

**NRC Regulation of the
Nuclear Fuel Cycle:
Security and Safety Concerns**

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CONTEXT

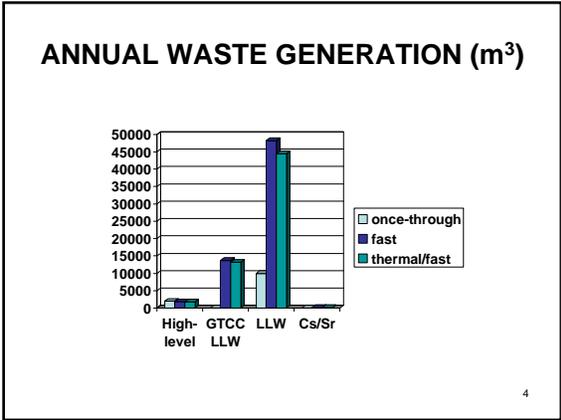
- 2006: Global Nuclear Energy Partnership (GNEP)
 - Initial concept: construction of commercial-scale facilities with reprocessing and fuel fabrication capabilities
- Late Commissioner McGaffigan on regulation of reprocessing facilities (COMEXM-06-0003)
 - "We need to prepare for our licensing role, if this occurs."
- Congress: scales back GNEP to R&D only
- April 2008: AREVA letter expressing interest in building a "used fuel recycling center" in the United States
- NRC: SECY-08-0134: proposes moving forward with a regulatory framework for reprocessing plants and associated fuel fabrication facilities

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**REPROCESSING:
DIRTY, DANGEROUS AND EXPENSIVE**

- UCS opposes GNEP and other schemes to move the US away from a strategy of direct disposal of spent fuel
- Reprocessing is
 - **Dirty**: according to the GNEP Programmatic EIS, Table 4.8-5, for the fast reactor "recycle" option,
 - total annual volume of waste is 5 times greater than direct disposal
 - annual volume of high-level and greater-than-class C low-level waste is about 8 times greater than volume of original spent fuel
 - **Dangerous**: can separate thousands of bombs' worth of strategic special nuclear material per year
 - **Expensive**: Argonne estimates reprocessing alone could cost 4-6 mils per kWh per year; about \$4 billion per year to reprocess the current U.S. spent fuel output

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REPROCESSING DOESN'T NEED A HELPING HAND FROM NRC

- New reprocessing regulations
 - should ensure that no reprocessing plant is built in the US unless there is sufficient protection against the exceptional safety, security and proliferation risks they pose
 - should not facilitate licensing of dangerous, inadequately safe and secure reprocessing technologies just because the industry can't do better

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REGULATORY ISSUES FOR REPROCESSING

- According to SECY-08-0134, NRC has identified the four most significant issues related to regulation of reprocessing:
 - Definition of "reprocessing" and "recycling"
 - Combined (one-step) licensing
 - Physical Protection and Material Control and Accounting (MC&A)
 - Waste

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“RECYCLING” vs. REPROCESSING

- Reprocessing alone is NOT “recycling”
 - Generates separated plutonium and reprocessed uranium, most of which is not re-used today
- Applicants seeking a license for a “recycling” facility
 - Should be required to demonstrate that there are committed customers for all SNM that is separated
 - should have strict limits imposed on the amount of separated SNM that can be stored on site
- Will avoid large decommissioning liabilities associated with disposition of unwanted plutonium and reprocessed uranium

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ONE-STEP, TWO-STEP, OR THREE-STEP?

- One option under consideration is to license reprocessing plants under Part 70, a nominally one-step process, rather than the two-step Part 50
- According to 10 CFR Part 70, applicants can start construction of uranium fuel cycle facilities nine months after submitting a license application to NRC

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ONE-STEP, TWO-STEP, OR THREE-STEP?

- But the procedure for “plutonium processing and fuel fabrication plant” licensing has an additional step, known as a “construction authorization”:
 - applicant must provide a “description and safety assessment of the design bases of the principal systems, structures and components [SSCs]” [10 CFR §70.22(f)]
 - prior to construction, NRC must determine that “design bases of principal SSCs ... provide reasonable assurance of protection against natural phenomena and the consequences of potential accidents.” [10 CFR §70.23(b)]
- And prior to issuance of a license, the NRC must determine that construction of the principal SSCs approved pursuant to the above have been completed in accordance with the application [10 CFR §70.23(a)(8)]

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APPLICATION FISSION

- NRC decided that this rule permitted the Savannah River Site MOX fuel fabrication facility (FFF) application to be split in two:
 - Construction Authorization Request (CAR) containing only description and SA of "design bases"
 - Operating License Application (contains Integrated Safety Assessment (ISA) Summary, Fundamental Nuclear Material Control Plan and Physical Protection Plan); can be submitted after construction begins
- This novel interpretation created a Part 50-like two-step process that allowed NRC to authorize construction of the MOX FFF based on a preliminary and incomplete design, but without the safeguards in Part 50 that require closure of any gaps in the preliminary design before an operating permit is granted
 - NRC granted construction authorization in March 2005; according to DOE, design only reached 70% completion in July 2005

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CONSEQUENCES

- MFFF construction could have begun without a mature design, potentially leading to large cost overruns later; however, construction did not actually begin until August 2007 because of delays due to external factors
- Continually evolving design caused difficulties in coordination between commitments made in the CAR and the safety basis of the operating license application
- Inadequate design bases for physical protection and MC&A

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SECURITY AND MC&A DESIGN BASES

- In a 2003 hearing contesting the construction authorization for the MOX FFF, NRC and the DOE contractor (DCS) both argued (successfully) that DCS was not required to provide design bases for physical protection and MC&A systems
- As a result, the facility is now being built according to a design that did not undergo a substantive security and safeguards review by NRC staff
 - Costly retrofits may have to be made later (e.g. enhanced aircraft protection)

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... SHOULD HAVE BEEN IN THE REGULATIONS

- But the original Atomic Energy Commission document approving the addition of a pre-construction review for plutonium facilities stated that (SECY-R-188, March 17, 1971):
 - “The following aspects would be evaluated prior to the start of construction ... design provisions relating to industrial security and nuclear material safeguards ...”
- However, this phrase didn’t make it into the regulations

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REQUIRING “SAFEGUARDS BY DESIGN”

- NRC should adopt a rule explicitly requiring that facility designs be optimized for effective application of material control and accounting (MC&A), physical protection and international safeguards measures
- Results of diversion path analyses and vulnerability assessments should be part of the application
- NRC approval of “safeguards by design” approach should be required before facility construction can commence

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ISSUES FOR MC&A DESIGN REVIEW

- Past examples of design flaws that have caused problems for MC&A include
 - Excessive scrap generation
 - Inadequate analytical laboratory capacity
 - Holdup accumulation (e.g. PFPF at Tokai-mura)
 - Careful choice of materials and geometries for gloveboxes and process equipment can help to reduce residual holdup
 - NDA measurement must be able to accurately account for significant amounts of holdup

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ISSUES FOR PHYSICAL PROTECTION DESIGN REVIEW

- Goal of the physical protection design review is to reduce burden on armed responders and other operational features
 - Delay provided by layout
 - Vault wall and door thicknesses
 - Vehicle bomb attack resistance
 - Aircraft attack resistance

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MC&A RULES FOR REPROCESSING PLANTS

- In NRC regulations, MC&A standards are the same for reprocessing plants as they are for Category II facilities (those possessing less than a Category I quantity of strategic special nuclear material (5 kg of HEU or 2 kg of Pu))
 - Even though NRC acknowledges that "a reprocessing facility would likely be considered a Category I facility based on possession limits for plutonium"
- Consequences:
 - Physical inventories only every 9 months (as opposed to every 6 months for Cat I facilities)
 - No need to assume insiders within the MC&A program
 - No requirement for process monitoring
 - Minimal item control requirements

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SOME HISTORY

- MC&A requirements for reprocessing plants seem to have fallen through the regulatory cracks
- In 1984, NRC proposed a substantial revision of its MC&A rules for Cat I facilities, including reprocessing plants
 - A key element was a new process monitoring requirement in exchange for a reduction in inventory frequency from every 2 to 6 months
- In 1987, NRC adopted a final Cat I MC&A rule that did not apply to reprocessing plants because it didn't know whether a reprocessing plant could comply with all the rule requirements (52 FR 10036, March 20, 1987)
- But NRC expressed hope that MC&A technology would improve "by the time reprocessing becomes ... viable ... in the United States..."

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CURRENT STATUS

- In SRM-SECY-08-0059 (February 2009), the Commission directed the staff to revise and consolidate MC&A requirements in Part 74
- This will enable NRC to correct the miscategorization of reprocessing plants as Category II facilities and regulate them as Category I facilities (Subpart E of Part 74)

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WHAT ABOUT "PROLIFERATION RESISTANCE"?

- Some argue that modified reprocessing techniques that do not separate "pure plutonium" such as COEX (50 Pu - 50 U) or the variants of UREX (Pu + minor actinides) are "proliferation-resistant" and therefore do not need to be protected as Category I materials
- However, the December 2008 NNSA GNEP Nonproliferation Impact Assessment has determined that all of these alternatives "present comparable proliferation risks" and are considered to be Category I nuclear material under current DOE and NRC guidelines
- This determination is unlikely to change even if NRC adopts an SNM categorization table and grades materials according to "attractiveness"
 - Np and Am will have to be considered strategic SNM
 - Pu will have to be diluted in U well below the 50-50 COEX mixture to reduce its attractiveness level

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CAT I MC&A STANDARDS

- The Cat I MC&A standards themselves need to be overhauled
 - Semi-annual vs. bi-monthly inventories
 - Is process monitoring technology sufficiently advanced to the point needed to detect abrupt losses?
 - Consistency with DOE standard
 - Throughput-dependent limit on the standard error of the inventory difference (SEID) (0.1% of active inventory)
 - Is this appropriate for very large reprocessing plants? (SEID could be on the order of 20-30 kg Pu, or 10-15 formula quantities, per year)
 - Can the limit be met even if it is not tightened?
 - Collusion threat restricted to two individuals
 - Impacts on MC&A of other weapon-usable special nuclear materials (Np, etc)

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INRA PROPOSALS: THE WRONG DIRECTION

- The International Recycling Alliance (INRA) presented a paper in July 2008 outlining its vision for safeguards and security requirements at U.S. "recycling" plants: these proposals would weaken standards to allow licensing of inadequately secure facilities
 - INRA proposes *decreasing* the frequency of physical inventories for reprocessing plants from every 9 months to every year, instead of increasing it for consistency with other NRC Category I facilities
 - Because the NRC SEID limit of 0.1% of active inventory is "not attainable in a typical reprocessing plant," INRA proposes raising the bar by replacing regulatory caps with license conditions based on actual plant measurement errors (which are at least ten times higher)

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PHYSICAL PROTECTION

- INRA recommends that the DBT for Cat I facilities be set "by the time preliminary design is initiated" and should remain stable for an extended period of time, because additional hardening of facilities cannot be easily accomplished
- This is reasonable, but only if the DBT considered in the design provides sufficient margin to accommodate potential increases in the threat over the lifetime of the facility

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A WORD ON SECRECY

- The public cannot have confidence in the licensing of fuel cycle facilities if the safety basis is kept a secret
- NRC's current policy is that the Integrated Safety Assessment (ISA) summary and all related documents are OJO-Security Related Information and are to be withheld from the public
- From the occasional mistakenly released document, the public has become aware that NRC is using the OJO-SRI classification to conceal basic safety information that would be of virtually no use to terrorists

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CONCLUSIONS

- NRC needs to revise its regulations for facilities handling weapon-usable materials to ensure that all SNM will be appropriately protected against the threats that our country faces
- The burden should be on applicants to demonstrate that they can account for and protect these materials to the highest standard before construction begins

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