

NEAC Fuel Cycle Technologies Subcommittee Report

Presentation to the
Nuclear Energy Advisory Committee
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Fuel Cycle Technologies Subcommittee Members

- Carol J. Burns
- Margaret Chu
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Fuel Cycle Technologies Subcommittee

- One day meeting on October 30, 2014
- Presentations covered:
 - FY15 Budget Overview
 - Nuclear Fuel Storage & Transportation – Overview
 - Used Fuel Disposition – International Programs
 - Deep Borehole Disposal Concept
 - NEUP Programmatic Overview
 - Fuel Cycle Options Study & Software Demo
 - Multi-Physics Benchmark Evaluation & Validation and INL V&V Center Program Overview
 - On-line Instrumentation H Canyon



Nuclear Fuel Storage & Transportation- Overview

General Comments:

- The objectives of the current program (with \$35 M in FY15) is to lay the groundwork for implementing interim storage and associated transportation, including a pilot interim storage facility for used fuel from shut-down reactor sites (by 2021), and a larger interim storage facility (by 2025)
- Lack of legislative authority has led to sensitive and challenging aspects of this planning project
- Most of activities are appropriate and necessary, some seem open-ended

Recommendations:

- If one has not already been completed, a comprehensive assessment that identifies potential opportunities (e.g., technical, safety, regulatory) that could be addressed should be prepared
- This overview was helpful, but left the Subcommittee with many questions; recommend we include a half-day session focused on this important planning project as part of our next meeting



Used Fuel Disposition - International Programs

General Comments:

- Program international cooperation guided by 2012 Used Fuel Disposition (UFD) International strategic plan:
 - Leverage global knowledge
 - Increase global deployment of advanced technology
 - Build a foundation for collaboration and joint action
 - Accelerate global learning and innovation
- Report issued September, 2014 outlined such multinational and bilateral cooperative activities, describing the opportunities, initiatives and status of the collaborations for UF disposal, storage and transportation

Recommendations:

- Given the progress by international partners in consent-based siting (Switzerland or Canada), NE should examine the lessons learned from these efforts



Deep Borehole Disposal Concept

General Comments:

- Concept has been considered for decades, but drilling technology was not suitable
- Advances in drilling technologies for gas and oil, coupled with lack of progress in mined geologic repository, has renewed interest in this technology
- Deep borehole disposal concept is believed to provide good isolation of radioactive materials from entering into the biosphere because of geochemically reducing conditions, low permeability, and long residence time of high-salinity groundwater in very deep wells
- A **non-radioactive** field test is being considered to demonstrate key aspects of this technology for possible waste disposal (for ~\$80M over 5 years)

Recommendations:

- Given the importance and cost of this field test, it is recommended that a disciplined approach to data gathering be employed, such as the Data Quality Objective (DQO) process



Deep Borehole Disposal Concept (Continued)

Recommendations (continued):

- Because of the continued expectations of the U.S. developing a mined repository, recommend DOE-NE provide a clearer rationale in this context for the mission need (e.g., types of waste and requirements) for borehole disposal
- Cost and schedule estimates for the field test appear to be overly optimistic given the previously identified uncertainties (both regulatory and technical); recommend these be reassessed
- We recommend a comprehensive scenario analysis be performed early in the project, once a site has been selected. This will identify vulnerability of features, events, processes of the site as well as engineering components that may create release pathways for radionuclides
- Stress the importance of evaluating other factors, such as leveraging other DOE expertise and for co-locating this demonstration with the FORGE R&D site for cost/benefit tradeoffs



NEUP Programmatic Overview

General Comments:

- Heeding the recommendations of a American Physical Society's Panel on Public Affairs (APS POPA) report, in 2009 NE began allocating approximately 20% of its R&D budget to university programs
- The Subcommittee applauds the work that NE has done via its 20% funding allocation to university programs
- Moreover, the management of the allocation of those funds has been exemplary. Leveraging the investment with international partners should continue.

Recommendations:

- NE maintain the current level of commitment (20%) in the future
- NE continue its commitment to “blue sky” university research, especially in the present climate of tight Federal funding that limits DOE laboratories from undertaking any significant amount of blue sky research
- DOE study the pros and cons of widely distributing its research and infrastructure awards in its present open competitive process



Fuel Cycle Options Study & Software Demo

General Comments:

- Fuel Cycle Options (FCO) Evaluation and Screening (E&S) Study has been briefed to NEAC in previous reports
- Study was formally released in October 2014 (prior to our Subcommittee meeting) along with a Screening Evaluation Tool (SET)
- The E&S Study used a logical framework and process to screen and evaluate alternative fuel cycles that may provide significant improvements over our current fuel cycle.
 - 9 evaluation criteria (with 25 metrics) were used to evaluate 40 fuel cycle evaluation groups (representing 4398 individual fuel cycle options)
 - 6 “benefit criteria” (waste management, proliferation risk, material security risk, safety, resource utilization, and environmental impact)
 - 3 “challenge criteria” (development or deployment risk, institutional issues, financial risk/economics).
- Substantial discussions within DOE over the previous 6 months resulted in a simplified approach for the proliferation risk and material security criteria (which largely reflects deployment in the U.S.)



Fuel Cycle Options Study & Software Demo

General Comments (continued):

- The study suggests that only the nuclear waste management and resource utilization criteria were strongly affected by the choice of fuel cycle.

Observations:

- Overall, the study does not represent much new information or surprising insights on nuclear fuel cycle options. It does provide, however, extensive documentation for transparency of the process and credibility of the data. This vast information data base and cataloging will be very useful for DOE-NE as well as the nuclear community in general.

Recommendations:

- The Subcommittee understands the rationale behind the simplification of the metrics supporting proliferation risk and material security, and recommends that the executive summary of the report be modified to reflect the associated limitations (it is discussed adequately in the body of the report).





Multi-Physics Benchmark Evaluation & Validation and INL V&V Center Program Overview

General Comments:

- Presentation detailed initial DOE-NE efforts to develop a U.S. program plan for forming a knowledge and validation center
- The NEAMS Subcommittee and our own have previously expressed concerns about the need to validate these new DOE-NE M&S tools
- If successful, the proposed program plan for establishing a knowledge and validation center would address this important need by establishing a framework to oversee validation efforts for the new modeling and simulation tools developed by DOE-NE
- Furthermore, the proposed effort is planning to leverage a similar effort recently initiated at the OECD NEA, Nuclear Science Committee

Recommendations:

- The Subcommittee applauds DOE-NE FCRD for proactively starting to address this much-needed validation effort





On-line Instrumentation H Canyon


General Comments:

- New program to perform an instrumentation evaluation by collaborating on an existing DOE Office of Environmental Management (DOE-EM) program to treat used fuel from the Material Test Reactor in H-Canyon at the Savannah River site (the National Nuclear Security Administration is also partnering in this effort)
- The goal is to improve the separation process controls through the use of advanced on-line instrumentation. Such instrumentation is capable of enhancing real-time material balances based on the on-line measurement of concentration, valence and isotopics of key elements in a separation process
- Effort has the potential for major breakthroughs in reprocessing plant effectiveness and material accountancy improvements

Recommendations:

- Consider key questions of real-time measurement accuracy and accountability as demonstration is planned





Thank you –
Questions

