

R E S P O N S E

NRDC's Perspective on the Nuclear Waste Dilemma

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While we agree with Richard B. Stewart, in his Article, *Solving the U.S. Nuclear Waste Dilemma*,¹ on some crucial issues—most notably that the national process for developing a geologic repository for disposal nuclear waste is currently a mess—we have a substantially different perspective on the reasons for the mess and the path forward.

I. Background on Geologic Repositories

As Stewart describes, efforts to geologically isolate high-level nuclear waste began more than forty years ago. The National Academy of Sciences in 1957 reported that a number of geologic disposal alternatives were possible, but indicated a preference for disposal in salt. In 1967, the Atomic Energy Commission (AEC) proposed Project Salt Vault, a plan to develop a geologic repository in the Carey salt mine at Lyons, Kansas. This plan was abandoned by the AEC in the early 1970s after the Kansas Geological Survey mounted a strong campaign against the site, pointing out that the area had been subjected to extensive exploratory drilling for oil and gas deposits, and noting that an adjacent salt mine could not account for the loss of a large volume of water used during solution mining of the salt.

In 1974, the Energy Research and Development Agency (ERDA), formed out of the AEC and the predecessor to the DOE, retreated from geological disposal by proposing a Retrievable Surface Storage Facility (RSSF) for interim storage of high-level waste while pursuing geologic disposal at a more leisurely pace. This idea was rejected by environmental-

ists and the Environmental Protection Agency (EPA) on the grounds that it would delay permanent disposal.

In the mid-1970s, it also became clear that commercial spent fuel reprocessing was uneconomical, environmentally unsound and represented a serious proliferation risk. President Gerald Ford refused to subsidize the completion of the Barnwell reprocessing plant, and then President Jimmy Carter pulled the plug on reprocessing. This gave a new urgency to finding a site suitable for geologic disposal of both spent fuel and high-level nuclear waste. In the late 1970s, President Carter initiated an Interagency Review Group (IRG) process to solve the nuclear waste problem in the United States once and for all. The IRG process involved numerous scientists, extensive public involvement, and a consultation and concurrence role for the states. The outcome of the IRG effort was a two-track program. The DOE was tasked with the responsibility for identifying the best repository site in the country, and EPA and the NRC were tasked with developing nuclear waste disposal criteria against which the selection and development of the final repository site would be judged.

II. The Nuclear Waste Policy Act

In 1982, Congress enacted the Nuclear Waste Policy Act (NWPA), which embodied in law the principal recommendations that grew out of the IRG process, including a commitment to geologic disposal, two repositories, and characterization of three sites before final selection of the first repository. The NWPA established a comprehensive program for the disposal of spent nuclear fuel and high-level radioactive waste (HLW) from the nation's commercial reactors and nuclear weapons complex.

At the time the NWPA was passed nearly thirty years ago, the federal government enjoyed fairly widespread support from within Congress, the environmental community, and

1. Richard B. Stewart, *U.S. Nuclear Waste Law and Policy: Fixing a Bankrupt System*, 17 N.Y.U. ENVTL. L.J. 783 (2008). This comment is based on Stewart's original 2008 published article rather than the version that appears at 40 ELR (ENVTL. L. & POL'Y ANN. REV.) 10783 (Aug. 2010) and may refer to material that appears in the original article only.

state governments for the site selection and development process proposed by the IRG. Now, nearly three decades later, the federal government has little, if any, support from the State of Nevada, and virtually no public support from the environment and public health community for the Yucca Mountain project.

III. What Went Wrong?

We are in agreement with Stewart on a few issues, but our perspective—shared by much of the environmental community—is that the process of developing, licensing, and setting environmental and oversight standards for the proposed repository were repeatedly rigged or dramatically weakened to ensure the licensing of the proposed site rather than to provide safety for the length of time that the waste is dangerous. Here are two simple examples that Stewart failed to touch upon.

A. Site Selection

First, DOE and then Congress corrupted the site selection process. The original strategy contemplated DOE choosing the best four or five geologic media, then selecting a best candidate site in each media alternative, then narrowing the choices to the best three alternatives, and then picking a preferred site for the first of two repositories. Site selection guidelines were strongly criticized as DOE was accused of selecting sites that they had previously planned to pick and favoring sites on DOE reservations. In May 1986, DOE announced that it was abandoning a search for a second repository, and it had narrowed the candidate sites from nine to three, leaving in the mix the Hanford Reservation in Washington (in basalt), Deaf Smith Co., Texas (in bedded salt) and Yucca Mountain in Nevada (in unsaturated volcanic tuff).

Whatever equity remained in the site selection process was lost in 1987, when Congress, confronted with a potentially huge cost of characterizing three sites and managing the attendant controversy, amended the NWPA of 1982, directing DOE to abandon the two-repository strategy and to develop only the Yucca Mountain site. At the time, Yucca Mountain was DOE's preferred site. The abandonment of the NWPA site selection process led directly to the loss of support from the State of Nevada, diminished congressional support (except to ensure that the proposed Yucca site remained the sole site), and less meaningful public support for the Yucca Mountain project.

B. Radiation and Environmental Standards

The second track of the process was also corrupted. Section 121 of the NWPA of 1982 directs EPA to establish generally applicable standards to protect the general environment from offsite releases from radioactive materials in repositories, and directs the NRC to issue technical requirements and criteria. Unfortunately, it has been clear for years that the projected

failures of the geologic isolation at Yucca Mountain are the determining factor in EPA's standards.

EPA repeatedly issued standards that were relaxed to ensure licensing the site rather than establishing adequately protective standards. EPA's original 1985 standards were vacated in part because it had failed to fulfill its separate duty under the Safe Drinking Water Act² to assure that underground sources of water will not be "endangered" by any underground injection.³

EPA's second attempt at setting standards that allow for a projected failure of geological isolation was again vacated, this time by the United States Court of Appeals for the D.C. Circuit. The D.C. Circuit found that EPA's Yucca Mountain rule (and the corresponding NRC standard), which ended its period of required compliance with the terms of those rules at 10,000 years was not "based upon or consistent with" the recommendations of the National Academy of Sciences (NAS) as required by the 1992 Energy Policy Act and therefore must be vacated.⁴

Giving significant deference to the agency, the D.C. Circuit did not vacate EPA's strangely configured compliance boundary for the Yucca Mountain site. The dramatically irregular line that represents the point of compliance has little precedent in the realm of environmental protection, and its shape is perhaps more reminiscent of gerrymandered political districts. Rather than promulgate protective groundwater standards, EPA pieced together a "controlled area" that both anticipates and allows for a plume of radioactive contamination that will spread several miles from the repository toward existing farming communities that depend solely on groundwater and perhaps through future communities closer to the site.

EPA's next proposed and revised rule, issued in 2005, retained the 15 millirem/year and groundwater standards for the first 10,000 years, but then establishes 350 millirem/year standard for the period after 10,000 years and does away with the groundwater standard entirely. Because of differences in the way the projected dose rates were to be calculated, the post-10,000 year standard was about 70 times less restrictive than the 15 millirem/year pre-10,000 year standard. This two-tiered standard failed to comply with the law and fails to protect public health, especially if the repository's engineered barriers were to fail earlier than DOE predicts. On October 15, 2008, EPA published the final version of its revised Yucca Mountain rule in the Federal Register.⁵ The 2008 Yucca Mountain rule's two-tiered individual protection annual dose standard establishes an initial 15 millirem first-tier limit, but weakens that limit to 100 millirem in the period after 10,000 years, when EPA projects peak dose to occur. Peak dose could occur significantly earlier if engineered barriers fail earlier than DOE and EPA have projected.

The final status of EPA's most recent two-tiered rule is likely null and void given the current administration's cessa-

2. 42 U.S.C. §§300f to 300j-26, ELR STAT. SDWA §§1401-1465.

3. *NRDC v. Environmental Protection Agency*, 824 F.2d 1258, 18 ELR 20088 (1st Cir. 1987).

4. *Nuclear Energy Institute, Inc. v. EPA*, 373 F.3d 1251 (2004).

5. 2008 Yucca Mountain rule, 73 Fed. Reg. 61255-89.

tion of the proposed Yucca Mountain repository project. The State of Nevada had challenged EPA's 2008 Yucca Mountain rule once again, but the matter is unlikely to proceed as the administration has turned the focus of the next two years to the President's Commission on America's Nuclear Future.⁶

IV. Reprocessing: The Federal Government Should Not Encourage or Support Commercial Spent Fuel Reprocessing

While we share his belief that we are not under a current necessity to "solve" the nuclear waste problem instantly (improved hardened on-site storage is certainly adequate for the near future), reprocessing of commercial spent fuel, as it is practiced today in France, Japan, and Russia, could reduce the uranium and enrichment requirements by up to 25%, but at great economic cost and numerous disadvantages over continuing to rely on the once-through nuclear fuel cycle as practiced in the United States and most other countries with nuclear power plants. There would be increased releases from other areas of the fuel cycle and greater proliferation and safety risks. The trend in recent years has been for more countries to abandon reprocessing than to initiate reprocessing.

Relative to the existing open fuel cycle, the use of a closed or partially closed mixed-uranium and plutonium oxide (MOX) fuel cycle in thermal reactors has proven to be more costly and less safe. It leads to greater routine releases of radioactivity into the environment, greater worker exposures to radiation, larger inventories of nuclear waste that must be managed, and it doesn't appreciably reduce the geologic repository requirements for spent fuel or high-level nuclear waste.

Because reprocessing as it is practiced today does not appreciably reduce repository requirements, it is not an alternative to Yucca Mountain. Advanced reprocessing technologies, heavily promoted under the Bush Administration's Global Nuclear Energy Partnership (GNEP), are unlikely to significantly impact repository requirements. This is because the fast reactors required for efficient waste transmutation are likely to remain more costly and less reliable than conventional thermal reactors, and hence will not be commercially deployed in sufficient numbers to effect the desired reductions.

The GNEP vision of burning the long-lived actinides requires that some thirty to forty percent of all reactor capacity be supplied by fast reactors. In other words, for every hundred thermal reactors of the type used throughout the United States today, some forty to seventy-five new fast reactors of similar capacity would have to be built. The commercial use of large numbers of fast reactors for actinide burning is unlikely to occur because—to borrow observations made by U.S. Navy Admiral Hyman Rickover more than fifty years ago that remain true today—fast reactors have proven

to be "expensive to build, complex to operate, susceptible to prolonged shutdown as a result of even minor malfunctions, and difficult and time-consuming to repair."

The development of fast reactors to breed plutonium failed in the United States, the United Kingdom, France, Germany, Italy, and Japan. We would argue it failed in the Soviet Union despite the fact that the Soviets operated two commercial-size fast breeder plants, BN-350 (now shut down in Kazakhstan) and BN-600 (still operational in Russia), because the Soviet Union and Russia never successfully closed the fuel cycle and thus never operated these plants using MOX fuel.

Moreover, the advanced reprocessing technologies are even more costly than the conventional PUREX method and produce even larger inventories of intermediate and low-level nuclear wastes. The closed fuel cycle technologies required by GNEP pose greater proliferation risks than the once-through fuel cycle. Even though GNEP's ambitious vision of deploying new reprocessing plants and fast reactors in large numbers will surely fail to materialize, the partnership's research program will encourage the development in non-weapon states of research facilities well suited for plutonium recovery, that is, small hot cells and even larger reprocessing centers, as well as the training of experts in plutonium chemistry and metallurgy, all of which pose grave proliferation risks. It is for this reason that we advocate terminating the GNEP research on advanced reprocessing technologies.

The Obama Administration does not support efforts to close the nuclear fuel cycle and introduce fast burner reactors in the United States in the near term. This leaves the question of what level of long-term DOE research funding is appropriate to explore advanced nuclear fuel recycling technologies.

We hold the view that even substantial research spending in this area is highly unlikely to lead to nuclear technology breakthroughs that actually meet the stated goals of the research—cost-effective and non-proliferative techniques for reprocessing, recycling, and transmuting plutonium-based fuels. And since the proliferation risks of this cooperative international research would be ongoing and tangible, we and many others in the nonproliferation community believe that shutting down the current U.S. plutonium recycle research effort, and any support it extends to foreign efforts, is the wisest course, at least until such time as the latent nuclear proliferation risk in the world is much better controlled than it is today.

Others, including Energy Secretary Steven Chu, appear to believe that some level of ongoing advanced fuel cycle research is appropriate and has some chance of yielding the desired nuclear technology breakthrough, if pursued for perhaps a decade or more. History has not been very kind to this view, but the plutonium fuel cycle community is a lot like the fusion energy community in this respect—hope springs eternal as long as federal research dollars are within reach.

So weighing these contrasting glass half-full and glass half-empty perspectives, one might conclude that some modest long-term research program, geared to narrowing the technical and cost uncertainties surrounding the toughest unresolved technical, economic, safeguards, and prolif-

6. See January 2010 Presidential Memorandum to the Secretary of Energy directing the establishment of the Presidential Commission, available at http://www.nuclear.energy.gov/BRC/pdfFiles/FR_NoticeofPresidentialMemorandumBRC.pdf.

eration issues, would be an appropriate and prudent middle path to pursue with respect to closing the fuel cycle. We would emphasize that even more important than the particular choice of technology is a better understanding of the requirements for the international institutional setting in which a large-scale fast reactor roll-out would be attempted. This, more than the technology, is the long pole in the closed fuel cycle tent. If one is serious about wanting to minimize the risks of proliferation, one is more or less driven to consider some form of international ownership and control over nuclear fuel cycle facilities, and this is likely to prove just as demanding a task as the development of more “proliferation-resistant” strains of reprocessing. We also note that absent such an international structure for closely regulating the closed fuel cycle, we are unlikely ever to transition to a world free of nuclear weapons.

V. Conclusion

The legislative history of the NWPA of 1982 includes the following admonition:

The Committee strongly recommends that the focus of the Federal waste management program remain, as it is today, on the development of facilities for disposal of high-level

nuclear waste which do not rely on human monitoring and maintenance to keep the waste from entering the biosphere.

This wise legislative direction has been ignored over the past several years. A central problem with the process for developing a geologic repository, and especially Yucca Mountain, has been that the site conditions have driven the standard. We observed this years ago when EPA abandoned its collective dose standard when it appeared that Yucca Mountain could not meet it. We observed this in 2001 when DOE placed greater hope on engineered barriers instead of on the geology of the site. We observed this again in 2001 when EPA limited the period of compliance to 10,000 years and gerrymandered the area of site compliance to allow for a massive (and diluting) spread of radioactive contaminants. Whether we'll observe the same type of process with the Blue Ribbon Commission on America's Nuclear Future remains to be seen. It is essential that this not continue.

If we are ever to have a robust repository program that both follows the original intent of the NWPA and gains the trust of the American public, then the federal government, in both its executive and legislative incarnations, must cease efforts to weaken meaningful and protective health and environmental standards applicable to the program.