WM2013 Conference Panel Report

PANEL SESSION 37: Used Nuclear Fuel and HLW from National and International Perspectives

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Panelists:

1. **William Boyle**, *Director, Office of Used Fuel Disposition R&D, US DOE Nuclear Energy*
2. **James Rubenstone**, *Chief, Science & Technology Branch, Division of Spent Fuel Alternative Strategies, US NRC*
3. **Graham Fairhall**, *Chief, Science &Technology Officer, National Nuclear Laboratory (United Kingdom)*
4. **Gary Lanthrum**, *Vice President of Consulting, NAC International*
5. **James Voss**, *Partner, Predicus*
6. **Robert Edmonds,** *Director, Business Services, AREVA Federal Services presented on behalf of* ***Dorothy Davidson****, Senior Vice President, Nuclear and Science Programs, AREVA Federal Services, LLC*

About 45 people attended this panel session which focused on options, engineering approaches and technical, regulatory, and nonproliferation/security issues associated with UNF/SNF and HLW disposition. Panelists provided perspectives from past and current programs, both in the US and internationally regarding packaging, transport, storage, recycling, and ultimate disposal of UNF/SNF and HLW.

Summary of Presentations

William Boyle described DOE Office of Nuclear Energy's activities focused on used nuclear fuel disposition. He summarized the DOE-NE organization responsible for used fuel disposition, including the two main elements within NE-5/Fuel Cycle Technologies including 1) Nuclear Fuels Storage and Transportation (NFST), and 2) R&D. Bill reviewed the Blue Ribbon Commission (BRC) summary assessment which focused on laying the groundwork for consolidated storage, and keeping non-site specific R&D repository program activities going.

The NFST organization is led by Jeff Williams, and their priorities include both transportation and storage elements. For transportation, they are engaging regional stakeholders to understand issues with movement of spent fuel; complete a planning report on shipping of fuel from shutdown reactor sites; finalizing policy regarding state assistance along transportation routes, and assessing transportation hardware needs. For storage, NFST will lay the groundwork for consolidated storage by: evaluating prior design concepts and developing communication packages for use with potential host communities, developing a consent based siting process, assessing the need/value of a PEIS, and developing standardized packaging.

The R&D organization is led by William Boyle, and their priorities include extended storage and disposal. For extended storage, R&D is preparing for eventual transport of SNF/HLW (e.g.,

large scale transport modules), including development of the technical basis for extended storage (e.g., degradation mechanisms for long term cask storage, modeling and testing, including issuance of an RFP for a full-scale storage demo for high burn-up UNF), retrievability and transport after extended storage, and transport of high burn-up UNF. For disposal, R&D is developing a sound technical basis to assure the US has multiple viable disposal options, increasing confidence in the robustness of a generic disposal concept; and evaluating the concept of borehole disposal for a near term demonstration. In summary, projects and R&D are underway within NE-5 to address key issues and lay the foundation for storage, transportation, and disposal options for used fuel disposition.

James Rubenstone presented an NRC perspective on UNF and HLW disposition. He emphasized that while US policy evolves, NRC's mission remains the same: ensuring safe and secure use of radioactive material. Successful spent fuel and HLW management requires independent regulation and system-level understanding. The spent fuel storage and transportation focus of NRC is on understanding the technical basis for extended storage and transport, including degradation processes, models, monitoring, and inspection, for which NRC issued a technical report last year. NRC can't afford to do all the research themselves, so they are coordinating with industry and other stakeholders. In addition, they are revising the regulatory framework as needed.

The disposal focus within NRC is built upon three decades of work which has led to a clear NRC understanding of the risks. A key aspect is to maintain and enhance staff expertise, knowledge, and Performance Assessment capabilities. They need to assure continued public awareness of NRC role and the open and credible process. NRC is focusing current work on technical issues and different host rocks, and using international engagement to help expand that knowledge base. These collaborations and coordination efforts are with NEA, IAEA, as well as specific cooperative projects such as DECOVALEX-2015.

Graham Fairhall provided a general European Union (EU) and more detailed UK perspective on spent nuclear fuel and HLW management. Within the EU, just over ½ of the 27 countries have nuclear programs. Germany is pulling out of nuclear power, and Poland is considering getting in. The EU is coordinating best practices, but each country makes their own decisions. Two countries (Finland, Sweden) have very clear and advanced plans for storage and direct disposal of SNF. France has a long term strategy for reprocessing and disposal of vitrified HLW. The EU issued a 201 directive that all EU countries must have a nuclear waste management plan by 2015.

The UK has a long history of reprocessing - since the 1960's. Fast reactors were part of the plan. Most UK fuel was reprocessed including Magnox fuel, for which reprocessing is ongoing, as well as completion of the THORP contracts. Advanced gas reactors (AGR) fuel was unique with its stainless steel cladding, and is planned for long-term storage. Fuel that won't be reprocessed is stored at Sellafield for ultimate disposal in a deep geologic repository. Fuel from future new builds will be stored pending a deep geologic repository. Understanding the long-term behavior of the stainless steel-clad oxide fuel is a key issue for the UK.

The current plan is for a UK repository by 2075 for disposal of SNF and HLW. There are risks of long-term storage and possible cladding degradation, and therefore technical efforts need to

assume decades of storage. Nuclear is now part of a longer term UK energy strategy, but how much is not yet clear. UK studies have been undertaken of different scenarios for both reducing carbon intensity and sustaining energy supply. Estimates of nuclear power demand range from 20GW (2X current UK production) to 75 GW. This represents up to 100,000 tons of SNF, and 100 tons of plutonium that needs to be managed securely. Scenarios and studies being performed include analysis of impacts on a deep repository, considering all SNF as well as impacts if the UK were to recycle the UNF.

Gary Lanthrum provided a perspective on the social dimension of UNF transportation planning. He started with a review of a National Academy of Sciences (NAS) study on relative risks of SNF transport, which concluded that accidents involving hazardous materials shipments of chlorine, propane, or methanol are 10,000 times more likely than an SNF accident, on a per shipment basis. He added that there were over 40 years of UNF shipments without any release of used fuel. In addition, he noted that less than ½ of 1% of DOD Hazard Class rail shipments constitute radioactive materials (2006 data). The conclusion is that radioactive waste is a low transportation risk, and a low quantity of transported material. So, why is it perceived as so dangerous? He offered an explanation rooted in transportation risk perceptions, which are always context dependent. The players in risk perceptions include victims, villains, and heroes. Just over 20% of public trusts the federal government regarding nuclear energy (villain). In contrast, trust in emergency response officials is over 80% (heroes). By their nature, people tend to respond more to negativity and fear (fight or flight), versus logic.

However, Gary offered a path to increasing public confidence. Safety of nuclear material shipments is by design, and Sandia National Laboratories had performed and filmed cask-rail collision tests in the ‘70s that demonstrated this fact. The NRC plans to redo full scale testing with the current generation of rail casks. The recommendation is that an emergency response exercise be combined with the rail cask test. This would provide first responders (heroes) with firsthand experience and more confidence in the transportation system, and we should give our trusted responders a role in communicating the safety of the radioactive waste transportation systems.

James Voss provided a perspective from past DOE accomplishments in the development of a monitored retrievable storage (MRS) facility, and its relevance to the current recommendation for one or more consolidated storage facilities. Work performed in the 1980’s for OCRWM and DOE-RL resulted in a 30% design for an MRS facility that would support 3600 MTHM/yr of fuel receipt, minimum of 72,000 MTHM total storage capacity, and 8000 MTHMe of HLW. In addition, a nationwide siting study was also performed, including transportation, socioeconomic, institutional, regulatory, environmental and cost analysis. The Clinch River Site in Tennessee was recommended, and a consultative process with the state was initiated.

By 1987, the *Nuclear Waste Policy Act* was amended and the MRS program was terminated. However, before the program was shut down, testing and design work was performed on major elements of the MRS system, including 1) Consolidation: A production-scale fuel consolidation system at TAN (INEL) was fabricated and operated (hot), with the goal to produce consolidated fuel for a dry storage demonstration; 2) Packaging: at NTS, 13 SNF assemblies were acquired and packaged to support the dry storage demo. At INEL, both consolidated and unconsolidated SNF was packaged; and 3) Dry Storage & Retrieval: At NTS, surface borehole storage was

evaluated at the Engine Maintenance and Disassembly (E-MAD) facility. Underground borehole storage was evaluated at the CLIMAX stock, and steel and concrete storage casks were evaluated at TAN-INEL. In summary, DOE has fully demonstrated key elements of production-scale consolidation, packaging, storage and retrieval of SNF. DOE completed designs, siting, systems and safety assessments. There is little visibility of these past activities. These accomplishments must be integrated into ongoing programs to cost effectively advance program objectives.

Robert Edmonds described UNF management activities in France, and AREVA's perspective on options for UNF management in the US. In France, nuclear fuel spends approximately 4 years within the EDF power stations, and then 2-3 years in the reactor storage pools before it is shipped to La Hague for interim storage. The fuel is much hotter, and is shipped in smaller casks (12 fuel assemblies/cask) than in the U.S. After 6 years in interim storage, the UNF is reprocessed at La Hague, with plutonium and uranium going to MOX fuel, and HLW fractions interim stored at La Hague prior to ultimate disposal in a repository at Andra.

In the US, a unique situation exists with 65,000 MT of UNF, which is growing by about 7500 assemblies/yr. More than 60,000 assemblies are in dry storage, and 186,000 are still in reactor pools (2013 data). Robert recommended that several options for UNF management in the US should be kept open, including 1) once thru reactor, to consolidated storage, and ultimate geologic disposal, and 2) recycle of uranium and plutonium to MOX for LWR reactors, then either to disposal, or future further recycling, or store for Gen IV reactors.

AREVA has conceptualized a consolidated storage facility for the US, with a phased build out that would leave options open. The first phase would be a dry storage pad. He emphasized that it is critical a site be identified early, and recommends that discussions with states and communities begin as soon as possible. A second phase would add an unloading facility including storage pool and/or storage handling hot cell for unpackaging, repackaging, examination, and testing. The facility would support 20-30 years of interim storage, and the US would probably need more than one facility. A third phase envisions an 800 MT recycling facility, which if co-located would avoid extra transport of UNF.

Questions and Answers

Gary Lanthrum was asked how he thought the US could revitalize discussion and the process for gaining host site volunteers. He replied that if you engage emergency responders in the process, then DOE is not the villain. Funding will be needed, but the US could realize consensus with NRC, transportation system owners, and first responders with a focus on the transportation infrastructure, to achieve credibility and trust of the communities. An example from the Yucca Mountain work involved transportation thru a California town. The Sheriff went on TV giving a positive message about SNF shipment through the community. A follow-up question was asked regarding who would do the communicating? DOE? NRC is not trusted either. Gary replied that first responders should be communicating. **Bob Edmonds** added that the GNEP program in the 2006-2007 timeframe had a good program or model for siting that involved communities, industry, and state representatives working together. **Jim Voss** added that former SC governor Jim Riley made the comment that "No votes are won in being for nuclear waste." Some states with a long history of support for nuclear energy, such as Tennessee and South Carolina may be the place to start.

A comment from the audience was made that in 2005, there were 28 deaths from a chlorine gas leak – may be useful to point out the reality of industrial hazards relative to radioactive waste.

William Boyle was asked whether the borehole he mentioned was supported by DOE, or an internal Sandia National Laboratories effort. He replied that SNL had done initial work under their internal (LDRD) funding, but he was pretty sure that current work was receiving DOE-NE funding.

William Boyle also responded to a question on what DOE could do short of legislation, given the aggressive timelines in DOE's strategy. He replied that the DOE-NE schedule laid out last month at the INMM meeting requires legislation in the 2013-2014 timeframe; otherwise DOE won't meet the schedule. However, R&D only needs continued appropriations to make progress, and even Jeff Williams' group can do quite a bit in the absence of new legislation. The current legislation (NWPA) specifies that "construction" of a consolidated storage facility may not begin until NRC approves the disposal site application.

In response to a follow up question from one of the panel members, **William Boyle** clarified that DOE cannot engage potential sites directly absent authorizing legislation. However, DOE can respond to questions if someone wants to ask. Another panel member asked if a commercial company pursuing a private fuel storage facility could interact with the government. He replied that current legislation restricts government from doing storage without a disposal site, but not private companies.

Gary Lanthrum responded to a question whether the US had the rail, roads, and casks infrastructure available. He replied that for rail, most likely areas have rail access, but standard freight cars cannot be used. Heavy rail cars for UNF transport will need to be built. The Navy has done it, but they still have some qualification testing to be done. Casks have been designed. **William Boyle** added that Jeff Williams' group in DOE-NE is doing an assessment for transportation in the US, and his R&D group in DOE-NE is also looking at a cask that can go directly to disposal. **James Rubenstone** commented that certification and licensing of a cask at this time would only be done for transport, as it is premature to license a disposal cask without a disposal site selected.

Graham Fairhall was asked if the UK was aware of US work on high burn-up fuel stability, and gap analysis regarding challenges of long-term storage. He responded that UK fuel is much lower burn-up than US LWR/PWR fuels, but that the National Nuclear Lab (NNL) is very much watching what's going on internationally.

William Boyle was asked about EPRI's recommendation on direct disposal using Dual Purpose Casks (DPCs), and who was doing work at DOE-NE. He replied that Tim Gunter's group was doing this with involvement from various national laboratories. **Jim Voss** noted prior EPRI work looking at direct borehole disposal, and how the weight of the wire rope becomes limiting at depth. **William Boyle** confirmed that weight of the wire rope becomes an issue at depths of 2000 feet.

A question was raised about the programmatic environmental impact statement (PEIS) assessment. William Boyle mentioned that a PEIS would be likely of consolidated storage was a

government action, and **Robert Edmonds** commented that a PEIS could probably be worked on without new legislation.

Jim Voss asked the panel the "elephant in the room" question: What to do about nuclear power with the uncertainty of the waste confidence rule being reopened. **James Rubenstone** responded that the issues with waste confidence are mostly in the context of NEPA, and potential impacts of a major federal action. It's less about the downstream disposition and more about NEPA communication and assessment of impacts. In a follow-up question**, Jim Voss** asked if the disposal facility license will become an issue on all power plant licenses. **James Rubenstone** replied that it could, if NRC efforts do not hold up, but there is no reason to believe they won't be able to address issues successfully with the court. An audience member from NRC added that the NRC approach is to treat impacts generally, not on every licensing option. They could do so, but their intent is to address these impacts generically.