

350 canisters ready for disposal. For perspective, the Yucca Mountain license application allocated space for 400 canisters of naval SNF in the total of 11,000 canisters it was designed to hold.

In 1995, DOE and the Navy entered into a formal agreement with the State of Idaho (known as the Batt Agreement). Among numerous other provisions, the Batt Agreement covers the storage, treatment, and disposal of DOE and Navy SNF stored at INL.²⁰ It allows limited quantities of naval SNF to continue to be shipped to INL (at an average rate of about 20 casks per year). It also sets two deadlines: first, that all SNF then at INL be placed in dry storage by December 31, 2023 and second, that spent fuel be removed from Idaho by January 1, 2035. If this last milestone is not met, the Navy will face a significant financial penalty of \$60,000 for each day the waste remains in Idaho after January 1, 2035.²¹ (A 2008 addendum to the Agreement modified its terms to allow for continued management and technical evaluation of a modest in-process inventory of naval SNF at NRF beyond 2035.) The Agreement also allows the State of Idaho to stop further shipments of Navy fuel to INL at any time if any key parts of the Agreement are not upheld. In a recent review of how the suspension of work on Yucca Mountain could impact SNF storage at DOE sites, the Government Accountability Office (GAO) reported²² that the Navy’s “greater concern” was not the financial penalties in the Idaho agreement if the 2035 deadline is not met, but instead the possibility that Idaho would bar further Navy shipments of SNF to the state. This would dramatically affect the Navy’s ability to refuel its nuclear fleet.

The Batt Agreement also requires that naval SNF be included “among the early shipments to a permanent geologic repository or interim storage site.” However, at the BRC’s September 13, 2011 meeting in Denver, a representative of the State of Idaho stated that “It may not make sense to send DOE spent nuclear fuel to interim storage as most of that waste is already in dry storage and some of it (Navy fuel) is ready for final disposal.”²³ The BRC Transportation and Storage Subcommittee reached a similar but more general conclusion, stating in its draft report that “[t]here appear to be no technical or safety-related reasons to move defense high-level waste and spent fuel from temporary storage at the DOE sites where these materials are now located, before final disposal capacity becomes available.” The Commission concurs with these conclusions. Furthermore, in comments on the draft BRC report,²⁴ the Navy has stated that the focus should be on disposing of naval SNF in a geologic repository when one becomes

available. The Navy’s comments point out that “naval SNF as a waste form is well suited for geologic disposal” and that “the NNPP has invested significant resources in a packaging and transportation infrastructure based on geologic disposal.” That said, it is important to stress that under current law, DOE (not the Navy) is responsible for final disposal of this federally-owned spent fuel.

The importance of providing a path forward for the disposition of Navy spent fuel is yet another reason why the Commission recommends that the United States promptly resume a program leading to the development of one or more deep geologic repositories.

3.4 HISTORY OF NUCLEAR WASTE MANAGEMENT POLICY IN THE UNITED STATES

Spent fuel and HLW have been produced in the United States since the 1940s, first as a byproduct of nuclear weapons research and production and later also as a byproduct of the civilian nuclear power industry. The record of past efforts to manage and dispose of these materials is long and complicated, so the overview presented here is necessarily condensed. A more complete history of nuclear waste policy in the United States is available from many sources (links to some of these sources are available at www.brc.gov).

3.4.1 EARLY U.S. POLICY ON NUCLEAR WASTE MANAGEMENT (1940s–1982)

In the 1940s, during the early days of nuclear weapons development in the United States, national security considerations took precedence over concerns about the safe disposal of nuclear waste. With the emphasis on rapid production of plutonium for use in weapons, storage in large, underground steel tanks was deemed adequate as an interim means of isolating the highly radioactive liquid waste that remained after acid was used to dissolve irradiated nuclear fuel as part of the plutonium separation process. Even at the time, however, the underground tanks were not considered a long-term solution; in a 1949 report the Atomic Energy Commission (AEC)²⁵ emphasized that “better means of isolating, concentrating, immobilizing, and controlling wastes will ultimately be required.”

In 1957, the National Academy of Sciences (NAS)²⁶ issued a report (titled *The Disposal of Radioactive Waste on Land*²⁷) that looked specifically at the question of nuclear waste disposal. That report reached several conclusions, among them that “radioactive waste can be disposed of safely in a variety of ways and at a large number of sites in the United States” and that geologic disposal in salt deposits

represents “the most promising method of disposal.” The NAS further concluded that solidification of liquid waste for transport and disposal would be “advantageous” and that transportation issues would need to be considered in the location of waste disposal facilities.

Prompted by these recommendations, the AEC began investigating mined geologic disposal options and potential salt bed repository sites in the late 1950s. Its early efforts included experiments with solids and liquids in salt mines and exploratory work on methods for solidifying liquid wastes. In June 1970, the AEC announced plans to investigate an abandoned salt mine in Lyons, Kansas as a potential demonstration site for the disposal of HLW and low-level waste (LLW). At the time, the AEC anticipated that the Lyons site could begin accepting LLW as early as 1974 and HLW by 1975. By 1971, however, state opposition to the project was growing and in 1972, after a number of technical problems had emerged that called into question the geological integrity of the Lyons site, the AEC announced that it would seek alternative sites and also pursue the development of long-term surface storage facilities for the waste.

During the same time period (i.e., in the early 1970s), the AEC—at the invitation of the local community—began exploring an area of deep salt beds near Carlsbad, New Mexico as a potential repository site for high-level radioactive waste. Disposal at the site, which became known as the Waste Isolation Pilot Plant or WIPP, was subsequently limited to defense-related TRU waste. Congress authorized WIPP to begin receiving waste as early as 1979 but it took until 1999, 20 years later, before the first shipments began arriving at the facility (see text box).

The search for a suitable site for long-term geologic disposal of spent fuel and HLW continued throughout the 1970s, first under the AEC and later under its successor agency, the Energy Research and Development Administration (ERDA).²⁸ Among the sites considered during this period were bedded salt formations in Michigan, Texas, and Utah; salt domes in Louisiana and Mississippi; basalt formations at Hanford; and welded volcanic tuff at Yucca Mountain in Nevada. Meanwhile, the focus of future waste management efforts had begun to shift as a result of policy changes prompted by weapons proliferation concerns.

Responding to these concerns, President Ford in 1976 issued a presidential directive deferring commercial reprocessing and recycling of plutonium in the United States. In 1977, President Carter extended this deferral indefinitely and directed the relevant federal agencies to focus on alternative fuel cycles and re-assess future spent fuel storage needs. The Carter policy was later reversed by

President Reagan but for a variety of reasons, including cost, commercial reprocessing was never resumed.

Recognizing that the commitment to an open fuel cycle with no spent fuel reprocessing would have an impact on the quantity and type of waste produced by the commercial nuclear power industry in the future, a DOE-led Interagency Review Group in 1979 recommended that a number of potential repository sites for spent fuel and HLW be identified in different geologic environments and in different parts of the country. Specifically, the Interagency Review Group recommended “several repositories sited on a regional basis insofar as technical considerations permit.” The Group saw multiple regional repositories as a way to respond to several concerns, including: (1) accommodating uncertainties inherent in future nuclear waste inventory projections; (2) reducing system-wide transportation requirements; (3) promoting regional equity in the siting of high-level radioactive waste facilities; and (4) providing “redundancy that would hedge against the possibility of operational difficulties causing unexpected repository shutdown.” At the same time, the Interagency Review Group was aware that with a regional approach “there is a risk that organizational and political commitments might develop to particular regions or locations to such an extent that less than full attention would be given to safety, environmental and security considerations.” For this reason the Group urged DOE to “be certain that technical adequacy is a prerequisite for site selection” and to “provide adequate assurance to the public in this regard.”

3.4.2 U.S. POLICY UNDER THE NUCLEAR WASTE POLICY ACT (1982–PRESENT)

Passage of the Nuclear Waste Policy Act (NWPA) in 1982 marked the beginning of a new chapter in U.S. efforts to deal with the nuclear waste issue. The legislation was the product of four years of Congressional debate marked, on the one hand, by growing concern about an imminent shortage of spent-fuel storage pool capacity at operating reactors and, on the other hand, by an equally urgent concern on the part of individual states that they not be selected to host a repository site.

Recognizing the need for a Congressional mandate to overcome opposition to the selection of any given site, Congress sought through the NWPA to establish a fair and technically sound process for selecting repository locations. In fact, to avoid the perception that any one state or locale would be asked to bear the entire burden of the nation’s nuclear waste management obligations, the Act provided for the selection of two repository sites (though not stipulated in the legislation itself, it was widely assumed that one of these sites would be located in the West, the

THE WASTE ISOLATION PILOT PLANT (WIPP)

WIPP is the world's only operating deep geological repository for long-lived nuclear waste. It is located in an ancient 2000-foot deep salt bed, 26 miles southeast of Carlsbad in Eddy County, New Mexico. WIPP is a DOE facility and accepts only defense TRU waste—that is, nuclear waste from past weapons programs that is not considered high-level waste, but that contains long-lived radioactive transuranic elements such as plutonium.

The Atomic Energy Commission first began looking at salt beds in southeastern New Mexico for the disposal of defense wastes in the early 1970s. The current WIPP site was selected for exploratory work in 1974 after local officials expressed interest in being considered; five years later Congress authorized an R&D facility at the site. By this time, tensions had begun to emerge between the federal government and New Mexico, which was concerned about the inclusion of high-level waste and commercial spent nuclear fuel in some of the early plans for WIPP. Authorizing legislation adopted by Congress in 1979 stipulated that WIPP could not be used for the *permanent* disposal of spent fuel and high-level waste but it also heightened tensions by denying the state veto power and removing the project from the licensing authority of the NRC. Two years later, when DOE attempted to move forward with construction, New Mexico filed suit against both DOE and the U.S. Department of the Interior (which had jurisdiction over the land at the site).

That suit was eventually settled out of court, but over the next decade difficulties arose in a number of areas, from problems with the design of transport casks to concerns about funding for road improvements, controversies over health and environmental standards, and plans for an early test phase during which waste could be stored at the facility without meeting final disposal standards. In 1987, DOE began withdrawing land around WIPP from general use and announced that the facility would open in 1988. This proved unrealistic, as efforts to complete the land withdrawal failed over the next few years. In 1991, the state again filed suit—this time to prevent the



transfer of land from public uses to use for a WIPP testing phase. In response, the courts issued an injunction against proceeding with the facility according to DOE's plans.

Progress on WIPP resumed when Congress passed the Land Withdrawal Act in 1992. This legislation required EPA (not DOE) to certify that WIPP met applicable standards and gave the state authority to regulate mixed waste at WIPP under the Resource Conservation and Recovery Act (RCRA), including issuing a hazardous waste permit for the facility. Other provisions prohibited high-level waste at WIPP, even for experiments; provided additional funding for highways and emergency preparedness; and directed DOE to prepare plans for retrievability and eventual decommissioning. DOE later announced that it would move radioactive waste experiments out of WIPP and into the national laboratories.

In 1998, EPA certified that WIPP met all applicable federal regulations for the disposal of TRU waste. Soon after, the 1992 court injunction was lifted and in 1999 WIPP received its first shipment of waste. As of mid-November 2011, WIPP had received 10,181 shipments for a total waste volume of approximate 68,200 cubic meters. DOE currently estimates that work to begin closing WIPP could commence as early as 2030. In contrast to the years of controversy and delay that surrounded the development of the facility, WIPP now enjoys considerable support at the state and local level.

other in the East). And to further ensure that the end result would not be a single, national repository, Congress included provisions explicitly limiting the capacity of the first repository to 70,000 metric tons until a second repository was opened.

Beyond establishing a process for the selection of two permanent geologic spent fuel and HLW repositories, the NWPA included a number of other provisions:

1. Established a new Office of Civilian Radioactive Waste Management (OCRWM) within DOE, with a director appointed by the President and confirmed by the Senate.
2. Authorized DOE to enter into contracts with utilities for federal removal of spent fuel from reactor sites beginning by 1998 in return for a fee on utilities' sales of nuclear-generated electricity.
3. Directed DOE propose a site and design for "monitored retrievable storage" of nuclear waste prior to its being shipped to a disposal site.
4. Provided for federal storage of civilian spent fuel/HLW on an interim basis in cases of need.
5. Granted states certain rights with respect to oversight over waste storage or disposal sites within their borders and the ability to veto DOE siting decisions, subject to override by both houses of Congress.
6. Gave the Nuclear Regulatory Commission (NRC) responsibility for licensing the construction and operation of waste facilities, subject to public health and environmental standards established by the Environmental Protection Agency (EPA).

In May 1986, Energy Secretary John Herrington recommended the Hanford site in Washington State, Deaf Smith County in Texas, and Nevada's Yucca Mountain for detailed site characterization as leading candidates for the nation's first permanent high-level geologic waste repository. By that time, however, DOE's efforts to identify promising sites—not only for the two permanent repositories but also for a monitored retrievable storage (MRS) facility—were drawing strong opposition from the elected officials of all potentially affected states. (As an aside, we note that while the federal government's performance on nuclear waste management has left a lot to be desired, state opposition has played a significant role in the federal government's failures. As we discuss at length in later chapters, it is clear that the cooperation of affected state governments will be vital to the success of the nuclear waste program going forward.)

Citing rising costs and lower projections for nuclear waste production in the future, Secretary Herrington announced that DOE was suspending efforts to identify and develop a second permanent geologic repository. This announcement

also came in May 1986—not surprisingly, it served to intensify the opposition of the three states that had been selected as potential hosts for the first repository.

Faced with a deteriorating political situation²⁹ and growing recognition that the NWPA's original timelines and cost assumptions were unrealistic, Congress revisited the issue of nuclear waste management in 1987. The resulting NWPA Amendments Act of 1987 halted then ongoing research in crystalline rock of the type found in the Midwest and along the Atlantic coast, cancelled the second repository program, nullified the selection of Oak Ridge, Tennessee as a potential MRS site, and designated Yucca Mountain as the sole site to be considered for a permanent geologic repository. The decision was widely viewed as political and it provoked strong opposition in Nevada, where the 1987 legislation came to be known as the "Screw Nevada" bill.

To address concerns about the technical integrity of DOE's assessments, Congress established a new federal agency—the U.S. Nuclear Waste Technical Review Board (NWTRB)—for the sole purpose of providing independent scientific and technical oversight of DOE's waste management and disposal program. Congress also tried a new approach to overcoming state and local opposition: under the 1987 amendments, states could receive up to \$20 million per year for hosting a repository and up to \$10 million per year for hosting an MRS site. The amendments also created the Office of the United States Nuclear Waste Negotiator with a presidentially appointed head authorized to reach agreements with states or Indian tribes to host nuclear waste facilities under any "reasonable and appropriate terms."

At the time, a negotiated, voluntary agreement seemed the best hope for siting a MRS facility that would enable DOE to meet its obligation to begin accepting waste from commercial reactors by 1998.³⁰ The hope was that a voluntary process that offered economic incentives might succeed where other siting efforts had failed.

This hope proved short-lived. The Office of the Nuclear Waste Negotiator closed in 1995, after just a few years in operation; the first head of the agency had not been appointed by President George H.W. Bush until 1990. And neither he nor his successor (who was appointed by President Clinton in 1993) succeeded in reaching an agreement despite reaching out to hundreds of potential host communities and Indian tribes and identifying a number of potentially promising candidate sites.

At one point in 1992, seven communities (including five Indian tribes) had formally notified the government of their interest in being considered.³¹ Each of these communities

was entitled to receive \$100,000 in DOE grants, while those that agreed to participate in a second phase of study could potentially have been eligible for several million dollars in grants. In no case, however, was a host state supportive of having the process go forward.

3.4.3 EXPERIENCE WITH THE YUCCA MOUNTAIN REPOSITORY PROGRAM

Following the dictates of the 1987 NWPA Amendments, DOE continued detailed site characterization studies at Yucca Mountain through the 1990s and issued a formal finding on the suitability of the site in 2002—four years past the 1998 deadline by which the federal government was obliged to begin accepting commercial nuclear waste for disposal under the NWPA. The President’s subsequent recommendation of the site to Congress prompted Nevada, which had remained staunchly opposed to the project throughout, to file an official “Notice of Disapproval.” A Congressional resolution to override the state’s veto, however, was signed by the President, clearing the way for DOE to apply to the NRC for a license to commence construction. The latter step was supposed to follow fairly quickly (within 90 days), but due to litigation over the repository safety standards, persistent funding shortfalls, and other problems it took another six years before the application for construction authorization was filed with the NRC.

In the end, DOE succeeded in completing the world’s first license application for a HLW repository. Submitted to the NRC in June 2008, the license application was deemed suitable for review three months later. Within a year, however, the new Administration declared its intent to suspend further work on Yucca Mountain and later moved to withdraw the application for a construction license to the NRC. At this point, with key decisions by the courts and the NRC still pending, the future of the Yucca Mountain project remains uncertain.

Several attributes of the nation’s approach to nuclear waste management generally, and to the selection and characterization of the Yucca Mountain site in particular, are widely viewed as having contributed to the long delays and significant difficulties encountered in implementing the NWPA Amendments. First, DOE’s termination of the siting process for the second repository, combined with Congress’s subsequent action to short-circuit the site selection process established under the original NWPA and single out Yucca Mountain as the sole site for consideration, created a widespread perception that the repository location was being determined on the basis of primarily political, rather than technical and scientific, considerations.³² Second, neither the

original site selection process established by the Act nor the subsequent legislative designation of Yucca Mountain as the sole site for consideration could be viewed as consent-based since the State of Nevada was not asked for, and did not provide, consent for the site to be selected for investigation. On the contrary, the state and a majority of its citizens strongly opposed the selection of Yucca Mountain as a potential repository site, although the project did have some support from local constituencies. (In comments submitted to the Blue Ribbon Commission during the course of its deliberations, several counties in Nevada—including Nye, Mineral, and Lincoln counties—have expressed support for the Yucca Mountain project or for at least allowing the license approval process for Yucca Mountain to go forward.)

A third issue, and one that pre-dated the decision to focus only on Yucca Mountain, was the practice of setting unrealistic and rigid deadlines. As DOE failed time and again to meet various deadlines, confidence in the federal government’s competence to manage either the Yucca Mountain project or its broader obligations concerning the management of civilian and defense nuclear waste eroded among all parties involved. Key stakeholders, including not only citizens of the communities where these materials were being stored, but also nuclear utilities and their customers, who continued to pay into the Nuclear Waste Fund even as the repository program fell further and further behind, became increasingly frustrated. All the while, the federal government was also exposing itself (and U.S. taxpayers) to liability and large financial damages arising from its failure to comply with its obligations under the Act and DOE contracts with utilities (discussed in section 3.6) in a timely manner.

Another fundamental flaw of the repository development process established under the 1982 Act, and one that carried over to Yucca Mountain after it was designated, was its relative inflexibility and prescriptiveness. This made it difficult to adapt or respond to new developments, whether in the form of new scientific information, technological advances, or (just as important) the expressed concerns of potentially affected publics and their representatives. The 1987 NWPA Amendments made no provision for an alternative path forward if Yucca Mountain proved untenable. This lack of adaptability further undermined confidence in the analysis and planning conducted by DOE and other federal agencies, making it easy to view these efforts as mere paper exercises, rigged to justify a preordained conclusion. Similarly, by directing EPA to develop safety standards specific to the Yucca Mountain site in the Energy Policy Act of 1992, Congress undermined confidence that those standards represented an independent scientific judgment about what was necessary to

protect human health and the environment.

These attributes of the Yucca Mountain siting process led to a serious erosion of trust, especially among the people of the state of Nevada. The recent decision by the Administration to attempt to withdraw the Yucca Mountain license application has further diminished confidence in the government's ability to provide a safe and timely solution for the disposal of spent fuel and HLW. This is not a comment on the merits of the Administration's decision; the Commission was not asked to examine that issue and offers no opinion. However, it is clear to the Commission that waste cleanup commitments were made to states and communities across the United States, and to the nuclear utility industry and its ratepayers and shareholders, that have not been upheld. The decision to suspend work on the repository has left all of these parties wondering, not for the first time, if the federal government will ever deliver on its promises.

3.5 UTILITY INITIATIVES

Following the federal government's abandonment of efforts to site an MRS facility through the Office of the Nuclear Waste Negotiator, a group of eight nuclear utilities formed a private consortium, called Private Fuel Storage, LLC (or PFS), with the objective of finding a community willing to host such a facility. In 1996, PFS signed an agreement with the leadership of the Skull Valley Goshute Indian Tribe to open an MRS facility on the Tribe's reservation in Utah. Details about the amount of compensation being offered have not been disclosed, but reportedly include millions of dollars in promised payments. The effort has generated controversy within the Tribe, however, and is strongly opposed by the state of Utah and a majority of Utah citizens, according to media reports.³³

PFS subsequently applied for and received a license to

construct the proposed facility from the NRC. In a comment letter from the Governor of Utah on the BRC draft report, one of the many reasons cited for state-level opposition to the PFS project was that the BRC-recommended "consent-based, transparent and standards- and science-based approach to nuclear waste management...was totally lacking in the NRC proceeding to license a private SNF storage facility."³⁴ The PFS project was later halted when the Department of the Interior's Bureau of Indian Affairs did not approve the Tribe's lease of land for the storage facility (citing the risk that it would become a permanent repository by default) and the Bureau of Land Management denied needed railroad rights of way over federal land. These decisions were recently found by a federal court to be arbitrary and capricious and were remanded for reconsideration, leaving the future of the facility, according to a recent (2010) article that appeared in the *Environmental Law and Policy Review*, "uncertain."³⁵

3.6 CURRENT WASTE ACCEPTANCE COMMITMENTS AND LITIGATION

The NWPA established the Nuclear Waste Fund (NWF) and authorized DOE to enter into Standard Contracts with commercial reactor licensees. During the 1980s, DOE entered into 76 such contracts. Under the Standard Contract, DOE agreed to take title to spent fuel or HLW and, in return for a payment of fees to the NWF, dispose of the materials beginning not later than January 31, 1998 (the fee amount was initially set at 1 mill or one-tenth of one cent per kilowatt-hour; it is reviewed annually to ensure that it is adequate to cover program costs and has never been changed). The NWPA also stipulated that the NRC may not issue or renew a commercial reactor license without a Standard Contract in place. In 2008, DOE amended the

