NRIC National Reactor Innovation Center

Demonstration Reactor Test Beds

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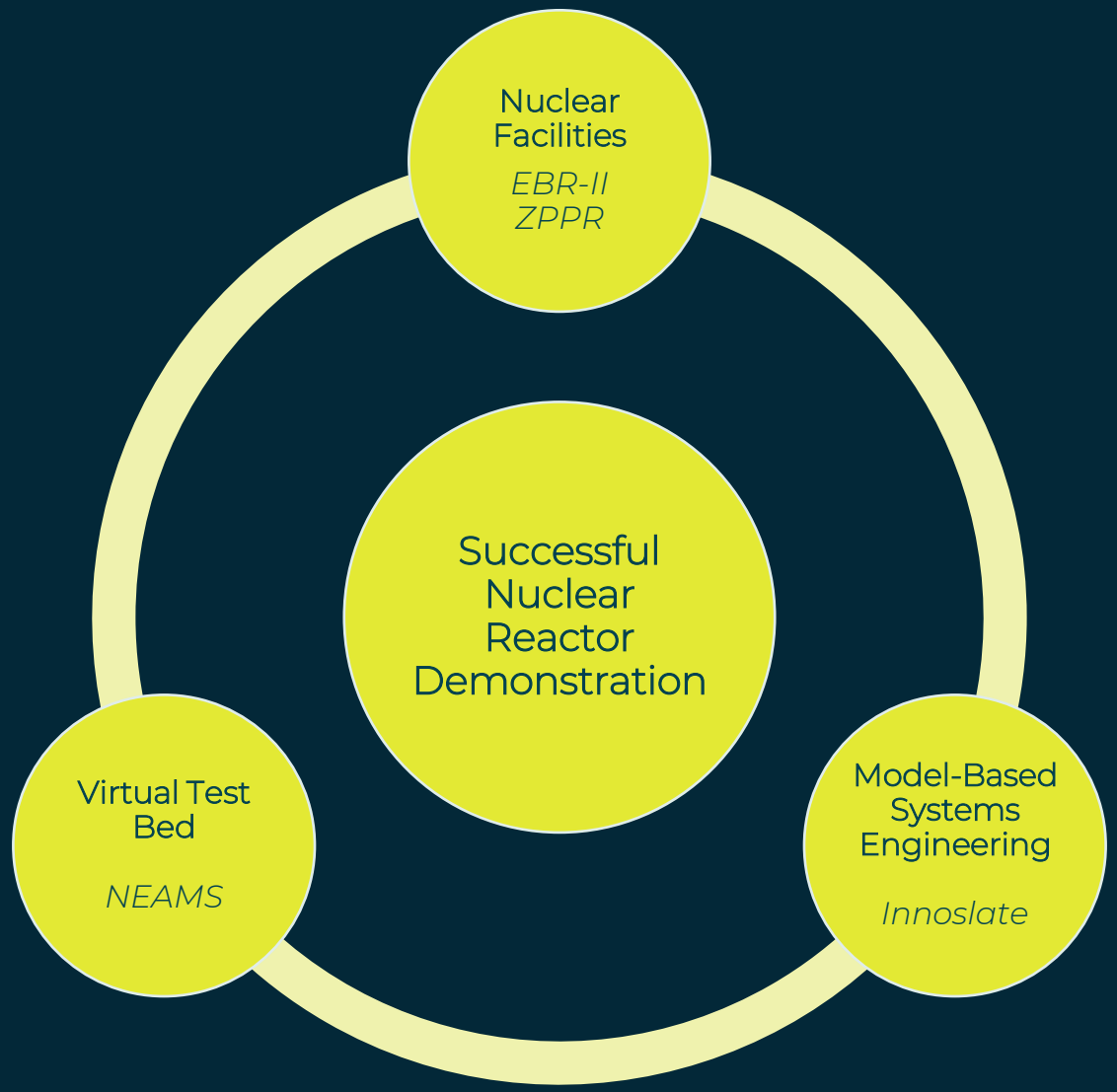
The Takeaway

NRIC developing and implementing a framework to enable nuclear reactor demonstration projects.

That outcome is achieved by integrating multiple tools of different functionality.

1. **Nuclear Facilities**
   Upgrade existing facilities to support physical nuclear demonstrations
2. **Virtual Test Bed**
   Utilization of NEAMS software tools and lab computing resources to enable virtual testing of reactor concepts
3. **Model-Based Systems Engineering**
   Requirements, Interfaces, and Functional management and integration through Innoslate software



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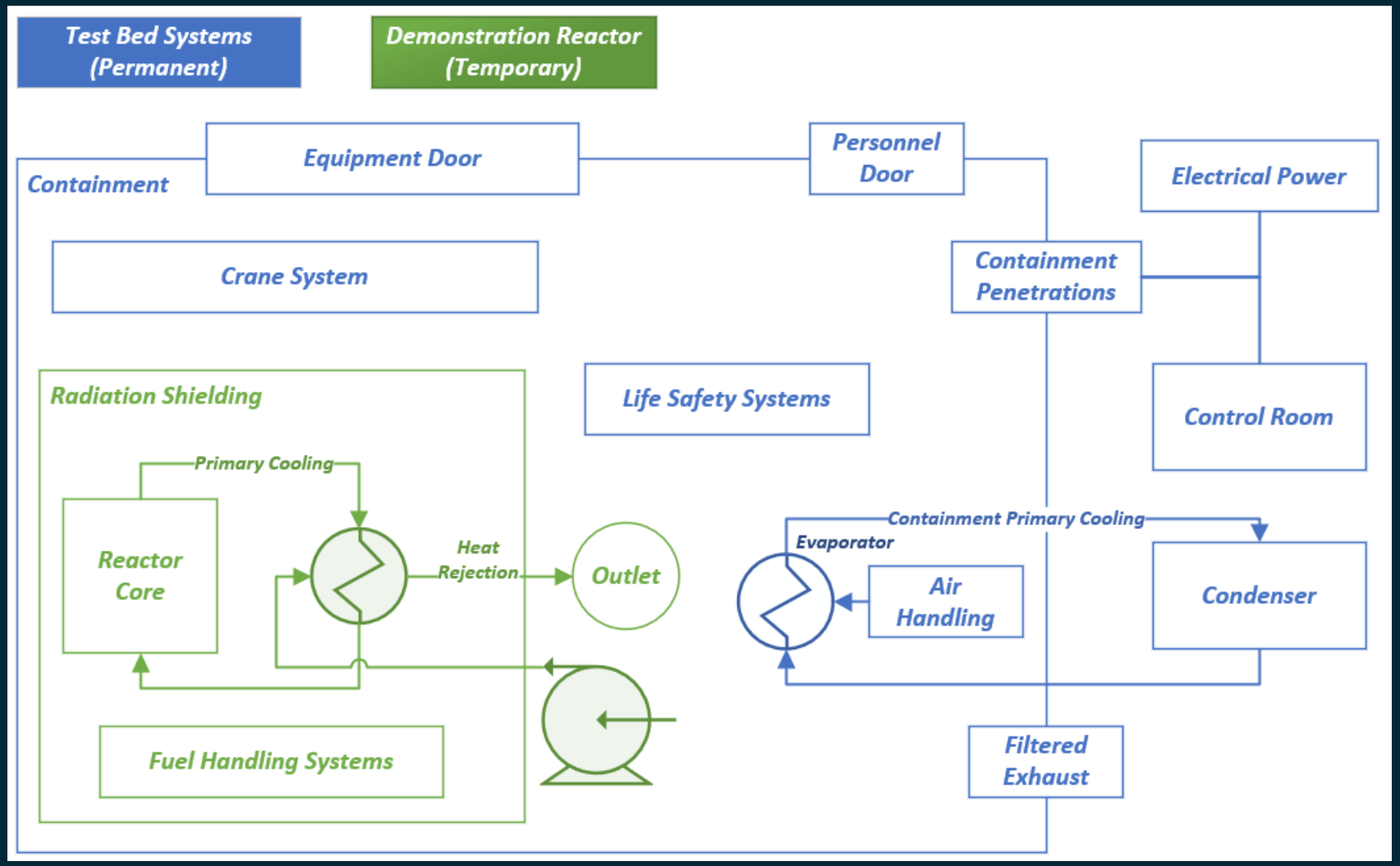
Initial Demonstration Reactor Test Bed Concept



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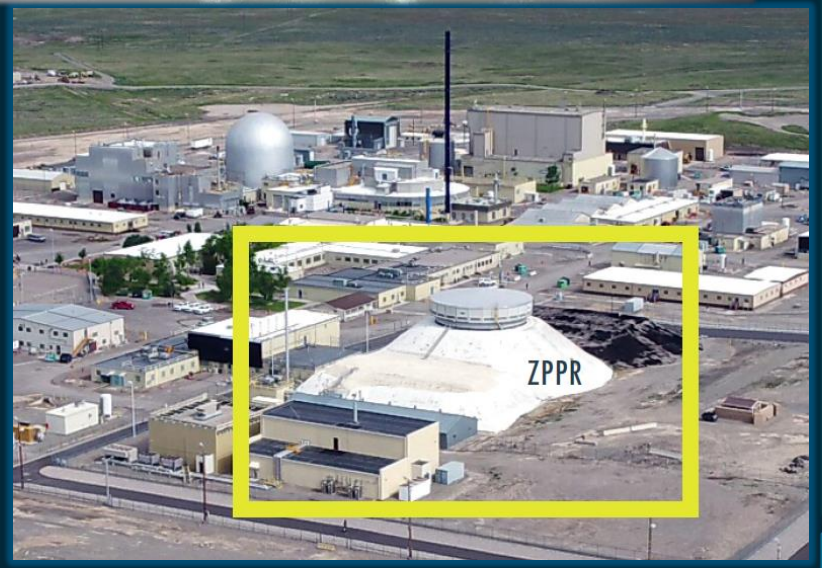
ZPPR Test Bed (ZTB) Information

- Built as Safeguards Category 1, Hazard Category 2 facility
- HEU and Pu fuel capable
- 500kW heat rejection system*
- Co-located with other MFC Capabilities:
  - Fuel production, hot cells, characterization, and machine shop
- Floor loading 3,000 psf or 500,000 lbs total
- 200 kVA, 480V electrical service
- Class 1E battery backup power and non-safety-related 100kW diesel generator*
- Compressed gas systems
- ~1,300 sqft floor space
- Co-located Control Room
- Roof entry point for installation of equipment and reactor packages*



*currently proposed in design

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EBR-II Test Bed (ETB) Information

- 80 ft diameter, 1ft thick rebar reinforced concrete walls with steel plating on exterior
- 10 MW heat rejection system*
- Reactor can be co-located with existing capabilities at MFC
  - Fuel production, hot cells, characterization, and machine shop
- Floor loading capacity of 3,750 psf
- Available utilities, including electrical power, communications, and compressed gas systems*
- ~4,800 sqft of floor space inside dome
- Near ground level entry point for installation of equipment*
- Class 1E battery backup power and non-safety-related 100kW diesel generator*
- Currently Safeguards Category 2, Hazard Category 2

*currently proposed in design

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Demonstration Test Bed Requirements Gathering Initiative

NRIC needs your input to effectively enable your demonstration

In 2020, the National Reactor Innovation Center (NRIC) initiated projects to develop test beds to provide capable facilities to support reactor demonstrations. Two existing facilities at Idaho National Laboratory were chosen for initial test beds: the Experimental Breeder Reactor-II (EBR-II) dome and the Zero Power Physics Reactor (ZPPR). Each provides unique capabilities to enable a wide range of demonstration projects. To support preparing these facilities for demonstrations, NRIC is gathering requirements from potential users. Your responses, along with those of other potential users, will influence project decisions and become part of the formal requirement documentation.

Please note which requirements may be negotiable and feel free to contact NRIC with follow-up questions or clarifications.

Reactor demonstration projects are assumed to be modularly constructed, delivered, and installed into the test bed facilities. Other baseline technical assumptions for the facilities are as follows.

Parameter	EBR-II	ZPPR
Maximum Reactor Thermal Power (MW)	10	0.5
Maximum Floor Loading (lbs) (total/psf)*	Not evaluated / 3,750	500,000 / 3,000
Module Transfer Port and Location	Near ground-level Door/Hatch	Roof Hatch
Largest Dimension of Opening (ft)*	9	Up to 20
Usable Area Inside Containment (ft²)	~4,000	~1,300
On-site Power Available	200 kVA @ 480V	200 kVA @ 480V
Target Ready-for-Demonstration Date	End of 2023	End of 2023

*May be negotiable depending on needs

Demonstrator Requirement Input

1. **Heating and Cooling**
   Our thoughts thus far regarding heat rejection are that the demonstration site's HVAC system would be capable of rejecting a specific amount of thermal energy deposited from reactor operations. The site's HVAC system would then interface with the reactor's heat removal system, if any.
   1.1. Planned maximum thermal power (steady-state) of the reactor system (e.g. 500kW)?
   1.2. Please describe the planned cooling system for the reactor. Consider the following questions.
      1.2.1. If the reactor system includes a heat removal system, is it planned to be a closed loop?
      1.2.2. If gas is used for the primary cooling and is not a closed loop, what is the flow rate? This information supports understanding requirements for rejecting radionuclides to the environment outside of the demonstration facility.
   1.3. Describe any environmental (dew point, ambient temperature, humidity, etc.) requirements for inside the demonstration site?
2. **Mechanical/Structural**
   2.1. What are the general dimensions of the reactor system?
   2.2. What are the general dimensions of the largest component?
   2.3. What are the general dimensions of components needing transport via shielded cask?
   2.4. To aid in understanding floor loading limitations, what is the rough weight of the heaviest component? *Optionally, floor loading requirements can be provided.*
   2.5. To aid in understanding floor loading limitations, what is the rough weight of the combined system? *Optionally, floor loading requirements can be provided.*

Activities

- Currently soliciting technical requirements information from potential demonstrators
- Feedback will inform design of:
  - Heat Rejection Systems
  - Mechanical/Structural
  - Lifting and Crane Support
  - Electrical
  - Gas Supply
  - Operations Support

Pre-Conceptual Design of Test Beds – FY 20

Phase 1 - Requirements Definition
Phase 2 - Technical Solution Definition
Phase 3 - Product Realization
Phase 4 - Technical Planning and Readiness

Expected to be operational in 2023

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