

LICENSING CHALLENGES FOR FUEL CYCLE FACILITIES UNDER GNEP

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OVERVIEW

- GNEP overview
- The MOX FFF debacle (or how NOT to license a Category I fuel cycle facility)
- Part 70 issues (safety)
- Part 73 issues (security)
- Part 74 issues (material control and accounting)
- Part 75 issues (international safeguards)

GNEP OVERVIEW

- The Global Nuclear Energy Partnership (GNEP) is DOE's attempt to launch a closed fuel cycle in the United States using taxpayer money
- Proposed facilities to be built in 1st stage of GNEP, potentially with NRC licensing :
 - Nuclear Fuel Recycling Center (NFRC):
 - 2,000 to 3,000 MTHM/yr LWR spent fuel reprocessing plant using a variant of conventional PUREX
 - Fast reactor fuel fabrication plant
 - Advanced “Recycling” Reactor (ARR)
 - 250-2,000 MW_{th} (plutonium-based fast reactor fuel; fuel type not decided)
- 2nd stage: transition to transuranic “transmutation fuel”
 - Addition of modules to NFRC to augment and modify separations processes
 - Conversion of ARR core to use transmutation fuel
- 3rd stage: additional ARRs, separations and fuel fabrication plants (may be combined)

NRC LICENSING OF DOE FACILITIES

- DOE's demonstrated ineptitude in project management will continue to provide major challenges to NRC's ability to effectively license DOE-contracted facilities
- NRC licensing should strive to counter --- not "enable" --- DOE mismanagement

THE FAILURE OF “DESIGN-BUILD”

- GAO has criticized DOE for a fast-track, design-build approach in which construction begins before the design is sufficiently complete and the technologies that will be used have been adequately demonstrated (GAO-07-336)
 - e.g. Hanford Waste Treatment Plant (WTP): project cost escalated from \$4.3 to \$12 billion in 3 years
 - GAO recommended that WTP construction be suspended until the facility design was 90% complete, in compliance with “nuclear industry guidelines” for complex, first-of-a-kind facilities (GAO-06-602T)

THE MOX FFF DEBACLE

- NRC's novel interpretation of 10 CFR §70.22(f) and §70.23(b) as permitting a two-part application for plutonium processing plants allowed NRC to authorize construction of the MOX FFF based on a highly preliminary and incomplete design
 - Initial CAR submitted in February 2001; revised CAR submitted in October 2002
 - According to DOE, design was only 60% complete in 2002
 - NRC granted construction authorization in March 2005; according to DOE, design reached 70% completion in July 2005
- If not for delays caused by external factors, NRC and DOE would have allowed construction of the MOX FFF to begin without a sufficiently complete design, potentially leading to even greater cost overruns later

SECURITY AND MC&A

“DESIGN BASES”

- The current criteria for construction authorization in §70.23(b) **do not** include a review of the design bases of the principal structures, systems and components (PSSCs) for physical protection or material control and accounting
 - e.g. MOX FFF
- Yet one of GNEP’s main selling points is that it would provide “the opportunity to design modern safeguards directly into the planning and building of new nuclear energy systems and fuel cycle facilities”
- NRC regulations should be revised to ensure that safeguards and security considerations are fully and effectively addressed in fuel cycle facility design

NRC DEFINITIONS REQUIRING REVISION FOR GNEP

- Category I, II and III special nuclear material
- Critical masses in solution for neptunium-237, americium-241, -242m, -243, curium-243, -244, -245
- Definition of “irradiated nuclear fuel” – DOE may greatly increase the self-protection threshold of 100 rem/hr at 1 meter

PART 73 ISSUES

- Category I design basis threat and related security requirements become applicable for facilities possessing “formula quantities of strategic special nuclear material” (SSNM) --- plutonium, HEU or U-233.
- Regulations do not generally refer to dilution or other material properties that may influence “attractiveness”
 - Requires security enhancements for SSNM not in the form of “alloys, fuel elements or fuel assemblies” and allows security reductions for HEU scrap with a U-235 content below 0.25 g/liter) [§73.46(c)5,6]
- Exemption from Category I requirements granted to Duke Energy for possession of SSNM at a power reactor in the form of LWR mixed-oxide (Pu and U) fuel assemblies with Pu < 10 wt% (based on DOE guidance)
 - Draft § 73.55 revision would institutionalize this exemption

PART 73 ISSUES

- DOE emphasizes that only technologies that “do not separate pure plutonium” will be considered under GNEP, but has not presented a clear definition of this concept
 - Runs the gamut from COEX (plutonium-uranium mixtures) to Pu+TRUs+lanthanides
- But no compelling technical basis exists for a relaxation of security standards for any of these materials
 - “MOX blends cannot be regarded as self-protecting at any concentration” (NUREG-0414, 1978, p. 6-8).
 - Plutonium-uranium oxide compounds with a “high content” of plutonium are weapon-usable, either directly or with relatively minor processing; “A successful explosive could be assembled directly with an amount of 30% material that is not unreasonably large” (NUREG-0414, p. 6-10).
 - Many TRU other than plutonium are weapon-usable (separated Np-237 and Am-241 must be accounted for as if they were U-235 under new DOE guidance)
- ARR fuels proposed for plutonium (or TRU) concentrations of 50 to 93%; a single driver fuel assembly would be a Category I item under DOE guidance
- NRC will need a firm technical basis for revising Part 73 to incorporate the variety of new special nuclear materials that might be separated, stored and processed under GNEP

PART 74 ISSUES

- Same issues as Part 73 with regard to definition of SSNM
- The difficulty of accurately accounting for other transuranics in addition to plutonium will increase the challenges of timely detection of anomalies and control of inventory differences
 - Greater uncertainties, isotopic errors
 - Reduced access to product streams
 - Inhomogeneous processes like electrometallurgical treatment (pyroprocessing)
 - Actinide content in waste streams

PART 75 ISSUES

- DOE emphasizes the benefits of the GNEP program for international safeguards in its promotional materials
 - “International nuclear safeguards are integral to implementing the GNEP vision of a peaceful expansion of nuclear energy and use of more proliferation-resistant fuel cycle technologies.” – from GNEP.gov web site
- Yet the U.S. has not committed to placing domestic GNEP facilities on the IAEA voluntary facilities list; and DOE has not proposed providing funds to the IAEA to fund such an effort
- However, application of safeguards is greatly facilitated with appropriate design features
- NRC should require that all GNEP facilities be “safeguardable” without waiting for a decision that they will actually be safeguarded