



NEAC Fuel Cycle Technologies Subcommittee Report

Presentation to the Nuclear Energy Advisory Committee

**Al Sattelberger, Chair
(Presented by Joy Rempe)**

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Fuel Cycle Technologies Subcommittee Members

- Carol J. Burns
- Margaret Chu
- Raymond Juzaitis
- Chris Kouts
- Sekazi K. Mtingwa
- Ronald P. Omberg
- Joy L. Rempe
- Dominique Warin
- Alfred P. Sattelberger (Chair)

FCT Subcommittee April 29 2015 Review Highlights

- **Separations R&D: Electrochemical Processing (aka Pyro) Technology and Joint Fuel Cycle Study**
- **Accident Tolerant Fuel (ATF) Update**
- **Stakeholder Tool for Assessing Transportation (START) Demonstration**
- **Nuclear Fuel Storage and Transportation (NFST) Topics**
 - Pilot Interim Storage Facility (ISF) Concept Design
 - Standardized Transportation, Aging, and Disposal (STAD) Task
- **Used Fuel Disposition (UFD) R&D Update**
 - High Burnup Demonstration Project
 - Deep Borehole Demonstration Project Status

Separations R&D: Electrochemical Processing (EChem) Technology and JFC Study

Comments:

- 'EChem' considers oxide and metallic fuels (high temperatures not required)
- Potential to reduce long-term radiotoxicity and heat loads of materials placed in repository
- Potential for recovered actinides to be reprocessed

Recommendations/Findings:

- SC pleased to see substantial university involvement, NE and NNSA collaboration, and significant progress made on EChem R&D
- SC recommends:
 - Domestic program budget, currently at \$1M, be increased in phases
 - Program continue lab-scale work prior to scale-up
 - NE and NNSA go beyond Safeguards and Security flowsheet analysis and apply safeguards technology to process material
- SC requests aqueous separations progress review at next meeting to benchmark EChem and Aqueous performance

Accident Tolerant Fuel (ATF) Update

Comments

- Program focused on developing and qualifying accident tolerant LWR fuels and cladding to improve reactor and/or spent fuel safety
- Top-level goal is to insert Lead Fuel Rod or Lead Fuel Assembly into a commercial reactor by 2022
- February 2015 ATF-I insertion of rodlets for four concepts into ATR significant accomplishment toward 2022 goal
- Additional tests, such as instrumented tests in PWR loops, required
- ATF analytical assessments another key aspect; includes developing new fuel performance codes and applying existing severe accident systems analysis codes

Recommendations/Findings:

- SC commends program on February 2015 ATF-I insertion and efforts to complete instrumented tests
- SC requests more detailed discussion on efforts to develop fuel performance codes and to evaluate integrated performance of fuel and other reactor components under severe accident conditions

Stakeholder Tool for Assessing Transportation (START) Demonstration

Comments:

- Development of START tool, which was previously briefed to NEAC, continues.
- Educational tool for identifying transportation routes and assessing impact of various shipping options.
- Several considerations affect routing and associated risk evaluations:
 - DOT highway and railway regulations can affect routing selection.
 - Data represented in START constantly changing.
 - Risk evaluations for escorted vehicle and dedicated rail shipments differ from general accident rate statistics.

Recommendations/Findings:

- SC concerned about possible misunderstandings associated with START until it is fully developed.
- SC recommends that the START disclaimer be expanded to acknowledge its current limitations.

Pilot Interim Storage Facility (ISF) Concept Design

Comments:

- ISFs could address Blue Ribbon Commission recommendations and Administration's strategy
- DOE planning to down-select to non-site specific generic pilot ISF design and submit topical report to NRC

Recommendations/Findings:

- SC recommends that program assess/clarify:
 - Authorizing legislation required before ISF siting and construction
 - No liability reduction if fuel from shutdown reactor site is prioritized
 - Impact of uncertainties associated with ultimate storage and regulatory requirements
 - Coordination between DOE-led and recently announced industry-led efforts

Standardized Transportation, Aging, and Disposal (STAD) Task

Comments:

- Standardized canister approach could:
 - Minimize amount of repackaging
 - Reduce total system-wide costs
 - Streamline fuel handling and licensing
 - Increase flexibility
 - Reduce waste acceptance liability
- Prior evaluations found smaller canisters result in more handling, higher worker exposures, and increased costs
- Uncertainties associated with ultimate storage and regulatory requirements limit ability to optimize design.

Recommendations/Findings:

- SC recommends STAD work be deferred until final repository site is identified and under development

High Burnup Dry Cask Research and Development Project (HDRP)

Comments:

- HDRP to provide technical bases to address aging management program licensing requirements for extended storage of HBU fuel (> 45 GWd/MTU)
- DOE co-funds this EPRI-led collaboration that includes AREVA, Dominion, Westinghouse, NAC, and several national laboratories
- HDRP includes:
 - Multiple fuel/cladding combinations in TN-32 bolted cask
 - Temperatures (from thermocouple lances installed in guide tubes) and gas samples will be obtained
 - Extensive characterization (non-destructive and destructive examinations) of sister rods

Recommendations/Findings:

- SC generally finds HDRP to be a well conceived project.


Deep Borehole Demonstration Project Status

Comments:

- Deep borehole concept increasingly attractive:
 - Advances in drilling technologies
 - Lack of progress in developing mined geologic repository
- Deep borehole concept features:
 - Drilled 5,000 m into crystalline “basement” rock
 - Canisters containing waste forms placed in lower 2,000 m
 - Upper borehole sealed
- Non-radioactive borehole field test effort initiated (Draft RFP released April 7, 2015 with responses due May 7, 2015)

Recommendations/Findings:

- Estimated field test cost and schedule (\$80 M over 5 years) appear optimistic
- Once the site is selected, SC recommends comprehensive scenario analysis be completed to identify vulnerabilities in site, design features, and processes



Thank you – Questions?