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NRC's Advanced Reactors Program "Enabling the Safe and Secure Use of Nuclear Materials"

- Commission Meeting
- April 24, 2018

Agenda

- NRC's Advanced Reactors Program – Fred Brown
- Licensing Readiness and Potential Policy Issues – John Monninger
- Analytical Codes, Tools, and Industrial Standards – Stephen Bajorek
- Fuel Cycle Considerations – Brian Smith

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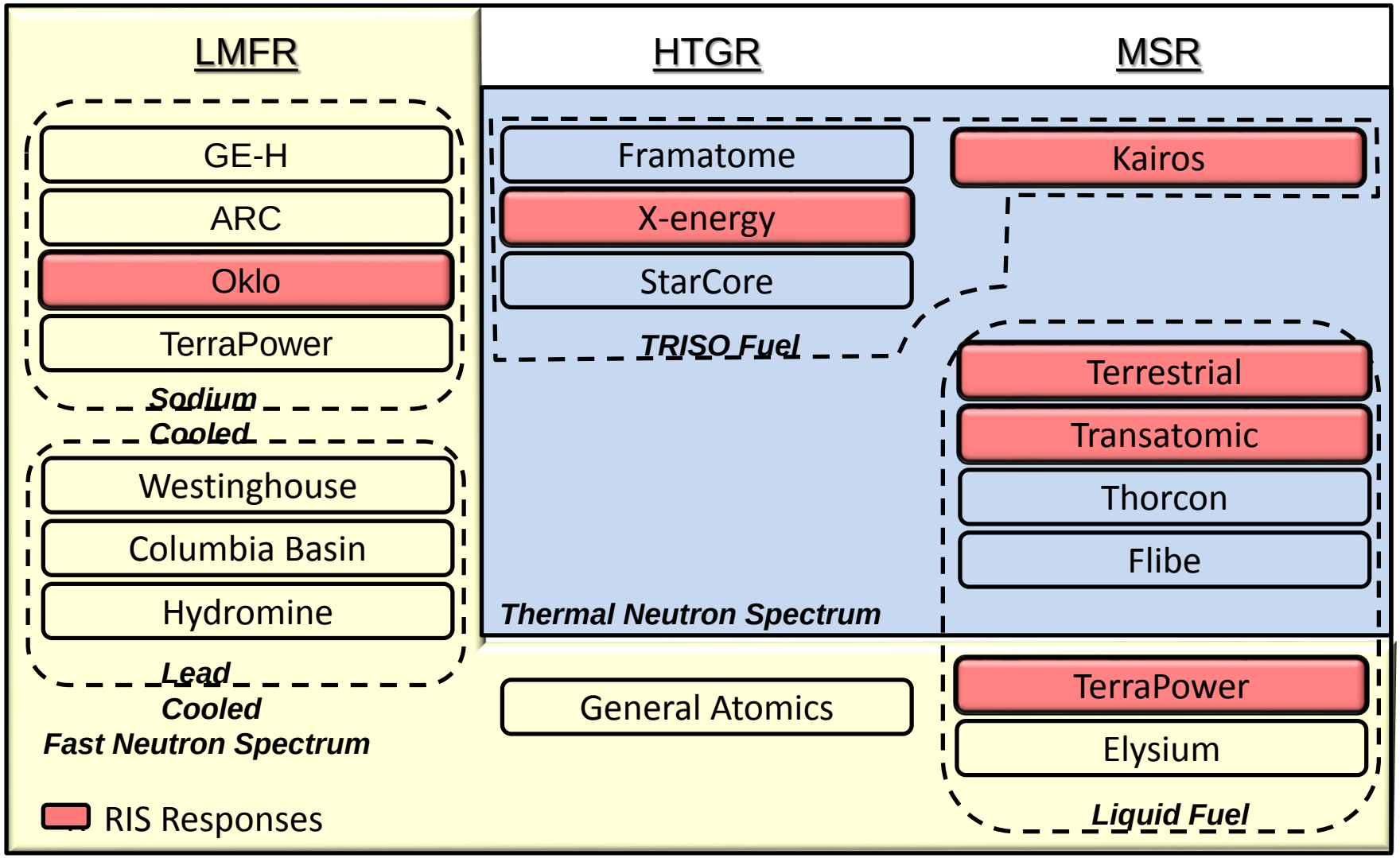
NRC's Advanced Reactors Program

Fred Brown, Acting Director
Office of New Reactors

Dynamic and Evolving Landscape



Assuring Readiness

- Developed the Vision and Strategy
- Executing the Implementation Action Plans
- Building capabilities
  - Incremental progress
  - Identifying key policy issues
  - Focused "Core" team concept

Potential Early Applications

- Individual developer's timelines
- Recognizing relative maturity
- Further transformation
  - Leveraging advancements from recent light water reactors licensing
  - Optimizing the regulatory structure

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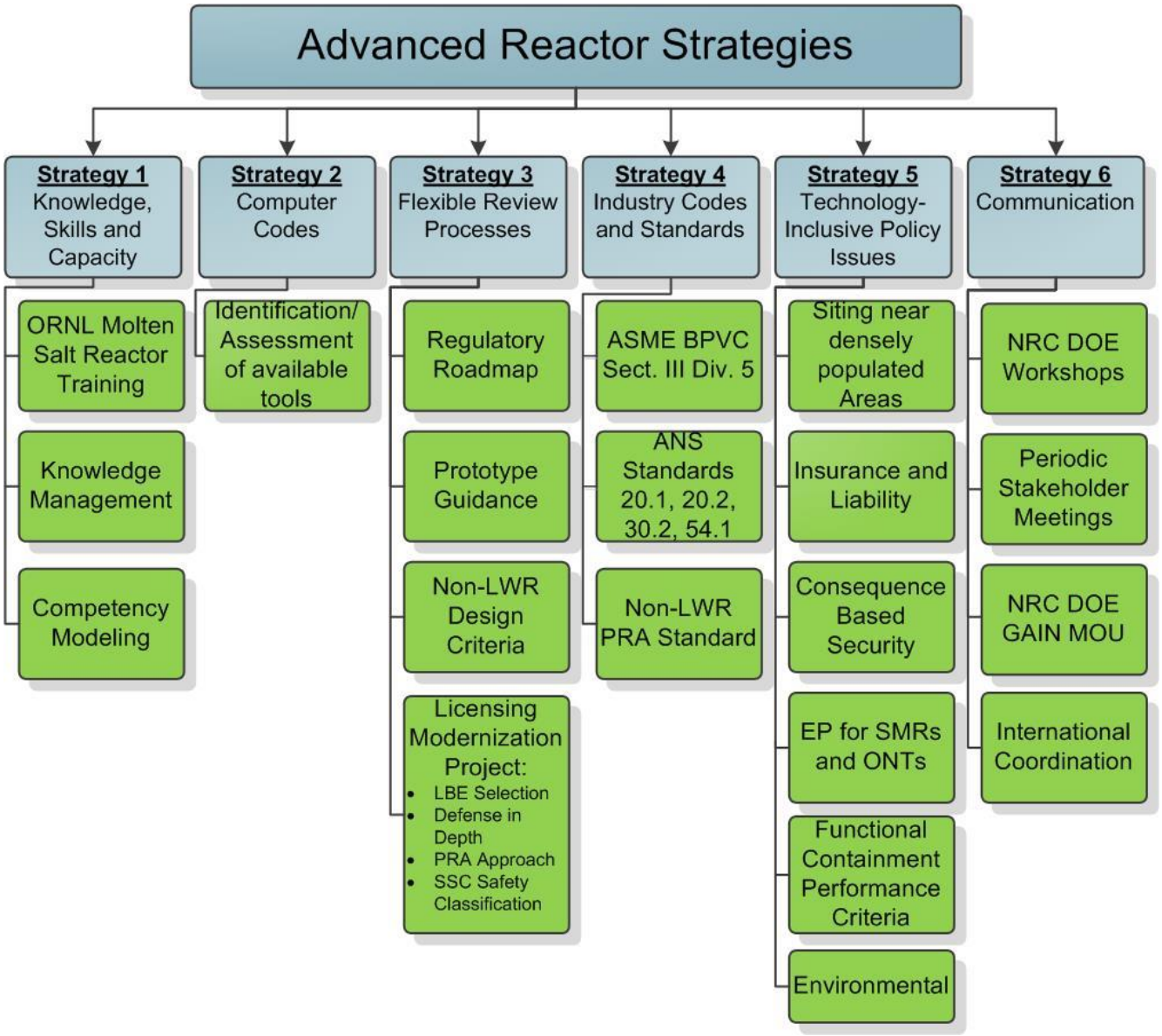
Licensing Readiness and Potential Policy Issues

John Monninger, Director
Division of Safety Systems, Risk Assessment, and Advanced Reactors
Office of New Reactors

Making Progress in the Near-Term



Modernizing the Licensing Approach

- Flexible, staged, and predictable processes
- Advanced Reactors Design Criteria
- Developing a risk-informed, and performance-based approach
  - Identification of licensing-basis events
  - Probabilistic risk assessment approach
  - Classification of structures, systems, and components
  - Defense-in-depth

Pursuing Resolution of Policy Issues

- Emergency preparedness for small modular reactors and other nuclear technologies
- Consequence based physical security
- Functional containment performance criteria

Evaluating Other Potential Issues

- Engaging with stakeholders to identify and prioritize potential policy issues
  - Siting
  - Insurance
- Technology-specific policy issues

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Analytical Codes, Tools, and Industrial Standards

Stephen M. Bajorek, Ph.D.
Senior Level Advisor for Thermal Hydraulics
Division of Systems Analysis
Office of Nuclear Regulatory Research

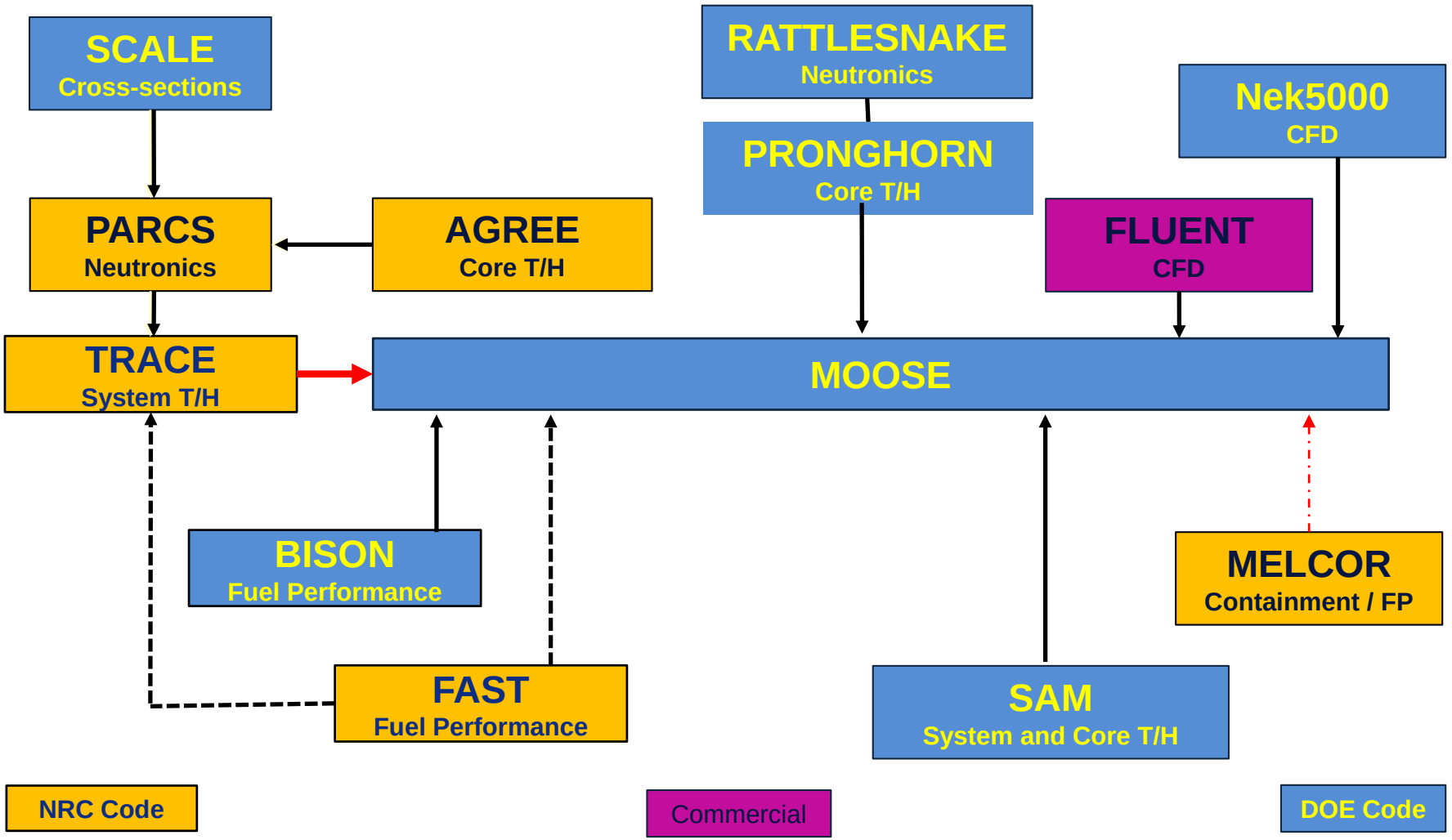
Progress in Technical Readiness

- Familiarization with advanced reactor technologies and technical issues
- Access and training with DOE analysis codes and evaluation of existing NRC code capabilities
- Identification of technical "gaps"
  - Code capabilities and limitations
  - Experimental data and code verification and validation
  - Industrial standards for materials

Methodical Approach to Selection of Codes

- Does a code contain the correct physics and modeling features?
- Is it more economical to develop an NRC code, or adopt use of a code developed elsewhere?
- If a non-NRC code is used, how does the NRC maintain its independence?
- Can a code be developed for application to more than one reactor design type?
- What applicable verification and validation exists for a particular code?

Comprehensive Reactor Analysis Bundle (CRAB)



Resolving Technical Challenges

- Numerous advanced reactor designs
- Some (vital) data is non-existent
  - Molten salt thermophysical properties
  - High temperature material behavior
- DOE and NRC codes have been developed for different purposes
  - DOE: Normal operation, very high detail
  - NRC: Accident scenarios, peak power regions
- DOE codes designed for high performance computing systems

Leveraging Industrial Standards

- NRC Objectives
  - Obtain performance needs and identify issues for structural materials and component integrity
  - Support consensus standards
- Staff participation on Industrial Standards activities
  - ASME Section III, Division 5 – High Temperature Materials
  - ANS Committees and Working Groups
  - ASME/ANS Joint Committee on Nuclear Risk Management

Path Forward

- Efforts in 2018 will be primarily generic and focus on identification of gaps in knowledge, data, and code modeling requirements
- DOE codes will continue to be tested and cooperative efforts expanded
- Support for Industrial Standards activities will continue with emphasis on high temperature materials

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Fuel Cycle Considerations

Brian Smith, Deputy Director
Division of Fuel Cycle Safety, Safeguards, and Environmental Review
Office of Nuclear Material Safety and Safeguards

Engagement on Fuel Cycle Considerations

- Participant in meetings with developers, industry, and DOE
- Participant in advanced reactors training
- Reviewed draft NEI white paper on challenges for front end fuel cycle

Evaluation of Fuel Cycle Regulatory Framework

- Existing framework has sufficient flexibility for solid-fueled reactors using once through fuel cycle
  - May require new regulatory guidance for new design characteristics
- Potential for regulatory challenges for fluid-fueled reactors or reactors with closed fuel cycles

Engaging on Issues that Need to be Addressed by Industry

- Obtaining uranium enriched greater than 5% and subsequent fuel fabrication
- New transportation packages
- Criticality benchmark experiments

Proactively Identifying Regulatory Issues

- Material control and accounting requirements for Category II facilities
- Physical security requirements for Category II facilities
- Material control and accounting requirements for fluid-fueled reactors

Continue Active Participation

- Maintain involvement in advanced reactors activities
- Encourage industry development of fuel cycle technology and designs in parallel with reactors design
- Encourage industry development and implementation of regulatory engagement plan

Acronyms

- ANS – American Nuclear Society
- ASME – American Society of Mechanical Engineers
- BPVC – Boiler and pressure vessel code
- DOE – Department of Energy
- EP – Emergency preparedness
- GAIN – Gateway for Accelerated Innovation in Nuclear
- HTGR – High temperature gas reactor
- LBE – Licensing basis events
- LMFR – Liquid metal fast reactor
- MOU – Memorandum of Understanding
- MSR – Molten salt reactor
- NEI – Nuclear Energy Institute
- Non-LWR – Non light-water-reactor
- ONT – Other nuclear technologies
- ORNL – Oak Ridge National Laboratory
- PRA – Probabilistic Risk Assessment
- RIS – NRC Regulatory Information Summary
- SMR – Small modular reactor
- SSC – Structures, systems, and components