Laying the Groundwork for a Large-Scale Spent Nuclear Fuel Transportation System[1] - 15408

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ABSTRACT

The US Department of Energy Office of Nuclear Energy established the Nuclear Fuels Storage and Transportation Planning Project to lay the groundwork for implementing an interim storage facility, including associated transportation activities. Efforts include the development of a system for the large-scale transport of spent nuclear fuel that will be necessary in an integrated waste management system. Progress is being made on long lead time, destination-independent aspects of the transportation infrastructure. The large-scale transportation system for spent nuclear fuel is divided into three elements: institutional, operational, and hardware. The institutional element refers to the various forms of stakeholder interaction that must occur for this type of transportation system to be successful. It includes activities like development of a national transportation plan, work on policy development for Section 180(c) of the Nuclear Waste Policy Act, and identification of a preliminary suite of national transportation routes that reflect the interests of a broad cross section of stakeholders while meeting regulatory requirements. The operational element refers to the activities that must be undertaken to run a large-scale transportation system. This element is currently focused on development of a new SNF transportation routing analysis tool, study of the infrastructure near SNF storage sites that may be de-inventoried first, and development of tools for modeling transportation activities. The hardware element refers to the casks, railcars, and other items necessary to operate the system. This element currently focuses on development of railcars compliant with Association of American Railroads Standard S-2043, as well as studies related to the use of rail casks and their ancillary equipment. The Nuclear Fuels Storage and Transportation Planning Project is making significant progress in all three of these areas along the path forward to a fully operational transportation system.

INTRODUCTION

The Blue Ribbon Commission on America's Nuclear Future made a series of recommendations to the Secretary of Energy in 2012 related to the management and eventual disposition of spent nuclear fuel (SNF). One of their recommendations was to make "prompt efforts to prepare for the eventual large-scale transport of spent nuclear fuel and high-level waste to consolidated storage and disposal facilities when such facilities become available" [1]. In response to these recommendations, the US Department of Energy (DOE) published the *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste* [2], and DOE's Office of Nuclear Energy (NE) established the Nuclear Fuels Storage and Transportation Planning Project (NFST). The mission of NFST is to lay the groundwork for implementing an interim storage facility, including associated transportation activities. This paper presents the work being done on long lead time, destination-independent elements of the large-scale transportation system that will be necessary for a future integrated waste management system.

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DISCUSSION

Planning for a large-scale transportation system to move SNF from nuclear reactor sites is an integral aspect of the Secretary of Energy's *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste* [2]. This is consistent with the recommendations of the Blue Ribbon Commission [1] to prepare for transportation of SNF to storage and disposal sites when such facilities become available. Planning is also focused on meeting the recommendations of the National Research Council of the National Academies comprehensive report on the safe transport of SNF [3].

The large-scale transportation system for SNF is divided into three primary elements: institutional, operational, and hardware. An in-depth look at the progress follows for all three elements of the NFST program, with an emphasis on recent activities and near-term future work in transportation planning.

Institutional

The institutional aspects of transportation planning refer specifically to the interactions between DOE staff and various transportation stakeholders, including state governments (via state regional groups, [SRGs]); tribal representatives; other federal agencies; scientific and academic institutions; and labor, industry, and citizen groups. It includes activities like development of a National Transportation Plan, work on policy development for Section 180(c) of the Nuclear Waste Policy Act, and identification of a preliminary suite of national transportation routes that reflect the interests of a broad cross section of stakeholders while meeting regulatory requirements.

Outreach to the respective stakeholders is accomplished through venues such as the National Transportation Stakeholders Forum (NTSF, Fig. 1), an organization established in 2009 for the purpose of bringing transparency, openness, and accountability to DOE's offsite transportation activities through collaboration with State and Tribal governments. DOE informs stakeholders of ongoing, upcoming, or tentatively planned shipments of radioactive material and receives input from stakeholders about relevant concerns. Stakeholders and DOE personnel collaborate to identify issues and concerns which may affect transportation operations and to find solutions to such issues that are amenable to all parties.

The NTSF includes a working group dedicated to the development of NE's National Transportation Plan. This document is the result of collaboration between DOE and stakeholders. It details the process to be followed to develop and implement a transportation system for the safe movement of SNF from shutdown sites. The plan identifies issues that must be resolved before SNF shipping can commence, details a standardized approach for de-inventorying reactor sites, and includes procedures which must be followed to protect the public and the environment during the shipping process. The roles and responsibilities for the organizations involved in SNF transportation are defined in this document, and the transportation system design and operations are described. Emergency and security considerations are also addressed in the plan.

The development of the National Transportation Plan is an ongoing activity. A draft was issued last year, and stakeholders were given an opportunity to provide feedback. Comments were received from state governments through SRGs, tribal governments, and labor and industry representatives. A new draft will be issued this year incorporating feedback from affected stakeholders.

Fig. 1. National Transportation Stakeholders Forum.

Section 180(c) of the Nuclear Waste Policy Act states that DOE is responsible for providing technical assistance and financial support to train public safety personnel from tribes and localities through which SNF or high-level waste (HLW) is transported. A working group within the NTSF was formed in order to help DOE identify and address the Section 180(c) issues important to stakeholders that must be resolved before transportation of SNF can begin. DOE and affected communities have been working on 180(c) for many years, and recommendations from the National Academy of Sciences (NAS) and the Blue Ribbon Commission on America's Nuclear Future (BRC) have refocused these efforts to address relevant issues before shipments commence [1, 3]. To this end, NFST, in conjunction with states and tribes, is conducting a 180(c) Policy Implementation Exercise. This exercise will simulate the process for state and tribal governments to apply for and receive funding under Section 180(c), including application review by an expert panel, assessment of allowable activities, and the grant negotiation process. The exercise will be conducted over a period of five months, with a full-day workshop at the upcoming NTSF meeting, to present the results of the Exercise and preliminary lessons learned. Follow-on discussions will evaluate how the process could be improved from both state and tribal perspectives, as well as from DOE's perspective. A report will be issued later this year analyzing the exercise, identifying lessons learned, and recommending any necessary improvements to the Department's current Proposed 180(c) Policy.

Although a site for an SNF interim storage facility or repository has yet to be determined, a standard procedure to select routes for shipments may still be established. Last year, a draft routing methodology for SNF shipments was developed for stakeholder input and identification of regulatory requirements. This methodology includes implementation of the regulations and available guidance for such shipments, consideration of lessons learned from previous radioactive material shipping campaigns, and opportunities for stakeholder input. At present, feedback from stakeholders on this proposed methodology is being actively sought and will be incorporated into a new draft of the procedure this coming year. Using this methodology, it will be possible to determine initial primary and secondary routes from shutdown sites to Class I railroads. Regardless of destination, the primary mode of transportation for SNF to an interim storage facility or repository will be by dedicated train. However, not all shutdown sites have direct rail access, requiring use of heavy haul truck or barge and a transload location to connect with rail. Evaluating and identifying potential routes from shutdown sites to rail access will help interested parties readily understand the collaborative process by which routes are chosen and how they will be able to participate in this process.

In conjunction with cooperative work to develop a routing methodology, the routing tool to be used by DOE—Stakeholder Tool for Assessing Radioactive Transportation (START) — is also being made available to stakeholders. Training sessions are being held so that stakeholders and DOE will have the same resources available during the SNF route planning process. This is expected to ensure that the process of route selection is transparent and acceptable to all stakeholders. Further description of START may be found in the following section.

Operational

The operational aspects of the transportation system are the activities and workings of the system itself. These currently include (1) development and use of computational tools for modeling transportation activities, (2) study of the sites from which SNF is to be removed first, and (3) the planning of procedures to be followed in the transportation of SNF from commercial nuclear power plant sites. Several operational activities are described in greater detail in this section.

The routing analysis tool START is currently being developed. This computational tool uses geographical information system (GIS) data and software to identify potential routes from sites of interest and summarize them based on characteristics such as distance; travel time; population; and proximity to tribal lands, environmentally protected areas, and emergency responder infrastructure. Version 1.1 of START is currently online. A sample screen is presented in Fig. 2. Version 1.2 is scheduled to be released in spring 2015. It will incorporate improvements made in response to suggestions from the user community, as well as updated infrastructure data and routing algorithms.

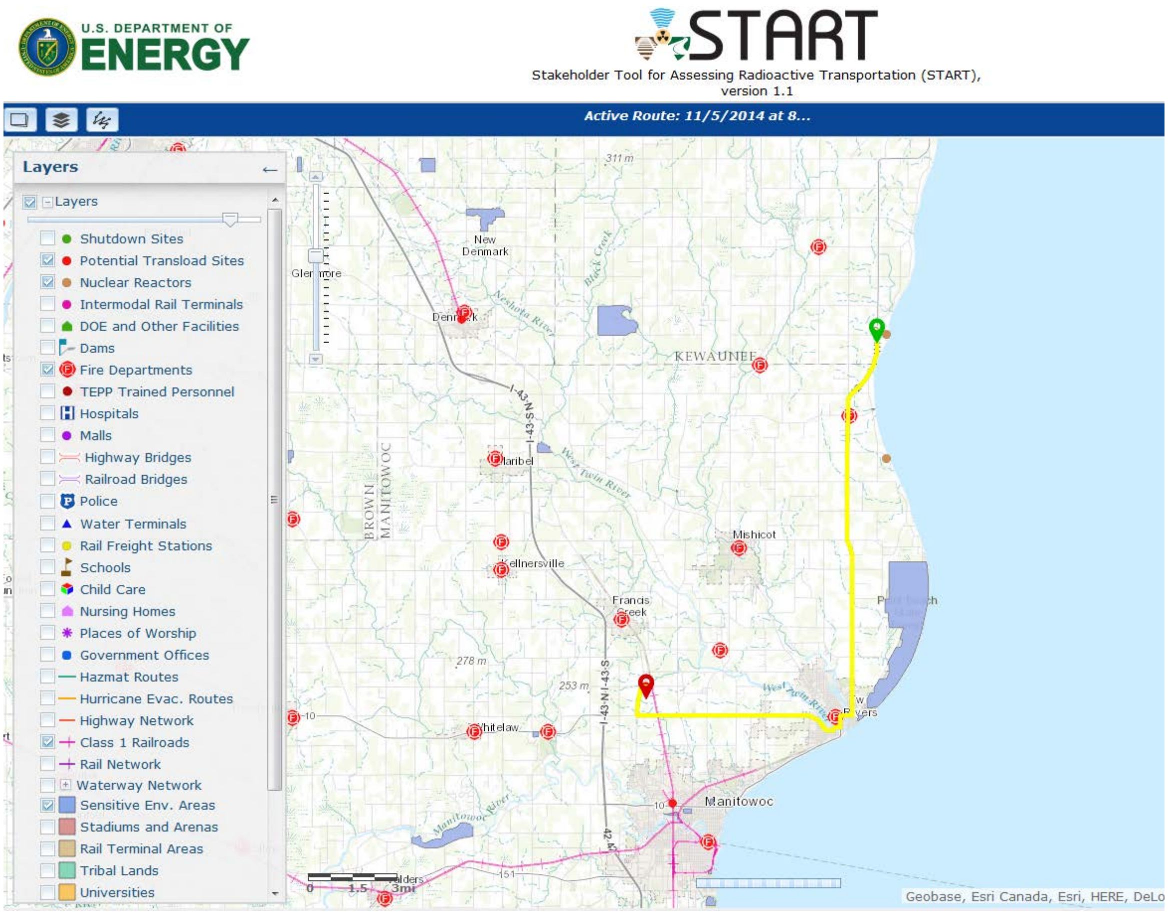

Fig. 2. Sample START Map Screen.

As of this writing in late 2014, twelve so-called shutdown sites are storing commercial SNF and have either completed or begun decommissioning of nuclear power operations, and by early 2015, there will be a total of thirteen shutdown sites. Thus far, members of NFST have toured ten of these sites to evaluate on-site and nearby transportation infrastructure and the remaining sites may be visited in the future. On the seven most recent tours, NFST was accompanied by representatives from the states, tribes, and the

Federal Railroad Administration. It is anticipated that future site visits will also include representation from these stakeholder groups.

NFST has prepared a detailed report of the SNF inventory at these sites, the near-site transportation infrastructure, and past experiences at each site for transporting heavy equipment (e.g., reactor pressure vessels, steam generators) on to or off of the site. This report is being continuously updated as new information becomes available regarding site status. While an SNF destination has not yet been selected, studies of the transportation infrastructure can be used to determine potential routes from the shutdown sites to Class I railroads that can be used to transport loaded casks.

While much of the transportation planning has been applicable to any reactor site and destination-independent, DOE studies have recently begun to plan the de-inventory of particular shutdown sites. This year, DOE will study specified sites individually to determine a strategy for removing SNF inventory. Sites anticipated to be studied this year are Big Rock Point (in Michigan), Connecticut Yankee (also known as Haddam Neck), and Humboldt Bay (in California). All sites will eventually be studied in depth to construct individual site de-inventory plans.

In order to effectively plan transportation of SNF, detailed information must be known about the material to be shipped. For example, it must be determined whether the transportation cask containing SNF meets regulatory requirements. A comprehensive system for the analysis of fuel from the time it is discharged from the reactor to its final disposition has been developed to supply much of the necessary information. This system, the Used Nuclear Fuel Storage, Transportation, and Disposal Analysis Resource and Data System (UNF-ST&DARDS), characterizes the SNF to be shipped, addressing such issues as thermal load, criticality, and dose rates. With this data, it will be possible to make more realistic assumptions rather than the overly conservative bounding regulatory assumptions typically used. Better data analysis will enable more efficient transportation of SNF when a destination becomes available. Using a combination of legacy tools and new methods, as well as data from up-to-date information and simulations, routing analyses will be performed. These analyses will include the dose to public due to incident-free transportation. Safety is of paramount importance. Once public safety and protection of the environment are ensured, then the most efficient, cost effective means of transporting SNF from reactor sites to their destination can be determined.

Hardware

The hardware element includes all physical items necessary for operation of the SNF transportation system: transportation casks and railcars to carry them, other transportation conveyances such as heavy-haul trailers and barges, and ancillary equipment such as lifting devices and cask cradles. It is anticipated that some equipment will be purchased and some will be leased. Design and development work is required for some of the equipment, such as the railcars, which are not currently available.

A highly visible component of the hardware element is the design, prototype fabrication, testing, and approval of a railcar that meets Association of American Railroads (AAR) Standard S-2043. (A US Navy railcar developed to meet the AAR S-2043 Standard with its cask payload are shown in Fig. 3.) A system requirement document was developed this past year, a Request For Information was published, the responses from industry were evaluated, and a statement of work has been established to advance the development of compliant railcars. Because railcar development is expected to take on the order of seven years—including design, prototype fabrication, and extensive testing—it is important that this work proceeds on schedule, so that railcars will be available once a destination has been selected for SNF shipments.

Fig. 3. US Navy AAR S-2043 Compliant Railcar with Cask (Not for transport of commercial SNF).

In addition to rolling stock, the hardware element also includes transportation casks. While most casks have already been developed and certified, some casks which are certified for storage have not been approved for transportation, and some casks will need additional analysis before they can be certified for high burnup fuel or damaged fuel assemblies. Furthermore, cost analyses must be performed to determine whether transportation casks should be purchased or leased, and long-term planning is necessary to ensure availability of casks, ancillary equipment, and rolling stock. Once the system has begun to operate, maintenance of existing hardware and acquisition of additional equipment will be necessary as de-inventory of sites ramps up. These are all areas of current and future study.

CONCLUSIONS

The NFST was established to lay the groundwork for implementing interim SNF storage, including associated transportation, per the Administration's *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste* [2], taking into account recommendations made by the NAS and BRC [1, 3]. While a complete transportation system cannot be developed until a destination site is known, long lead time activities necessary to transportation system development can be addressed now. NFST is proactively developing the transportation infrastructure's institutional, operational, and hardware aspects. These activities will ensure that once a destination site is determined, the transportation system will be available to ensure safe, secure, and efficient movement of SNF from commercial nuclear power reactor sites.

REFERENCES

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