System Integration and Analysis Technical Area Overview

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INL Idaho National Laboratory | Oak Ridge National Laboratory | MRP Microreactor Program | Los Alamos National Laboratory | Argonne National Laboratory

Agenda

10:25 – 10:40 SIA overview	**Alex Huning**
10:40 – 11:10 Emerging markets for microreactors	David Shropshire
11:10 – 11:30 Development of a CRAB/MELCOR framework	Jason Christensen
11:30 – 11:50 Flexible Siting Criteria (NEUP – MIT)	Jacopo Buongiornio
11:50 – 12:10 Well-characterized micro-grid… (NEUP – UIUC)	Caleb Brooks
12:10 – 12:25 Emergency planning for transportation	Steve Maheras
12:25 – 12:30 Wrap up	

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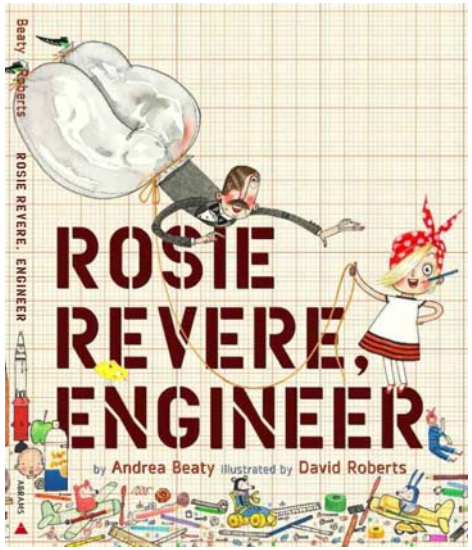
The dictionary is the only place where success comes before work.
– Mark Twain

The most certain way to succeed is always to try just one more time.
– Thomas Edison



The only true way to fail is if you quit.

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National Laboratory Team

- Alex Huning
- Steven Arndt
- Randy Belles

- Jason Christensen
- David Shropshire
- Efe Kurt
- Abdalla AbouJaoude

- Steve Maheras
- Harold Adkins

- Dave Luxat*

*No cost peer-consultant

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Background

- **DOE Microreactor Program (MRP)** established to support R&D of technologies related to development, demonstration, and deployment of low-power, transportable reactors.
- Fundamental and applied R&D, to de-risk technology performance and manufacturing readiness.
- Key microreactor features:

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Scope

- **Systems Integration & Analysis (SIA)** – This scope will identify the needs, applications and functional requirements for microreactors through **market analysis** which will be used to drive future focus of the Microreactor Program toward **improving economics and/or viability of microreactors**. It will seek understanding of the microreactor design space by investigating innovative microreactor technology supporting concepts and will **perform regulatory research** to help develop the regulatory basis for microreactor deployments.

- **Key SIA areas of research:**

Efficient Regulations

Economic Viability

Analysis Tools

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Efficient Regulations

- 2019, NEI published a series of microreactor regulatory challenges:
  - Duration and cost of licensing microreactors / NRC review scope and level of effort
  - Operators / remote operations
  - Inspections / resident site inspectors
  - Emergency preparedness
  - Physical security
  - Aircraft impact assessment
- In response, NRC published SECY-20-0093 acknowledging these challenges, with the current state of stakeholder opinions and feedback received
- In 2021, NRC published a draft white paper on microreactor licensing strategies
- Many regulatory challenges remain, some maybe addressed through 10 CFR Part 53 development and associated guidance
  - NRC is open to some new limited rulemaking for microreactors, currently in planning stages
  - Still seeking more stakeholder feedback

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Efficient Regulations, continued

- Focus of SIA has been on “unique” (low-to-mid TRL) microreactor regulatory challenges
  - Manufacturing
  - Transportation
  - Emergency planning
- Several cross-cutting (micro- and large reactors), regulatory challenges appear to have **very little momentum despite significant interest** (lengthy NRC safety and environmental review processes, physical security)
  - No expectation for negotiation on a case-by-case basis either
  - **Licensing modernization** (Part 53 or other?) may offer ***some solutions*** through risk-informing low-hazard (low-power) reactor safety and environmental reviews
    - But what about **quickly deploying** a microreactor to a new location?
    - **Will local and state governments support microreactor deployments** and their unique operational aspects?

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Economic Viability

- Many of the regulatory challenges tie directly to economic viability (transportability, remote operations, review cost and licensing, etc.)
- Geography and regional conditions highly influence microreactor economic viability
  - Alaska, Wyoming are investigating microreactor deployment
  - Remote Canadian communities have significant interest
- District heating may be equally as valued as electricity
- Transportability offers unique advantages for other industries
  - Mining
  - Trona (chemical processing)
- University campuses exploring and planning for microreactor operations (ACU, UIUC)
- Strong DOD and space applications for small power systems

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Analysis Tools

- Many thermal hydraulic, neutronic, fuel performance, and other nuclear engineering analysis tools exist for design purposes… **MRP SIA focus is on tools which support safety and regulatory analysis** (reduces licensing uncertainty and accelerates deployment)
- Critical that all accident phenomena associated with the safety of the plant be modeled with **uncertainties appropriately documented and quality supporting data**
- Gaps and high uncertainty regions may necessitate additional data gathering (experiments)
  - Critical to identify these gaps and uncertainties in the design phase rather than during licensing
- Given the wide range of microreactor developers, technology experience levels, guidance on code usage, integration between codes, and application of the codes to safety analysis **will provide compounding benefits for these companies going into licensing**

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FY23 Tasks and Status

Research Area	Task	Description
Analysis Tools	Development of a CRAB/MELCOR framework	(1) perform an assessment of potential microreactor safety analysis scenarios and (2) investigate CRAB tools for the identified scenarios highlighting any potential development needs, coupling challenges between CRAB and MELCOR
Efficient Regulations	Emergency Planning for Transportation	Identify and describe challenges associated with microreactor emergency planning during transportation
Economic Viability	Emerging markets for microreactors (Tasks 1 and 2)	Assess barriers and opportunities for microreactors with an initial focus on Alaska (AK) and Wyoming (WY) energy markets
	Cost Efficient-by-Design Microreactors (Task 3)	Evaluate functional containment aspects for microreactors and how this could result in economic optimizations

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Questions?

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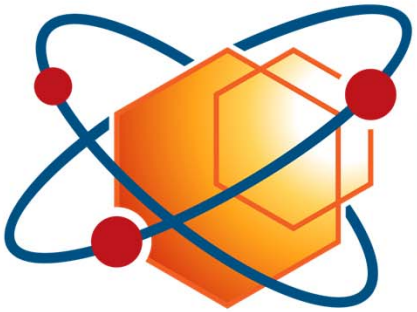

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