UCS Perspectives on Advanced Reactor Regulatory and Policy Issues

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Advanced reactors

- All non-light water reactor (LWR) reactor concepts have both advantages and disadvantages compared to LWRs
- All non-LWRs have novel features whose behavior will require significant testing and analysis to quantify margins and uncertainties for licensing purposes
- At this stage of development, there is **no technical basis** to support the assertion that non-LWRs will be inherently safer or more secure than LWRs
- In fact, there is reason to believe that characteristics of non-LWRs could render them less safe and secure overall than LWRs, requiring compensatory measures

Advanced reactor licensing

- The NRC's regulatory processes are being unfairly maligned as significant obstacles to advanced reactor deployment
- In fact, the main barriers are the huge investments in cost and time required for non-LWR vendors to develop their concepts to the level of maturity needed to support high-quality applications
- Weakening NRC licensing standards to expedite advanced reactor licensing is unnecessary and potentially dangerous
- Congress should ensure that the NRC has licensing authority over any advanced reactor built in the U.S., even when the Atomic Energy Act does not require it

Expectation versus reality

- ***"The new designs typically have lower probabilities of severe accidents because of their smaller size or innovative safety features, which would also likely lower impacts to public health and safety from any radiological emergency."*** – NRC, Final Regulatory Basis, Rulemaking for Emergency Preparedness for Small Modular Reactors and Other New Technologies," Sept. 2017
- For non-LWRs of any size, this is an unverified and likely false assertion
- The Advanced Reactor Policy Statement "expects," but does not require, that advanced reactors "will provide enhanced margins of safety and/or use simplified, inherent, passive, or other innovative means to accomplish their safety and security functions."
  - This non-mandatory expectation must be extensively validated before it can be used as a basis for regulatory decisions

A self-defeating prophecy

- Even for designs that can be shown to have additional inherent safety, overall safety will depend on NRC policy decisions on
  - siting
  - functional containment and other changes to the General Design Criteria
  - emergency preparedness
  - security
  - use of probabilistic risk assessment (PRA)
  - testing requirements/acceptance of advanced modeling and simulations
  - special treatment requirements
- Excessive reductions in safety margin and defense-in-depth could undermine, rather than enhance, safety
- Rather than reduce margin, the NRC should treat any first-of-a-kind (FOAK) demonstration reactor as a “prototype” and require additional safety features to compensate for uncertainties

Non-LWR safety and security vulnerabilities

- Gas-cooled reactors can be seriously damaged by air or water ingress
- Liquid sodium-cooled fast reactors have reactivity instabilities and flammable coolant
- Molten-salt reactors must be kept within a narrow temperature range to prevent freezing of the coolant or rapid destruction of the reactor (within ten minutes)
- Must consider implications for the entire fuel cycle
  - Any reactor with co-located reprocessing facilities will raise many novel safety and security issues

“Risk-informing” advanced reactor licensing

- PRAs for non-LWR designs are largely academic exercises and lack data for validation
  - Uncertainties in defining design-basis accident spectrum
  - Uncertainties in evaluating severe accident progression and consequences
- Thus the risk information from such models has little utility for FOAK reactor licensing
- Over time, use of PRA may be increased as operating reactor information becomes available

Non-LWR security rulemaking

- The Nuclear Energy Institute (NEI) has proposed that the NRC weaken its security requirements for advanced reactors that meet certain conditions:
  - No need to protect against the design basis threat (DBT)
  - No need for security performance evaluations
- The NRC's position is that the current regulatory framework for security is already flexible enough to accommodate different design features that may impact security
- However, the staff is scheduled to submit a paper to the Commission later this year that may include a rulemaking option
- In our view, this would be an unnecessary effort
  - there is no conceivable circumstance under which the fundamental requirements for protection against radiological sabotage could be safely waived for advanced reactors

Excessive secrecy

- It appears that vendors are withholding far more basic information about their designs during pre-application reviews than in the past
  - Toshiba 4S fast reactor: detailed design and safety basis information were presented in several public meetings (e.g. ML072950026)
- There is virtually no comparable information about the Oklo or Terrestrial Energy design or safety basis on ADAMS
- It is unclear why the standard for proprietary information protection would be different today
  - UCS may need to test the standard by challenging the NRC's proprietary information determinations
- Much more information will have to be eventually released if vendors pursue design certifications or construction/operating licenses
  - Why shouldn't early engagement with the public be as important to the vendors as early engagement with the regulator?

Acronyms

- **DBT: Design Basis Threat**
- **EP: Emergency Preparedness**
- **FOAK: First of a Kind**
- **NEI: Nuclear Energy Institute**
- **PRA: Probabilistic Risk Assessment**
- **UCS: Union of Concerned Scientists**