

CURRENT STATUS OF U.S. NUCLEAR WASTE MANAGEMENT PROGRAMS¹**Evaristo J. (Tito) Bonano, Ph.D.**Sandia National Laboratories²

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ABSTRACT

This paper provides an update on the U.S nuclear waste management programs since the Third East Asia Forum on Radwaste Management (EAFORM) held in the Republic of Korea in October 2010. First, the third re-certification for the Waste Isolation Pilot Plant was completed. Second, the Blue Ribbon Commission on America's Nuclear Future (BRC), established by the U.S. Department of Energy (DOE) to evaluate and make recommendations on a new strategy for the management of nuclear wastes issued

its report and the DOE issued a strategy with respect to how the BRC recommendations will be implemented. Third, the DOE's research and development program related to storage, transportation and disposal of nuclear wastes continued has made considerable progress, and a new planning project related to storage in one or more interim storage facilities and the associated transportation of the fuel has been initiated.

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INTRODUCTION

Since the Third East Asia Forum on Radwaste management (3rd EAFORM) held in the Republic of Korea in October 2010 there have been a series of developments regarding progress of nuclear waste management programs in the United States (U.S.). The U.S. Department of Energy (DOE) has completed two re-certification applications for the Waste Isolation Plant (WIPP) under the DOE Office of Environmental Management (DOE-EM), and is in the process of preparing the third recertification application scheduled to be completed in 2015. In addition, successful disposal operations at WIPP continue. The Blue Ribbon Commission on America's Nuclear Future (BRC), established in 2010 by the current U.S. Administration to recommend future strategies for implementing the nuclear waste management program, issued its final report in January 2012. The DOE, on behalf of the Administration, published in January 2013 its strategy for storage, transportation and disposal in light of the BRC's recommendations. Lastly, under the DOE Office of Nuclear Energy (DOE-NE) the Used Fuel Disposition Campaign (UFDC) has continued to make progress in research, development and demonstration related to storage, transportation and disposal of used nuclear fuel. In addition, DOE-NE established the Nuclear Fuels Storage & Transportation Planning Project (NFSTPP) for the purpose of identifying, planning and conduct activities that would facilitate the implementation of milestones in the DOE's strategy for interim storage and transportation.

WASTE ISOLATION PILOT PLANT

The Waste Isolation Pilot Plant (WIPP), located approximately 42 km (26 miles) due east of Carlsbad, New Mexico (Figure 1), is the first deep geologic repository certified in the U.S. to safely and permanently dispose of transuranic (TRU) waste generated from the research and production of nuclear weapons. TRU waste is the U.S. equivalent to Europe's intermediate-level waste, between low-level waste (LLW) and high-level waste (HLW), and requires long-term isolation in a deep geologic repository.

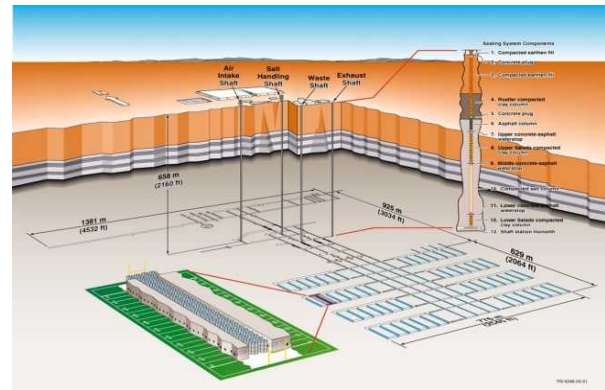


Figure 1. Schematic of the WIPP Facility.

The Waste Isolation Pilot Plant Land Withdrawal Act of 1992 (Public Law 102-579) [1] mandates the location and provisions for development of WIPP, including compliance with U.S. Environmental Agency (EPA) disposal regulations. DOE's Compliance Certification Application (CCA) was submitted to the EPA in October 1996. EPA initially certified WIPP in May 1998 and WIPP received the first shipment of TRU waste on March 26, 1999. As of July 2013, nearly 11,500 waste shipments, totaling more than 87,000 m³ of contact handled (CH) waste and more than 300 m³ of remote handled (RH) TRU waste have been made to WIPP. WIPP has assisted in the cleanup of TRU waste from 22 sites across the U.S.

At WIPP, TRU waste is placed in disposal rooms located 655 meters (2,150 feet) underground within a geologically stable salt formation known as "the Salado." The WIPP design includes ten panels, each made up of seven disposal rooms. Waste has been emplaced in Panels 1 through 5, and disposal operations are currently taking place in Panel 6. Mining of Panel 7 is underway. The DOE has submitted a Planned Change Request (PCR) to EPA and a Permit Modification Request (PMR) to the New Mexico Environmental Department (NMED) that proposes relocation of Panels 9 and 10 due to an increase in ground movement. Panels 9 and 10 were originally planned to be centrally located in the disposal area in the access drifts between Panels 1-4 and 5-8. Instead of enlarging the access drift to create Panels 9 and 10, the PCR and PMR proposes mining two additional panels (Panels 9A and 10A) south of Panels 4 and 5. The main driver for the modification is increasing worker safety. Enlarging the access drifts would increase ground movement and increase the risk to those working in the area.

A key requirement for WIPP is recertification at five-year intervals following initial receipt of waste to ensure that WIPP continues to comply with the applicable disposal regulations.

EPA's first recertification of WIPP was in March 2006 and the second in November 2010. The DOE will submit the 2014 compliance recertification application to the EPA in March of 2015. The EPA will evaluate changes at WIPP, to determine whether the facility continues to meet the disposal radiation protection standards.

The New Mexico Environmental Department (NMED) has been given the authority by the EPA to regulate hazardous waste disposal at WIPP under the Resource Conservation and Recovery Act (RCRA). The DOE submitted the first hazardous waste facility permit renewal in 2009 and, after formal hearings, public comment and amendments, the NMED declared the renewal application administratively complete. A new permit was issued in April 2011.

In addition to being the U.S. national repository for TRU wastes, WIPP is a unique facility for researching a variety of subjects. WIPP provides a suitable environment for the conduct of experimental programs in many scientific disciplines, including particle astrophysics, waste repository science, mining technology, low radiation dose physics, fissile materials accountability and transparency, and deep geophysics. Current and past underground experiments include:

- The Enriched Xenon Observatory (EXO), an experiment in particle physics aiming to detect "neutrino-less double beta decay". A 200-kg detector using liquid xenon is currently being installed at the WIPP. Many research and development efforts are underway with the goal of probing new physics and the mass of the neutrino.
- Biological experiments continue underground testing effects of low background radiation on bacteria.

BLUE RIBBON COMMISSION ON AMERICA'S NUCLEAR FUTURE

Contemporaneous with the decision to terminate the Yucca Mountain Project, the U.S. Secretary of Energy, on behalf of the U.S. Administration, established the Blue Ribbon Commission on America's Nuclear Future (BRC). The BRC was asked to conduct a comprehensive review of policies for managing the back end of the nuclear fuel cycle, including alternatives for the storage, transportation, processing, and disposal of civilian and defense used nuclear fuel, high-level radioactive wastes and materials derived from nuclear activities.

The BRC consisted of fifteen members representing a broad range of nationally recognized policy, technical, academic, corporate and union expertise. The BRC established three subcommittees among its members to address specific aspects of the nuclear fuel cycle: Disposal, Reactor and Fuel Cycle Technology, and Transportation and Storage.

The BRC and its subcommittees met numerous times between March 2010 and January 2012 to gather information from experts and other interested parties (i.e., stakeholders), and visited nuclear waste management facilities in the U.S. and other countries. After issuing a draft report in August 2011, the BRC conducted five public meetings throughout the U.S. as way of gathering reactions on the draft report. Many organizations, interest groups, and individuals provided input to at these meetings as well as in written comments.

In January 2012 the BRC issued its final report to the U.S. Secretary of Energy; the report contained eight major recommendations [2]:

1. A new, consent-based approach to siting future nuclear waste management facilities;
- A new organization dedicated solely to implementing the waste management program and empowered with the authority and resources to succeed;
- Access to the funds nuclear utility ratepayers are providing for the purpose of nuclear waste management;
- Prompt efforts to develop one or more geologic disposal facilities;
- Prompt efforts to develop one or more consolidated storage facilities;
- 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;
- Support for continued U.S. innovation in nuclear energy technology and for workforce development; and
- Active U.S. leadership in international efforts to address safety, waste management, non-proliferation, and security concerns.

DOE'S STRATEGY FOR THE BACK END OF NUCLEAR FUEL CYCLE

In January 2013, DOE issued its strategy for the management of back end of the nuclear fuel cycle [3]. The strategy has three main objectives: (1) state the importance that the U.S. Administration places on addressing the issues associated with the management of used nuclear fuel and high-level

radioactive waste; (2) respond to the BRC's recommendations; and (3) provide a framework for initiating discussions among the Administration, Congress and stakeholders on the path forward leading eventually to final disposition of nuclear wastes.

The three main aspects of the proposed nuclear waste management system are: (1) a pilot interim storage facility by 2012; (2) a larger, full-scale interim storage facility by 2025; and (3) a geologic repository by 2048. A fundamental tenet of the strategy is the implementation of a consent-based process for the siting and licensing of the different waste management facilities that will be needed. The strategy recognizes that a consent-based process involving host communities could lead to more than one interim storage facilities and/or geologic repositories. The strategy also recognizes that congressional action will be needed in the form of authorization and appropriation legislation in order to implement the three main aforementioned aspects. The strategy components are illustrated in Figure 2 [3].

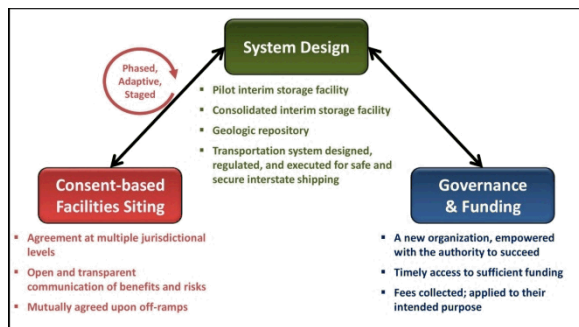


Figure 2. Elements DOE Strategy [3]

The timeline for implementation of the proposed nuclear waste management system³ is illustrated in Figure 3.

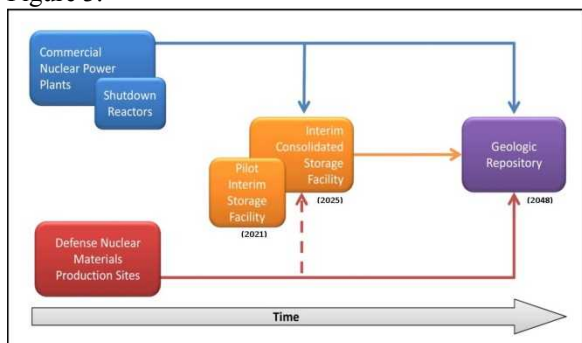


Figure 3. Nuclear Waste Management System [3]

Currently, except for WIPP, DOE-NE has the responsibility for responsibility for activities related to the research and development (R&D) and implementation of the nuclear waste management system. DOE-NE has organized its generic R&D activities under the Used Fuel Disposition Campaign (UFDC) and the Nuclear Fuels Storage & Transportation Planning Project (NFSTPP). These programs are discussed in another paper presented at this conference [4], so they will not be discussed here in detail other than to state their high-level objectives.

Used Fuel Disposition Campaign

The UFDC has both near-term objectives and long-term objectives. The near-term objectives are:

1. Provide technical expertise to inform policy regarding the management of used nuclear fuel (UNF) and radioactive waste that would be generated under existing and potential future nuclear fuel cycles.
2. Develop a comprehensive understanding of the current technical bases for storing UNF and high-level radioactive waste to identify long-term research and development opportunities.
3. Develop the technical basis for the retrievability and transportation of high-burnup UNF.
4. Develop a comprehensive understanding of the current technical bases for disposing of UNF, low-level radioactive waste, and high-level radioactive waste in a range of potential disposal environments to identify long-term research and development opportunities.
5. Continue model development, confirmed by experiment, for the evaluation of disposal system performance in a variety of generic disposal system concepts and environments.

The UFDC long-term objectives are:

1. Develop a fundamental understanding of the performance of potential storage system concepts over many decades for a variety of UNF types and radioactive waste forms based on simulation and experiment.
2. Initiate long-term storage strategies through a small-scale demonstration project that incorporates the technologies identified and developed from the near-term storage objectives.
3. Develop a fundamental understanding of disposal system performance in a range of environments for potential wastes that could arise from future nuclear fuel cycle alternatives through theory, simulation, testing, and experimentation.
4. Develop a computational modeling capability, confirmed by experiment, for the performance of

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storage, transportation, and disposal options for a range of fuel cycle alternatives.

Under the UFDC a number of R&D activities are being performed to address technical challenges related to storage, transportation and disposal of UNF and other existing and reasonably expected future nuclear wastes. Storage R&D is focusing on the long-term storage of high-burnup fuels and UNF integrity for transportation after long-term storage, among others. Transportation R&D priorities include: understanding of material properties through modeling and experimentation, cladding integrity investigations, and impacts of transportation of fuel assemblies over roads. Disposal R&D is evaluating four generic disposal options: deep geologic disposal in three generic rock types (salt, shale and granite), and disposal in small-diameter boreholes 5 kilometers deep, referred to as deep-borehole disposal. These four disposal options are shown in Figure 4.

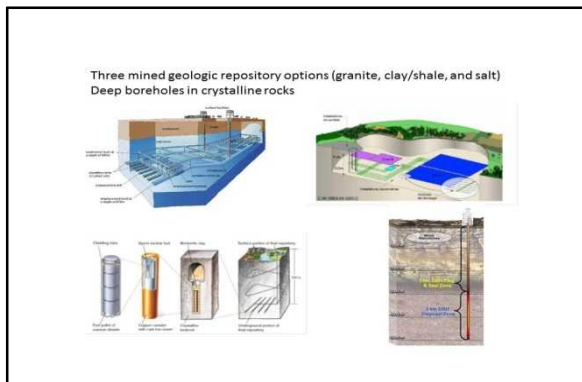


Figure 4. Disposal Options under UFDC

Nuclear Fuels Storage and Transportation Planning Project

DOE-NE established the NFSTPP for the purpose of planning and implementing, to the extent allowed by present Congressional authorization and appropriation, the storage and transportation aspects of the DOE strategy [3].

As stated earlier in this paper, the DOE plans to implement a program that consists of the major milestones:

1. 2021 – site, design and license, construct, and begin operations of a pilot interim storage facility (ISF) with an initial focus on accepting used nuclear fuel from shutdown reactor sites
2. 2025 – site and license a larger ISF with sufficient capacity to provide flexibility in

the waste management system and allow for acceptance of enough used nuclear fuel to reduce expected government liabilities

3. 2048 – make demonstrable progress on the siting and characterization of repository sites to facilitate the availability of a geologic repository

The objectives of the NFSTPP is to develop and begin implementation of an integrated management plan to: (1) implement interim storage; (2) improve the overall integration of storage as a planned part of the waste management system; and (3) prepare for the large-scale transportation of used nuclear fuel and high-level waste, focusing initially on removing UNF existing shutdown reactor sites.

CONCLUSIONS

Since the Third East Asia Forum on Radwaste Management in October 2010, there have been a number of significant developments on the U.S. nuclear waste management programs. First, the EPA issues its second re-certification for WIPP which determined that this facility continues to meet the established TRU waste disposal standards. In addition, the NMED issued WIPP's renewed WIPP's the permit as a hazardous waste facility.

Second, the Blue Ribbon Commission on America's Nuclear Future, established in 2010 to make recommendations future nuclear waste management policies, issued its final report in 2012 containing six major recommendations.

Third, the DOE in 2013 issued a strategy, largely in response to the BRC's recommendations, which is committed to – assuming the necessary Congressional authorization and appropriation – to a program that will have an operational geologic repository by 2048 with two intermediate steps consisting of a pilot interim storage facility by 2021, a larger interim storage facility by 2025, and the needed large-scale UNF transportation system.

Fourth, DOE continues to focus on generic storage, transportation and disposal R&D campaign focused on addressing key technical challenges, and has initiated a new program aimed at the planning of the two aforementioned interim storage milestones.

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