U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Reprocessing And Recycling: Safety And Risk Information

U.S. Nuclear Regulatory Commission
Reprocessing Workshop
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Two Main Aspects

- Total safety and risk
  - Aggregation of impact (safety/risk) from all credible accident sequences
  - A safety/risk goal
  - A minimization process (e.g., application of ALARA)
- Safety and risk assessment approach or methodology
- NRC website on risk: http://www.nrc.gov/about-nrc/regulatory/risk-informed.html

U.S. NRC Approach To Risk

Five fundamental documents:

- Policy Statement: Safety Goals for the Operations of Nuclear Power Plants (1986)
- Policy Statement: Use of Probabilistic Risk Assessment (PRA) Methods in Nuclear Regulatory Activities (1995)
- White Paper on Risk-Informed and Performance-Based (RIPB) Regulation (1998)
- Revised Part 70: Domestic Licensing of Special Nuclear Material (2000)
- Risk Informed Decision Making (RIDM) for Nuclear Material and Waste Applications, Revision 1 (2008)

NRC Safety Goals (1986)

- Qualitative
  - Public individual: no significant additional risk to life and health from nuclear power plant operations
  - Society: nuclear power risks comparable or less than other viable, electrical generation risks and should not be a significant contributor to societal risks
- Quantitative (individual)
  - Prompt public fatality/accidents: < 0.1% sum of typical, other U.S. accident risks
  - Cancer risk: <0.1% sum of all typical cancer fatality risks
- On average, these generally translate to a risk less than one in a million per year (<1E-6/year)

Commission PRA Policy Statement (1995)

- Increase use in all policy matters to the extent supported by the state-of-the-art
- Reduce unnecessary conservatism and support proposals for additional regulatory requirements
- PRA evaluations to be as realistic as practicable
- Safety goals and subsidiary objectives to be used with appropriate consideration of uncertainties

PRA Usage

- Current PRA standards and guidance developed for operating LWRs:
  - Different amounts of detail
  - Different intended results (e.g., probabilities of failure(s), types and quantities of releases, consequences)
- Current PRA standards do not fully address all facility aspects, for example the scope for:
  - Plant design and construction
  - Passive systems
- Additional standards will be needed to support new designs and a fully risk-informed regulatory structure
- PRA significantly more quantitative than ISA

RIPB – Risk-Informed, Performance Based (1998)

RIPB uses risk insights, engineering analyses and judgements, and performance history to:

- Focus attention on the most important activities
- Establish objective criteria based upon risk insights for evaluating performance
- Develop measurable or calculable parameters for monitoring performance
- Focus on the results as the primary basis for regulation

Part 70 Risk Informed Fuel Cycle Regulation (2000)

- Subpart H added for SNM processing facilities
- Incorporates risk via binning process, similar to chemical industry approaches
  - Three consequence levels – high, medium, low (default)
  - Three likelihood levels – highly unlikely, unlikely, not unlikely (default)
  - Qualitative/semi-quantitative methodologies
  - Also includes chemical risks and baseline design criteria
- Requires ISA and safety controls (IROFS)
- Sequence, not aggregate risk
- Generally corresponds to facility risk less than one in a million per year to an individual

Risk-Informed Decision-Making (ML080720238, 2008)

- RIDM describes general concepts of risk and total quantitative health guidelines (QHGs)
- Provides three regions of risk (unacceptable, tolerable, and negligible)
- Suggests QHGs
  - For acute and latent fatality – generally one in a million or less
  - Negligible dose risk/limit
  - Limit for serious injury several times higher than fatality limits
- These are total risk values (summed over all scenarios); 2006 U.S. worker fatality risk around 3.9E-5/yr

Potential Questions For Discussion

- Should NRC have safety/risk goal for reprocessing, or is the current approach for fuel cycle facilities sufficient to demonstrate adequate public health and safety?
- What type of safety/risk assessment methodologies should NRC require for reprocessing facilities?
  - Type of methodology – PRA, ISA, LOPA, etc., or a combination of these?
- Can semi-quantitative or qualitative risk assessment methodologies, such as those used for Part 70 facilities, be used?

Potential Questions For Discussion

- How can NRC apply its PRA Policy Statement to reprocessing facilities?
- Based on current practice with PRA, are there limits or obstacles on use of PRA for evaluating reprocessing facility risks?
- What should be the balance between risk-informed & performance based requirements, such as ISA and PRA, and specific or prescriptive regulatory requirements, such as GDCs, technical specifications, etc.?
- Are there any specific hazards and accident categories that should be quantitatively assessed in reprocessing facility safety analysis?

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Background Slide

Matrix - Part 70 and Limits

Receptor / Event	Worker	Individual Outside Controlled Area (IOC) (aka General Public)
High Consequence: **- Prevent to highly unlikely** **- Prevent or mitigate to intermediate or low**	- > 100 rem (TEDE) - Endanger life of worker (chemical)	- > 25 rem - > 30 mg soluble U - Irreversible or serious, long-lasting health effects (chemical)
Intermediate Consequence: **- Prevent to unlikely** **- Mitigate to "low"**	- > 25 rem - Irreversible or serious long-lasting effect (chemical)	- > 5 rem - Mild transient health effects (chemical) - > 5000x Part 20, App B
(Low Consequence)	**Mild transient health effects or less**	**Lesser effects**