it. A future pro-Yucca president, or changes in control of Congress, could potentially resuscitate Yucca, which, GAO concluded, could become operational within fifteen years of approval; developing a repository at a new site would take much longer.[39]

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[36] *In re* Aiken Cnty., No. 11–1271, Nuclear Reg. Rep. P 20,728 (D.C. Cir. Aug. 3, 2012) (order without opinion).

[37] *In re* Aiken Cnty., 725 F.3d 255 (D.C. Cir. 2013). Judges Kavanaugh and Randolph joined the court's opinion; Chief Judge Garland dissented.

[38] *See* Steven Dolley & Elaine Hiruo, *US NRC to Resume Yucca Mountain Waste Repository Licensing Review*, PLATTS (Nov. 18, 2013, 4:10 PM), http://www.platts.com/latest-news/electric-power/washington/us-nrc-to-resume-yucca-mountain-waste-repository-21838672.

[39] 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, SNF REPORT

Given the political uncertainties over Yucca, a serious search for another repository site must begin now. This would require canvassing suitable sites and identifying those that are suitable in terms of geology, transportation access, and willingness to accept such a site. In-depth discussions with potential hosts and detailed site investigations would be part of the process. An immediate target of opportunity is presented by the WIPP facility, the world's only operating deep geologic repository for disposal of highly radioactive wastes. WIPP is currently restricted to disposing of defense TRU wastes.[40] An SNF disposal facility might be developed at WIPP or nearby, but the State of New Mexico would, as a practical political matter, have to agree to such a venture, and Congress would have to change existing statutes that currently preclude this option.

Interest in development of SNF consolidated storage facilities has burgeoned in the face of the delays and uncertainties in developing a repository and resistance to indefinite at-reactor storage.[41] The nuclear utilities support such a step.[42] The record to date on the potential for successfully developing such facilities is not encouraging. Despite significant efforts from 1985 to 1990, DOE has failed to site any interim consolidated storage facility. NWPA leaves open the alternative possibility of private facilities. A small consolidated pool storage facility developed by GE in the 1970s, located in Morris, Illinois, currently holds around 675 metric tons of heavy metal (MTHM) of SNF in pool storage.[43]

2012], *available at* http://www.gao.gov/assets/600/593745.pdf.

[40] For background discussion and history of WIPP, *see* FUEL CYCLE TO NOWHERE, *supra* note 11, at 162–85.

[41] MARK HOLT, CRS, R40202, NUCLEAR WASTE DISPOSAL: ALTERNATIVES TO YUCCA MOUNTAIN 13–15 (2009) [hereinafter HOLT, ALTERNATIVES TO YUCCA MOUNTAIN]; NUCLEAR ENERGY STUDY GRP., AM. PHYSICAL SOC'Y, CONSOLIDATED INTERIM STORAGE OF COMMERCIAL SPENT NUCLEAR FUEL: A TECHNICAL AND PROGRAMMATIC ASSESSMENT 1–2 (2007); *see also* MARK HOLT, CRS, NUCLEAR WASTE POLICY: HOW WE GOT HERE, PRESENTATION TO THE BLUE RIBBON COMMISSION ON AMERICA'S NUCLEAR FUTURE 40 (Mar. 25, 2010), *available at* http://www.brc.gov/sites/default/files/meetings/presentations/crs_blueribboncommissionwastepolicyhistory.pdf.

[42] *See, e.g.*, *Used Nuclear Fuel Storage*, NUCLEAR ENERGY INSTITUTE, http://www.nei.org/Issues-Policy/Nuclear-Waste-Management/Used-Nuclear-Fuel-Storage (last visited Jan. 25, 2014) ("NEI supports the development of a consolidated facility for temporary storage of used nuclear fuel in a willing host community and state . . . .").

[43] ANTHONY ANDREWS, CRS, RS22001, SPENT NUCLEAR FUEL STORAGE LOCATIONS AND INVENTORY 5 (2004). In 2004, NRC renewed the Morris

Beginning in the early 1990s, Private Fuel Storage LLC (PFS), a consortium of nuclear utilities, developed an ambitious project for a 40,000 MTHM consolidated storage facility on land leased from the Skull Valley Band of the Goshute Nation in Utah.[44] The facility was strongly opposed by dissenting members of the tribe, local communities, the State of Utah, and NGOs.[45] Although PFS eventually received a NRC license for the facility, the Interior Department denied PFS needed federal permits.[46] After protracted litigation and continuing failure to obtain needed permits, PFS terminated the project.[47] A recent new initiative may have a better likelihood of success. The Eddy-Lea Energy Alliance LLC (ELEA), a joint venture of local governments in partnership with Areva and others,[48] has announced plans to develop a consolidated SNF storage facility on private land that it owns in southeastern New Mexico.[49]

BRC's final report recommended federal development of one

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facility's storage license for a further 20 years. Press Release, U.S. NRC, *NRC Renews License for Interim Spent Fuel Storage Installation at G.E. Morris Facility in Illinois* (Dec. 30, 2004), *available at* http://www.nrc.gov/reading-rm/doc-collections/news/2004/04-166.html.

[44] *See* Skull Valley Band of Goshute Indians v. Nielson, 376 F.3d 1223, 1227–28 (10th Cir. 2004); John K. Gross, Note, *Nuclear Native America: Nuclear Waste and Liability on the Skull Valley Goshute Reservation*, 7 B.U. J. SCI. & TECH. L. 140, 152 (2001) [hereinafter *Nuclear Native America*]. In the early 1970s, GE developed a small private storage facility located at its failed Morris, Illinois, reprocessing plant; it currently holds around 675 MTHM of SNF from several different reactor sites in pool storage.

[45] *See Opposition to High-Level Nuclear Waste: Information on Private Fuel Storage's Proposal to Locate a High-Level Nuclear Waste Storage Facility on the Skull Valley Goshute Indian Reservation*, UTAH DEP'T OF ENVTL. QUALITY, http://www.deq.utah.gov/Issues/topics/highlevelwaste/concerns/concerns.htm (last updated July 19, 2012) (detailing Utah's objections to the PFS disposal site); *Nuclear Native America*, *supra* note 44, at 153.

[46] MARK HOLT, CRS, CIVILIAN NUCLEAR WASTE DISPOSAL 12 (2006), *available at* http://www.hsdl.org/?view&did=466932.

[47] In December 2012, PFS requested that NRC terminate its license, thus formally ending the consolidated storage project. *See* Elaine Hiruo, *Costs Drove PFS Move to Terminate US Spent Fuel Storage License: Exec,* PLATTS (Jan. 2, 2013, 5:06 PM), http://www.platts.com/RSSFeedDetailedNews/RSSFeed/ElectricPower/6977321.

[48] *Areva Led Team Selected by Eddy Lea Energy Alliance LLC to Develop Interim Consolidated Storage Facility*, AREVA, http://us.areva.com/EN/home-2016/areva-eddy-lea-unf-storage-facility.html (last visited Mar. 18, 2014).

[49] Letter from James M. Maddox, Chairman, Eddy Lea Alliance, to Catherine Haney, Dir., Office of Nuclear Safety and Safeguards, NRC (Feb. 26, 2013), *available at* pbadupws.nrc.gov/docs/ML1306/ML13067A278.pdf.

or more consolidated facilities to store SNF in dry casks in the interim before a repository becomes available, with priority for storage of SNF from decommissioned sites.[50] Both the House and Senate Appropriations Committees have called for DOE development of interim storage facilities.[51] The Senate Committee's report noted that federal storage of SNF would stem the rising tide of government liability to utilities for failure to take SNF. The DOE Strategy calls for federal development of a pilot consolidated interim storage facility for SNF, focused initially on SNF from decommissioned reactors, to be operational by 2021, and of a larger consolidated SNF interim storage facility, to be operational by 2025.[52]

A consensus is emerging among local communities at decommissioned reactors, the nuclear utilities, and at least one leading environmental group that the SNF at decommissioned sites should be moved to consolidated interim storage.[53] With reactors

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[50] BRC REPORT, *supra* note 1, at 32, 35–36.

[51] *Compare* HOUSE APPROPRIATIONS COMM., Report on 2012 Energy and Water Development Appropriations Bill, 2012, H.R. Rep. 112–118 (2011), *available at* http://www.gpo.gov/fdsys/pkg/CRPT-112hrpt118/pdf/CRPT-112hrpt118.pdf, *with* SENATE APPROPRIATIONS COMM., Report on 2012 Energy and Water Development Appropriations Bill, 2012, S. Rep. 112–75 (2011), *available at* http://www.gpo.gov/fdsys/pkg/CRPT-112srpt75/pdf/CRPT-112srpt75.pdf.

[52] DOE STRATEGY, *supra* note 13, at 2.

[53] NRDC, a leading national environmental organization, is on record as supporting consolidated interim storage of stranded fuel. Geoffrey H. Fettus, Senior Project Att'y, NRDC, Statement on S. 3469 Nuclear Waste Administration Act (2012) (*transcript available at* http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=54965bf6-e91b-41f8-a3e7-342b695c58aa, at 9). However, another influential NGO, Union of Concerned Scientists, while earlier appearing to support consolidated storage of stranded SNF, now disputes the need for it. The organization stated in 2012 comments on the BRC final report:

> UCS is not persuaded that new legislation and other actions to facilitate the prompt siting and development of consolidated interim storage facilities are necessary, either for spent fuel from operating reactors or from shutdown reactors. The argument for consolidating spent fuel from shutdown reactors is more compelling than for fuel from operating reactors, but UCS has yet to see an analysis clearly demonstrating that the benefits of interim storage outweigh the additional costs and risks associated with siting and licensing new storage facilities and the additional transportation that would be required—even for spent fuel from shutdown reactors. An alternative that might be more desirable would be to arrange to ship spent fuel from each shutdown reactor to the nearest operating reactor that has the space to accommodate it, thus eliminating the need to license greenfield facilities, capitalizing on existing

no longer operating, local communities no longer derive any appreciable benefits from the sites. Assuring the safety and security of this stranded fuel imposes relatively high costs on the licensee, who remains responsible for it. It also prevents reuse of the site for other purposes. There is, however, no consensus that SNF at operating reactors should be moved to consolidated storage. A host of competing and complex cost, transport, security, and other considerations are presented in the choice between at-reactor and consolidated storage. Some environmental and nuclear policy groups fear that consolidated storage will sap efforts to develop a new repository. Those who favor opening Yucca as a repository, including many House Republicans, are, for similar reasons, also cool to consolidated interim storage. DOE, moreover, concluded in 2008 that NWPA precludes it from developing consolidated interim storage facilities without further legislation by Congress.[54] Yet BRC's recommendation has put consolidated storage squarely on the political and policy agenda.

One option for developing consolidated interim storage facilities is for Congress to authorize construction of federal storage facilities at existing DOE sites, possibly in conjunction with co-development of energy parks, which could include nuclear technology R&D facilities and other installations at the same sites to provide additional economic and other benefits to host jurisdictions. Another option is private development of consolidated storage facilities on private or tribal lands. A further, hybrid option is private development of a facility on a current DOE site through a lease arrangement. These alternatives are not mutually exclusive. But whatever the form and location of a storage facility, it risks opposition from potential host states, even if local communities favor it. Further, the issues of consolidated storage and a repository are linked; in the absence of a credible plan to develop a repository for permanent burial of waste, potential hosts may fear that an "interim" storage facility will in

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infrastructure and reducing transport distances.

Dr. Edwin Lyman, Senior Scientist, Global Security Program, Union of Concerned Scientists, Testimony Before the Subcommittee on Environment and the Economy of the House Committee on Energy and Commerce 6–7 (Feb. 1, 2012).

[54] OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT, DOE/RW-0596, REPORT TO CONG. ON DEMONSTRATION OF INTERIM STORAGE OF FUEL FROM DECOMMISSIONED REACTORS 15–16 (2008), *available at* http://pbadupws.nrc.gov/docs/ML0834/ML083450160.pdf.

fact be permanent.

Consolidated storage facilities also face complex financial and regulatory issues. In the case of a government facility, financing might come from the NWPA Nuclear Waste Fund (NWF), funded by a fee on nuclear electricity generation that utilities have been paying since 1982. The NWF currently has an accounting surplus of over $26 billion, but fee revenues are not set aside and available without appropriation for financing nuclear waste disposition. The NWPA set an initial fee of one-tenth percent per kilowatt-hour of nuclear generated electricity but directed DOE to annually evaluate the level of the fee, in relation to the anticipated costs to the government of SNF management and disposal, and make adjustments up or down as appropriate.[55] DOE has never adjusted the fee, even after the Obama administration cancelled Yucca without moving forward on an alternative. Utilities brought litigation challenging DOE's failure to reduce the fee, the proceeds of which are effectively being used to help fund the government's deficit. In 2012, the D.C. Circuit in *NARUC v. DOE*[56] set aside DOE's refusal to adjust the fees as arbitrary and capricious, finding that it had not provided adequate reasons for its action. Following remand, DOE again concluded that no adjustment in the fee was warranted, finding that the amount and timing of future disposal and storage costs were too uncertain to determine whether an adjustment was appropriate. On further review, the D.C. Circuit, in a sharply worded opinion, again found DOE's refusal to adjust the fees as arbitrary and capricious.[57] It stated that uncertainties are endemic in regulatory decisions and cannot justify a failure to decide. Rather than remanding once again, the court suspended fee collections and directed DOE to submit a proposal to Congress to set the fee at zero.[58] The effect of the decision is to deny the Treasury a significant revenue stream and thereby create additional pressure on the political branches to address the SNF disposal problem.

Resolving the federal government's past and ongoing liability for failure to take SNF beginning in 1998 adds further complexity

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[55] 42 U.S.C. § 10222(a)(4).

[56] Nat'l Ass'n of Regulatory Util. Comm'rs v. DOE, 680 F.3d 819 (D.C. Cir. 2012).

[57] Nat'l Ass'n of Regulatory Util. Comm'rs v. DOE, 736 F.3d 517 (D.C. Cir. 2013).

[58] *Id.* at 519.

to the financial arrangements for dealing with SNF. Because Yucca has yet to open, the federal government has been in default for well over a dozen years—and remains in default now—on its obligations to utilities. In litigation against DOE, the utilities argued that they are entitled to specific performance—the federal government must take title to and possession of the wastes—but the federal courts have ruled that their remedy is limited to money damages for the costs incurred by the utilities for waste management and storage.[59] The funds being used to pay the utilities for their SNF storage costs in these lawsuits come from the federal Judgment Fund, which means that taxpayers, rather than utility ratepayers, are financing the liabilities for the government's breach. Logically, one might think that the storage might be financed by past Fund fee payments, but these have been spent by Congress for other purposes.

The following sections of this article provide a detailed analysis of the various options for management of SNF going forward, pending development of a repository for permanent disposal. The analysis addresses the safety of SNF storage in pools or dry casks at reactors; the comparative costs and benefits of at-reactor versus consolidated storage; and the advantages and disadvantages of government versus private development of consolidated storage facilities, especially with respect to siting; and organizational and financing options.

II. SNF STORAGE SAFETY AND SECURITY

Nuclear safety watchdog groups have for many years challenged the safety of existing SNF storage practices,[60] but these criticisms did not attract wide notice until recently. The Fukushima incident has grabbed the attention of Congress, NRC, the media, and many members of the public. This Section provides an overview of NRC regulation of SNF storage, the safety issues presented by various storage options, and recent regulatory responses to post-Fukushima concerns.

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[59] *See, e.g.*, Indiana Michigan Power Co. v. DOE, 88 F.3d 1272 (D.C. Cir. 1996).

[60] *See, e.g.,* Union of Concerned Scientists, *Nuclear Power Safety in New England* (2012), *available at* http://www.ucsusa.org/assets/documents/nuclear_power/nuclear-power-safety-in-new-england.pdf.

A. *NRC Regulation of SNF Storage*

The Atomic Energy Act (AEA) confers upon NRC the authority to license and regulate storage and disposal of SNF.[61] NRC regulations for SNF storage, found in Title 10 of the Code of Federal Regulations (C.F.R.), have developed over time in response to both technological advances and policy changes.

The principal method for storing SNF, historically and to the present day, is in the cooling pools built as an integral part of nuclear power plant reactors. These pools are used in connection with refueling the reactor and to store discharged, used fuel assemblies.[62] Originally, commercial power plants were designed with relatively small fuel pools, as it was assumed that SNF would be stored on-site for cooling for only a few years before being transferred to a reprocessing facility.[63] As a result of the demise of reprocessing in the 1970s due to federal government concerns with proliferation and the dismal performance of the only U.S. reprocessing plant to operate, utilities no longer had anywhere to send their SNF, and it was becoming clear that a permanent repository would not be available quickly.[64] In the absence of alternatives, plants have, with NRC's approval, re-racked the spent fuel pool grid in order to consolidate assemblies and pack more SNF into the same pool space.[65] Newer power plants were constructed with larger pool storage capacities.[66] Construction of new storage pools at existing reactors in need of more SNF storage capacity has not occurred and is not likely to occur because they

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[61] Atomic Energy Act of 1954, § 1 et seq., as amended; 42 U.S.C. § 2011 et seq. (2012).

[62] NAT'L ACADEMY OF SCIENCES [hereinafter NAS], COMM. ON SAFETY AND SEC. OF COMMERCIAL SPENT NUCLEAR FUEL STORAGE, SAFETY AND SEC. OF COMMERCIAL SPENT FUEL STORAGE: PUBLIC REPORT 40 [hereinafter NAS, SPENT FUEL SAFETY]. Approximately every 18 to 24 months, reactor operators offload all of the used reactor fuel rods in order to discharge and replace about one-third of the fuel inside the reactor. The transfer of SNF from the reactor to the pool is done by remote handling under water in order to shield workers from any radiation and to provide constant cooling. *Id.* at 41. The transfer of SNF from pool to dry cask storage is also accomplished underwater in cooling pools by remote handling techniques.

[63] Robert Alvarez, et al., *Reducing the Hazards from Stored Spent Power-Reactor Fuel in the United States*, 11 SCI. AND GLOBAL SEC. 1, 16 (2003).

[64] *Id.*

[65] NAS, SPENT FUEL SAFETY, *supra* note 62, at 23; *see also Spent Fuel Pools*, NRC, http:/www.nrc.gov/waste/spent-fuel-storage/pools.html (last visited Mar. 18, 2014).

[66] NAS, SPENT FUEL SAFETY, *supra* note 62, at 21.

cost more than installing dry cask storage.

Not long after reprocessing was shuttered, the need for alternatives to indefinite at-reactor pool storage became clear.[67] In 1980, NRC began development of 10 C.F.R. § 72, a set of regulations to govern Independent Spent Fuel Storage Installations (ISFSIs), interim storage facilities for SNF that were operationally independent of the reactors and their associated refueling or cooling pools.[68] ISFSIs could be located either at reactor sites or elsewhere. This set of regulations was initially developed with the idea of a "wet storage environment for spent fuel."[69] Because of the high costs of pools, however, private firms developed dry cask technology to provide utilities with a cheaper storage alternative.[70] NRC accordingly expanded Part 72 to include dry storage ISFSIs;[71] it licensed the first at-reactor dry cask storage facility in 1986.[72]

As the amount of SNF in pools has approached capacity, utilities have resorted to dry cask storage by building ISFSIs. Based on estimates by the Nuclear Energy Institute, an industry institution, GAO reports that currently just under one-quarter of SNF is being stored in dry casks at ISFSIs.[73]

Decommissioned reactors present special circumstances. Under NRC regulations, utilities remain responsible for providing security and insurance, and maintaining the funding for eventual decommissioning of the SNF stored at a reactor pool or ISFSI.

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[67] *Id.*

[68] *General License Considerations for Spent Fuel Storage in an Independent Spent Fuel Storage Installation at a Reactor Site*, NRC, http://www.nrc.gov/waste/spent-fuel-storage/sf-storage-licensing/license-considerations.html (last visited Mar. 18, 2014).

[69] *Id.* The example that NRC had in mind was the GE Morris Facility. GE's facility originally had been designed as a reprocessing facility, but due to equipment failures and technical difficulties, it was never able to achieve full-scale operation. The facility's pool was subsequently licensed as a GE-operated ISFSI for the storage of the SNF that several utilities had shipped to Morris for reprocessing.

[70] GAO, SNF REPORT 2012, *supra* note 39, at 38.

[71] NRC, *General License Considerations for Spent Fuel Storage*, *supra* note 68.

[72] *Backgrounder on Dry Cask Storage of Spent Nuclear Fuel*, NRC, http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/dry-cask-storage.html (last visited Mar. 18, 2014) [hereinafter NRC, *Backgrounder*].

[73] BRC REPORT, *supra* note 1, at 34 (reporting Electric Power Research Institute figures).

Currently, nine of the ten decommissioned reactor sites with stranded fuel have moved all of their SNF to at-reactor dry storage ISFSIs.[74] The remaining site should complete transfer to dry storage by 2014.[75]

According to a 2012 report by the Congressional Research Service (CRS):

> [f]ew debate that dry cask storage provides greater safety than wet storage pools. The questions on which there are diverse views include (1) whether wet storage pools provide 'adequate' safety, (2) whether the added safety of dry casks is worth the added short-term costs and the potential safety risks during the transfer process, and (3) whether either technology provides adequate safety under extended storage periods (more than 100 years) and under previously unforeseen occurrences.[76]

Concern over the safety and security risks posed by storage in cooling pools has prompted demands—resisted thus far by the nuclear industry and NRC—that utilities transfer all SNF at all reactor sites from pool to dry cask storage as soon as it has cooled sufficiently to permit cask storage, whether at at-reactor ISFSIs or consolidated storage facilities. Industry resists the move because it is cheaper to place more SNF in existing pools at operating reactor sites than to buy casks and develop ISFSI facilities. Proponents of consolidated away-from-reactor dry cask storage assert that it would be safer than either pool storage or at-reactor dry cask storage because consolidated facilities could be sited at locations with low risk of natural disasters and because it is easier to maintain a high level of security at one or a few consolidated facilities than at many dispersed ones. With pool capacity limited, the percentage of SNF in dry cask storage will steadily increase as reactors continue to produce SNF at the rate of about 2000 metric tons per year. The total amount of SNF generated by past or existing operating reactors is projected to double by the year 2055, from over 69,000 metric tons at present to 140,000. The question confronting policymakers now is whether to require accelerated transfer of SNF from wet to dry storage.

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[74] *See Backgrounder on Decommissioning Nuclear Power Plants*, NRC (May 14, 2014), http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/decommissioning.html (detailing the decommissioned sites that have transferred SNF to ISFSI).

[75] *See id.* ("Completion of the spent fuel transfer to the ISFSI [at Zion Units 1 and 2] is scheduled for 2014.").

[76] WERNER, *supra* note 19, at 38.

B. *Post-Fukushima SNF Storage Safety and Security Concerns*

The disaster that struck the six-reactor Fukushima Daiichi nuclear power complex in Japan in 2011 was the product of a severe earthquake and tsunami that caused extensive physical damage and a prolonged, total loss of power to a number of the reactors and cooling pools at the site. To date, there is no evidence to suggest that loss of coolant and cooling capacity in pools caused releases of radioactivity from SNF stored in them.[77] The SNF dry storage casks at Fukushima escaped damage.

Fukushima has prompted growing concern in the United States over the safety of SNF storage; this concern has been reinforced by concerns over the risk of terrorist attacks. In this context, safety is typically used to refer to protection against accidents caused by human error or natural disaster, whereas security refers to protection against intentional assaults on facilities. Concern has been exacerbated by the fact that SNF in pool storage in the U.S. is far more densely packed than was the case at the Japanese reactors, and therefore, an accident affecting storage pools in the U.S. could have more serious consequences. NRC has authorized many U.S. nuclear power plants to add to their storage pools up to five times the number of fuel rods authorized in the plants' original licenses.[78]

1. *Pool Storage Safety and Security*

SNF storage pools require a continuous supply of electricity to circulate and cool the pool water. In the event that the plant loses external power, electricity needed to run the cooling system must be supplied by emergency diesel generators.[79] In the U.S., plants are required to have enough fuel to operate the backup diesel generators for seven days, and have battery capacity that lasts for four to eight hours.[80] At Fukushima, the initial earthquake

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[77] *See* AM. NUCLEAR SOC'Y SPECIAL COMM. ON FUKUSHIMA, FUKUSHIMA DAIICHI: ANS COMMITTEE REPORT, 13 (2012), *available at* http://fukushima.ans.org/report/Fukushima_report.pdf ("No subsequent evidence has emerged" to suggest that spent fuel was exposed or damaged at any pool).

[78] LISBETH GRONLUND ET AL., UNION OF CONCERNED SCIENTISTS, NUCLEAR POWER IN A WARMING WORLD 47 (2007) [hereinafter GRONLUND ET AL.].

[79] *See* STAFF OF REP. EDWARD J. MARKEY, FUKUSHIMA FALLOUT: REGULATORY LOOPHOLES AT U.S. NUCLEAR PLANTS 9 (2011) [hereinafter Markey Staff Report], *available at* http://a4nr.org/wp-content/uploads/2011/05/051211-Markey-Nuclear-Report.pdf.

[80] *Id.*

and the ensuing tsunami caused the entire facility to lose all external power. Four of the six generating units also lost backup power.[81] Cooling systems for the SNF pools consequently failed.[82] Loss of cooling can lead to SNF meltdown and fires, which could cause releases of radiation even more significant than those from meltdown of reactor cores. In addition to the risks posed by natural disasters, the Union of Concerned Scientists (UCS) contends that terrorists could exploit the high vulnerability of SNF cooling pools by attacking pools and their cooling systems.[83]

The SNF in pools could release radiation if the fuel rods are exposed to the air. This could generally happen in two different ways: through loss of circulation of the cooling water, or through loss of water through rupture of the pool structure or sloshing. Loss of circulation could be caused by power losses or damage to the pumps and other components of the cooling system. This could result from natural causes, such as earthquakes, flooding, or tornadoes; from accidents, including falling airplanes; or from terrorist attacks or other acts of sabotage.[84]

Once the water no longer covers the spent fuel assemblies, the fuel rods would heat up and accelerate the reaction between steam or air and the fuel rod's zirconium alloy cladding.[85] A 2001 study by NRC found that once uncovered, the most recently discharged fuel could reach temperatures required for the fuel rods to ignite in as little as a few hours.[86] As temperature inside the fuel rods continued to increase, the cladding could rupture and react with the uranium oxide fuel, leading to releases of radioactivity into the environment.[87] A complete loss of coolant could push the

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[81] NRC NEAR-TERM TASK FORCE, RECOMMENDATIONS POST-FUKUSHIMA, *supra* note 22, at 45.

[82] A. Stohl, et al., *Xenon-133 and Caesium-137 Releases Into the Atmosphere from the Fukushima Dai-ichi Nuclear Power Plant: Determination of the Source Term, Atmospheric Dispersion, and Deposition*, 11 ATMOS. CHEM. AND PHYS. 2315–16 (2011).

[83] GRONLUND ET AL., *supra* note 78, at 4. ("*Spent fuel pools are highly vulnerable to terrorist attack.* Unlike reactors, the pools used to store spent fuel are not protected by containment buildings, and thus are attractive targets for terrorist attacks. Such attacks could result in the release of large amounts of dangerous radioactive materials into the environment.") (emphasis in original).

[84] NAS, SPENT FUEL SAFETY, *supra* note 62, at 48.

[85] *Id*. at 39.

[86] T.E. COLLINS & G. HUBBARD, NRC, TECHNICAL STUDY OF SPENT FUEL POOL ACCIDENT RISK AT DECOMMISSIONING NUCLEAR POWER PLANTS (2001).

[87] NAS, SPENT FUEL SAFETY, *supra* note 62, at 39.

temperature of the SNF in a fuel assembly above 1650 degrees Fahrenheit, the ignition point of a self-sustaining fire.[88] NRC has found that if such a fire were to occur, it could disperse radioactivity over a large area, causing "thousands of latent cancer fatalities."[89]

According to NRC, the risk that an earthquake or an accidental airplane crash could damage a storage pool, causing loss of water coolant and leading to a fire, is "very low."[90] NRC views the risk as low because of the multiple safety systems that it requires, the design of the pools, and the amount of time required for the fuel to heat up to the point of combustion.[91] A 2013 draft report of a NRC staff study of earthquake risks conducted in response to Fukushima concluded that pool storage of spent fuel, even in high density figuration, is safe and that the risk of a large release is very low.[92] But these scenarios involve accidents; a terrorist attack might deliberately seek to cause a complete loss of coolant. UCS has expressed serious concern about the risk of a successful terrorist attack on SNF pools and the relative ease with which it might be accomplished under current nuclear power plant security arrangements.[93] NAS, UCS, Robert Alvarez (the Senior Policy Advisor to the Secretary of Energy and Deputy Assistant Secretary of Energy for National Security and the Environment in the Clinton administration), and others contend that terrorists could exploit the vulnerability of SNF cooling pools by attacking pools and their cooling systems, causing catastrophic releases of radiation.[94] The NAS Committee on Science and Technology for

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[88] U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-03-426, SPENT NUCLEAR FUEL: OPTIONS EXIST TO FURTHER ENHANCE SECURITY 15 (2003) [hereinafter GAO, SNF REPORT 2003], *available at* http://www.gao.gov/new.items/d03426.pdf.

[89] *Id.* at 13.

[90] *Id.* at 13–16. *See generally* COLLINS & HUBBARD, *supra* note 86.

[91] GAO, SNF REPORT 2003, *supra* note 88, at 14.

[92] ANDREW BARTO ET AL., NRC, CONSEQUENCE STUDY OF A BEYOND-DESIGN-BASIS EARTHQUAKE AFFECTING THE SPENT FUEL POOL FOR A U.S. MARK I BOILING WATER REACTOR 280 (DRAFT REPORT, JUNE 2013).

[93] GRONLUND ET AL., *supra* note 78, at 47.

[94] *See, e.g.*, NAT'L RESEARCH COUNCIL, SAFETY AND SEC. OF COMMERCIAL SPENT NUCLEAR FUEL STORAGE: PUB. REPORT (2006); EDWIN S. LYMAN, CHERNOBYL ON THE HUDSON?: THE HEALTH AND ECON. IMPACTS OF A TERRORIST ATTACK AT THE INDIAN POINT NUCLEAR PLANT 7 (2004); ROBERT ALVAREZ, SPENT NUCLEAR FUEL POOLS IN THE U.S.: REDUCING THE DEADLY RISKS OF STORAGE, INST. FOR POLICY STUDIES (2011), *available at*

Countering Terrorism concluded in 2002 that the "potential . . . is high" for "a 9/11 type attack" on spent fuel storage at nuclear power plants, and that SNF stored in vulnerable storage pools should be moved to dry cask storage.[95] NRC has in various documents addressed risks associated with some of the more extreme scenarios, such as the deliberate crashing of an airplane into a SNF pool.[96]

2. *Dry Cask Storage Safety and Security*

Dry cask storage involves placing SNF that has been cooled for at least several years in a cooling pool into metal container, which is then placed into a metal or cement outer-cask shell; the cask is cooled through natural circulation of air.[97] Although the cask cooling system prevents the waste from heating up to combustion temperature, the waste inside remains quite hot—around six hundred degrees Fahrenheit.[98]

Dry cask storage is considered safer and more secure than pool storage because it does not pose the risks involved with loss of coolant.[99] Also, there is much less fuel in each cask than in a cooling pool, and the fuel is generally cooler on average than that in a pool and would thus be more difficult to ignite. Studies suggest that the risks associated with dry cask storage are very low to negligible.[100] The Government Accountability Office reported that tests conducted by DOE and the Army Corps of Engineers

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http://www.ipsdc.org/reports/spent_nuclear_fuel_pools_in_the_us_reducing_the_deadly_risks_of_storage.

[95] COMM. ON SCI. & TECH. FOR COUNTERING TERRORISM, NAT'L RESEARCH COUNCIL OF THE NAT'L ACADS., MAKING THE NATION SAFER 46–47 (2002), *available at* http://www.nap.edu/catalog.php?record_id=10415. For a discussion of the risks of terrorist attacks on SNF pools, see NUCLEAR REGULATORY COMM'N, NRC REVIEW OF PAPER ON REDUCING HAZARDS FROM STORED SPENT NUCLEAR FUEL (Aug. 2003), *available at* http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/reducing-hazards-spent-fuel.pdf; *see also* Waste Confidence Decision Update, 75 Fed. Reg. 81,037, 81,051 (Dec. 23, 2010).

[96] *See, e.g.,* BARTO ET AL., *supra* note 92; *see also* Waste Confidence Decision Update, 75 Fed. Reg. 81,037, 81,051 (Dec. 23, 2010).

[97] NRC, *Backgrounder*, *supra* note 72.

[98] David Kravets, *With No Long-Term Solution, Nuclear Pallbearers Bury Waste in America's Backyard*, WIRED (Mar. 16, 2009), http://www.wired.com/politics/security/news/2009/03/nuclear?currentPage=all.

[99] MARK HOLT, CRS, CIVILIAN NUCLEAR SPENT FUEL: TEMPORARY STORAGE OPTIONS FOR SPENT FUEL 16 (1998), *available at* http://cnie.org/NLE/CRSreports/waste/waste-20.cfm.

[100] *Id.* at 15, 17.

found that, due to the strength and thickness of the concrete and steel they incorporate, the dry-storage casks currently used would not release significant amounts of radioactivity if struck by crashing airplanes, armor-piercing rounds, or high explosives.[101] NRC has determined that SNF storage in dry casks, even if not entirely free from risk, is "safe and environmentally sound."[102] NRC currently issues licenses for dry cask interim storage for up to forty years, with the option of renewal.[103]

Terrorist attacks on dry cask storage have to be considered along with natural disasters and accidents. NRC evaluates the risk of widespread release of radioactivity from such an attack as "very low" because of the robust physical properties of containers used for transportation and dry storage.[104] The NAS Counter Terrorism Committee found it unlikely that a terrorist attack would be able to penetrate dry casks or cause a significant release of radiation.[105] UCS believes that terrorism attacks could potentially cause releases of radioactivity from SNF in dry casks,[106] but believes that dry cask storage can be made "acceptably safe" for the next fifty years by "hardening" such facilities against attack by constructing protective structures.[107] BRC recommended that NRC examine whether it would be prudent to further develop and implement hardened on-site dry cask storage (HOSS) facilities.[108]

Regardless of whether dry cask storage were to be required, some SNF storage at reactor pools would still be needed because SNF must cool for a period before it can safely be stored in dry

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[101] GAO, SNF REPORT 2003, *supra* note 88, at 16–17.

[102] NRC, *Backgrounder, supra* note 72. Experiments have shown that dry storage casks are capable of resisting crashing airplanes, armor-piercing rounds, and high explosives. *See* GAO, SNF REPORT 2003, *supra* note 88, at 16-17.

[103] Cask models are NRC-certified when the cask vendor obtains a Certificate of Compliance (CoC) for the cask model. 10 C.F.R. § 72.236. Cask certificates issued before May 17, 2011 expire 20 years from the date of issuance and may be renewed for an additional 20 years. In February 2011, NRC amended part 72 to change the 20-year term and renewal period to a term not to exceed 40 years. *See* 76 Fed. Reg. 8872, 8875-76. (Feb. 16, 2011) (codified at 10 C.F.R. §§ 72.238-72.240 (2012)).

[104] GAO, SNF REPORT 2003, *supra* note 88, at 8.

[105] COMM. ON SCIENCE & TECH. FOR COUNTERING TERRORISM, NAT'L RESEARCH COUNCIL OF THE NAT'L ACADS., MAKING THE NATION SAFER 46–47 (2002).

[106] GRONLUND ET AL., *supra* note 78, at 45, 47.

[107] *Id.*

[108] BRC REPORT, *supra* note 1, at 44.

casks. Under prevailing practice, SNF exiting the reactor generally needs to be cooled for at least three to five years before it can be transferred to existing dry storage in casks.[109] However, in order to expand output, the nuclear utilities have turned to use of high-burn-up fuel, which produces hotter SNF that requires up to seven years of pool storage and may present distinctive dry storage and transport risks.[110] Both BRC and Congress have directed DOE to devote resources and attention to studying and enhancing the safety of dry cask storage.[111]

C. *Reassessments of U.S. SNF Storage Safety in Response to Fukushima*

Fukushima was the first major nuclear power plant incident to be initiated by a natural disaster.[112] As the events in Japan unfolded, NRC established a task force, comprised of NRC senior officials, to undertake a systematic review of U.S. nuclear plant

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[109] *See* NRC, *Backgrounder*, *supra* note 72. From a technical and practical standpoint, heat and radiation have decreased enough after three years for the fuel to be passively cooled in dry storage casks that are available and in use in other parts of the world. However, most dry-storage systems approved by NRC for use in the U.S. require that the fuel have been cooled for five years. *Id.* at 1. Some experts have suggested that it is technologically possible for spent fuel that has been pool-cooled for as little as one year to be safely stored in advanced-design dry casks. *Ask an Expert: Answering FAQs*, NUCLEAR ENERGY INST., http://safetyfirst.nei.org/ask-an-expert/ (last visited Mar. 18, 2014).

[110] *See* INT'L ATOMIC ENERGY AGENCY, IMPACT OF HIGH BURNUP URANIUM OXIDE AND MIXED URANIUM-PLUTONIUM OXIDE WATER REACTOR FUEL ON SPENT FUEL MANAGEMENT 1 (2011).

[111] *See* BRC REPORT, *supra* note 1, at 44; H.R. REP. NO. 112-331, at 850–51, 855 (2011) (Conf. Rep.).

[112] While what exactly happened in the spent fuel pools at the Fukushima Daiichi reactors is still unclear, it is known that the initial earthquake caused the entire facility to lose external power. Soon thereafter, the first large tsunami inundated the facility, exceeding by 27 feet the site design protection, and resulting in the loss of all but one of the emergency diesel generators. This caused the inability to cool the spent fuel pools, which were eventually kept cool by employing pumper trucks using high booms to spray seawater into the pools from a relatively safe distance. At least one of the spent fuel pools is reported to have lost water due to sloshing during the earthquake, and there were also initial concerns that at least one pool might have lost all water, although NRC now believes that all of the pools retained at least some water. However, the dry casks, which were located further from the ocean than the reactors and pools, did apparently escape any damage and did not release any radiation. Matthew L. Wald, *Spent Fuel Pools as a Bright Spot in Fukushima's Crisis*, N.Y. TIMES (July 26, 2011), *available at* http://green.blogs.nytimes.com/2011/07/26/spent-fuel-pools-in-japan-survived-disaster-n-r-c-report-says/.

safety programs.[113] The NRC Near-Term Task Force, however, did not include any independent experts; this fact was noted by BRC, which called for an independent investigation by NAS. The NRC Task Force identified a number of flaws in NRC's current regulatory approach and made detailed recommendations for changes to enhance the safety and security of SNF storage. Nevertheless, the Task Force concluded—not surprisingly, given that its members are all NRC staff—that continued operation and licensing of nuclear power plants pose no imminent risk to health, safety, defense, or security.[114] The Task Force proposed schedules and milestones extending over a multi-year period for implementing the measures recommended.[115] On October 3, 2011, NRC issued a document that separated the Task Force recommendation into three tiers for phased, prioritized implementation.[116] Following directions in a congressional appropriations conference committee report,[117] NRC subsequently accelerated the schedule for regulatory actions, with initial regulatory orders to be issued on the one-year anniversary of the Fukushima disaster.[118]

The Fukushima incident has broadened support for long-standing calls by UCS and other nuclear safety watchdogs that SNF in cooling pools be moved to dry cask storage as promptly as feasible. UCS has renewed its calls for transfer to dry cask storage of fuel that has been cooled for five years.[119] Robert Alvarez likewise believes that the transfer of spent fuel to dry cask storage should be "a public safety priority of the highest degree."[120] The

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[113] NRC NEAR-TERM TASK FORCE, RECOMMENDATIONS POST-FUKUSHIMA, *supra* note 22, at 1.

[114] *Id.* at 18.

[115] *Id.* at Appendix A.

[116] NRC, SECY-11-0137, PRIORITIZATION OF RECOMMENDED ACTIONS TO BE TAKEN IN RESPONSE TO FUKUSHIMA LESSONS LEARNED (2011).

[117] *Id.*; MILITARY CONSTRUCTION AND VETERANS AFFAIRS AND RELATED AGENCIES APPROPRIATIONS ACT, H.R. REP. NO. 112-331, at 881 (2011) (Conf. Rep.). The Conference Report also called for NRC to provide the Senate and House Committees on Appropriations with a status report on the one-year anniversary of the Fukushima accident. *Id.*

[118] *Japan Lessons Learned*, NRC, http://www.nrc.gov/reactors/operating/ops-experience/japan-dashboard.html (last visited Mar. 18, 2014).

[119] NRC NEAR-TERM TASK FORCE, RECOMMENDATIONS POST-FUKUSHIMA, *supra* note 22, at 3.

[120] *See* ALVAREZ, SPENT NUCLEAR FUEL POOLS, *supra* note 94, at 24. Alvarez has also voiced concerns about criticality safety, asserting that packing more

NAS Board on Radioactive Waste Management recommended in a 2001 report that most or all SNF at reactor pools be moved to dry cask storage as soon as possible due to vulnerability to terrorism.[121] A NAS committee on spent fuel safety reached a similar conclusion.[122] There have also been calls from Congress urging NRC to mandate the transfer of spent fuel into dry cask storage as soon as feasible.[123] Rep. Markey (D-MA) introduced a bill that, in addition to calling for a wholesale review of NRC safety regulations and suspension of all licensing and re-licensing activities until that occurs, would mandate the transfer of SNF from pools into dry cask storage within one year of NRC's deeming it feasible to be transferred.[124]

The Task Force maintains that the risks posed by leaving in pools SNF that has cooled sufficiently to be transferred to dry storage are so low that removing it to dry casks would not provide appreciable safety benefits. [125] The Task Force also maintains that

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SNF into pools has led to an undue risk that the fissile elements in the spent fuel assemblies could react with each other. *Id.* at 16. He notes that in 2010, the neutron-absorber material in the spent fuel pool in the Turkey Point plant outside of Miami, Florida was found to be so degraded that protection against a chain reaction could no longer be assured even with no loss of water. *Id.* at 17. Because NRC often relies on self-reporting, it took the Commission five years to recognize the problem. *Id.* at 2, 17. *See also* Keith Bradsher & Hiroko Tabuchi, *Greater Danger Lies in Spent Fuel Than in Reactors*, N.Y. TIMES (Mar. 17, 2011), *available at* http://www.nytimes.com/2011/03/18/world/asia/18spent.html.

[121] NAT'L RESEARCH COUNCIL, SAFETY AND SEC. OF COMMERCIAL SNF STORAGE 71 (2006).

[122] *See, e.g.*, NAS, SPENT FUEL SAFETY, *supra* note 62, at 71.

[123] *See, e.g.*, Press Release, Sen. Dianne Feinstein, Feinstein Urges Reform of U.S. Spent Nuclear Fuel Storage (Apr. 11, 2011), *available at* http://www.feinstein.senate.gov/public/index.cfm/press-releases?ID=46244216-5056-8059-76e0-3d5a15d5d570; Press Release, Sen. Barbara Boxer, Senator Boxer's Statement on NRC's 90-day Review (July 13, 2011), *available at* http://www.epw.senate.gov/public/index.cfm?FuseAction=PressRoom.PressReleases&ContentRecord_id=24612e38-802a-23ad-4f3a-bc85c83cd929&Designation=Majority.

[124] *See* Nuclear Power Plant Safety Act of 2011, H.R. 1242, 112th Cong. (2011). The bill was introduced on March 29, 2011, and had 16 co-sponsors; it was not reported out by the committee.

[125] *See Spent Fuel Pool Safety and Consideration of Expedited Transfer To Dry Cask Storage: Commission Meeting*, NRC 13 (Jan. 6, 2014), http://www.nrc.gov/reading-rm/doc-collections/commission/slides/2014/20140106a/nrc-staff-20140106a.pdf (insisting spent fuel pools "adequately protect public health and safety" and faster transfer to dry storage "does not substantially enhance safety and [its] costs outweigh benefits").

the number of assemblies in a fuel pool does not significantly affect the ability to cool the pool.[126] NRC's position has been and remains that spent fuel pools and dry casks are both safe and secure, and as a result, that there is no pressing concern to mandate immediate transfer to dry storage.[127] The nuclear industry has strongly urged NRC to maintain this stance and resisted calls for regulation to require dry cask storage.[128] The Electric Power Research Institute (EPRI) objected to a proposal that would mandate that all SNF be transferred to dry casks after five years of storage, on the ground that there are no safety benefits to transferring SNF out of wet storage.[129] NRC is concurrently conducting a long-term review of the lessons learned from Fukushima.[130] In the context of its lessons learned review, NRC is evaluating whether regulatory action is needed to accelerate transfer of SNF from pool to dry storage, but at a recent NRC briefing four of the five commissioners expressed the view that continued use of pool storage is safe.[131]

The conclusions of the industry, NRC, and its task force regarding continued intensive use of pool storage have not

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[126] *Id.*

[127] *Spent Fuel Storage in Pools and Dry Casks: Key Points and Questions & Answers*, NRC, http://www.nrc.gov/waste/spent-fuel-storage/faqs.html (last visited Mar. 18, 2014).

[128] Hannah Northey, *Senators Argue over Fate of Nuclear Safety Proposals*, N.Y. TIMES (Aug. 2, 2011), *available at* http://www.nytimes.com/gwire/2011/08/02/02greenwire-senators-argue-over-fate-of-nuclear-safety-pro-79067.html.

[129] ELEC. POWER RESEARCH INST., IMPACTS ASSOCIATED WITH TRANSFER OF SPENT NUCLEAR FUEL FROM SPENT FUEL STORAGE POOLS TO DRY STORAGE AFTER FIVE YEARS OF COOLING, 5-1 (2010), *available at* http://my.epri.com/portal/server.pt?space=CommunityPage&cached=true&parentname=ObjMgr&parentid=2&control=SetCommunity&CommunityID=405.

[130] Memorandum from Annette L. Vietti-Cook, Sec'y of Commission, NRC, to R. W. Borchardt, Exec. Dir. for Operations, NRC, Proposed Charter for the Longer-Term Review of Lessons Learned from the March 11, 2011, Japanese Earthquake and Tsunami (Oct. 19, 2011), *available at* http://www.nrc.gov/reactors/operating/ops-experience/japan/japan-activities.html. *Japan Lessons Learned*, NRC, http://www.nrc.gov/reactors/operating/ops-experience/japan-dashboard.html (last visited Mar. 18, 2014).

[131] Matthew L. Wald, *Nuclear Fuel Storage Remains Safe, Panel Members Say*, N.Y. TIMES (Jan. 6, 2014), *available at* http://www.nytimes.com/2014/01/07/us/nuclear-fuel-storage-remains-safe-panel-members-say.html?_r=0; NRC, *Briefing on Spent Fuel Pool Safety and Consideration of Expedited Transfer of Spent Fuel to Dry Casks*, NRC (Jan. 6, 2014), http://video.nrc.gov/vPlayer.php?eventID=880&type=JW.

persuaded the critics. The report prepared by Congressman Markey's staff found that in the past eight years, there have been at least sixty-nine reports of emergency diesel generator inoperability spanning thirty-three different power plants.[132] The report also warns of the danger that reactors using boiling water technology with pools elevated above ground level—of which there are thirty-five in the U.S.—will lose water due to seismic activity, just as the Fukushima boiling water reactor pools did.[133] In California, earthquakes have caused heavy water losses in elevated spent fuel pools due to sloshing out of the top of the pool.[134] Robert Alvarez has also identified ten instances since 9/11 when there was a significant loss of water in spent fuel pools due to various factors.[135] BRC's report did not contain a recommendation to accelerate transfer of SNF from pool to dry storage, but urged an independent evaluation of the SNF transfer issues by NAS.[136]

D. *Security Issues: Managing Terrorism Risks*

Since the World Trade Center attacks on September 11, 2001, there has been extensive focus on the possibility of terrorist attacks on nuclear power plants and their spent fuel storage facilities.[137] It is now understood that al-Qaeda had considered attacking a nuclear plant on 9/11, only to abandon the plan primarily due to

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[132] Markey Staff Report, *supra* note 79, at 3.

[133] *Id.* at 10.

[134] *Id.* at 12. *See also* Keith Bradsher and Hiroko Tabuchi, *Greater Danger Lies in Spent Fuel Than in Reactors*, NY TIMES (Mar. 17, 2011), *available at* http://www.nytimes.com/2011/03/18/world/asia/18spent.html.

[135] ALVAREZ, SPENT NUCLEAR FUEL POOLS, *supra* note 94, at 16.

[136] Transp. and Storage Subcomm. of the Blue Ribbon Comm'n on America's Nuclear Future, Report to the Full Commission Updated Report 24 (January 2012), *available at* http://cybercemetery.unt.edu/archive/brc/20120620215746/ http://brc.gov/sites/default/files/documents/final_updated_ts_report_012612.pdf. The report stated:

> The Subcommittee believes the NRC and industry are working appropriately to identify and address potential issues [with pool storage of SNF]; in addition, the Subcommittee is recommending that the NAS be engaged to conduct an independent investigation. Such analysis might indicate that moving fuel earlier than previously planned from reactor pool storage to dry casks, either on site or away from reactors, is a prudent safety measure. Such measures carry their own potential costs and risks, however, and will need to be carefully considered.

[137] Hui Zhang, *Radiological Terrorism*: *Sabotage of Spent Fuel Pools*, 22 INT'L NETWORK OF ENGINEERS AND SCIENTISTS AGAINST PROLIFERATION BULL. 75, 75 (2003).

the mistaken belief that airspace around the plants would be restricted, and that a hijacked airplane would be shot down before it could hit the plant.[138] Nuclear power plants, all of which were constructed decades ago, were built primarily with ensuring safety, rather than security, in mind.[139] While the regulatory program in place for power plants to prevent or minimize the effects of accidents and promote resilience against extreme natural events—if fully implemented—could assist in protection against a terrorist attack, the magnitude and type of terrorist threats that we face today were not considered when these plants were built.[140]

Spent fuel pools, located outside of the reactor containment structure, are more exposed to terrorist attack than the reactor itself.[141] There are numerous different ways that terrorists could attack spent fuel pools.[142] The NAS Committee on Science and Technology for Countering Terrorism concluded in 2002 that the "potential for 9/11-type attacks is high in the near term" for SNF pools, and that SNF should be moved to dry cask storage.[143] UCS asserted in 2006 that the risk and potential consequences of terrorist attacks on SNF stored at reactor sites have been significantly underestimated and that the security of both spent fuel pools and dry cask storage was currently "unacceptable."[144] Both UCS and other critics of current arrangements have advocated various steps to increase security, including construction of protective HOSS structures.[145] The utilities have generally resisted this idea, contending that current NRC requirements

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138 *See* EDWIN S. LYMAN, CHERNOBYL ON THE HUDSON?: THE HEALTH AND ECON. IMPACTS OF A TERRORIST ATTACK AT THE INDIAN POINT NUCLEAR PLANT 7 (2004); THE 9/11 COMM'N, THE 9/11 COMM'N REPORT 245 (2004), *available at* http://www.9-11commission.gov/report/911Report.pdf (noting that 9/11 hijacker Mohamed Atta "considered targeting a nuclear facility he had seen during familiarization flights near New York.").

139 NAS, SPENT FUEL SAFETY, *supra* note 62, at 47

140 *See id.*

141 UNION OF CONCERNED SCIENTISTS, U.S. NUCLEAR POWER AFTER FUKUSHIMA: COMMON SENSE RECOMMENDATIONS FOR SAFETY AND SEC. 6 (2011).

142 Zhang, *supra* note 137, at 75.

143 The NAS committee did not believe that a terrorist attack scenario would be likely to penetrate dry casks or result in a significant release of radiation, however. NAS, SPENT FUEL SAFETY, *supra* note 62, at 47.

144 GRONLUND ET AL., *supra* note 78, at 47.

145 *See id.*; Transp. and Storage Subcomm. Updated Report, *supra* note 136, at 19–20.

already ensure the security of dry cask storage, and that HOSS structures could actually increase the risk of a nuclear incident were the structure to collapse during an attack.[146] BRC recommended that NRC examine whether it would be prudent to further develop and implement HOSS protections.[147]

While rejecting calls to require transfer of SNF from pools to dry casks following 9/11, NRC eventually instituted new security regulations that strengthened pre-existing measures,[148] such as updating the Design Basis Threat (DBT) scenarios of terrorist attacks that a nuclear plant, including its cooling pools (but not dry cask ISFSIs), must be able to withstand.[149] NRC also requires each nuclear plant to undergo Force-on-Force inspections every three years.[150] The updated DBT did not, however, include requirements to protect against air attacks. Public Citizen, San Luis Obispo Mothers for Peace, and the State of New York filed suit against NRC, challenging this omission; the State of California supported their position as amicus curiae. The Ninth Circuit, however, rejected their contentions.[151] In separate litigation, San Luis Obispo Mothers for Peace, the Sierra Club, and an individual challenged NRC's failure to prepare a NEPA EIS in licensing an ISFSI installation for dry cask SNF storage at California's Diablo Canyon plant.[152] In 2006, the Ninth Circuit ruled in that case that

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[146] BRC REPORT, *supra* note 1, at 46.

[147] *Id.*

[148] *See* 10 C.F.R. § 50.54(hh) (2013). These pre-Fukushima regulations required licensees to maintain cooling of both the reactor and the spent fuel in the event of a large fire or explosion. *See* NRC NEAR-TERM TASK FORCE, RECOMMENDATIONS POST-FUKUSHIMA, *supra* note 22, at 17.

[149] *See* 10 C.F.R. § 73.1 (2013). ISFSIs are not subject to the DBT. Instead, they are subject to regulations that mandate that the licensee prevent the "loss of control" of the facility that causes the release of more than a total effective dose of 5 rem of radiation at the boundary of the controlled area. *See* 10 C.F.R. §§ 72.180, 73.51, 72.106 (2013).

[150] *See* MARK HOLT & ANTHONY ANDREWS, CRS, RL34331, NUCLEAR POWER PLANT SECURITY AND VULNERABILITIES 8 (2010); NRC, REPORT TO CONG. ON THE SEC. INSPECTION PROGRAM FOR COMMERCIAL POWER REACTORS AND CATEGORY I FUEL CYCLE FACILITIES: RESULTS AND STATUS UPDATE 8 (2011), *available at* http://pbadupws.nrc.gov/docs/ML1118/ML11181A024.pdf.

[151] Pub. Citizen v. NRC, 573 F.3d 916, 926 (9th Cir. 2009). NRC had determined that instead of requiring plant licensees to prevent potential air attacks, it was better to rely on other federal agencies to do so and instead have licensees focus on mitigative measures that would limit any damage that would result from an air attack. The court held that this determination was not arbitrary and capricious.

[152] *See* San Luis Obispo Mothers for Peace v. NRC, 449 F.3d 1016 (9th Cir.

NRC had violated NEPA by categorically refusing to consider the environmental impact of potential terrorist attacks and remanded the issue to NRC.[153] NRC's actions on remand were ultimately upheld by the same panel of the Ninth Circuit in 2011.[154] While the petitioners argued that NEPA, the AEA, and the Ninth Circuit's previous ruling gave petitioners the right to have their security scenario fully litigated before NRC, the court rejected their contention and held that that NRC was not required to disclose, in a closed hearing or otherwise, any security-sensitive information.[155] Although ultimately unsuccessful, these lawsuits may be the harbinger of future challenges by states, localities, and environmental and community groups to continued or expanded at-reactor SNF storage.

As the Diablo Canyon litigation illustrates, an important problem in assessing the adequacy of current security measures is that the public has very little detailed information about them. Because any information available to the public could also be accessed by those wishing to attack nuclear power plants, many of the details of security plans and identified security deficiencies are withheld under NRC information security policies.[156] A recent GAO report found that NRC does not have an adequate system for identifying and accessing secure information on SNF security and recommended that it develop a mechanism for individuals with appropriate clearances to identify and access relevant studies in order to preserve institutional knowledge.[157]

E. *Extended SNF Storage and Judicial Invalidation of NRC's WCD*

In the absence of a repository, new consolidated storage

2006).

[153] *See id.* at 1035. Note that only the Ninth Circuit has imposed this requirement, and NRC has only considered terrorism in EISs prepared for facilities within the Ninth Circuit's jurisdiction. *See* HOLT & ANDREWS, *supra* note 150, at 7. The Third Circuit has ruled that the environmental impact of terrorism does not have to be considered in an EIS. *See* N.J. Dep't of Envtl. Prot. v. NRC, 561 F.3d 132 (3d Cir. 2009).

[154] *See* San Luis Obispo Mothers for Peace v. NRC, 635 F.3d 1109 (9th Cir. 2011).

[155] *Id.* at 1115.

[156] *Information Security*, NRC, http://www.nrc.gov/security/info-security.html (last visited Mar. 18, 2014).

[157] GAO, SNF REPORT 2012, *supra* note 39, at 36, 47.

facilities, or reprocessing, the default option is indefinite storage at reactor sites in pools and ISFSIs, a prospect that has provoked debate over its safety. As early as 1990, NRC determined that storage of spent fuel in dry casks at reactor sites is safe for a minimum of one hundred years.[158] The American Physical Society has found that dry cask storage containers can be securely maintained for at least fifty years with a high degree of confidence, and that replacing aging casks can further extend the secure storage period, making safe on-site storage feasible for as long as adequate resources and attention can be directed to facility maintenance.[159] Former DOE Secretary Chu stated that dry cask storage could be relied upon for half a century, perhaps longer, while alternatives to Yucca are explored and developed. Studies have found that SNF can, with proper controls, be safely stored on the surface for around one hundred years.[160]

Opponents of long-term SNF storage at nuclear plants recently won a significant court victory in *New York v. NRC*,[161] where the D.C. Circuit set aside and vacated NRC's 2010 updated version of its WCD[162] and the accompanying amended Temporary Storage Rule (TSR), which determined that SNF storage, whether wet or dry storage, at-reactor or at on-site or off-site ISFSIs, is safe

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[158] Waste Confidence Decision Review, 55 Fed. Reg. 38,474, 38,482 (Sept. 18, 1990).

[159] NUCLEAR ENERGY STUDY GROUP, AM. PHYSICAL SOC'Y, CONSOLIDATED INTERIM STORAGE OF COMMERCIAL SPENT NUCLEAR FUEL 3 (2007).

[160] According to DOE's 2008 supplemental EIS for Yucca Mountain, extended surface storage of highly radioactive defense wastes and SNF can be accomplished safely with adequate institutional controls for up to a hundred years. OFFICE OF CIVILIAN RADIOACTIVE WASTE MGMT, DOE, FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT FOR A GEOLOGICAL REPOSITORY FOR THE DISPOSAL OF SPENT NUCLEAR FUEL AND HIGH-LEVEL RADIOACTIVE WASTE AT YUCCA MOUNTAIN, NYE COUNTY, NEVADA, DOE/EIS-0250F-S1, S-50 (2008). Beyond that period, the report warns, unforeseen circumstances would be expected to cause security and maintenance to fall below acceptable levels. Without institutional controls, releases of radioactivity would be expected to reach the accessible environment within ten thousand years, eventually causing "catastrophic consequences for human health." *Id.* at S-51. *See also* COMM. ON DISPOSITION OF HIGH-LEVEL RADIOACTIVE WASTE THROUGH GEOLOGICAL ISOLATION, NAT'L RESEARCH COUNCIL, DISPOSITION OF HIGH-LEVEL WASTE AND SPENT NUCLEAR FUEL: THE CONTINUING SOCIETAL AND TECHNICAL CHALLENGES 115 (2001); E.A. Hoffman & W.M. Stacey, *Nuclear and Fuel Cycle Analysis for a Fusion Transmutation of Waste Reactor*, 63–64 FUSION ENGINEERING & DESIGN 90 (2002).

[161] 681 F.3d 471 (D.C. Cir. 2012).

[162] Waste Confidence Decision Update, 75 Fed. Reg. 81037 (Dec. 23, 2010).

for up to a total of 120 years.[163] The WCD had also determined that NRC need not consider the risk of pool fires because the risk was so low. The court's decision has great practical significance because, since 1984, NRC has relied on the generic determinations in the WCD and TSR to avoid case-by-case litigation that might be brought by nuclear opponents regarding storage safety issues in licensing and relicensing reactors and ISFSIs.[164]

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[163] Consideration of Environmental Impacts of Temporary Storage of Spent Fuel after Cessation of Reactor Operation, 75 Fed. Reg. 81,032, 81,037 (Dec. 23, 2010), revising 10 C.F.R. § 51.23(a) (1984) (known as the TSR) to provide as follows:

> § 51.23 Temporary storage of spent fuel after cessation of reactor operations—generic determination of no significant environmental impact.
>
> The Commission has made a generic determination that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor in a combination of storage in its spent fuel storage basin and at either onsite or offsite independent spent fuel storage installations. Further, the Commission believes there is reasonable assurance that sufficient mined geologic repository capacity will be available to dispose of the commercial high-level radioactive waste and spent fuel generated in any reactor when necessary.

10 C.F.R. § 51.23(a) (2013).

[164] The opinion in *New York v. NRC* summarized the specific findings made by NRC in the 1984 WCD and subsequent decisions by NRC updating it. 681 F.3d 471, 475 (D.C. Cir. 2012). As explained in further detail in FUEL CYCLE TO NOWHERE, the WCD and associated TSR originated in earlier proceedings, begun in the 1970s by NRC's predecessor, the AEC. FUEL CYCLE TO NOWHERE, *supra* note 11 at 52–54. At that time, nuclear power plant opponents sought, with considerable success, to delay plant licensing and highlight nuclear power risks by arguing that NEPA required AEC to consider, in each individual plant licensing adjudication, the environmental impacts of storing and disposing of the SNF wastes that the plants would produce. AEC responded with a NEPA rulemaking adopting a generic rule determining the environmental impacts of SNF storage; AEC would then use that determination in all licensing decisions, avoiding the need to hold plant-by-plant adjudicatory hearings on the issue. AEC's generic rule included Table S-3, often referred to as the "S-3 rule," which determined that there would be no adverse environmental impacts of SNF generated by new power plants and that, for purposes of licensing individual reactors, such impacts should be treated as zero. Notwithstanding two adverse D.C. Circuit rulings, the S-3 rule and its use summarily to resolve SNF issues in individual licensing decisions was upheld by the Supreme Court in two landmark decisions. *See* Vt. Yankee Nuclear Power Corp. v. Natural Res. Def. Council, Inc., 435 U.S. 519 (1978); Baltimore Gas & Elec. Co. v. Natural Res. Def. Council, 462 U.S. 87 (1983).

Undaunted, opponents challenged NRC's grant of license amendments for expansion of operating power plants' SNF cooling pools; the pools were rapidly

The court found that NRC had not provided sufficient basis for its WCD determinations that "reasonable assurance exists" that: (1) SNF "can be stored safely and without significant environmental impacts for at least 60 years beyond the licensed life for operation" of the reactor in a combination of on-site and off-site pool and dry cask storage; and (2) "sufficient mined geologic repository capacity will be available . . . when necessary . . . ." for permanent disposal of SNF.[165] Prior to the court's decision, NRC had begun considering further modifications to its WCD and was evaluating the long-term effects of storing SNF for up to three hundred years.[166] The court further found that NRC should have evaluated the impacts of storage pool leaks and fires. It also ruled that issuance of the WCD update and the amended TSR constituted a "major federal action" under NEPA, and accordingly, that NRC should have prepared an EIS or issued

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filling up and threatening to shut down plant operations. Opponents argued that NEPA required NRC to review the environmental consequences of long-term storage of SNF in the individual licensing proceedings. NRC rejected this argument, finding reasonable assurance that a repository would be built to dispose of the SNF and that storage in the interim would be safe. The D.C. Circuit, however, held that NRC could only make such a determination through a fact-finding proceeding, Minnesota v. NRC, 602 F.2d 412, 418–19 (D.C. Cir. 1979), prompting NRC to initiate a Waste Confidence Proceeding in 1979. *See* New York v. NRC, 681 F.3d 471, 474–475 (D.C. Cir. 2012) (recounting history and origin of WCD proceeding). The WCD, issued in 1984, reaffirmed NRC's earlier conclusion of reasonable confidence that SNF could be safely stored pending development of a repository for permanent disposal of the waste. Waste Confidence Decision, 49 Fed. Reg. 34,658, 34,659–60 (Aug. 31, 1984).

Since issuance of the 1984 WCD, NRC has used the WCD's findings (reasonable assurance of safe storage and availability of repository storage) and the accompanying TSR, codified at 10 C.F.R. § 51.23(a), together with the S-3 rule (no adverse environmental impact from SNF storage and disposal), codified at 10 C.F.R § 51.51 tbl. S-3, to resolve summarily SNF environmental issues in individual reactor and storage licensing proceedings.

[165] New York v. NRC, 681 F.3d 471, 478 (D.C. Cir. 2012). These were Finding 2 (repository) and Finding 4 of the updated WCD. *Id.* at 475.

[166] NRC, BACKGROUND AND PRELIMINARY ASSUMPTIONS FOR AN ENVIRONMENTAL IMPACT STATEMENT—LONG-TERM WASTE CONFIDENCE UPDATE, DRAFT REPORT FOR COMMENT [hereinafter WASTE CONFIDENCE] (2011), *available at* http://pbadupws.nrc.gov/docs/ML1134/ML11340A141.pdf. NRC announced that it was considering four different scenarios: "continued spent fuel storage at reactor sites, storage at regional facilities, storage at one central site, and limited reprocessing with co-located storage of resulting high-level wastes." *Id.* at i. NRC recently indicated that this "extended storage effort," is continuing, and that NRC expects to complete it by the end of the decade. Waste Confidence—Continued Storage of Spent Nuclear Fuel, 78 Fed. Reg. 56776, 56782 (Sept. 13, 2013).

a finding of no significant impact.[167]

Following the court's decision, a number of states and environmental organizations, led by New York State, petitioned NRC to suspend all further licensing of nuclear power plants.[168] Given that NRC grants power plant licenses based, in part, on the WCD's and TSR's generic findings concerning the safety of SNF storage and the availability of a repository, NRC had little choice but to respond affirmatively to the petitions. In August 2012, NRC ordered that it would suspend issuance of final licenses and license renewals until such time as it had completed actions necessary to address the deficiencies cited by the court in *New York v. NRC*. However, NRC's order made clear that, in the interim, NRC would continue to move forward with the licensing proceedings themselves.[169]

The nuclear industry and NRC have played down the significance of NRC's license suspension order, pointing out that most of the 104 nuclear reactors in the U.S. have already been relicensed in the last ten years and that only eighteen have not.[170] Under NRC rules, plants that have timely filed a complete application for a license renewal but whose licenses expire before NRC has decided the application, are allowed to continue operating until NRC makes a final decision.[171] Further, according to NRC, no plant licensing decisions are imminent.[172]

Nonetheless, NRC has conceded that its suspension order potentially affects as many as twenty-one new plant licenses and

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[167] New York v. NRC, 681 F.3d 471, 473 (D.C. Cir. 2012).

[168] *See, e.g.*, Petition to Suspend Final Decisions in All Pending Reactor Licensing Proceedings Pending Completion of Remanded Waste Confidence Proceedings (June 18, 2012) (Petition).

[169] NRC Order, *supra* note 10, at 4.

[170] *See, e.g.,* James Conca, *Nuclear Waste Confidence—NRC Ruling No Big Deal*, FORBES (Aug. 11, 2012), http://www.forbes.com/sites/jamesconca/2012/08/11/nuclear-waste-confidence-nrc-ruling-no-big-deal/. Conca points out that the four new Gen III reactors being built at Vogtle and Virgil C. Summer already have received final licenses and are thus unaffected by the NRC order. *Id.*

[171] *See* FREQUENTLY ASKED QUESTIONS ON LICENSE RENEWAL OF NUCLEAR POWER REACTORS, NRC 1–10 (2006), http://pbadupws.nrc.gov/docs/ML0611/ML061110022.pdf.

[172] *See NRC Halts Plant License Approvals to Resolve Waste Issue*, REUTERS (Aug. 8. 2012), http://www.reuters.com/article/2012/08/08/utiltiies-nuclear-idUSL2E8J81DX20120808?type=companyNews&feedType=RSS&feedName=companyNews&rpc=31.

twelve license renewals at existing plants.[173] NRC has also indicated that it will take two years (and possibly longer) for it to complete the NEPA analysis ordered by the court and issue revised versions of the WCD update and TSR, a process that will include providing opportunities for public comment.[174] Because the vacated generic findings on storage and disposal in the WCD and TSR cannot be relied upon in individual licensing proceedings during the period while NRC is revising them, NRC has conceded that it may be necessary in some "rare" cases to address these issues on a site-specific basis.[175] Indeed, the *New York v. NRC* petitioners contend that the court's decision requires NRC to address site-specific SNF storage issues, including whether SNF in pools must be moved to dry cask storage, before it can extend any power plant's license, presaging fresh site-by-site litigation.[176]

As noted previously,[177] in September 2013, NRC issued a draft generic environmental impact statement (DGEIS) on the safety of long-term storage of SNF at reactor pools and dry casks at ISFSIs, and a proposed rule finding that it would be safe to store SNF for up to sixty years past the licensed operating life of

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[173] *See* Dave McIntyre, *Deciphering the Waste Confidence Order*, NUCLEAR REG. COMM'N BLOG (Aug. 9, 2012), http://public-blog.nrc-gateway.gov/2012/08/09/deciphering-the-waste-confidence-order/. The blog's moderator, a NRC Public Information Officer, accordingly calls the potential impacts of the Commission's order "enormous."

[174] Memorandum from Annete L. Vietti-Cook, Sec'y to R.W. Borchardt, Exec. Dir. for Operations (Sept. 6, 2012), *available at* http://pbadupws.nrc.gov/docs/ML1225/ML12250A032.pdf. Petitioners had sought, and NRC in its order granted, opportunities for public review and comment "in advance on any generic waste confidence document that the NRC issues on remand—be it a fresh rule, a policy statement, an EA, or an EIS." NRC Order, *supra* note 10, at 4.

[175] *See id.*

[176] *See* Matthew Wald, *Court Forces a Rethinking of Nuclear Fuel Storage*, N.Y. TIMES, June 9, 2012, at A11, *available at* http://www.nytimes.com/2012/06/09/science/earth/court-says-nuclear-agency-must-rethink-fuel-storage.html (reporting that New York State officials contend ruling meant NRC must complete sweeping analysis of waste storage at reactors, including movement into dry casks, before extending licenses of shut-down Indian Point reactors in Westchester County, NY.); Keith Heffintrayer, *NRDC Opposing License Renewal for Limerick Reactors*, PERKIOMEN VALLEY PATCH (July 13, 2012, 6:45 AM), http://perkiomenvalley.patch.com/groups/editors-picks/p/nrdc-opposing-license-renewal-for-limerick-reactors (reporting that NRDC contends that Limerick reactors in Pottstown, PA cannot be relicensed until a long-term storage strategy for the plant's SNF is in place).

[177] *See supra* notes 25, 26 and accompanying text.

reactors, at which point a geologic repository would be available for disposal of the wastes. The sixty-year period is the same as that in the prior rule invalidated by the court. The proposed rule further determines, based on the DGEIS, that the environmental impacts of long-term storage, including the risk of fires and other accidents, are very low, and that accordingly individual EISs will not be prepared in connection with licensing reactors or storage facilities. In its analysis, NRC determined that the maximum licensed operating life of a reactor would be eighty years, based on an initial term of forty years and two twenty-year renewals. It found that the earliest date at which a reactor would cross the threshold of sixty years past its licensed operating life would be 2059 (for the decommissioned Dresden 1 reactor).[178] In the case of new reactors, the period would run well into the next century. NRC further determined that development of the deep geologic repository was technically feasible and could reasonably be expected to occur by 2059, citing the DOE Strategy's stated goal of opening a repository by 2048.[179] The DGEIS and the proposed rule preamble discuss the safety issues posed by long-term SNF storage in reactor pools and dry cask ISFSIs. A final rule reflecting these findings will surely be challenged in court.

The court's decision and NRC's suspension order have highlighted the nation's failure to develop a repository for permanent disposal of SNF. The delays and uncertainty resulting from the court's ruling and the continuing failures of Congress and the administration to address the SNF problem could adversely affect power plant financing arrangements and chill new nuclear power plant development. They could also afford opponents of nuclear power significant time and leverage to stimulate legislative and other action to obstruct the expansion of nuclear power and, building on post-Fukushima fears and concerns, to further sway public opinion against it. These legal developments have renewed calls for Congress to implement BRC's recommendations for development of consolidated interim storage facilities for SNF pending development of a repository, and for the government to develop new plans for permanent disposal of SNF.

In its report, BRC concluded that there were no "unmanageable safety or security risks" associated with the

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178 WASTE CONFIDENCE, *supra* note 166, at 56,784.

179 *Id.*

continued at-reactor storage of SNF in either spent fuel pools or dry casks.[180] However, BRC cautioned that, since it will take years to open any consolidated storage facility or a repository, NRC, DOE, and the nuclear industry need to remain vigilant to identify any new risks associated with continued at-reactor storage, including risks of fuel degradation during long-term storage.[181] BRC recommended an independent NAS review of the implications of the Fukushima disaster for continued at-reactor pool SNF storage.[182] NRC is reportedly now studying the issues surrounding accelerated SNF transfer, and has also been examining high-burn-up SNF safety.

F. *Conclusions Regarding SNF Safety*

The questions confronting policymakers now are whether the transfer from wet to dry storage should be significantly accelerated, and whether SNF stored in dry casks should remain at reactor sites at ISFSI facilities or be moved to new consolidated storage facilities. GAO has found that NRC has not conducted any comprehensive analysis of the advantages and disadvantages of accelerating the transfer of SNF from pools to dry storage, including cost, enhanced safety and security from dry cask storage, and worker risks and operational constraints associated with the transfer process.[183] The reduction in the risk of releases posed by dry cask relative to pool storage is difficult to determine. The 2012 GAO SNF report summarized the available studies on risks of radiological release from pool fire versus risk of releases from dry casks, but reached no conclusions.[184] Regarding cost, GAO estimated the per-canister cost of transferring SNF to dry casks at $1-1.75 million and the costs of constructing an ISFSI at $19-44 million. Costs would increase to the extent younger SNF or higher-burn-up SNF is transferred to casks before substantial cooling, because lesser amounts of hotter SNF can be safely stored in dry casks.[185] Transferring SNF from pools to casks would also present some worker exposure and accident risks. Further, most of the casks now used for storage are not suitable for transport or

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180 BRC REPORT, *supra* note 1, at 44.
181 *Id.*
182 *Id.*
183 GAO, SNF REPORT 2012, *supra* note 39, at 39, 41.
184 *Id.* at 42.
185 *Id.*

disposal, requiring another transfer in the future. In such cases, the SNF will have to be transferred to a different kind of cask for transportation or ultimate disposal of the SNF, thus necessitating repackaging of the waste at a later point when SNF disposal arrangements have been sorted out, increasing costs and risks to workers. By that time, fuel or cask degradation may have occurred. The risks of such degradation, especially in the case of high-burn-up SNF, are currently not well understood.[186]

The big questions regarding nuclear waste—such as SNF transportation, consolidated storage, repository disposal, and the development of multi-purpose casks—reach beyond the authority and competence of NRC. Additionally, there is a need to better understand the safety and other implications for storage and transport of the growing inventory of high-burn-up SNF, and to research and develop new cladding and storage technologies that will better assure the safety of SNF, both traditional and high-burn-up, in long-term dry storage and disposal. Although NRC has regulatory authority over the relevant activities, DOE has major managerial responsibilities and technical capacities with respect to fuel design, cask and container R&D, transport, consolidated storage, and disposal in a repository, not to mention deep and broad experience and expertise developed in connection with past siting efforts and with Yucca Mountain. An adverse consequence of the 1970s legislation that split the former AEC's responsibilities between its successor, DOE, and the then-newly-formed NRC, has been that decision-making by the two bodies on functionally interrelated SNF management issues is typically conducted independently, risking inconsistency and ineffectiveness. The overlapping responsibilities of these two bodies relating to SNF disposition and management need to be better coordinated and conducted in partnership, rather than in isolation. In particular, DOE needs to be included in NRC analysis and decision-making processes regarding at-reactor SNF storage safety, which is of critical importance to DOE decision-making on consolidated storage of SNF and repository development. Accordingly, Congress should direct DOE and NRC to establish a joint institutional mechanism to determine whether transfer of SNF from pool to dry storage should be accelerated, and what other

[186] *Id.* at 39–42. If at that time the reactor sites at which ISFSIs are located no longer have the pools or infrastructure to effect transfers, they would have to be constructed, at considerable additional cost. *Id.* at 43–44.

steps should be taken to address the safety of long-term SNF storage, as well as transportation and disposal issues. Research questions might include examining the issues posed by widespread use of high-burn-up fuel, the integrity of fuel rod cladding and casks, and integrated cask design for storage, transport, and disposal. The two agencies should develop a joint plan to implement their determinations and other relevant activities, which should be subject to review by NAS or a similar independent body. NRC and DOE should also be tasked with developing a program to ensure maintenance and accessibility of security-sensitive information on SNF risks and for taking steps to provide independent review bodies, the courts, and the public with information that is not required to be kept confidential, including review of confidentiality practices by an appropriate outside entity. These steps are necessary to help rebuild public confidence in the adequacy of SNF safety and security regulatory measures. Joint NRC-DOE determinations, programs, and policies should be subject to independent review by NAS or a similar independent body that would report to Congress and the President. NRC would retain ultimate regulatory authority.

III. OPTIONS FOR LONGER-TERM SNF STORAGE: AT-REACTOR OR CONSOLIDATED AWAY-FROM-REACTOR?

BRC's report firmly recommends development of one or more consolidated storage facilities at DOE sites, a position endorsed by the DOE Strategy. But such initiatives will remain controversial due to the competing considerations presented in the choice between at-reactor and consolidated storage, the uncertainties over relative costs and benefits, and the conflicting interests and values involved. One area in which there is general agreement is the desirability of consolidated storage in the specific case of "stranded" SNF located at decommissioned power plants. But even here, there are serious political and financial obstacles to siting and constructing a facility for such storage. This Section first provides an overview of the competing considerations presented in the choice between at-reactor and consolidated SNF storage. It then examines in greater detail the comparative costs of the alternatives. Next, the special issues presented by stranded SNF at decommissioned reactor sites are examined. The Section then reviews experience with consolidated storage in other countries, and presents a brief conclusion.

A. *Competing Considerations in the Choice Between At-Reactor and Consolidated SNF Storage*

A variety of crosscutting cost, transportation, ethical, political, social, security, and safety considerations must be taken into account in choosing between at-reactor storage and consolidated away-from-reactor storage.

It is difficult to compute the costs of the respective options because so many of the costs depend on uncertain variables and future conditions stretching over many decades. For instance, we currently do not know when a repository may be developed, for how long interim storage will be needed, the time needed for development of consolidated storage facilities, the location of the facilities, and how much transportation will cost. Storing SNF at existing reactor sites will require the construction of new ISFSI facilities at many reactor sites, but avoid the costs of constructing new consolidated facilities and transporting SNF to them. Due to economies of scale, consolidated facilities would have lower operating costs per metric ton of SNF stored. The fact that the alternatives will require different levels of expenditures over long time periods presents additional complexities, including the appropriate choice of a discount rate to compare alternatives, the need to assure stable funding, and considerations of geographical and intergenerational equity.

There is also the question, discussed in detail in Section VI, of how consolidated storage would be financed. These issues are entangled with resolution of the government's mounting legal liabilities for failure to take SNF from utilities beginning in 1998. Development by the government of consolidated SNF storage facilities would relieve the government of continuing liability once utilities' SNF were stored there.

Regarding safety, as discussed above, studies indicate that (assuming institutional controls are in place and functioning as planned) the safety and security risks from dry cask storage of conventional SNF are very low to negligible, regardless of whether casks are located at numerous power plant sites or at only a few consolidated storage facilities.[187] Public concern over the safety of

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[187] HOLT, ALTERNATIVES TO YUCCA MOUNTAIN, *supra* note 41, at 15, 17. Studies on dry cask storage of SNF generally do not assume very long-term storage following power plant retirement. NRC's judicially-overturned 2010 WCD rule finding SNF storage safe was based on storage of SNF for up to 60 years after reactor retirement; the duration of reactor life was assumed to be 60

SNF storage at reactor sites is, however, likely to intensify, leading to political and legal action by states and localities against long-term at-reactor storage. *New York v. NRC*, also discussed above, will undoubtedly encourage further litigation challenges. Like the WCD overturned by the court, NRC's newly-proposed WCD rule would (if finalized) establish a generic finding that storage of SNF for sixty years beyond termination of reactor operating lives is safe, thus eliminating the need for operators to evaluate the safety of storage on a site-specific basis. No individual reactor site has yet conducted an environmental review to determine the safety of on-site storage after the end of the license period. GAO has suggested that such reviews will be necessary.[188]

Proponents of reprocessing have reason to favor consolidated storage, judging that in order to win host jurisdiction assent to consolidated storage facilities, the government is likely to place reprocessing and other advanced fuel cycle R&D facilities at the same location.[189] This same logic gives opponents of reprocessing reason to oppose consolidated storage. They assert that on-site storage avoids the risks of transporting SNF twice (first to consolidated storage and later to a repository), and that continued on-site storage can be done safely for up to a century.[190] The implications of industry's switch to high-burn-up fuel have not as yet been adequately factored into the calculus.[191]

Leaving SNF at reactor sites carries more general political costs. As recognized by BRC, the failure to open Yucca is a blow to the federal government's credibility and contradicts its promises to the public and states to begin permanently burying wastes within a matter of years.[192] This continued failure to "solve" the

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years, making the total SNF safe storage period 120 years. NRC's prior WCD rule had found SNF storage safe for a total of 60 years (30 years reactor life plus 30 years storage after reactor retirement). NRC is currently studying SNF storage of up to 300 years following power plant retirement.

[188] *See* U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-10-48, NUCLEAR WASTE MANAGEMENT: KEY ATTRIBUTES, CHALLENGES, AND COSTS FOR THE YUCCA MOUNTAIN REPOSITORY AND TWO POTENTIAL ALTERNATIVES 38 (2009) [hereinafter GAO, NUCLEAR WASTE MANAGEMENT].

[189] *See* BRC REPORT, *supra* note 1, at 37–38.

[190] *See, e.g.,* GRONLUND ET AL., *supra* note 78, at 47.

[191] High-burn-up SNF poses risks of cask and contents degradation and resulting problems for transportation that have not been systematically studied or factored into the debate; GAO has reported that this complicates matters considerably. *See* GAO, SNF REPORT 2012, *supra* note 39, at 45–46.

[192] *See* BRC REPORT, *supra* note 1, at 23–24.

nuclear waste problem, as the federal government itself has defined it, represents a significant political obstacle to expanded use of nuclear power. For many nuclear power skeptics, the government's inability to remove and safely dispose of SNF stored at reactor sites represents an inherent and insoluble problem with reliance on nuclear power and a powerful argument against further public investment in the industry or licensing new reactors. While developing and opening a repository will take many decades, consolidated storage facilities to store SNF in the interim could, in principle, be developed much sooner, and would demonstrate government progress in taking charge of the waste problem. Proponents of nuclear power expansion tend to favor consolidated storage, based on the belief that the removal of SNF from power plant sites will curb opposition to the construction of new nuclear power plants.[193] Many opponents of nuclear power oppose consolidated interim storage of SNF, arguing that SNF is safer if left where it is now rather than having to be transported to a consolidated storage facility.[194] NRDC favors consolidated storage, but only for currently stranded SNF.[195]

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[193] *See* CLIFF W. HAMAL ET AL., SPENT NUCLEAR FUEL MANAGEMENT: HOW CENTRALIZED INTERIM STORAGE CAN EXPAND OPTIONS AND REDUCE COSTS 50 (2011), *available at* http://cybercemetery.unt.edu/archive/brc/20120620222955/http://brc.gov/sites/default/files/documents/centralized_interim_storage_of_snf.pdf [hereinafter HAMAL ET AL.]; *The PFS Project Benefits Nuclear Power Generators and Customers*, Private Fuel Storage, LLC, http://www.privatefuelstorage.com/benefit/industry.html.

[194] *See, e.g.*, Mark Holt, CRS, *Civilian Nuclear Fuel Temporary Storage Options* (1998), *available at* http://cnie.org/NLE/CRSreports/waste/waste-20.cfm.

[195] *Nuclear Waste Administration Act of 2012: Hearing on S.3469: Before the Comm. on Energy & Natural Res.*, 112th Cong. 9 (2012) (statement of Geoffrey H. Fettus, Senior Project Att'y, Natural Res. Defense Council), *available at* http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=54965bf6-e91b-41f8-a3e7-342b695c58aa ("While NRDC can agree with the overall concept of consolidated interim storage for a measured amount of spent fuel that meets strong safety criteria (moving fuel from seismically active areas, for example) and removing the stranded fuel from decommissioned plants, we can only do so after the introduction of a phased approach [linking progress on consolidated interim storage facilities to progress on a repository]. Indeed, the only situation where NRDC sees merit in a pilot project(s) [for consolidated interim storage facilities] is to address the current total stranded spent fuel at the nine closed reactor sites, accommodated in a hardened building at one or more sites that follows the example of the Ahaus facility in Germany. Potential volunteer sites that have already demonstrated "consent" are operating commercial reactors. Far less in the way of new infrastructure would be required and the capacity for fuel management and transportation is already in place,

The possibility of eventually reprocessing SNF also plays a role in the debate. Proponents of reprocessing tend to favor consolidated storage, judging that in order to win host jurisdiction assent to consolidated storage facilities, the government is likely to place reprocessing and other advanced fuel cycle R&D facilities at the same location. Correspondingly, some opponents of reprocessing tend to oppose consolidated storage.

BRC's report came down firmly in favor of consolidated storage, not just for stranded fuel, where the cost savings and other benefits are typically accepted as strong, but also for SNF generally. Although it did not find that consolidated storage for SNF generally would be cheaper than at-reactor storage, BRC emphasized the potential safety benefits of storing SNF at sites selected in areas with low population density and low risk of natural disasters. The BRC report concluded that consolidated storage would:

- Allow the government to begin to meet its waste acceptance obligations and thereby avoid enormous and mounting liability;
- Provide flexibility to respond to the lessons of Fukushima, including by creating capacity to move SNF from at-reactor pools if safety considerations dictate, and deal with even relatively hot SNF in case of a reactor emergency that necessitated clearance of storage pools;
- Support the development of a repository through the experience gained in developing storage facilities, and provide buffer capacity and allow for simplification of repository operations once a repository is open and receiving SNF;
- Facilitate R&D on safer and more effective methods of SNF storage; and
- Provide greater flexibility and efficiency in storage and future

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along with consent necessary for hosting nuclear facilities in the first instance."). For an example of nuclear power opponents categorically opposed to consolidated SNF storage, see KEVIN KAMPS, THE NRC'S NUCLEAR WASTE CONFIDENCE GAME 5 (2013), http://www.beyondnuclear.org/storage/kk-links/9%2012%2013%20Nuke%20Waste%20Con%20Game%20White%20Paper.pdf ("As the Alliance for Nuclear Accountability and other environmental coalitions have long held, [SNF and other high-level radioactive wastes] should be stored . . . as close to the point of generation as possible . . . . [P]roposals to transfer [them] to 'centralized' or 'consolidated interim storage' represent a thinly veiled radioactive waste shell game, which could even lead to a relapse into reprocessing.").

waste-handling operations.[196]

The choice between at-reactor and consolidated storage also raises complex but important ethical and social considerations. Communities near reactors are growing increasingly restive at the government's failure to honor its promise to take SNF for disposal, and fear that they will become hosts of de facto SNF repositories. This sentiment is especially powerful at sites where reactors have been shut down and are no longer producing local benefits.[197] These communities are forced to play caretaker to SNF indefinitely, something to which they never agreed, and the land cannot be returned to the community for other uses until the site is fully decommissioned. The six governors of the New England states in December 2009 wrote to DOE requesting that it remove spent fuel from nuclear reactor sites in the region "at the earliest possible date."[198] The governors expressed their concern that the waste had not been removed "as required by law and contract" and was limiting alternative use of three former reactor sites in the region that have been decommissioned.[199]

Yet some experts have suggested that on-site storage is the most equitable solution for nuclear power plant waste. If waste is left at the reactor sites, the risks and responsibilities remain with the communities that benefited most from the activities that created the waste.[200] Developing consolidated facilities will encounter opposition from potential host localities and states who will question why they should assume responsibility for SNF generated elsewhere, a sentiment also exacerbated by fears that the interim storage facility will become a de facto permanent disposal facility in light of the government's continuing failure to develop a repository.[201] The difficulties in siting consolidated interim SNF

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196 BRC REPORT, *supra* note 1, at 36–39.

197 Tux Turkel, *Spent Fuel Could Stay in Maine for Decade*, Portland Press Herald, Mar. 10, 2009, at A1; Thomas Burr and Judy Fahys, *After Yucca: America's Homeless Nuclear Waste*, SALT LAKE TRIBUNE (Mar. 21, 2009, 10:24 PM), http://www.sltrib.com/ci_11967458.

198 Letter from New England Governors' Conference, Inc., to Steven Chu, Sec'y, DOE (Dec. 16, 2009), *available at* http://www.sustainablefuelcycle.com/resources/20091216GovernorsNEGCNuclearWasteLetter.pdf.

199 *Id.*

200 *See* GAO, NUCLEAR WASTE MANAGEMENT, *supra* note 188, at 38–37.

201 This, of course, assumes that it is unlikely that any community would volunteer to host a consolidated storage facility for SNF. As described later in this article, a consortium of local governments in New Mexico has. *See infra* Section IV.B.

storage facilities are illustrated by the PFS case and DOE's unsuccessful efforts during the 1980s to site a consolidated storage facility.[202] Opposition by those fearing that consolidated storage will impede repository development is also likely. Transportation raises significant issues as well. Although SNF has been safely shipped in the past, shipping the SNF from power plants around the country to one or a few storage facilities and thence to a repository would involve waste transport on an unprecedented scale and could encounter strong resistance from transit and host states and localities, tribes, and citizen and environmental groups. As a result, attempts to site and license a new consolidated storage facility could take many years and face substantial opposition by both potential host jurisdictions and others.[203]

The ethical issues also include questions of intergenerational equity. When many of the costs of disposing of existing wastes will be incurred far in the future, consideration should be given to whether it is fair to force future generations to bear these costs, and whether there are means of shifting more of the costs onto present generations who have benefited from the power produced. The Hamal Report, commissioned by BRC, found that more of the costs of consolidated storage would be incurred earlier, closer in time to the generation that produced the waste, than the costs of continued at-reactor storage.[204]

In this tangled web of competing considerations and interests, time becomes a double-edged sword. The longer the time period required for interim storage pending opening of a repository to take SNF, the stronger the economic justification for consolidated storage,[205] but simultaneously, the further away we are from the goal of safe, permanent disposal of SNF.

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[202] *See* HOLT, ALTERNATIVES TO YUCCA MOUNTAIN, *supra* note 41, at 13–14.

[203] For an alternative perspective on why this should not matter, *see* David R. Hill, *The NWPA and the Realities of our Current Situation*, 40 ENVTL. L. REP. 10795, 10799 (2010) (arguing that we should be skeptical of the prospect of achieving a "happy consensus" where all can agree on a disposal pathway for SNF and HLW).

[204] HAMAL ET AL., *supra* note 193, at 31.

[205] *See infra* Section III.D. To the extent that Yucca is a precarious option, even if revived by the D.C. Circuit, and development of a new repository could be many decades away, the economics of consolidated storage accordingly become more favorable, as discussed further in HAMAL ET AL., *supra* note 193, at 1.

B. *At-Reactor Costs Versus Consolidated Storage Costs*

This Section addresses the issues presented by, and findings of studies regarding, the relative costs of at-reactor versus consolidated storage of SNF, in general. The case of stranded fuel—SNF stored at decommissioned reactor sites—presents distinct issues discussed in Subsection C.

The biggest cost element in consolidated SNF storage is the need to transport the waste twice (once to consolidated storage, and again, later, to a repository), versus single transport to a repository if SNF is stored at reactor sites. The extent of the extra transport costs is subject to considerable uncertainty. They depend on the precise locations of the consolidated storage facilities and of the repository. Furthermore, packaging and transporting such large amounts of SNF is an enterprise without precedent.[206] Extra transport costs could amount to a substantial majority of the total costs of consolidated storage.[207] The costs for dry casks are the same no matter where they are ultimately stored. The costs of actually constructing a new consolidated storage facility are comparatively modest. DOE would need to acquire land, construct the facility,[208] install needed security structures and measures, and probably also improve transportation infrastructure. A private developer would also need to acquire or lease land for the facility. In addition, there would be the costs of securing permits, defending litigation and other challenges, and providing inducements for host jurisdictions; these costs could be substantial, especially if there were vigorous and prolonged opposition to the facility, but might be reduced significantly if facility siting were accomplished using the consent-based process recommended by BRC and others. On the other hand, consolidated storage could achieve significant scale economies in operating and maintaining security, yielding very significant operating cost savings relative to the costs of providing security for the numerous storage facilities at nuclear power plants dispersed across the country.[209]

The most important variable in determining which alternative costs less is the time at which SNF would eventually be disposed

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[206] HAMAL ET AL., supra note 193, at 37–42.

[207] *Id.* at 5–6.

[208] Such a facility would be basically a concrete pad on which casks would be installed, together with fencing and other security.

[209] FRANK VON HIPPEL, MANAGING SPENT FUEL IN THE UNITED STATES: THE ILLOGIC OF REPROCESSING, INT'L PANEL ON FISSILE MATERIALS 26 (2007).

of in a repository. If a repository were substantially delayed, the operating cost savings of consolidated storage would outweigh its higher start-up costs, including the costs of transporting SNF to the facility.[210] For example, a 2007 study found that if Yucca opened by 2017, it would be cheaper for the federal government to pay for at-reactor dry cask storage than to build a consolidated interim storage facility, but repository delay past that date would tip the balance in favor of consolidated storage.[211]

More recent studies attempting to determine the costs of each option have reached a range of varying and less clear-cut conclusions.[212] The findings of the reports are often not comparable because they apply different methodologies and use differing assumptions, and often the results do not show a clear advantage of one form of storage over the other.

The most recent, comprehensive, and sophisticated analysis of cost issues, prepared by Cliff F. Hamal for BRC, found that the total costs of at-reactor storage without a consolidated interim storage facility would amount to $93.2 billion in 2009 dollars, while the total costs of storage with a centralized interim storage facility would amount to $87.6 billion in 2009 dollars, both figures being calculated without discounting.[213] This analysis makes three key assumptions: (1) a permanent repository would be opened in 2050; (2) a consolidated interim storage facility, if built, would open in 2020 (a date the authors concede may be optimistic in light of potential siting difficulties); and (3) transportation of SNF would be at a rate of 3000 metric tons of uranium (MTU) per year, with priority given to SNF at shut-down reactors.[214] The report's analysis contains a range of cost projections for each alternative, with a mean cost for consolidated storage of $51 billion, and for

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[210] The Nuclear Energy Study Group of the American Physical Society noted that it was reasonable to expect that consolidation would lead to some cost savings due to economies of scale, but emphasized that no comprehensive studies on the matter were available. *See* John Ahearne, et al., Nuclear Energy Study Group, American Physical Soc'y, Consolidated Interim Storage of Commercial Spent Nuclear Fuel: A Technical and Programmatic Assessment 10 (2007).

[211] *Id.*

[212] The Hamal study, conducted for BRC, identified and discussed eight studies of the comparative costs of at-reactor and consolidated storage beginning in 1985, five of which were published in the last three years. HAMAL ET AL., *supra* note 193, at 14.

[213] *Id.* at 27–29.

[214] *Id.*

at-reactor storage without consolidated storage of $55 billion. It acknowledges that the cost scenarios for the two alternatives overlap to a considerable degree and that the mean savings of $4 billion for consolidated storage is small relative to both the total average cost of the alternatives and the range of possible costs, roughly $25 billion to $80 billion.[215] The Hamal report underscores that the biggest uncertainties in costs relate to the cost of transportation, which accounts for a substantial majority of the total costs of the consolidated storage option.[216]

One step that the federal government could take in order to ultimately reduce transportation costs, not addressed in the Hamal report, would be the standardization of dry cask design. There are currently many different cask designs; standardization, including development of casks that could be used for transportation as well as storage, could reduce costs and produce other efficiencies.[217] In standardizing cask use, it would be important to ensure that whatever cask design is approved for use keeps pace with advancing technology; this could be particularly significant with respect to the development of dry casks safe for storing younger fuel or high-burn-up SNF.

A key consideration in analyzing the costs of the two options is the choice of discount rate. Under the consolidated interim storage scenario examined by Hamal, the majority of the storage costs are incurred between now and 2070, whereas without centralized storage, most of the storage costs will be incurred between 2040 and 2110.[218] Because the two options involve different proportions of capital and of operating costs that will be incurred over different periods of time, far into the future, the choice of discount rate becomes critical in determining their relative costs under a discounted net present value (NPV) approach. The choice of discount rate also raises questions of intergenerational ethics. A higher discount rate would tend to reduce the NPV of long-term at-reactor storage and thereby tend to favor its adoption. But under this alternative, future generations would pay for the costs of storing waste produced by earlier generations, unless some reliable way can be found for

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[215] *Id.* at 26–33.

[216] *Id.* at 5, 37–42.

[217] *See* TRANSP. AND STORAGE SUBCOMM. UPDATED REPORT, *supra* note 136, 14–15 (2012).

[218] HAMAL ET AL., *supra* note 193, at 27–29.

maintaining a secure fund, perhaps financed by nuclear electricity users, for funding long-term storage costs. In the absence of such a mechanism, consolidated storage might be favored on ethical grounds, because a greater share of the costs of storage would be imposed on earlier-in-time nuclear electric consumers. Still, much of the SNF that would be shipped to consolidated storage is from power produced in past decades that benefited past consumers.

A 2012 study by the Brattle Group found, based on EPRI estimates, that the capital costs of a large consolidated storage facility would be $757 million (2009 estimate, assuming transportation of 3000 MTHM SNF annually, Department of Interior's projected rate for shipments to Yucca), and that operational cost savings relative to at-reactor ISFSI storage would be $200 million annually. It further found that the annual cost of casks for transfer and storage would be $600 million annually and transportation costs to the consolidated facility would be $28 million annually, assuming rail transport.[219] The study emphasizes the importance both of providing consolidated storage for stranded fuel on the one hand, and on the other of removing SNF from crowded cooling pools while avoiding the costs of constructing additional ISFSIs at each reactor site. As a practical matter, there might well be conflicts in achieving these two objectives simultaneously.

Notwithstanding its findings regarding overlapping ranges and uncertainties in the costs of the two alternatives, the Hamal report strongly and persuasively recommends that the government begin the process of developing one or more consolidated SNF storage facilities.[220] It notes that although previous studies had assumed an irreversible choice between the two alternatives, development of consolidated storage would in fact proceed incrementally, through siting, transportation design, facility development, etc. This would afford valuable opportunities for learning, gained through an initial investment in siting, designing, and permitting a facility, that would reduce uncertainty about the costs of consolidated storage. The passage of time would also reduce uncertainty about other important variables, such as the

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[219] Frank Grave, et al., The Brattle Group, *Centralized Dry Storage of Nuclear Fuel: Lessons for U.S. Policy from Industry Experience and Fukushima,* 10–11 (2012), *available at* http://www.state.nv.us/nucwaste/library/ Storage/Brattle%20Group%20Report%20on%20Dry%20Storage.pdf.

[220] HAMEL ET AL., *supra* note 193, at 33–34.

timing of a repository. By proceeding step-by-step, decision-makers would retain the option of continuing with consolidated storage or leaving SNF at reactor sites, making a definitive choice at a later time depending on the information acquired. The Hamal report concludes that it would make eminent sense to make a comparatively modest initial investment—on the scale of tens of millions of dollars—to begin to develop the consolidated interim storage option, which has the potential to save many billions of dollars over the longer run and could also promote intergenerational equity.[221] It likens the decision facing policymakers today to that of the purchase of insurance: do we want to spend money today to ensure that we can have a centralized facility in the future if we really need it?[222] BRC and the DOE Strategy properly answered that question in the affirmative.

A recent MIT study, "The Future of the Nuclear Fuel Cycle," reports that "centralized storage has become the preferred option for most countries. . . with significant nuclear power programs."[223] There are stand-alone consolidated SNF interim storage facilities operating, located in Germany, Sweden, and Switzerland, and several more proposed, including in Canada, Russia, Spain, South Korea, and Japan.[224] Most of these are designed to store SNF for a considerable period before development of a repository for its disposal. Countries that have constructed or are constructing consolidated SNF storage facilities include Canada, Russia, South Korea, and Sweden. The widespread use of these facilities around the world bolsters BRC's recommendation and DOE's proposal to develop such facilities in the United States.

C. *Stranded SNF at Decommissioned Reactors*

Stranded fuel presents a special case in the evaluation of at-reactor and consolidated storage options, involving both cost and

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[221] *Id.* at 5.

[222] *Id.* at 10.

[223] THE FUTURE OF THE NUCLEAR FUEL CYCLE, MIT 47 (2011), http://mitei.mit.edu/system/files/The_Nuclear_Fuel_Cycle-all.pdf.

[224] *See Survey of Nat'l Program for Managing High-Level Radioactive Waste and Spent Nuclear Fuel, A Report to Cong. and the Sec'y of Energy*, U.S. Nuclear Waste Technical Review Board (2009), http://www.nwtrb.gov/reports/nwtrb%20sept%2009.pdf; GAO, SNF REPORT 2012, *supra* note 39, at 53–55.

equity considerations. Currently, there are nine commercial power plant sites with all reactors shut down, storing a total of about 2800 metric tons of SNF. Two sites use pool storage, storing 1067 metric tons of SNF, while the rest use dry cask storage. The SNF maintenance and security costs at such sites are substantially higher than at sites with operating reactors, and there are no revenues from power generation to offset these costs. Further, the presence of SNF prevents reuse of the site for other purposes. Accordingly, tribes and communities with such sites bear SNF storage burdens without obtaining offsetting benefits and are partners in a "deal" to which they did not agree.

There is broad support in principle for moving SNF at shut-down reactors to consolidated storage, thus freeing their "host" communities from SNF storage burdens and allowing the reactor sites to be converted to beneficial use. NRDC favors such a move, although it maintains that SNF at operating reactors should remain at reactor sites until a repository becomes available.[225] The nuclear industry favors moving SNF from decommissioned reactors to consolidated storage because of the significant cost savings involved.[226] While both the House and Senate Appropriations Committees recently expressed support for consolidated SNF storage, the House Committee Report limited its support to consolidated storage for stranded fuel and did not include SNF at operating reactors.[227]

BRC concluded that the "savings achievable by consolidating stranded spent fuel at a centralized facility would be enough to pay for that facility."[228] It found that the added costs for maintenance and security of stranded fuel, relative to those for SNF at operating reactors, ranged from $4.5 million to $8 million annually per site. While a reactor is still active, stringent security measures for the

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[225] *Opportunities and Challenges for Nuclear Power: Hearing before the House Committee on Science and Technology*, 110th Cong. 41 (2008) (Statement of Thomas B. Cochran, Ph.D., Senior Scientist, Nat. Resources Defense Council, Inc. at p. 13), *available at* http://docs.nrdc.org/nuclear/files/nuc_08042301A.pdf. As described above, UCS formerly appeared to support consolidated storage for stranded SNF but recently testified that it is not persuaded that such storage is necessary; it advocated moving stranded SNF to the nearest operating reactor site with available storage capacity. *See supra* note 53 and accompanying text.

[226] HOLT, ALTERNATIVES TO YUCCA MOUNTAIN, *supra* note 41, at 14.

[227] HOUSE APPROPRIATIONS COMM., 112TH CONG., REPORT ON 2012 ENERGY AND WATER DEVELOPMENT APPROPRIATIONS BILL, 2012, H.R. REP. 112–118 (2011).

[228] BRC REPORT, *supra* note 1, at 35.

reactor itself can be extended to protect the SNF as well, at modest additional cost. This is not the case at shut-down reactors; all expenditures are directly related to securing the SNF.[229] While the proportion of SNF that is stranded is relatively small today, BRC noted that as more reactors are decommissioned in the coming decades, the amount of stranded SNF will inexorably grow.[230] It found that, assuming a sixty-year operating life, on average, for current plants, the number of shut-down sites could reach thirty by 2035 and seventy (i.e., almost all current sites storing commercial SNF) by 2050.[231] On these assumptions, the savings achieved by moving the SNF at seventy shut-down reactor sites to consolidated storage "could be in the area of $350 to $550 million per year at today's costs,"[232] sufficient to pay for the facility.[233] The Hamal Report reached a similar conclusion, finding dramatic cost savings from moving stranded fuel to consolidated storage.[234] For both cost and equity reasons, BRC recommended that SNF at shut-down reactor sites be "first in line" for transfer to consolidated storage.[235] The DOE Strategy envisaged that stranded fuel would receive priority at the initial pilot consolidated storage facility that it proposed.

Accordingly, giving priority to consolidated storage of stranded fuel would require significant changes in existing DOE-utility SNF arrangements, which incorporate a policy of taking the oldest fuel first. However, Hamal concluded that such a change would be warranted based not only on the cost savings achieved by prioritizing stranded fuel, but also on a number of other considerations.[236] Under its current Oldest Fuel First (OFF) policy, DOE has committed to accepting the oldest SNF, regardless of

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229 HAMAL ET AL., *supra* note 193, at 32. Other estimates put the cost of monitoring stranded fuel even higher. For example, according to Hamal, MIT's 2010 report estimated it at $8 million per year per site. *Id.*

230 BRC REPORT, *supra* note 1, at 35.

231 This is out of a total of 75 currently existing sites storing commercial SNF in the U.S. (not including 4 additional DOE sites that also store some commercial SNF). As of now, 65 of these sites have one or more operating reactors, 9 sites are shut down and storing stranded SNF, and 1 site (which never had a reactor) is a licensed SNF storage site. *See* GAO, SNF REPORT 2012, *supra* note 39, at 6.

232 BRC REPORT, *supra* note 1, at 36.

233 *Id.* at 35.

234 HAMAL ET AL., *supra* note 193, at 19–33.

235 BRC REPORT, *supra* note 1, at 36.

236 HAMAL ET AL., *supra* note 193, at 45–48.

whether the reactor at which it is stored is shut down or active. This policy, by one estimate, could increase the total costs over the next century by $6.3 billion in 2009 dollars, relative to a policy that would prioritize SNF at shut-down reactors.[237] While DOE has the legal authority to change the queue if it decides to accept SNF from shut-down sites first, it has repeatedly rejected requests to do so, announcing that it would continue with the OFF policy.[238] DOE's justification is apparently one of equity, as it believes that it would be unfair to the active sites that would continue to house older SNF.[239] However, DOE has stated that it would assign priority to the stranded SNF if it were directed to do so by Congress.[240] Financial transfers could address any strong equity claims by active sites. The Brattle Group study concluded that the question of stranded fuel priority could be solved by contractual agreements among utilities, which are allowed to swap places in the queue subject to DOE approval; however, these agreements might not adequately serve the broader societal interests involved.

D. *Conclusions Regarding Consolidated Storage*

There is wide agreement on the need for consolidated storage of stranded SNF at decommissioned reactors, on both economic and equity grounds. But the considerations invoked by BRC and the Hamal report also justify development of consolidated storage facilities for SNF that now resides at reactor sites. In terms of perceived equity and transportation considerations, it would be desirable to have at least two consolidated storage facilities, in different regions of the country. The DOE Strategy envisages a phased development pattern, with an initial smaller facility targeted at stranded fuel and a second larger facility several years later.[241] From the viewpoint of SNF safety and costs, it would be desirable to include SNF from operating reactors as well as from

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[237] *Id*. at 25.

[238] REPORT TO CONG. ON THE DEMONSTRATION OF THE INTERIM STORAGE OF SPENT NUCLEAR FUEL, DOE 5 (2008) [hereinafter 2008 DOE INTERIM STORAGE REPORT], *available at* http://pbadupws.nrc.gov/docs/ML0834/ML083450160.pdf.

[239] *See id*. at 65.

[240] *See id*. at 4. The proposal under consideration at the time of this statement was a limited demonstration project wherein SNF from shut-down reactors would be consolidated at a central facility.

[241] *Id.* at 6.

decommissioned reactors in consolidated storage sooner rather than later. On the other hand, the lessons from the success of WIPP demonstrate the need for flexibility to address the concerns and needs of community and state hosts, especially regarding the scale of the facility. Accordingly, we believe it would make more sense to have the flexibility to determine the exact scope of the facilities in accordance with the views of, and agreements negotiated with, potential hosts, which might accommodate a full-scale facility at the outset, or provide for a "pilot" facility with the possibility of later scaling it up. Congress could specify the basic parameters for the facilities, such as their minimum and maximum capacities and the corresponding range of inducements to hosts.

Further, lessons from the demise of the second repository originally envisioned under the 1982 NWPA show the perils of sequential siting; the second facility can easily get dropped, leaving all of the eggs in one basket.[242] When, as in the case of Yucca, the first facility is also dropped, no alternative is available. While there may be some political logic in an initial smaller-scale "pilot," if a host is willing to accept a full-scale consolidated storage facility, it does not make technical, economic, or environmental sense to require that a smaller facility be built for stranded fuel only, followed a few years later by a larger facility (in some other community) that would take SNF from operating reactors.[243] The economic justification for consolidated storage facilities lies in the economies of scale that they afford. Just as consolidated storage costs less per metric ton of SNF than storage at many reactor sites, so does storage of SNF at a larger consolidated facility cost less than SNF storage at a smaller facility. To the extent that consolidated storage is safer than at-reactor storage, it also makes sense to accommodate SNF from operating reactors sooner rather than later.

Some communities may only be comfortable with smaller

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[242] *See infra* notes 331–343 and accompanying text.

[243] As more and more power plants retire in the coming decades, the proportion of stranded fuel will increase and continue to grow. GAO reports: "Assuming that no centralized storage or permanent disposal facility becomes available, our analysis indicates that by 2040, the amount of stranded spent fuel in closed commercial nuclear power plants will total an estimated 3,894 metric tons; by 2045, that amount could increase to 28,751 metric tons; and by 2050, the amount could be 62,237 metric tons. By 2067, nearly all of the 140,000 metric tons of spent fuel could be stranded in dry storage." GAO, SNF REPORT 2012, *supra* note 39, at 26.

pilot facilities. For this and other reasons, it would be best not to limit the number of consolidated storage facilities to only two if there truly are realistic prospects, in terms of receptive hosts and economics, for one or two additional facilities. Reviving some version of the now-lapsed Office of Nuclear Waste Negotiator (ONWN), which had been tasked under NWPA with scouting potential MRS sites, in new legislation, would help the government determine which communities are likely prospects for consolidated storage facilities now, and to begin negotiations with them. It is also important, as emphasized by the Brattle Group study, to avoid the costs of building additional ISFSIs at operating reactors if less costly consolidated dry storage could be made available promptly. Accordingly, starting development of at least two consolidated storage facilities simultaneously, rather than only one, is supported by economic and environmental factors and would also help assure regional equity. Simultaneous development of a repository is also essential. The DOE Strategy does not promise a repository until 2048,[244] and does not propose any interim program targets or timetables for its development. Unless such measures are developed in a credible manner, it will be difficult to site consolidated storage facilities because potential hosts will fear such facilities becoming de facto repositories.

IV. DEVELOPING CONSOLIDATED SNF STORAGE FACILITIES AT DOE SITES

There are two basic options for building consolidated storage facilities: development by a federal government entity (DOE or a successor entity with waste management and disposition as its sole function) or private development. This Section examines the first option, discussing the history of DOE's unsuccessful efforts to develop MRS facilities pursuant to NWPA; its experience with storing limited amounts of civilian SNF pursuant to NRC license; legal issues regarding the extent, if any, of DOE's current authority to develop and construct consolidated SNF storage facilities without new legislation; potential locations for DOE storage of commercial power plant SNF; and the siting challenges that DOE would face and the means of overcoming them. Part V discusses private development of consolidated SNF storage facilities, including the option of private facilities on DOE sites pursuant to

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[244] WASTE CONFIDENCE, *supra* note 166, at 56,784.

leases from DOE.

A. *DOE's Unsuccessful Efforts to Develop MRS Facilities*

The 1982 NWPA embodied a comprehensive plan for permanent disposal of SNF and high level waste (HLW) (highly radioactive wastes generated in the process of nuclear weapons production and reprocessing of SNF). Its overriding goal was the siting, construction, and operation of two repositories for that purpose. Congress deliberately restricted DOE's authority to provide consolidated storage.[245] At the time of passage of NWPA, there was a great deal of resistance to the idea of consolidated storage of SNF. Much concern focused on fear that the availability of an MRS would take away momentum from the push to develop a permanent repository.[246] Congress accordingly granted DOE authority to develop one or more away-from-reactor consolidated interim SNF storage facilities (MRS facilities) under circumscribed conditions that included review and funding by Congress of any facility.

In 1985, after considerable efforts to locate suitable sites with willing local hosts, DOE eventually developed and submitted to Congress a proposal to build an MRS facility at Clinch River, Tennessee, and two alternative sites, also in Tennessee.[247] Although local Tennessee communities were receptive, the proposal provoked strong opposition from Tennessee state officials and the state's congressional delegation. The Tennessee delegation obtained a provision in the 1987 amendments to NWPA that prohibited construction of any MRS facility in the state.[248]

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[245] NWPA also authorized a very limited federal interim storage program, designed to alleviate temporarily utility storage capacity problems; this program was never implemented and authority for it has lapsed.

[246] *See Statements made in Nuclear Waste Disposal Policy: Hearings on H.R. 1993, H.R. 2881, H.R. 3809, and H.R. 5016 Before the Subcomm. on Energy Conservation & Power of the H. Comm. on Energy & Commerce*, 97th Cong. 248, 258, 357, 378, 575 (1982) (statements of James Edwards, Sec. of Energy, Rep. Ed Markey, Rep. Stan Lundine, James Tierney, Att'y Gen., Maine, Brooks Yeager, Sierra Club, and Renee Parsons, Friends of the Earth).

[247] David Ross, *Yucca Mountain and Reversing the Irreversible: The Need for Monitored Retrievable Storage in a Permanent Repository*, 25 VT. L. REV. 815, 844 (2001); OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT, DOE, SCREENING AND IDENTIFICATION OF SITES FOR A PROPOSED MONITORED RETRIEVABLE STORAGE FACILITY 1 (1985).

[248] Nuclear Waste Policy Amendments Act of 1987, Pub. L. No. 100-203 § 5021, 101 Stat. 1330-227, 1330-232 (1987) (codified at 42 U.S.C. § 10162(a)

The 1987 NWPA Amendments also imposed additional far-reaching limitations on the MRS program. The amendments provided that DOE could construct only one MRS facility,[249] which could not be located in Nevada.[250] DOE could not select a potential MRS facility site until the Secretary of Energy had recommended a site for development of a permanent repository pursuant to the statute—i.e., Yucca Mountain.[251] The amendments also provided that construction of an MRS facility could not start until NRC had issued a construction license for the Yucca Mountain repository.[252] Further, the MRS facility could not store more than ten thousand MTHM until a permanent repository had begun accepting SNF or HLW, and was limited to storing no more than fifteen thousand MTHM thereafter.[253]

The 1987 Amendments also created ONWN to "attempt to find a State or Indian tribe willing to host a repository or [MRS] facility at a technically qualified site on reasonable terms."[254] This program envisaged a facility built and operated by the federal government.[255] The first negotiator took office in 1990 and established a voluntary siting program that allowed interested host communities to apply for a phased series of study grants to fund research on the effects of hosting an MRS facility.[256] Twenty-four

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(2006)). The amendments annulled DOE's proposed action, under the 1982 NWPA, to site an MRS facility at Oak Ridge, Tennessee.

[249] *Id.* DOE has expressed to Congress its view that the amended act authorizes federal interim storage only at an MRS facility or as provided under the NWPA hardship provision. *See* OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT, DOE, REPORT TO CONG. ON DEMONSTRATION OF INTERIM STORAGE OF FUEL FROM DECOMMISSIONED REACTORS 7–8 (2008).

[250] Nuclear Waste Policy Amendments Act of 1987 § 5021. Congress's concern was that an MRS would be sited near Yucca Mountain and become a de facto repository, so that the Yucca repository would never be built. Hardin, *supra* note 20, at 297–98.

[251] NWPA § 145(b).

[252] Nuclear Waste Policy Amendments Act of 1987 § 5021.

[253] *Id.* § 5021.

[254] *Id.* § 5041; M.V. Rajeev Gowda & Doug Easterling, *Nuclear Waste and Native America;: The MRS Siting Exercise*, 9 RISK: HEALTH, SAFETY & ENVIRONMENT 231 (1998) [hereinafter *Nuclear Waste and Native America*].

[255] Nuclear Waste Policy Amendments Act of 1987 § 5041.

[256] Grants were divided into three phases: I, II-A, and II-B. Phase I granted applicants $100,000 to begin independently studying MRS facilities; Phase II-A granted applicants $200,000 for continued education and feasibility studies; Phase II-B granted applicants $2.8 million to continue steps taken in previous phases, enter formal negotiations, identify potential sites, and commence an environmental assessment. *Nuclear Waste and Native America*, *supra* note 254,

tribes and four counties in four states applied for initial grants. NWPA authorized state governors to block counties from participating in the program—which the governors in fact did—but states could not veto participation by tribes.[257]

Because of intense political resistance at the state level, the only two applicants that progressed to the third and final study grant phase were New Mexico's Mescalero Apache Nation and Utah's Skull Valley Band of the Goshute Nation.[258] The Mescalero Apaches came close to agreeing to host an MRS facility, but were unable to overcome New Mexico's opposition to the facility.[259] Although the state lacked authority to block the facility, a senator from New Mexico successfully sponsored legislation in Congress that blocked federal funding of MRS study grants in the state.[260] This action by Congress undermined the authority of the negotiator and discouraged tribes from dealing with him further.[261] After Congress failed to reauthorize ONWN in 1994, the position lapsed, and the program to site a federal MRS facility died with it.[262]

B. *DOE's Legal Authority to Store Civilian SNF*

DOE has maintained that NWPA generally precludes it from undertaking storage of commercial SNF except pursuant to

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at 232–233; JON D. ERICKSON, DUANE CHAPMAN, & RONALD E. JOHNNY, MONITORED RETRIEVABLE STORAGE OF SPENT NUCLEAR FUEL IN INDIAN COUNTRY: LIABILITY, SOVEREIGNTY, AND SOCIOECONOMICS (1992) [hereinafter MRS IN INDIAN COUNTRY]; Noah Sachs, *The Mescalero Apache Indians and Monitored Retrievable Storage of Spent Nuclear Fuel: A Study in Environmental Ethics,* 36 NAT. RESOURCES J. 881, 884 (1996).

[257] NWPA § 116(b)(2)–(3); *see generally Nuclear Waste and Native America*, *supra* note 254, at 9 (describing how negotiations between ONWN and States left Native American nations as the only practical options). Although state governors were required to provide a statement of reasons for disapproval, no specific criteria for disapproval were established by the Act. The scope of state veto authority explicitly excluded sites on Indian reservations. NWPA § 116(b)(2)–(3).

[258] *See Nuclear Waste and Native America*, *supra* note 254, at 235 (describing how, out of twenty-four initial applications, only two submitted applications for Phase II-B grants); *see also* MRS IN INDIAN COUNTRY, *supra* note 256, at 80.

[259] *Nuclear Waste and Native America*, *supra* note 254, at 236.

[260] *Id.* at 235; Sachs, *supra* note 256, at 884–85.

[261] *Nuclear Waste and Native America*, *supra* note 254, at 236.

[262] Alex Tallchief Skibine, *High Level Nuclear Waste on Indian Reservations: Pushing the Tribal Sovereignty Envelope to the Edge?*, 21 J. LAND RESOURCES & ENVTL. L. 287, 291 (2001).

NWPA. Because DOE recommended construction of the Yucca repository to President Bush in 2002, DOE has since that time had the authority under NWPA to begin siting and planning the development of an MRS facility and to take other steps short of actual construction. DOE has, however, not taken such steps.[263] DOE has claimed that its NWPA MRS authority has lapsed[264]—a position that the State of Utah also supports[265]—and has also asserted that it has no general authority under the AEA to store civilian SNF at its existing sites.[266] The BRC report asserts that DOE enjoys NWPA authority to develop an MRS facility up to the point of construction. There is no debate that DOE currently lacks authority to receive SNF, commercial or otherwise, at WIPP.

1. *Relevant Statutes and Their Interpretation: NWPA and AEA*

The AEA provides that DOE is "authorized, to the extent it deems necessary to effectuate the provisions of [the Act], to purchase, . . . take, requisition, condemn, or otherwise acquire any special nuclear material or any interest therein."[267] This very broad authority would include the power to accept civilian SNF and store it at DOE facilities, since civilian SNF is a form of "special nuclear material" under the Act. Pursuant to the 1974 Energy Reorganization Act, such facilities would be subject to NRC licensing and safety regulation. However, in its 1995 Final Determination of Nuclear Waste Acceptance, DOE maintained that the later-enacted MRS provisions of NWPA deprived the department of any general AEA authority to store civilian SNF at its sites.[268] DOE reached the same conclusion on similar reasoning

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[263] *See* 42 U.S.C. §10165(b) (2006); FUEL CYCLE TO NOWHERE, *supra* note 11, at 236; HOLT, CIVILIAN NUCLEAR WASTE DISPOSAL, *supra* note 46, at 7, 10; Robert J. Cynkar, *Constitutional Conflicts on Public Land: Dumping on Federalism*, 75 U. COLO. L. REV. 1261, 1277 (2004).

[264] 2008 DOE INTERIM STORAGE REPORT, *supra* note 238, at 7.

[265] Comments to The Blue Ribbon Commission on America's Nuclear Future on The Commission's Draft Report to the Secretary of Energy, State of Utah (2011), http://cybercemetery.unt.edu/archive/brc/20120621064843/http://brc.gov/sites/default/files/comments/attachments/utah_comments_to_brc_sept._13_2011_w_exhs._1-7.pdf..

[266] Office of Civilian Radioactive Waste Management; Nuclear Waste Acceptance Issues, 60 Fed. Reg. 21,793, 21,797 (May 3, 1995).

[267] Atomic Energy Act of 1946 § 5(b)(5), *as enacted*, Pub. L. No. 79-585, 60 Stat. 755, 762 (1946).

[268] Nuclear Waste Acceptance Issues, 60 Fed. Reg. 21,793, 21,797 (May 3, 1995).

in a 2008 report to Congress on interim storage of SNF from decommissioned reactors.[269]

In these same reports, DOE also claimed that its NWPA MRS authority was "unusable" because of "the required linkages to repository development."[270] It did not further explain this conclusion. In comments on the BRC draft report, Utah asserted that DOE's authority to site an MRS "has now expired" because the "Secretary of Energy has not selected an MRS site in accordance with NWPA."[271] These claims by DOE and Utah are groundless. The statutory "linkages to repository development" in the NWPA are that the Secretary recommend Yucca to the President, which in turn enables DOE to site, develop, and apply to NRC for a construction license for an MRS. This "linkage" has been satisfied. DOE fails to explain what other "linkages to repository development" there might be under NWPA and why they have not been satisfied. Nor can *Chevron* deference sustain DOE's interpretation. The explicit statutory language contradicts DOE's interpretation, which is also not supported by any persuasive reasoning.[272] Utah's claim is equally baseless; nothing in NWPA sets a deadline for MRS selection.[273]

If, as concluded above, DOE does enjoy MRS development authority under NWPA, there is a very strong argument that it now

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[269] 2008 DOE INTERIM STORAGE REPORT, *supra* note 238, at 7–8.

[270] *Id.* at 7.

[271] COMMENTS TO THE BLUE RIBBON, *supra* note 265, at 4 (2011).

[272] The D.C. Circuit's decision in Bullcreek v. NRC, 359 F.3d 536, 537 (D.C. Cir. 2004), does not restrict NRC's authority to license a private consolidated SNF storage facility under the AEA. This decision, which did not rest on Chevron deference, is entirely distinguishable, as discussed at text accompanying note 356, *infra*.

[273] The theory seems to be that if the Secretary of Energy fails to submit to Congress a proposal for one or more MRSs by June 1, 1985, as provided in Section 141(b) of NWPA, he loses any authority to do so thereafter. It is quite common for federal agencies, such as EPA, to miss statutory deadlines for taking action, but that fact without more has not been held to deprive the agency of the ability to exercise such authority thereafter. *See* Barnhart v. Peabody Coal Co., 537 U.S. 149, 172 (2003) ("The way to reach the congressional objective . . . is to read the statutory date as a spur to prompt action, not as a bar to tardy completion of the business of ensuring that benefits are funded . . . ."); Dolan v. United States, 130 S.Ct. 2533, 2539 (2010) ("The fact that a sentencing court misses the statute's 90–day deadline, even through its own fault or that of the Government, does not deprive the court of the power to order restitution."); Nat'l Petrochemical & Refiners Ass'n v. EPA, 630 F.3d 145, 154 (D.C. Cir. 2010) (discussing whether the EPA's failure to meet a statutory deadline required courts to bar future action).

lacks independent authority under the AEA to develop consolidated storage facilities. The overriding purpose of NWPA was to force development of repositories. Congress, in 1982 and again in 1987, deliberately restricted the development by DOE of MRS consolidated storage facilities so as not to undermine that objective.[274] Although President Obama's abandonment of Yucca has sabotaged the entire statutory scheme, NWPA remains in force. It would contradict the NWPA scheme if DOE were free, independent of the MRS provisions in NWPA, to develop consolidated SNF storage facilities pursuant to the AEA.[275] Upholding such authority on the part of DOE would require the courts, as Judge Calabresi has advocated they do,[276] to frankly recognize that Yucca's demise has made the NWPA scheme obsolete and allow the responsible agency to rewrite NWPA in order to advance its purposes under current conditions. This would require greater boldness than even "dynamic" courts would accept.

Notwithstanding DOE's position that NWPA precludes authority that it would otherwise have under the AEA to develop consolidated SNF storage facilities, DOE currently has custody of relatively limited amounts of commercial SNF at several of its sites. DOE has taken title to commercial SNF under at least four sets of circumstances: in the 1970s and 1980s, DOE took responsibility for civilian SNF from the Peach Bottom Unit 1 High Temperature Gas Cooled Reactor and the Shippingport Light Water Breeder Reactor;[277] in the wake of the Three Mile Island

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[274] Fuel Cycle to Nowhere, 66–67, 193, 200.

[275] If, on the other hand, the entire NWPA Subtitle C MRS scheme has expired, as Utah contends, or has become "unusable" as DOE asserted in 1995 and 2008, then the argument that Subtitle C supersedes DOE's AEA consolidated storage authority is substantially undermined. If the carefully crafted MRS mechanism is no longer operative, then its supercessive effect arguably lapses and DOE would be free to exercise its authority under AEA to develop consolidated storage facilities for SNF unfettered by NWPA. On the other side, it could be argued that even if Subtitle C is no longer operative, NWPA "occupies the field" of DOE SNF storage; the statutory intent to exclude DOE's AEA authority in order to preclude storage facility development that would undermine the push for Yucca would still hold, whatever the fate of Yucca.

[276] *See generally* GUIDO CALABRESI, A COMMON LAW FOR THE AGE OF STATUTES 246–66 (1982).

[277] K.I. KINGREY, FUEL SUMMARY FOR PEACH BOTTOM UNIT 1 HIGH-TEMPERATURE GAS-COOLED REACTOR CORES 1 AND 2, at 4 (2003), *available at* http://www.inl.gov/technicalpublications/Documents/2699826.pdf; G. L. OLSON, ET AL., FUEL SUMMARY REPORT: SHIPPINGPORT LIGHT WATER BREEDER

disaster, DOE took title to and possession of the damaged TMI-2 reactor core; DOE agreed in 1984 to accept SNF assemblies remaining at the failed commercial reprocessing facility at West Valley, New York;[278] and DOE took title in 1996 to SNF from the decommissioned experimental reactor at Fort St. Vrain, Colorado. In addition, on an ongoing basis, DOE has accepted SNF from foreign research reactors, citing non-proliferation concerns. DOE currently holds these various sources of SNF in dry storage facilities at its Idaho National Laboratory (INL) and its Savannah River Site (SRS) in South Carolina, pursuant to licenses issued to DOE by NRC.

In its 2008 report to Congress, DOE attempted to square these practices with its denial of AEA authority to store civilian SNF other than in a NWPA MRS by arguing that "[p]rior to the enactment of the NWPA in 1982, the Department had authority and continues to have authority to accept SNF in certain circumstances pursuant to the AEA."[279] Pursuant to this AEA authority, DOE has accepted and stored U.S.-supplied foreign reactor fuel at various DOE sites. DOE has also used this authority to accept small amounts of SNF for research and development purposes, such as parts of the Three Mile Island Unit 2 damaged reactor core and other damaged SNF. DOE has also accepted commercial SNF under settlement of disputes resulting from contracts that predate enactment of the NWPA.

However, the later-enacted NWPA provided a detailed statutory scheme for SNF storage and disposal and limited DOE's authority to accept SNF under the AEA except in compelling circumstances such as acceptance of SNF to abate a public health risk in an emergency. DOE could only accept commercial SNF pursuant to the identifiable exceptions specified in the AEA. In the absence of statutory direction to accept SNF from decommissioned reactors that explicitly addressed the limitations imposed by the NWPA, the Department does not believe that the acceptance of the SNF from [decommissioned power plants] would be permitted under an identifiable exception in the AEA.[280]

DOE suggests, without supporting analysis, that in each

REACTOR 1-1 (2002), *available at* http://www.inl.gov/technicalpublications/Documents/2664750.pdf.

[278] FUEL CYCLE TO NOWHERE, *supra* note 11, at 242–44.

[279] 2008 DOE INTERIM STORAGE REPORT, supra note 238, at 6.

[280] 2008 DOE INTERIM STORAGE REPORT, supra note 238, at 6.

instance in which it has taken civilian SNF (discussed above), it was utilizing still-existing AEA authority pursuant to "identifiable exceptions" to the NWPA limitations. Taking the damaged TMI reactor core might be rationalized under the AEA provision relating to "research and development purposes," and the foreign research reactor fuel could be understood as taken to further "international cooperation and nuclear nonproliferation."[281] The Fort St. Vrain waste might be characterized as taken to settle a "dispute[] resulting from [a] contract[] that predate[s] enactment of the NWPA," but this is not an "exception" specifically identified in the AEA.[282] Storage of the waste from West Valley would seem even harder to justify consistent with DOE's supercession argument; in its report to Congress, DOE does not try to.

In many, if not all, of the cases where DOE has taken relatively limited amounts of civilian SNF from specific sources for context-specific reasons, the practice was initiated before enactment of NWPA. DOE might well have chosen to justify its practice on this ground, arguing that the supercessive effect of NWPA on its AEA authority was only prospective. In choosing not to make this argument, DOE evidently wishes to claim authority to take limited amounts of civilian SNF in the future pursuant to claimed "identifiable exceptions" to the NWPA's preclusive effect. These "exceptions" would not, however, authorize DOE to take and store power plant SNF on a broad scale.

Whatever the status of these "exceptions," DOE's basic conclusion that NWPA deprives it of AEA authority that it would otherwise enjoy to build consolidated civilian SNF storage facilities, free of the NWPA restrictions on MRS, is generally sound, for reasons discussed above. Regardless, NWPA confers on DOE authority to start developing an MRS.

2. *Potential Locations for DOE Consolidated SNF Storage Facilities*

DOE has concluded that some of its sites already hosting defense wastes—the SRS in South Carolina, the Hanford Site in

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[281] *Id.* at 6. Interestingly, DOE does not suggest that the TMI-2 core was taken for purposes of public emergency.

[282] *Id.* at 6. DOE does not explain which exception it thinks the foreign research reactor falls under, but given that its stated purpose was nonproliferation concerns, it seems likely that this was the relevant exception intended.

the state of Washington, and possibly the INL—could be appropriate for consolidated interim storage of some SNF, but that express congressional authorization would be required. An advantage of these defense legacy waste sites is, as stated in DOE's 2008 report, that they already have infrastructure and security programs, operational and regulatory expertise, fully developed environmental baselines, and ready rail access.[283] Experience also indicates that local communities, having grown familiar with the presence of nuclear waste at nearby DOE facilities and accustomed to the economic benefits that those facilities provide, often have become some of the strongest supporters of hosting nuclear waste sites.[284] In fact, six of the eleven sites whose local communities volunteered as potential hosts of a pilot project on SNF reprocessing under the (now-extinct) Global Nuclear Energy Partnership (GNEP) program of the George W. Bush administration were already owned and operated by DOE.[285]

As explained in *The Fuel Cycle to Nowhere*:

> The experience with siting new nuclear waste facilities, however, shows that even where a local community might be willing to host a facility, potential host states are generally opposed, due to the political "doughnut" effect—where people in nearby communities tend to perceive the risks posed by the facilities as relatively low, while those further away (50-150 miles) view them as significantly higher, even though risks in fact decline with distance. This problem might be mitigated by federal inducements for states and localities in the form of co-located job-producing and -sustaining developments at or near the same facility. These developments could include 'energy parks' "and other energy technology R&D facilities and university-based research programs in

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[283] *Id.* at 11.

[284] A survey of the public in various communities with former or current nuclear facilities on attitudes toward hosting new nuclear waste facilities found that "by facility type, respondents of the four older DOE nuclear weapons sites (Hanford, Idaho, Oak Ridge, Savannah River) were the strongest supporters of new waste management facilities." Michael R. Greenberg, *NIMBY, CLAMP, and the Location of New Nuclear Facilities: U.S. National and 11 Site-Specific Surveys*, 29 RISK ANALYSIS 1242, 1246–47 (2009).

[285] *See* Press Release, Department of Energy Selects Recipients of GNEP Siting Grants, DOE (Nov. 29, 2006), *available at* http://energy.gov/articles/department-energy-selects-recipients-gnep-siting-grants.

renewable energy, energy conservation, and the nuclear fuel cycle, including nuclear waste management.[286]

One substantial problem with siting civilian SNF storage at DOE legacy waste sites, however, is that DOE has longstanding legal obligations to the host states to clean up nuclear wastes and, with respect to some sites, to remove nuclear wastes from the site and from the state by specific dates.[287] These obligations could preclude DOE from bringing new wastes onto the site, or from keeping such wastes there past specified deadlines.[288] Obtaining modifications of relevant agreements, court decrees, and related regulatory permits might be difficult. Moreover, even where DOE is not under a specific, legally-binding agreement to remove wastes by a certain date, state and local constituencies and environmental organizations that had long fought for highly-radioactive wastes to be remediated or removed from DOE sites might well oppose bringing more wastes onto them. For example, the State of Washington, tribes, and other stakeholders are adamant that no commercial radioactive wastes—not even low-level wastes (LLWs)—be brought to Hanford until DOE fulfills its obligations to clean up the site.[289] Similarly, stakeholders at the SRS would likely oppose commercial SNF interim storage, as would those at West Valley, New York, where it took many years to compel DOE to remove unreprocessed power plant and defense

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[286] FUEL CYCLE TO NOWHERE, *supra* note 11, at 267. For an in-depth discussion of the doughnut effect, *see* NAT'L RESEARCH COUNCIL STAFF, DISPOSITION OF HIGH-LEVEL RADIOACTIVE WASTE THROUGH GEOGRAPHICAL ISOLATION: DEVELOPMENT, CURRENT STATUS, AND TECHNICAL AND POLICY CHALLENGES 9 (1999).

[287] *See* VAN NESS FELDMAN, P.C., FEDERAL COMMITMENTS REGARDING USED FUEL AND HIGH-LEVEL WASTES 3 (2010), http://www.brc.gov/sites/default/files/documents/federal_commitments_paper_revised_w-disclaimer_20101203_.pdf (obligating DOE to remove all SNF located at Fort St. Vrain facility from Colorado by 2035).

[288] *See id.* at 2–3. An example of such an obligation is the Batt Settlement Agreement with the State of Idaho. Under the agreement, SNF at DOE's INL site must be put into dry storage by December 31, 2023, and all of the fuel must be removed from Idaho by January 1, 2035. The penalty for missing either of these deadlines is $60,000 per day. 1995 Settlement Agreement in United States v. Batt, No. CV-91-0054-S-EJL (D. Id.), at C.3, *available at* https://idahocleanupproject.com/Portals/0/documents/1995SettlementAgreeement.pdf. *See also* VAN NESS FELDMAN, P.C., *supra* note 287, at 3 (listing a table of DOE obligations).

[289] *Hanford*, WASHINGTON STATE OFFICE OF THE ATTORNEY GENERAL, http://www.atg.wa.gov/divisions/ecology/hanford.aspx (last visited 1/26/14).

SNF left over from a failed commercial SNF reprocessing venture.[290]

3. *Storage of SNF at WIPP*

The federal site near Carlsbad, New Mexico, on which WIPP is located might be an option for locating a federal consolidated interim storage facility for civilian SNF; indeed, it might be a suitable site for permanent disposal of such waste. Initially, DOE developed WIPP under its general AEA authority, which would have enabled it to store or dispose of any type of defense waste, as well as civilian SNF, at the site. But, due to New Mexico's objections to receiving high-level defense wastes and commercial SNF, subsequent federal legislation continues to limit WIPP's use for disposal to TRU defense wastes: no civilian wastes or non-TRU defense wastes are allowed.[291]

WIPP is the world's only operating deep geologic repository for highly radioactive waste; it was constructed in a salt formation on federal land and has been successfully operated by DOE for over a dozen years. WIPP is disposing of most of the country's defense TRU wastes, which it receives in shipments transported by truck from DOE sites around the country. DOE developed the repository over a 25-year period beginning in 1974, through a process of contestation, litigation, and negotiation with the State of New Mexico. During this process, the federal courts and Congress intervened on several occasions to protect the interests of the state. DOE initially developed the facility under its general AEA authority, and later under WIPP-specific congressional legislation. As a result, the facility gained local community support.[292] The documentary record of interactions among the actors in the WIPP

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[290] FUEL CYCLE TO NOWHERE, *supra* note 11, at 243–44.

[291] BRC REPORT, *supra* note 1, at 21. WIPP-conforming "Transuranic Waste" (TRU) is defined by the WIPP Land Withdrawal Act as "waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for—(A) high-level radioactive waste; (B) waste that the Secretary has determined, with the concurrence of the Administrator, does not need the degree of isolation required by the disposal regulations; or (C) waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with part 61 of title 10, Code of Federal Regulations." Waste Isolation Pilot Plant Land Withdrawal Act, Pub. L. No. 102-579, § 2(20), 106 Stat. 4777, 4779 (1992).

[292] The ELEA interim storage project is discussed in further detail in the text accompanying notes 344–53, *infra*.

process reflects growing, strong cooperative relationships developed over the years among the State of New Mexico, the DOE WIPP team, state regulators (who oversee WIPP's RCRA facility permit), and neighboring states (which cooperate in facilitating safe transport of wastes to the site).

The possibility of expanding WIPP's mission to include SNF and HLW disposal is emerging in the wake of Yucca's termination. Consolidated interim storage of SNF or HLW in surface facilities at or near the site would make especial sense if the WIPP repository were ultimately to be used for disposing of such wastes. Carlsbad and neighboring community leaders are actively promoting expanding WIPP's mission to allow disposal of other defense wastes, including HLW, SNF, and possibly civilian SNF. Permitting acceptance of new wastes would avert the expected shut-down of the facility when it completes its TRU disposal mission. Carlsbad's mayor has already begun to suggest this possibility to Congress.[293] A consortium, composed of Carlsbad, a neighboring town, and two counties in New Mexico, is actively pursuing development of an interim storage facility for SNF near WIPP on private land that the consortium members own jointly.[294]

WIPP could well be technically suitable for repository disposal of HLW or SNF, although comprehensive testing and environmental assessment would be needed in order to determine this. In the late 1970s, DOE and others regarded WIPP as a potentially acceptable site for disposal of SNF and HLW, although Congress eventually restricted its mission to disposal of defense TRU.[295] Success in winning the support of the state for such initiatives might well hinge on whether the federal government could provide New Mexico with enough in the way of concessions, assurances, and inducements to address the state's concerns and win its assent to expanding WIPP's role. The benefits package for New Mexico ought to include appropriate state decision-making and oversight authority, federal commitments that are judicially enforceable, and substantial economic benefits. Past experience suggests that New Mexico,

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[293] Sue Vorenberg, *WIPP Wonders*, SANTA FE NEW MEXICAN, A1 (Mar. 29, 2009).

[294] *See infra* text accompanying notes 344–53.

[295] *See* FUEL CYCLE TO NOWHERE, *supra* note 11, at 59–60, 163–67, 231–32, 256–57.

which has no nuclear power plant, would be substantially more resistant to hosting power plant SNF from other states than to accepting additional types of defense wastes.[296] The recent ELEA proposals to develop a consolidated SNF storage facility on private land near WIPP, discussed in Section V, present an alternative to storage at the WIPP site itself that would not need congressional legislation, but could be blocked by the state.

C. *Siting Challenges*

Regardless of whether a consolidated storage facility is developed by the federal government or a private entity, history shows that developers typically face resistance from potential host localities and states. Although local community support for a facility can sometimes be obtained, as indicated by the ELEA initiative, objections based on the risks of nuclear transportation, storage, and disposal, as well as equity-based objections to hosting out-of-state wastes, are likely to generate strong legal and political opposition. This was the case with DOE's efforts to site HLW/SNF repositories, MRS facilities for SNF storage, and the WIPP facility for TRU disposal. State-level opposition has also plagued the private PFS/SNF interim storage facility. Thus far, WIPP is the only case of a major storage or disposal facility for highly-radioactive nuclear waste where this opposition has been successfully overcome. Close analysis of this history, including both the failures and the eventual, hard-won success at WIPP, provides important lessons for DOE and private entities seeking to develop consolidated SNF storage facilities.[297] Reflecting this experience, both BRC and the DOE Strategy endorse a consent-based, phased, adaptive approach to siting consolidated storage facilities and a repository.

1. *Securing Host Jurisdiction Assent*

The record of federal failures in siting HLW/SNF repositories and MRS facilities, and the eventual success of WIPP, are powerful evidence that successful siting of new nuclear waste repositories and storage facilities requires host consent. As Yucca and DOE's siting failures show, although the federal government may have overriding legal authority to build a new nuclear waste

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[296] *See id.*

[297] *See id.* at 254–305.

repository or storage facility on its own lands, deeply entrenched political and institutional safeguards of federalism make it very difficult to impose such facilities against the determined opposition of host jurisdictions. The BRC report properly concludes that facility siting is most likely to succeed if it is "consent-based—in the sense that affected communities have an opportunity to decide whether to accept facility siting decisions and retain significant local control."[298] The federal government must accordingly abandon the "top-down" prescriptions embraced in NWPA and its 1987 amendments, and the dysfunctional approach to their implementation. DOE subsequently recognized this imperative when it invited host jurisdictions to express interest in siting GNEP facilities; a number of jurisdictions did so.[299] Future siting decisions will require the federal government to collaborate with states, tribes, and localities through open processes that provide ready access to key information and ensure opportunities for meaningful involvement in decision-making on facility siting, development, transportation, and operations, as well as other key issues. This will require a variety of initiatives, including:

- partnering of facility developers with, and close engagement of, host states, tribes, and localities in risk assessment, siting, design, and operational planning and decision-making;
- ensuring that host jurisdictions can "enter into legally-binding, court-enforceable agreements" with the federal government to ensure that all federal commitments are upheld;[300]
- providing public access to all relevant information, and creating meaningful opportunities for public involvement, beginning early in, and at every stage of, the facility siting, development, operation, post-operation closure, and post-closure processes;
- providing funding for technical assistance and expertise for stakeholders, on a reliable and continuous basis throughout the siting process and thereafter, which allows for effective participation of individuals, citizen groups, and other stakeholders regarding "technical and other aspects of the

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[298] BRC REPORT, *supra* note 1, at 47.

[299] Under the program, DOE offered $16 million in grants to communities that volunteered to host a GNEP site. Leonor Tomero, *The Future of GNEP: Domestic Stakeholders*, BULL. OF ATOMIC SCIENTISTS (Aug. 8, 2008), http://thebulletin.org/future-gnep-domestic-stakeholders.

[300] BRC REPORT, *supra* note 1, at 56.

nuclear waste management program;"[301]

- developing a process for independent technical and scientific oversight and review;
- addressing the concerns of host and transit states, tribes, localities, and other key stakeholders regarding safety and security, including concerns relating to waste transportation;
- providing meaningful and appropriate oversight or regulatory roles for host states, tribes, and localities with respect to facility operations, closure and post-closure arrangements, and other important matters;
- providing economic and other benefits to host states, tribes, and localities, such as priority for receiving federal monies, and federal investment in physical, economic, or social infrastructure that will support long-term job creation and growth.

Successful siting will also require a flexible, step-by-step approach by federal or private facility developers, which must be willing to seize available opportunities while also being respectful of and responsive to contestation and doubt.

Future siting strategies can build on the lessons of WIPP and Yucca.[302] In order to win host trust and assent, the process for making siting decisions must bring in states, localities, tribes, and members of the public at the early stages of the planning process; stakeholders must be given access to all relevant information about the proposal, be able to voice concerns and demands, and have the opportunity to resolve them through discussion, deliberation, and negotiation. *Informed* public assent implies that all stakeholders have full and accurate information about the important aspects of the project, including: characteristics of the wastes; the environmental, health, and safety risks posed; characteristics of the site and proposed facility; and arrangements for transportation, safety, and security. Moreover, the process must ensure that stakeholders continue to receive timely and relevant information

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[301] *Id.* at 55.

[302] A number of these strategies are discussed in NAT'L RESEARCH COUNCIL, DISPOSITION OF HIGH-LEVEL WASTE AND SPENT NUCLEAR FUEL 66 (2001) (identifying the most notable lessons learned from the WIPP program as being "the importance of choosing a suitable site; allowing sufficient time to undertake the scientific and technical investigations necessary to demonstrate its suitability; and obtaining external, independent scientific and technical reviews of these investigatory efforts.").

throughout development. Achieving informed public assent also requires that host states, tribes, and communities have or are given the resources to hire independent experts to evaluate claims made by the project proponents, perform their own investigations, and gather information on issues of importance to them. Correlatively, informed assent also requires public trust in the government or private entity developing the facility, and confidence that decisions will be made on the basis of publicly-available information and well-founded public reasons.

Winning host assent may also require developers to provide economic and development benefits beyond those offered by the waste facility itself. In the case of WIPP, these included federally-financed construction of a highway bypass of Santa Fe and $300 million in unrestricted grants to the state.[303] Further inducements could include coupling the waste facility with other economically and socially beneficial facilities or projects, such as R&D facilities, or support for research, education, and development activities at universities and technical institutes in the region. Facilities and projects that provide benefits that extend beyond the host locality, and temporary construction jobs there, are likely to be viewed as far more valuable. In addition, as illustrated by WIPP, the federal government can meet state transportation safety concerns by funding training, emergency preparedness, emergency response, and other initiatives.

Finally, steps to gain host assent must take into account differences in the risk and political legitimacy of the wastes involved. The public seems to view all forms of nuclear waste as highly hazardous, judging by the opposition to new LLW facilities in California, Nebraska, and North Carolina,[304] although a new LLW facility was recently sited in Texas.[305] The difficulties in

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[303] Samuel D. Rauch III, Note, New Mexico v. Watkins *and the Waste Isolation Pilot Plant Withdrawal Act: The Importance of FLPMA's Procedural Requirements*, 24 ENVTL. L. 225, 257 (1994); Kerry E. Rodgers, *Identifying the Crucial Elements of States' Collaboration Over the Long Haul: The Transportation of Nuclear Waste to New Mexico*, 41 N.M. L. REV. 361, 369–71 (2011).

[304] *Low-Level Nuclear Waste Disposal Update (10-4-02)*, AM. GEOLOGICAL INST., http://www.agiweb.org/gap/legis107/lowlevel_waste.html (last visited Mar. 18, 2014) (discussing the California, Nebraska, and North Carolina waste disposal sites).

[305] See *Texas Low-Level Radioactive Waste Disposal*, TEX. COMM'N ON ENVTL. QUALITY, http://www.tceq.texas.gov/permitting/radmat/licensing/wcs_license_app.html#timeline (last visited Apr. 11, 2013), for a timeline of the

siting HLW and SNF repositories are far greater, as illustrated by the NWPA siting experience, as well as by the strong state-level resistance DOE encountered when, years ago, it sought to dispose of those wastes at WIPP.[306] The origin of the wastes also appears to be relevant to host assent. New Mexico was more willing to accept defense wastes, even from out of state, than SNF from civilian power plants in other states.[307] In the cases of both Nevada and New Mexico, opposition to SNF disposal was heightened by the fact that neither state has a nuclear plant.

WIPP was shaped over many years by an evolving process of incremental decision-making that sustained its uneven but continuing progress from a pilot project with an undefined mission to its successful operation as a TRU repository more than twenty years later. WIPP was largely a negotiated package, rather than a top-down decision made in Washington.[308] There was no blueprint drawn up in advance. The key decisions about the location and basic design of the facility and the wastes it would hold were made over a substantial period of time, through an ad hoc, incremental process of contestation and negotiation that directly involved the state, DOE, the federal courts (as a result of litigation brought by New Mexico and environmental and citizen groups), and Congress, and indirectly involved the Town of Carlsbad, other western states, and other stakeholders.[309] This flexible, iterative process enabled the state to have effective input and influence on key decisions, and to secure many of its most important objectives. By contrast, NWPA imposed a blueprint for Yucca that defined the key elements of the repository project at the outset and prescribed a rigid timetable for implementation.[310] This blueprint provided

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approval process. Significantly, the facility has been licensed to take all classes of LLW, even Class C—the most hazardous form of radioactive LLW that can, under current law, be disposed of in near surface land disposal facilities.

[306] *See* DON HANCOCK, A PERSPECTIVE ON THE CONTINUING WIPP EXPERIENCE 6 (2010), *available at* http://brc.gov/sites/default/files/meetings/presentations/sric_statement_070710finalcorrected.pdf (discussing public opposition to expanding WIPP's mission to include HLW).

[307] *See* FUEL CYCLE TO NOWHERE, *supra* note 11, at 163–67.

[308] Christopher J. Wentz, *WIPP Chronology*, N.M. ENERGY, MINERALS, & NAT. RES. DEP'T, *available at* http://www.emnrd.state.nm.us/WIPP/wippchronology.html (last updated Feb. 1999) (tracking WIPP development until 1998).

[309] *Id.*

[310] *See* Richard B. Stewart, *Solving the Nuclear Waste Dilemma*, 40 ENVTL. L. REP. 10783, 10785, 10790 (2010). *Compare* Richard B. Stewart, *U.S. Nuclear*

only limited scope for addressing fundamental state concerns or for altering course in response to new information.

D. *Transportation of SNF*

Although the public often perceives transportation of SNF to be quite risky, the consensus of independent experts, based on the record of TRU transport to WIPP and the limited transport of SNF that has occurred, is that transportation of SNF can be done safely, if properly managed. SNF is transported in NRC-certified-and-inspected shipping containers, which provide a considerable amount of protection to the waste in the event of accidents, drops, or fires. The American Physical Society concluded in 2007 that the accident risks posed by transporting SNF to consolidated storage facilities are so low as to be *de minimis*.[311] A 2006 NAS report by a committee that studied the transportation of SNF to Yucca for disposal concluded that existing technologies and regulatory arrangements are generally adequate to ensure safe transport of large volumes of SNF.[312] These findings are consistent with the extensive record of transportation of TRU by truck to WIPP, with relatively few reported accidents and no releases of radioactivity to the environment. However, independent experts have not studied risks posed by deliberate terrorist attacks during SNF transshipment because the federal government has classified the information necessary to evaluate such risks.

Moreover, the TRU shipment experience, while encouraging, does not provide a sufficient benchmark for assessing the potential safety and security of the much bigger transportation effort that would be needed to move SNF from scores of reactors around the country to one or more consolidated interim storage facilities and,

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Waste Law and Policy: Fixing a Bankrupt System, 16 N.Y.U. ENVTL. L J. 783, 787–800 (2008), *with* Thomas B. Cochran & Geoffrey H. Fettus, *NRDC's Perspective on the Nuclear Waste Dilemma*, 40 ENVTL. L. REP. 10791, 10792-93 (2010).

[311] NUCLEAR ENERGY STUDY GRP., AM. PHYSICAL SOC'Y, CONSOLIDATED INTERIM STORAGE OF COMMERCIAL SPENT NUCLEAR FUEL 5 (2007). *See also* GAO, SNF REPORT 2003, *supra* note 88, at 8.

[312] *See* NAT'L RESEARCH COUNCIL, GOING THE DISTANCE? 7–8 (2006). According to GAO, in order to threaten residents near a transportation accident site, not only would the containers have to be breached, but also the SNF would have to be "pulverized" by an explosion or high-speed collision into particles small enough to be carried by the air. GAO, SNF REPORT 2003, *supra* note 88, at 7–9.

ultimately, to a repository.[313] The BRC report found that DOE could and should build on its successful WIPP experience in transportation planning for civilian SNF.[314]

Transportation of SNF is a likely flashpoint for state and local opposition to consolidated interim storage facilities. Unless storage and disposal facilities are located near each other, having to transport SNF from reactor sites to a consolidated storage site means that the SNF will have been transported twice before it reaches a permanent repository, and may be transported a much longer total distance. As a practical matter, transportation routes would have to be negotiated with states in order to gain their cooperation in monitoring and assuring the safety of each shipment. If transit states were to threaten to block shipments of SNF over their roads—despite federal authority to regulate interstate transportation and the potential for legal challenge to state measures based on the Commerce Clause of the Constitution and the federal transportation regulatory statutes—concerted state opposition could effectively hinder development of a consolidated storage facility.[315]

In order to meet the concerns of states and localities, DOE

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[313] The NAS committee emphasized that large-scale transport of SNF would be an unprecedented and highly-challenging enterprise, and that it would be particularly important to address public concerns about the risks involved and to work closely with state and local authorities on coordination and issues such as emergency preparedness. *See* NAT'L RESEARCH COUNCIL, *supra* note 312, at 212–215.

[314] BRC REPORT, *supra* note 1, at 85–87.

[315] Under similar circumstances, the Western governors were able to use organization (specifically, forming the Western Governors' Association) and political leverage to ensure their active participation in decision-making and management of transportation of TRU waste shipments to WIPP in New Mexico. The Western Governors' Association insists that DOE must coordinate and cooperate with the states in identifying routes for shipment of SNF and HLW. Information on the activities of the Western Governors' Association High-Level Radioactive Waste Committee can be found at http://www.westgov.org/ wieb/site/hlwpage/index.htm. According to a report prepared for BRC, one important component of Utah's (to date successful) campaign to block construction of the NRC-licensed PFS consolidated interim storage facility for SNF was the state's success in blocking access to the site by rail— by creating a new federal wilderness area through which the originally-planned dedicated rail spur to the facility would have had to run. *See* Richard C. Moore, ENHANCING THE ROLE OF STATE AND LOCAL GOVERNMENTS IN AMERICA'S NUCLEAR FUTURE: AN IDEA WHOSE TIME HAS COME 2 (2011), http://brc.gov/sites/default/files/ documents/enhancing_the_role_of_state_and_local_governments_in_americas_n uclear_future.pdf.

must engage them in the planning of transportation routes and safety measures and programs, including emergency response. In evaluating and selecting sites for consolidated storage facilities, as well as for repositories, DOE must examine whether there is already existing transportation infrastructure (e.g., rail and road routes) that would be suitable for transporting SNF from reactor sites to potential consolidated storage facilities and on to potential repository sites. According to expert testimony noted by BRC, it would take around a decade to plan and coordinate a transportation strategy and to establish the institutional and physical infrastructure to conduct a large-scale shipping operation.[316] BRC recommends that DOE provide, pursuant to NWPA Section 180(c), technical assistance and funds for training to local governments and tribes in transit states, independent from progress on facility siting.[317] BRC also calls for Congress to amend Section 180(c) of NWPA to authorize grants to enable states, tribes, and local governments to respond to emergencies and take other steps to deal with large-scale SNF transport.[318]

E. *Conclusions Regarding Government Consolidated Storage*

The federal government should move forward promptly to site at least two consolidated SNF storage facilities, simultaneously rather than sequentially, through an iterative, consent-based process. The government should be given flexibility to develop the facilities as pilot or full-scale facilities, depending on the receptiveness and needs of volunteer host communities and host states, and in accordance with binding agreements with these hosts. BRC and the DOE Strategy outline some of the basic elements of such a program. What is needed now is to define and begin to implement the program elements, drawing on the lessons of past failed DOE siting efforts, and the successes at WIPP and in other countries. DOE should be tasked with initiating this effort now, without waiting for the creation of a new federal waste management entity.

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[316] *See generally* Lisa Janairo, Statement before the Transportation and Storage Subcommittee of the Blue Ribbon Commission on America's Nuclear Future (Nov. 2, 2010), *available at* http://cybercemetery.unt.edu/archive/brc/20120621033136/http://brc.gov/sites/default/files/meetings/presentations/janairo_presentation.pdf.

[317] BRC REPORT, *supra* note 1, at 85.

[318] *Id.* at 86–87.

V. PRIVATE CONSOLIDATED SNF STORAGE FACILITIES

If political, legal, or financial obstacles block or delay development of consolidated SNF storage facilities by DOE or a successor entity, private development and public-private partnerships are potential alternatives. However, any new legislation promoting private development should ensure that the measures for public involvement and obtaining host consent and agreement discussed above in Part IV are also applied to development of facilities by private entities and public-private ventures. The comparative functional advantages and disadvantages of private consolidated storage facilities relative to at-reactor storage—cost, transportation issues, and removal of SNF from populated areas—are similar to those of government facilities. The procedures for NRC licensing of SNF storage facilities are the same for private applicants as for DOE, and most of the substantive requirements are identical.[319]

However, private developers enjoy certain advantages over the government in developing facilities. Unlike DOE, they do not need congressional approval under NWPA to build a facility, are not subject to NWPA MRS capacity limitations, and are not subject to the special procedural requirements imposed on DOE by NWPA for siting and facility development.[320] Private development could be more efficient, less bureaucratic, more timely, and cheaper than federal development. These features may make private development attractive to utilities.

European utilities have developed a number of consolidated SNF storage facilities, either privately or in some form of hybrid public-private undertaking. Several German facilities were built, and continue to be operated, by private companies formed by Germany's nuclear utilities.[321] In Sweden, radioactive waste is managed by the Swedish Nuclear Fuel Waste & Management Company (SKB), a private corporation formed by the nuclear

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[319] *See* 10 C.F.R. § 72 (2010) (repeatedly using the disjunctive "MRS or ISFSI" in the procedures, indicating equal treatment).

[320] *See* HOLT, ALTERNATIVES TO YUCCA MOUNTAIN, *supra* note 41, at 15. The absence of such restrictions, however, may increase the risk that a private facility could become a de facto repository, inviting opposition by potential host jurisdictions. *See generally Nuclear Native America*, *supra* note 44.

[321] *Nuclear Power in Germany*, WORLD NUCLEAR ASS'N, http://www.world-nuclear.org/info/Country-Profiles/Countries-G-N/Germany/ (last visited Mar. 18, 2014).

power utilities in 1973.[322] In 1985, SKB commissioned the CLAB facility at Oskarshamn. CLAB has underground storage pools that were originally built with capacity for up to five thousand tons of SNF; however, they have since been upgraded to hold eight thousand tons.[323] In Switzerland, the Central Storage Facility in Würenlingen, near the Beznau Nuclear Power Plant, stores vitrified reprocessing waste and SNF in dry casks from various nuclear power reactors, on an interim basis, until the country develops a geological repository. The facility was built by ZWILAG, a corporation owned by the four nuclear utilities cooperatively, in proportion to their nuclear power output.[324] In the Netherlands, the HABOG facility was commissioned in 2003 for consolidated dry cask storage of vitrified reprocessing waste and SNF from the nation's research reactors.[325] The facility was built by COVRA, a corporation that was privately owned by the waste producers until its shares were transferred to the state in 2002.[326] Consortiums of utilities are developing SNF interim storage facilities in Japan and Canada. In all of these countries, the private entities operate in close cooperation and under the active supervision of government.

In the United States, PFS and ELEA initiatives suggest that there may be substantial incentives for utilities to develop private consolidated storage facilities or pay such facilities to store their SNF pending repository development. These include: lower SNF storage costs, most dramatically in the case of stranded SNF; the

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[322] U.S. NUCLEAR WASTE TECHNICAL REVIEW BOARD, EXPERIENCE GAINED FROM PROGRAMS TO MANAGE HIGH-LEVEL RADIOACTIVE WASTE AND SPENT NUCLEAR FUEL IN THE UNITED STATES AND OTHER COUNTRIES 18 (2011), *available at* http://www.nwtrb.gov/reports/intl%20rpt_final.pdf.

[323] *Nuclear Power in Sweden*, WORLD NUCLEAR ASS'N, http://www.world-nuclear.org/info/Country-Profiles/Countries-O-S/Sweden/ (last visited Mar. 18, 2014).

[324] *Id.*

[325] *Nuclear Power in The Netherlands*, WORLD NUCLEAR ASS'N, http://www.world-nuclear.org/info/inf107.html (last updated Sept. 2013); *see also* J. KASTELEIN & DR. H.D.K. CODÉE, HABOG: ONE BUILDING FOR ALL HIGH LEVEL WASTE AND SPENT FUEL IN THE NETHERLANDS. THE FIRST YEAR OF EXPERIENCE 170-71 (2005), *available at* http://www.euronuclear.org/pdf/RRFM2005-Session4.pdf#page=20.

[326] *Organisation*, COVRA, http://www.covra.nl/about-covra/organisation (last visited Apr. 13, 2013); *see also Nuclear Power in The Netherlands*, *supra* note 325; *Netherlands 2009–Milestones*, IAEA, http://newmdb.iaea.org/Admin/Reports/Published/Milestones.aspx?Pub=1&IsoCode=NL&PeriodID=9 (last visited Apr. 13, 2013).

potential to outsource the costs of developing ISFSIs at reactor sites, and of dealing with local opposition; and countering diffuse opposition to nuclear power based on the failure to "solve" the SNF problem.[327] Additionally, the federal government is liable for the utilities' post-1998 SNF storage costs, including any costs arising from on-site storage or from off-site storage at a private facility. The utilities are, however, forced to bring litigation to recover these costs. Further, the interest paid by the government on reimbursement claims is likely to be less than the utilities' internal rate of return. Still, the recent *Dairyland Power Cooperative v. United States* decision,[328] in which a utility was able to recover its full investment in the PFS facility as damages for the government's ongoing failure to take its SNF, provides some encouragement for utility investment in consolidated storage facilities. To the extent that privately developed consolidated storage can be brought online more quickly and cheaply than federal facilities, the utilities' economic calculus will favor private development.

From the government's perspective, there could also be advantages in private development. Not only could it be more efficient, timely and, inexpensive, but it could also set a yardstick for gauging development efforts by the government, and deflect some of the burdens and political controversies away from the government entity responsible for siting. On the other hand, if there were only one or two private developers, they could wield significant market power, to the detriment of any utilities who did not participate in a development consortium like PFS, and to the detriment of the government, which might have to pay for inflated storage costs.

Private developers of consolidated storage facilities also suffer from certain disadvantages compared to the federal

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[327] The availability of away-from-reactor storage may also make it easier to site new nuclear power plants and address opposition driven by the prospect of long-term, at-reactor SNF storage. *See* GOV'T ACCOUNTABILITY OFFICE, COMMERCIAL NUCLEAR WASTE: EFFECTS OF A TERMINATION OF THE YUCCA MOUNTAIN REPOSITORY PROGRAM AND LESSONS LEARNED 32 (2011), *available at* http://www.gao.gov/assets/320/317627.pdf ("Some experts noted that without progress on a centralized storage facility or repository site . . . some state and local opposition to reactor storage site recertification will increase, and so will challenges to nuclear power companies' applications for reactor license extensions and combined licenses to construct and operate new reactors.").

[328] Dairyland Power Coop. v. United States, 645 F.3d 1363 (Fed. Cir. 2011).

government. Unlike federal projects on federal lands, private projects on private lands are subject to the full extent of state and local jurisdiction. They are also subject to certain federal permitting requirements, such as the need to obtain right-of-way permits for transportation over federal lands. As a result, private projects may be more vulnerable to state and local opposition. As the PFS experience illustrates, private developers may lack the financial staying power to surmount opponents' use of legal proceedings to block or delay a project, or may be deterred at the outset by the legal, regulatory, and financial uncertainties involved.

This Section first examines the history of private consolidated storage initiatives in the U.S. It then examines the distinctive federal regulatory issues presented by private consolidated storage facilities, the most important being whether or not NWPA permits them at all. It then discusses the distinctive siting problems faced by private developers and how they might be addressed. A short conclusion includes a discussion of federal financial incentives for private development of consolidated storage facilities.

A. *History of Private Consolidated SNF Storage Projects*

1. *Morris*

The Morris, Illinois site was initially to be used by General Electric Co. (GE) for development and operation of a nuclear fuel reprocessing plant, with federal financial support. GE received SNF from several utilities for reprocessing and stored it in a cooling pool.[329] GE eventually decided to abandon the venture, but applied to NRC for a license to store the SNF, which continued to be owned by the utilities. In 1982, NRC granted GE a twenty-year ISFSI license for SNF storage, and renewed the license in 2004, effective through May 2022. The license renewal does not allow any additional SNF to be brought on-site.[330] The site

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[329] PLANNING INFORMATION CORPORATION, THE TRANSPORTATION OF SPENT NUCLEAR FUEL AND HIGH-LEVEL RADIOACTIVE WASTE: A SYSTEMATIC BASIS FOR PLANNING AND MANAGEMENT AT THE NATIONAL, REGIONAL, AND COMMUNITY LEVELS (2006), *available at* http://www.state.nv.us/nucwaste/trans/1pic06.htm.

[330] News Release, Nuclear Regulatory Comm'n, NRC Renews License for Interim Spent Nuclear Fuel Storage Installation at G.E. Morris Facility in Illinois (Dec. 30, 2004), *available at* http://www.nrc.gov/reading-rm/doc-collections/news/2004/04-166.html.

currently stores about seven hundred metric tons of SNF in spent fuel pools. Because of its particular history and limited capacity, Morris is not a model for future consolidated storage.

2. *PFS*

A consortium of eight nuclear utilities formed PFS to develop a private, consolidated interim storage facility for up to 44,000 metric tons of commercial SNF.[331] The site for the facility is located on tribal lands held by the Skull Valley Band of the Goshute Nation in Utah. DOE and ONWN had identified the site during an unsuccessful federal effort to site a federal MRS facility in the mid-1980s. The Skull Valley Band is an offshoot of the Confederated Tribes of the Goshute Nation, consisting of 125 members who live on an 18,000-acre reservation located about fifty miles west of Salt Lake City. The reservation is near a chemical weapons destruction facility on a site that also includes an incinerator, a low-level radioactive waste disposal facility, and a coal-burning power plant. According to the State of Utah, B-61 bombers also overfly it on test bombing runs. Some members of the Skull Valley Band, together with the Confederated Tribes of the Goshute Nation, opposed the facility and contended that the tribe's lease agreement with PFS was invalid.[332] Along with local communities near the site, the State of Utah vehemently opposed the PFS facility,[333] including during the licensing process at NRC.[334] Utah's senators also put pressure on various utilities to

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[331] *See Private Fuel Storage*, WWW.STORENUCLEARFUEL.COM, http://www.storenuclearfuel.com/new-sites/private-fuel-storage (last visited Jan. 26, 2014). The consortium members are Xcel Energy, Genoa Fuel Tech, American Electric Power, Southern California Edison, Southern Nuclear Company, First Energy, Entergy, and Florida Power and Light. *Id.*

[332] *White Paper Regarding Opposition to the High-Level Nuclear Waste Storage Facility,* THE COALITION OPPOSED TO HIGH LEVEL NUCLEAR WASTE (Nov. 28, 2000), *available at* http://www.deq.utah.gov/Issues/topics/highlevelwaste/docs/2005/Sep/HLW112800.pdf.

[333] *Id.* at 7–8; *Nuclear Native America*, *supra* note 44 at 150–53; UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY, OPPOSITION TO HIGH-LEVEL RADIOACTIVE WASTE: INFORMATION ON PRIVATE FUEL STORAGE'S PROPOSAL TO LOCATE A HIGH-LEVEL NUCLEAR WASTE STORAGE FACILITY ON THE SKULL VALLEY GOSHUTE INDIAN RESERVATION, *available at* http://pbadupws.nrc.gov/docs/ML0508/ML050820360.pdf (last visited Jan. 26, 2014) (explaining Utah's concerns about the proposed storage facility).

[334] *See, e.g.*, State of Utah's Comments on the Commissioners' Effectiveness Review of a License to Private Fuel Storage, Private Fuel Storage, LLC, Docket No. 72-22-ISFSI (NRC), *available at* http://www.deq.utah.gov/Pollutants/H/

withdraw support for the project.[335]

After nearly ten years of effort on the part of PFS and project proponents within the Skull Valley Band, in 2006 NRC issued a twenty-year license to PFS for dry cask storage of up to 44,000 metric tons of SNF at the Skull Valley Goshute Facility.[336] However, the license was granted conditionally upon PFS obtaining approval from several other agencies, including two bureaus within the Department of Interior (DOI): the Bureau of Indian Affairs (BIA) and the Bureau of Land Management (BLM). BIA and BLM subsequently denied PFS's applications for the necessary authorizations.[337] BIA disapproved the lease of tribal lands needed to construct the facility on the basis that the storage facility risked becoming a de facto permanent repository.[338] BLM denied rights-of-way across federal land for a truck-to-rail transfer site and a rail spur needed to transport SNF to the facility on the ground that these installations would threaten the federal wilderness area designated by Congress through the efforts of the

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highlevelnw/opposition/docs/2006/02Feb/00UtahCommentsImmedEffect License.pdf.

[335] Dave Hoopman, *Private Parking: Industry Steps Up with Nuclear-Storage Solution*, WIS. ENERGY COOP. NEWS, (May 2006), http://www.wecnmagazine.com/2006issues/may/may06.html.

[336] Notice of Issuance of Materials License Snm-2513 for the Private Fuel Storage Facility, 71 Fed. Reg. 10,068 (Feb. 28, 2006); NRC, *NRC Issues License to Private Fuel Storage for Spent Nuclear Fuel Storage Facility in Utah*, Feb. 22, 2006, *available at* http://www.nrc.gov/reading-rm/doc-collections/ news/2006/06-028.html; UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY, HIGH LEVEL NUCLEAR WASTE STORAGE IN UTAH 1 (2006).

[337] Notice of Availability of the Record of Decision for the Right-of-Way Applications Filed by Private Fuel Storage, L.L.C., for an Independent Spent Fuel Storage Installation on the Reservation of the Skull Valley Band of Goshute Indians and the Related Transportation Facility in Tooele County, UT, 71 Fed. Reg. 57,005 (Sep. 28, 2006); Notice of Availability of the Record of Decision for a Proposed Lease of Tribal Trust Lands between Private Fuel Storage, L.L.C., and Skull Valley Band of Goshute Indians in Tooele County, UT, 71 Fed. Reg. 58,629 (Oct. 4, 2006); Bureau of Indian Affairs, *Record of Decision for the Construction and Operation of an Independent Spent Fuel Storage Installation (ISFSI) on the Reservation of the Skull Valley Band of Goshute Indians (Band) in Tooele, Utah* (2006), *available at* http://www.deq.utah.gov/Issues/topics/ highlevelwaste/docs/2006/Sep/ROD%20PFS%2009072006.pdf; BUREAU OF LAND MGMT., RECORD OF DECISION ADDRESSING RIGHT-OF-WAY APPLICATIONS U76985 AND U76896 TO TRANSPORT SPENT NUCLEAR FUEL TO THE RESERVATION OF THE SKULL VALLEY BAND OF GOSHUTE INDIANS (2006); HOLT, ALTERNATIVES TO YUCCA MOUNTAIN, *supra* note 41, at 15.

[338] Bureau of Indian Affairs, *supra* note 337; HOLT, ALTERNATIVES TO YUCCA MOUNTAIN, *supra* note 41, at 15.

Utah delegation.[339] The surface roads in the region were inadequate for SNF transport by truck alone, and permission to use them had been denied by neighboring localities. In addition to the reasons BLM and BIA gave for their decisions, their actions may well have reflected pressure exerted by Utah and its congressional delegation, as well as concern on the part of the Bush administration that approval of the PFS facility would undermine the push to develop the Yucca repository. Opposition to the facility by many Goshutes may also have played a role, providing justification for BIA's denial of permission to the tribe to lease its lands to PFS.

In 2007, PFS and the Skull Valley Band filed suit against DOI in federal district court in Utah, challenging the BIA and BLM permit denials.[340] In July 2010, the court overturned the denial of the permits as arbitrary and capricious and remanded the decisions to DOI.[341] At the same time, the State of Utah, a group of Goshutes who opposed the PFS project, and other petitioners sought review of NRC's issuance of the license in the D.C. Circuit, which stayed the proceedings.[342] In 2012, PFS, having still failed to obtain the DOI permits, withdrew its NRC license and abandoned the project.[343]

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[339] Notice of Availability of the Record of Decision, 71 Fed. Reg. 57005 (Sept. 28, 2006). As part of an effort to block the project, Utah's congressional delegation succeeded in having a rider added to a defense appropriations act designating the public lands over which PFS had sought rights-of-way as part of a wilderness area. National Defense Authorization Act for Fiscal Year 2006, Pub. L. No. 109-163, § 384, 119 Stat. 3136 (2006).

[340] *See* Amended Complaint, Skull Valley Band of Goshute Indians v. Davis, 728 F. Supp. 1287 (D. Ut. 2010) (No. 2:07cv00526) 2007 WL 5354505.

[341] Skull Valley Band of Goshute Indians v. Davis, 728 F. Supp. 1287, 1287 (D. Ut. 2010). The court found that BIA's disapproval of the lease did not show proper deference to the tribe's right of self-determination, as BIA had failed even to consider the tribe's offer to address the bureau's concerns regarding the lease. The court also found that BLM's denial of rights-of-way was arbitrary and capricious. BLM had explicitly rested its denial of the rights-of-way on problems with the Final Environmental Impact Statement, which DOI itself had prepared. The decisions were remanded to the bureaus for further consideration. Neither BIA nor BLM sought appeal of the court's decision.

[342] Ohngo Gaudadeh Devia v. NRC, 492 F.3d 421 (D.C. Cir. 2007).

[343] Elaine Hiruo, *See Costs Drove PFS Move to Terminate U.S. Spent Fuel Storage License*, PLATTS (Jan. 2, 2013),http://www.platts.com/RSSFeedDetailedNews/RSSFeed/ElectricPower/6977321.

3. *ELEA-Areva*

In 2006, two New Mexico counties, Eddy and Lea, together with the towns of Carlsbad and Hobbs, formed ELEA and purchased 964 acres of private land to the east of the towns, not far from WIPP.[344] In 2007, ELEA applied for and received funds from DOE, under the GNEP program, to study potential use of the site for a reprocessing pilot project.[345] The GNEP program was subsequently cancelled. In 2011, ELEA announced that it was seeking private sector partners to develop the site for a consolidated SNF storage facility. ELEA selected an Areva-led group in October 2012, and the parties are now developing a memorandum of understanding.[346]

The proposed ELEA consolidated interim storage project is notable for several reasons. First and foremost, the potential host communities not only support, but are the driving forces behind, the initiative. Before the recent fire and leak at WIPP, Governor Susana Martinez had hinted that New Mexico might be open to accepting HLW at WIPP in the future, but had not taken a firm position on the expansion of WIPP.[347] Neither PFS, nor any of the candidate MRS sites identified by ONWN, had support at both the local and state levels. Additionally, the site's relatively remote location in an area that is becoming known as New Mexico's "Nuclear Corridor," near the successfully operating WIPP defense TRU disposal facility and other nuclear facilities, including a new uranium enrichment plant, makes it consonant with local experience and aspirations.[348] PFS, by contrast, was viewed by

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[344] *See* R. KEHRMAN, ET AL., THE GLOBAL NUCLEAR ENERGY PARTNERSHIP AND THE YIMBY SYNDROME 1 (2008), *available at* http://www.wmsym.org/archives/2008/pdfs/8056.pdf.

[345] *See id.*

[346] Press Release, Areva, Areva Led Team Selected by Eddy Lea Energy Alliance LLC to Develop Interim Consolidated Storage Facility (Oct. 5, 2012), *available at* http://www.us.areva.com/EN/home-2016/areva-eddy-lea-unf-storage-facility.html.

[347] *See* Rene Romo, *Officials Support WIPP Expansion*, ALBRQUERUE JOURNAL (Jan. 28, 2011), http://abqjournal.com/news/state/28239304930newsstate01-28-11.htm ("If it's done right, New Mexico may be interested in the future."); Matthew L. Wald, *Nuclear Waste Solution Seen in Desert Salt Beds*, N.Y. TIMES, Feb. 9, 2014, http://www.nytimes.com/2014/02/10/science/earth/nuclear-waste-solution-seen-in-desert-salt-beds.html ("[Governor Martinez] ha[s] not taken any position on any possible future mission for WIPP.").

[348] *See* KEHRMAN ET AL., *supra* note 344, at 1.

neighboring localities, a number of tribe members, and the host state as an imposition by outsiders.

The ELEA project's configuration as a locality-led venture might help it avoid some, although by no means all, of the pitfalls experienced by past efforts. Because it is sited by a non-federal entity on non-federal land, the project would not be subject to the potentially contentious federal land withdrawal process faced by WIPP, nor would it face the legal issues surrounding DOE's statutory authority to develop interim storage facilities for commercial SNF. Additionally, the project would not be subject to the federal BIA approval required for a project on tribal lands. If a transportation right-of-way through federal lands is required, however, as was the case with PFS, DOI would still play a role.

The ELEA site would be highly advantageous if Congress were to expand WIPP's mission to include disposal of civilian SNF, as the town of Carlsbad has proposed. Proximity to WIPP confers the further advantage, much touted by the project's proponents, that the project could to some extent piggyback on WIPP's physical and institutional infrastructure, especially its truck transportation infrastructure. To date, however, there has been no serious undertaking to obtain the changes in federal and New Mexico law, regulations, and agreements that would be needed in order to open WIPP to commercial SNF.

Following the fire and radioactive releases at WIPP, Texas Governor Rick Perry endorsed development of private consolidated storage facilities in Texas to store SNF from the four nuclear power plants located in Texas.[349] If a facility is developed, a logical next step would be to accept SNF for storage from other states.

Many questions remain, including how the ELEA or similarventures such as an SNF storage facility in Texas would be funded. Unlike PFS, the developers of the ELEA project are local governments, the utilities whose SNF might be stored do not appear to be directly involved in providing financing, and the local sponsors' arrangements with Areva are not yet known. Areva has stated that it will seek funding from DOE for an initial project assessment and studies. ELEA has indicated that potential sources

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[349] Betsy Blaney, *Perry Backs Storage Site for Texas Nuclear Waste*, ASSOCIATED PRESS (Apr. 2, 2014), http://www.star-telegram.com/2014/04/02/5704242/perry-backs-storage-site-for-texas.html.

of project funding might include the NWF.[350] However, for reasons explained in Section VI of this article, the availability of such funding is subject to doubt. ELEA has also raised the prospect of tapping federal funds allocated to a new federal corporation for handling SNF storage and disposal should Congress decide to act on BRC's recommendation that such an entity be established.[351] A third potential funding source mentioned by ELEA is the "settlement fund" (presumably the Judgment Fund, used by the federal government to pay damages to utilities for their costs of storing SNF).[352] This option, however, would require nuclear utilities first to invest in development of the storage facility and then to successfully assert liability claims against the government to recover those costs as damages for the government's breach of its obligation to take the utilities' SNF. A recent court decision, *Dairyland*,[353] discussed in Section VI.D, allowed a utility that was part of the PFS consortium to recover its full investment in the project as mitigation damages for DOE's breach, setting a precedent that could encourage private development of consolidated storage facilities such as ELEA.

B. *Federal Statutory and Regulatory Authority for Private Consolidated SNF Storage Facilities*

The broad regulatory authority over civilian nuclear activities conferred on NRC under the AEA and the Energy Reorganization Act of 1974 includes regulating and licensing away-from-reactor consolidated SNF storage facilities developed, owned, and operated by private entities. The subsequent enactment of NWPA raises questions about whether Congress intended to limit that authority. As discussed above, DOE has concluded, on respectable legal grounds, that NWPA's restrictions on MRS facility development for SNF and HLW deprive it of the authority that it would otherwise have under the AEA to develop a consolidated civilian SNF storage facility. Does the same logic also extend to preclude private development of consolidated storage facilities for civilian SNF and NRC licensing of such facilities?

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350 JOHN HEATON, PRESENTATION TO WEST VALLEY CITIZENS TASK FORCE Slide 31 (2012), *available at* http://www.westvalleyctf.org/2012_Materials/01/2012-01-25_Carlsbad_NM_Presentation_to_CTF.pdf.

351 *Id.*

352 *Id.*

353 Dairyland Power Coop. v. United States, 645 F.3d 1363 (Fed. Cir. 2011).

Section 135(h) of NWPA provides that the statute shall not "be construed to encourage, authorize, or require the private or Federal use, purchase, lease, or other acquisition of any storage facility located away from the site of any civilian nuclear power plant and not owned by the Federal Government on [January 7, 1983]."[354] The now-expired hardship storage provisions of NWPA state that reactor owners have the "primary responsibility for providing interim storage of [SNF] . . . by maximizing . . . the effective use of existing storage facilities *at the site of* each civilian nuclear power reactor, and by adding new *on[-]site* storage capacity."[355] But, in contrast to the restrictions imposed on DOE in developing a federal MRS, NWPA contains no provision explicitly prohibiting or limiting the construction of a private, away-from-reactor, consolidated storage facility for such waste.

In opposing NRC's grant of a license to PFS, Utah and others challenged NRC's authority to license private consolidated SNF storage facilities. In *Bullcreek v. NRC*, the D.C. Circuit upheld NRC's authority to license PFS.[356] The court concluded that nothing in the text or structure of NWPA indicated that Congress intended to repeal or supersede NRC's AEA authority to license and regulate private, away-from-reactor SNF storage facilities.[357]

C. *Challenges to Siting and Developing Private Consolidated Storage Facilities*

Private consolidated storage facilities, whether sited on tribal or private lands, are, like federal MRS facilities, vulnerable to opposition by potential host jurisdictions, especially states.[358]

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[354] NWPA § 135(h).

[355] § 131(a)(1) (emphasis added).

[356] Bullcreek v. NRC, 359 F.3d 536 (D.C. Cir. 2004).

[357] *Id.* at 543. The court noted that Section 135(h) of NWPA contains no such prohibitory language, stating:

> In providing [in Section 135] that ''nothing in this chapter shall be construed to authorize'' private storage facilities, . . . "Congress limited the scope of the NWPA, but left untouched prior statutes such as the AEA that authorized such facilities. [The Section] is "facially neutral: neither prohibiting nor promoting the use of private [away–from-reactor] storage facilities." In the absence of irreconcilability between the AEA and the NWPA, there is no basis to conclude that in enacting the NWPA Congress implicitly repealed or superseded the NRC's authority.

Id.

[358] *See* DON MUNTON, ED., HAZARDOUS WASTE SITING AND DEMOCRATIC

There are, however, special considerations presented, depending on whether private SNF facilities are sited on private lands, tribal lands, or leased DOE lands.

A state's general authority to regulate private activities and land use within its jurisdiction would not allow it to prohibit an SNF storage facility, because such action would be federally preempted by the AEA's conferral of plenary nuclear regulatory authority on the federal government. For example, the PFS project prompted the State of Utah to enact legislation prohibiting the storage of SNF in the state. The Tenth Circuit, in *Skull Valley Band of Goshute Indians v. Nielson*, held that federal nuclear regulatory policy preempted Utah's storage prohibition law.[359] Utah had also considered imposing restrictions that stopped short of outright prohibition, such as high fees and stringent regulations on the PFS facility.[360] If it lacks direct authority over the site and activities on the site, an unwilling host state or locality can still exercise leverage and cause delay by seeking to obstruct transportation to the site or deny necessary ancillary permits, such as water permits and rights-of-way for power lines. Utah was ultimately able to derail the PFS project by securing the enactment of federal legislation declaring federal lands needed for a right-of-way to the storage site as National Wilderness, thus providing grounds for DOI's subsequent denial of the federal permit that PFS needed as a condition of its NRC license. Nevada used a similar tactic in opposing Yucca, a federal facility on federal land, by denying state and local water and other ancillary permits necessary for development of the site. The exact scope of federal AEA preemption over such indirect state measures is unclear.[361]

As the *Nielson* court noted, NRC licensing decisions afford facility opponents extensive procedural and legal rights, offering

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CHOICE (1996) [hereinafter MUNTON, ED.].

[359] Skull Valley Band of Goshute Indians v. Nielson, 376 F.3d 1223 (10th Cir. 2004).

[360] Alex T. Skibine, *High Level Nuclear Waste on Indian Reservations: Pushing the Tribal Sovereignty Envelope to the Edge*, 21 J. LAND RESOURCES & ENVTL. L. 287, 287–88 (2001).

[361] According to one commentator, NRC's issuance of a license for a private storage facility "come[s] attached with a comprehensive federal regulatory scheme which will preempt most state regulations"—but the full reach of such preemption is not clear. *Id.* at 315. For an analysis of the constitutional ramifications of state attempts to regulate nuclear waste storage on Indian reservations, see *id.*

states and localities ample opportunities to voice and litigate their concerns.[362] Among other steps, NRC must prepare an EIS and afford public participation in the licensing process. Opponents can also appeal issuance of a license. These rights give the potential host states and localities more leverage to block projects or win concessions from project developers.

1. *Private Storage Facilities on Tribal Lands*

States, as a general matter, lack authority to regulate land use on tribal lands. For that reason, PFS may have believed that siting the consolidated storage facility on tribal lands pursuant to an agreement with the tribe would prevent state and local actors from vetoing the project. But the PFS story shows that siting a facility on tribal lands does not confer immunity from legal and regulatory tripwires that state and local opponents can use to delay or block a project; moreover, it illustrates that gaining a tribe's agreement (where a number of individual tribe members disagree)[363] and BIA's needed approval of a tribe's decision to host the project can both be fraught with obstacles as well.

As in the case of a facility on private land, state and local governments can deny or delay ancillary permits or transportation access needed by a facility on tribal land, and can oppose NRC licensing of the facility. Moreover, environmental justice advocates often oppose private siting of locally undesirable land uses on tribal lands, asserting that it results in poor communities of disadvantaged peoples hosting a disproportionate share of environmentally hazardous facilities because they would agree to host facilities for less in the way of compensation than would their more affluent counterparts.[364] State officials such as Utah's have protested that sovereign tribes with very small populations should

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[362] *See id.*

[363] The PFS project was divisive within the Goshute tribe; some members sided with PFS, including in litigation to overturn federal permit denials, while others brought court challenges seeking to overturn the lease with PFS and halt the project. One commentator asserts that over half of the tribe members living on the reservation joined litigation opposing the consolidated storage facility in 1999. *See* DAVID R. KELLER, NUCLEAR WASTE, ENVIRONMENTAL JUSTICE AND NATIVE AMERICAN SOVEREIGNTY 4 (2009), *available at* https://www.uvu.edu/ethics/docs/Goshute%20case%20study.pdf.

[364] Environmental justice groups opposed ONWN's efforts to site MRS facilities on tribal lands on precisely these grounds. *See* Sachs, *supra* note 256, at 897–98.

not be able to impose significant negative externalities on their non–Native American neighbors in the form of proximity to nuclear waste, transportation of nuclear waste, and the stigma associated with the presence of such facilities.[365]

The development of a private SNF facility on tribal lands can be accomplished only through a lease of tribal lands that is subject to BIA approval. The Indian Long-Term Leasing Act requires a tribe to obtain the Secretary of the Interior's approval of a lease on "[a]ny restricted Indian lands, whether tribally, or individually owned."[366] The inability of PFS to obtain BIA approval of its tribal lease for the facility was a pivotal factor in the failure of the project.[367] In addition to the need to secure BIA approval of leases, any proposed SNF storage facility on tribal lands would trigger NEPA requirements, although preparation of an EIS would, in any event, be required in connection with NRC licensing the facility.

2. *Private Storage Facilities on Leased Federal Lands*

To alleviate some of the problems with developing private consolidated storage, DOE could utilize its existing AEA authority to lease DOE-owned land for a storage facility for commercial SNF to a private firm, as it did for storage of civilian ISFSI at its INL site.[368] This approach, under which a private developer would

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[365] *Id.* at 907–10.

[366] Indian Long-Term Leasing Act of 1955, 25 U.S.C. § 415(a) (2011). BIA has issued regulations regarding lease approvals. 25 C.F.R. § 162.107(a). In the case of PFS, BIA denied approval. Its decision was set aside and remanded by federal district court, but the matter did not proceed. The court held that BIA's denial of permission for the lease was arbitrary and capricious because the bureau had failed to: evaluate the lease in accordance with its own regulations; give reasons for rejecting the Band's determination that the lease to PFS was in its best interests; and show deference to the tribe's own determination. Skull Valley Band of Goshute Indians v. Davis, 728 F. Supp. 2d 1287, 1287 (D. Ut. 2010).

[367] According to BIA, its decision not to approve the lease of Indian lands to PFS was based on inadequacies in the EIS prepared by BIA's parent agency, DOI (including failure to consider the impacts of the PFS storage facility on the adjacent federal wilderness area), concerns that continuing delays in the Yucca Mountain repository project could mean indefinite or potentially permanent storage of SNF at the reservation, and BIA's lack of enforcement authority to assure removal of SNF from the site. *See,* Bureau of Indian Affairs, *supra* note 337.

[368] NRC, *Environmental Impact Statement for the Proposed Idaho Spent Fuel Facility at the Idaho National Engineering and Environmental Laboratory in Butte County, Idaho*, NUREG-1773, at xvi (2004), *available at*

design, own, and operate the interim storage facility on land leased from DOE, would enable DOE to select or influence selection of a site as well as other aspects of the interim storage operation. Opponents might, however, challenge such an arrangement as an evasion of the MRS provisions of NWPA. DOE has used its leasing authority to lease lands for energy projects at various sites. For example, in 1965 DOE entered into a one hundred year lease agreement with US Ecology, Inc. to operate a LLW disposal site.[369] DOE also used its AEA authority in 1972 to lease land at Hanford on which the Columbia Generating Station, a nuclear power plant, was built.

The most significant benefit for the private sector of using a DOE-leased site for SNF storage is the potential to reduce the risk of siting failure. First, it might reduce regulatory uncertainty if the land is owned by DOE, rather than being private or tribal land, because there could well be broader scope for federal preemption and fewer obstacles to licensing. Second, DOE leasing might reduce the risk of project failure due to local opposition, if, as shown in recent studies, people living near DOE sites tend to value the economic benefits of operations at such sites and are more accustomed to, and less concerned by, potential safety risks.[370] Third, as owner and lessor of the site, DOE would shoulder some of the oppositional burden that would otherwise be directed solely at the private entity were it not only the operator but also the owner of the site. By mitigating a significant part of the investment risk, this approach could encourage greater market participation and competitive efficiency. A leasing arrangement would also enable DOE to exercise control over various aspects of the storage facility project. DOE would be able to determine the location of

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http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1773. DOE's main authority to do so comes from the Atomic Energy Act, which authorizes DOE "to sell, lease, grant, and dispose of such real and personal property as provided in this Act." Atomic Energy Act of 1954, § 161(g), 42 U.S.C. § 2201(g). DOE also has leasing authority under the Hall Amendment to the National Defense Authorization Act of 1994. National Defense Authorization Act of 1994, § 3154(c), 42 U.S.C. § 7256(c).

[369] *History of the Commercial Low Level Radioactive Waste Disposal Site in Eastern Washington*, WASHINGTON STATE DEP'T OF HEALTH, http://www.doh.wa.gov/CommunityandEnvironment/Radiation/WasteManagement/CommercialLowLevelRadioactiveWasteDisposal/History.aspx (last visited Jan. 20, 2014).

[370] *See* Michael Greenberg, *NIMBY, CLAMP, and the Location of New Nuclear Facilities*, 29 RISK ANALYSIS 1242 (2009).

the storage facility and negotiate lease terms relating to the facility's design and operations as well as price controls. On the other hand, DOE would be dependent on the market as to whether and on what terms utilities decide to participate.

3. *Meeting Opposition*

Private developers of consolidated storage facilities will have to overcome potential opposition by host jurisdictions, regardless of whether the facility is located on private, tribal, or federal lands. In doing so, they will have to follow the same basic approach in siting that the federal government must follow: a phased, adaptive, consent-based approach that involves transparent decision-making procedures that provide ready access to information and ensure opportunities for meaningful involvement by potential hosts and the public in decision-making on facility siting, development, and operations, as described in Section IV.C. As the PFS experience illustrates, these processes must include development of needed transportation infrastructure, including rights-of-way. The project must also provide economic and other benefits to host jurisdictions. Sophisticated private developers of projects, such as hazardous waste disposal facilities, that are perceived as undesirable follow such an approach in order to persuade host jurisdictions that project risks will be responsibly managed and that projects will provide them substantial benefits.[371]

A significant difference between private and federal facility development, however, is the way in which potential host states, transit states, localities, tribes, NGOs, and members of the public are able to participate effectively in facility siting, design, and operational decisions. Both federal and private SNF consolidated storage facilities are subject to the same basic NRC licensing process and NEPA requirements. Private facilities are not, however, subject to the NWPA procedures governing DOE MRS facilities; these procedures encompass a much broader range of issues than the NRC licensing process, most notably where facilities will be sited and related issues such as transportation, social, economic, and general environmental impacts.[372] Under NWPA, DOE must prepare an environmental assessment on the

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[371] *See* MUNTON, ED., *supra* note 358.

[372] As noted above, however, a private consolidated storage facility on federal lands leased from DOE might be considered a de facto DOE MRS facility and subject to the full panoply of NWPA MRS requirements.

site selection and conduct at least one public hearing.[373] Moreover, DOE must consult with host states and tribes regarding siting and facility development, and potential hosts are entitled to funds to enable them to hire experts and participate in an informed way in MRS decision-making.[374] The host state or tribe has the right to disapprove an MRS siting decision by DOE, subject to congressional override.[375] These stakeholder-involvement processes do not apply to private developers, although private developers may choose to adopt equivalent procedures in order to win host jurisdiction assent. Nonetheless, congressional legislation is needed to assure that the same public involvement and host consent safeguards apply to facility development by private, as well as government, entities.

D. *Conclusions Regarding Private Consolidated Storage*

Developers of a private consolidated storage facility face significant hurdles. The PFS experience is a sober warning to firms and investors contemplating a similar venture.[376] Ultimately, the risks and uncertainties in successfully siting, constructing, and operating a private facility may be too great for a private venture to overcome. The government, not subject to market disciplines, may be better equipped to tackle the challenges. Yet the political logjam in Congress—where proponents of Yucca's revival who perceive consolidated interim storage of SNF as a threat to their goal may block federal development of consolidated storage facilities—may make a private facility a more attractive option. The ELEA proposal, which combines local and private initiatives in a state that has shown itself receptive to nuclear facilities, has much promise, but significant hurdles remain in obtaining host state assent and assured financing. Project promoters are openly planning to solicit some form of federal financial assistance for the project.

If the federal government found it desirable to promote private development of consolidated storage facilities, it could do so using a variety of means. It could provide grants and other inducements to jurisdictions hosting private facilities, as provided

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373 NWPA § 145.
374 *Id.* §§ 141(h), 149.
375 *Id.* § 146.
376 *See supra* text accompanying notes 331–43.

in a bill introduced in the last Congress by Senator Lisa Murkowksi, who is now the ranking minority member of the Senate Energy Committee.[377] In addition, the federal government could lease federal land for facilities (potentially on very favorable terms), make loans or grants to subsidize development, or pay developers a guaranteed fee to store wastes and thereby help the government meet its NWPA responsibilities for SNF. In any event, the basic rules for public involvement and access to information, transparency in decision-making, and host consent should be the same regardless of whether the facility is developed by the government or a private entity. These requirements should be explicit in new legislation, in order to ensure a level playing field.

Another strategy, as discussed in Section VI.C, would be to create a hybrid public-private corporation to take over nuclear waste management, including construction of storage and disposal facilities for SNF. Utilities could share ownership and governance responsibilities with the federal government. The corporation could receive the fee payments that presently flow to the NWF, and issue bonds and other financial instruments to finance development. The model of a federal corporation owned jointly by the government and the private sector has been used successfully

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[377] Senator Lisa Murkowksi (R-AK) introduced a bill in 2011 that would attempt to provide incentives for local governments to volunteer to host a private consolidated storage facility for SNF. Nuclear Fuel Storage Improvement Act of 2011, S. 1320, 112th Cong. (2011). The bill was co-sponsored by Senator Mary Landrieu (D-LA). The bill would ask local governments, with the written approval of the governor of their state, to submit a notice of willingness to host a private interim facility before January 1, 2013. *Id.* § 3(c). DOE would then pay $1 million each year for three years to up to three local governments that submitted notices of willingness while further plans are developed. *Id.* § 3(d)(1). Once an application for a license for a facility has been docketed, the bill calls for DOE to offer to enter into a "temporary used fuel storage facility agreement" with the local government. *Id.* § 3(e)(1). However, DOE is prohibited from entering into any more than two agreements at one time. *Id.* § 3(e)(5). Upon the formation of agreement, DOE would be required to pay the local government and its state $6 million, and would require payments of $10 million per year until either fuel is first received or the license application is denied, whichever is later. *Id.* § 3(e)(6)(A)(i))(I)–(II). While the facility is in operation, the payments would increase to either $15 million per year, or $15,000 per metric ton of fuel received each year, up to $25 million, whichever is higher. *Id.* § 3(e)(6)(A)(i)(III). The final payment would be made upon the closure of the facility, and would be $20 million. *Id.* § 3(e)(6)(A)(ii). All payments are to be made out of the Nuclear Waste Fund. *Id.* § 3(f). Importantly, as discussed earlier, this bill also orders DOE to provide priority to fuel from shutdown reactors if a shutdown reactor owner requests fuel removal. *Id.* § 4(c)(1).

in some areas of the financial sector in the U.S., and functionally similar organizational models have been followed for nuclear waste storage and disposal in many European countries, as discussed in Section VI.C.

The issue of private and public development of consolidated storage facilities is not a choice between two mutually exclusive frameworks. In order to maximize the opportunities for successful development, the federal government could encourage private development while launching its own initiative and fostering various forms of public-private collaboration.

VI. FINANCING AND MANAGING SNF STORAGE AND DISPOSAL AND DEALING WITH FEDERAL GOVERNMENT SNF LIABILITIES

In enacting NWPA in 1982, Congress provided for what it envisaged as secure, long-term funding for development of federal repositories for SNF and highly radioactive defense wastes and consolidated interim SNF storage facilities. The mechanism for this funding, the NWF, would be a fee on nuclear electricity generation, paid by utilities and used for disposal of their SNF. The consumers who benefitted from nuclear power would thus pay for the cost of dealing with the spent fuel that had produced it.[378]

This scheme, which was intended to be self-financing, has not operated as promised, in part due to the statutory design of the NWF and in part due to Congress's subsequent adoption of new budgeting rules and practices that have left funding of long-term capital-intensive nuclear waste facilities subject to the vicissitudes of the annual congressional appropriations process. At the same time, the long delays in establishing a repository have resulted in a surplus in the NWF in excess of $26 billion, which has effectively been used by Congress for general spending.[379] These delays have also exposed the federal government to mounting liabilities to utilities for their SNF storage costs because of the government's failure to accept SNF from power plant sites beginning in 1998. If the government were to succeed in developing federal away-from-reactor consolidated interim storage facilities, it could take the SNF off-site and avoid these liabilities going forward. This would

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[378] *See* 42 U.S.C. § 10131(b)(4) (1982). Because highly radioactive defense wastes would also be buried in a repository along with commercial SNF, the federal government would contribute an appropriate share of repository funding.

[379] *See* BRC REPORT, *supra* note 1, at 72.

not, however, relieve the government of past liabilities that have been accruing since 1998.

As BRC and the DOE Strategy have recommended, new funding arrangements for both consolidated SNF storage facilities and one or more repositories are needed to ensure the stable and reliable financing needed for the long planning horizons and large capital investments required. DOE's ability to access the NWF currently depends entirely on annual congressional appropriations. Absent such appropriations, the accounting surpluses in the NWF are funds on paper only. This Section discusses a number of options for achieving the goal of stable, long-term funding, ranging from incremental reforms of the existing NWF structure to more fundamental changes.

Closely related to funding issues are the form and structure of the institution responsible for management and disposition of SNF after it is relinquished by utilities. BRC recommended the creation of a new single-purpose entity, in the form of a federal corporation, which would take over the management, storage, and disposal of commercial SNF and, possibly, defense wastes from DOE.[380] BRC contended that this institutional form, endowed with a single mission, would better ensure focused and sustained long-term management insulated from short-term political and bureaucratic pressures.[381] The DOE Strategy envisages either a federal corporation (which could be owned wholly by the government, or jointly by the government and nuclear utilities) or a new, single-purpose federal agency (which could be located within, or independent of, DOE). A new entity would also create opportunities for new funding arrangements, which would depend, in part, on the specific form that the entity takes.

Funding of consolidated nuclear waste storage and disposal should be linked to the resolution of the government's liabilities for failure to take utility SNF. Business as usual—leaving the issue to be resolved through scores of lawsuits—is not a sound basis for financing nuclear waste management. This Section discusses a number of ways to address this problem. Ideally, Congress should, in a unified statutory package, resolve the government's SNF storage liabilities to utilities, establish a new funding arrangement for consolidated interim storage and disposal of SNF, and establish

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[380] *Id.* at 61–64, 70.
[381] *Id.* at 61–62.

a new SNF management entity, preferably a public-private federal corporation that could take advantage of multiple funding mechanisms.

A. *The NWF and Its Dysfunctions*

NWPA provided that nuclear waste repositories would be financed by the NWF, to be drawn primarily from fees on nuclear-generated electricity.[382] The act provided that "in return for the payment of fees," the Secretary of Energy would sign contracts to "take title to the high-level radioactive waste or spent nuclear fuel . . . upon the request of the generator or owner of such waste or spent fuel; and . . . beginning not later than January 31, 1998, [to] dispose of [it]."[383] DOE duly executed such contracts with the nuclear utilities. It was recognized, however, that it would take considerable time for DOE to collect and assume the management of SNF from numerous reactor sites across the country.

NWPA's optimistic expectation that a repository would be available to take SNF beginning in 1998 proved unfounded. DOE was also unsuccessful in efforts to develop a federal MRS facility for interim storage of SNF. As a result, DOE has been unable to fulfill its obligations to take the utilities' waste.[384] Utilities have been forced to bring repeated claims for damages. The federal courts have consistently found DOE in breach, and have ordered damages to be paid to utilities out of the federal Judgment Fund (which pays money judgments and claims settlements against the United States through an open-ended appropriation from the Treasury) for the costs incurred by utilities in storing SNF, including the materials and labor required for the construction and maintenance of new, at-reactor dry cask storage facilities.[385] Because payments from the Judgment Fund come out of the general federal Treasury, rather than the NWF, taxpayers are ultimately paying for the cost of SNF storage.

Although many factors have severely hampered DOE's efforts to develop repositories and MRS facilities, BRC found that an

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[382] NWPA §§ 302(c)–(d).

[383] *Id.* § 302(a)(5)(B). *See* 10 C.F.R. § 961.11 for the Standard Contract's complete text.

[384] As described above, DOE has taken quite limited amounts of SNF from a number of utilities under arrangements that largely predate NWPA.

[385] *See*, *e.g.*, Sacramento Mun. Util. Dist. v. United States, 70 Fed. Cl. 332, 378 (Fed. Cl. 2006).

important hindrance has been the NWPA requirement that Congress must appropriate monies from the NWF before they can be spent.[386] Although the NWF was supposed to provide a guaranteed funding stream separate from general revenues and their appropriation,[387] the statutory arrangements in fact leave DOE at the mercy of unpredictable annual appropriations.[388] Utilities have been making fee payments into the NWF at the rate fixed by Congress in 1982. However, spending has seriously lagged, and the NWF had a balance of $26 billion at the start of fiscal year 2012, comprised of past fee receipts and interest on them from investments in Treasury debt.[389] The Fund is currently growing by about $800 million per year in new generation fees and $1.5 billion per year in interest on its accumulated surplus.[390] Since the Obama administration has jettisoned Yucca Mountain, it has proposed zero spending out of the NWF.[391] Meanwhile, the D.C. Circuit's recent decision in *NARUC v. DOE*,[392] discussed in detail below, castigated DOE's refusal to adjust the NWF fees paid by utilities and suspended collection of fee payments.

1. *Funding Sources*

Pursuant to NWPA, the NWF may receive money from four sources: a fee on "newly-generated" nuclear electricity, namely

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[386] NWPA § 302(e)(2).

[387] BRC REPORT, *supra* note 1, at 72.

[388] *Id.* at 71–74.

[389] The NWF invests in Treasury obligations, with maturities negotiated between DOE and Treasury "appropriate to the needs of the Waste Fund." NWPA § 302(e)(3). The interest rate is determined by the Treasury bond market, but cannot exceed the average interest on loans the NWF has taken from the Treasury. *Id.*

[390] *See* BUDGET OF THE UNITED STATES GOVERNMENT, FISCAL YEAR 2012, App'x, at 415.

[391] H.R. 2354, 112th Congress (2011) (as passed by the House), appropriates $25 million for DOE to spend on nuclear waste disposal, $10 million for NRC to spend on reviewing the Yucca license application, and $3.4 million for the Nuclear Waste Technical Review Board (NWTRB). Section 604 of the bill prohibits using any funds to end the Yucca program or the license application unless NRC votes to allow DOE to withdraw its Yucca license application. The Senate committee's version tracks the president's request more closely. It appropriates just $3.4 million from the NWF for the NWTRB, and directs DOE to develop a new disposal strategy within three months of the BRC's final report. *See* H.R. 2354, 112th Congress (2011) (as reported in Senate).

[392] Nat'l Ass'n of Regulatory Util. Comm'rs v. DOE, 736 F.3d 517 (D.C. Cir. 2013).

energy generated since March 6, 1983;[393] a fee on SNF used to generate electricity before April 7, 1983;[394] interest on accumulated surplus in the NWF; and loans from the Treasury.[395]

a. *Fee on Nuclear-Generated Electricity*

NWPA imposes a fee on newly-generated electricity which Congress initially set at a rate of one mil ($0.001) per kilowatt-hour of electricity.[396] In NWPA Section 302(a)(4), Congress instructed DOE to reconsider the rate each year to ensure "full cost recovery" over the life of the repository project. "In the event the Secretary determines that either insufficient or excess revenues are being collected, in order to recover the costs incurred by the Federal Government . . . , the Secretary shall propose an adjustment to the fee to insure full cost recovery" and submit it to Congress.[397] However, DOE has never adjusted the fee. In the 2008 assessment, DOE declined to reduce the fee, even though its analysts forecast a surplus in twenty-six out of twenty-eight financial scenarios.[398] The Obama administration then stopped running new financial analyses, under the theory that, since so much uncertainty exists in the waste program, there can be no basis for setting the fee at a new level.[399] However, in *NARUC v. DOE*, a case brought by utilities and state public utility regulators in 2013, the D.C. Circuit overturned DOE's refusal to adjust fees and ordered suspension of fee collections until Congress resolves the matter, rebuking DOE's flawed decision-making.[400]

Invoking NWPA Section 302(a)(4), the nuclear utilities and state regulators petitioned DOE with regard to the Department's 2010 annual fee evaluation, seeking suspension of all further fee

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[393] Specifically, electricity generated after March 6, 1983. See NWPA § 302(a)(2).

[394] Specifically, SNF that had previously been used to generate electricity before April 7, 1983. *Id.* § 302(a)(3).

[395] *Id.* § 303(e)(5).

[396] *Id.* § 302(a)(2).

[397] *Id.* § 302(a)(4).

[398] *See* GENERAL TECHNICAL SUPPORT SERVICES, CIVILIAN RADIOACTIVE WASTE MANAGEMENT 2008 FEE ADEQUACY ASSESSMENT i (2009).

[399] *See* Memorandum from David K. Zabransky, Dir., Office of Standard Contract Management, for Scott Bake Harris, Gen. Counsel (Oct. 18, 2010), *available at* http://www.thenwsc.org/ym/YM%20NWF%20Fee%20DOE%20Annual%20Adequacy%20Report.%20101810.pdf.

[400] Nat'l Ass'n of Regulatory Util. Comm'rs v. DOE, 736 F.3d 517 (D.C. Cir. 2013).

collections. They argued that the impact of Yucca's cancellation on the costs of the government's SNF disposal program rendered further fee collections unnecessary at this time. DOE refused to suspend or otherwise adjust the fee schedule. The petitioners sought review in the D.C. Circuit, which in a 2012 decision set aside DOE's refusal as arbitrary and capricious and remanded the matter to DOE.[401]

DOE had defended its refusal to adjust fees, and its maintenance of fees at their past levels, on the ground that Section 302(a)(4) only mandated annual review of the fee level while conferring on the Secretary broad discretion in his review and his determination whether available information is sufficient to support a fee change.[402] The government also argued that DOE was justified in continuing to use Yucca's previously estimated costs of $97 billion as a proxy for current storage costs. After noting that DOE had never adjusted the fees in the entire history of the program, the court rejected DOE's broad interpretation of its fee-setting discretion under NWPA, calling it "farfetched, almost absurd."[403] The court also found that DOE's justifications for its refusal to adjust fees were unsupported, arbitrary and capricious, and contrary to NWPA. It remanded the fee evaluation issue to DOE for a new determination within six months (by Dec. 1, 2012). Further, the court stated that it had the clear authority to suspend further collection of NWF fees, but that to do so now would be "premature"; it accordingly declined to suspend DOE's fee collection from the utilities "at this time," but retained jurisdiction over the case.[404]

Notwithstanding the strong language in *NARUC*, in January 2013, DOE Secretary Chu reaffirmed DOE's decision not to adjust fees, setting the stage for a second round in court. He relied on a new DOE financial analysis that contained revised storage and repository scenarios, timelines, and accompanying financial projections, and found that future expenses and revenues are highly uncertain. Chu determined that the results of the assessment "do not demonstrate that either insufficient or excess revenues are being collected to ensure full cost recovery," and that accordingly

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[401] Nat'l Ass'n of Regulatory Util. Comm'rs v. DOE, 680 F.3d 819 (D.C. Cir. 2012).

[402] *Id.* at 824–26.

[403] *Id.* at 824.

[404] *Id.* at 820, 826.

no adjustment to fees was warranted.[405]

On further review, the D.C. Circuit, in a sharply worded opinion, again found DOE's decision to be arbitrary and capricious, reasoning that uncertainties are endemic in regulatory decisions and cannot justify a failure to decide. Rather than remanding again, the court suspended fee collections and directed DOE to submit a proposal to Congress to set the fee at zero. It stated that DOE could not base the fee on the costs of implementing the measures set forth in the DOE Strategy—consolidated storage and a new repository—because these options were precluded by NWPA. DOE could not rely on the earlier cost projections for Yucca, since it has abandoned Yucca. The opinion called DOE's arguments "pie in the sky," and stated that its remand decision "reminds us of the lawyer's song in the musical, 'Chicago'—'Give them the old razzle dazzle.'"[406]

b. *Other NWF Revenue Sources*

The second source of revenues for the NWF is a lump-sum fee on energy generated before April 7, 1983, calculated per kilogram of SNF heavy metal at a rate "equivalent to an average charge of 1.0 mil per kilowatt-hour."[407] Some of these fee payments have been deferred until DOE accepts the waste.[408] The third source is interest on accumulated surplus; currently, interest receipts are nearly twice fee receipts. Finally, the NWF may borrow from the Treasury at interest rates similar to government bonds.[409] However, the NWF may only take out loans to the extent that its balance is insufficient to cover its appropriations.[410] In other words, DOE cannot use this borrowing authority to maneuver around a lack of appropriations by Congress.[411]

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[405] DEP'T OF ENERGY, U.S. DEPARTMENT OF ENERGY NUCLEAR WASTE FUND FEE ADEQUACY ASSESSMENT REPORT TO CONG. 8 (2013).

[406] *Nat'l Ass'n of Regulatory Util. Comm'rs*, 736 F.3d at 519.

[407] NWPA § 302(a)(3).

[408] As of Sept. 30, 2009, utilities owed $3,234,024,000 in deferred fee payments. Of this, $880,489,000 is principal and $2,353,535,000 is accrued interest. OFFICE OF CIVILIAN RADIOACTIVE WASTE MGMT., ANNUAL FINANCIAL REPORT, YEARS ENDED SEPTEMBER 30, 2009 AND 2008 (2009).

[409] NWPA § 302(e)(5).

[410] *Id.*

[411] Originally, these loans may have been considered a major funding source, on the assumption that repository development and construction would involve large capital and other expenditures in the early years. See CBO, FINANCING RADIOACTIVE WASTE DISPOSAL 16 (1982) (depicted in Figure 1). But the NWF's

2. *Authorized Uses of the Fund*

NWPA defines "disposal" for purposes of NWF expenditures as "the emplacement in a repository of high-level radioactive waste, spent nuclear fuel, or other highly radioactive material with no foreseeable intent of recovery."[412] Section 302(d) of NWPA provides that the "Secretary [of DOE] may make expenditures from the Waste Fund . . . only for purposes of radioactive waste disposal activities" pursuant to NWPA, including "seven specific activities listed in Section 302(d) of NWPA.[413] The most important of these listed activities are found in Section 302(d)(1): "the identification, development, licensing, construction, operation, decommissioning, and post-decommissioning maintenance and monitoring of any repository, monitored retrievable storage facility[,] or test and evaluation facility constructed under [NWPA]."[414]

As discussed in Section IV, DOE currently has authority to begin to develop an MRS consolidated storage facility up to the point of construction; NWF funds would be available for such activities. Would the NWF be available to finance a non-MRS DOE facility, assuming, as also discussed in Section IV, that DOE

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balance is now so large compared to its spending that loans are not a relevant funding source, at least for the foreseeable future. The NWF took fairly small loans to fulfill its appropriations early in its history, before it started collecting significant fees.

412 NWPA § 2(9).

413 *Id.* § 302(d).

414 Other activities specified in Section 302(d) as eligible for funding are:

- (2) the conducting of nongeneric research, development, and demonstration activities under [NWPA];
- (3) the administrative cost of the radioactive waste disposal program;
- (4) any costs that may be incurred by the Secretary in connection with the transportation, treating, or packaging of spent nuclear fuel or high-level radioactive waste to be disposed of in a repository, to be stored in a monitored retrievable storage site[,] or to be used in a test and evaluation facility;
- (5) the costs associated with acquisition, design, modification, replacement, operation, and construction of facilities at a repository site, a monitored[] retrievable storage site[,] or a test and evaluation facility; and
- (6) the provision of assistance to States, units of general local government, and Indian tribes under Sections 116, 118, and 219 [of NWPA].

Id.

had authority to develop such a facility, or to authorize a private facility? NWPA Section 302(d) provides that "[n]o amount may be expended . . . for the construction or expansion of any facility unless such construction or expansion is expressly authorized by this or subsequent legislation."[415] Invoking this provision, DOE determined in 1995 that it lacked authority to use the NWF to finance any non-MRS storage facility.[416] The reasoning of the Eleventh Circuit in *Alabama Power Co. v. Department of Energy*[417] suggests a different answer. The court held that NWPA does not permit DOE to spend NWF monies on at-reactor storage or to pay damages to utilities for failing to take their waste.[418] Exelon sought damages for DOE's failure to take its SNF, based on the costs that it had incurred for SNF storage.[419] DOE had sought to settle the claim by giving Exelon a credit against the company's NWF fee obligations, pursuant to the Standard Contract.[420] Several other utilities, including Alabama Power, sued to stop the Exelon settlement.[421] The court viewed Exelon's credit as an expenditure out of the NWF, just as if DOE had "settle[d] its breach of contract liabilities by paying money out of the NWF and continue[d] charging all utilities the same fee as it always had."[422] The key question, then, was whether reimbursement for on-site storage costs was an authorized NWF expenditure. The court decided that "the items in the list [in NWPA Section 302(d)] all have one thing in common: they entail some kind of advancement or step toward permanent disposal, or else an incidental cost of maintaining a repository."[423] Since on-site storage, unlike storage

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415 *Id. See also* Nuclear Waste Acceptance Issues, 60 Fed. Reg. 21793, 21797 (May 3, 1995) (concluding, similarly, that DOE lacks authorization to build any non-MRS storage facility using funds from the NWF).

416 *Id.* at 21797.

417 Alabama Power Co. v. Dep't of Energy, 307 F.3d 1300 (11th Cir. 2002).

418 Instead, utilities must seek reimbursement from the U.S. Treasury's Judgment Fund. *See id.* at 1314.

419 Brief of Intervenor Exelon Generation Co., Alabama Power Co. v. Dep't of Energy, No. 00-16138-J, 2001 WL 34091129 (11th Cir. June 15, 2001).

420 *Alabama Power Co.*, 307 F.3d at 1302; 10 C.F.R. § 961.11 (2010).

421 The court granted the utilities standing to sue on the ground that any diminution in the NWF corpus resulting from DOE's grant of an allegedly unlawful credit to Exelon would inevitably work detriment to the other utilities, which would have to pay higher fees or receive lower rebates as a result. *See Alabama Power Co.*, 307 F.3d at 1309.

422 *Id.* at 1312.

423 *Id.* at 1313.

at an MRS, did not represent a move toward permanent disposal, the costs of at-reactor storage could not be paid out of the NWF.[424] The *Alabama Power* criterion—whether NWF funds are used to make progress toward permanent disposal—suggests that funding for packaging SNF in casks for shipment would fall within the scope of authorized expenditures.[425] It also suggests that NWF financing of transportation and storage costs for taking SNF from reactor sites to interim storage, and then to a repository for disposal, might be permissible. Under *Alabama Power*'s reasoning, such activities would be "some sort of advancement or step toward permanent disposal."[426]

3. *Appropriations from the NWF*

In developing SNF repositories and storage facilities, DOE may only expend such funds as Congress authorizes every three years and appropriates annually.[427] The original plan for NWF spending was that the program's budget, after review by OMB, would be authorized by Congress every three years, and that Congress would make annual appropriations in line with these authorizations.[428] The NWF funding mechanism was supposed to "eliminate not only annual budgetary perturbations in an ever more

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[424] *Id.* The court of appeals also suggested that the now-expired NWPA Interim Storage Fund (ISF), *see* NWPA §§ 131–37, was the sole mechanism intended to provide NWF funding for on-site storage. *Alabama Power Co.*, 307 F.3d at 1314. However, the purpose of the ISF was to enable utilities that ran out of room in their on-site storage to pay the government to move the utility's excess waste into *off-site* storage, so that the utility could keep operating. NWPA §§ 131(b)(2), 136(a)(1); *see also* H.R. REP. NO. 97-491(I), 97th Cong. (1982), *reprinted in* 1982 U.S.C.C.A.N. 3792, 3803. Storage in an ISFSI was not a planned interim step towards disposal of SNF in a repository.

[425] The committee report accompanying NWPA says that the NWF may be used "for such treatment and packaging as is technically required to be accomplished prior to disposal of such fuel." H.R. REP. NO. 97-491(I), 97th Cong. (1982), *reprinted in* 1982 U.S.C.C.A.N. 3792, 3825–26.

[426] Financing storage in a private consolidated storage facility scenario would, however, require the term "monitored retrievable storage" to be interpreted broadly, so as to include any consolidated storage facilities that are part of a federal plan to implement a stepwise process of SNF disposal. It is most doubtful that under *Chevron*, or even *Holy Trinity*, courts would uphold such an interpretation by DOE, which is contrary to congressional intent as of 1982 and the NWPA text, however strongly it advances the statutory purpose. *See* Chevron, U.S.A., Inc. v. Nat. Res. Def. Council, Inc., 467 U.S. 837, 842–44 (1984); Church of the Holy Trinity v. United States, 143 U.S. 457 (1892).

[427] NWPA § 302(e)(2).

[428] *Id.*

constrained Federal budget, but the too often repeated shifts of policy direction under succeeding administrations."[429] However, congressional practice and a line of budget disciplines since adopted by Congress have frustrated this plan.

The Balanced Budget and Emergency Deficit Control Act of 1985 (commonly called Gramm-Rudman-Hollings) created automatic spending cuts, called "sequestrations," that take effect whenever the government fails to hit deficit reduction targets.[430] Gramm-Rudman-Hollings counted NWF spending as part of the annual budget.[431] Consequently, funds for SNF disposal had to compete with all other discretionary federal programs in meeting deficit targets, and thus were susceptible to sequestration. Further, the Budget Enforcement Act of 1990 (BEA) put constraints on both discretionary spending programs financed by congressional appropriations and on mandatory programs like Social Security. BEA also established a "pay-as-you-go" rule, providing that each year's legislative changes to mandatory programs must be deficit-neutral on net, or else the president must sequester entitlement spending.[432] BEA designated the NWF's *outlays* as discretionary since they are subject to annual appropriation, but designated the NWF's fee *receipts* as mandatory, since they are determined by the NWPA formula.[433] As a result, NWF spending fell within the BEA's spending cap regardless of how much money came into the Fund.[434] Meanwhile, any legislative changes that reduced the NWF's fee revenues would run into the pay-as-you-go rules and

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[429] JOSEPH S. HEZIR, BUDGET AND FINANCIAL MANAGEMENT IMPROVEMENTS TO THE NUCLEAR WASTE FUND (NWF): BACKGROUND REPORT TO THE BLUE RIBBON COMMISSION ON AMERICA'S NUCLEAR FUTURE 10 (May 2011), http://brc.gov/sites/default/files/documents/brc_hezir_nwfbudget_051511.pdf [hereinafter HEZIR] (quoting Statement of Sen. James McClure, Chair of the Sen. Comm. on Energy and Natural Res., Apr. 28, 1982).

[430] Robert Reischauer, *Taxes and Spending Under Gramm-Rudman-Hollings*, 43 NAT'L TAX J. 223, 224 (Sept. 1990).

[431] HEZIR, *supra* note 429, at 40.

[432] *Id.*; *see also* Omnibus Budget Reconciliation Act of 1990 § 13101, Pub. L. No. 101–508, 104 Stat. 1388 (1990).

[433] *See* KIM CAWLEY, CONG. BUDGET OFFICE (CBO), THE FEDERAL GOVERNMENT'S RESPONSIBILITIES AND LIABILITIES UNDER THE NUCLEAR WASTE POLICY ACT 4 (2010), *available at* http://www.cbo.gov/ftpdocs/117xx/doc11728/07-27-NuclearWaste_Testimony.pdf; OFFICE OF MGMT AND BUDGET, BUDGET OF THE U.S. GOV'T, FISCAL YEAR 2011 APP. (not deducting any fee revenue from gross NWF budget authority in a calculation of net budget authority).

[434] HEZIR, *supra* note 429, at 40.

require offsetting revenue increases or expenditure cuts.

When BEA expired in 2002, both the pay-as-you-go rules and the discretionary spending caps lapsed. However, recent legislative measures, including the 2011 Statutory Pay-As-You-Go Act, have revived both budget disciplines.[435] Under the current pay-as-you-go rules, each year's legislative changes to revenues and mandatory spending must be deficit neutral on net, or else the President must sequester entitlement spending. Since the NWF's fee revenues are treated as separate from its spending, any legislative changes that reduce its revenues must be offset by increasing other revenues or decreasing mandatory spending. As BRC acknowledged in its report, this restriction makes it difficult to simply turn over the NWF's fee revenues to a new waste management entity, since Congress would have to find an offset somewhere for the reduction in federally-collected receipts to the Treasury.[436] Additionally, since the NWF's outlays are still classified as discretionary, the Budget Control Act's new discretionary spending caps will make it more difficult for Congress to spend money on nuclear waste storage and disposal.

Finally, in addition to caps on total discretionary spending, each year's budget resolution sets limits on each separate category of discretionary spending.[437] Since NWF spending is appropriated in a category as part of the DOE budget, every dollar spent on the nuclear waste program takes away from the ability to spend money on other DOE programs.[438]

B. *Reforming the SNF Financing System*

BRC found that the current NWF arrangements are seriously dysfunctional and fail to provide the stable, long-term funding required for sound nuclear waste management and disposal. It

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[435] Rules of the House of Representatives XXI cl. 10, H.R. 6 (2007), and the Statutory Pay-As-You-Go Act, Pub. L. No. 111–139, 124 Stat. 8 (2010) (codified at 2 U.S.C. §§ 931–37) (2010)), brought back the pay-as-you-go rules, while the Budget Control Act of 2011, Pub. L. No. 112-25, 125 Stat. 239 (2011), reimposed discretionary spending caps.

[436] BRC REPORT, *supra* note 1, at 77.

[437] 2 U.S.C. § 633 (2006). House and Senate appropriators must stay within these limits or else their appropriations bills will be subject to points of order in both houses. *Id.* § 633(f).

[438] The progressive layering over time of budget constraints on appropriations from the NWF is summarized in a table in the BRC Report. BRC REPORT, *supra* note 1, at 73.

recommended specific steps to address these problems in the short term. The DOE Strategy also recommended changes in funding arrangements. This Subsection addresses the steps proposed by BRC and the DOE Strategy and other potential options for incremental changes in the NWF structure. BRC also recommended, for the longer term, more fundamental reforms to provide dedicated funding for a new, autonomous, self-financed federal corporation to manage and dispose of SNF.[439] This approach is discussed in Subsection C. The D.C. Circuit's 2013 decision suspending DOE collections of fees from utilities and directing it to submit to Congress a proposal to set fees at zero could help trigger broad legislative review and reform of SNF management and disposal financing.

1. *BRC Recommendations*

The BRC report recommends two budgetary accounting changes, which BRC believes could be adopted in the near future, that would stop the NWF's surplus from increasing further (thereby effectively preventing Congress from spending future NWF fees for other purposes), ease the constraints that current budget rules impose on appropriations for SNF management and disposition, and provide a segue for potential transfer of DOE's nuclear waste management responsibilities to a federal corporation. First, BRC recommends reducing fee collections to the level of the NWF's annual outlays. Second, BRC recommends moving the NWF's revenues onto the discretionary side of the budget as offsetting collections to NWF spending.[440] To be fully effective, these changes would have to be made simultaneously.

The first change would have DOE collect only as much of the nuclear electricity fee each year as is needed to fund that year's appropriations. The utilities would be allowed to reserve the remainder of the fee in a trust, to be paid later with interest.[441] The BRC proposal would have the utilities pay the remainder of their fees when DOE takes title to the waste. However, it is likely that DOE would need some of that remainder sooner, during the repository's high-cost construction phase, when annual expenditures will exceed the annual fees. Therefore, DOE should

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439 *Id.* at 74–75.
440 *Id.* at 75.
441 *Id.* at 75–76.

be able to call in reserved fees whenever it needs more money than current fees provide. DOE already has statutory authority to "establish procedures for the collection and payment of the [NWF] fees,"[442] and has previously used this authority to delay collection of the lump-sum fee on pre-1983 waste.[443]

The second change would be to reclassify annual NWF fee receipts as an offsetting collection, equal to annual NWF spending, on the discretionary side of the budget.[444] Under this system, NWF spending, net of collections, would always be zero. As a result, appropriators could authorize spending for SNF management and disposition without being subject to the constraints of overall federal spending budget caps and the SNF program would not have to compete with other DOE or federal discretionary programs. This reclassification can be made either legislatively by Congress or administratively with agreement of the budget scorekeepers, OMB, the Congressional Budget Office, and the House and Senate budget committees.[445] The advantage of an administrative reclassification is that it would have no pay-as-you-go impact.[446]

The approach of reclassifying annual NWF fee receipts has a number of advantages. First, because NWF fee collections would be reduced to the level of annual spending, the unexpended NWF balance would stop increasing as a result of surplus fee receipts. This would prevent Congress from using excess receipts for purposes other than nuclear waste management and disposition, thus "put[ting] an end to the perception that the fee is simply being used to reduce the federal budget deficit."[447] Additionally, because NWF spending would always be counted as zero spending, energy appropriators could increase NWF spending as needed without squeezing money from other discretionary federal or DOE programs. Moreover, aside from annual appropriations, no new statute is necessary to put this approach into place. Finally, under the current scheme, any law that transfers the nuclear waste fee collection to a new waste management entity would be scored

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[442] Nuclear Waste Policy Act of 1982 § 302(a)(4), 42 U.S.C. § 10222(a)(4) (2006).

[443] Standard Contract, 10 C.F.R. § 961.11 Art. VIII(B)(2)(a) (2010).

[444] BRC REPORT, *supra* note 1, at 77.

[445] *Id.*

[446] OFFICE OF CIVILIAN RADIOACTIVE WASTE MGMT., DEP'T OF ENERGY, ALTERNATIVE MEANS OF FINANCING AND MANAGING THE CIVILIAN RADIOACTIVE WASTE MGMT. PROGRAM 17 (2001).

[447] BRC DISPOSAL SUBCOMM., REPORT TO THE FULL COMMISSION 59 (2012).

under pay-as-you-go rules as increasing the federal deficit. However, if the nuclear waste fee were reclassified as an offsetting collection, there would be no pay-as-you-go problem with moving the NWF to a new corporation in the future.[448]

Nevertheless, this approach also has a few difficulties. Regular congressional appropriation would still be necessary in order to spend money out of the NWF, although passing a substantial appropriation might be easier since it would be scored as zero spending. Additional means would have to be found to fund the program during years when construction costs exceed the annual fee accrual. If, under the scheme proposed above, DOE could collect accumulated fees that were not collected in previous years and reserved by utilities, such fees could count as another offsetting collection against NWF spending on those activities, and congressional appropriations would not be required. But spending money from the existing NWF balance would require congressional appropriations in excess of annual NWF revenue that would compete with other DOE programs in the appropriations subcommittees, as well as with discretionary federal spending generally.

2. *DOE Strategy Proposals*

The DOE Strategy, mindful of Congress's jealousy of its fiscal prerogatives and the need to win its assent, takes a cautious three-pronged approach to funding issues.[449] First, regular and recurring expenses such as program management costs, including salaries, benefits, and studies, would be funded by annual discretionary appropriations by Congress. The DOE Strategy states that engaging the Appropriations Committees in this way will ensure annual oversight and increase the likelihood of congressional commitment to the nuclear waste management and disposal mission. Second, annual fee revenues would be used to fund activities such as development of consolidated storage facilities, a repository, and transportation infrastructure, as well as regulatory development and oversight. This would be accomplished either through legislative reclassification of fee collection from mandatory to discretionary (as recommended by BRC), direct mandatory appropriation of the fees, or some

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[448] BRC REPORT, *supra* note 1, at 76–77.

[449] DOE STRATEGY, *supra* note 13, at 11–12.

combination thereof. Third, where direct access to annual fee revenues would not suffice to fund capital-intensive activities, direct access to the NWF corpus would be provided through mandatory appropriations that would limit such access to specific types of capital expenditures, tie access to performance triggers such as licensing actions and major construction milestones, or be subject to spending caps. The DOE Strategy thus envisages much closer congressional control over the new entity's revenues and spending than does the BRC approach, creating the risk that the new entity will be vulnerable to shifting congressional priorities and parochial interests.

3. *Mandatory Authorizations*

The result of moving NWF outlays to the mandatory side of the budget would, like moving revenues to the discretionary side, be that NWF spending would not compete for appropriations with other DOE programs and federal discretionary spending generally. Furthermore, the authorization could provide that specified portions of the existing NWF balance could be spent, free of annual discretionary spending caps.

If Congress were to reclassify outlays as mandatory, it would have to decide how to determine spending levels. For the most part, mandatory spending levels are determined by a permanent statutory formula. For instance, Social Security pays its beneficiaries based on the formulas set in the Social Security Act, not on the basis of annual budgeting.[450] But it is not clear what formula-based spending would look like for consolidated SNF storage and repository projects, since no one knows how much money will be required for each future year. One option would be for Congress to continue managing NWF spending each year through appropriations. Although most mandatory spending is managed outside the appropriations process, Congress reviews some entitlements, such as Medicaid, annually.[451] But this approach could fail to provide predictable and assured funding for the program. Another approach, as proposed by the DOE Strategy, is to try to tie spending authorizations to program elements and milestones.

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[450] 42 U.S.C. § 415 (2006).

[451] *See* BILL HENIFF, JR., CRS, ENTITLEMENTS AND APPROPRIATED ENTITLEMENTS IN THE FEDERAL BUDGET PROCESS (2012).

4. *Other Options for NWF Reform*

Experts have suggested using a system of escrow accounts to provide more secure and assured financing for SNF management, storage, and disposal. Under this approach, some number of escrow accounts would be established within the Treasury to receive and hold funds, which could be withdrawn only by specified entities for these purposes.[452] A general escrow account could be established, or a separate account could be created for each reactor and its SNF. To the extent that utilities continue to hold title to and manage the waste, they could draw funds from the escrow to cover specified expenses. If a government agency assumed responsibility for SNF, it could draw upon escrowed funds. Transitional measures would be needed to phase in these new arrangements.[453]

As another option, Congress could take the NWF entirely off of the federal budget, meaning that its receipts and outlays would not be considered in deficit calculations or scored for purposes of pay-as-you-go rules and discretionary spending caps. Several recent bills introduced in Congress that would have made this change died in committee.[454]

Further, Congress could, in conjunction with many of the measures discussed above (including those recommended by BRC and the DOE Strategy), make multi-year appropriations for the program's capital expenditures, such as construction.[455] This approach would provide more certain and steady funding, in line with the original intent of NWPA to support planning and facility development over timeframes of several years. OMB recommends multi-year appropriations "for buildings, equipment, and other

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[452] RODNEY EWING, CLIFFORD SINGER & PAUL WILSON, PROGRAM IN ARMS CONTROL, DISARMAMENT, AND INT'L SEC., UNIV. OF ILL. AT URBANA-CHAMPAIGN, "PLAN D" FOR SPENT NUCLEAR FUEL 3 (2009), *available at* http://acdis.illinois.edu/assets/docs/PlanD.pdf.

[453] *See id.*

[454] H.R. 3385, 111th Cong. (2009); Clean, Affordable, and Reliable Energy Act of 2009, S. 1333, 111th Cong. (2009). Section 3 of H.R. 3385 provided: "The receipts and disbursements of the [Nuclear] Waste Fund shall not be counted as new budget authority, outlays, receipts, or deficits or surplus for purposes of the budget of the United States Government as submitted by the President; the congressional budget; or the Balanced Budget and Emergency Deficit Control Act of 1985." The language of Section 111(2) of S. 1333, the companion bill in the Senate, was essentially the same. *See* S. 1333, 111th Cong. § 111(2) (2009).

[455] *See* HEZIR, *supra* note 429, at 17.

types of fixed capital assets . . . with long acquisition cycles."[456]

C. *An Independent Nuclear Waste Management Entity: Financing and Other Implications*

1. *Recommendations for an Independent Nuclear Waste Management Entity*

BRC recommended creation of a new federal corporation dedicated solely to the management and disposal of highly radioactive nuclear wastes. BRC also noted, but reserved for decision by the administration and Congress, the question whether the new waste management entity would have responsibility for defense waste as well as civilian SNF.[457] The DOE Strategy envisages either a single-purpose federal waste management agency or a federal corporation, without specifying their precise structures or indicating a preference between them, and does not take a clear position regarding responsibility for defense and civilian wastes.[458]

BRC found that a single-purpose entity would be better able to sustain the focused and disciplined long-term effort needed to develop consolidated storage facilities and repositories than the current arrangement, which lodges that responsibility within a huge government department with many functions, constituencies, and exposures to political pressures. This new form of organization would invite and facilitate funding arrangements that would provide more assured and predictable funding for waste management and disposition. Although noting that the organization could take various forms, BRC recommended a

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[456] OFFICE OF MGMT. & BUDGET, EXEC. OFFICE OF THE PRESIDENT, OMB CIRCULAR A–11; PREPARATION, SUBMISSION, AND EXECUTION OF THE BUDGET § 31.7 (2012).

[457] BRC REPORT, *supra* note 1, at 60–61. BRC stated that it did not have sufficient time or resources to fully evaluate the issue, and thus called on the administration and Congress to do so. *Id.* at 64–65. BRC also formed an Ad Hoc Subcommittee on Commingling of Wastes, which is currently in the process of developing a report. *Id.* at 1–2. However, BRC cautioned that the administration and Congress should not await resolution of this issue to begin implementing BRC's recommendations. *Id.* at 65.

[458] *Compare id.* at 10 (stating that funding for the new entity "could include the management and disposition of waste resulting from processing of defense material"), *with* DOE STRATEGY, *supra* note 13, at 9 (stating that the "government will continue to manage its own high-level nuclear waste and used nuclear fuel until it is transferred to [a new entity] for storage and/or disposal").

federal corporation wholly owned by the government.[459]

Similar prescriptions were made three decades ago.[460] The Interagency Review Group report of the late 1970s concluded that the operational tasks of SNF waste management required a managerial structure with well-defined program authority, efficient, businesslike operations, and a predictable, transparent funding mechanism.[461] A 1982 congressional Office of Technology Assessment (OTA) report examined a number of options, including a new executive branch agency similar to NASA; an "independent" agency with loose ties to DOE, such as the Bonneville Power Administration (BPA); a government corporation, such as the Tennessee Valley Authority (TVA); and a federally-chartered, non-federal entity such as the Communications Satellite Corporation (COMSAT), the global telecommunications firm created by the Communications Satellite Act of 1962.[462] The OTA report indicated that a corporate structure might be most desirable, because it would allow for direct funding through user fees and greater flexibility in personnel policies and could "increase accountability for the achievement of the goals of the program."[463] A 1982 National Academy of Public Administration study[464] and a 1984 report to the Secretary of Energy by his Advisory Panel on Alternative Means of Financing and Managing Radioactive Waste Management Facilities[465] both followed a similar analysis, stressing the need for a financing mechanism outside the normal congressional budget process. The advisory panel recommended creating a federal corporation to take

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[459] BRC REPORT, *supra* note 1, at 61.

[460] *See* FUEL CYCLE TO NOWHERE, *supra* note 11, at 295–96 (discussing in further detail the reports discussed in this paragraph).

[461] INTERAGENCY REVIEW GROUP ON NUCLEAR WASTE MGMT., REPORT TO THE PRESIDENT 118, 122 (1979).

[462] Communications Satellite Act of 1962, Pub. L. No. 87-624, 76 Stat. 419 (codified as amended at 47 U.S.C. § 701 et seq. (2006)).

[463] OFFICE OF TECH. ASSESSMENT, MANAGING COMMERCIAL HIGH-LEVEL RADIOACTIVE WASTE 57 (1982), *available at* http://www.fas.org/ota/reports/rp82-4.pdf.

[464] NATIONAL ACADEMY OF PUBLIC ADMINISTRATION, BUILDING THE INSTITUTIONAL CAPACITY FOR MANAGING COMMERCIAL HIGH-LEVEL RADIOACTIVE WASTE (1982).

[465] ADVISORY PANEL ON ALTERNATIVE MEANS OF FINANCING AND MANAGING RADIOACTIVE WASTE MGMT. FACILITIES, DOE, MANAGING NUCLEAR WASTE XI-4 (1984).

over nuclear waste management functions.[466] An internal DOE group established to review the panel's recommendations concluded, however, that the recommendations should not be implemented, and that internal DOE reforms would suffice.[467] Neither Congress nor any President has, however, taken any steps to implement these options or recommendations.

The recurring theme in BRC's report and in previous reports is that nuclear waste management requires an institution with a clearly-defined mission; management on a business or military model with unity, continuity of leadership, and clear lines of control and accountability; high-quality, technically-adept personnel; and assured, long-term, stable funding.

The remainder of this Subsection first discusses the various specific forms that a new single-purpose entity for nuclear waste management might take, and then discusses their implications for financing waste management and disposition.

2. *Alternative Forms for a Single-Purpose Nuclear Waste Management Entity*

There are a variety of institutional and legal forms that an independent, single-purpose nuclear waste management entity might take, with a number of potential variations on each. We find that the most promising and viable alternatives are three:

1. A single-purpose federal agency with a head appointed by the President, organizationally located either within DOE and reporting to the Secretary of Energy, or outside of DOE and reporting to the President.
2. A federal corporation, wholly owned by the federal government, with a board of directors appointed by the President, which selects and supervises a chief executive.
3. A hybrid federal corporation, owned in part by the federal government and in part by the nuclear utilities, with a board selected by both.

As the DOE Strategy notes, DOE would support an independent federal agency or a government-owned federal corporation. The DOE Strategy relies on a DOE-commissioned

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[466] *Id.* at XI-1.

[467] DEP'T OF ENERGY REVIEW GROUP, REPORT TO THE SECRETARY OF ENERGY ON THE CONCLUSIONS OF AND RECOMMENDATIONS OF THE ADVISORY PANEL ON ALTERNATIVE MEANS OF FINANCING AND MANAGING RADIOACTIVE WASTE MANAGEMENT FACILITIES 2 (1984).

RAND study of organizational issues.[468] The study considers the above three basic models in terms of a wide variety of attributes including public interest orientation, insulation from political control, accountability, technical capacity, organizational and managerial stability and durability, political credibility, transparency, efficiency, and cost-effectiveness. Although many of these attributes are in tension with one another, the report makes no serious effort to analyze the relative strengths and weaknesses of each model. However, at a minimum, the notion of a wholly privately owned, for-profit corporation serving as the primary nuclear waste management entity appears to be a non-starter. We find, however, that the study fails to sufficiently analyze the choice between locating a single-purpose federal agency within DOE or outside of it, or—even more important—the distinction between a non-profit federal corporation wholly owned by the federal government and one in which ownership is shared between the federal government and the nuclear utilities.

a. *Single-Purpose Federal Agency*

The DOE Strategy proposes, as one of two alternatives, a single-purpose nuclear waste management agency, without identifying its location within the federal governmental structure. If located within DOE, giving such a body a distinct organizational form would afford it some autonomy and insulation from political pressures and distractions, and promote adherence to its mission (to some extent). Locating it within DOE would promote coordination with other functionally related branches of DOE; for example, in science and R&D. If the agency were located outside of DOE, as an "independent" agency with its head reporting to the President, the degree of autonomy and insulation would be correspondingly greater, but this could make it more difficult to ensure coordination with related activities carried on within DOE.

An example of a single-purpose agency located within DOE is the BPA, which Congress created in 1937 as a bureau within DOI with an administrator appointed by the Secretary.[469] BPA was transferred to DOE by executive reorganization in 1977.[470] BPA is

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[468] LYNN DAVIS ET AL., RAND, CHOOSING A NEW ORGANIZATION FOR MANAGEMENT AND DISPOSITION OF COMMERCIAL AND DEFENSE HIGH LEVEL RADIOACTIVE MATERIALS (2012).

[469] Bonneville Project Act of 1937, 16 U.S.C. §§ 832–832m (2006).

[470] Department of Energy Organization Act, Pub. L. No. 95-91, §

responsible for constructing and operating thirty-one hydroelectric facilities in the Northwest and selling the electricity generated.[471] BPA also has one nuclear power plant located at Hanford, although it otherwise produces exclusively hydroelectric power. As a result, it sometimes runs deficits during years when weak snowfall produces less runoff in the Columbia River watershed.[472]

The organizational form exemplified by BPA has certain advantages in accessing the capital markets. BPA issues bonds to fund capital investments.[473] The American Recovery and Reinvestment Act of 2009 increased its authorization to $7.7 billion.[474] Instead of selling these bonds to the public (as the Tennessee Valley Authority does), BPA sells them to the Treasury at a rate similar to the rate on bonds issued by government corporations.[475] The Treasury is allowed to resell BPA debt on the open market.[476] Additionally, BPA receives annual congressional appropriations for capital investments, which it is obliged to repay to the federal government with interest at rates similar to interest rates on Treasury debt.[477] This form of debt was significantly restructured in 1996, but BPA appears to have repaid its debt on schedule and now has significant cash reserves.[478]

b. *Wholly Owned Federal Corporation*

BRC proposes a federally chartered corporation wholly owned by the federal government, with a board composed of

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302(a)(1)(D), 91 Stat. 565 (1977).

471 16 U.S.C. §§ 832, 832a, 832d (2006).

472 *FY 2011 Budget Request-Power Marketing Administrations: Hearing Before the H. Subcomm. on Water and Power, H. Comm. on Nat. Res.*, 111th Cong. 2–3 (2010) (statement of Stephen J. Wright, Administrator, Bonneville Power Administration, U.S. Dep't. of Energy), *available at* http://energy.gov/sites/prod/files/ciprod/documents/3-410_Final_Testimony_%28BPA%29_%28Wright%29.pdf [hereinafter *2011 Budget Request*].

473 16 U.S.C. § 838k(a) (2006).

474 American Recovery and Reinvestment Act of 2009, Pub. L. No. 111–5, § 401, 123 Stat. 115, 140 (2009) ("For the purposes of providing funds to assist in financing the construction, acquisition, and replacement of the transmission system of the Bonneville Power Administration and to implement the authority of the Administrator of the Bonneville Power Administration . . . an additional $3,250,000,000 in borrowing authority is made available . . . to remain outstanding at any time.").

475 16 U.S.C. § 838k(a).

476 *Id.* § 838k(c).

477 *Id.* § 838k(a).

478 *2011 Budget Request*, *supra* note 472, at 1, 3.

directors appointed by the President and confirmed by the Senate (with the exception of the CEO, who would be appointed by the Board and serve *ex officio*).[479] BRC envisages that the President would appoint a board of directors to "set broad policies and objectives . . . ; select top managers, establish the management structure, and define personnel policies; approve annual budgets; and report to external stakeholders on the performance of the organization."[480] The DOE Strategy proposes a federal corporation as one option without specifying its ownership and governance.

The corporate form could more fully secure the advantages of the business model than would a government agency. It would also free the entity from federal personnel and procurement requirements, thus promoting flexibility and efficiency, as well as improving its capacity to hire and retain highly qualified personnel.[481] It would be less subject to political direction and accountability, which could present disadvantages as well as advantages.

The Tennessee Valley Authority (TVA) provides an example of this model. TVA was created by the Tennessee Valley Authority Act of 1933[482] as a federally incorporated entity, wholly owned by the federal government.[483] It has a board composed of directors who are appointed by the President and confirmed by the Senate and who must meet certain qualifications, including "management expertise."[484] The board selects and supervises the chief executive officer. TVA's initial mission was to build hydroelectric dams in the Tennessee River watershed, promote navigation, and control flooding.[485]

Originally, TVA depended on congressional appropriations for funding. It subsequently expanded into other sources of electricity generation. The appropriations process proved to be an unreliable mechanism for funding its growing need for capital.[486]

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[479] BRC REPORT, *supra* note 1, at 63.

[480] *Id.* at 66; *see also* United States Nuclear Fuel Management Corporation Establishment Act of 2010, H.R. 5979, 111th Cong. § 3104 (2010) (enacted) (appointment of CEO and personnel oversight) [hereinafter Voinovich-Upton].

[481] A. Michael Froomkin, *Reinventing the Government Corporation*, 3 U. ILL. L. REV. 543, 557–58, 582 (1995).

[482] 16 U.S.C. §§ 831–831ee (2006).

[483] *Id.* § 831 (2012).

[484] *Id.* § 831a(a)–(b) (2012).

[485] *Id.* § 831h–1 (2012).

[486] *See The Great Compromise*, TENNESSEE VALLEY AUTHORITY,

For example, congressional Republicans opposed TVA's entry into the market for coal-generated electricity.[487] In the 1950s, the TVA board of directors and the Eisenhower administration pushed for the authority to issue bonds.[488] Ultimately, in 1959, Congress granted TVA the authority to issue bonds, on the condition that TVA not expand its services beyond its 1957 area of operation.[489] TVA continued to receive small appropriations from Congress for non-power programs (navigation, anti-flooding, recreation, etc.) until 1999.[490]

Today, TVA is authorized to issue up to $30 billion in bonds to fund capital investments in electric generation and transmission facilities.[491] The federal government does not legally back these bonds.[492] Payments of interest and principal on the bonds may come only from net revenue proceeds from sales of electricity generated.[493] Like Treasury bonds, they are exempt from state income tax.[494] The Treasury Department has limited power to regulate the terms of TVA's bonds.[495]

Several years ago, DOE floated the idea of a government-chartered corporation like TVA to assume responsibility for nuclear waste management, storage, and disposal.[496] In 2010, Senator George Voinovich and Representative Fred Upton introduced identical bills in the House and Senate to establish a United States Nuclear Fuel Management Corporation, modeled on TVA.[497]

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http://www.tva.com/heritage/great_compromise/index.htm (last visited Mar. 18, 2014).

[487] *Id.*

[488] *Id.*

[489] TVA Revenue Bond Act of 1959, Pub. L. No. 86-137, §1, § 831n-4(a), 73 Stat. 280 (1959); 16 U.S.C. § 831n-4(a).

[490] *Id.*

[491] *Id.*

[492] *Id.* § 831n-4(b).

[493] *Id.* § 831n-4(a).

[494] *Id.* § 831n-4(d).

[495] *Id.* § 831n-4(c).

[496] *See* FUEL CYCLE TO NOWHERE, *supra* note 11, at 296.

[497] S. 3322, 111th Congress (2010); Voinovich-Upton, *supra* note 480. The corporation would be wholly-owned by the federal government, with directors appointed by the President and confirmed by the Senate. The proposed legislation provided for nine members, serving staggered 5-year terms, of whom at least three would be from "stakeholder organizations" and at least two from state public utility commissions. *Id.* § 3103(b)(1) (identical texts in both bills).

c. *Hybrid Public-Private Corporation*

A third option is for nuclear utilities to own some portion of the shares in a federal corporation and participate in its governance by electing board members along with the federal government. This arrangement could build on a commonality of interests in successful waste management. The current NWPA waste management scheme, especially the funding and SNF liability elements, creates an adversarial relationship between the government and the utilities. The model adopted by Sweden and Finland gives operational responsibility for centralized nuclear waste management to a utility-owned corporate entity,[498] while Belgium, Germany, France, Switzerland, and the United Kingdom have opted for various forms of hybrid public-private governance of SNF waste management.[499] Canada has established the Nuclear Waste Management Organization (NWMO) to manage and dispose of SNF.[500] NWMO's shareholders are three Canadian nuclear utilities; they have appointed several outside directors to represent broader perspectives.[501]

In the U.S. context, a hybrid federal corporation, co-owned by

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[498] For information on the Swedish model, see Rogers, *Fire in the Hole: Review of National SNF Disposal Policy* 51 PROG. NUCL. ENERGY 281 285 (2009) [hereinafter Rogers, *Fire in the Hole*]; SKB, http://www.skb.se (last visited Jan. 27, 2014). Posiva Oy was founded by Finnish utilities in 1995 and, with the approval of the Finnish government, conducted research, development, and implementation of a strategy for nuclear waste disposal. Rogers, *Fire in the Hole at* 283–284; *Posiva's Operating Policy*, POSIVA, http://www.posiva.fi/en/posiva/about_us (last visited Mar. 18, 2014).

[499] For information on the Belgian model, see Rogers, *Fire in the Hole*, *supra* note 498, at 282; Belgian Agency for Radioactive Waste and Enriched Fissile Materials, *Collaboration*, *available at* http://www.nirond.be/engels/9_samenwerking_eng.html. For information on the German model, see Rogers, *Fire in the Hole*, *supra* note 498, at 284. The German Company for the Construction and Operation of Waste Repositories (DBE) was created by the Federal Office for Radiation Protection. *See* DBE, *Activities*, *available at* http://www.dbe.de/en/about-dbe/activities-of-dbe/index.php. German utilities hold the majority of shares in DBE. For information on the French model, see NUCLEAR WASTE TECHNICAL REVIEW BOARD, SURVEY OF NATIONAL PROGRAMS FOR MANAGING HLW AND SNF 26 (2009). For information on the Swiss model, see *About Nagra*, NAGRA, http://www.nagra.ch/en/aboutnagra.htm (last visited Mar. 18, 2014).

[500] NUCLEAR WASTE MGMT. ORG., ABOUT THE NWMO: MANDATE (2010), *available at* http://www.nwmo.ca/mandate.

[501] Rogers, *Fire in the Hole*, *supra* note 498, at 282–283; *Board of Directors*, NUCLEAR WASTE MANAGEMENT ORGANIZATION, http://www.nwmo.ca/board (last visited Mar. 18, 2014).

the government and the nuclear utilities, would represent an American variation on these approaches. There currently exist over ten such public-private federal corporations, almost all in the financial sector.[502] Engaging the utilities in this enterprise would promote closer coordination in waste management and disposal activities, including development and employment of multipurpose SNF casks. It could also promote potential private or public-private development of consolidated storage facilities, and leverage private financing. As part of this approach, it would be essential to resolve the federal government's ongoing liabilities to the utilities for failure to take SNF, and to simultaneously establish a secure funding mechanism for storage and repository development. On the other hand, the division in ownership and governance could raise concerns over conflict, irresolution, blurred accountability, and fears of corporate "capture." Coordination with related functions being carried out by DOE and other government agencies would also be an issue.

d. *Evaluating the Options*

The federal government corporation model appears to provide the best combination of performance advantages and political viability. A corporate model makes sense for an entity with a highly focused mission that must be accomplished over a long time period and requires heavy capital investment. If limited to management of civilian SNF, a hybrid public-private entity, echoing the European and Canadian approaches, would be logical and appropriate, as its sole mission would be disposal of civilian SNF for which the utilities are responsible. Such a model would enjoy important management, operational, and financing advantages relative to the alternatives. It would foster substantially similar interests between the utilities and the government partners in a joint venture.

For this and other reasons, it would be preferable to limit the new entity's mission to civilian SNF. Defense wastes include a wide variety of wastes in different forms with different radioactive characteristics, located at a various DOE legacy waste sites that have other operations ongoing. The DOE Office of Environmental Management has been engaged for over twenty years in inventorying, remediating, treating, storing, and disposing of these

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[502] LYNN DAVIS ET AL., *supra* note 468, at 91.

wastes. The complex and deeply contextualized character of these tasks is such that they could not readily be transferred to a new, independent-purpose entity that also had responsibility for civilian wastes. Such a dual-purpose arrangement would also present difficult questions as to how to finance its operations. The financial arrangements would be much cleaner if the new entity were responsible only for civilian SNF, such that the entity could access private financing that would not easily be applicable to defense wastes. Keeping responsibility for management of defense wastes with DOE, while giving responsibility for civilian SNF to a new entity, would present issues of coordination and financing if high-level defense wastes and SNF were co-disposed with civilian SNF in the same repository. Congress has addressed the financing issues in NWPA before, and can do so in a new context. The coordination problems should be manageable.

3. *Opportunities for New Financing Sources and Arrangements*

The creation of a special-purpose nuclear waste management entity opens up a variety of new financing possibilities, beyond the changes to the NWF structure discussed above, that are currently impossible or unlikely—for both functional and political reasons—so long as responsibility for nuclear waste management rests with DOE. The availability of some of these opportunities would vary, depending on which of the three forms discussed above a new entity takes.

Under all three forms of organization, Congress could give the entity authority to directly receive the nuclear electricity generation fees currently paid into the NWF, thus eliminating the need for congressional appropriations and assuring a stable funding stream.[503] The corporation or a federal agency might be given the power to set or vary the fee, depending on needs, subject to some opportunity for review by an independent body that has expertise and experience in setting utility rates, such as FERC. In the case of a hybrid corporation, bargaining between the governmental and utility participants might essentially set the fee level. In periods where capital needs for construction and the like exceed fee revenues, a single-purpose federal agency could borrow

[503] Even if it were not willing to take this step, Congress might be more willing to give a single purpose entity more assured access to appropriations, for example through escrow accounts, entitlement revenues, or multi-year appropriations.

from the Treasury, on the BPA model. A federal corporation could issue bonds. The hybrid corporation could issue bonds and also raise equity capital from its utility shareholders or private third parties.

While the BRC report contains an extensive discussion of short-term technical alterations to the current appropriations process,[504] it has far less to say about how a new corporation should finance waste disposal. It simply states that the new corporation should have "authority to use its revenues to carry out its civilian nuclear waste obligations independent of annual appropriations," similar to the TVA's and BPA's authority.[505] The DOE Strategy, as noted above, would fund the regular operating expenses of the new waste management entity out of annual appropriations and presents various options for funding and capital-intensive undertakings, many of which call for significant congressional control of funding. These arrangements would significantly hamper the ability of a new entity to realize the advantages of a business model.

Another funding approach is that in the Voinovich–Upton bill, which provides for two different revenue sources for a Nuclear Fuel Management Corporation: the operating account and the capital reserve account.[506] The operating account would be funded by current fee collections from utilities.[507] The corporation would set those fees with DOE approval.[508] The corporation could invest the operating account as it saw fit, and use it to achieve its mission without any further appropriation from Congress.[509] Separately, the capital reserve account would consist of the unappropriated corpus of the existing NWF.[510] It could be spent only on activities at the end of a repository's life cycle, such as decontamination and decommissioning.[511] Until then, the corporation could pledge the capital reserve account's holdings as collateral for its own bond

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504 BRC REPORT, *supra* note 1, at 70–78.

505 *Id.* at 78.

506 *See* Voinovich-Upton, *supra* note 480, § 3107.

507 *Id.* § 3107(b)(2)(B).

508 *Id.* §§ 3102(b)(5), 3201(b)(2). It should be noted that the Voinovich–Upton bill does not address whether the corporation can defer fee collections. However, if DOE can defer collections under current law, then the new corporation should be able to do so as well.

509 *Id.* § 3107(c)(1).

510 *Id.* § 3107(b)(2)(A).

511 *Id.* § 3107(c)(2)(B).

issuances.[512]

The financing opportunities available with the corporate form risk certain disadvantages beyond issues of coordination with DOE and Congress's reluctance to cede funding control. They would subject the corporation to both political and private capital market incentives and influences, potentially blurring responsibility and undermining accountability for its policies and finances.[513] The recent saga of Fannie Mae and Freddie Mac illustrated just such an eventuality, in which incentives created by management compensation based on relatively short-term financial performance, together with political influences from Congress and elsewhere, produced excessive risk-taking and other distortions.[514] The design of any new corporate entity and its financing must draw on the lessons of this experience.

D. *Resolving Federal Liabilities for DOE's Failure to Take Utility SNF*

1. *The Current Regime: Mounting Government Liabilities and Endless Litigation*

Asserting that the government has been in default on its obligations to take SNF since 1998, utilities have brought many claims seeking judgments requiring the government to take the SNF waste and pay monetary damages for its failure to do so thus far.[515] The Standard Contract between DOE and utilities provides that neither party will be liable for damages caused by DOE's failure to perform its obligations under the contract "if such failure arises out of causes beyond the control and without the fault or negligence of the party failing to perform."[516] Anticipating that it

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[512] *Id.* § 3107(c)(2)(A).

[513] Froomkin, *supra* note 481, at 560, 594–595, 607–608.

[514] William R. Emmons & Gregory E. Sierra, *Incentives Askew?*, 27 REGULATION 22 (2004).

[515] *See, e.g.*, FUEL CYCLE TO NOWHERE, *supra* note 11, at 331 n.550 (collecting cases); *see also* Daniel Thies, *The Decline of the Court of Federal Claims in* Nebraska Public Power District v. United States*, 590 F.3d 1357 (Fed. Cir. 2010)*, 33 HARV. J. L.& PUB. POL'Y 1203 (2010) [hereinafter Thies, *Federal Court of Claims*], (discussing recent court decisions finding that NWPA unconditionally required DOE to accept SNF from utilities by Jan. 31, 1998, and rejecting DOE's argument that failure to accept waste from the utilities resulted from "unavoidable delays" that would absolve the government of liability).

[516] Standard Contract, 10 C.F.R. § 961.11 (2010). The contract also provides that in the event of delays in the delivery, acceptance, or transport of waste, the

would be unable to take SNF by the 1998 deadline, DOE in 1994 took the position that unless a federal repository or other SNF facility became available, "[DOE] has no statutory obligation to accept spent nuclear fuel beginning in 1998."[517] Acknowledging that it had previously "created an expectation" contrary to this view, DOE promised to "explore" different forms of cost-sharing with the utilities.[518] Subsequently, the government argued that the failure to develop a repository was due to unavoidable delays that relieved it of liability pursuant to the contract provision regarding causes beyond its control. The courts rejected this claim and held the government in breach of its obligations to take the utilities' SNF.[519]

The federal courts, however, have not granted specific performance of the contracts. They have ruled that the government does not have to take title to the SNF, but must pay damages based on the economic losses that the utilities have incurred by reason of the government's breach.[520] Ongoing litigation controversies over damages include how much SNF DOE is contractually obligated to take and how quickly, and the priority for removal accorded to SNF stored at different reactor sites. For example, in *Sacramento Municipal Utilities District v. United States*, the U.S. Court of

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charges will be equitably adjusted.

[517] DOE, Notice of Inquiry: Waste Acceptance Issues, 59 Fed. Reg. 27,007, 27,008 (May 25, 1994).

[518] *Id.* at 27,008–09. One congressional observer summed up the ironclad public expectations created by NWPA and DOE: "The utility and nuclear industries assume that the NWPA of 1982 commits the Federal government to accept SNF for disposal beginning in 1998. *DOE reiterates this commitment at every opportunity*." (emphasis added)..

[519] *See, e.g.,* N. States Power Co. v. DOE, 128 F.3d 754, 760 (D.C. Cir. 1997); Neb. Pub. Power Dist. v. United States, 590 F.3d 1357, 1376 (Fed. Cir. 2010); *see also* Thies, *Federal Court of Claims*, *supra* note 515.

[520] *See, e.g.,* FUEL CYCLE TO NOWHERE, *supra* note 11, at 331, n.550 (collecting cases). *Sys. Fuels Inc. v. United States,* 79 Fed. Cl. 37, 125–126 (2007), required DOE to compensate a utility for the cost of expanding on-site SNF storage. The U.S. Court of Federal Claims recently awarded more than $50 million to Wisconsin Electric Power Company for the partial breach by DOE of its contract to accept and dispose of wastes from the company's Point Beach Nuclear Power Plant. *See* Wis. Elec. Power Co. v. United States, 90 Fed. Cl. 714, 803 (Fed. Cl. 2009). Damages awarded through settlements typically include an initial payment to compensate for past storage costs, as well as annual reimbursement for future storage costs. Damages awarded by courts through litigation cover only past costs, so utilities must continue filing claims as they accrue more costs. *See* HOLT, CIVILIAN NUCLEAR WASTE DISPOSAL, *supra* note 46, at 4.

Federal Claims ordered damages to be paid for the materials and labor required for the construction and maintenance of at-reactor dry cask storage for SNF.[521] The court did not, however, require the government to pay for the additional cost of dual-use dry storage casks capable of being used for the transport of waste to a repository or MRS.[522] Other utility lawsuits have reached similar results.[523] These results, however, seem entirely contrary to the overall purpose of NWPA and the NWF, which is to ensure and finance ultimate disposal of SNF.

On the other hand, a utility's investment in the PFS private consolidated storage facility was held to be a compensable item of mitigation damages in *Dairyland Power Cooperative v. United States*.[524] Dairyland did not have sufficient space at its lone reactor site to construct a dry storage ISFSI facility for its accumulating SNF. Distinguishing *Indiana Michigan Power Co. v. United States*,[525] which had disallowed damages for another utility's investment in PFS as "speculative," the Federal Circuit remanded to the Court of Federal Claims for a determination of what portion of Dairlyland's investment in PFS was reasonably justified to secure future storage for its SNF. The Court of Federal Claims awarded damages for the entire amount of the investment.[526] The decision ought to encourage investment in a private consolidated storage facility such as that proposed by ELEA-Areva.

BRC reported that, as of December 2011, utilities had filed seventy-eight lawsuits against the government seeking damages for the SNF storage costs that they have incurred by reason of the government's default, of which twenty-four remain pending before the trial court and eleven are on appeal.[527] The rest were settled, litigated to final judgment, or withdrawn.[528] While under the George W. Bush administration there was discussion of seeking Supreme Court review of a group of adverse court decisions,[529]

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[521] Sacramento Mun. Util. Dist. v. United States, 70 Fed. Cl. 332, 367–73 (Fed. Cl. 2006).

[522] *Id.* at 378.

[523] *See, e.g.*, *Sys. Fuels, Inc.*, 79 Fed. Cl. at 74.

[524] 645 F.3d 1363 (Fed. Cir. 2011).

[525] 422 F.3d 1369, 1376 (Fed Cir. 2005).

[526] Dairyland Power Coop. v. United States, 106 Fed. Cl. 102 (Fed. Cl. 2012).

[527] BRC REPORT, *supra* note 1, at 80.

[528] *See id.*

[529] *See* Marcia Coyle, *Nuclear-Fuel Lawsuits Spawn Damage Award Fallout*,

the Obama Department of Justice (DOJ) has been silent on this possibility. As of 2011, two billion dollars had been paid from the taxpayer-funded Judgment Fund to cover both court-ordered damages and settled lawsuits, and there were court-ordered awards of $509 million then being appealed.[530] This process of seemingly endless litigation and negotiation with dozens of separate utilities is costly, wasteful, and inefficient. The cost to date to the government, solely for litigating the claims filed, has been estimated at $188 million for experts and support, excluding the salaries of DOE and DOJ personnel.[531] The nuclear industry has claimed that the government's total liabilities could mount to $50 billion.[532] BRC has estimated that the government's liability would be around $20.8 billion if it were to begin accepting power plant nuclear waste in 2020, plus an additional $500 million for each additional year thereafter that it fails to take such waste.[533] As discussed above, the Eleventh Circuit has ruled that DOE may not use the NWF to pay damages to utilities and may not offset damages through compensating adjustments to a utility's future NWF fee payments.[534]

Although the government has been found in partial breach, it has not been in total breach since it has not repudiated its obligations to take SNF entirely.[535] As a result, utilities can only bring claims for storage costs after they have been incurred. This means that utilities face uncertainty about how much of their costs they will be able to recover and must keep suing the government every few years to get reimbursed. The Obama administration's recent abandonment of Yucca raises the stakes on the government's potential liability significantly. In the cases decided thus far, DOE was held to be in partial breach on the premise that

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NAT'L LAW JOURNAL, Aug. 23, 2006, *available at* http://www.yuccamountain.org/pdf-news/lawsuits_082306.pdf.

[530] BRC REPORT, *supra* note 1, at 79–80.

[531] *Id.* at 80.

[532] Marcia Coyle, *Breach Cases Could Cost U.S. Government Billions*, NAT'L LAW JOURNAL, Sep. 8, 2008, *available at* http://www.law.com/jsp/article.jsp?id=1202424340326.

[533] BRC REPORT, *supra* note 1, at 80.

[534] Alabama Power Co. v. Dep't of Energy, 307 F.3d 1300, 1315 (11th Cir. 2002); *see also supra* text accompanying notes 417–26.

[535] Indiana Michigan Power Co. v. United States, 422 F.3d 1369, 1374 (Fed. Cir. 2005).

Yucca would eventually open.[536] If, however, Yucca is conclusively terminated, utilities could argue that the government has committed a complete breach, because there is no prospect that a repository will be available in the foreseeable future. In the event of a complete breach, the utilities could seek permanent damages based on the net present cost to them of either building or operating a consolidated storage facility or maintaining at-reactor storage indefinitely. On the other hand, at least one court has suggested that a successful action by a utility for total breach would *discharge* the government from the contract to take SNF and that, under a NWPA provision making such contract a condition of reactor operating licenses, the utility would be unable to renew its reactor license.[537]

2. *Resolving Government SNF Storage Liabilities*

The only recommendation that BRC made for resolving government SNF storage liabilities was a bland exhortation to the government and the utilities to work out better ways to resolve claims: "The Commission . . . urges all parties to continue to work to conclude these proceedings in a fair manner, either through settlement agreements or through another process, such as mediation or arbitration, consistent with the precedents set by past court decisions."[538] The DOE Strategy does not address the issue beyond recommending that the estimated cost of future liabilities

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[536] Sacramento Mun. Util. Dist. v. United States, 70 Fed. Cl. 332, 378 (Fed. Cl. 2006).

[537] Indiana Michigan Power Co. v. United States, 422 F.3d 1369, 1374. The court stated:

> Had Indiana Michigan brought an action for total breach, DOE would have been discharged from further responsibility under the contract, a situation apparently not desired by appellant and foreclosed by statute. The NWPA directed that DOE and all nuclear utilities enter into Standard Contracts, 42 U.S.C. § 10222(a)(1), and concomitantly conditioned the issuance and renewal of Nuclear Regulatory Commission operating licenses upon the execution of those contracts, Id. § 10222(b)(1)(A). Additionally, the NWPA provided that DOE was exclusively responsible for SNF collection and disposal in the United States, thereby prohibiting Indiana Michigan or any other nuclear utility from seeking alternative disposal means. See 42 U.S.C.§ 10131(a)(4), (b)(2) . . . Therefore, Indiana Michigan had no choice but to hold the government to the terms of the Standard Contract while suing for partial breach.

[538] BRC REPORT, *supra* note 1, at 80.

be included in budget baselines.[539]

Rather than leaving it to the lawyers, the administration and Congress must take decisive action to resolve the federal government's SNF liabilities without unending litigation. Such actions ought to include: development by the government of consolidated storage facilities or other measures that would enable the federal government to fulfill its contractual obligations to take SNF from the utilities, adoption of a more efficient system than piecemeal litigation to resolve claims, legislation authorizing government liabilities to be paid out of the NWF, and congressional enactment of a "grand bargain" that would resolve storage liabilities as part of a broader deal to provide a new financing structure for SNF storage and disposal for a new waste management entity.

a. *Development of Consolidated Storage Facilities to Fulfill DOE's Contractual Obligations*

In order to curtail ongoing liability for breach of its contractual obligations, the federal government—operating through DOE or a new waste management entity—could build and operate consolidated interim storage facilities to receive utility SNF. This would require congressional legislation that would address the legal cloud cast by the current NWPA MRS restrictions by authorizing development by DOE or the new entity of several SNF consolidated interim storage facilities and authorize NWF expenditures for this purpose. An alternative would be for one or more private firms or non-federal entities, such as the ELEA-Areva partnership, to develop consolidated interim storage facilities. The federal government could then take SNF from utilities and pay the private storage facilities for storing it. The availability of some form of government financing is likely to be crucial for the successful development of the ELEA or similar ventures. Legislation to grant DOE explicit authority to help fund private consolidated storage facilities would eliminate legal uncertainties. A further possibility is an omnibus settlement of government SNF liabilities that would address ongoing as well as past liabilities, as discussed below. Any comprehensive liquidation of future liabilities would have to be resolved by congressional legislation unless the government and the utilities could negotiate

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[539] DOE STRATEGY, *supra* note 13, at 12.

an omnibus consent judgment for a set amount, in which case it might be paid out of the Judgment Fund.

If it proves impossible to develop consolidated interim storage facilities in a timely manner, the federal government might conceivably take title to, and management of, utility SNF located in at-reactor dry cask storage facilities, including ISFSI facilities already built and additional facilities that may be needed. In order to do this, the utilities and the government would have to find a way to divide responsibility for on-site dry cask storage from responsibility for operating the reactor itself. This might be difficult where the two operations share buildings, security, power systems, and other facilities and services. Moreover, the parties would have to come to agreement on a method for cost-sharing. These problems would make it infeasible to include pool storage in the arrangement, and might make it infeasible even for dry cask storage. Also, the government in many cases is not yet liable under the Standard Contract for some of the SNF currently stored at reactor sites,[540] so some cost-splitting would be needed for the waste storage in any event. These problems may make this option impractical. Legislation would also be needed to authorize and fund such an arrangement.

b. *"Wholesale" System for Resolving Accrued and Future Liabilities*

The development of consolidated storage facilities will take many years. During this time, the government will continue to accrue liabilities. An alternative to the current inefficient and costly piecemeal approach is needed for resolving such liabilities. One possibility is a generic approach with standardized payouts based on the amount of SNF that DOE should have taken between 1998 and date that the legislation is passed.

DOE could develop and offer such a system as a means for resolving its liabilities, and commit to fully litigate claims brought by utilities that do not accept the offer. Under such a system, the amount of payment per metric ton of heavy metal of SNF would represent an average. Different utilities' costs at different sites vary.[541] Judgments and settlements are typically based on utilities'

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[540] For example, if spent fuel is too new to remove from a storage pool, it is not the government's responsibility to take it.

[541] For example, some utilities have had to pay for dry casks or pool re-racking, while others have not.

actual expenses, and apply to waste storage costs incurred up to a certain date. Using an average could lead some utilities to be overcompensated, and others to be undercompensated, relative to their particular costs; those substantially undercompensated would likely reject DOE's standardized offer. The resource savings to the government of using a wholesale approach could enable DOE to err on the high side in setting the standardized payouts, reducing the underpayment problem. Additionally, the pressure to minimize litigation costs could lead utilities with higher costs to accept the standard amount. It might also be possible to identify objective factors that influence storage costs for utilities, such as the form of storage (whether pool or dry cask), and build them into the payout schedule.

This basic approach was proposed in H.R. 2300, the American Energy Innovation Act, proposed by Rep. Rob Bishop (R–UT) in the 111th Congress.[542] Section 3212(3) of the bill would amend NWPA Section 302 to instruct DOE to offer settlements for failing to accept SNF on time, at a rate of $150/kg of SNF. To calculate how much of each utility's waste should have been accepted, the bill would require DOE to assume that it should have accepted aggregate quantities of 400 MTU in 1998; 600 MTU in 1999; 1200 MTU in 2000; 2000 MTU in 2001; and 3000 MTU in subsequent years.[543] Nothing in the proposal, however, requires utilities to accept the government's offer.

As an alternative, Congress could enact legislation establishing a standardized payout system as the exclusive means for resolving government SNF liabilities, superseding individualized determinations of liability under the Standard Contract. This would avoid settlement holdouts, ensure a more efficient system for resolving liabilities, and give utilities incentives to minimize storage costs in ways that they might not if they had to prove their costs and get reimbursed by the government. But utilities might challenge such an approach under the Takings Clause of the Constitution.[544]

Another possible option is for Congress to require nuclear

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[542] American Energy Innovation Act, H.R. 2300, 111th Cong. (2009).

[543] American Energy Innovation Act § 3212(3).

[544] When Congress attempted to cancel a World War I compensation agreement in the early 1930s, the Supreme Court held that "Congress was without power to reduce expenditures by abrogating contractual obligations of the United States." Lynch v. United States, 292 U.S. 571, 580 (1934).

utilities to negotiate collectively. The utilities would appoint an industry group or special negotiator to bargain with the government, and then would vote on whatever deal the collective negotiation reached. If a certain percentage of utilities favored the deal, it would apply to all of them. While there might be constitutional issues posed by this approach as well, the use of group decision-making has been upheld in the contexts of collective bargaining agreements in employment and agricultural marketing orders that regulate crop outputs and prices.

Furthermore, the wholesale system could allow utilities to trade their settlement rights, which would enable utilities to centralize waste at locations with spare capacity or efficient operations and to remove waste from closed reactors where political opposition is at its highest. This flexibility, however, would raise fairness concerns and opposition from communities that would end up hosting more SNF, and would also involve additional transport of SNF, another flashpoint of opposition.

c. *NWF Payment of SNF Storage Liability Awards*

So long as the government continues to be liable to utilities for SNF storage costs, it might seem that NWPA should be amended to provide for payment of awards out of the NWF, rather than out of the Judgment Fund.[545] At first blush, it appears wholly contrary to the goal of NWPA for federal taxpayers to be saddled, via appropriations to the Judgment Fund, with SNF storage costs that Congress directed be paid by nuclear electricity consumers. Yet nuclear electricity consumers may justifiably complain that they have already paid for storage costs of the SNF generated to date through past NWF fees, which have largely been used by Congress to support other programs and their beneficiaries, and that current NWF fees should be earmarked for future storage and disposal costs rather than being used to cover past storage costs.[546]

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[545] Paying SNF liabilities out of the NWF would require either annual appropriations to cover damages awards, or an open-ended appropriation, as is done for the Judgment Fund. Under existing budget accounting arrangements, discussed *supra* at text accompanying notes 378–438, such payments would probably be scored against budget caps and subject to pay-as-you-go rules, although there may be techniques for avoiding this result.

[546] The recent settlement of Xcel's liability claims against the government is a good example of this. Xcel's customers were over-discouraged from using electricity between 1998 and 2011 by paying for the extra costs of storing spent fuel. But now that Xcel plans to refund at least some of its settlement receipts,

Since the taxpayers ultimately have to take responsibility for the financial fallout from government failures, placing the financial burden of the government's SNF defaults on them makes crude equitable sense. But using case-by-case litigation to deal with the financing problem involves huge transaction costs, uncertainties, and other drawbacks. Additionally, because Congress has made a permanent, indefinite appropriation to the Judgment Fund for the payment of government liabilities, paying out of the Judgment Fund will not cause the kind of fiscal pain that fosters political accountability.

The government's continued failure to take SNF and the future of the NWF are already being politically linked. The administration's abandonment of Yucca has triggered proposals to modify or eliminate the current NWF financial arrangements. A group of Senate Republicans introduced a bill in 2009 to liquidate the NWF if Yucca is cancelled and distribute an amount equal to 75% of the accrued unspent revenues to utility consumers.[547] Maine adopted a resolution urging President Obama and Congress to reduce fees that utilities pay and pass on to consumers, while Michigan adopted a resolution to put fees paid by the utilities into an escrow account.[548] The Senate Appropriations Committee Report accompanying the FY 2010 appropriations bill recommended suspending the collection of payments from the utilities.[549] The National Association of Regulatory Utility Commissioners wrote to Energy Secretary Chu, requesting that he suspend payments into the fund.[550] DOE rejected requests that it stop collecting NWF fees,[551] but its decision was overturned by

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future customers will get the benefit and will be over-encouraged to use electricity.

[547] Rebating America's Deposits Act, S. 861, 111th Cong. (2009).

[548] Steve Tetrault, *States Resist Adding to Nuclear Waste Construction Fund*, LAS VEGAS REVIEW-JOURNAL, Apr. 9, 2009, at A7.

[549] Richard M. Jones, *FY 2010 Energy and Water Development Appropriations Bill: Nuclear Waste*, 119 AIP BULL. OF SCIENCE POL'Y NEWS (2009), *available at* http://www.aip.org/fyi/2009/119.html.

[550] Letter from the Nat'l Ass'n of Reg. Util. Comm'rs to Steven Chu, Sec'y, DOE (Jul. 8, 2009), *available at* http://www.naruc.org/Filings/11%200822%20Brief%20of%20Consol%20Petitioners%20NARUC%20NEI%20v%20DOE.pdf.

[551] Ben German, *Utilities Sue Energy Department to Stop Nuclear Waste Management Fees*, THE HILL, Mar. 4, 2010, *available at* http://thehill.com/blogs/e2-wire/e2-wire/90695-utilities-take-energy-dept-to-court-over-nuclear-waste-fees.

the D.C. Circuit, which suspended fee collections. The D.C. Circuit's order puts new pressure on Congress and the administration to deal with the SNF financing tangle. Comprehensive legislation is needed to address and resolve the mounting discontents with the dysfunctional status quo.

E. *Comprehensive Legislation for SNF Storage and Disposal Financing and Liabilities*

The most ambitious—but by far the best—means for resolving the government's SNF liabilities is to liquidate those liabilities through legislation that would establish a secure system of financing for SNF management, storage, and disposal. Such legislation must include financing arrangements for a new single-purpose nuclear waste management entity, as well as arrangements to liquidate accrued liabilities and cover future utility storage costs pending development of federal consolidated storage and a repository to deal with the waste. Such a "grand bargain" could enable all involved to put the failures of NWPA and the NWF behind, and move forward with a much stronger system for nuclear waste financing and management. Ultimately, the costs would have to be shared by the utilities (and indirectly, their customers) and the taxpayers in a proportion that would be a central issue in any such bargain.

Liquidation of accrued but unresolved DOE SNF storage liabilities to utilities could be implemented either by legislation using a "wholesale" approach, along the lines previously discussed, or by authorizing an independent, expert administrative body (such as FERC) to resolve utility claims, subject to judicial review. Under the administrative option, the agency would be directed to use, to the maximum extent feasible, a methodology for determining past and future storage costs, with such adjustments as necessary to accommodate for variations in individual circumstances. These alternatives would provide a more efficient and consistent resolution of liabilities than can be achieved through case-by-case litigation. If properly designed, they would also survive any challenges under the Takings or Contract Clauses of the Constitution. In this way, the waste management entity would be responsible for all storage costs going forward, giving it an incentive to manage disposition of the waste in the most cost-effective way possible. Efficiency must be balanced with equitable cost-sharing between current and future nuclear electricity

consumers, through fee payments whose levels could be adjusted by an independent regulatory body in accordance with statutory criteria, and contributions by federal taxpayers in recognition of the government's responsibility for its waste management failures.

VII. CONCLUSION

This article has amply demonstrated the bankruptcy of current federal law and policy for dealing with the SNF challenge, and the failures of Congress and the administration to deal with the resulting nuclear waste impasse. Nearly sixty years since the federal government decided to use uranium-based nuclear weapons technology to generate electricity, the nation is still searching for a way to deal with the highly radioactive spent fuel rods that the technology produces. The methods to store and safely dispose of these wastes have long been available, but the institutional, financial, and political means of doing so continue to elude us.[552]

Congress and the administration have yet to seriously engage in fixing the bankrupt NWPA nuclear waste management and disposal scheme. While the DOE Strategy tracks BRC's major recommendations, it is disappointingly brief and general. Major legislative changes to NWPA will be needed to implement BRC's recommendations and the DOE Strategy framework for moving forward with consolidated storage and a repository. The administration has yet to make any proposals for such legislation, or to elaborate on the generalities of the DOE Strategy. This article proposes that the administration adopt four initiatives to resolve the SNF challenge.

First, Congress and the administration should establish a new SNF waste management and disposal program that provides for development of at least two consolidated SNF storage facilities and a new repository other than Yucca Mountain. The status quo—leaving to indefinite at-reactor storage, in scores of unwilling "host" communities, the bulk of the nation's SNF—is difficult to justify, especially given that, within a few decades, many if not most sites will be stuck with stranded SNF. Unless a credible program for repository development moves forward in parallel with consolidated storage facilities, it will be difficult to find jurisdictions to host such facilities. As recognized by BRC and the

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[552] For a summary of this history, see FUEL CYCLE TO NOWHERE, *supra* note 11, at 15–83.

DOE Strategy, the consolidated storage and repository program must abandon the inflexible, top-down, NWPA "command" approach in favor of a facility siting approach informed by the evolving and more flexible approach that ultimately proved successful at WIPP and in other countries: an approach that is phased, adaptive, and consent-based.

Second, Congress should make a clean break from the broken institutions of the past by creating a new, special-purpose entity independent of DOE. Preferably, this new institution would be a public-private federal corporation that has the focus, continuity, and discipline to plan, finance, and execute the highly challenging tasks involved in developing consolidated storage facilities and a new repository and carrying out the transportation and other logistical arrangements involved in managing, storing, and disposing of SNF. The new approach may well involve explicit reliance on, and federal financial and other support for, private development of consolidated interim storage facilities, as proposed by the ELEA-Areva consortium. One of the consolidated storage facilities might be developed entirely by the new federal waste management entity, the other by a joint venture between the new entity and private developers. But regardless of whether private or federal development is involved, the rules regarding public involvement, access to information, transparency, and host consent should be the same.

Third, Congress must establish entirely new, comprehensive financial arrangements that will provide assured and predictable funding for the new entity's operations. This would include a nuclear electricity fee funding mechanism that addresses the failure of the NWF system and the problems highlighted in the NARUC litigation, requires that fees are set at levels commensurate with program needs, and ensures that fee revenues are available for and spent solely on SNF disposition. Given the capital-intensive nature of the projects involved, the ability to tap private capital is desirable, and would be enhanced by the corporate form—especially a hybrid, public-private corporation. As part of the new financial structure, Congress should resolve through legislation the federal government's past and future contractual liabilities to utilities, which have been accruing since 1998, using an independent regulatory agency with rulemaking as well as adjudicatory responsibilities to implement the program, rather than continuing piecemeal litigation in the courts.

Finally, Congress and the administration must address the issue of at-reactor SNF storage safety and the concerns raised by Fukushima, pending development of consolidated storage and a repository. The risks of continued SNF storage at reactor sites, especially in pools, must be addressed squarely and openly, as the D.C. Circuit has recently required NRC to do by invalidating NRC's WCD findings and rule. It remains to be seen whether the revised NRC WCD rule will survive a second round of challenges in court.

These at-reactor storage issues are closely interrelated with issues of transportation, consolidated storage, and disposal safety and security, for which DOE and its waste management successor bear responsibility. DOE should be made an integral partner with NRC in addressing SNF safety issues, and DOE's expertise and experience should be expressly brought to bear in decision-making on these issues. Accordingly, Congress should direct DOE and NRC to establish a joint NRC-DOE initiative to address and resolve the critical questions regarding SNF storage. This taskforce should address whether transfer of SNF from pool to dry storage should be accelerated and what other steps should be taken to enhance the safety of SNF storage and transport, taking into account the distinctive safety and other issues posed by high-burn-up SNF. NRC-DOE determinations should be subject to independent review by NAS or another independent, expert body, with NRC retaining ultimate regulatory authority.

Congress and the President must recognize that the top-down strategy for nuclear waste disposal has led to prolonged failure. If the U.S. is to overcome its nuclear waste storage challenge and forge a workable long-term solution, the leadership in Washington must adopt an iterative, collaborative strategy focused on developing strong partnerships with state and local officials of potential host sites. A legislative package embodying these principles, containing the policy proposals discussed herein, is essential to finally achieving the vision that has eluded us for over sixty years: long-term, safe, and practical nuclear waste storage.

THE EFFICIENCY AND MANAGEMENT OF THE INTERNATIONAL TRADE IN ELECTRONIC WASTE: IS THERE A BETTER PLAN THAN A BAN?

JENNIFER CHEN*

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* J.D., 2012, New York University School of Law. I am grateful to Professors Richard Stewart and Michael Livermore for their encouragement and helpful comments. I am also indebted to the N.Y.U. Environmental Law Journal editors for their helpful suggestions and hard work in preparing this manuscript for publication. All opinions and any mistakes herein are, of course, my own.

INTRODUCTION

Two modern trends contribute to a serious international electronic waste ("e-waste") problem: the growing turnover of electronics and an increase in global trade. Specifically, electronics become obsolete quickly, and as electronics become smaller and more powerful, consumers upgrade before the end of the gadget's useful life.[1] This desire for cutting-edge technology generates mountains of waste that is both toxic and expensive to properly recycle.[2] And with global free trade, the e-waste routinely finds its way to the lowest cost method of recycling and disposal: burning and dumping in countries with little or no environmental and worker protections.

From a purely economic perspective, there is nothing wrong with exporting e-waste to other countries for reuse or lower-cost recycling if costs are not foisted on non-parties to the trade. The trade provides developing countries with reusable secondhand

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[1] *See, e.g.*, *Electronic Hazardous Waste (E-Waste)*, CAL. DEP'T OF TOXIC SUBSTANCES CONTROL, http://www.dtsc.ca.gov/hazardouswaste/ewaste (last visited May 5, 2014) ("Due to ongoing technological advancement, many of [sic] electronic products become obsolete within a very short period of time, creating a large surplus of unwanted electronic products . . . ."). As a result, "[e]-waste is one of the fastest growing waste streams in the world." 2 U.N. ENV'T PROGRAMME, E-WASTE MANAGEMENT MANUAL 2 (2007).

[2] E-waste is highly toxic because it contains heavy metals and plastics treated with flame retardants that produce carcinogens when burned. *See, e.g.*, U.N. ENV'T PROGRAMME, SUSTAINABLE INNOVATION & TECH. TRANSFER INDUS. SECTOR SERIES, RECYCLING—FROM E-WASTE TO RESOURCES 12 (July 2009) [hereinafter UNEP, StEP]. Many states, therefore, have laws against discarding electronics in normal landfills, which are not equipped to accept hazardous waste. *See, e.g.*, *States Where You Can't Throw E-Waste into the Trash*, ELECS. TAKEBACK COAL., http://www.electronicstakeback.com/wp-content/uploads/Disposal_Ban_Bills.pdf (last visited May 5, 2014).

goods and cheaper raw materials (while reducing the need to mine raw materials and saving landfill space). Free trade has been extolled for its ability to maximize efficiency by eliminating the barriers that reduce the gains from trade, but this efficiency calculation is only as good as the accuracy and completeness of its inputs, which should include social costs not reflected in trade prices. In the international trade of e-waste, the apparent gains from trade are likely derived from an incomplete accounting of costs or risks, particularly those related to human health and the environment.[3]

Journalists and advocacy organizations have documented e-waste processing in developing countries where workers (including children) sort hazardous waste without protective gear, extract metals through open burning acid baths, and dump refuse into swamps, irrigation channels, and rivers.[4] Burning electronics releases dioxins and other carcinogens; dumping e-waste into water contaminates it with lead, mercury, cadmium, and other heavy metals.[5] People live, eat, raise livestock, and work in these e-waste villages,[6] and exposure to these contaminants has measurable effects. For example, children in the e-waste village of Guiyu, China have blood lead levels 50 percent higher than the limit set by the U.S. Centers for Disease Control; such elevated

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[3] *See* Jack Caravanos, Edith Clark, Richard Fuller & Calah Lambertson, *Assessing Worker and Environmental Chemical Exposure Risks at an E-Waste Recycling and Disposal Site in Accra, Ghana*, 1 J. HEALTH & POLLUTION 16, 17 (2011), *available at* http://www.journalhealthpollution.org/ojs/ojs2.2.4/index.php/journalhealthpollution/article/view/22/31 (documenting the impact of e-waste on human health and the environment in Ghana).

[4] U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-08-1044, ELECTRONIC WASTE: EPA NEEDS TO BETTER CONTROL HARMFUL U.S. EXPORTS THROUGH STRONGER ENFORCEMENT AND MORE COMPREHENSIVE REGULATION 16 (2008) [hereinafter GAO]; U.S. INT'L TRADE COMM'N, USED ELECTRONIC PRODUCTS: AN EXAMINATION OF U.S. EXPORTS 1-3, 2-13 (2013) [hereinafter ITC].

[5] *See, e.g.*, ITC at 5-11, 5-12; LINDA LUTHER, CONG. RESEARCH SERV., R40850, MANAGING ELECTRONIC WASTE: ISSUES WITH EXPORTING E-WASTE 3 (2010).

[6] For documentaries and photographs that convey human health and environmental atrocities more forcefully than academic text, see, for example, *Frontline/World: Ghana, Digital Dumping Ground* (PBS broadcast June 23, 2009), http://www.pbs.org/frontlineworld/stories/ghana804/video/video_index.html; *60 Minutes: Following the Trail of Toxic E-Waste* (CBS broadcast Nov. 9, 2008), http://www.cbsnews.com/8301-18560_162-4579229.html; Chris Carroll, *High-Tech Trash*, NATIONAL GEOGRAPHIC (Jan. 2008), *available at* http://ngm.nationalgeographic.com/2008/01/high-tech-trash/carroll-text.

levels are not seen in children from nearby villages where e-waste is not processed.[7] As discussed in Part I, these are some of the costs and risks to human health and the environment that appear not to be factored into deciding whether to trade e-waste.

Despite the horrendous conditions at e-waste processing villages, the e-waste trade arguably has upsides for workers. The trade provides jobs to poor workers, and erstwhile farmers have chosen to sort e-waste instead because it is more lucrative.[8] Nevertheless, better regulation of the e-waste processing industry could improve human health and environmental protections while still allowing these workers an alternative livelihood.

This paper explores international e-waste trade efficiency and governance as well as potential improvements, and focuses on the problematic aspects of exporting broken or obsolete electronics and electronic parts to countries not equipped to recycle or dispose of them in a safe and environmentally responsible manner. In this paper, the term "e-waste" refers to electronic equipment that is near or at the end of its useful life. The trade in high-value used electronics (such as refurbished smartphones) or commodity scrap (such as sorted metals derived from electronics) between developed countries has not presented the same human health and environmental concerns,[9] and thus these types of goods will not be considered "e-waste" for the purposes of this paper.

Part I of this paper discusses the economic efficiency of the international e-waste trade in light of unaccounted costs, risks, and benefits; whether the trade could be more efficient; and the regulatory response necessary to improve efficiency. Part II discusses the lack of incentives and capacity to enforce current e-waste trade bans and proposes that a responsible and efficient trade could be established by allowing the trade and then redistributing

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[7] GAO, *supra* note 4, at 18 (citing Xia Huo et al., *Elevated Blood Lead Levels of Children in Guiyu, an Electronic Waste Recycling Town in China*, 115 ENVTL. HEALTH PERSP. 1113 (2007)).

[8] *See, e.g.*, BASEL ACTION NETWORK, EXPORTING HARM: THE HIGH-TECH TRASHING OF ASIA (2002), *available at* http://www.ban.org/E-waste/technotrashfinalcomp.pdf; Adam Minter, *How China Profits from Our Junk*, THE ATLANTIC (Nov. 1, 2013), *available at* http://www.theatlantic.com/china/archive/2013/11/how-china-profits-from-our-junk/281044/.

[9] Developed countries tend to have the capacity to manage the hazardous components in electronics. *See, e.g.*, Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, Mar. 22, 1989, 1673 U.N.T.S. 57, pmbl [hereinafter *Basel Convention*].

the gains from trade. For example, e-waste importing countries could charge a tariff to fund development of governance and infrastructure necessary for responsible e-waste processing. Part III highlights some of the relevant World Trade Organization law and suggests that an e-waste tariff could be designed and implemented in a manner that is compatible with it.

Part IV discusses efforts in the United States to address the e-waste export problem, specifically, those undertaken by the Environmental Protection Agency (EPA) and the states, as well as the difficulties encountered. In particular, the EPA's regulatory authority for e-waste exports stems from the Resource Conservation and Recovery Act (RCRA),[10] which has a definition of "waste" that may not cover e-waste that is purportedly reused. Part IV also discusses constitutional limits on the states' power to control transboundary movement of e-waste.

The paper concludes that in light of the potential efficiency gains and fairness considerations, imposing a tariff on the e-waste trade to fund development of responsible e-waste management in developing countries is a better option than a ban. And because the EPA may have limited statutory authority to regulate e-waste purportedly exported for reuse, and the states are constitutionally limited in regulating e-waste exports, they are hindered from effectively addressing the international e-waste problem without U.S. legislation or treaty ratification.

I. THE EFFICIENCY OF THE INTERNATIONAL E-WASTE TRADE

While economic efficiency is not dispositive as to whether a trade or decision is good policy, it is a principle useful in decision-making.[11] In particular, under Kaldor-Hicks efficiency (which is often considered the basis of cost-benefit decision-making),[12] a trade or decision is desirable if those who gain do so by an amount sufficient to compensate those who lose.[13] Essentially then, the

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[10] 42 U.S.C. §§ 6901–6992k (2006).

[11] *See, e.g.*, RICHARD REVESZ & MICHAEL LIVERMORE, RETAKING RATIONALITY 12 (2008); Matthew D. Adler & Eric A. Posner, *Rethinking Cost-Benefit Analysis* 1 (John M. Olin Law & Econ. Working Paper No. 72, 2d series) *available at* http://www.law.uchicago.edu/files/files/72.EPosner.CBA_.pdf.

[12] *See, e.g.*, Adler & Posner, *supra* note 11, at 3 (stating that the Kaldor-Hicks principle is a traditional economic defense of cost-benefit analysis).

[13] *See, e.g.*, Adler & Posner, *supra* note 11, at 27. Hereinafter, "efficiency" will refer to Kaldor-Hicks efficiency.

trade is desirable if its total benefits exceed its total costs.

Although e-waste traders may obtain net benefits from trade (otherwise, they would rationally decide not to trade), this does not mean that the trade is Kaldor-Hicks efficient because there may be externalities—costs and benefits not reflected in the market price of the transaction that are borne by non-parties to the transaction.[14] The externalities of the e-waste trade include the costs of harm to human health and the environment not compensated by the traders. Not factoring these costs into the efficiency analysis could lead to trades where the total costs exceed the total benefits from trade. A thorough accounting of all externalities would need to include costs that are difficult to quantify (e.g., environmental damage) and data that are currently unavailable (e.g., the volume of e-waste that is being smuggled into developing countries). Absent this information, this paper takes a qualitative approach in discussing costs, risks, and benefits and exploring potential ways to ameliorate the e-waste trade problem. Further, whether the trade as reformed is efficient should depend on the cost of preventing damage to human health and the environment, not the cost of remedying the harm after the fact (which may be more). Thus, if the goal is to reform the e-waste trade, lacking some information on the trade as it exists will not greatly hinder the analysis as to whether the trade can be made efficient.

A. *High E-Waste Demand from Developing and Industrializing Countries*

Currently, developed countries export e-waste that is costly to recycle or dispose of domestically to developing countries with lax or nonexistent environmental, health, and safety regulations, and poor labor forces.[15] There is demand in developing countries for e-waste, either as a source of raw materials or as reusable electronics,[16] and the cheap labor and lax regulations lower the

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[14] *See, e.g.*, SCOTT J. CALLAN & JANET M. THOMAS, ENVIRONMENTAL ECONOMICS & MANAGEMENT: THEORY, POLICY, AND APPLICATIONS 62 (5th ed. 2010).

[15] Luther, *supra* note 5, at 10–11 (discussing the costs of domestic recycling and disposal and the economic incentive to export e-waste); *see also* GAO, *supra* note 4, at 19–20 (discussing testimony from Indonesian, Cambodian, and Indian officials that local environmental controls do not sufficiently protect people working in e-waste recycling and disposal).

[16] The GAO observed that over a three-month period, brokers in developing countries made 230 requests for about 7.5 million used cathode ray tubes on two

visible costs of e-waste processing in these countries.[17] Direct data on e-waste movements are unavailable, but the U.S. International Trade Commission (ITC) estimated that in 2011, the United States exported about 325,000 tons of used electronic products (UEPs)[18] to India, China, Hong Kong, Sub-Saharan Africa, and unaccounted destinations.[19]

African and Asian markets differ in their demands for e-waste. Industrializing Asian countries, where most electronics are manufactured, primarily need raw materials extractable from e-

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e-commerce websites. About 70 percent of the requests came from developing countries in Asia, mostly from China and India, and the remaining requests came largely from Africa. GAO, *supra* note 4, at 16.

[17] *See supra* notes 7–9.

[18] UEPs, as defined in the ITC report, are electronic products no longer useful to the original owner, and thus include more than what is commonly considered e-waste. ITC, *supra* note 4, at 1-3. For example, a refurbished smartphone selling for hundreds of dollars in the United States would fit within this definition. The ITC acknowledges that products at the end of their useful life are often referred to as "e-waste" due to the risks posed by improper handling of the potentially hazardous materials that they contain and considers e-waste to be a subset of UEPs. *Id.*

[19] *See* ITC, *supra* note 4, at 2-13. This export estimate is further broken down: India, Hong Kong, China, and unaccounted destinations receive UEPs in the tens of thousands of tons, while Africa is reported to receive about seventy-eight tons from the United States. *Id.* However, there are a number of reasons why the latter figure could be especially underreported. The ITC obtained this data through surveys because there is no official trade data on U.S. exports of UEPs, and no quantitative data on the informal, unregulated trade of e-waste. *Id.* at 1-2, xviii, 3-11. However, surveyed exporters are unlikely to report questionable or illegal activity to a government agency. Unlike Asia, Africa has very little formal recycling. *Id.* at 5-3. Thus, unless shipments to Africa are entirely working or repairable electronics (which is unlikely), any junk in the shipments is likely dumped irresponsibly. This is in contrast to shipments to Asia, where formal recycling exists, and there is a better chance that the trade may be legitimate. Also, the ITC survey excluded firms with fewer than ten employees. *Id.* at 1-7 n.25. This may have significantly affected the survey results as small firms may be numerous and potentially exporting to problematic destinations. *Statement from the Electronics TakeBack Coalition and the Basel Action Network on the new ITC report on exports of electronic waste*, ELECS. TAKEBACK COAL (2013), http://www.electronicstakeback.com/wp-content/uploads/Comments-on-report-from-ITC-report-March-2013.pdf.
As acknowledged by the ITC report, another study that included such small firms indicated that they represented about half of the respondents. ITC, *supra* note 4, at 1-10. Lastly, it should be stressed that these estimates are for U.S. exports alone. The ITC report suggests that UEPs entering Africa from the United States accounted for only about 5 percent of observed UEP imports into Nigeria and 8 percent of those into Ghana, and thus seventy-eight tons would be just the tip of the iceberg of UEPs imported into Africa. *Id.* at 5-3.

waste.[20] They generally have access to new electronics and are increasingly generating significant amounts of their own e-waste.[21] In fact, China has reportedly constructed recycling centers and tightened enforcement against illegal e-waste imports.[22] Nevertheless, there still appears to be demand for foreign e-waste for its recoverable materials.[23]

In contrast, African countries with little access to new electronics have a demand for reusable or repairable units and less of a need for recyclable scrap because there are no nearby markets for these commodities.[24] But because e-waste exporters are interested in disposing of junk, and African importers can do this cheaply by dumping and burning it in the open environment, African buyers are willing to accept unrepairable junk as long as there are enough functioning units to make a profit.[25] According to one source, a shipment can contain up to 75 percent junk and still be profitable.[26]

If African buyers incurred the cost of proper disposal for irreparable units (e.g., if dumping or burning in the open

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[20] *Id.* at 2-15, 3-2. GAO, *supra* note 4, at 21. "Malaysia . . . not only recycles CRT [(cathode ray tube)] glass but also manufactures new CRT televisions containing as much as 50 percent recycled-glass content." *Id.* at 15.

[21] China generates around 2.3 million tons of e-waste for disposal annually. ITC, *supra* note 4, at 5-12. "[T]he volume of obsolete PCs generated in developing regions will exceed that of developed regions by 2016–2018." Jinglei Yu et al., *Forecasting Global Generation of Obsolete Personal Computers*, 44 ENVTL. SCI. TECHNOL. 3232 (2010).

[22] ITC, *supra* note 4, at 5-13.

[23] *Id.* at 5-12.

[24] GAO, *supra* note 4, at 21 ("Recycling is not as prevalent in West Africa as it is in Southeast Asia, in part because West Africa is farther from markets where recycled commodities are sought."); *see also* ITC, *supra* note 4, at 5-3.

[25] Charles W. Schmidt, *Unfair Trade e-Waste in Africa*, 114 ENVTL. HEALTH PERSP. 232, 234 (2006). For example, functioning cathode ray tube television and computer monitors are considered obsolete in developed countries, but are apparently still used in Africa. ITC, *supra* note 4, at 3-10. Exporters mix broken cathode ray tubes into shipments to avoid incurring their disposal costs in developed countries, and importers can dump these at no cost. *Id.* at 3-12.

[26] A functional computer can fetch about $130, and shipping from the United States to Africa costs around $5,000 for a forty-foot container holding about eight hundred computers. Thus, it only takes about forty salable computers to pay to ship the entire container, which is only 5 percent of eight hundred computers. Even accounting for other costs, a container with up to 75 percent junk (the high end of what Nigerian experts estimate to be useless from incoming shipments of e-waste) likely still leaves a comfortable margin. 114 ENVTL. HEALTH PERSP. at 233–34.

environment were illegal), they might be willing to pay more to receive less junk. Thus, if the importing country were to enact and enforce laws requiring proper disposal of e-waste so that these costs were imposed on e-waste buyers accepting junk, these laws could incent better sorting prior to shipping and lead to less dumping and burning of junk. Buyers would also need information on exactly what they are getting in order to properly value the goods and negotiate a lower price to take into account any disposal costs they might incur. This could be accomplished with the help of third party certification programs, such as e-Stewards, which only permit working electronics that have been tested in the United States and non-toxic commodity materials to be exported to countries outside the Organization for Economic Cooperation and Development (OECD).[27]

B. *Large E-Waste Supply from Developed Countries*

The United Nations Environment Programme estimated in 2006 that around 22 to 55 million tons of e-waste is generated worldwide every year.[28] The EPA estimated that 2.37 million tons of electronic products were ready for end-of-life management in 2009 in the United States, of which 25 percent was collected for recycling.[29] The quantity of end-of-life electronics is expected to grow since Americans are consuming more electronics and have stockpiled electronics awaiting disposal.[30] Once e-waste is ready for end-of-life management, its fate can be disposal in a landfill (or incinerator), recycling, or export. As described below, domestic disposal and recycling currently impose costs on consumers or the government, and export generates revenue for the exporter.

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[27] ITC, *supra* note 4, at 6-10.

[28] Press Release, U.N. Env't Programme, Basel Conference Addresses Electronic Wastes Challenge (Nov. 27, 2006), *available at* http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=485&ArticleID=5431&l=en. Global trade data on e-waste are unreliable, however, partly because there is no single accepted definition of e-waste. *See, e.g.*, Rolf Widmer et al., *Global Perspectives on E-Waste*, 25 ENVTL. IMPACT ASSESSMENT REV. 436, 439 (2005); ITC, *supra* note 4, at 1-3.

[29] U.S. ENVTL. PROT. AGENCY OFFICE OF RES. CONSERVATION & RECOVERY, ELECTRONICS WASTE MANAGEMENT IN THE UNITED STATES THROUGH 2009 5 (May 2011), *available at* http://www.epa.gov/wastes/conserve/materials/ecycling/docs/fullbaselinereport2011.pdf.

[30] In 2009, there were approximately 5 million tons of electronic products in storage. *Id.*

Electronics can contain around sixty different elements, some of which are hazardous as waste under U.S. law[31] and can contaminate soil and water if disposed of in municipal landfills not designed to accept hazardous waste.[32] In the United States, e-waste is estimated to account for 70 percent of the heavy metals found in municipal landfills.[33] Proper hazardous waste disposal requires a landfill that meets certain requirements under RCRA.[34]

Recycling is another option for e-waste, but the cost of domestic recycling currently exceeds the revenue received from selling the processed materials.[35] This is because electronic device disassembly and sorting is complicated by the fact that electronics are not uniform in content or assembly and contain unidentified materials.[36] Recycling is therefore highly labor-intensive; in

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[31] For example, some of the metals contained in computers are listed as hazardous waste under the RCRA, including antimony, arsenic, cadmium, chromium, cobalt, lead, mercury, and selenium. DONALD BLEIWAS & THOMAS KELLY, U.S. DEP'T OF THE INTERIOR, U.S. GEOLOGICAL SURVEY, FACT SHEET FS-060-01, OBSOLETE COMPUTERS, "GOLD MINE," OR HIGH-TECH TRASH? RESOURCE RECOVERY FROM RECYCLING (2001), *available at* http://pubs.usgs.gov/fs/fs060-01/. Other common metals include aluminum, barium, beryllium, copper, gallium, gold, iron, manganese, palladium, platinum, silver, and zinc. *Id.* For the definition of hazardous waste, see 42 U.S.C. § 6903(5) (2006) and 40 C.F.R. § 261.3 (2013).

[32] Claire Veuthey, *Importing Electronics, Exporting E-Waste: Financial, Human Costs of Electronics Disposal Spread Worldwide*, RISKMETRICS GRP. (Aug. 6, 2010, 3:05 PM), http://blog.issgovernance.com/esg/2010/08/e-waste-trade.html. For municipal solid waste landfills criteria, see 40 C.F.R. pt. 258 (2012).

[33] Op-Ed., *Time to Deal with E-Waste*, N.Y. TIMES, Dec. 9, 2007, http://www.nytimes.com/2007/12/09/opinion/nyregionopinions/CIewaste.html?_r=1.

[34] RCRA section 3004(k); 42 U.S.C. § 6924(k) (2006); 40 C.F.R. Parts 264–265, Subpart N (2012).

[35] *See* Luther, *supra* note 5, at 9–10. California's e-waste recycling program illustrates the cost of domestic recycling. *See infra* Part IV.B. However, the profitability of domestic recycling could change, depending on collection methods, the quality of the collected e-waste, whether processing is automated or done by hand, market factors, and regulatory requirements. *See, e.g.*, Hai-Yong Kang & Julie M. Schoenung, Economic Analysis of Electronic Waste Recycling: Modeling the Cost and Revenue of a Materials Recovery Facility in California, 40 ENVTL. SCI. & TECH. 1672, 1677, 1679 (2006). An increase in commodity prices may help make domestic recycling cost effective. ITC, *supra* note 4, at 3-7.

[36] *See* Luther, *supra* note 5, at 9-10; U.S. ENVTL. PROT. AGENCY, Automated Identification and Sorting of Rare Earth Elements in an E-Waste Recycling Stream, http://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.abstractDetail/abstract/10019/report/0 (last visited May 5, 2014).

California, the cost of recycling passed on to the consumer is $6 to $10 per item.[37] Further, once a unit has been broken down into its component parts, facilities with the capacity to recycle those components are limited. For example, few American facilities are capable of processing flame-retardant plastic or leaded glass from computer monitors, or of recovering metals from circuit boards.[38] Some recyclers simply export entire units overseas where labor is cheaper.[39]

In light of the costs of recycling and disposal, and the fact that most markets for raw materials derived from e-waste are overseas, it is no surprise that much of American e-waste is exported. Indeed, a 2008 report estimated that 77 to 89 percent of the end markets for televisions and computer monitors were outside the United States.[40]

C. *Summary of Costs and Benefits*

The existence of willing sellers and buyers of e-waste implies that both sides of the transaction derive net benefits. But the costs and benefits not seen by the parties to the transaction must also be accounted in assessing the overall efficiency of the trade. If negative externalities could be eliminated through regulation, the relevant costs and benefits to consider would include those associated with proper recycling. Thus, the costs and benefits differ somewhat for the trade as it currently stands and for a reformed e-waste trade—these are discussed below.

1. *Benefits of Trading*

The accounted costs of the e-waste trade include savings in recycling costs as well as new job opportunities and a supply of secondhand electronics. To the extent that the trade allows for

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[37] CAL. CODE REGS. tit. xiv, § 18660.40(a)-(c) (West 2014).

[38] Luther, *supra* note 5, at 11.

[39] *See, e.g.*, *Do you know where your electronic waste goes?*, 89.3 KPCC SOUTHERN CALIFORNIA PUBLIC RADIO (Dec. 21, 2010), http://www.scpr.org/news/2010/12/21/22070/do-you-know-where-your-electronic-waste-goes/. Exporters can export units, claiming they are for reuse when they are in fact taken apart overseas. *See infra* Part III on the lax U.S. export rules for reuse.

[40] EPA OFFICE OF SOLID WASTE, ELECTRONIC WASTE MANAGEMENT IN THE UNITED STATES (2008), *available at* http://www.epa.gov/epawaste/conserve/materials/ecycling/docs/app-1.pdf. Industry experts estimate that up to 200 million pounds of used electronics leave the country each year. *See, e.g.*, KPCC SOUTHERN CALIFORNIA PUBLIC RADIO, *supra* note 39.

reuse and recycling that would not have otherwise occurred if e-waste were domestically confined, the resulting environmental benefits may also be attributed to the trade.

Lower labor costs abroad reduce the cost of recycling e-waste,[41] which is composed of heterogeneous materials that require a great deal of labor to disassemble and sort.[42] Dismantling by hand produces more reusable components and less contamination[43] and is done more cheaply abroad. In addition, recycling and reuse save hazardous-waste landfill space in exporting countries, which is another form of cost savings.

Importing resources that need processing creates employment alternatives.[44] For example, Chinese farmers choose to sort e-waste because it is more lucrative than farming,[45] and banning the trade would eliminate this choice of livelihood. In addition, reuse provides secondhand electronics to developing countries that have little access to new units.

Recycling provides a source of raw materials and reduces the need to mine.[46] E-waste has a higher concentration of gold and copper than natural ores; for example, a ton of recycled computer scrap produces as much gold as 17 tons of ore.[47] A ton of used mobile phones (which constitutes 0.0006 percent of annual global production of mobile phones) contains about 3.5 kilograms of silver, 340 grams of gold, 140 grams of palladium, and 130 kilograms of copper.[48]

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[41] The 2010 average hourly labor compensation in manufacturing is almost 20 times higher in the United States than in China and India. *See* ITC, *supra* note 4, at 6-14.

[42] GREEN ELECTRONICS COUNCIL, CLOSING THE LOOP: ELECTRONICS DESIGN TO ENHANCE REUSE/RECYCLING VALUE 5–7 (Jan. 2009), *available at* http://www.electronicsrecycling.org/public/UserDocuments/Design%20for%20End%20of%20Life%20Final%20Report%20090208.pdf.

[43] GAO, *supra* note 4, at 18 n.16; ITC, *supra* note 4, at 3-7.

[44] The benefits offered by these employment alternatives, however, may be diminished if the workers are not fully aware of the health risks to themselves and their children, and thus are not making informed decisions. Enforced health and safety regulations could ameliorate these risks, but that would increase the costs associated with hiring workers, which would likely reduce the number of these jobs available.

[45] *See* BASEL ACTION NETWORK, *supra* note 9.

[46] Adam Minter, *How China Profits From Our Junk*, THE ATLANTIC (Nov. 1, 2013), *available at* http://www.theatlantic.com/china/archive/2013/11/how-china-profits-from-our-junk/281044/.

[47] BLEIWAS & KELLY, *supra* note 31.

[48] *Set World Standards for Electronics Recycling, Reuse to Curb E-Waste*

Some cost savings of recycling over mining may be priced into transactions, but environmental benefits are not factored in unless environmental regulations impose compliance costs on the mining industry. For example, recycling could result in lower environmental costs than mining since e-waste contains lower concentrations of arsenic, mercury, and sulfur than that commonly found in ores.[49] But ecological and aesthetic benefits of not having to mine are likely unaccounted for (unless they are protected by regulation).

Recycling saves energy, some of which is accounted for (such as the energy bill savings). Recovering aluminum via recycling, for example, uses no more than 10 percent of the energy required for primary production and has the environmental benefit of reducing carbon dioxide and sulfur dioxide emissions[50] (which may be priced in depending on what regulations are in place).

Reuse could also save energy and other resources by extending the life of electronics and thus saving or delaying new units from being manufactured. These savings can be significant because manufacturing electronics is energy intensive: of the total energy spent in the lifecycle of a product, the manufacturing process makes up 81 percent.[51] For example, a computer takes at least 530 pounds of fossil fuels, 48 pounds of chemicals, and about 1.5 tons of water to manufacture.[52] Thus, to the extent that continuing to use an old product saves a new one from being manufactured, energy is saved in manufacturing fewer products over time.[53]

Exports to Developing Countries, U.N. UNIV. (Sept. 15, 2009), http://www.eurekalert.org/pub_releases/2009-09/unu-sws091009.php (last visited May 31, 2012).

[49] BLEIWAS & KELLY, *supra* note 31 (Electronic scrap "contains much lower levels of deleterious elements common to ores, such as arsenic, mercury, and, especially, sulfur.").

[50] U.N. UNIV., *supra* note 48.

[51] Eric Williams, *Energy Intensity of Computer Manufacturing: Hybrid Assessment Combining Process and Economic Input-Output Methods*, 38 ENVTL. SCI. & TECH. 6166, 6166 (2004).

[52] S. Schwarzer et al., *Environment Alert Bulletin, E-Waste: The Hidden Side of IT Equipment's Manufacturing and Use*, U.N. ENV'T PROGRAMME (Jan. 2005), *available at* www.grid.unep.ch/products/3_Reports/ew_ewaste.en.pdf.

[53] If, however, the used product is sold to someone who would not have been able to afford a new product, reuse generates no energy savings.

2. *Costs of Trading*

The accounted costs of the e-waste trade include those associated with collection, transportation, labor, supplies, and basic infrastructure. Unaccounted costs of the trade currently include harm to workers and the environment, and these costs increase when hazardous waste is moved from countries with relatively strong worker and environmental protections to countries with weaker protections. Quantifying these costs requires an estimate of how importing countries value human health and clean air and water, but even lacking this information, the fact that many importing countries have e-waste import bans (albeit poorly enforced ones)[54] implies that these values are not being taken into account. Thus, the costs to human health and the environment are not part of the e-waste bargain between traders and are not factored into the transaction price.

Under the current system, e-waste workers typically handle hazardous materials with no protective gear or training. They may not have adequate information about health risks when they decide to sort waste over other occupations, such as farming.[55] If regulations were to require hazardous waste training, protective equipment, or health care, they would introduce compliance or liability costs but would eliminate the hidden costs that are currently being externalized.

Dumping e-waste into bodies of water contaminates the water with heavy metals, and open burning of the e-waste pollutes the air and releases carcinogens.[56] Developing countries with lax environmental standards may eventually adopt laws that require pollution prevention or clean-up, which would transform externalized environmental costs into compliance or liability costs (e-waste traders faced with the choice of preventing pollution or cleaning it up will probably choose the cheaper option). For developing countries accumulating waste from both domestic and global sources, hazardous waste sites are likely to be even more expensive to clean up than U.S. Superfund sites.[57]

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[54] *See infra* Part II.A.

[55] Even if the workers perceive a risk, they might systematically underestimate it because the risks associated with e-waste processing, such as lead poisoning, are not readily apparent. *See, e.g.*, BASEL ACTION NETWORK, *supra* note 8, at 16.

[56] UNEP, StEP, *supra* note 2.

[57] BASEL ACTION NETWORK, HAZARDOUS WASTE RECYCLING: NO

D. *Improving the Efficiency of Trade*

From the available information, it appears that trade in e-waste could be made more efficient by correcting for externalities and by using better technology and processes. Requiring that the trading parties internalize (that is, price into the transaction) negative externalities would incent them to avoid these negative outcomes at the lowest cost, e.g., by taking preventive measures to cause less environmental damage. Adopting better processes (such as sorting or specializing), better technology, and leveraging economies of scale may also improve efficiency. Process and technology improvements could enable sorters to extract more value while generating less waste and to do so in a manner that results in less harm to their health and the environment.

1. *Preventive Measures*

Improper e-waste disposal tends to create Superfund-like sites that likely will cost more to clean up than to prevent, because clean-up involves the extra expense of removing hazardous waste from soil and water (in addition to the cost of proper hazardous waste disposal). Similarly, harm to human health generally incurs greater medical costs (if medical care is available) than prevention[58] and decreases the productivity of the workforce. While requiring that parties to the trade undertake preventative measures may increase their costs, doing so could decrease the overall costs of trade (when those imposed on non-parties are factored in).

2. *Sorting*

Sorting e-waste by units destined variously for reuse and recycling prior to shipment could decrease the amount of e-waste being disposed, increase gains from trade, and thus improve efficiency. Sending non-reusable units to Africa generates unnecessary shipping costs and harms workers and the

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JUSTIFICATION FOR TOXIC TRADE (2008), *available at* http://www.ban.org/library/BP07_June_2008.pdf ("Historically, hazardous waste recycling has proven to be an environmental nightmare even in rich developed countries. For example, a full 11 percent of U.S. Superfund priority sites that were required to be cleaned up at enormous costs were caused by recycling operations.").

[58] Dean Ornish, *Health: Prevention Is Worth the Money*, NEWSWEEK, http://www.newsweek.com/health-prevention-worth-money-86075 (last updated Mar. 13, 2010, 4:57 PM).

environment. It may be that exporters, who are in a sense operating a disposal service, are interested in quickly eliminating the waste, and do not properly sort because the cost of testing, sorting, and holding inventory is greater than the benefits from any increased revenue generated from sorting. Enacting and enforcing laws protecting worker health and the environment in developing countries would change this calculation by eliminating the cheap disposal-by-dumping option. No longer able to externalize the cost of disposal, importers would become more discerning in what they buy, which would pressure exporters to sort.

3. *Innovation, Specialization, and Economies of Scale*

Trade in waste (electronic or otherwise) may be advantageous if there is innovation, specialization, or economies of scale in disposal techniques or comparative advantages based on geological and transportation access.[59] None of these elements, however, appear to characterize the e-waste trade; overseas transportation adds to the cost, and recycling in developing countries is done through basic techniques.[60] There appears to be potential to improve efficiency through innovation and economies of scale, but overseas transportation is necessary to take advantage of cheap labor and markets for recycled materials.

Innovation and specialization already enable state-of-the-art facilities to recycle a large percentage of certain e-waste. While most smelters and refineries specialize in extracting certain metals from disassembled and sorted electronic parts, Umicore of Belgium, reportedly can extract 20 types of metals from whole units, such as phones and laptops.[61] Major electronics companies, such as IBM, can recycle more than 90 percent of their own products.[62] Plastics may be used as a fuel for cement kilns in the smelting process, conserving landfill space and decreasing the use of coal.[63] But the variety of plastics used and a lack of labeling

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[59] Richard B. Stewart, *International Trade and Environment: Lessons from the Federal Experience*, 49 WASH. & LEE L. REV. 1329, 1338 (1992) ("Free trade in wastes should promote joint welfare for reasons similar to those that justify free trade in ordinary goods and services: economies of scale in disposal techniques, comparative advantage based on geology and transportation access, and innovation through specialization.") (internal citation omitted).

[60] *See supra* Introduction, Part I.A.

[61] ITC, *supra* note 4, at 5-9; GAO, *supra* note 4, at 14–15.

[62] BLEIWAS & KELLY, *supra* note 31.

[63] *Id.* (citing NAT'L SAFETY COUNCIL, ELECTRONIC PRODUCT RECOVERY

hinder effective recycling of plastics from computers. Sorted plastics can fetch from $265 to $900 per ton, depending on the type of plastic, but a load of mixed plastics has little value.[64] Cathode ray tubes (CRTs), the glass and metal components of obsolete computer and TV monitors, may also be recycled. CRTs are about 10 to 13 percent copper, which can be recovered and converted into salable metal.[65]

High-tech recycling facilities that can handle these types of end-of-life products have high startup costs (some reportedly as high as $2 billion) and are located in OECD countries.[66] While industrializing Asian countries are beginning to build recycling facilities, hand dismantling is still prevalent because it more completely separates materials, resulting in higher quality materials than mechanical methods, and because labor is cheap in these countries.[67] Developing African countries appear to not have these facilities, likely due to their high costs, and investment is not likely to happen where dumping is essentially free. Moreover, high-tech electronic scrap recycling facilities appear to benefit from scale and are not widespread even in developed countries. The United States does not have large-scale smelters capable of recycling circuit boards and instead sells much of its electronics recycling abroad.[68] Export provides free electronics disposal for consumers, whereas proper domestic recycling and disposal imposes a cost on consumers (as seen in California's recycling program, discussed below, where consumers must pay a fee to cover the cost of recycling[69]).

Modern technology, however, does not completely eliminate the labor needed to sort through the various types of e-waste for recycling,[70] and locating recycling plants in countries where labor

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AND RECYCLING BASELINE REPORT, RECYCLING OF SELECTED ELECTRONIC PRODUCTS IN THE UNITED STATES 47 (1999) (stating that one ton of plastic can replace nearly 1.3 tons of coal)).

[64] *Id.*

[65] *Id.* Note, however, that CRT glass is expensive to recycle and there is not much of a market for it. ITC, *supra* note 4, at 2-10. Firms must typically pay to dispose of CRTs, which are often exported. *Id.* at 3-9, n.33, 3-12.

[66] ITC, *supra* note 4, at 3-8, 5-9.

[67] *Id.* at 3-7, 5-13, n.55, 6-14.

[68] *See* Luther, *supra* note 5, at 10–11; ITC, *supra* note 4, at 1-6, n.21, 3-7, 3-8.

[69] *See* CAL. CODE REGS. tit. xiv, § 18660.40(a)–(c) (West 2014).

[70] *See* Luther, *supra* note 5, at 7, 10–11.

is cheap and allowing for trade in e-waste could increase efficiency. In addition, if recycled raw materials are ultimately shipped to Asia where new electronics are manufactured, these shipping costs would have to be incurred regardless of where the recycling is done. Asian countries, which are beginning to generate significant amounts of their own e-waste,[71] could take advantage of economies of scale by investing in recycling infrastructure. They are beginning to invest or attract foreign investment in recycling plants,[72] but apparently not to the extent necessary to fully process all of the e-waste.

E. *Considerations Beyond Economic Efficiency*

The disparities in negotiating power between those involved in the e-waste trade weigh in favor of looking beyond the economic efficiency of a negotiated transaction to achieve a fair result. These disparities can lead to inequities: various industry players taking advantage of poor e-waste sorters and wealthy exporting countries taking advantage of developing importing countries.

First, supposing the e-waste trade is efficient, that determination does not ensure an equitable result because Kaldor-Hicks efficiency does not require that the winners in a transaction compensate the losers. The winners in the e-waste trade include the importers and exporters (who presumably would not reach a negotiated agreement unless both parties gain), and the losers include those who gain nothing from the trade but live in environments polluted by e-waste operations and e-waste workers who may unknowingly expose themselves to risks for which they are not compensated. Thus, even if the total benefits exceed the total costs of the trade, the trade would be inequitable so long as the losers are not made whole. Poor laborers may not have the bargaining power necessary to achieve a fair result without outside intervention. Further, even if worker and environmental regulations were to be adopted, externalities are difficult to fully eliminate in practice, so some redistribution of the gains from trade would be needed to make whole those who lose more than they

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[71] By 2020, China and South Africa are expected to increase e-waste generation from computers by 200 to 400 percent compared to 2007 levels. UNEP, StEP, *supra* note 2, at 50.

[72] ITC, *supra* note 4, at 5-13 n.55.

benefit.

Second, assuming trade is currently inefficient, but could be made efficient, the importing (usually developing) countries may not be able to overcome financial and political costs associated with making a transition to a more efficient trade. There may be regulatory uncertainty, capital markets may not be functioning, upfront costs may be high, and traders and recyclers may not be organized enough to pool resources or invest. Importing countries may need outside assistance, and fairness suggests that exporting countries benefiting from cheap e-waste disposal should help.

II. INTERNATIONAL E-WASTE TRADE MANAGEMENT

Ideally, e-waste trade regulation should be informed by whether the trade is efficient, but there is insufficient information to make this determination. For example, the acceptable level of risk to human health or of environmental pollution differs by country, and the efficiency of different trades between different trading partners varies. To simplify the analysis, the rest of the paper considers two possibilities for managing the international e-waste trade: (A) banning trade if it is not and cannot be made efficient or (B) allowing trade but redistributing the gains from trade if it is or could be made efficient.

If the trade cannot be made efficient, it should be banned or other measures should be taken to stem the flow. Developed countries may currently be benefitting from the trade's inefficiency by externalizing costs to importing countries; they should internalize these costs by dealing with e-waste domestically. While developing countries are beginning to generate significant amounts of e-waste domestically, a ban may still help as a stopgap until their e-waste recycling governance and infrastructure improves. Because this governance and infrastructure is not yet in place, many developing countries are in favor of e-waste trade bans, as discussed in the next part.

The factors discussed above, however, hint that the e-waste trade, with improvements, could become efficient. If the e-waste trade is allowed and there are net gains from trading even when externalities are internalized, there is a potential win-win solution for exporting and importing countries. Developed countries seeking to export e-waste could help developing countries build the necessary infrastructure to safely manage e-waste and train

workers. This would provide economic opportunity and employment alternatives in developing countries, and a source of reusable electronics and raw materials. Establishing an e-waste recycling infrastructure also would be beneficial for countries needing to manage their own growing domestic e-waste streams, such as China and India.[73]

In light of imperfect information on e-waste trade efficiency, a tariff set at a level to help fund responsible recycling would be better than a blanket ban; any trade where the gains do not offset the tariff would not proceed. Thus, a tariff would work like a ban on the least efficient trades. A tariff set too high would ban some of the efficient trades, but that would still be better than a blanket ban stopping all of the efficient trades.

A. *Stemming the Flow of E-Waste through an E-Waste Trade Ban*

China, Thailand, Vietnam, and Uganda have imposed import bans,[74] and certain African states have agreed to adopt hazardous waste import bans.[75] But despite these measures, the illegal e-waste industry appears to be robust in both China and Africa.[76]

Bans also play a significant role in the main international agreement on trade in hazardous waste, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (Basel Convention).[77] The Basel Convention's objective is to "protect, by strict control, human health and the environment against the adverse effects which may result from the generation and management of hazardous wastes."[78] The parties' obligations under Article 4 include minimizing the generation and

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[73] This does not imply that these countries should also manage other countries' waste streams, but once the infrastructure is established, economies of scale could help make it profitable for them to recycle foreign waste. Further, the manufacturers that use these recycled materials are located in some of these countries.

[74] ITC, *supra* note 4, at 6-18; GAO, *supra* note 4, at 37.

[75] Most African states have adopted their own ban on the import of hazardous waste. Bamako Convention on the Ban of the Import Into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes Within Africa, Jan. 30, 1991, 2101 U.N.T.S. 177.

[76] *See supra* notes 4–7.

[77] *Basel Convention*, *supra* note 9. Some agreements overseen by the World Trade Organization are also relevant, as discussed in Part III.

[78] *Id.* at pmbl.

movement of hazardous waste, ensuring that human health and the environment are protected from the adverse effects of the transboundary movement of hazardous waste, abiding by the import bans of certain countries,[79] preventing the import of wastes if there is reason to believe that the wastes will not be managed in an environmentally sound manner[80] and not permitting wastes to be exported or imported to or from a non-party.[81] This non-party ban provision has an exception: parties may arrange to move wastes across boundaries with non-parties provided that it is done in an environmentally sound manner.[82] In an attempt to prevent abuse of this exception, the parties adopted an amendment to ban all transboundary movements of hazardous wastes from OECD member states destined for disposal in non-OECD states.[83] This ban, known as the Basel Ban Amendment,[84] currently does not have enough support to enter into force.[85]

It appears that e-waste bans are generally ineffective. This could be due to the fact that the developing countries desiring bans lack the resources to enforce them,[86] and that developed countries do not have an incentive to help enforce bans.[87] In fact, developed countries disfavor bans, likely because bans eliminate a means of waste management.[88]

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[79] Aside from the Basel Ban Amendment (see below), countries can impose import bans through the Convention itself, which allows parties to prohibit the import of hazardous waste. *Id.* at art. 4, 13.

[80] *Id.* art. 4.1(b), 4.2(a), (d), (e), (g).

[81] *Id.* art. 4.5.

[82] *Id.* art. 11.1.

[83] Basel Convention, Second Conference of the Parties, Mar. 25, 1994, Decision II/12(1).

[84] The Basel Ban Amendment, Third Conference of the Parties, Decision III/1 and Annex VII, Sept. 22, 1995, http://www.basel.int/pub/baselban.html.

[85] As of this writing, only 74 of the 179 parties to the Ban Amendment have ratified it. Ban Amendment to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal Geneva, Sept. 22, 1995, http://www.basel.int/Countries/StatusofRatifications/BanAmendment/tabid/1344/Default.aspx; Parties to the Basel Convention, http://www.basel.int/Countries/StatusofRatifications/PartiesSignatories/tabid/1290/Default.aspx. Notably, non-ratifiers include Japan, Canada, and the United States (which has not even ratified the Basel Convention).

[86] BASEL ACTION NETWORK *supra* note 8, at 23.

[87] According to the U.S. Government Accountability Office, the EPA does very little to prevent exports of e-waste going to countries that ban its imports, even when the EPA is aware of the problem. GAO, *supra* note 4, at 7.

[88] Developed countries typically do not favor bans in waste trade. *See* Nina

B. *International Measures for Managing E-Waste Trade and Processing*

E-waste import bans have been ineffective, likely because bans forgo gains from trade, and importing countries generally have not been able to enforce them. It is thus worthwhile to consider responsible, less trade-restrictive alternatives that allow gains from trade and that incent developed countries to help develop and support the trade measures. Efforts relevant to building responsible trade are now underway: Africa[89] and China[90] are developing e-waste governance, and India has issued

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Bomber, *The Basel Convention's Complete Ban on Hazardous Waste Exports: Negotiating the Compatibility of Trade and the Environment*, 7 J. ENVTL. L. & PRACTICE. 325, 334 (1997). Canada and Japan have not ratified the Ban Amendment. BASEL ACTION NETWORK, *supra* note 8. The European Communities fought to lift the import ban in *Brazil—Retreaded Tyres*, a case concerning the import of used tires that pose human health and environmental hazards. Appellate Body Report, *Brazil—Measures Affecting Imports of Retreaded Tyres*, WT/DS332/AB/R (Dec. 3, 2007) [hereinafter *Appellate Body Report*, *Brazil—Retreaded Tyres*]. The U.S. Congress has twice introduced a bill unsuccessfully that would limit e-waste exports. *Infra* Part IV.A. The Institute of Scrap Recycling Industries opposed it, claiming that "the legislation could hurt U.S. businesses and backfire against efforts to improve overseas recycling operations" and "would 'stifle' a growing market for U.S. exports and increase costs in the growing e-waste industry in the U.S., because U.S. companies would be shut off from using foreign recycling facilities." Grant Gross, *Congress Weighs Rules on E-Waste*, IDG NEWS SERV. (June 26, 2011, 1:33PM), http://www.pcworld.com/article/231072/congress_weighs_rules_on_ewaste.html.

[89] *E-Waste Africa Project*, BASEL CONVENTION, http://www.basel.int/Implementation/TechnicalAssistance/EWaste/EwasteAfricaProject/tabid/2546/Default.aspx (last visited May 5, 2014) (The e-waste Africa project coordinated by the Secretariat of the Basel Convention is working on e-waste environmental governance in Africa's recycling sector. This includes gathering information, increasing the capacity of certain countries to manage e-waste, investigating the feasibility of establishing environmentally sound materials recovery operations and enhancing the capacity to monitor and prevent illegal traffic).

[90] China recently promulgated regulations that establish a fund to subsidize e-waste recycling, to which electronics manufacturers and consignees of electronics imports must contribute. Further, disposal enterprises must have an environmental monitoring system for waste product treatment and report the data to the local environmental agency. Liability provisions penalize the failure to supply information on hazardous substance content, engaging in e-waste disposal without requisite qualifications, applying obsolete e-waste disposal technology and processes, and causing environmental pollution through e-waste disposal. Wendy Zeldin, *China: Regulations on Electronic Waste*, GLOBAL LEGAL MONITOR (Apr. 24, 2009), http://www.loc.gov/lawweb/servlet/lloc_news?disp3_l205401235_text; *see also* Wendy Zeldin, *China: Surcharge on Electronic Waste Takes Retroactive Effect*, GLOBAL LEGAL MONITOR (Sept. 12, 2012),

guidelines for managing e-waste[91] and has required industry to clean up hazardous waste.[92]

Improving e-waste trade efficiency requires an overhaul in governance and recycling infrastructure, a difficult task for importing countries to accomplish alone. Principles of efficiency and fairness suggest that some of the gains from trade should be allocated to help importing countries acquire proper recycling technology, train e-waste workers and government officials and fund monitoring and enforcement programs. Ideally, the gains from trade would be distributed so that developing countries would find it worthwhile to give up their bans.

If allowing the e-waste trade is desirable, how much in funds should be transferred and how should these funds be collected and distributed? Ideally, the exporting country should transfer funds to the importing country equal to the cost of the exported e-waste's proper disposal (perhaps receiving a price adjustment for the value extractable from the e-waste).[93] This could be a tariff paid by exporters, who may collect the money from consumers who are disposing of the waste.

The importing country could also be paid through funds from taxing purchased electronics (which consumers would pay) or hazardous components used in products (which producers would pay). This way, consumers disposing of e-waste or producers responsible for its hazardous content would directly pay for proper disposal.[94] But at the time the tax would be collected from the consumer or producer, the disposal destination would be unknown, and this contribution would not necessarily be proportionate to the

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http://www.loc.gov/lawweb/servlet/lloc_news?disp3_l205403322_text.

[91] CENT. POLLUTION CONTROL BD., MINISTRY OF ENV'T & FORESTS, GUIDELINES FOR ENVIRONMENTALLY SOUND MANAGEMENT OF E-WASTE (2008) (India).

[92] Frederick Noronha, *India's Supreme Court Panel Cracks Down on Hazardous Waste*, ENV'T NEWS SERV. (Nov. 19, 2004), http://www.ens-newswire.com/ens/nov2004/2004-11-19-01.asp. *See also* UNEP, StEP, *supra* note 2, at 59 (identifying India and China "as having a significant potential for the introduction of pre- and end-processing technologies with a strong support in capacity building in the informal sector").

[93] The disposal fee might have to be adjusted each time the e-waste is processed so that as more of the high-value components are extracted, the fee transmitted properly reflects the cost of disposal less the value of the e-waste.

[94] Taxing producers based on the hazardous content of their electronics directly incents them to minimize hazardous materials in designing and manufacturing electronics.

e-waste transferred between countries. These funds, however, could form the basis of an international funding mechanism (perhaps supplemental to a tariff). An international entity could collect such funds and disburse them to importing countries, like the Least Developed Countries Fund under the United Nations Framework Convention on Climate Change, where developed nations pledge money and developing countries apply for the funds.[95] The importing countries would be held accountable for effectively using funds and might have to accept outside monitoring and assistance as a condition for receiving funding.

Returning to the tariff, it appears that a key benefit is that it can be set at a level to internalize the externalities of the trade (i.e., pay for proper disposal). It could be an import or export tariff, and agreements between the exporting and importing countries could help ensure that the funds are used properly.[96] If the importing country were to impose the tariff, it would be able to determine the level of the tariff and retain more control over the funding.[97] Managing the import tariff and its use would require that the importing country have governance capability for implementing the overhaul. A disadvantage of the importing countries individually imposing the tariff is that the e-waste could preferentially go to countries with no tariff or a lower one. If the exporting country were instead to impose an export tariff, it could then transfer the funds to the importing country or to a third party implementing the e-waste recycling program. Theoretically, who collects the funds should not matter, but an exporting country would likely face internal political difficulty in adopting and maintaining a tariff for the benefit of another country, and it may never get done. This weighs in favor of an import tariff as the most viable option.

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[95] *See Least Developed Countries Fund*, U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/cooperation_support/least_developed_countries_portal/ldc_fund/items/4723.php (last visited Jan. 30, 2013).

[96] If tariff proceeds were not used for e-waste related programs, the tariff could be challenged under World Trade Organization law as a barrier to trade. *See infra* Part III.

[97] An import tariff for e-waste would be analogous to the Superfund tax, which the United States imposes on certain imported substances, such as petroleum, to fund Superfund site clean-up. Such a tariff would also be similar to a carbon border tax adjustment, where the importing country with a price on carbon imposes a tariff on the foreign goods to take into account the carbon emitted in the production of those goods.

Another issue is that a tariff is a trade-restricting measure subject to challenge at the World Trade Organization (WTO). It is therefore crucial to design and implement the tariff in compliance with relevant WTO law.

III. COMPATIBILITY OF AN E-WASTE TARIFF WITH WTO LAW

An e-waste tariff is a restriction on trade and may be challenged under WTO law. However, the following analysis suggests that a tariff-funded e-waste program may be designed and implemented in a manner that is consistent with WTO law.

The relevant WTO agreements for an e-waste tariff are the General Agreement on Tariffs and Trade (GATT)[98] and the General Agreement on Trade in Services (GATS).[99] Whether e-waste is a good or its disposal is a service would determine which agreement applies. E-waste likely would be considered a good governed by the GATT since it has monetary value and is traded.[100] But if the waste is not reused or recycled into raw materials but is instead disposed of, this would be considered a service governed by the GATS.[101] Analyses under the GATT and the GATS would be similar because they have analogous provisions (except for GATT Article XX(g) as noted below), so little is lost by focusing on the GATT.

A. *Some Relevant GATT Obligations*

Assuming the e-waste trade is governed by the GATT and the trading countries are WTO members, an e-waste import tariff would need to be designed and implemented consistently with GATT obligations. Of these, Article III, which requires that

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[98] General Agreement on Tariffs and Trade 1994, Apr. 15, 1994, 1867 U.N.T.S. 190 [hereinafter GATT].

[99] General Agreement on Trade in Services 1993, in the Uruguay Round Final Act, Dec. 15, 1993, Annex 1B, 33 I.L.M. 1167 (1994).

[100] The European Court of Justice (ECJ), for example, considers "goods" to be "products which can be valued in money" and that are "the subject of commercial transactions." Case 7/68, Comm'n v. Italy, E.C.R. 428 (1968). The ECJ has in fact specifically stated that waste is a "good" in the context of the European Economic Community Treaty. Case C-2/90, Comm'n v. Kingdom of Belgium, 1992 E.C.R. I-04431 ¶ 23.

[101] *See, e.g.*, U.S. INT'L TRADE COMM'N, SOLID AND HAZARDOUS WASTE SERVICES: AN EXAMINATION OF U.S. AND FOREIGN MARKETS, PUB. NO. 3679, app. D, tbl. D-1 (2004), *available at* http://www.usitc.gov/publications/332/pub3679.pdf (listing refuse disposal commitments under GATS).

imported products be treated no less favorably than like domestic products,[102] is likely problematic if a country imposes an e-waste import tariff but cannot impose a similar tax on domestically generated e-waste.[103] If the importing country could tax domestically generated e-waste similarly to imported e-waste, the tax on imported e-waste could qualify as a border tax adjustment under Article II:2 and avoid a conflict with Article III.[104] Article II:2 also allows for fees for costs of services (which could perhaps include proper disposal services).[105]

1. *United States—Taxes on Petroleum and Certain Imported Substances*

A WTO Panel report, *United States—Taxes on Petroleum and Certain Imported Substances*,[106] illustrates relevant aspects of

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[102] Imported products "shall be accorded treatment no less favourable than that accorded to like products of national origin in respect of all laws, regulations and requirements affecting their internal sale, offering for sale, purchase, transportation, distribution or use." GATT, *supra* note 98, at art. III, para 4. The purpose of Article III is to avoid protectionism of domestic production and to ensure that imported products are treated in the same way as like domestic products once they have cleared customs. Appellate Body Report, *Japan—Taxes on Alcoholic Beverages*, WT/DS11/AB/R, p.16 (Oct. 4, 1996).

[103] A tax on domestically generated e-waste could be akin to a disposal fee, which may be financially challenging for some citizens in developing countries. China has a rule which requires manufacturers to pay a fee that goes toward disposal and recycling costs, but it is not obvious that this would qualify as a similar internal tax under Articles II and III. UNEP, StEP, *supra* note 2. If the internal tax is too onerous, the government could theoretically tax and then subsidize domestic e-waste generators (i.e., disposers of e-waste) who cannot afford to pay an e-waste disposal tax. Article III provides that the "provisions of this Article shall not prevent the payment of subsidies exclusively to domestic producers, including payments to domestic producers derived from the proceeds of internal taxes." GATT, *supra* note 98, at art. III, para 8(b).

[104] Article II:2(a) provides that parties may impose on the importation of any product: "a charge equivalent to an internal tax imposed consistently with the provisions of paragraph 2 of Article III in respect of the like domestic product or in respect of an article from which the imported product has been manufactured or produced in whole or in part." GATT, *supra* note 98, at art. II, para 2(a). Article III:2 provides that imported products shall not be subject to internal taxes in excess of those applied to like domestic products. *Id.* at art. III, para 2.

[105] Article II:2(c) provides that parties may impose on the importation of any product: "fees or other charges commensurate with the cost of services rendered." *Id.* at art. II, para 2(c).

[106] Report of the Panel, *United States—Taxes on Petroleum and Certain Imported Substances*, L/6175 (June 17, 1987), GATT B.I.S.D. (34th Supp.) at 136 (1988) [hereinafter *US—Superfund*]. The dispute panel is the fact finder and interprets WTO law, while the Appellate Body decides legal issues on appeal. It

Articles II:2 and III. There, the United States had levied a tax on imported petroleum products at a higher rate than crude oil received by U.S. refineries,[107] and imposed a tax on imported substances produced using chemical feedstock domestically taxable under the Superfund Act.[108] The tax on petroleum was deemed inconsistent with Article III:2[109] because the tax on the imported product (petroleum products) was higher than that on the like domestic product (crude oil), and Article III:2 applies whether or not trade is adversely affected.[110] However, it was determined that the tax on imported substances produced using domestically taxable chemical feedstock was border tax adjustment eligible.[111] This is because the tax on the imported substances equaled, in principle, the Superfund tax that would have been imposed on the chemicals used in producing the imported substance, had these chemicals been sold in the United States.[112]

Thus, an importing country could impose an e-waste import tariff in conjunction with a similar tax on domestically generated e-waste; however, without the domestic e-waste tax, the import tariff would likely be deemed inconsistent with Article III, even if trade is not affected.

B. *GATT Article XX(b) and (g) Exceptions*

If a trade measure is inconsistent with GATT obligations, the measure could still be allowed if excepted under Article XX. This involves a two-tiered analysis. First, the measure must qualify for an enumerated exception under Article XX, as determined by its

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is important to note that dispute panel and Appellate Body reports are case-specific and do not bind other disputes, even if the issues are the same. Interpretations of the rules are persuasive, however, in that future panel and Appellate Body decisions may follow them. *Dispute Settlement System Training Module: Chapter 7.2 Legal Status of Adopted/Unadopted Reports in Other Disputes*, WORLD TRADE ORG., http://www.wto.org/english/tratop_e/dispu_e/disp_settlement_cbt_e/c7s2p1_e.htm (last visited Nov. 19, 2013).

[107] *US—Superfund*, *supra* note 106, ¶ 2.2.

[108] *Id.* ¶ 2.4.

[109] Imported products cannot be subject to internal taxes or other internal charges of any kind in excess of those applied to like domestic products. GATT, *supra* note 98, at art. III, para 2.

[110] *US—Superfund*, *supra* note 106, ¶¶ 5.1.1, 5.1.12. The Panel decided that an evaluation of the trade *impact* of the tax was not relevant to the inquiry of whether the petroleum tax at issue was consistent with Article III. *Id.* ¶ 5.1.12.

[111] *Id.* ¶¶ 5.2.7, 5.2.10.

[112] *Id.* ¶ 5.2.8.

design and content.[113] Second, the measure cannot be applied in a discriminatory manner between similarly situated countries or be a disguised restriction on trade, as required by the introductory paragraph of Article XX (known as the "chapeau").[114]

There are two exceptions under Article XX relevant to health and environmental concerns associated with e-waste: Article XX(b) (which excepts measures necessary to protect life or health) and Article XX(g) (which excepts measures relating to the conservation of exhaustible natural resources). Supposing that an e-waste tariff is found to be inconsistent with GATT obligations, the following subparts discuss how these exceptions are applied.

1. *Article XX(b) Exception for Measures Necessary to Protect Life or Health*

Article XX(b) of the GATT provides that, subject to the requirements in the chapeau, "nothing in this Agreement shall be construed to prevent the adoption or enforcement by any contracting party of measures . . . necessary to protect human, animal or plant life or health."[115] Its application and the meaning of "necessary" are discussed in *Brazil—Measures Affecting Imports of Retreaded Tyres* (*Retreaded Tyres*).[116]

In *Retreaded Tyres*, Brazil had banned the import of retreaded tires, which are used tires with worn treads replaced by new material.[117] Retreaded tires have a shorter life span than new tires and contribute to the accumulation of waste tires.[118] Waste tire accumulation, like e-waste accumulation, poses health and safety risks,[119] and the objective of the import ban was to reduce these risks arising from the accumulation of waste tires to the "maximum extent possible."[120] The European Communities

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[113] Appellate Body Report, *United States—Import Prohibition of Certain Shrimp and Shrimp Products*, ¶ 118, WT/DS58/AB/R (Oct. 8, 1998) [hereinafter *US—Shrimp*] (citing Appellate Body Report, *United States—Standards for Reformulated and Conventional Gasoline*, p. 22, WT/DS2/AB/R (Apr. 29, 1996) [hereinafter *US—Gasoline*]).

[114] *See* GATT, *supra* note 98, at art. XX.

[115] *Id.* at art. XX(b) (emphasis added).

[116] *Appellate Body Report, Brazil—Retreaded Tyres*, *supra* note 88.

[117] *Id.* at n.2., ¶ 1.

[118] *Id.* ¶ 121.

[119] The risks associated with waste tire accumulation include mosquito-borne diseases, toxic chemicals, and fire hazards. *Id.* ¶ 119.

[120] *Id.* ¶ 134.

alleged that the import ban violated a number of GATT provisions.[121] Brazil defended the measures as being justified under Article XX(b).[122]

For the import ban to qualify under Article XX(b), the measure must be necessary to protect human, animal, or plant life or health: it must contribute to the realization of its stated objective, and there cannot be a reasonably available alternative to the measure.[123] Brazil's import ban satisfied this test.[124] Notably, it was unnecessary for the ban to eliminate waste tire accumulation, and it was unnecessary to quantify the risk reduction (a qualitative analysis sufficed).[125] While a ban is deemed to be the most trade-restrictive measure, the ban does not have to be "indispensable" to be "necessary;" it must be "apt to make a material contribution to the achievement of its objective."[126] It was noted that the contribution did not have to be immediately observable, as "certain complex public health or environmental problems may be tackled only with a comprehensive policy" that "can only be evaluated with the benefit of time."[127]

Alternatives proposed by complaining WTO members must be less trade restrictive than the measure at issue while preserving the desired level of protection, and they also must be "reasonably available."[128] An alternative (such as landfilling or incineration) is not reasonably available if associated risks (such as that from toxic leaching from landfilling or toxic emissions from incineration) would not arise from the measure at issue (an import ban).[129] Further, complementary measures to the measure at issue are not alternatives; better management of the waste or better disposal techniques would not be an alternative to the ban, but instead part of a comprehensive strategy to achieve the objective of the ban.[130]

Like retreaded tires, e-waste poses health and environmental

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121 *Id.* ¶ 2.
122 *Id.* ¶ 3.
123 *Id.* ¶ 146.
124 *Id.* ¶¶ 134, 144, 183.
125 *Id.* ¶¶ 147–49.
126 *Id.* ¶ 150 (noting that a ban is the most trade-restrictive measure implicitly acknowledges that an import tariff would be less trade-restrictive than a ban).
127 *Id.* ¶ 151.
128 *Id.* ¶ 156.
129 *Id.* ¶ 174.
130 *Id.* ¶ 172.

risks, and one objective of a tariff would be to reduce these risks by funding ways to safely process e-waste. The Article XX(b) analysis in *Retreaded Tyres* could apply to an e-waste tariff with a few differences. Compared to a ban, a tariff is less trade restrictive, but the connection between a tariff and the objective of reducing risks from improperly managed e-waste is less direct than that of a ban (because a tariff is only a funding mechanism and requires complementary programs to achieve the objective). Since the Appellate Body has recognized the need for comprehensive policies with interacting measures to address health and environmental problems, and the difficulty in isolating the contribution of a particular measure to the objective,[131] a tariff that funds the measures that reduce harm from e-waste could fit in the "comprehensive policy," especially given that funding materially contributes to achieving this objective. This, together with the tariff being less trade restrictive than a ban, suggests that an e-waste tariff could be provisionally justified under this exception.

2. *Article XX(g) Exception for Measures Relating to the Conservation of Exhaustible Natural Resources*

Article XX(g) provides that (subject to the chapeau's requirements) nothing in the GATT shall be construed to prevent members from adopting or enforcing measures "relating to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption."[132] The "relating to" clause requires an inquiry into the connection between the measure and the objective, and "made effective in conjunction with" is meant to ensure evenhanded imposition of restrictions on imported and domestic products.[133] *United States—Standards for Reformulated and Conventional Gasoline* (*US—Gasoline*)[134] and *United States—Import Prohibition of Certain Shrimp and Shrimp Products* (*US—Shrimp*)[135] illustrate this exception.

At issue in *US—Gasoline* were the baseline establishment

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[131] *Id.* ¶ 151.

[132] *See* GATT, *supra* note 98, at art. XX(g) (Article XX(b) in GATT corresponds to GATS XIV(b), but there is no GATS analog to GATT Article XX(g)).

[133] *See, e.g.*, *US—Gasoline*, *supra* note 113, at 20–21.

[134] *Id.*

[135] *US—Shrimp*, *supra* note 113.

rules, a part of a pollution control regulation promulgated under the 1990 Clean Air Act.[136] The baselines were set at a statutory level for foreign gasoline refiners, while domestic refiners were allowed to individually establish baselines.[137] This was determined to be inconsistent with Article III:4, but justifiable under Article XX(g).[138] The baseline establishment rules were "related to" the conservation of clean air in the United States because some kind of baseline was needed for monitoring compliance, and the objective of the regulation would be "substantially frustrated" without the baseline establishment rules.[139]

Adding to the "related to" analysis, *US—Shrimp* explained that the "substantial relationship" between the baseline establishment rules in *US—Gasoline* and the conservation of clean air in the United States was a "close and genuine relationship of ends and means."[140] Further, it held that the measure at issue must be "fairly narrowly focused" in scope with respect to the conservation objective.[141]

The second clause, which requires that the measure at issue is "made effective in conjunction with restrictions on domestic production or consumption," means that the measure must evenhandedly impose restrictions on foreign and domestic production or consumption of exhaustible natural resources for conservation purposes.[142] The baseline establishment rules in *US—Gasoline* satisfied this requirement.[143] Identical treatment of domestic and imported products was unnecessary; inconsistency with Article III:4 would not arise in the first place if treatment was identical. However, it was noted that if restrictions were imposed on imported products alone and not on like domestic products, the measure would simply be discrimination and not designed for implementing conservationist goals.[144]

For an e-waste tariff to qualify under Article XX(g), it must relate to the conservation of exhaustible natural resources, such as

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136 *US—Gasoline*, *supra* note 113, at 2, 4–5.
137 *Id.* at 5, 6.
138 *Id.* at 21–22.
139 *Id.* at 19.
140 *US—Shrimp*, *supra* note 113, ¶ 136.
141 *Id.* ¶ 138.
142 *US—Gasoline*, *supra* note 113, at 20–21.
143 *Id*. at 20.
144 *Id.* at 21.

clean air or water (which are polluted by e-waste dumping and incineration), and it must work in conjunction with domestic conservation measures for air or water. The tariff could be "related to" conservation because without the tariff (which funds responsible e-waste processing in a country that could not otherwise afford it) the conservation of clean air or water would be substantially frustrated. Note that this requires the importing country to have domestic conservation measures in place that could be substantially frustrated. The tariff also must be "narrowly focused," which could mean that it may only cover e-waste participating in the program funded by the tariff.

The evenhandedness requirement means that the tariff must work in conjunction with domestic conservation-related restrictions. The appropriate domestic restriction would likely be a tax on domestically generated e-waste, which could be a problem if the importing country were seeking an Article XX exception because it could not adopt a domestic tax in the first place to satisfy Article II:2. While domestic and imported products need not be treated identically, according to *US—Gasoline*, it appears that a domestic tax cannot be entirely absent. But because WTO cases are highly fact specific, there is the possibility that a future panel or appellate body would determine that the evenhandedness requirement is not necessarily the same for developed and developing countries. If a developing country does not impose a tax on domestic e-waste in conjunction with an import tariff, this disparity in treatment may be due to inability rather than protectionism, which was the concern articulated in *US—Gasoline*.

3. *Article XX Chapeau*

A trade-restricting measure provisionally justified under an Article XX exception must also satisfy the chapeau, which concerns the measure's application.[145] Satisfying the chapeau is a "heavier task" than showing that the measure fits within one of the exceptions, because the member seeking the exception must show

[145] *US—Shrimp*, *supra* note 113, ¶ 116. To run afoul of the chapeau, the measure would have to be applied in manner that results in discrimination, the discrimination would have to be arbitrary or unjustifiable in character, and this discrimination would have to occur between countries where the same conditions prevail. *Id.* ¶ 150. *US—Gasoline* clarified that such discrimination could occur between exporting and importing members as well as between different exporting members. *US—Gasoline*, *supra* note 113.

that the measure is not applied in an abusive manner.[146] Indeed, none of the provisionally justified measures in the Article XX cases discussed above satisfied the chapeau.[147]

In *US—Gasoline*, the United States was deemed not to have adequately explored means of mitigating problems associated with imposing the same baseline establishment rules on foreign and domestic refiners, because it should have pursued cooperative agreements with the complaining WTO members.[148] This deficiency of process was deemed "unjustifiable discrimination" and a "disguised restriction on international trade."[149] Similarly, the United States was found not to have sufficiently engaged all of the members selling it shrimp "in serious, across-the-board negotiations with the objective of concluding bilateral or multilateral agreements" before banning imports from them.[150] This was especially important in light of the fact that the objective of the measure, protecting migratory sea turtles, required cooperation from many countries.[151] The United States was found to have negotiated seriously with some but not all members selling it shrimp, and to have endeavored to transfer turtle-protecting technology unequally among the countries.[152] Because the "cumulative effect" of the measure's application to various members is considered, the differences in treatment were deemed to constitute "unjustifiable discrimination."[153]

In *Retreaded Tyres*, Brazil was found to have applied its import ban in a manner constituting arbitrary or unjustifiable discrimination[154] because it granted an exception to the ban to Mercosur[155] members for remolded tires.[156] Even though this

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146 *US—Gasoline*, *supra* note 113, at 22–23.

147 *Appellate Body Report, Brazil—Retreaded Tyres*, *supra* note 88, ¶ 252; *US—Shrimp*, *supra* note 113, ¶¶ 142, 145, 186; *US—Gasoline supra* note 113, at 29.

148 *US—Gasoline*, *supra* note 113, at 25, 26, 28.

149 *Id.* at 29.

150 *US—Shrimp*, *supra* note 113, ¶ 166.

151 *Id.* ¶ 168.

152 *Id.* ¶ 175.

153 *Id.* ¶ 176. The rigid and inflexible application of the measure was also deemed to constitute "arbitrary discrimination between countries where the same conditions prevail." *Id.* ¶ 177.

154 *Appellate Body Report, Brazil—Retreaded Tyres*, *supra* note 87, ¶¶ 232–33.

155 Mercosur, or the Mercado Común del Sur (Southern Common Market), is a regional trade agreement between Brazil, Argentina, Uruguay, and Paraguay.

exception arose out of a decision by a Mercosur arbitral tribunal, it was determined that despite the fact that discrimination may arise from a rational decision, it still can be "arbitrary or unjustifiable" because its underlying rationale is not related to the objective of the measure seeking Article XX exception.[157]

While treating similarly situated WTO members differently is expressly disfavored,[158] treating differently situated members the same has also been deemed unacceptable. In *US—Shrimp*, the United States was faulted for imposing "essentially the same" policy on countries importing shrimp into the United States as that enforced on American shrimp trawlers; for applying a "rigid and unbending standard" for certifying countries that may export shrimp to the United States; and for not accounting for different conditions that may occur in other members' territories.[159]

The Appellate Body decisions discussed above indicate that the chapeau, as interpreted, imposes a high standard. While a defect in a measure's application under the chapeau may be cured by a serious, good faith attempt to negotiate a multilateral agreement with all involved members, prolonging discourse increases the cost of delay in implementing a measure.[160] Nevertheless, this process may be necessary in implementing an e-waste tariff that can satisfy the chapeau.

See, e.g., *Appellate Body Report, Brazil—Retreaded Tyres*, *supra* note 88, at vi.

[156] Remolded tires are a subcategory of retreaded tires. *Id.* at n.8.

[157] *Id.* ¶¶ 228, 232.

[158] GATT Article I attempts to minimize discrimination based on a product's country of origin by extending preferential treatment granted to any one country to all countries. GATT, *supra* note 98, at art. I.

[159] *US—Shrimp*, *supra* note 113, ¶¶ 163, 164. The Appellate Body stated that "discrimination results not only when countries in which the same conditions prevail are differently treated, but also when the application of the measure at issue does not allow for any inquiry into the appropriateness of the regulatory program for the conditions prevailing in those exporting countries." *Id.* ¶ 165.

[160] The United States revised its guidelines in response to the Appellate Body's decision in *US—Shrimp* to introduce flexibility in the application of the measure at issue and made "serious, good faith efforts" to negotiate an international agreement. This effort was sufficient, and the Appellate Body clarified that an international agreement need not be concluded. *United States—Import Prohibition of Certain Shrimp and Shrimp Products*, *Recourse to Article 21.5 of the DSU by Malaysia*, WT/DS58/AB/RW (Oct. 22, 2001) ¶¶ 6–7, 134. Note, however, that this decision to uphold the import ban came three years after the Appellate Body decision to strike it down.

C. *GATT Provisions Aimed at Facilitating Economic Development*

For developing countries implementing tariffs, there are a number of GATT provisions available to aid their development. For example, Article XVIII:4 allows qualifying countries "to deviate temporarily from the provisions of the other Articles" of the GATT.[161] Article XXVIII *bis* provides that tariff negotiations should consider "the needs of less-developed countries for a more flexible use of tariff protection to assist their economic development and the special needs of these countries to maintain tariffs for revenue purposes," as well as "all other relevant circumstances," including fiscal, developmental, and strategic needs.[162] Thus, Article XVIII:4 could provide temporary relief from GATT obligations for an e-waste tariff, and Article XXVIII *bis* could help with e-waste tariff negotiations and potentially negotiations needed to satisfy the chapeau.

In summary, an e-waste import tariff adopted in conjunction with a tax on domestic e-waste likely could qualify as a border tax adjustment under Article II:2. If the domestic tax is infeasible, the provisions facilitating development in Article XXVII may still allow the tariff to stand temporarily despite Article III obligations. Otherwise, the importing country would have to ensure that the process of adopting and implementing the tariff and its substance will enable it to be justified as an Article XX exception.

To be provisionally justified under Article XX(b) or (g), the importing country must articulate the tariff's objective as one that protects human, animal, or plant life or health; or conserves exhaustible natural resources, such as clean air or water. To qualify under Article XX(g), the importing country must also have domestic conservation laws (e.g., for clean air or water) with which the tariff would work. This could be an issue if the importing country does not have these environmental laws or if the laws are not sufficient to justify the tariff.

As discussed above, the tariff is likely to be necessary under Article XX(b), as it is apt to make a material contribution to protecting human life or health. Also, the tariff could be related to the conservation of clean air or water under Article XX(g), and in countries that otherwise have little funding for conservation,

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[161] GATT, *supra* note 98, at art. XVIII, para. 4.

[162] *Id.* at art. XXVIII *bis*, para. 3.

conservation efforts associated with e-waste processing would be substantially frustrated without the tariff. To qualify for this exception, the tariff would have to be narrowly focused (e.g., it probably could not cover imports that would not be processed through the program funded by it).

Article XX(g)'s evenhandedness requirement may be difficult to satisfy because it requires that the tariff work in conjunction with domestic conservation-related restrictions. *US—Gasoline* did not require that the domestic restriction be identical to that imposed on the imported product, but it could not be entirely absent. For an e-waste import tariff, the appropriate domestic restriction would likely be a tax on domestically generated e-waste. This could be a problem if the importing country had to seek an Article XX exception because it could not adopt a domestic tax that satisfies Article II:2 in the first place. For this reason and because of the potential inadequacy of domestic conservation laws, the case for an Article XX(b) exception may be stronger than that for Article XX(g).

Once the tariff is provisionally justified under one of the exceptions, it still needs to satisfy the chapeau. From the cases discussed above, there appears to be very little tolerance for discrimination in the measure's application. However, a WTO member seeking to impose a tariff that is applied in a discriminatory way may be able to overcome invalidity under the chapeau by making a serious, good faith attempt to negotiate a multilateral agreement with all involved members. In this way, an importing country could unilaterally impose a tariff absent international cooperation after a lengthy process.

A problem that is fundamentally international is likely best addressed at the international level, but piecemeal measures at the national and state levels could also help. On the national level, the e-waste problem could be addressed by importing countries enacting and enforcing laws protecting against the hazards of e-waste processing. But unless all of the importing countries take action, e-waste will end up in the countries that do not have adequate and enforced regulations. Ideally, this would lead to a race to the top, where every country adopts and enforces laws to avoid becoming the global dumping ground. But this has not occurred to the extent necessary, whether due to political failure, lack of capacity, or desire for a short-term gain from trade at the expense of costs likely to be borne in the future. Exporting

countries could also adopt laws prohibiting exports to countries without adequate protections for human health and the environment, but this has not happened to the extent necessary either, likely because developed countries do not have an incentive to eliminate the option to cheaply dispose of e-waste, or because it is politically infeasible. The United States' efforts in regulating e-waste exports are discussed in the first part of Part IV. Individual state efforts are discussed in the second part. While states may regulate some e-waste recycling and disposal activities, they are constitutionally limited in regulating export and thus cannot fully address a problem involving international trade.

IV. U.S. E-WASTE REGULATION

Apart from participating in a tariff scheme, the United States could help address the e-waste problem on multiple levels. It could ratify the Basel Convention and the Ban Amendment; legislate to address the e-waste export problem or allow explicitly for states to do so; and promulgate, amend, and enforce federal export regulations related to e-waste.

The United States has signed but has not ratified the Basel Convention, and ratification would help in several ways. For example, ratification would require the United States to expand the scope of waste that it regulates to be consistent with Basel Convention definitions. The United States would have to be aware of what it cannot export to certain countries, ensure that the wastes would be handled and disposed of in an environmentally sound manner abroad, and take back exports of hazardous waste refused by the importing country.[163]

A. *Federal Legislation and Regulations*

There is currently no federal legislation governing e-waste recycling and export, despite attempts in 2010 and 2011 to pass a bill banning certain e-waste exports.[164] The most applicable

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[163] *See* GAO, *supra* note 4, at 34–35.

[164] The Responsible Electronics Recycling Act was introduced to prohibit the export of certain electronics whose improper disposal may create environmental, health or national security risks. *Reps. Green and Thompson Introduce Electronic Waste Recycling Bill, H.R. 2284, The Responsible Electronics Recycling Act of 2011* (June 23, 2011), http://green.house.gov/press-release/reps-green-and-thompson-introduce-electronic-waste-recycling-bill. Senator Whitehouse sponsored companion legislation, S. 1270. S. 1270 (112th): Responsible

statutory framework related to e-waste is RCRA,[165] a statute governing solid and hazardous waste. While some electronics can be considered hazardous under RCRA,[166] the EPA has exempted some e-waste from hazardous waste handling requirements to facilitate recycling and reuse.[167] However, there is no regulatory mandate to recycle e-waste under RCRA.

As to e-waste export, the EPA regulates only CRTs,[168] which are typically hazardous due to high lead content.[169] The EPA recognized that the "unfettered export of CRTs for recycling could lead to environmental harm," and that CRTs are "sometimes managed so carelessly that they pose possible human health and environmental risks from such practices as open burning, land disposal, and dumping into rivers."[170] Thus, the EPA requires

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Electronics Recycling Act, GOVTRACK.US, http://www.govtrack.us/congress/bills/112/s1270. Both bills died after being referred to Committee. *Id.*; *H.R. 2284 (112th): Responsible Electronics Recycling Act*, GOVTRACK.US, http://www.govtrack.us/congress/bills/112/hr2284. In opposition was the Institute of Scrap Recycling Industries. Gross, *supra* note 88. The 2010 e-waste bill was similar to the 2011 bill. *Id.*

165 42 U.S.C. §§ 6901–6992k (2006).

166 Resource Conservation and Recovery Act section 1004(5) defines "hazardous waste" as a "solid waste" that may significantly contribute to an increase in mortality or serious illness; or pose a substantial hazard to human health or the environment when improperly treated, stored, transported, disposed of or otherwise managed. 42 U.S.C. § 6903(5) (2006). Hazardous waste is more specifically defined in 40 C.F.R. § 261.3 (2013). Once a material is determined to be "solid waste," it can be "hazardous waste" if it is listed under 40 C.F.R. §§ 261.3(a)(2)(ii), 261.31–33 (2013), or if it exhibits ignitability, corrosivity, reactivity or toxicity. 40 C.F.R. §§ 261.3(a)(2)(i), 261.21–24 (2013).

167 *Wastes – Resource Conservation – Common Wastes & Materials – eCycling*, U.S. EPA, http://www.epa.gov/osw/conserve/materials/ecycling/rules.htm (last updated Nov. 7, 2013). Other exemptions and exclusions from RCRA include conditionally-exempt small quantity generators, 40 C.F.R. § 261.5(2013), and the Household Waste Exclusion, which excludes from federal hazardous waste management requirements all waste generated by normal households, hotels, campgrounds, and other facilities offering residential services, 40 CFR § 261.4(b)(1)(2013). Thus, the source of the e-waste is partially determinative of whether it is hazardous waste.

168 *See* GAO, *supra* note 4, at 6. A CRT is the vacuum-sealed glass and metal unit found in obsolete computer monitors and televisions. *Id* at 12.

169 Each CRT contains up to seven pounds of lead. *See, e.g.*, KPCC SOUTHERN CALIFORNIA PUBLIC RADIO, *supra* note 39. Color CRTs sampled as entire units will almost always fail the Toxicity Characteristic Leaching Procedure, 40 C.F.R. § 261.24(a), for lead. TIMOTHY G. TOWNSEND ET AL., RCRA TOXICITY CHARACTERIZATION OF COMPUTER CPUS AND OTHER DISCARDED ELECTRONIC DEVICES x, 5-1, 5-2 (2004).

170 Modification of the Hazardous Waste Program; Cathode Ray Tubes, 71

exporters of CRTs for recycling to comply with requirements similar to those for hazardous waste exports,[171] but the EPA's CRT export rules for recycling exclude CRTs from the definition of solid waste under RCRA if certain requirements are satisfied.[172] An exporter for recycling must notify the EPA and obtain consent from the destination country, provide shipping route information, and provide information on the manner in which the CRTs will be handled and recycled abroad.[173]

The EPA's rule for CRT exports for reuse requires less from exporters than for recycling because the EPA does not have the same RCRA authority over reuse (even though CRTs exported for reuse are often similarly treated once abroad).[174] An exporter for reuse need only send a one-time notification to the EPA and maintain records demonstrating that each shipment of exported CRTs will be reused.[175] But the rule does not require exporters to provide the date and destination of the export or the nature of the reuse, and nothing in the rule explicitly enables the EPA to request records demonstrating reuse. This makes it difficult for the EPA to determine whether these exporters should have followed the rules for recycling or for disposal. Consent from the receiving country is not required before CRTs are exported for reuse, and this is especially problematic in cases where there is a ban on the import of used CRTs. Because notice does not have to be given in advance or indicate the destination country, it is difficult to identify and intercept problem shipments before they leave the United States. Further, "reuse" and "recycling" are not defined for the purposes of CRT exports. Lacking definitions, CRTs that should be exported pursuant to the rules for recycling are sometimes exported under the rules for reuse.[176] The CRT export rules are therefore easily circumvented by exporters,[177] and

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Fed. Reg. 42928, 42938 (July 28, 2006).

[171] *Id.*

[172] 40 C.F.R. §§ 261.39–40 (2013).

[173] 40 C.F.R. §§ 261.39(a)(5)(i), (v) (2013).

[174] *See* BASEL ACTION NETWORK, *supra* note 8, at 7.

[175] 40 C.F.R. § 261.41(a) (2013).

[176] The EPA recognizes that "some CRTs allegedly exported for reuse are actually recycled in the receiving country, sometimes under unsafe conditions." Revision to the Export Provisions of the Cathode Ray Tube (CRT) Rule, 77 Fed. Reg. 15336, 15339 (proposed Mar. 15, 2012). *See also* GAO, *supra* note 4, at 17.

[177] GAO, *supra* note 4, at 23 ("43 U.S. companies that responded to our fictitious requests were willing to export nonworking CRTs to us, in apparent

lacking export restrictions on other forms of e-waste, e-waste exports from the United States are virtually unimpeded.[178]

While the EPA could promulgate stronger regulations for e-waste export under RCRA, there are challenges with regulating e-waste purportedly exported for reuse under RCRA. For e-waste to fall within the scope of RCRA, it has to be "solid waste."[179] Solid waste is defined to be "discarded material," among other things.[180] Discarded material includes that which is abandoned, and abandonment includes disposal, burning, incineration, or accumulation.[181] Much of the e-waste shipped abroad is disposed of, burned, incinerated, or accumulated and would fit within the definition of solid waste. But material that is actually reused is not solid waste,[182] and an exporter may assert that its e-waste is being exported for reuse and escape regulation. Thus, RCRA's scope makes it difficult to regulate e-waste that is purportedly intended for reuse, but is in fact shipped abroad for disposal or recycling.

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violation of the CRT rule.").

[178] *Id.* at 6. The EPA is in the process of revising the CRT export rules to collect more information from exporters. Revision to the Export Provisions of the Cathode Ray Tube (CRT) Rule, 77 Fed. Reg. 15336, 15339 (proposed Mar. 15, 2012). The final rule was expected in July 2013, but has yet to be promulgated. Revision to the Export Provisions of the Cathode Ray Tube (CRT) Rule, http://www.regulations.gov/#!docketDetail;D=EPA-HQ-RCRA-2011-1014.

[179] *See* 42 U.S.C. § 6901(a) (discussing Congressional findings with respect to solid waste); 42 U.S.C. § 6902(a) (discussing the statute's objectives with respect to solid waste). In the Ninth Circuit, whether material is "waste" under RCRA depends on: "(1) whether the material is destined for beneficial reuse or recycling in a continuous process by the generating industry itself, Am. Mining Cong. v. EPA, 824 F.2d 1177 (D.C. Cir., 1987) at 1186; (2) whether the materials are being actively reused, or whether they merely have the potential of being reused, Am. Mining Cong. v. EPA, 907 F.2d 1179 (D.C. Cir., 1990) at 1186; (3) whether the materials are being reused by its original owner, as opposed to use by a salvager or reclaimer, U.S. v. ILCO, 996 F.2d 1126 (11th Cir.,1993) at 1131." Safe Air for Everyone v. Meyer, 373 F.3d 1035, 1043 (9th Cir. 2004) (internal quotation omitted).

[180] Resource Conservation and Recovery Act of 1976 § 1004(27), 42 U.S.C. § 6903 (2006). EPA regulations define solid waste to be "any discarded material," that is not excluded under 40 C.F.R. §§ 261.5(a), or granted a variance under §§ 260.30–31. 40 C.F.R. § 261.2(a)(1) (2013).

[181] 40 C.F.R. § 261.2(a)(2)(i)(A), (b) (2013).

[182] "Materials are not solid wastes when they can be shown to be recycled by being . . . [u]sed or reused as effective substitutes for commercial products," 40 C.F.R. § 261.2(e)(1)(ii) (2013). But the definition of discarded material does include recycled materials that are used in a manner constituting disposal. 40 CFR § 261.2(a)(2)(i)(B), (c)(1) (2013).

Incorporating waste intended for reuse within the meaning of "solid waste" under RCRA has been difficult. Industry has successfully challenged the EPA's definition of solid waste in the past with respect to reuse: the DC Circuit held that the EPA exceeded its authority "in seeking to bring materials that are not discarded or otherwise disposed of within the compass of 'waste.'"[183] The Court held that Congress used the term "discarded" in its ordinary sense, to mean "disposed of" or "abandoned" and that the term "discarded materials" under RCRA section 1004(27) could not include materials "destined for beneficial reuse . . . in a continuous process by the generating industry itself."[184] Since Congress had directly spoken to this issue,[185] the EPA's definition was not entitled to *Chevron* deference.[186]

In light of this history, the EPA may have difficulty bringing e-waste purportedly intended for reuse directly within the meaning of "solid waste,"[187] but this situation could be distinguished from the aforementioned case. Note that e-waste purportedly destined for reuse is not part of "a continuous process by the generating industry itself."[188] It is shipped to another end user overseas, so it is difficult to monitor and verify that the e-waste will be reused. Indeed, courts have found that material, presumably reusable, could be solid waste if it is not clear that the material will actually be reused or sold.[189]

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[183] Am. Mining Cong. v. EPA, 824 F.2d 1177, 1178 (D.C. Cir. 1987).

[184] *Id*. at 1186, 1188–90.

[185] *Id*. at 1193.

[186] Chevron U.S.A., Inc. v. Natural Res. Def. Council, Inc., 467 U.S. 837 (1984).

[187] The EPA has proposed revisions to the CRT export rule which would require that the reuse and recycling of solid waste be legitimate as specified in 40 C.F.R. § 260.43, which describes the conditions for the legitimate recycling of hazardous secondary materials. Definition of Solid Waste, 76 Fed. Reg. 44094, 44150, 44153 (proposed July 22, 2011). A hazardous secondary material includes spent material or by-product that would be hazardous waste under 40 C.F.R. pt. 261 when discarded. But hazardous secondary materials are not necessarily solid waste until discarded. *See id*. at 44096, n.1. Thus, the proposed rule would not bring e-waste purportedly destined for reuse within the definition of solid waste until it is discarded. As of this writing, the final rule has not been promulgated. *See Docket Folder Summary: Revisions to the Definition of Solid Waste*, REGULATIONS.GOV, http://www.regulations.gov/#!docketDetail;D=EPA-HQ-RCRA-2010-0742 (last visited May 5, 2014).

[188] 824 F.2d at 1186.

[189] *See* Am. Mining Cong. v. EPA, 907 F. 2d 1179, 1185–86 (D.C. Cir. 1990)

B. *State E-Waste Recycling Programs*

The EPA establishes minimum waste management standards under RCRA, but states may adopt requirements that are more stringent or broader in scope.[190] About half of the states have enacted e-waste recycling legislation, which comes in two types: advance recovery fee (ARF) and extended producer responsibility (EPR).[191]

The ARF system, adopted by California, requires that consumers pay a disposal fee when they purchase certain electronics (discussed further below). An advantage of this system is that it is visible to consumers and could help raise awareness of e-waste disposal issue and incent them to generate less waste. California is the only state to have adopted the ARF system.[192]

EPR programs vary and may require that manufacturers pay all or a portion of end-of-life management costs, take possession of their products after consumer discard, label products with component or materials lists to reduce the cost of third-party recycling, or be financially liable for environmental damage and clean-up costs from hazardous waste disposal.[193]

An advantage of EPR is that it could incent producers to minimize hazardous components[194] and design products that are

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(The 1987 *American Mining Congress* "holding concerned only materials that are 'destined for immediate reuse in another phase of the industry's ongoing production process'" and that "have not yet become part of the waste disposal problem." Potential reuse of a material does not prevent EPA from classifying it as "discarded.") (citing Am. Petroleum Inst. v. EPA, 906 F.2d 729, 740–41 (D.C.Cir.1990)); Owen Elec. Steel Co. v. EPA, 37 F.3d 146, 150 (4th Cir. 1994) (finding that slag held untouched for six months before sale for use as road bed could constitute solid waste).

190 RCRA § 3009, 42 U.S.C. § 6929 (2006); 40 C.F.R. § 271.1(i) (2008).

191 *See, e.g.*, *State Legislation*, ELECS. TAKEBACK COAL, http://www.electronicstakeback.com/promote-good-laws/state-legislation (last visited May 5, 2014). A benefit of state action in the e-waste arena is that patchwork state regulation may drive industry to lobby Congress for federal legislation that creates a more uniform framework.

192 *See id.*

193 *See, e.g.*, Noah Sachs, *Planning the Funeral at the Birth: Extended Producer Liability in the European Union and the United States*, 30 HARV. ENVTL. L. REV. 51, 63 (2006); Hannah G. Elisha, Note, *Addressing the E-Waste Crisis: The Need for Comprehensive Federal E-Waste Regulation Within the United States*, 14 CHAP. L. REV. 195, 213 (2010).

194 In conjunction with the ARF, California has required that manufacturers of certain electronic devices demonstrate their efforts to reduce toxic substances and increase recycled content in their devices. *See*, CAL. PUB. RES. CODE §

easier to recycle, but only if producers see the costs of proper disposal.[195] If e-waste can be cheaply disposed of out-of-state or abroad, producers in EPR schemes will do just that. Some form of international measure, such as a trade ban or tariff system, could work with domestic measures to put disposal responsibility on those taking back the waste. A ban would force these actors to recycle the waste domestically, and a tariff system that takes into account the cost of proper disposal would incent producers to design products with lower hazardous content to minimize the tariff.

Incenting consumers to generate less waste and dispose of it responsibly would also be helpful. Although consumers do not directly see the disposal fee in EPR, they may pay these costs through higher product prices passed on by the manufacturer. Higher prices may drive consumers to be more discerning in their purchases, use the products longer and, in doing so, consume fewer resources, and generate less hazardous waste.

Any e-waste recycling scheme also would need to incent consumers to actually turn in the e-waste—otherwise, even with ARF or EPR schemes in place, consumers might not expend the effort to turn e-waste in for recycling and simply throw it in the dumpster instead. An incentive scheme could take the form of a deposit-refund system,[196] where consumers pay a deposit upon purchase and retrieve the deposit upon proper disposal.

To illustrate some of the challenges faced by state e-waste

42465.2(a)(1)(B) (West 2004).

[195] Consumers can pressure producers to design and manufacture products with lower hazardous content; a tax on consumer purchases proportional to the hazardous content of the products purchased would incent consumers to exert this type of purchasing power. Consumers may not, however, be able to achieve this through purchasing decisions because consumers buy products based on bundled factors and may not select products based on hazardous content. Regulations that encourage innovative waste reduction are another option. For example, requiring manufacturers to incorporate modular design would enable consumers to easily disassemble their electronic devices and replace certain parts (rather than the entire unit) as they break or become obsolete. This would generate less waste and save money for consumers. Further, the component parts could be designed to be easily disposed of by making them small enough to mail. *Electronic Waste: Garbage In, Garbage Out*, ECONOMIST (Apr. 24, 2011), *available at* rss.economist.com/blogs/babbage/2011/04/electronic_waste.

[196] *See, e.g.*, NAT'L CTR. FOR ENVTL. ECON, U.S. EPA, EPA-240-R-01-001, THE UNITED STATES EXPERIENCE WITH ECONOMIC INCENTIVES FOR PROTECTING THE ENVIRONMENT , 57 (Jan. 2001), *available at* http://yosemite.epa.gov/ee/epa/eerm.nsf/vwAN/EE-0216B-13.pdf/$file/EE-0216B-13.pdf.

recycling programs, it is useful to discuss California's program as an example. California was the first state to enact an e-waste recycling law, the Electronic Waste Recycling Act of 2003. The two primary objectives are to limit the amount of toxic substances in certain electronic products sold in California and to establish a funding system for their collection and recycling.[197] Under the first objective, manufacturers of covered electronic devices must provide information demonstrating their efforts in reducing toxic substances and increasing recyclable materials in their electronics.[198] The funding system established under the second objective requires that retailers collect a fee from consumers purchasing covered electronic devices.[199] This fee is deposited into a state-managed account, and payments are transferred to approved recyclers based on the weight of covered electronics recycled.[200]

From 2005 to 2012, California's program diverted more than a billion pounds of e-waste from landfills.[201] But the program has not stopped the export of its e-waste to developing countries, and by paying recyclers for processed e-waste by weight, the state has "built a magnet for fraud totaling tens of millions of dollars, including illegal material smuggled in from out of state."[202] Because California regulations stipulate that recyclers and collectors can only receive payments for in-state generated waste,[203] the state must verify that every piece of waste submitted

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[197] *E-Waste More Information*, CAL. DEP'T TOXIC SUBSTANCES CONTROL, http://www.dtsc.ca.gov/HazardousWaste/EWaste/MoreInfo.cfm (last visited July 21, 2014). *See generally* CAL. PUB. RES. CODE § 42461 (West 2014) *and* CAL. PUB. RES. CODE § 42463(e) (West 2014) (The electronic devices covered are video display devices as specified in the regulations).

[198] CAL. PUB. RES. CODE § 42465.2 (West 2014).

[199] CAL. CODE REGS. tit. xiv, § 18660.40(a)–(c) (West 2014).

[200] CAL. PUB. RES. CODE § 42476(a)(2) (West 2014).

[201] CALRECYCLE, UPDATE ON CALIFORNIA'S COVERED ELECTRONIC WASTE RECYCLING PROGRAM IMPLEMENTATION OF THE ELECTRONIC WASTE RECYCLING ACT OF 2003 (2012), *available at*, http://www.calrecycle.ca.gov/electronics/CEW/ProgramStats.pdf.

[202] Tom Knudson, *Recycling E-Waste Yields Unexpected Byproduct: Fraud*, PORTLAND PRESS HERALD, Aug. 1, 2010, http://www.pressherald.com/business/recycling-e-waste-yields-unexpected-byproduct_2010-08-01.html ("Faulty and fraudulent claims of $1.9 million the first year climbed to $6.8 million in 2008 and to $9.8 million last year; the state has rejected payment on 6.5 percent of all claims—$22.6 million out of $347 million.").

[203] CAL. CODE REGS. tit. xiv, § 18660.6(c) (West 2014). Waste collectors must certify that they "shall make reasonable efforts to ensure that any [covered

for a claim is associated with a California address,[204] which can be a resource-intensive process. But the program is structured in this way to ensure that it fits within the market participant exception to withstand Dormant Commerce Clause challenges.

The Dormant Commerce Clause is the negative implication of the Constitutional grant to Congress of the power to "regulate Commerce with foreign Nations, and among the several States."[205] Because the federal government, and not the states, was explicitly delegated this power, the states are impliedly preempted from exercising this authority.

Whether a state law violates the Dormant Commerce Clause depends on whether it discriminates against interstate commerce. "Discrimination" means "differential treatment of in-state and out-of-state economic interests that benefits the former and burdens the latter."[206] Discriminatory laws motivated by "simple economic protectionism" are subject to a "virtually per se rule of invalidity."[207] This can be overcome by showing that there is no other means to advance a legitimate local purpose[208] or by invoking the market participant exception: a state law that discriminates against out-of-state waste may be valid if the state is acting as a purchaser, seller, or subsidizer.[209] The exception allows states to engage in certain discriminatory practices so long as the state is "acting as a market participant, rather than as a market

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electronic wastes] for which payment is claimed originate from a California source." CAL. CODE REGS. tit. xiv, § 18660.12(a)(3)(A) (West 2014). In submitting payment claims, recyclers must certify that the weights include "the adjustments for [covered electronic wastes] from non-California sources." CAL. CODE REGS. tit. xiv, § 18660.22(7)(A)(3).

[204] *See* Knudson, *supra* note 202.

[205] U.S. CONST. art. I, § 8.

[206] Or. Waste Sys., Inc. v. Dep't of Envtl. Quality of Or., 511 U.S. 93, 99 (1994).

[207] Philadelphia v. New Jersey, 437 U.S. 617, 624 (1978) (striking down a statute that stated "[n]o person shall bring into this State any solid or liquid waste which originated or was collected outside the territorial limits of the State." N.J. Stat. Ann. § 13:1I-10 (West Supp. 1978)).

[208] The law would have to meet the strict scrutiny standard, as in *Maine v. Taylor*, 477 U.S. 131, 138 (1986). But note that this is the only case that has met this standard. Benjamin J. McCracken, *Combating Canadian Trash Under the Guise of Dormant Commerce Clause*, 82 U. DET. MERCY L. REV. 59, n.77 (2004).

[209] *See, e.g.*, South-Central Timber Dev., Inc. v. Wunnicke, 467 U.S. 82, 93 (1984).

regulator."[210]

California declared in its Electronic Waste Recycling Act that it is a market participant[211] and designed its program as a subsidy in order to fit within this exception.[212] Thus, California subsidizes voluntary e-waste recycling and does not at the same time mandate recycling in order to avoid engaging as a regulator.

Should California's program hypothetically fall outside the market participant exception, the program would not necessarily be invalid. If the state regulation is not considered discriminatory in intent, the balancing test under *Pike v. Bruce Church* would apply.[213] The *Pike* court held that the challenged statute did not have a discriminatory intent because it was a fraud prevention statute and did not mean to treat differently "in-state and out-of-state economic interests that benefit[] the former and burdens the latter."[214] Arguably, California's statute is similarly nondiscriminatory in intent because its objective is to promote e-waste recycling, which is funded by its own residents.[215] Under

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[210] *Id.* at 93 ("Our cases make clear that if a State is acting as a market participant, rather than as a market regulator, the Dormant Commerce Clause places no limitation on its activities."). The issue in *Wunnicke* was whether Alaska could require that locally harvested timber be "partially processed" in-state before leaving the state. The Court held that this made Alaska a regulator, taking it outside of the scope of the market participant exception.

[211] *See generally* CAL. PUB. RES. CODE § 42476(f)(4) (West 2014) ("The board declares that the state is a market participant in the business of the recycling of covered electronic waste for all of the following reasons: (A) The fee is collected from the state's consumers for covered electronic devices sold for use in the state. . . . (C) The recycling system funded by the fee ensures that economically viable and sustainable markets are developed and supported for recovered materials.").

[212] A state can directly subsidize the primary-processing industry within the state. *See, e.g.*, Hughes v. Alexandria Scrap Corp., 426 U.S. 794 (1976) (upholding a Maryland statute that differentiates between in-state and out-of-state scrap processors in terms of the needed documentation in order to receive a subsidy for the processed scrap).

[213] Pike v. Bruce Church Inc., 397 U.S. 137, 142 (1970).

[214] Or. Waste Sys., Inc. v. Dep't of Envtl. Quality of Or., 511 U.S. 93, 99 (1994).

[215] In *United Haulers Association Inc. v. Oneida-Herkimer Solid Waste Management Authority*, 550 U.S. 330 (2007), the Supreme Court decided that county ordinances requiring that all solid waste generated within the county be delivered to the county's publicly-owned solid waste processing facility do not violate the Dormant Commerce Clause. The plurality upheld the ordinance under the *Pike* balancing test, pointing out "that the most palpable harm imposed by the ordinances—more expensive trash removal—is likely to fall upon the very people who voted for the laws. Our Dormant Commerce Clause cases often find

the *Pike* test, a court should uphold a nondiscriminatory statute "unless the burden imposed on [interstate] commerce is clearly excessive in relation to the putative local benefits."[216] But California's program does not bar out-of-state e-waste from being recycled in California (it merely refrains from authorizing state funds to pay for its recycling). Therefore, the e-waste recycling law does not affect out-of-state e-waste, and thus arguably does not burden it. It would be even harder to argue further that the law imposes a burden on interstate commerce "clearly excessive in relation to the putative local benefits."[217]

Operating a recycling subsidy program to take advantage of the market participant exception is one way to avoid invalidity under the Dormant Commerce Clause, but it is resource intensive because the state must verify that each piece of e-waste recycled under its program originated from within the state. And while processing hazardous e-waste domestically could ensure that it is not dumped on developing countries, doing so has a similar effect as a ban by forgoing a more efficient alternative for responsible e-waste recycling elsewhere. To take advantage of such a possibility, the state might be able to collect e-waste as part of a voluntary program and sell it to responsible recyclers overseas. Whether this would pass muster under the dormant Foreign Commerce Clause is unclear, as the U.S. Supreme Court has not formally decided whether the dormant Foreign Commerce Clause has a market participant exception.[218] But to stay within the market participant exception, the state would not be able to mandate participation in the e-waste collection program, as doing so would be to engage as

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discrimination when a State shifts the costs of regulation to other States, . . . Here, the citizens and businesses of the Counties bear the costs of the ordinances." *Id.* at 345. Similarly, the citizens of California, under its program, bear the costs of e-waste recycling.

[216] Pike v. Bruce Church Inc. 397 U.S.137, 142 (1970).

[217] The Supreme Court struck down a flow control ordinance that forced haulers to deliver waste to a particular private processing facility in *C & A Carbone, Inc. v. Clarkstown*, 511 U.S. 383, 386 (1994). But this precedent is inapplicable to California's e-waste recycling program, which does not force anyone to deliver waste to a particular private processing facility. California's recycling program is voluntary and does not favor any particular business.

[218] The Supreme Court has hinted that the exception could apply to the dormant Foreign Commerce Clause by analyzing whether it applied in *Wunnicke*, which concerned foreign commerce. South-Central Timber Development, Inc. v. Wunnicke, 467 U.S. 82, 93 (1984).

a regulator.[219]

Since the EPA does not allow states to administer their own export provisions,[220] California e-waste export regulations largely follow the EPA's CRT export rules. California law differs, however, in that it more broadly concerns "covered electronic wastes"[221] and "covered electronic devices."[222] But these categories do not extend to electronic scrap that has been processed by recyclers.[223] California law therefore does not inhibit the export of processed but still hazardous e-waste scrap; an estimated 160 million to 210 million pounds[224] of e-waste that cannot be profitably recycled in California is exported per year.[225]

While the states are making progress in e-waste recycling, the

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[219] This article does not develop the possibility of state e-waste export measures. If the constitutional hurdles to a state banning or taxing the export of e-waste to foreign countries could be overcome, the exporter could export from the next state that does not have export regulations.

[220] Revision to the Export Provisions of the Cathode Ray Tube Rule 77 Fed. Reg. 15336-01, 15340 (proposed Mar. 15, 2012) ("Because of the Federal Government's special role in matters of foreign policy, EPA does not authorize States to administer Federal import/export functions in any section of the RCRA hazardous waste regulations. This promotes national coordination, uniformity and the expeditious transmission of information between the United States and foreign countries.").

[221] *See* CAL. PUB. RES. CODE § 42463(f) (West 2014) ("'Covered electronic waste' or 'covered e-waste' means a covered electronic device that is discarded.").

[222] *See* CAL. PUB. RES. CODE § 42463(e)(1) (West 2014) ("Except as excluded in paragraph (2), 'covered electronic device' means a video display device containing a screen greater than four inches, measured diagonally, that is identified in the regulations adopted by the department. . . .").

[223] The provisions in 22 C.C.R § 66273.1 do not cover scrap. See 22 C.C.R § 66273.9 (2013) for definitions.

[224] Tom Knudson, *Where's Most of That Toxic E-Waste Going? Overseas*, SACREMENTO BEE, Nov. 28, 2010, http://www.mcclatchydc.com/2010/11/28/104396/wheres-most-of-that-toxic-e-waste.html, ("State records do not clearly reflect how much is exported, but industry officials put the number at 160 million to 210 million pounds a year. That is enough to fill more than 4,500 shipping containers.").

[225] *Id.* ("Domestically, California's program is doing just what officials intended: It has outlawed e-waste from landfills and jump-started a multimillion-dollar state industry to recycle televisions, computer monitors and other video display devices, paid for with public money. But there is a blind spot: The program provides no money for anything else, meaning large volumes of low-value, hazardous electronic waste that are difficult to recycle at a profit in California are instead being exported, a consequence the state did not anticipate. Much of it is flowing to developing nations where it is picked apart by workers exposed to a high-tech cocktail of contamination.").

constraints on California's ability to regulate e-waste illustrate the limits of state power with respect to the transboundary movement of e-waste.[226] Ultimately, the federal government is best positioned to address problems involving interstate and international commerce.

CONCLUSION

This paper considered the economic efficiency of the international e-waste trade and how it should inform international trade and U.S. e-waste management practices. The trade as it currently stands imposes costs on human health and the environment that are not accounted for by the parties to the trade. It is unknown whether internalizing these costs would make the trade prohibitively expensive. If it would, then the trade's costs exceed its benefits, and halting the trade would increase social welfare. If the trade is or can be made efficient, the importing country could adopt an e-waste import tariff that prices in the costs of protecting its workers and environment from the hazards of the trade.

From an economic efficiency perspective, a tariff scheme that could fund responsible trade appears to be more appealing than a trade ban. Blanket bans forgo potential gains from trade, which disincentivizes compliance with the bans and could explain why current e-waste import bans are generally not well enforced. Tariffs that price in the cost of proper recycling and disposal could filter out inefficient trades while allowing gains from efficient trade. These tariffs could help fund responsible e-waste recycling in developing countries, and governments in these countries are more likely to enforce schemes that generate revenue. Meanwhile, developed countries are more likely to agree to international e-waste management that enables them to enjoy relatively inexpensive—but also responsible—disposal of waste (which a tariff does but a ban does not).

An e-waste import tariff could be formulated to be consistent with WTO law. The tariff would have to be adopted in conjunction with a domestic e-waste tax in order to qualify as a border tax

[226] Note that EPR programs face even greater difficulties under the Commerce Clause: if manufacturers are only required to take back waste, and not required to recycle it in-state, they could simply ship the waste to another state or country that does not have e-waste laws.

adjustment under the GATT. If the domestic tax is infeasible, the tariff could be deemed discriminatory under the GATT, and the importing country would have to ensure that the tariff's substance, as well as the process of negotiating and implementing it, satisfies the criteria allowing for exception under the GATT.

Turning to how the e-waste problem is being addressed domestically, the United States has not been a leader in this arena and is the only developed country withholding ratification of the Basel Convention. On the federal level, the EPA has promulgated limited e-waste export rules, but in practice, e-waste exports from the United States are essentially unimpeded. While the EPA could employ RCRA authority to promulgate stronger rules, a potential difficulty is that the scope of RCRA only covers waste, which typically does not include materials destined for reuse. The states are also attempting to regulate e-waste, but their power to control the transboundary movement of e-waste is constitutionally limited. Given these constraints on the EPA and the states, Congress may need to step in and coordinate with the international community in addressing this international problem.

Coordinating U.S. and international measures could also indirectly encourage electronics manufacturers to design and make products with less hazardous material. A trade ban or a tariff working together with a domestic producer take-back program could produce such an incentive. If trade is banned, and producers must recycle their own products, lowering the hazardous content in their products would reduce their recycling costs. Similarly, if trade is allowed, but with a tariff internalizing the cost of proper disposal, producers paying disposal costs would have an incentive to reduce that cost by reducing the amount of hazardous materials in their electronics.