Industry Perspectives on the Development of Recycling Regulations

Rod McCullum, Nuclear Energy Institute
May 13, 2009

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Integrated Used Fuel Management

- Industry supports a three-pronged approach to used fuel management
  - Interim storage at reactor sites and centralized location(s)
  - Recycling
    - present day recycling technologies
    - development of advanced used fuel recycling technologies
    - new fuel types and improved waste forms
    - new reactor designs
  - Permanent disposal facility
- Blue Ribbon Panel considering options

Industry Support for Recycling

- Recycling benefits the long term future of nuclear energy
- Recycling technology should be deployed at the appropriate time
  - Technology decisions will be market-driven
  - Regulatory uncertainty affects market conditions
- Regulatory infrastructure to support recycling is 1st need
  - Must be available to inform future decision-making
  - Regulatory framework should be built on what we have learned from U.S. and international experience with present day technologies
  - The framework should be structured so that it can evolve to accommodate advanced technologies ahead of the need for it to do so

Obama Administration Support for Recycling

- Enabling sustainable fuel cycles identified as one of five “nuclear imperatives” (1)
- “Work on advanced reactor technologies, fuel cycle technologies, waste management, and cross-cutting technologies and transformative concepts will help ensure that nuclear energy remains a safe, secure, economical source of clean energy” (2)
- Developing sustainable fuel cycles identified as one of four “nuclear R&D objectives” (3)

(1) Pete Miller, Assistant Secretary of Energy, presentation to NAS NRSB 12/10/2009
(2) Steven Chu, Secretary of Energy, Congressional Testimony, 3/10/2010
(3) Buzz Savage, Dep. Assist. Secy. For Fuel Cycle Technologies, presentation to NEI Dry Storage Forum 5/4/2010

Blue Ribbon Commission Consideration of Recycling

Blue Ribbon Commission on America's Nuclear Future
U.S. Department of Energy

Advisory Committee Charter

3. **Objectives and Scope of Activities.** The Secretary of Energy, acting at the direction of the President, is establishing the Commission to conduct a comprehensive review of policies for managing the back end of the nuclear fuel cycle, including all alternatives for the storage, processing, and disposal of civilian and defense used nuclear fuel, high-level waste, and materials derived from nuclear activities. Specifically, the Commission will provide advice, evaluate alternatives, and make recommendations for a new plan to address these issues, including:

   a) Evaluation of existing fuel cycle technologies and R&D programs. Criteria for evaluation should include cost, safety, resource utilization and sustainability, and the promotion of nuclear nonproliferation and counter-terrorism goals.

   b) Options for safe storage of used nuclear fuel while final disposition pathways are selected and deployed;

   c) Options for permanent disposal of used fuel and/or high-level nuclear waste, including deep geological disposal;

   d) Options to make legal and commercial arrangements for the management of used nuclear fuel and nuclear waste in a manner that takes the current and potential full fuel cycles into account;

   e) Options for decision-making processes for management and disposal that are flexible, adaptive, and responsive;

   f) Options to ensure that decisions on management of used nuclear fuel and nuclear waste are open and transparent, with broad participation;

   g) The possible need for additional legislation or amendments to existing laws, including the Nuclear Waste Policy Act of 1982, as amended; and

   h) Any such additional matters as the Secretary determines to be appropriate for consideration.

Regulatory Infrastructure that meets the current need

- A new rule should be promulgated expeditiously (as proposed in NEI recommended Part 7X)
- Rule should be technology neutral
- Rule should be risk-informed and performance-based
  - approaches are well suited for technology neutrality
- Rule should accommodate potential advanced separations technologies (e.g. via reserved sections and regulatory guidance)
- Rulemaking should advance at pace that will pro-actively inform ongoing decision-making

SECY 09-0082

"The reprocessing framework will enable licensing of pyroprocessing facilities due to a risk-informed, performance-based approach. However, the framework will not support fast reactors, the usual disposition path for pyroprocessed fuel…… Additionally, applications that result in separate, pure streams of various transuranics, such as americium and neptunium, and others, as demonstrated in some uranium extraction (i.e., UREX+) reprocessing applications will require further evaluation."

Suggested Approach

- NEI proposed Part 7X is technology neutral
- NRC should move forward with rulemaking, staying technology neutral to the maximum extent possible.
- If there is an area where technology neutrality is problematic, NEI suggests NRC build in mechanisms (e.g. reserved sections) to accommodate potential future technology specific features.
- Industry would be interested in engaging in additional dialogue on this topic

Regulatory Gaps to be discussed today

- #3 HLW/WIR Definition – John Greeves
- #5 Risk Considerations – Bob Pierson
- #8 Risk Informing Pt 73/74 – Jack Bailey
- #9 Baseline Design Criteria – Robert Hogg

Conclusion

- The nuclear industry is pursuing an integrated approach to commercial used fuel management
- There is broad agreement that recycling should be part of this approach
  - This is reflected in current Administration Policy
  - This is reflected in the Blue Ribbon Commission Charter
- There are multiple potential ways to implement recycling
  - Decision-making on approaches and timeframes are still evolving
  - This evolution must be informed by knowledge of the regulatory framework in which it will occur

GAP 3

John Greeves

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GAP 3

- GAP: NRC lacks regulations defining certain waste streams from spent fuel recycling as waste incidental to recycling (WIR) rather than HLW.
- Staff basis: The staff has long held the view that not all waste resulting from reprocessing would be HLW.
- The criteria contained in the NDAA section 3116 should be used to define WIR in a Part 7X rule.
  - NRC has the authority to address “highly radioactive” and “sufficient concentrations” in the definition of WIR
- What is NRC staff view on industry recommendations (ML093030353) for defining WIR in this manner?

HLW/WIR EVOLUTION

Industry Recommendation

- Define HLW & Waste Incidental to Recycling in Part 7X
- HLW is the highly radioactive material resulting from recycling of spent nuclear fuel and any other material from such waste that contains fission products in sufficient concentrations. HLW does not include waste incidental to recycling.
- This recommendation is a more technology neutral version of that provided in industry's original white paper

Industry Recommendation

WIR is: Waste material resulting from recycling of spent nuclear fuel produced directly in recycling and any solid material derived from such waste that contains fission products that is not so highly radioactive or contains insufficient concentrations of fission products to be classified as HLW.

Such waste is not so highly radioactive or of sufficient concentration if it

(1) has been processed to remove key radionuclides to the maximum extent that is technically and economically practical, and

(2) either meets Class C concentrations under 10 CFR part 61 or will meet the performance objectives in 10 CFR part 61, subpart C if disposed of in a near surface disposal site based on a site specific performance assessment.

Justification

- Builds on section 3116 and past NRC policies and practices
- Defines WIR consistent with “highly radioactive” and “sufficient concentration”
- Section 3116, defines WIR only for ID and SC
- Section 3116 has been successfully implemented
- Provides regulatory certainty
- Provides predictability
- Provides transparency
- Is technology neutral

Industry Recommendation

- Industry recommends that NRC define WIR in a manner consistent with the precedent set in NDAA 3116, 2005
- Industry is interested in engaging NRC and others on this topic in a specific and detailed follow-up discussion

Gap 5

Bob Pierson

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GAP # 5

- **Issue:** qualitative/ISA vs. quantitative/PRA assessment of risk
- **Basis:** Recycling facility will have a higher source term than that of other fuel cycle facilities
- **The NRC Identified Gap**: The risk assessment by 10 CFR Part 70 involves an integrated safety assessment (ISA) , and allows a qualitative characterization of the consequences and likelihoods of credible accident sequences . Currently , these existing requirements do not adequately address the increased risk a reprocessing facility poses relative to that of other fuel cycle facilities

What Does NRC Regulate

- NRC's primary responsibility is to regulate radiological hazards
- Agency also addresses certain hazardous chemicals
  - Chemicals that are radioactive themselves
  - Those that result from the processing of licensed nuclear material
  - Those that have the potential for adversely affecting radiological safety

Hazard Identification for Recycling Facilities

- To identify hazards must have design specific information on and be able to assess many factors, including;
  - Radiological properties
    - (Radioactive half-life, biological half-life, particle size)
  - Conditions for the presence or accumulation of fissionable materials
  - Chemical hazards
    - (Toxicity, flammability, potential reactions)
- Assigning numerical probability values to these hazards is very inexact

Discussion

- Chemical processes do not lend themselves to Boolean evaluation
- Brookhaven National Laboratory report on Red Oil Excursions noted “the very limited data available for equipment failures and potential human errors in fuel cycle” allowed for a “limited” quantitative analysis
- Unlike reactors, no high energy systems and most event sequences are not coupled
- Mixed Oxide Fuel Fabrication Facility application submitted with a qualitative ISA, with the exception of Natural Phenomena Hazards
- INRA GNEP experience (compared ISA approach to PRA approach for some distinct events)
- International experience (France ~ISA, Japan ~ISA/S-PRA)
- For on-site worker:
  - Unique to Part 70/7x, as Part 50 facilities do not have a radiological performance requirement for workers
  - Other safety analysis techniques are more appropriate

Industry Recommendation

- NEI believes that the existing requirements for an ISA address the safety hazards a recycling facility poses
- ISA can be supplemented by quantitative assessments for high consequence events involving individuals exposed to fission products outside the controlled area
- NEI Part 7X recognizes this

Gap 8

Jack Bailey

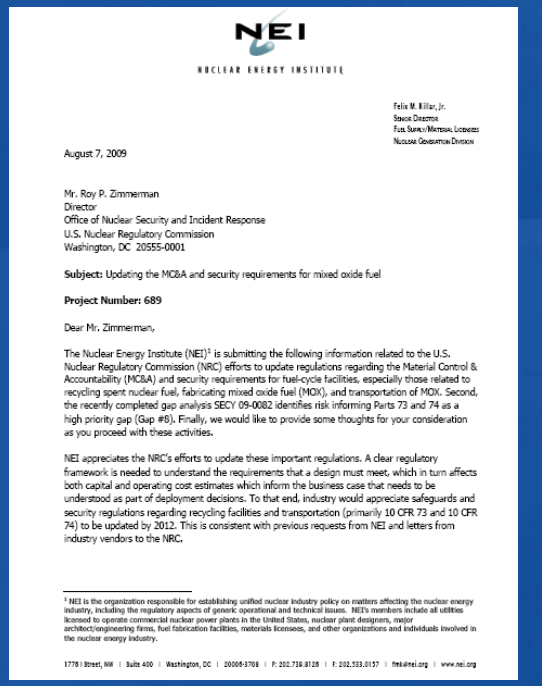
NUCIFAR ENERGY INSTITUTE

GAP # 8

- The current quantity-based categorization scheme in the existing regulations may pose an undue regulatory burden in operating a reprocessing facility. Risk-informing 10 CFR Part 73, “Physical Protection of Plants and Materials,” and 10 CFR Part 74, “Material Control and Accounting of Special Nuclear Material,” is needed to prevent unintended consequences associated with a quantity-based material categorization scheme for potential materials resulting from a reprocessing operation. SECY-09-0082.

NEI August 7, 2009 Letter

- Clear regulatory framework needed to understand the requirements that a design must meet, which affects costs and informs the business case
- Implement a categorization scheme that considers additional factors in determining material attractiveness
- Initially implement regulations that address MOX fuels and their transportation
- NRC should not delay in working with DOE on the "further evaluation" described by NRC staff in SECY-09-0082 regarding regulations to deal with other actinides, such as americium and neptunium



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Felix M. Killar, Jr.
Senior Director
Fuel Supply/Materials Licensees
Nuclear Generation Division

August 7, 2009

Mr. Roy P. Zimmerman
Director
Office of Nuclear Security and Incident Response
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Updating the MC&A and security requirements for mixed oxide fuel

Project Number: 689

Dear Mr. Zimmerman,

The Nuclear Energy Institute (NEI)[1] is submitting the following information related to the U.S. Nuclear Regulatory Commission (NRC) efforts to update regulations regarding the Material Control & Accountability (MC&A) and security requirements for fuel-cycle facilities, especially those related to recycling spent nuclear fuel, fabricating mixed oxide fuel (MOX), and transportation of MOX. Second, the recently completed gap analysis SECY 09-0082 identifies risk informing Parts 73 and 74 as a high priority gap (Gap #8). Finally, we would like to provide some thoughts for your consideration as you proceed with these activities.

NEI appreciates the NRC's efforts to update these important regulations. A clear regulatory framework is needed to understand the requirements that a design must meet, which in turn affects both capital and operating cost estimates which inform the business case that needs to be understood as part of deployment decisions. To that end, industry would appreciate safeguards and security regulations regarding recycling facilities and transportation (primarily 10 CFR 73 and 10 CFR 74) to be updated by 2012. This is consistent with previous requests from NEI and letters from industry vendors to the NRC.

[1] NEI is the organization responsible for establishing unified nuclear industry policy on matters affecting the nuclear energy industry, including the regulatory aspects of generic operational and technical issues. NEI's members include all utilities licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel fabrication facilities, materials licensees, and other organizations and individuals involved in the nuclear energy industry.

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Industry Recommendation

- Implement graded approach to safeguards and material attractiveness
- Implement regulations in the near-term that address MOX fuel safeguards, security and transport
- Build into regulation the ability to accommodate advanced recycling schemes (e.g. separate streams of americium and neptunium)
- Coordinate with appropriate foreign and domestic regulators/governments (e.g. DOE, DOS, IAEA)
- In coordination with industry, develop a design basis threat to support safeguards and security rule making
- Any NRC feedback on NEI's August 7, 2009 letter?

Gap 9

Robert Hogg

NUCIFAR ENERGY INSTITUTE

GAP # 9

- Existing baseline design criteria (BDC) in 10 CFR Part 70 do not comprehensively address hazards posed by the operation of a reprocessing facility.
- Some of the General Design Criteria in Appendix A, and those in 10 CFR Part 70 and 10 CFR Part 72 may be appropriate for reprocessing and recycling facilities. These can be the starting point for development of BDC's for reprocessing facilities.
- Is the NEI list of BDC adequate?

Justification

- Recycling of LWR used nuclear fuel by aqueous processes (i.e. PUREX, Aqueous Polishing) is a mature technology
- Design criteria for PUREX and MOX processes are in use at facilities around the world today
- NRC can validate the completeness of the existing BDC for a wide range of recycling processes (e.g. pyroprocessing)

Justification

- "The NEI white paper contained examples of BDC, expanded beyond those in 10 CFR Part 70. **The BDC comprehensively cover five main categories**: Overall requirements, Radiological Protection, Chemical and Hazardous Materials Protection, Equipment Services Protection, and Facility Confinement Protection. These categories encompass many of the important and significant safety aspects related to reprocessing and associated facilities." – SECY-09-0082 (emphasis added)

Industry Recommendation

- NEI list of BDC in the white paper is complete and adequate for existing recycling technologies based on the adequacy of Parts 50, 70, and 72 and industry's international experience.
- Hold open (and identify potential additional BDC topics for) "reserved" sections in NRC rulemaking for BDC to be applied for future technologies.