DOE-NE Microreactor Program

Licensing and Regulatory Development

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Objectives for Microreactor Regulatory Development

- Address and resolve key regulatory framework and licensing technical issues that directly support the “critical path” to advanced reactor demonstration and deployment
- Provide recommendations and solutions to regulatory issues associated with the program
- Develops licensing and regulatory strategies to enable future microreactor deployments
- Program activities include a particular focus on addressing and resolving regulatory uncertainties in the next 1-2 years that challenge near-term (5-7 years) deployments
- In essence, the program is seeking ways to provide impactful DOE funding for cross-cutting industry-identified experimental work at DOE complex labs that will support the near-term licensing of micro-reactors

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FY21 Regulatory Research Plan

- The Regulatory Research Plan (RRP) generated in FY21 was a significant driver in the work being performed in FY22 and beyond
- The RRP surveyed major industry organizations and reactor developers to determine their most critical regulatory needs that have not yet been addressed by NRC at this time
- Specifically, this survey asked the organizations to rank the following items by criticality:
  - Autonomous and Remote Control/Monitoring
  - Grid Interaction
  - Factory Assembly
  - Transportation
  - Staffing
  - Digital Controls
  - Instrumentation
  - Modeling and Simulation
  - Siting and Environmental Impact
  - Security and Safeguards

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FY21 RRP Results

- The initial survey results were grouped into bands based on importance and time criticality
- The areas of highest priority are band 1 and are needed before subsequent bands

Band	Topic Area
1	Autonomous and Remote Control/Monitoring
	Modeling and Simulation
2	Transportation
	Siting and Environmental Impact
	Security and Safeguards
	Factory Assembly
3	Operations, Maintenance, and Security Staffing
	Grid Interaction
	Digital Controls
	Instrumentation

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Manufacturing Licenses for Microreactors

- Some microreactor vendors have stated the desire to construct their entire reactor in a factory setting under a manufacturing license (some including factory fueling)
  - Allows for many duplicate reactors to the fabricated in the same facility with no location change
  - Reduces complexity of on-site assembly and construction
  - These microreactors would then be shipped (fueled or unfueled) to an operating site licensed under 10CFR Part 50/52/53
    - In most cases, the used microreactors would be returned to the factory for refurbishment or decommissioning
    - In some cases, the used microreactors would be transported to other locations for installation and re-use

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Conclusions to the RRP and Path Forward

- The survey indicated the two highest areas of need as autonomous operations and/or remote control/monitoring as well as modeling and simulation
- After review staff determined that significant work was being performed in those areas
- The next band of survey results contained two items of significant interest: transportation and factory assembly/manufacturing licenses.
- These two items became our focus for FY22 and beyond

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History of Manufacturing Licenses

- Manufacturing licenses date back to the early 1970's when the Atomic Energy Agency (AEA) developed Appendix M to 10 CFR Part 50
  - Would still be part of a construction permit
  - This did NOT constitute a final design certification by NRC

- With the development of 10 CFR Part 52, NRC initially did not include manufacturing licenses. This would change during later revisions
  - Subpart F was developed to house the manufacturing license regulations
  - Unlike Part 50, a Final Safety Analysis Report (FSAR) was required for a manufacturing license
  - This would also require the inclusion of inspections, tests, analyses, and acceptance criteria (ITAAC) that would be inspectable by NRC

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FY22 Activities: Manufacturing Licenses and Transportation

- Some microreactor vendors have stated the desire to construct their entire reactor in a factory setting under a manufacturing license (some including factory fueling)
  - Reduces complexity of on-site assembly and construction
  - These microreactors would then be shipped (fueled or unfueled) to an operating site licensed under 10CFR Part 50/52/53
- Currently, the draft regulation for 10CFR Part 53 Subpart E addresses traditional manufacturing licenses but does not address Part 70 (SNM possession and use), Part 71 (transportation), or Part 72 (spent fuel storage)
- NEI White Paper from July 2021 provided recommendations to NRC staff on how to address these needs
- INL report (due March 2022) will provide a recommendation from INL/ORNL staff on how to address these needs
  - INL/ORNL staff will then draft a report (due September 2022) that discusses and provides recommendations for transportation of a fueled or unfueled microreactor from the factory to the operational site

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Manufacturing Licenses in 10 CFR Part 53

- While still under development, 10 CFR Part 53 will contain manufacturing license regulations under Subpart E, “Construction and Manufacturing”. The final draft of this Subpart has not been fully completed at this time
- This will cover quality control and post-manufacturing testing/inspections (similar to ITAAC from Part 52)
- Initially, the draft regulation for 10CFR Part 53 Subpart E addresses traditional manufacturing licenses but does not address Part 70 (SNM possession and use), Part 71 (transportation), or Part 72 (spent fuel storage)
- Since the report was submitted in February, the NRC has decided to include information about factory-fueling of a microreactor prior to shipment
  - Transportation (Part 71) and spent fuel storage (Part 72) are not being considered for inclusion at this time

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NEI White Paper: “Proposed Approach for Manufacturing License Requirements in 10 CFR Part 53”

- NEI’s white paper broke the manufacturing of microreactors into eight business cases
  - These cases included unfueled, factory fueled, factory-fueled and tested manufacturing of microreactors with no current contract/demand
  - Other cases were considered as well but will not be discussed here
- NEI provided three major options for the Part 53 Subpart E rulemaking
  - Part 53 Only- all necessary sections from 10 CFR would be included, even fitness for duty, material control and accounting, etc.
  - Part 53 Centric- all design, licensing, manufacturing, transporting, and operations would fall under this option
  - Part 53 Limited-Part 53 would only address reactor delivery safety requirements in an FSAR
- NEI chose the Part 53 Limited option as their recommendation

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Microreactor Program Recommendations

- INL/ORNL staff reached the same basic three options after research and review
- Microreactor Program staff recommend a path similar to the Part 53 Only Option, with some exceptions
  - Parts 70-73 would be addressed in Part 53. These reactors are new technology and the incorporation of these would allow changes to be made that would not affect the current operating fleet. Additionally, it would allow designers to take advantage of technological advances in their reactor type
- The introductory report written by INL and ORNL staff will be modified through the end of FY22
- The final report (due in September 2022) will contain updates of this information but will begin to discuss the transportation aspects of shipping a microreactor to its intended use location

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Transportation of Fueled or Unfueled Microreactors

- Transportation:
  - There are multiple stages of transportation throughout the life of a microreactor
    - From factory to use site (fueled but not yet operational)
    - Between use sites (post-operation)
    - From use site to disposition process facility (spent fuel for disposal)
  - Each of these stages of transport are unique and will require the applicant to meet different regulations, such as:
    - Transport Container Design
    - Shielding for each operational stage
    - Shipping Type (air, train, ship, truck)
    - Emergency response

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FY23 Proposal: Transition from Shipping to Operational Status

- Microreactors are slated to have modular construction techniques that will ship major components or possibly near complete units from the factory to approved siting locations
  - Reduces complexity of on-site assembly and construction
- The transition from shipment regulations (10CFR Part 71) to an operating license under 10CFR Parts 50/52 is not currently addressed by regulations
- 10CFR Part 53 will need to address this missing piece (likely under Subpart E, which contains construction aspects and inspections, tests, analyses, and acceptance criteria)

- **Key Question:** What regulatory process will be used during the transition of a mobile reactor from 10 CFR Part 71 to 10CFR Part 50/52 or Part 53?
  - **Deliverable:** Regulatory Strategy Report that outlines the transition that could be submitted to NEI/NRC for comment or endorsement

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Conclusions

- Microreactor regulatory staff continue to seek new and updated needs to support the development and deployment of microreactors
- For more information, request a survey, or to provide specific research input, please contact:

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