# The DOE Microreactor Program

## Why MARVEL?

**2022 MARVEL Technology Review**

October 19th – 20th , 2022

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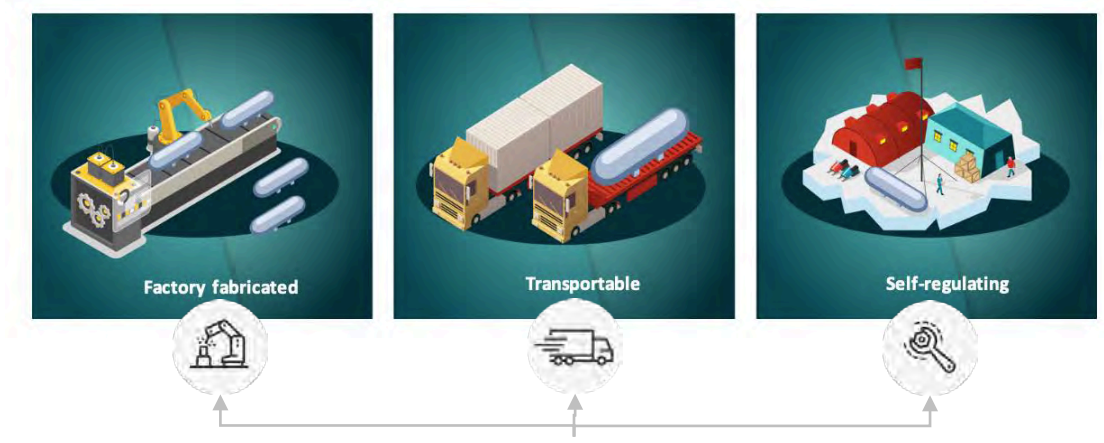
# Microreactors
## Megawatt-scale Advanced Nuclear Reactors




## ENABLING TECHNOLOGIES

### Fuel & Moderator

- Small Core,
- Long life,
- HALEU
- High-T Moderator

### Reactor Controls

- Automation
- Compact, in-core sensors
- AI/ ML
- Remote Control

### Power Conversion

- Skid mounted
- High Temp.
- Robust
- Flexible operation

### Structural Material

- Creep resistance
- ASME Sec III, Div. 5 compliant
- NQA-1 supply chain

### Neutron Reflector


- Low cost
- Manufacturability
- High moderating ratio
- High temperature

### Transport & Siting


- NEPA
- Vibration isolation
- Transport shielding
- Licensing modernization

# DOE Microreactor Program

## ***Program Vision***

***Through cross-cutting research and development and technology demonstration support, by 2025 the Microreactor Program will:***

- Achieve technological breakthroughs for key features of microreactors
- Empower initial demonstration of the next advanced reactor in the US
- Enable successful demonstrations of multiple domestic commercial microreactors.

## ***Program Objectives***

- Address critical cross-cutting R&D needs that require unique laboratory/university capability or expertise
- Develop R&D infrastructure to support design, demonstration, regulatory issue resolution, and M&S code validation
- Develop advanced technologies that enable improvements in microreactor viability

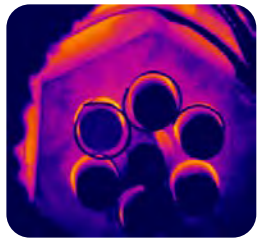
Technology Readiness Level

**Microreactor Application**

- Integrated Nuclear Testing
- Applied R&D

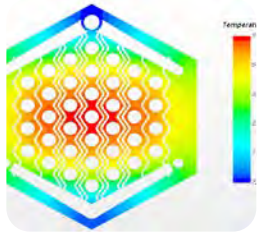
**Demonstration Support Capabilities**

- Non-nuclear Testing
- Test-beds for developers/regulators



**Technology Maturation**

- Matures fundamental microreactor enabling technologies and capabilities



**System Integration & Analyses**

- Identification of technology and regulatory gaps for Microreactors

MRP Microreactor Program

# MARVEL Can Enable a New Class of Nuclear Reactors

**(Microreactor Applications Research, Validation & EvaLuation)**

***Project Goals:***

- Rapid development of a small-scale microreactor that provides a platform to test unique operational aspects and applications of microreactors

***Primary Objectives:***

- Operational microreactor in the most **accelerated timeline** possible
- Produce **combined heat and power (CHP)** to a functional **microgrid**
- **Share lessons learned** with commercial developers
- **Train** future operators

***U.S. DOE Sponsor Program:***

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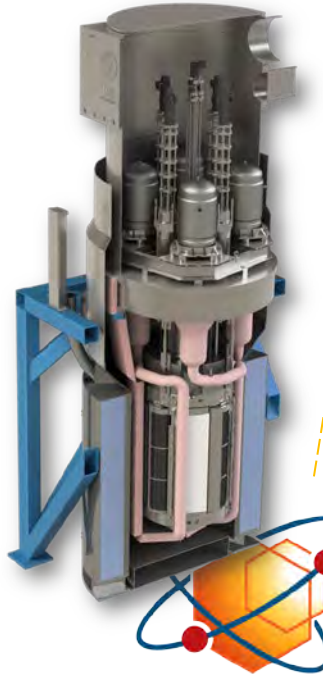
Create momentum,
Champion rapid technology maturation to de-risk industry
Collaborate and engage microreactor end-user companies

- 100 kW-thermal
- 20 kW-electric
- ~10 feet tall
- < 12 tons
- 2 operators
- Self-regulating

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# MARVEL Value Statement for Public/End Users

- Nuclear Energy is new to microreactor entry market
  - Operation complexity
  - Fear of colocation
  - Training needs
  - Reliability
- Customers reluctant to adopt microreactor technology unless they “see one” first (not willing to be the first in their backyard)
- Having no real test reactor is a barrier to market entry
  - End users deem it necessary to “interact” with a microreactor prior to providing customer requirements
  - End users unsure of technology potential prior to interaction

MARVEL will be the first microreactor to achieve criticality to power end user applications

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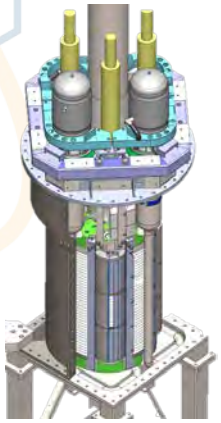
# MARVEL Value Statement for Developers

OKLO Westinghouse BWXT BWX Technologies, Inc. X energy RADIANT GENERAL ATOMICS LOCKHEED MARTIN



*"With many companies working on microreactor concepts behind closed doors, I see unique value in having a system that can be shared and discussed across teams "*

Fuel

Reactor Controls

NEPA
National Environmental Policy Act

NEPA

Fuel Loading

Power Conversion

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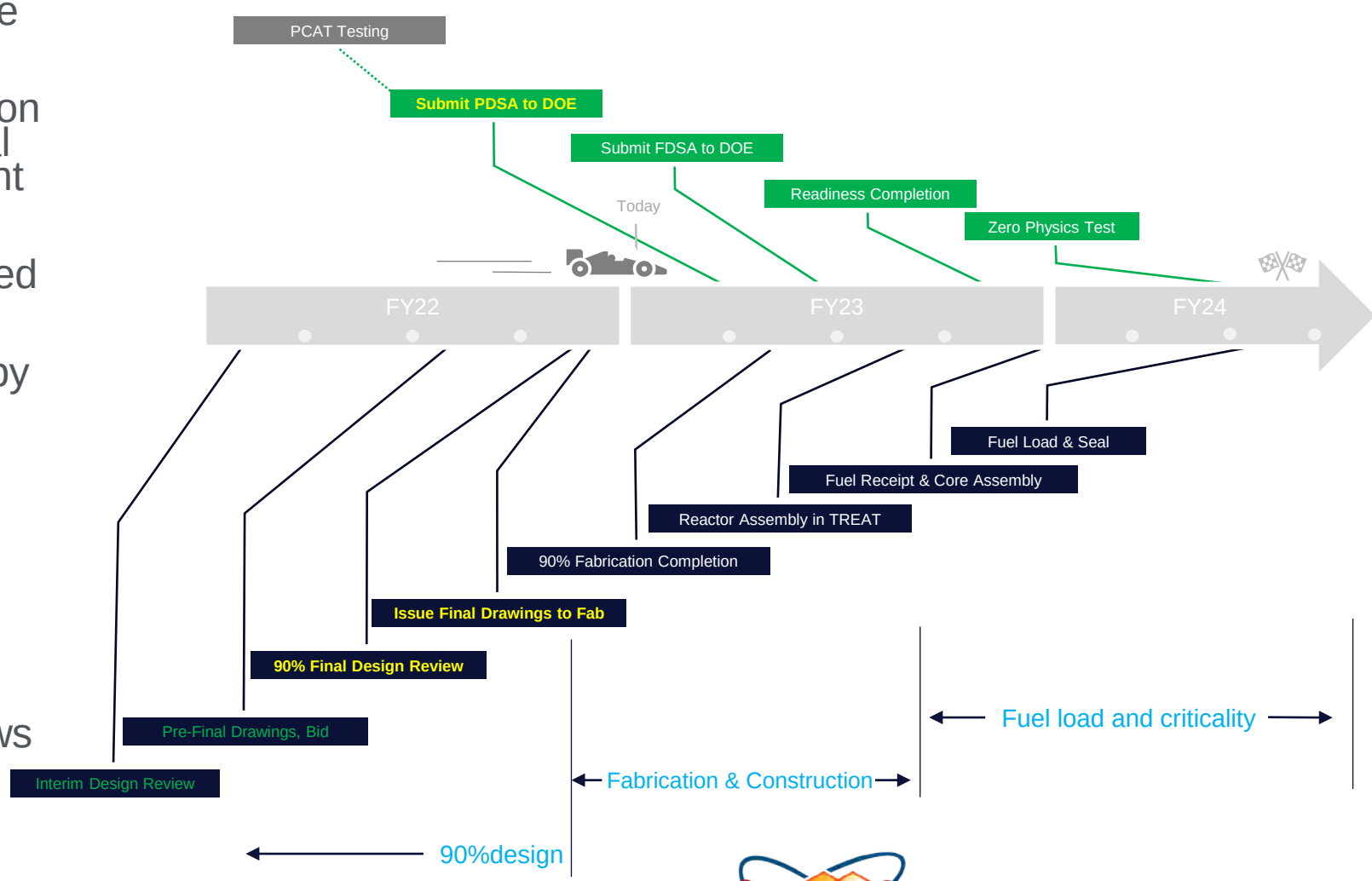
# Key Accomplishments in FY22 & Project Milestones

- **Completed 11+ tests** to increase technology readiness levels
- **Completed accident analyses** on expected performance on normal operation and postulated accident analyses
- **Safety Design Strategy** approved by DOE-ID
- **Final EA and FONSI** approved by DOE-ID
- **Completed design, fabrication and assembly of full-scale electrically heated test system** (aka PCAT).
- **Fuel** Supplier finalized
- **Entered Final Design Stage-** Completed Interim Design reviews
- ***Fabricators and suppliers*** *engaged*




**Innovation**- Speed without sacrificing safety, quality and creativity

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# Questions?

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