

UCS Perspectives on Accident Tolerant Fuel Technologies and Licensing Process

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Is the purpose of accident-tolerant fuel development ...

- to make nuclear reactors safer?
 - 2012 Consolidated Appropriations Act conference report: funding provided “to develop and qualify meltdown-resistant, accident-tolerant nuclear fuels that would enhance the safety of light water reactors.”
- or*
- to provide economic benefits to licensees?
 - Ben Holtzman, NEI: “There is no safety imperative for why we are going to be implementing ATF ... it is for determination of the benefits in economic space.” (ACRS subcommittee meeting, 9/17/19)
- The Nuclear Energy Innovation and Modernization Act (NEIMA) implies both; but can both be realized?

UCS position

- UCS believes that the primary purpose of ATF fuel development is to increase reactor safety margins
- But the NRC could undermine this goal
 - If it continues to weaken its licensing standards to enable the ATF program to go forward
 - If it approves ATF batch loading before obtaining and reviewing sufficient safety data for representative fuel under normal and accident conditions
 - If it allows licensees to take credit for ATF to reduce safety margins in other areas for economic benefit

ATF safety benefits to date are modest at best

- It now appears that no currently identified ATF concept, either near- or longer-term, will be the safety silver bullet that Congress was hoping for:
 - Marginal impact on anticipated operational occurrences and design basis accidents
 - Modest increase in coping time during certain severe accidents (1-3 hours)
 - Minimal impact on core damage frequency (CDF)
 - Potential for additional uncertainties and even worse behavior than current fuels under some conditions
 - Delamination of clad coatings and introduction of other new degradation mechanisms
 - Breakaway oxidation of silicides and nitrides

Economic benefits to industry are unclear

- ATF licensing not likely to be a decisive factor in subsequent license renewal decisions
 - Increased fuel cost but how much actual benefit from increased cycle length and burnup?
- Safety criteria may have to be changed to credit ATF
 - Cladding strength criterion instead of minimum departure from nucleate boiling ratio
- Minimal impact on probabilistic risk assessment (PRA) suggests that ATF will not have a significant benefit for risk-informed applications

So what's the rush?

- The industry timetable for batch ATF loading by 2023 is unrealistic and may compromise safety
- Absence of specific and standardized testing requirements raises questions
 - Lead test assemblies should be irradiated under representative conditions to the planned peak batch burnup and should undergo thorough post-irradiation examination (~ 8 years)
 - Al Csontos, EPRI: “It’s between the vendors and NRC in terms of the negotiated maximum range for the highest burnup for the available possible data sets ... ” – ACRS subcommittee meeting, September 17, 2019
- And what about transient and LOCA testing of irradiated fuels?

Ensuring defense-in-depth

- In comments on the Interim Staff Guidance for chromium-coated fuel, NEI requested that
 - the NRC weaken deterministic standards for ensuring fuel and cladding integrity
 - The NRC state that fuel manufacturing process parameters will be off-limits for ATF reviews, even though some ATF properties will be very sensitive to manufacturing processes
- UCS is encouraged that the staff rejected these requests, which would reduce defense-in-depth

10 CFR 50.46(c)

- The most apparent safety benefit of ATF is the potential for improved cladding and fuel behavior during loss-of-coolant accidents
- This could be addressed most efficiently through Commission approval of the stalled 50.46(c) rulemaking (in addition to ensuring reasonable assurance of adequate protection for current high-burnup fuels)

Licensing standards

- UCS was disappointed that the NRC decided not to require license amendments and exemptions for ATF LTA loading despite the reasoned objections of several staff members
- NRC still has an opportunity to change this policy before the more exotic ATF concepts (materials, enrichment > 5.0% U-235) are ready for LTA irradiation
- The NRC should not take safety shortcuts in reviewing applications for batch and full-core ATF loading
- NRC should favor licensing approaches that maximize opportunities for public input (rulemaking, license amendment requests, topical report reviews)

Acronyms

- **ATF: Accident tolerant fuel**
- **CDF: Core damage frequency**
- **LTA: Lead test assembly**
- **PRA: Probabilistic risk assessment**
- **UCS: Union of Concerned Scientists**