Stranded Fuel, Orphan Sites, Dead Plants: Transportation Planning Considerations After the BRC Report - 13393

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ABSTRACT

The author explores transportation, packaging and storage questions related to a primary recommendation of the Blue Ribbon Commission on America's Nuclear Future; i.e., that fuel from shutdown plants be removed to consolidated storage as soon as possible to enable final decommissioning and beneficial re-use of those sites. The paper discusses the recommendations of the BRC, the implications and challenges that implementing those recommendations present, and provides recommended solutions for beginning the multi-year planning, coordination, material acquisition, and communications processes that will be needed to move fuel from shutdown plants when a destination site becomes available.

Removal of used nuclear fuel from shutdown reactor sites (which are serving no other purpose other than storing SNF and GTCC, at considerable expense) was a central recommendation of the BRC, for a number of reasons. This recommendation was one of the most widely acclaimed that the Commission put forward. However, there are significant challenges (such as availability of fuel canister overpacks, lack of infrastructure, handling constraints and others) that will need to be addressed, apart from the critically important identification of a suitable and workable storage destination site. Resolving these logistical challenges will need to begin even before a destination site is identified, given the long lead-times required for planning and procurement.

Based on information available today, it is possible to make informed predictions about what will be needed to modify existing contractual arrangements with utilities, address equipment and infrastructure needs, and begin working with states, tribes and local governments to start initial preparation needs. If DOE, working with industry and other experienced parties, can begin planning and acquisition activities in the near term, overall schedule risk can be reduced and potential cost avoidance achieved.

The most immediate benefit will accrue to the operators of the shutdown plants, but beginning to accept fuel as required under the NWPA will reduce the liability to the federal government, and also offer some assurance to other utilities and the public that DOE (or another entity if one is established) is capable of meeting its obligations under the NWPA. The indirect benefits, therefore, will be quite broad.

BACKGROUND

On March 1, 2010, the Department of Energy issued its charter for the Blue Ribbon Commission on America's Nuclear Future, or BRC.[1] The BRC was established by Energy Secretary Steven Chu at the direction of the President to "conduct a comprehensive review of policies for managing the back end of the nuclear fuel cycle and recommend a new strategy."[2] The Commission conducted a series of public meetings throughout the country, and conducted site visits to facilities in the United States and abroad, over the course of nearly two years, issuing its final report in January 2012.

The BRC made eight major recommendations to overhaul the national policy of the United States for managing its spent nuclear fuel (SNF) and high-level waste (HLW), including establishing a new process for selecting sites, a new entity to manage the program, changes to how funding for SNF management is treated, and others. Two of the recommendations were to initiate "prompt efforts to develop one or more consolidated storage facilities" and to conduct "early preparation for the eventual large-scale transport of spent nuclear fuel and high-level waste to consolidated storage and disposal facilities."[3]

The Case for Consolidated Storage

The Commission recommended "promptly" developing capability for consolidated storage for a number of reasons.[4] Siting, licensing, and constructing a repository (either at Yucca Mountain or at some other location, the BRC did not take a position on any specific facility or site) are complex processes that could take much longer than developing away-from-reactor storage. While that essential disposal capability is being developed, the Commission concluded that "consolidated storage would enable the federal government to begin meeting waste acceptance obligations."[5] Under the Nuclear Waste Policy Act of 1982 (NWPA), the federal government was supposed to begin accepting commercial SNF beginning in 1998, and the delay in performance is costing the U.S. government several hundreds of millions of dollars annually, which is paid from the Judgment Fund managed by the Department of Justice (not the ratepayer-funded Nuclear Waste Fund). Away-from-reactor storage would also offer flexibility and options if, for whatever reason, SNF needed to be moved from a reactor on an expedited basis.

There is currently no option for managing significant volumes of waste other than where it is being stored right now—at operating and shutdown reactor sites, in wet and dry storage configurations.

The BRC also concluded that consolidated storage would support the repository program.[6] If waste acceptance commenced at a storage facility before a repository were to become operational, it could serve as a "pilot program" to demonstrate how large volumes of waste would be packaged, transported, and stored, and should provide valuable lessons learned in developing capabilities and infrastructure necessary to support safe and secure operations. There are potential technical issues resulting from the long-term storage of SNF, and the BRC found that centralized storage as a pilot "would provide an excellent platform for ongoing research and development to better understand how the storage systems currently in use at both commercial and DOE sites perform over time."[7]

Even after a repository becomes operational, the Commission found, consolidated storage could play an important role by providing "buffer" capacity.[8] If one views operation of a repository as an industrial enterprise, one which would of necessity be required to accept hundreds of shipments and thousands of tons of waste annually, one could imagine any number of reasons why a shipment schedule from many different sites could be disrupted or delayed, especially since the national and international experience in operating repositories is so limited. If, for instance, a blizzard or hurricane temporarily disrupted the transportation system, shipments could be diverted to a storage facility and the waste acceptance schedules negotiated with the utilities could be maintained.

But apart from these reasons, the BRC's chief rationale for advocating "prompt" development was that "consolidated storage would allow for the removal of 'stranded' spent fuel from shutdown reactor sites."[9] The Commission found that approximately 2,800 MTHM of SNF was being stored at nine commercial sites, with an additional 15 MTHM being managed by DOE at the Fort St. Vrain facility in Colorado.[10] Since the BRC report was issued, two additional plants—Kewaunee in Wisconsin and Oyster Creek in New Jersey—have indicated they will permanently cease operation on or before 2019, which would bring the "stranded plant" SNF inventory to about 3,600 MTHM[11] on or about 2020, which is a reasonably achievable start date for commencement of stranded plant SNF removal.

"Stranded" SNF at shutdown reactor sites is stored on site, typically in dry cask storage configurations, and must be managed safely and securely according to that facility's NRC license requirements, just like any other Independent Spent Fuel Storage Installation (ISFSI). On-site storage is a well-understood and widespread practice—indeed, operating reactors must have SNF storage capacity near reactors to support offloading of fuel for maintenance and other reasons—and the Commission noted the practice "is not thought to present immediate safety or security concerns."[12] Stand-alone storage is, however, costly.

A stand-alone ISFSI at a shutdown site—one that cannot share a security "envelope" with an operating reactor that must provide those resources and share in those costs—has to go it alone, and the costs are substantial. A study conducted for the BRC by Hamal *et al.* used a General Accountability Office estimate of $4.5 million annually for security and maintenance costs.[13] Others have estimated the costs to be about $8 million annually, and perhaps even higher depending on requirements at specific sites.[14]

Looking forward, it is difficult to forecast what the future security climate will look like, but it is reasonable to assume that security and safety requirements will not be lessened appreciably in the foreseeable future—in fact, some have advocated increasing those requirements. But if one assumes current practices and expenditures stay more or less the same in future years, then between $40.5-72 million is being spent annually to protect and monitor fuel at shutdown sites, which exist for no other reason. The presence of this material at these sites further prevents those sites' redevelopment for other beneficial uses.

The numbers of shutdown sites is also expected to increase dramatically as reactors reach the end of their operating lives, even with extensions, and begin to shut down. The Hamal study predicts a

"mountain of costs" that will begin escalating around 2030, even if a repository becomes available by then.[15] This trend toward ever-increasing "sunk" costs for security and maintenance at stranded sites led the BRC to conclude that *"even assuming no further change in security requirements at shutdown sites, these cost estimates suggest that the savings achievable by consolidating stranded spent fuel at a centralized facility would be enough to pay for that facility"*[16] (emphasis in original). The Commission thus found that, apart from the operational advantages that could be provided by consolidated storage, there are cost-based reasons for doing so as well.

Post-BRC Developments

After the BRC issued its report in January 2012, the Department of Energy set up an internal task force—the Materials Disposition Working Group—to examine the recommendations and develop a strategy for implementing them.[17] That strategy, originally scheduled for release in July 2012, has not yet been issued, but DOE is conducting a study of infrastructure and other transportation-related issues at shutdown sites, so that if a decision is taken to consolidate SNF from those sites, preparations for doing so can commence.[18]

The stranded fuel "pilot project" concept has also garnered some support in Congress. In April 2012, Senator Dianne Feinstein offered an amendment to S. 2465, the Energy and Water Development and Related Agencies Appropriations Act of 2013, which would authorize a pilot storage project:

> Sec. 312 (b) Pilot Program- Notwithstanding any provision of the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10101 et seq.), the Secretary is authorized, in the current fiscal year and subsequent fiscal years, to conduct a pilot program, through 1 or more private sector partners, to license, construct, and operate 1 or more government or privately owned consolidated storage facilities to provide interim storage as needed for spent nuclear fuel and high-level radioactive waste, *with priority for storage given to spent nuclear fuel located on sites without an operating nuclear reactor.* (emphasis added)[19]

Congress has not enacted a budget for the 2013 fiscal year, and the federal government continues to operate under a continuing resolution. However, given the prominence of this issue and the support it has received, one could reasonably expect it to receive some treatment in future appropriations.

Transportation of Stranded Fuel—Getting Started

Although SNF transportation has been done safely and securely for many years, it is a complex undertaking—one heavily regulated by, and requiring the involvement of, federal, state, and local law enforcement and public safety officials. As the BRC report states;

> Extensive planning and preparation for transport arrangements will be required even if only the 2,800 metric tons of spent fuel currently being stored at shutdown reactors are slated for initial transfer to consolidated storage. The Commission has

> heard testimony indicating that advance planning timeframes on the order of a decade could be required to plan and coordinate a transportation strategy and to establish the institutional and physical infrastructure to conduct a large-scale shipping operation. Historically, some programs have treated transportation planning as an afterthought. No successful programs have done so.[20]

So if DOE, or another successor entity (if one is established), is to successfully launch a project, what are the near- and medium-term issues and challenges related to transportation that will need to be addressed? There are there are three main categories of issues that should be examined closely—logistics, planning, and policy. All of these categories will need to be addressed in some fashion regardless of who eventually performs these functions or where it takes place. And the necessary steps have varying levels of difficulty in terms of implementation. Some can be started under DOE's existing authority and funding levels. Others would require specific appropriations from Congress for that purpose, and some major steps would likely require not just appropriations but also modifications to the NWPA or other statutes.

Logistics Issues

SNF and Greater than Class C (GTCC) waste is currently being stored at nine shutdown sites—they are either loaded in dry canisters that can be loaded into transportation overpacks for shipment, or there are plans to do so (as at the Zion site, which will begin loading operations soon). However, although designs for these overpacks have been approved by NRC, they do not exist, except for a few casks at Rancho Seco that do not have impact limiters. The overpacks are for the most part not interchangeable—different designs will be needed to ship canister fuel from these sites.

Fabrication and testing of new designs can take several years—estimates range from four years to six for current designs, and possibly up to eight years for new designs. If one or more casks are selected to undergo full-scale demonstration tests (as proposed by NRC and DOE in the Package Performance Study that was approved but never funded), more time to conduct that testing would be required.

In addition, railcars (rolling stock) and specialized equipment such as yokes, etc. will need to be designed, tested, and installed. Both casks and rolling stock are manufactured by a fairly small number of specialized manufacturing firms whose capacity to rapidly ramp up production may be "inelastic." Train consists that will be used to transport SNF must also meet the Association of American Railroads' (AAR's) S-2043 design standard, which includes requirements for electronic braking systems and other state-of-the-art equipment. While the components called for in the AAR standard have been developed independently, they have never been installed and tested together in a complete consist, and doing so may well result in unanticipated delays if problems are encountered.

Since the designs for the casks are available, and the basic requirements of the cask equipment and rolling stock are known, it would seem prudent for DOE to begin the procurement process for a small number of different casks now, since they will eventually be needed in any case. If the casks

are completed and readied for service before the receiving site is available, or before the transportation system is able to handle them, they could be made available for emergency response training and demonstration purposes, or simply wrapped up and stored in some secure location. The costs and risks of producing casks "too early" are likely much lower than the consequences of being ready to ship fuel at some future date, but not having a packaging in which to ship it (or, more likely, not having a large enough cask fleet to initiate a substantial campaign).

The transportation infrastructure at and near stranded fuel storage sites will need to be examined, and some site improvements may need to be planned. At shutdown plant sites, pools are no longer available to handle fuel and casks; transfer systems may need to be brought on-site. Portable cranes may need to be erected. Barge slips, rail spurs, and heavy-haul roads may need to be repaired or built. In 2012, DOE funded a small project by several national laboratories to examine infrastructure at shutdown sites and begin making preliminary assessments of what modes and procedures may need to be developed to move fuel from the sites. This work should continue, with close cooperation from the site owners. The issue of who will be responsible for paying for such upgrades may need to be negotiated among the parties. But, as is the case with canister overpacks, the improvements are going to be needed regardless of whom is responsible for paying for them or conducting the shipments when they take place. And although the sites are no longer conducting nuclear generation activities, some do have fossil plants or other operations at or near the sites. Close coordination on planning movements with the site owners, and with local public safety officials, will be critically important, and initial contacts should be established now.

Finally, whether DOE or some other entity is ultimately responsible for shipping fuel from shutdown sites, the actual transportation will almost certainly be performed by a private company that specializes in such work. Nearly all SNF transported in the U.S. and abroad uses contracted services from companies with experience in handling and shipping radioactive materials. It may be advantageous for DOE to retain consulting services from one or more firms with direct relevant experience in this field. Even if the transportation will not take place for some years, or may even be performed by other companies when it does take place, a modest investment to obtain specialized expertise now could help avoid potentially costly mistakes.

Planning Issues

DOE has already restarted agreements with the state regional groups (SRGs) such as the Western Interstate Energy Board, the Southern States Energy Board, and the Northeastern and Midwestern Councils of State Governments, to work with state officials to plan for eventual transportation from shutdown sites. The SRG committees are comprised of state officials with many years' combined experience with the safe handling of hazardous materials transportation, and for managing emergency response activities when needed. DOE works with other state and tribal entities through its National Transportation Stakeholders Forum, which meets annually and also conducts webinars to communicate and disseminate information. This work should continue and be expanded to include logistics and transportation companies with experience in handling spent fuel, including the railroads that will be involved when the time comes.

Under Section 180(c) of the NWPA, DOE is obligated to provide funding and technical assistance to states and tribes to prepare for SNF shipments through their jurisdictions. Whether 180(c) applies to these shipments, or even if an entity other than DOE conducts these shipments, the shipper who will be managing these shipments should make available resources for reasonable and appropriate training, preparation, and public information activities. This is consistent with well-established and successful transportation programs like WIPP. State, tribal and local officials generally enjoy higher levels of public trust and confidence, and they know their constituencies well. As involved and supportive planning partners, they are uniquely positioned to prepare their communities and provide information. These activities can require sustained effort over years, and should begin early.

Policy Issues

The overriding policy issue that must be overcome before stranded waste can be shipped is, of course, identification of a potential destination site, and construction and licensing of a suitable facility to receive the waste. The BRC recommended that siting a facility be "consent-based;" that is, with the active and sustained support of the local community and the state in which the facility is to be located.

This will be no mean feat, but recent experience in Canada and Europe suggests that it can be done. Presumably a willing host community and/or state will want to negotiate for an oversight role, in addition to compensation and other incentives it might want. The BRC did not offer a detailed listing of what incentives or other aspects of such an agreement might be, instead suggesting that the involved parties are best positioned to fashion a negotiated package. Congressional approval could be sought to ratify any such agreement—certainly, funding an agreement using monies from the Nuclear Waste Fund or another public source would require appropriations for that purpose. Transportation-related incentives, such as infrastructure upgrades near a potential site, should be included if the negotiating parties so desire.

CONCLUSIONS

Despite the ongoing public debate over continued or possibly expanded use of nuclear energy, the waste that has been generated indisputably exists, and must be managed responsibly. Stranded SNF at shutdown sites that are serving no useful purpose can be safely consolidated at one or more storage sites, permitting final decommissioning of those sites. The technical challenges of preparing and transporting this waste for subsequent storage, until final disposition in a repository, are well-understood. The practical capability to do so can be developed and readied relatively quickly, but some logistical and planning considerations are likely to take some years. If a future transportation effort is to succeed, preparations need to begin now.

REFERENCES

[1] Blue Ribbon Commission on America's Nuclear Future Charter, Mar. 1, 2010.
[2] Blue Ribbon Commission on America's Nuclear Future *Report to the Secretary of Energy*, Jan. 2012 (hereinafter referred to as the "BRC Report"), preamble.
[3] BRC Report at xiii.
[4] BRC Report at 35
[5] BRC Report at 36.
[6] BRC Report at 38.
[7] BRC Report at 39.
[8] BRC Report at 39.
[9] BRC Report at 35.
[10] BRC Report at 36.
[11] U.S. Department of Energy Savannah River Site, Inventory and Description of Commercial Rector Fuels Within the United States, FCRD-USED-2011-000093, March 31, 2011 (available at http://sti.srs.gov/fulltext/SRNL-STI-2011-00228.pdf) Estimates are of inventories as of 2011 but totals in 2019 will be higher—perhaps an additional 100 MTHM for both plants until that time.
[12] BRC Report at 35.
[13] Hamal et al, Spent Nuclear Fuel Management: How Centralized Interim Storage Can Expand Options and Reduce Costs, May 2011, at 20.
[14] BRC Report at 35.
[15] Hamal at 21.
[16] BRC Report at 35.
[17] Presentation by Corinne Macaluso, DOE, at the National Stakeholders Transportation Forum, May 2012 (available at http://www.em.doe.gov/PDFs/Task%20Force.pdf).
[18] Presentation by Jeffrey Williams, DOE, at the Nuclear Waste Technical Review Board , Oct. 2012 (available at http://www.nwtrb.gov/meetings/2012/oct/12oct.html).
[19] S. 2465, Energy and Water Development and Related Agencies Appropriations Act of 2013, Sec. 312.
[20] BRC Report at 85.