U.S. DEPARTMENT OF ENERGY | Office of NUCLEAR ENERGY

Office of Nuclear Reactor Deployment (NE-52) Overview

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FY2024 CINR Webinar

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NE-52

Office of Nuclear Reactor Deployment

Reactor Optimization and Modernization

Light Water Reactor Sustainability

- LWR modernization and optimization
- Hydrogen production demonstrations

Advanced Reactor Modernization

- Integrated Energy Systems
- Safeguards and Security

Advanced SMR R&D

- Industry Awards

Advanced Reactor Development

Advanced Reactor Technologies

- Advanced non-LWRs R&D
  - Gas-cooled/TRISO
  - Molten Salt cooled/fueled
  - Fast metal cooled
- Advanced structural materials
- Microreactor R&D
- ARC-20 Projects

Advanced Reactor Demonstration Program

- National Reactor Innovation Center
- Risk Reduction Projects
- Regulatory framework and technical support

Light Water Reactor Sustainability Program Overview

LWRS Mission: Enable long term operation of the existing commercial nuclear power fleet.

Focus: Originally material issues related to SLR applications, recent shift toward improving economic competitiveness

Plant Modernization
- Modernize technology by replacing existing I&C technologies with digital systems
- Leverage digitalization to modernize business model

Flexible Plant Operation and Generation
- Maximize revenue by producing new economic products and integrating energy storage
- Decarbonize industrial processes and support the grid as variable resources increase

Risk Informed System Analysis
- Applies quantitative methods to optimize safety, reliability, and economics
- Coupling probabilistic risk assessment and systems margin quantification to achieve accurate modeling and representation of safety margins

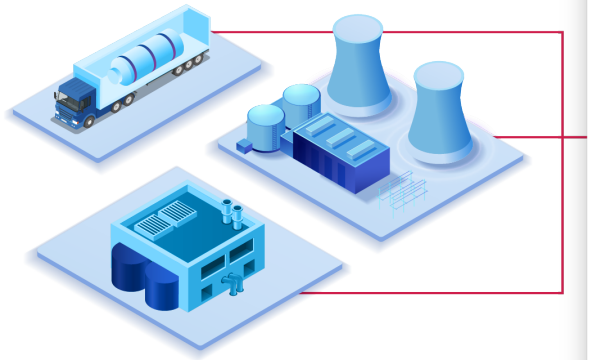
Materials Research
- Understand and predict long-term behavior of materials
- Including detecting, characterizing, and mitigating aging degradation

Physical Security
- Improve efficiency of physical security posture
- Conduct research on risk-informed techniques, apply advanced modeling and simulation tools assess benefits from proposed enhancements and novel mitigation strategies

Flexible Plant Operation Generation

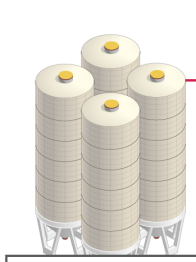
Flexible Reactor Siting

Data Centers
Manufacturing Plants
Biofuel Plants / Processing
Desalination
Industrial Parks / Plants
Fueling Stations

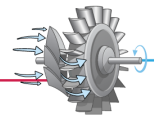


CO2 / Carbon Sources

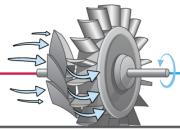
- Ethanol Plants
- Direct Air Capture
- Power Generators
- Cement Plants
- Biomass
- Polymer / Chemical Waste



Thermal Energy Storage

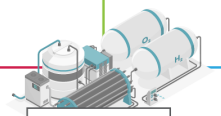


Peaking Generator



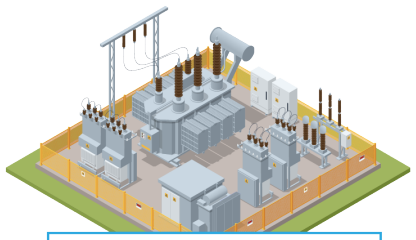
Primary Generator

Industry/Chemical Plant



Hydrogen

Utility-Scale Batteries

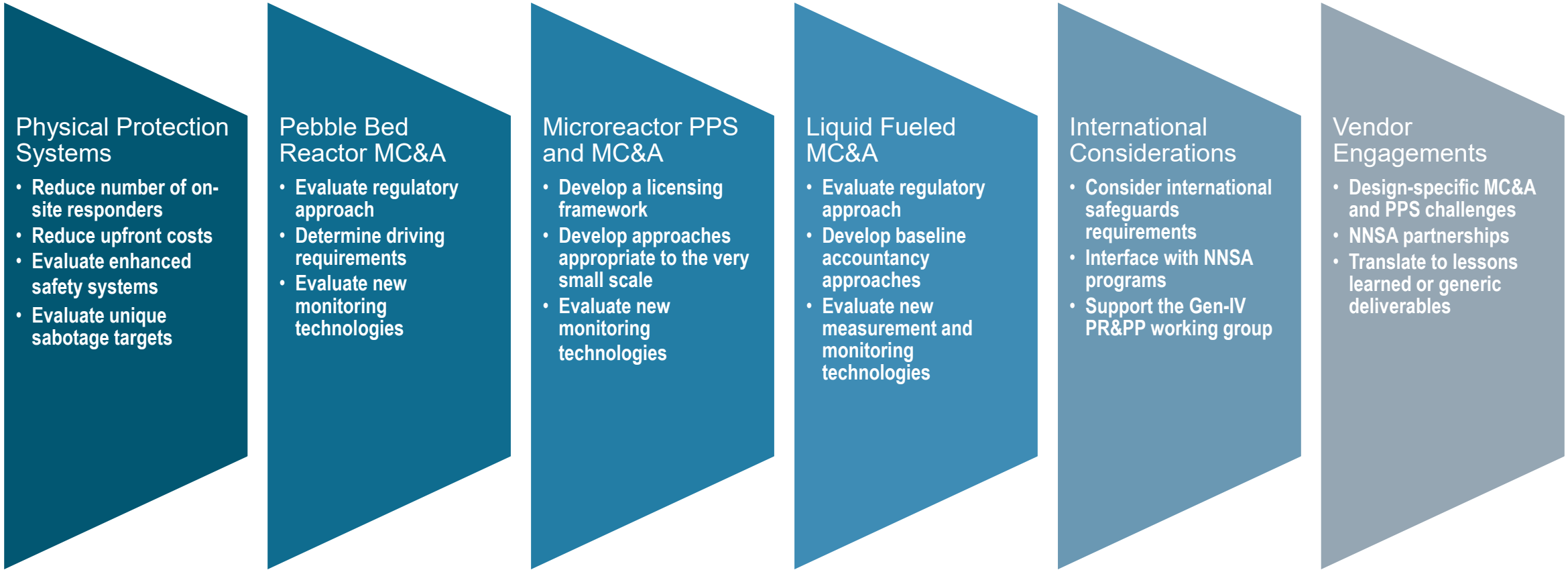


Grid Capacity
Firm, Flexible, Zero Carbon

- Transportation Fuels
- Steel Production
- Fertilizer / Ammonia
- Polymers / Chemicals
- Hydrogen

- Refineries / Oil Production
- Minerals
- Wood / Paper Plants
- District Heating

Advanced Reactor Safeguards Program Areas



Advanced Reactor Technologies (ART) Program

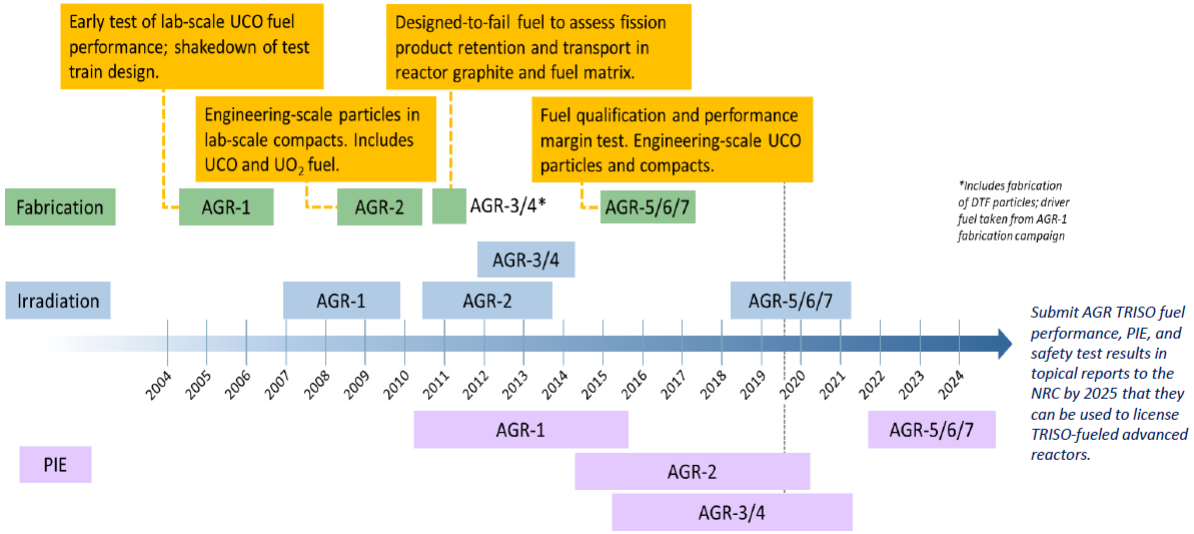
Mission: Support the development and commercialization of innovative concepts including microreactor, fast reactor, molten salt reactor (MSR), and high temperature gas-cooled reactor (HTGR) technologies through national laboratory-led R&D, university research programs, and cost-shared private-public industry partnerships.

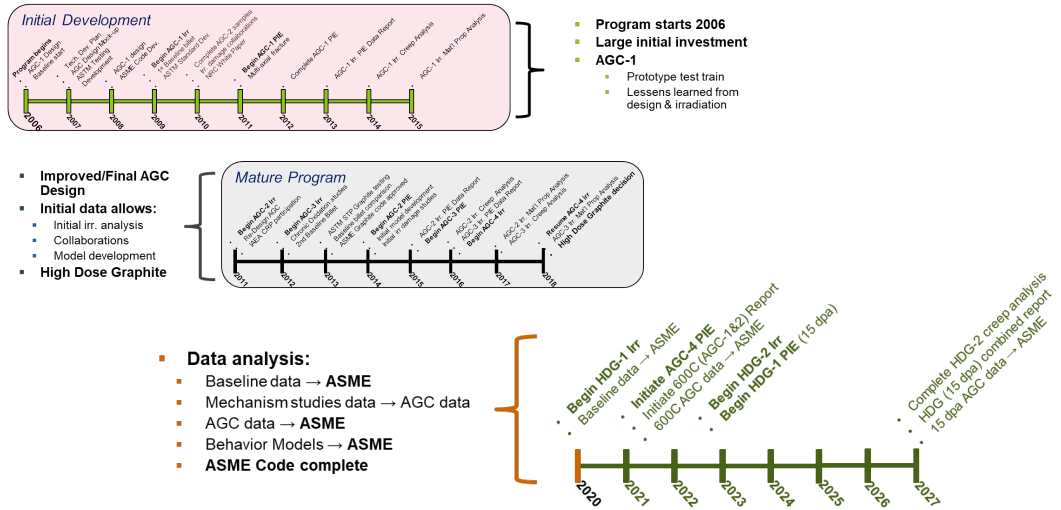
- **Fast Reactor Technologies**
  - Demonstrate feasibility of advanced systems and component technologies
  - Methods and code validation to support design and licensing
- **Gas Reactor Technologies**
  - Advanced alloy qualification
  - Scaled integral experiments to support design and licensing
- **MSR Technologies**
  - Investigate fundamental salt properties
  - Materials, models, fuels and technologies for salt-cooled and salt-fueled reactors
- **Microreactors**
  - Non-nuclear and nuclear integrated system testing supporting commercial demonstrations and end-user applications
  - Maturation of innovative components and semi-autonomous operating regimes

METL Facility , Argonne National Laboratory

TRISO Fuel and Graphite Qualification Program

- **TRISO Fuel Development and Qualification**
  - Generate UCO TRISO fuel performance data to support fuel qualification.
  - Establish a domestic commercial TRISO fuel fabrication capability.
- **Graphite Qualification**
  - Select, irradiate, and characterize existing nuclear grades.
  - Qualify nuclear grade graphite and establish design rules for use in HTGR core.

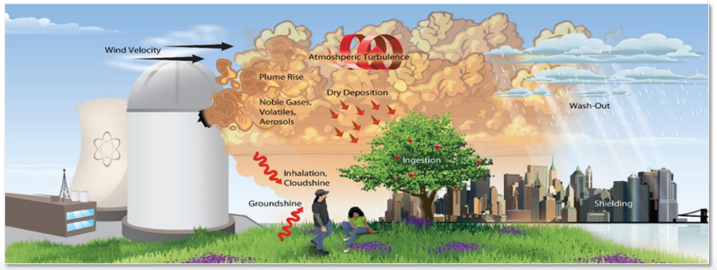


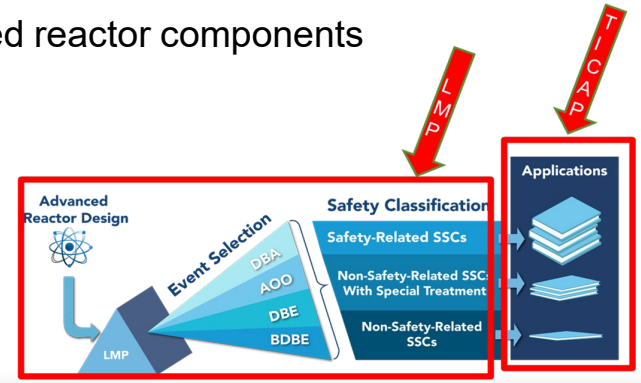


Advanced Reactor Regulatory Development

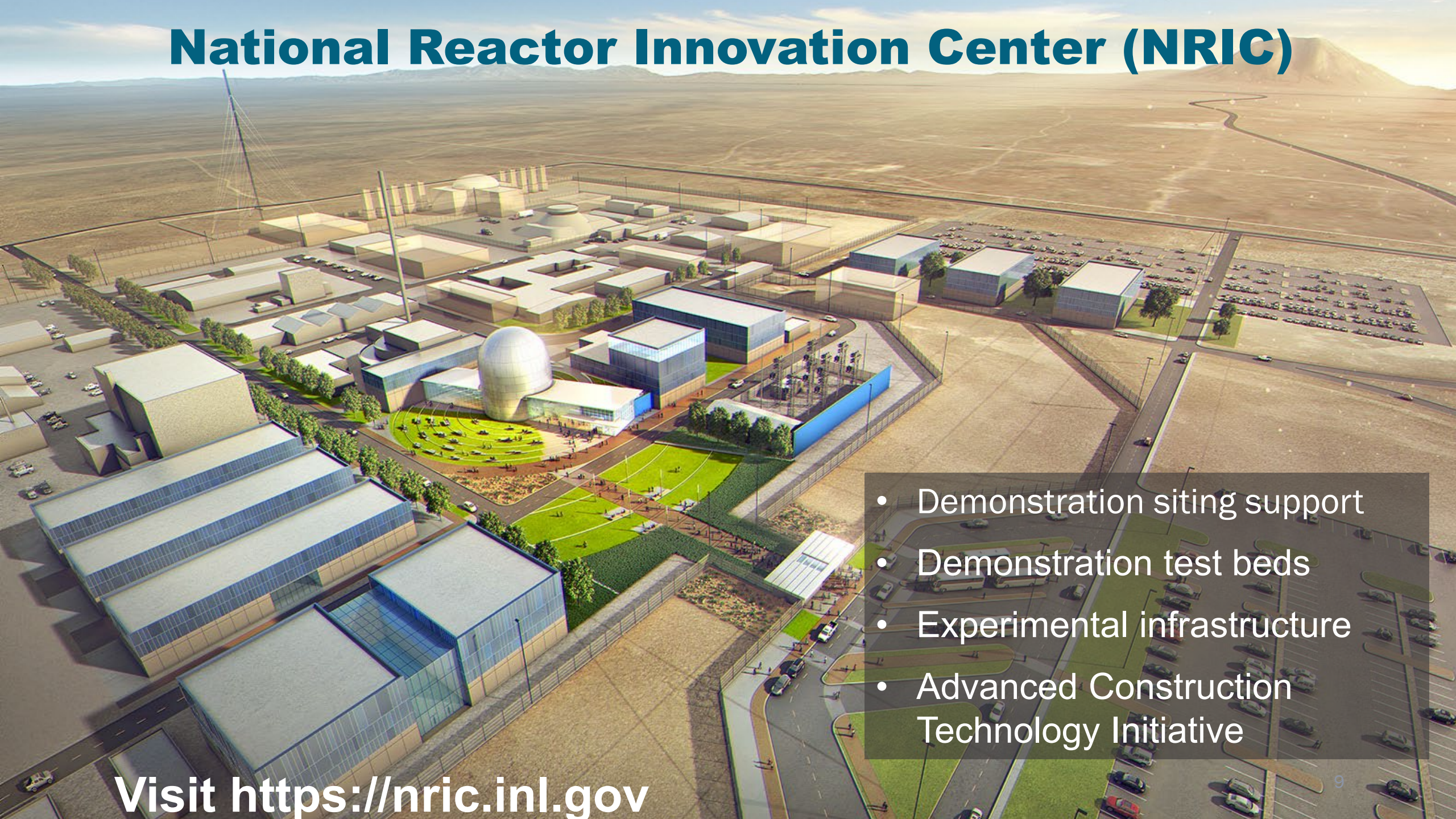
Mission: Coordinate with the Nuclear Regulatory Commission (NRC) and industry to address and resolve key regulatory framework issues that directly impact the "critical path" to advanced reactor demonstration and deployment.

- **DOE NE cost-share support of industry-led initiatives to adapt and establish a regulatory framework for advanced reactors**
  - Technology-Inclusive Content of Applications Project (TICAP) is a risk-informed, performance-based (RIPB) approach to right-size information in a license application to increase efficiency of generating and reviewing an application
  - Builds on NRC-endorsed Licensing Modernization Project systematic risk-informed process
  - Opportunity for early movers to demonstrate implementation of risk-informed, performance-based approach
- **NE R&D activities directly reduce technical and regulatory risks by providing bases for establishment of licensing technical requirements**
  - Establish technical insights and tools regarding radionuclide transport and release from advanced reactors, including fast reactors, gas-cooled reactors, and molten salt reactors
  - Supporting NRC endorsement of codes and standards important for the manufacture of advanced reactor components
  - Validation and access to priority material property data to be used in safety codes and models





National Reactor Innovation Center (NRIC)



- Demonstration siting support
- Demonstration test beds
- Experimental infrastructure
- Advanced Construction Technology Initiative

Visit https://nric.inl.gov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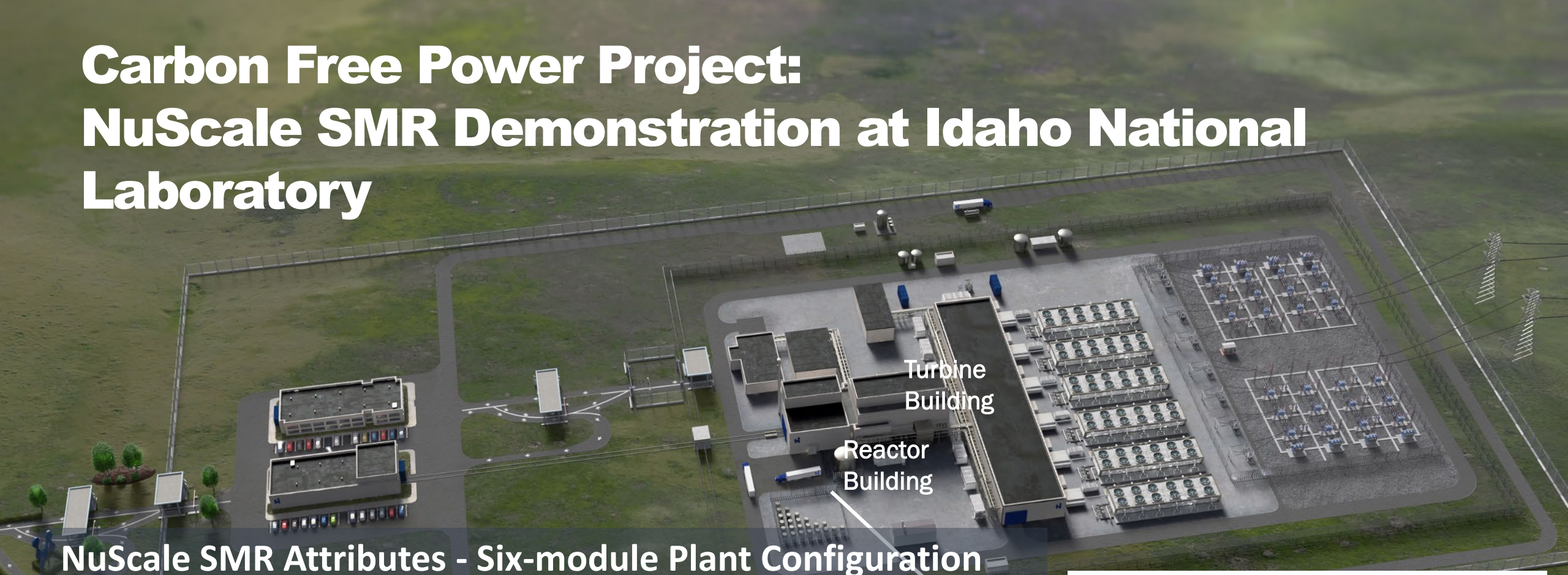
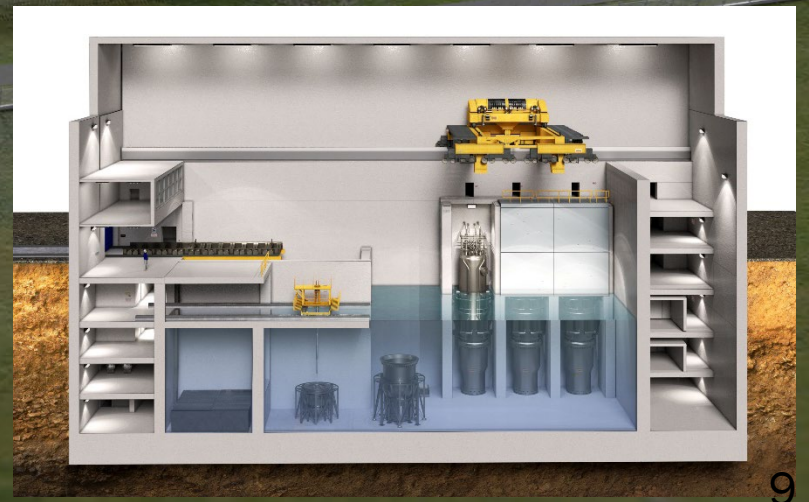
Carbon Free Power Project: NuScale SMR Demonstration at Idaho National Laboratory



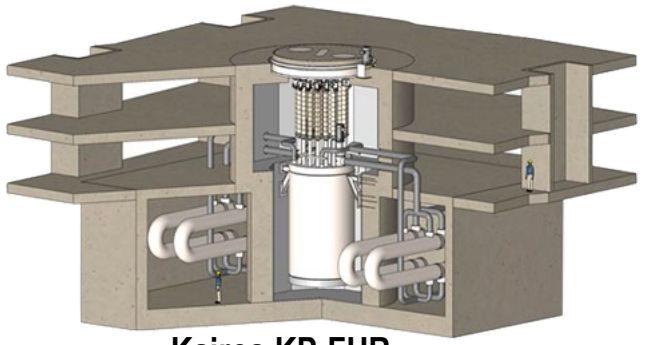
NuScale SMR Attributes - Six-module Plant Configuration

- 6 Nuclear Power Modules - 462MWe (77 Mwe per module)
- Leverages proven and commercially-available LWR fuel
- Air Cooled Condensers – significantly reduces water use
- Initial site characterization work completed
- First module operation planned for 2029



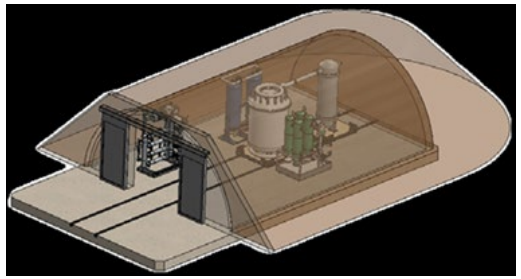
Risk Reduction Pathway Selected Technologies

- Kairos KP-FHR fluoride salt-cooled, TRISO pebble fueled MSR
- Westinghouse eVinci microreactor – heat pipe cooled, TRISO compact fueled
- BWXT BANR – transportable microreactor, TRISO fueled
- Holtec SMR-160 – LWR-cooled SMR (only LWR design supported under ARDP)
- Southern/TerraPower Molten Chloride Fast Reactor (only liquid fueled design supported under ARDP)

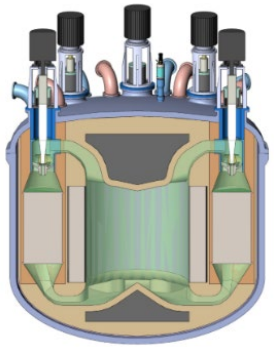


Kairos KP-FHR

Westingouse eVinci



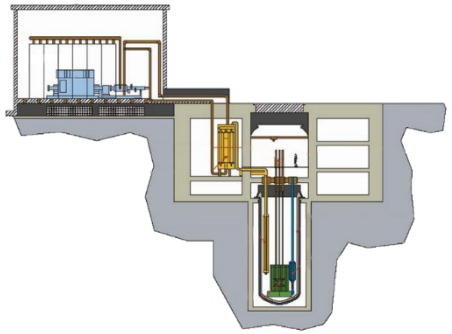
BWXT BANR



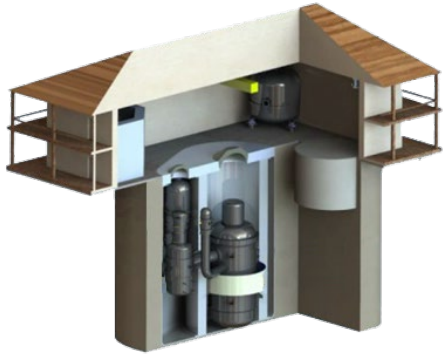
TerraPower MCFR

Holtec SMR-160

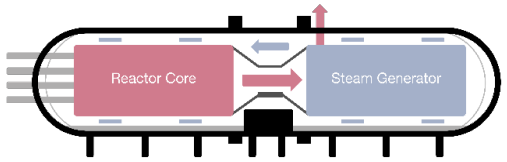
Advanced Reactor Concepts (ARC)-20 Awards



Advanced Reactor Concepts



General Atomics



MIT

Prime Applicant	Reactor Type	Key Deliverables
Advanced Reactor Concepts	ARC-100 100 MWe pool type sodium-cooled fast reactor	Conceptual and preliminary design of a seismically isolated advanced sodium-cooled reactor facility
General Atomics	GA-EMS 50 MWe gas-cooled fast modular reactor	Conceptual design, Increase maturity of systems and components, develop prelim. cost estimates
MIT	Modular Integrated Gas-cooled High Temperature Reactor (MIGHTR)	Conceptual design and support for future commercialization