Savannah River Site
Citizens Advisory Board

Recommendation 320

Chemical Separation or Partitioning and Transmutation (P/T) of Used Nuclear Fuel and Defense High-Level Radioactive Waste

Background

Used nuclear fuel and defense high-level radioactive waste have been stored at commercial and government sites for over a half century at a cost of billions of taxpayer dollars, safety and health challenges, environmental threats, proliferation risks, and with no return on investment. Engineering and scientific principles were earlier ignored in some cases, resulting in exorbitant cleanup costs. Failed deep geologic repository programs in Kansas and Nevada have cost billions of dollars with no return on taxpayer investment. Congressional action in 1982 led to the expenditure of approximately $13 billion dollars for the development of a national repository at Yucca Mountain. The repository plan was cancelled prior to completion and stands incomplete and unused. A federal office, the Nuclear Negotiator Office, unsuccessfully attempted to locate consent-based nuclear waste storage sites on Native American reservations and in other communities between 1987 to 1994. That office was officially closed after additional taxpayer dollars were expended and there was no return on investment.

In January 2012, the special presidential Blue Ribbon Commission (BRC) issued a final report containing a series of recommendations, including the establishment of a consent-based pilot site, a possibly co-located consent-based interim storage site, and one or more consent-based permanent nuclear waste repositories. In response to the BRC recommendation for consent-based consolidated storage locations, the Department of Energy (DOE) issued a 2013 Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste. The Strategy committed to protect public health and safety, security, and the environment through a “safe, long-term management and disposal program”. The Strategy outlines a program which provides for siting, designing and licensing a pilot interim storage facility by 2021, a larger interim storage facility by 2025, and over the next ten years, the administration currently plans to make “demonstrable progress on the siting and characterization of repository sites to facilitate the availability of a geologic repository by 2048”. Both defense high-level radioactive waste and commercial used nuclear fuel would be co-located at the geologic repository. In addition to the defense waste that must be cleaned up, there is approximately 75,000 tons of commercial used nuclear fuel currently awaiting disposition in 34 states at 103 nuclear power plants across America. The inventory of used nuclear fuel is increasing at an annual rate of some 2,000 tons per year. The nuclear industry claims that a “Nuclear Renaissance” is underway. If successful, spent nuclear fuel inventories will grow in proportion to the number of new reactors brought on line.

The DOE 2013 Strategy also included comments on the technical review by the Oak Ridge National Laboratory (ORNL) which found that “approximately 98 percent of the total current inventory of commercial used nuclear fuel by mass can proceed to permanent disposal without the need to ensure post-closure recovery for reuse based on consideration of the viability of economic recovery of nuclear materials, research and development (R&D) needs, time frames in which recycling might be deployed, the wide diversity of types of used nuclear fuel from past operations, and possible uses to support national security interests”.

Discussion

On March 19, 2013, David Huizenga, Senior Advisor for Environmental Management (EM), DOE, submitted a written statement in testimony before the U.S. House of Representatives Subcommittee on Energy and Water Development. In his statement, Mr. Huizenga reported that the nation faces cleanup of 88 million gallons of the “world’s most dangerous radioactive wastes, thousands of tons of spent nuclear fuel (SNF), over ten thousand containers of excess plutonium and uranium, over five thousand contaminated facilities, millions of cubic meters of contaminated soil and billions of gallons of accumulated nuclear material from five decades of nuclear weapons development and government sponsored nuclear energy research. It is the world’s largest environmental cleanup program, charged with cleaning up 107 sites across the country; an area equal to Rhode Island and Delaware combined”.

“The price tag for cleaning up the Cold War legacy waste [alone] is estimated at over $300 billion, with a life span of at least 40 years. Budgetary issues continuously obfuscate the cleanup efforts. Federal funding becomes problematic for each Congressional budget call due to the scale and complexity of the challenge, combined with the country’s increasing financial exigencies. Such issues as the expanding national debt and growing political pressures to reduce federal spending add to the funding challenges annually faced by DOE as it struggles to keep the EM legacy cleanup program above water.” The cleanup effort would require the pilot site, interim storage site(s) and permanent repository discussed above.

The 2013 DOE Strategy, an integral part of the cleanup effort, projects a 34-year time span before a permanent disposal site is made available. By then, much of the nation’s nuclear waste will have awaited dispositioning for almost a century. The cost to taxpayers for a resolution to this problem will have been in the hundreds of billions of dollars with no return on investment.

The ORNL evaluations indicate that the nation’s used nuclear fuel has no value in terms of economics, R&D or national security. Therefore, there is no justification for maintaining it in any recoverable form. Technological procedures should be sought which essentially destroy much of its energy and ability to harm or pollute and eliminates or minimizes the costs for its storage.

Rather than one monolithic geologic plan, which has a history of failure, there are alternative approaches which could compliment the geologic repository approach that has previously been the focus of DOE nuclear waste management programs. At the 1999 NATO Advanced Study Institute, leading international experts presented research results indicating that chemical separation technologies, or partitioning and transmutation (P/T), have positive applications for nuclear waste management. Developing chemical separation technologies as one branch of the national repository program could accelerate the decay rate of nuclear waste, lower the material’s volume, and reduce its half-life. Such approaches, depending on fuel types, might also be applied in the transformation of nuclear waste and UNF to more stabilized forms compatible with packaging and shipping requirements.

Research costs required to develop and achieve accelerated decay rates of nuclear waste can be partially offset by operating on the concept that “polluters pay”. That approach could function to defray costs where existing and future UNF is concerned. While such advanced technologies might not turn the waste into “fairy dust”, it could result in the need to store less of it, in a less radioactive form, for a shortened time period. That approach could not only substantially reduce the magnitude of the waste storage by eliminating the need to develop and maintain exorbitantly expensive permanent storage sites, it would support DOE’s commitment to “to protect public health and safety, security, and the environment” through the development of a comprehensive plan to manage the nation’s nuclear waste and UNF. Choppin and Khankhosayev (1999) claim “separation technologies are of crucial importance to the goal of significantly reducing the volume of high-level nuclear waste, thereby reducing the long-term health risks to mankind”.

Some types of UNF and HLW stored at SRS could be used as test materials for investigating such technologies. The skills and facilities at the Savannah River National Laboratory (SRNL) could also be utilized in this effort. SRNL staff have gained considerable knowledge relevant to such technologies in their previous investigations in the areas of Melt-Dilute, Electrochemical Separation, Electrodialysis Separation, Selective Electrochemical Extraction, and Chromatographic Separation. R&D is also needed on the dry cask storage systems and their monitoring requirements in harsh environments in preparation for shipment to consolidation sites. SRS offers opportunities for such R&D through its available property and staff abilities. These potential technological options, in tandem with development of interim and permanent disposal sites, could greatly enhance DOE efforts to provide a national cleanup and nuclear waste management.

Recommendations

The Savannah River Site Citizens Advisory Board recommends that DOE:

1. Develop a systemic plan which outlines and prioritizes the development of advanced separation technologies.
2. Develop a strategy which integrates such advanced technologies with efforts to construct a repository.
3. Task the SRS SRNL with implementing an investigative program in support of the systemic plan and the integration plan.
4. Develop a funding approach adequate to the task of supporting the systemic plan, the integrative plan, and the investigative program assigned to the SRS SRNL.
5. Provide a draft plan and funding approach for public information and input by FY 2016.

References:

1. Department of Energy Strategy For The Management And Disposal Of Used Nuclear Fuel And High-Level Radioactive Waste, January 2013.
2. Categorization of Used Nuclear Fuel Inventory in Support of a Comprehensive National Nuclear Fuel Cycle Strategy, ORNL/TM-2012/308 (FCRD-FCT-2012-00232). Oak Ridge National Laboratory, Oak Ridge, Tenn., December 2012.
3. Chopin, Gregory R. and Mikhail Khankhasayev. 1999 Chemical Separation Technologies and Related Methods of Nuclear Waste Management: Application Problems and

Research Needs. Presented at the NATO Advanced Study Institute. May 1998. Dubna, Russia.
4. Chemical Separations in Nuclear Waste Management: The State of the Art and a Look to the Future. Gregory R. Choppin (Editor), Mikhail K. Khankhasayev, (Editor), and Hans S. Plendl (Editor). Kluer Academic Publishers. P.O. Box 17, 3300 Dordrecht, The Netherlands. 1998