Office of Reactor Fleet and Advanced Reactor Deployment Mission

• **Vision** – Be a catalyst for the commercialization of NE-sponsored research, development and demonstration products

• **Mission** – Integrate NE’s research investments to achieve a productive and balanced portfolio of competitive and crosscutting research, development, and demonstration (RD&D) and research infrastructure to enable expansion of the U.S. commercial nuclear industry

• **Objectives**
  – Full and effective integration of NE RD&D planning, execution and oversight
  – Systematic management of NE investments in research capabilities
  – Alignment of NE’s RD&D programs with industry-identified technical and regulatory needs
  – Accelerate the introduction of innovative technologies into the marketplace through multiple mechanisms
Overview of Office of Reactor Fleet and Advanced Reactor Deployment

• Programs in the Office of Nuclear Reactor Deployment (NE-52)
  – Advanced Small Modular Reactor Research and Development (R&D)
  – Advanced Reactor Technologies
  – Microreactors
  – Light Water Reactor Sustainability

• Programs in the Office of Nuclear Energy Technologies (NE-51)
  – Crosscutting Technology Development
    • Advanced Sensors and Instrumentation, Advanced Methods for Manufacturing, Integrated Energy Systems, Cybersecurity
  – Nuclear Science User Facilities
  – Advanced Modeling and Simulation
  – Transformational Challenge Reactor
U.S. Advanced Reactor Landscape

- Over 60 companies and research institutions are working on advanced nuclear projects for a wide array of capabilities to meet the energy needs of the future
  - e.g., sodium-, gas-, lead-, molten-cooled reactors (versus LWR-cooled)
  - Significant levels of private sector investment

- Motivation for advanced reactor development
  - Potential for improved safety and
  - Various options for future commercial (civilian), limited-grid and military applications
  - Potential for improved nuclear resource utilization and reduced nuclear waste
  - Flexible operation to support the national grid of the future containing many energy-source options
  - Application of advanced manufacturing and modeling techniques to bring nuclear into the 21st century

- DOE Advanced Reactor Demonstration Program
  - $230 million initial year funding to establish a program to demonstrate multiple advanced reactor designs at various stages of technological maturity
  - Construction of two demonstration reactors within five to seven years
  - Solicitation under way; awards to be announced in fall 2020
Goal of the ARDP

- Focus DOE and non-federal resources on the construction of real demonstration reactors and supporting activities for commercial use.
- Congress funded DOE to establish a program to demonstrate multiple advanced reactor designs.
- Technology agnostic – all advanced technologies are eligible, including LWR-based designs.
- Construct and demonstrate several advanced reactors with beneficial capabilities, such as:
  - Inherent safety features
  - Superior reliability
  - Lower waste yields
  - Proliferation resistance
  - Greater fuel utilization
  - Improved thermal efficiency
  - Ability to integrate electric & non-electric applications
Demonstration Structure

Three tier structure based concept maturity and deployment timeline

• **Advanced Reactor Demonstrations (Demos)**
  – Closest to commercialization
  – Deployment and operation 5-7 years following award

• **Risk Reduction for Future Demonstrations (Risk Reduction)**
  – Substantial risks remain to be addressed before designs can be demonstrated
  – Commercial horizon approximately 5 years later than the Demos

• **Advanced Reactor Concepts-20 (ARC-20)**
  – Design maturity is lowest Technology Readiness Level (TRL) scale
  – Commercialization horizon in the mid-2030’s
Other DOE Activities and Capabilities Supporting Industry in Advanced Reactor Development

- National Reactor Innovation Center (NRIC)
  - Addresses key gaps & barriers to enable developers to demonstrate nuclear reactor concepts supporting commercialization
  - Provides well-characterized locations to site reactors, access to key resources, and promotes collaboration with laboratory experts in nuclear science and engineering to support technology development

- Gateway for Accelerated Innovation in Nuclear (GAIN) Initiative
  - Allows industry access to DOE lab RD&D infrastructure to achieve faster and cost-effective development of innovative nuclear technologies toward commercial readiness
    - Nuclear and radiological testing facilities, e.g., thermal-hydraulic loops, control systems testing
    - Computational capabilities along with state-of-the-art modeling and simulation tools
    - Information and data through knowledge and validation center
    - Land use and site information for demonstration facilities

- US Industry Opportunities for Advanced Nuclear Technology Development FOA (Industry FOA)
  - Currently 3 application review cycles per year
  - Cost shared cooperative agreements with industry (Requires between 20% – 50% industry contribution)
  - Project funding aligned with NE programs with same goals

- Advanced Small Modular Reactor (SMR) R&D Program
  - Focuses on cost-shared, private-public R&D partnerships to address technical, operational, and regulatory challenges specific to SMRs
Advanced Reactor Potential Advantages

• Construction timelines for advanced designs expected to be shorter than the current generation of LWRs
• Advanced designs will take advantage of advanced manufacturing techniques and modular construction capability
  – Hands-on labor costs significantly reduced
  – Most work done in a controlled factory environment vs. field
  – Increased repeatability and quality, reducing component inspection times and rejection rates
• Simplicity of design reduces system and component complexity
• Reduced commodity and labor costs (steel, concrete, and rebar) due to smaller systems and lower pressures
Importance of Codes and Standards to Advance Reactors

- Standards provide the basis for efficiency, standardized products, improved trade and commerce, and safety and quality objectives
- Incorporate the evolving technical advancements and lessons-learned from real world use to ensure the standard continues to be relevant
- Set minimum requirements to protect health, safety, general welfare & affordability
- They set an understandable and reliable basis that reduces vulnerability to a wide range of hazards.
- Serves as a common language in increasing interconnected industrial complex
DOE Role in Codes and Standards

- Providing technical experts to key working meetings and as coordinators
- Accelerating the identification of gaps in the standards development process and the methods to close the gaps
- Providing support for international standards meetings
- Supporting research and development activities needed for standards development
- Supporting the codes and standards adoption process.
- Integration
Topography Considerations

- Currently there is a unique moment at DOE
  - Examples:
    - The ARPD program will award projects at multiple technology levels with their associated timeline.
    - DOE Advanced Manufacture Program is refocusing to deployment readiness of technology.
- Current Congressional support for reactor deployment
- Codes and standards efforts will need to be prioritized and integrated given the current landscape.
- Need to consider the push of Data driven/risk based decision making
  - This is an evolving process that considers discrete risk events and integrated effects of multiple risk internal and external to efforts.
Potential Path Forward

• Evaluate the ARDP awards, other demonstration projects, and future concepts.
• Understand the risks (opportunities and consequences) of current standards, potential changes or new needs.
• Begin to prioritize efforts and determine potential road map

The key will be establishing a multi-organization working group that represents the stakeholder community. That can effectively reach a consensus priorities and road map
Summary

- DOE-NE provides sustained investments to support codes and standards development.
- The Advanced Reactor Demonstration Program provides a unique opportunity to advance the development and application of new standards.
- DOE-NE investments in Advanced Manufacturing increase stakeholder participation (Industry, DOE offices, Standards, NRC, National laboratories, etc.).
- Consensus priorities need to be established and road mapped.
Questions?