Systems Integration and Analysis Technical Area Overview

Winter Program Review – March 3 – 4th, 2022

Alex Huning, Oak Ridge National Laboratory
Technical Area Lead

Agenda for this session

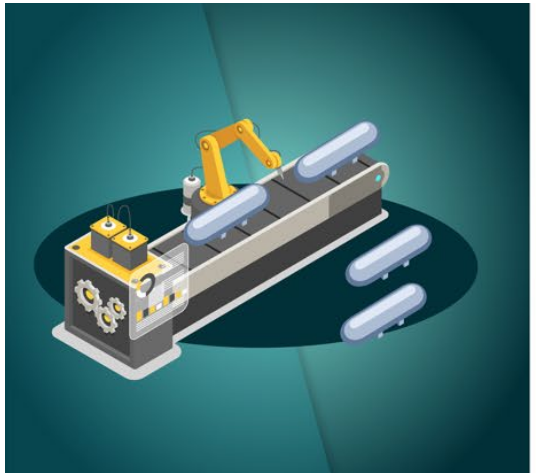
10:25 Overview	**Alex Huning**
10:40 Global Market Analysis	David Shropshire
11:10 Regulatory Support for Microreactors	Jason Christensen
11:40 NEUP – MIT, Flex. Siting. and Staff…	Jacopo Buongiorno
12:00 NEUP – UI, MR req. and micro-grid…	Caleb Brooks
12:20 – 12:35, Wrap up	Alex Huning

MRP Microreactor Program

Scope (Microreactor program plan, INL/EXT-20-58919)

- **Systems Integration & Analysis** – 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.

Microreactor Key Features



Factor Fabricated

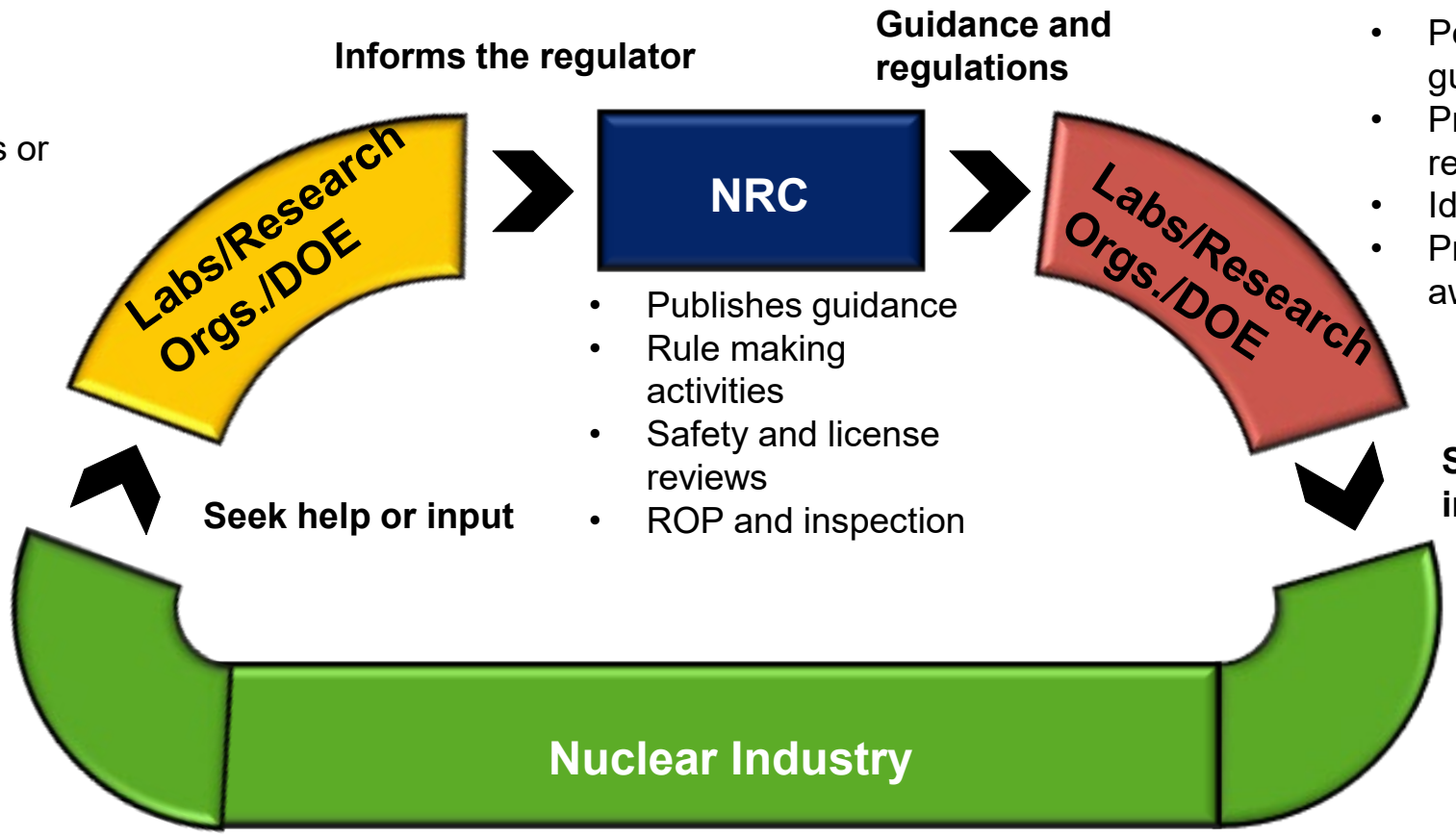
Transportable

Self-Regulating

MRP Microreactor Program

What role do research organizations have in nuclear regulations and licensing?

- Develops options for improving regulations or guidance
- Preforms analyses
- Collects data
- Supports codes and standards orgs.



- Publishes guidance
- Rule making activities
- Safety and license reviews
- ROP and inspection

- Performs review of new guidance and regulations
- Provide feedback for regulatory improvement
- Identify broad issues
- Provide training and awareness to industry

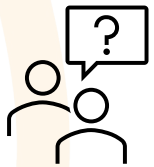
- Develops new technologies and/or applications pending regulatory approval
- Identifies specific regulatory challenges with existing fleet or associated with new reactor licensing and/or safety reviews

MRP Microreactor Program

How does the NRC view micro-reactor licensing?

Ref. NRC "Micro-reactor Licensing Strategies" (ML21328A189)

- *"NRC staff is receptive to requests for exemptions from the existing regulations"*
  - Caution: in practice this could be difficult and costly without additional guidance and agreement by the staff (see the quick note at the bottom)
- The NRC staff anticipates that:
  - **Reactor designs will be standardized**
  - **Manufactured and transported to a site with/without fuel**
  - Operational programs will be standardized
  - No site-specific departures (in the license and safety analysis) are anticipated
  - No spent fuel storage at the installation site
  - Generic EIS will be used
  - All ACRS and mandatory hearings will be conducted according to the AEA



Quick Note:

In January of 2022, the NRC rejected Oklo's license application, without prejudice (i.e., they may reapply after a specified time)

MRP Microreactor Program

Design standardization observations

- No site-specific features relied on for safety
- Using bounding site parameters
- Operational programs are reviewed in the design stage:
  - Inservice inspection and testing
  - Environmental qualification
  - Reactor vessel material surveillance
  - Containment leak rate testing
  - Fire protection
  - Reactor operator training and qualification
  - Emergency planning
  - Security (cyber and physical)
- Final technical specifications are expected to be approved in a design certification for "group 1" programs (everything except for EP and security)

Challenge:

Heavy burden for industry and design organizations (especially "lean" organizations such as microreactors developers)

MRP Microreactor Program

Manufacturing license observations

- Reactors will be **(1) manufactured** and **(2) transported** along routes to **(3) sites** which all fall within site parameters postulated for the design
  - Proposed inspections, tests, analyses, and acceptance criteria needed for all three
  - Technical specifications
- ML license holders can only transport the produced reactors to sites which hold a construction permit or COL
- To install and operate the reactor an operating license or COL is needed
- No-fuel loaded reactors would reduce the need for site-specific inspections and verifications
  - This is then a trade-off with the design benefits of factory fueling
- Regulations for factory fueling are being developed and considered
  - A lot of transportation of SNM regulations
    - Specific exemptions likely
    - Our task is looking at regulation changes, suggestions

MRP Microreactor Program

Focus areas for FY21 and FY22

FY21 – Regulatory Research Planning for Microreactor Development

Industry survey identified areas:

- Autonomous and Remote Control/Monitoring
- Grid Interaction
- **Factory Assembly**
- **Transportation**
- Staffing
- Digital Controls
- Instrumentation
- Modeling and Simulation
- Siting and Environmental Impact
- Security and Safeguards

FY22 – Regulatory Analysis of the Transportation of a Factory Manufactured Microreactor

Provide a background and gap analysis of the current transportation regulations for the transport of a microreactor from a factory-setting to a licensed site. Provide recommendations for the development of regulations to address the identified gaps.

10 CFR Part 53 Developments and Implications

MRP Microreactor Program

Execution of scope and SIA objectives

NEUP University Colleagues

- **To improve the viability and economics of microreactors through market analysis and assessing technology options and concepts.**
- **To help enable the deployment of microreactors by identifying potential solutions to regulatory challenges.**

Next presentation by David Shropshire

Presentation by Jason Christensen

Finally, in the wrap-up session…

How well is this executed, and how can we improve?

MRP Microreactor Program

Wrap-up discussion and questions?

Questions/comments?

MRP Microreactor Program

MRP Microreactor Program