



# TMCES 2023 Panel Presentation

August 2023

*Changing the World's Energy Future*

Daniel Mark Mikkelsen



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# **TMCES 2023 Panel Presentation**

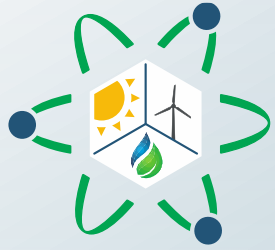
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**August 2023**

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# IES

Integrated Energy Systems

# Energy Storage Projects at Idaho National Laboratory

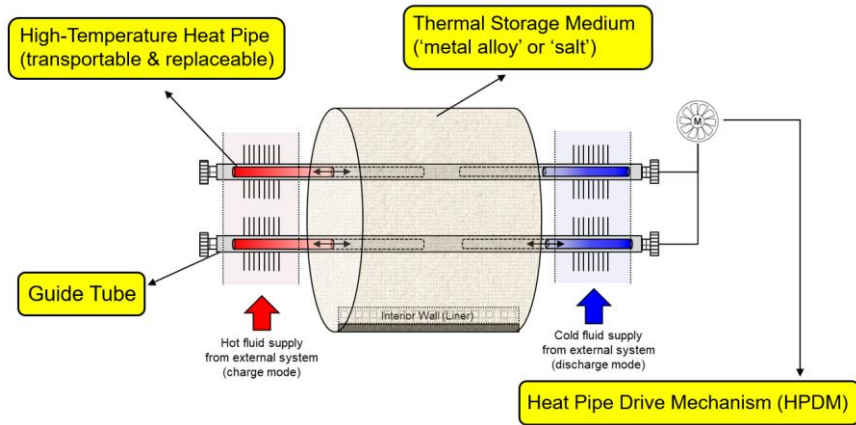
**TMCES Workshop**  
**August 2-3, 2023**

**Presented by:**  
**Daniel Mikkelsen, Ph.D.**

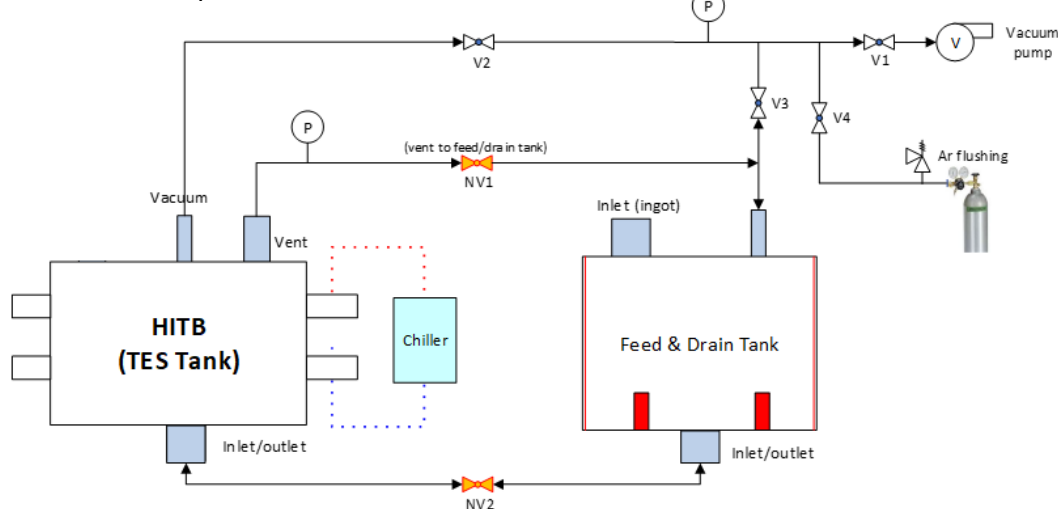
# Heat Pipe-Integrated Thermal Battery (HITB) for Versatile Integration with Emerging Microreactors

*INL Laboratory Directed Research Development Program*

Heat pipe-Integrated Thermal Battery (HITB)



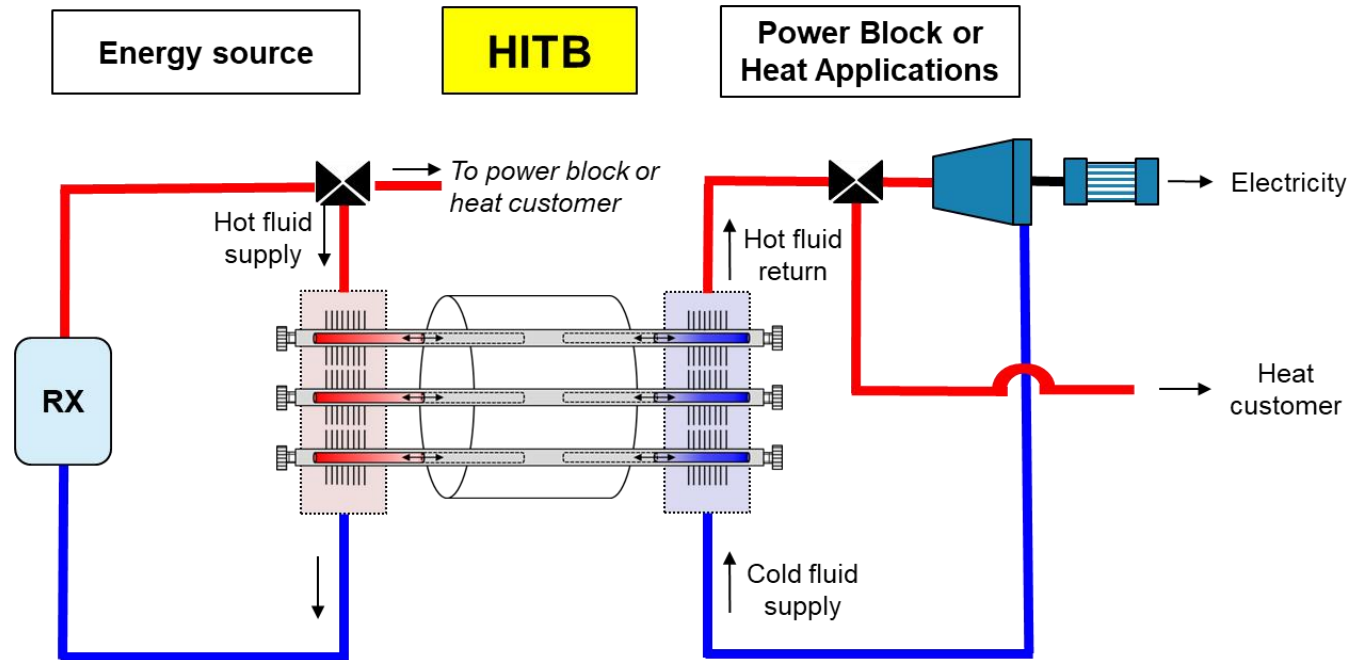
Experimental Demonstration Plan for HITB



- HITB is a high-temperature latent-heat thermal energy storage (TES) that allows for versatile integration with various thermal systems, including nuclear microreactors.
- Alkali-metal heat pipes, designed to be displaceable using a driving mechanism, are introduced for dynamic control of TES operation at high temperatures.
- Easy to scale up to multiple modules and can be interfaced with any thermal systems with minimal safety issues.
- Detailed design of experimental demonstration facility has been completed through small-scale experimental demonstrations and modeling-informed optimization efforts.
- Experimental facility will be built at INL this year for demonstration and associated validation research.

# Heat Pipe-Integrated Thermal Battery (HITB) for Versatile Integration with Emerging Microreactors

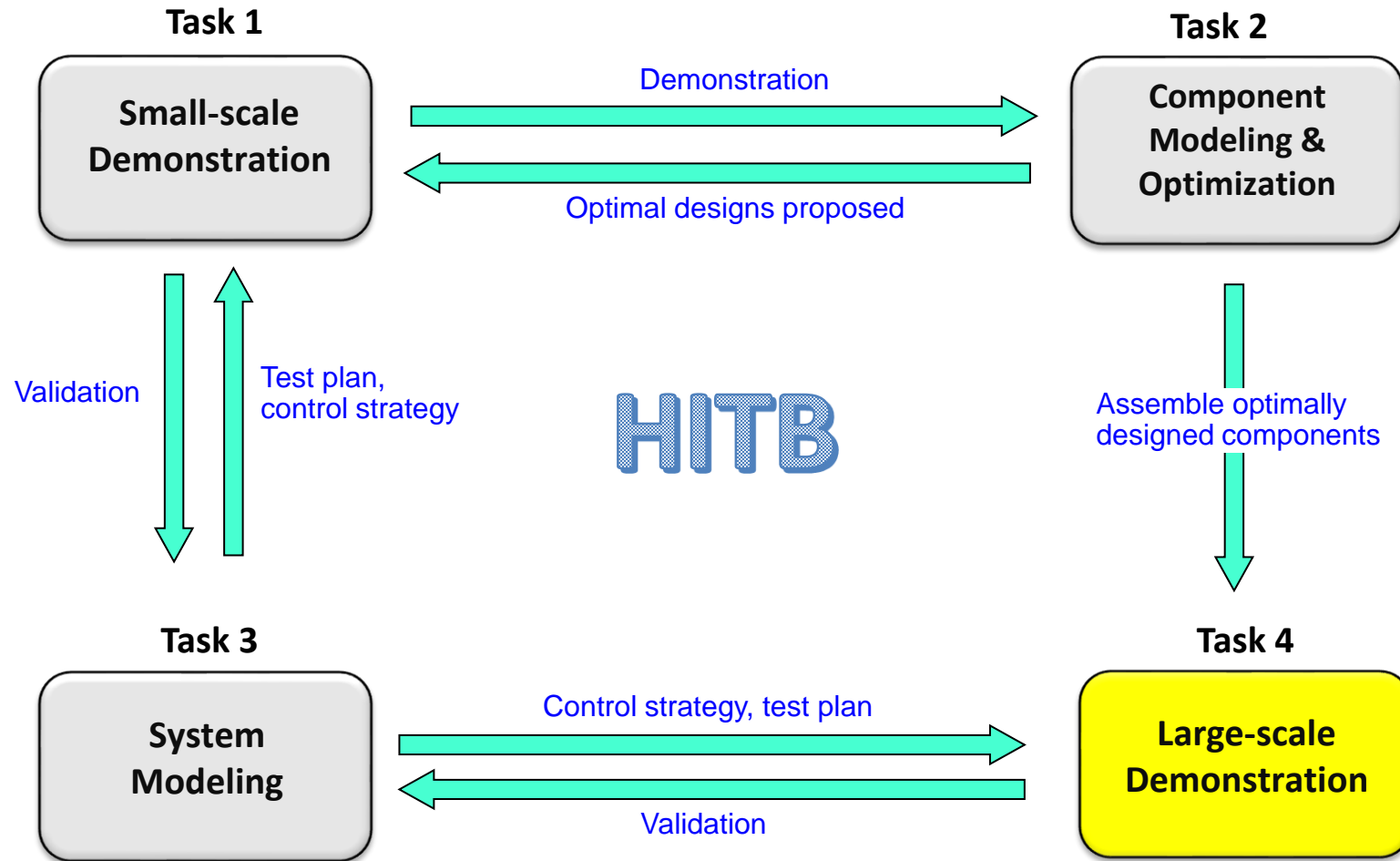
INL Laboratory Directed Research Development Program



- ✓ Easy coupling
- ✓ No additional pump or heat exchanger
- ✓ Low cost for integration and maintenance
- ✓ High temperature application
- ✓ Easy to install and operate (like battery)

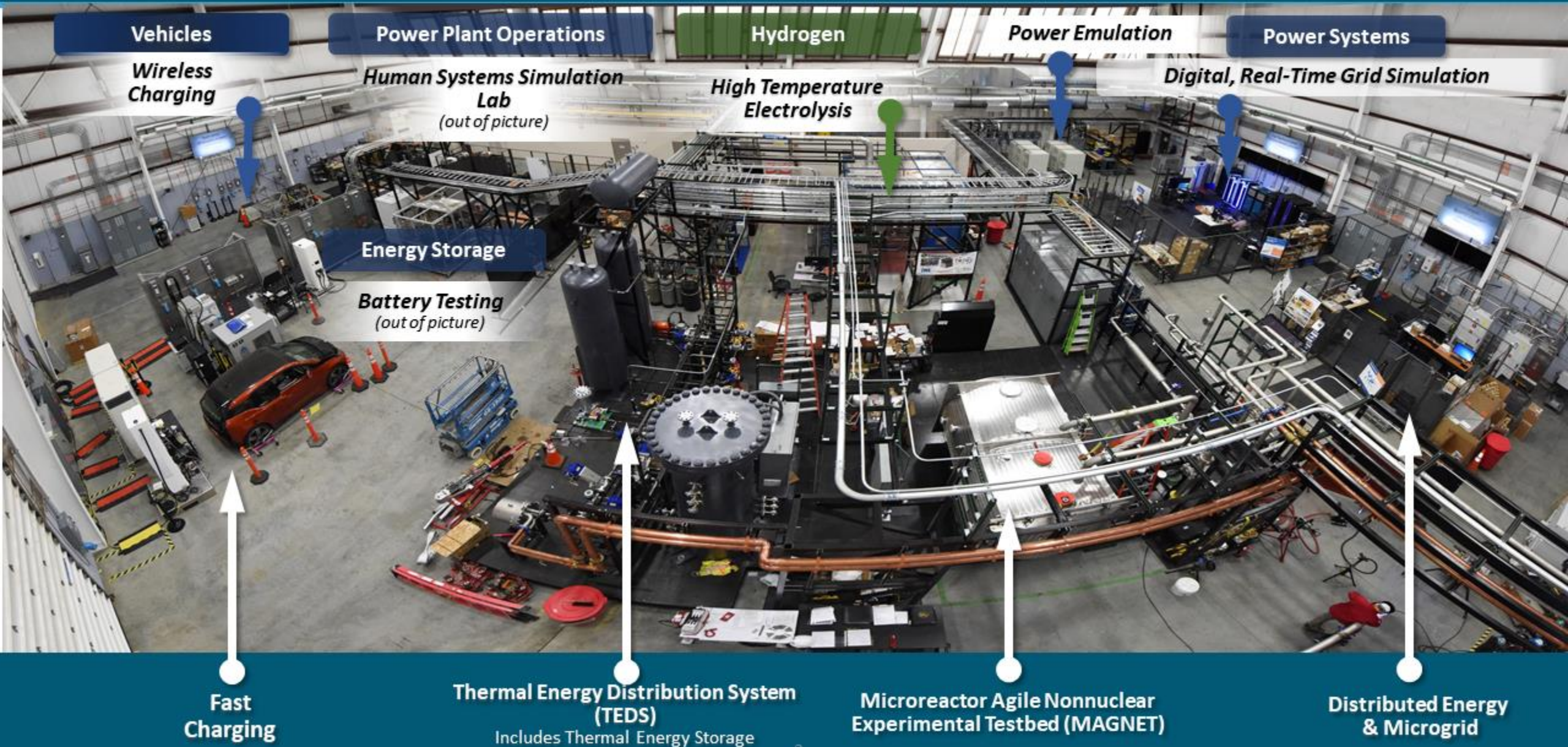
# Heat Pipe-Integrated Thermal Battery (HITB) for Versatile Integration with Emerging Microreactors

INL Laboratory Directed Research Development Program



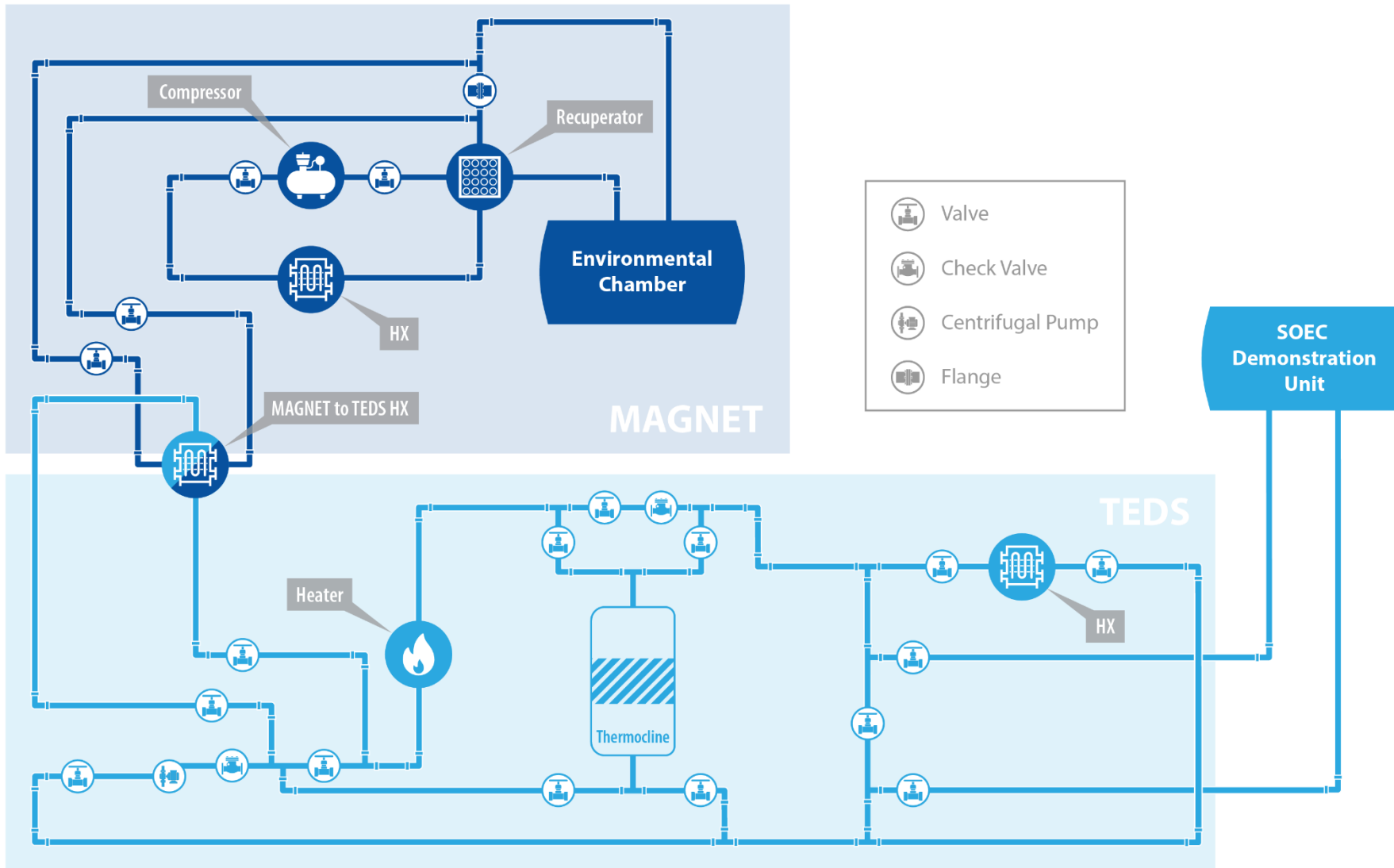


# Systems Integration Laboratory

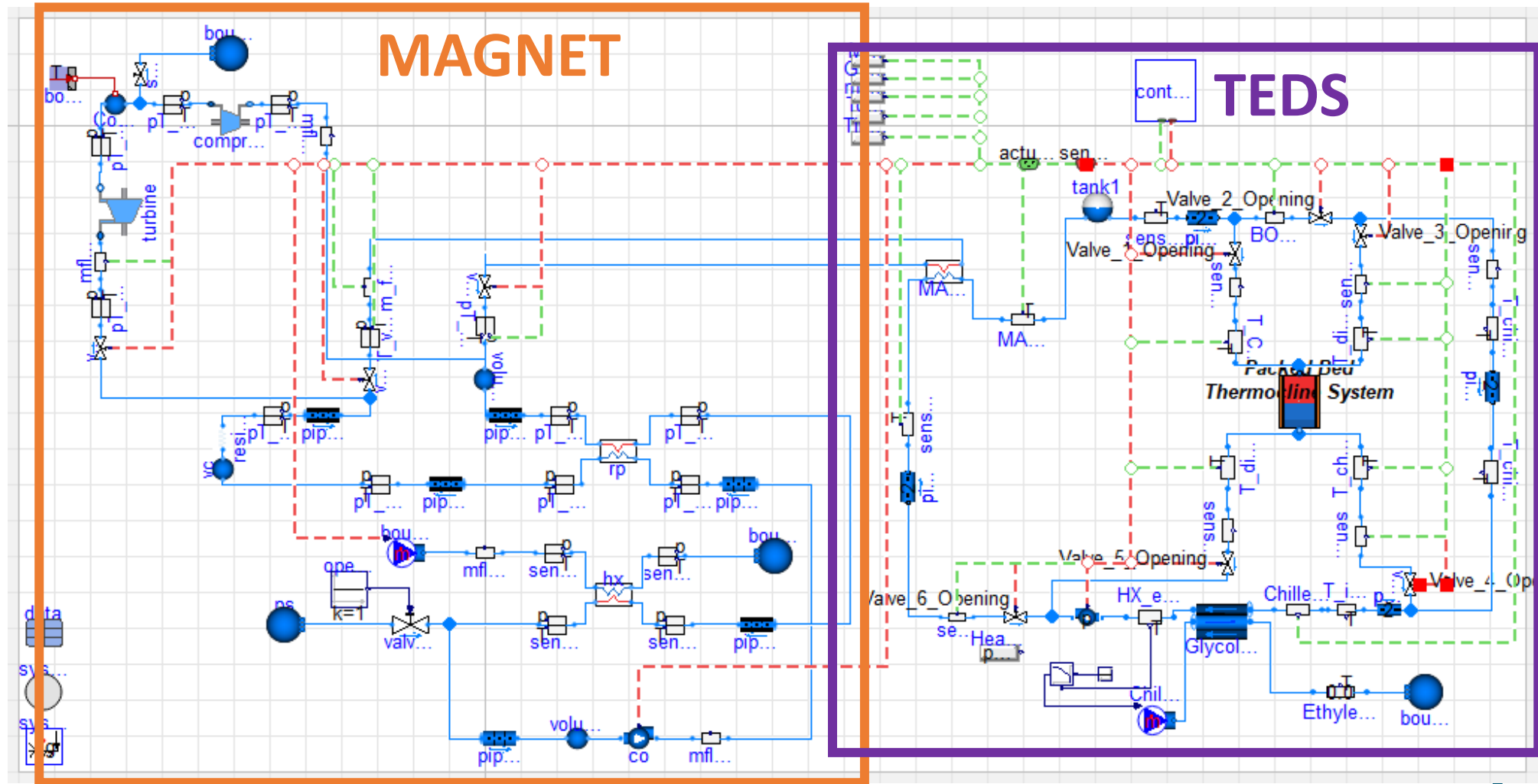




# DETAIL Flow Diagram

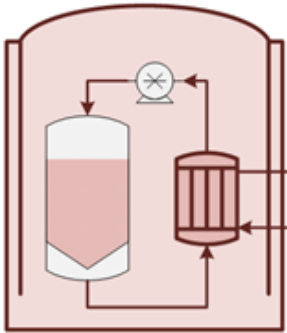


# DETAIL Model for V&V

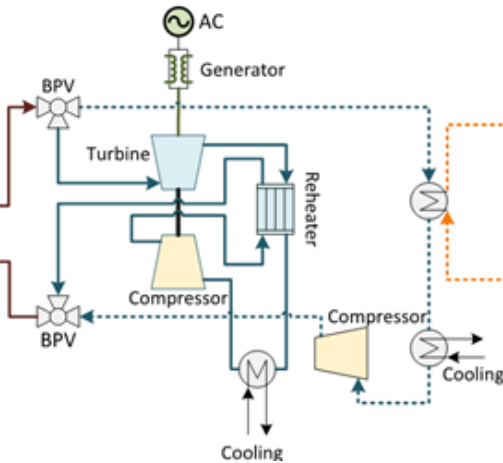


# Advanced Reactor Integrated Energy System (AR-IES)

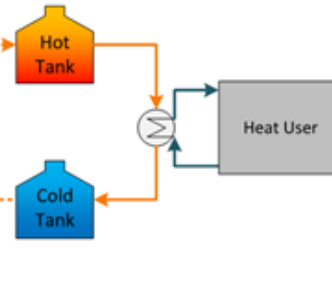
Nuclear Power Plant



Balance Of Plant



Thermal Energy Storage



## Overall objectives:

- In collaboration with National Reactor Innovation Center (NRIC), design and construct an advanced reactor integrated energy system (AR-IES) demonstration
- Incorporate a TES study/facility to enable understanding and coupling with various thermal loads/users

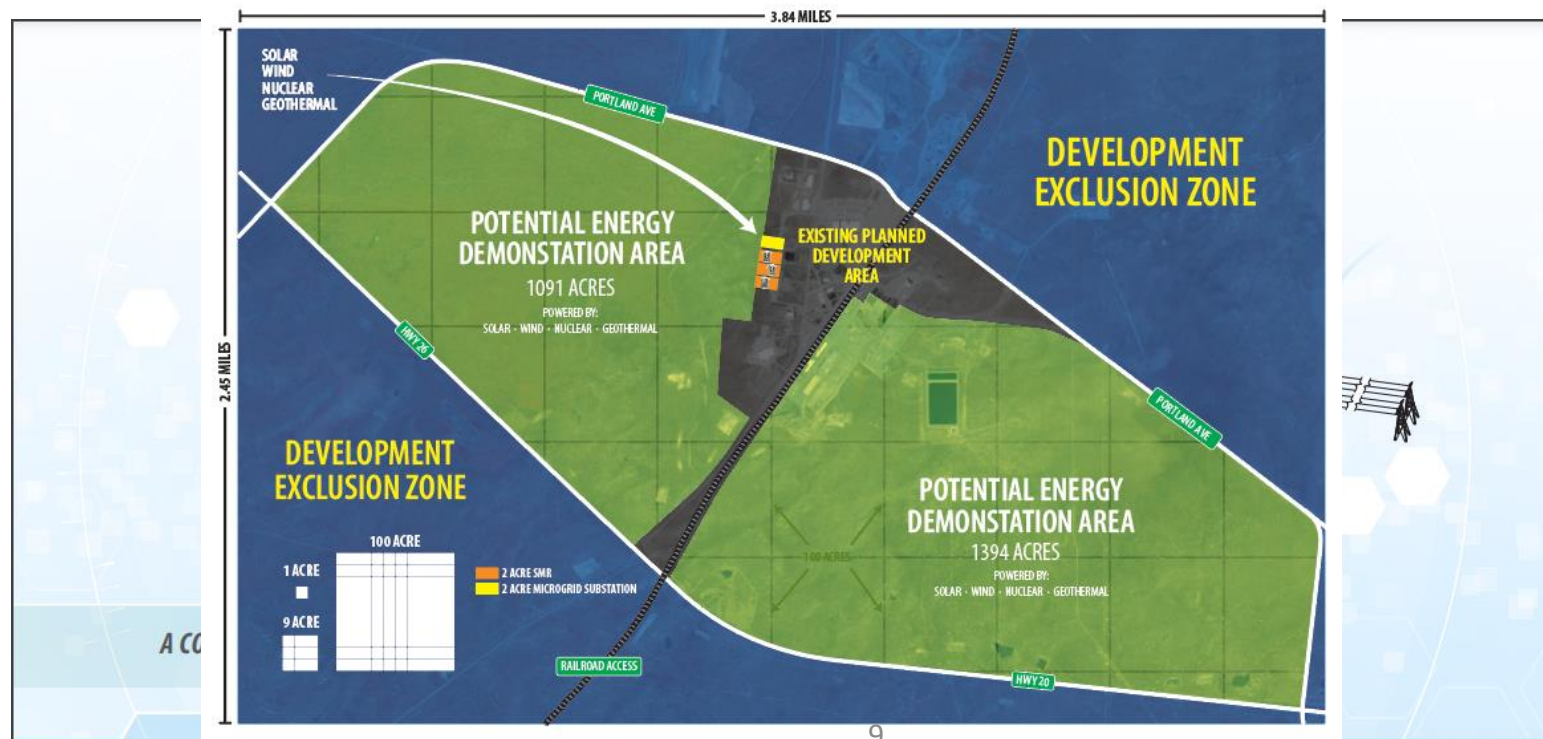
## Background:

- Location: EBR-II Dome Testbed
- Demonstration platform to couple the thermal output from an advanced reactor to a controllable load and TES system.



# Net-Zero IES at CFA

- IES program involved with Net-Zero planning
- System size plan 15MWe
- Installation by 2031
- Supports thermal islands for integration and distribution of heat to multiple users, with TES and conditioning







# Idaho National Laboratory

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