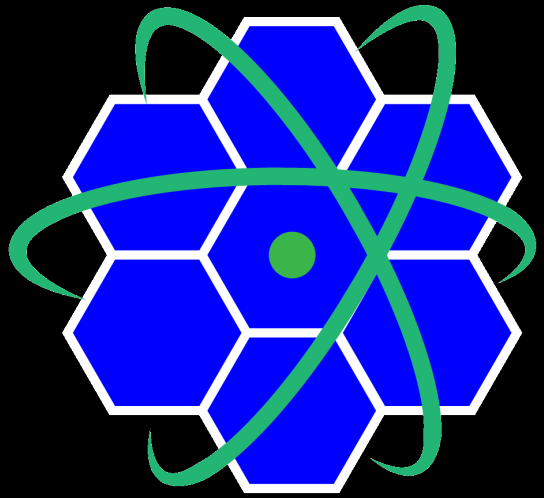

FRWG

Fast Reactor Working Group

NRC Standards Forum

September 26, 2017

Fast Reactor Working Group

- **Multiple developers working on multiple technologies**
  - 9 developers, 10 designs
- **Spans a variety of fast reactor technologies in development:**
  - Sodium, lead, salt, and gas coolants using metal, oxide, carbide, nitride, and salt fuels

ARC
GE
TerraPower
Oklo

Westinghouse
Columbia Basin
Hydromine
Elysium Industries
General Atomics

Southern
Exelon
Duke
EPRI

Industry Engagement

- Fast reactors offer a near limitless source of clean and affordable energy, which have attracted the participation of a diverse group of technology developers and other stakeholders
- The FRWG works with developers and fast reactor stakeholders to further the state-of-the-art
  - Technology development
  - Regulatory
  - International collaboration

High Level Perspectives

- Diverse technologies spanning a spectrum of technical readiness with varying needs
- General consensus that standards need to be modernized as the industry grows, but are generally adequate to support initial deployment strategies
  - Concerns about certain technology-specific gaps
  - Concerns about standards development timeframes and delays

High Level Perspectives

- Standards are most effective when there are multiple industry stakeholders with significant technology maturity and overlap, who have a sophisticated understanding of what is needed in particular areas
- Must consider industry needs in light of industry maturity
- Standard modernization will become increasingly useful as the advanced reactor industry grows

Paradigm Shifts from LWRs

	LWRs (PWR & BWR)	Non-LWRs
Fuel	UO_2	Metals, oxides, carbides, nitrides, salts
Cladding	Zirconium alloys	Steels, ceramics, no cladding
Coolant	Water	Sodium, lead, other liquid metals, gas, salts
Moderator	Water	Graphite, hydrides, no moderator
Spectrum	Thermal	Fast, epithermal, thermal
Temperature	280°C to 320°C	300°C to >850°C
Fuel cycle	1 to 2 years	Up to 60 years, possibly more

Standards of Interest

- NQA-1
  - Useful to advanced reactor work currently
  - Continue to modernize as appropriate and as needed

Standards of Interest

- Materials
  - Structural alloys, cladding materials, and coating materials for the temperature ranges and fluences of interest
    - BPV code for GFR
  - Concrete considerations at high temperature and fluence
- I&C
  - Spectral, material, temperature, and lifetime considerations
- Fuel and material handling variations

Standards of Interest

- Decay heat
  - Different from LWR standard due to fast spectrum, fuel management, and fuel configuration variations
- Risk-informed design and risk analysis
  - Important to consider implications of inherent safety characteristics
- General reactor design standards
- Varying considerations for fire protection, operations, offsite/backup power, and seismic standards

Standards Gaps

- Standards gap analysis efforts for sodium fast reactors provides initial insights into future standards needs
- This work benefits other technologies
  - Similar investigations may be desired, but results must be kept in context to technology and industry maturity