



Program Review: Thermal Systems Pillar

May 2024

Changing the World's Energy Future

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Program Review: Thermal Systems Pillar

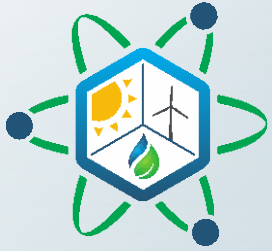
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IES

Integrated Energy Systems

Program Review: Thermal Systems Pillar

May 2024

Funding program: Integrated Energy Systems

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DETAIL Summary

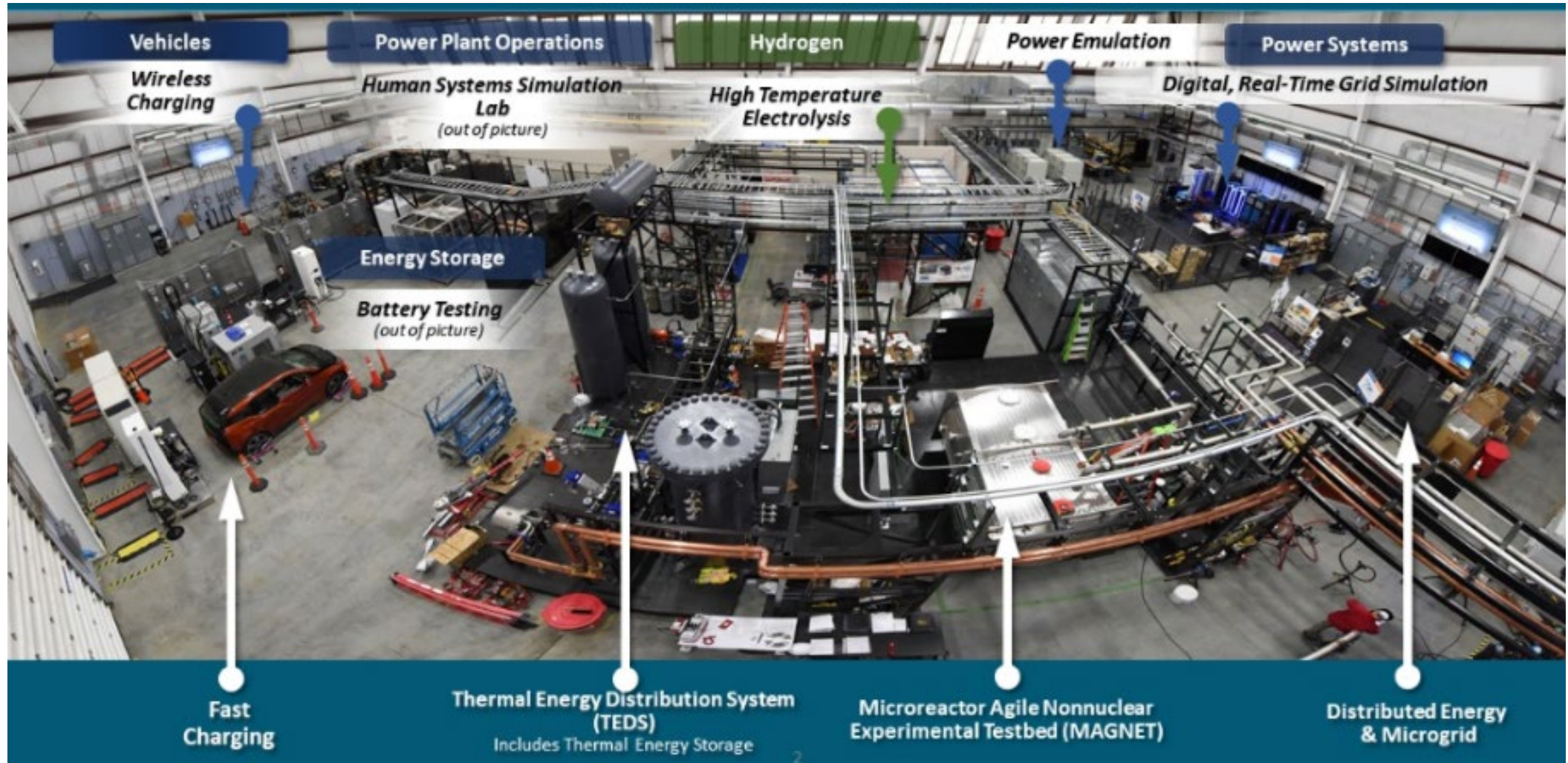
Summary:

Thermal Energy Delivery System (TEDS): Electric heater connected to thermocline thermal energy storage, Brayton cycle power conversion unit, and a controllable load through a therminol synthetic oil loop. Connected to Real Time Digital Simulator.

Microreactor Agile Non-Nuclear Experimental Testbed (MAGNET): Inert gas chamber for high temperature (~600C) component testing. Connected to TEDS.

High temperature steam electrolysis (HTSE) test stations: Modular and reconfigurable stations allow isolation of components and bi-directional fuel cell operation

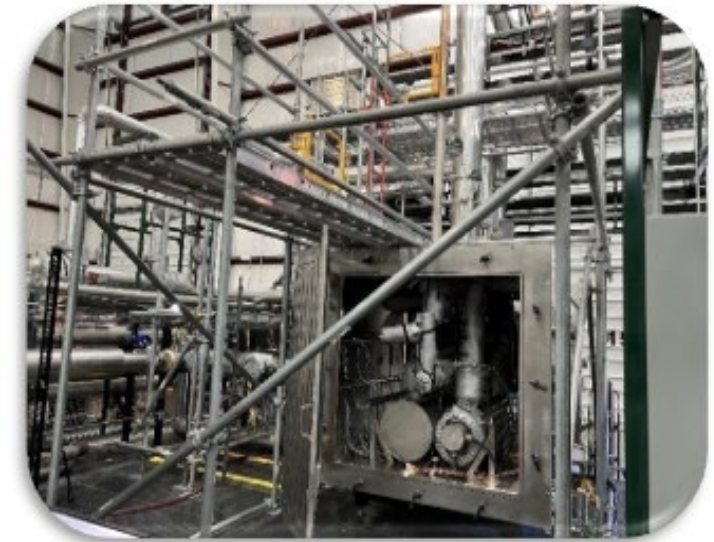
DETAIL Summary



DETAIL Introduction

Demonstration Objectives

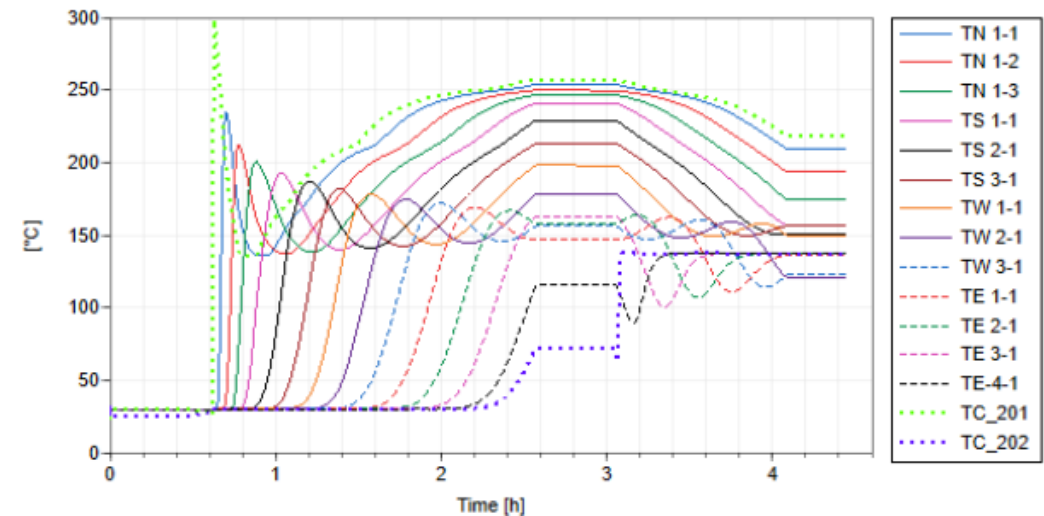
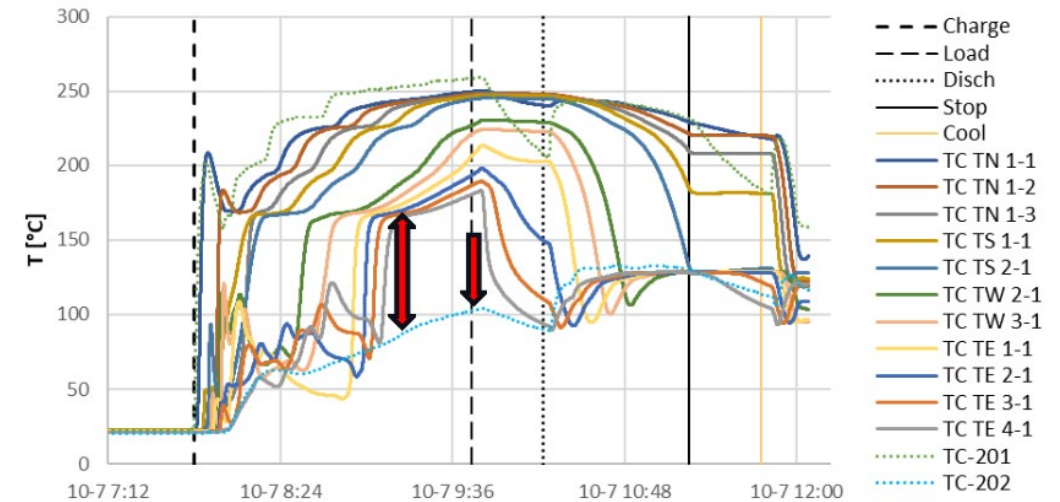
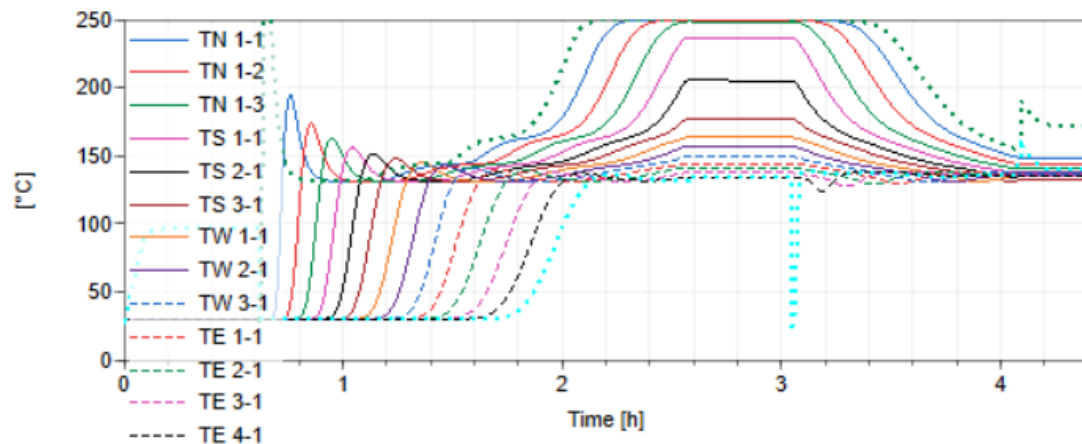
- DETAIL supports Integrated Energy Systems through 3 primary outcomes
 - Reduce risk and enhance designs and performance of future integrated system tests at megawatt scale.
 - Obtain integrated system testing data at 100-kilowatt level to complement future corresponding data at megawatt scale that will support scaling up models and experimental data to the capacity of industrial operations at hundreds of megawatts.
 - Support integrated system testing sponsored by partners of the Integrated Energy Systems (IES) Program.
- DETAIL continues to provide a space for small scale projects
- DETAIL continues to provide lessons learned for the proving grounds once construction is complete



Previous Experiments

Scope: Data collected for baseline charge, load, and discharge modes and compared to modeled results

- Anomalies observed within the temperature profiles
- Concluded leaky valve within system
- System modeled with and without leaky valve



DETAIL 3-Year Plan Overview

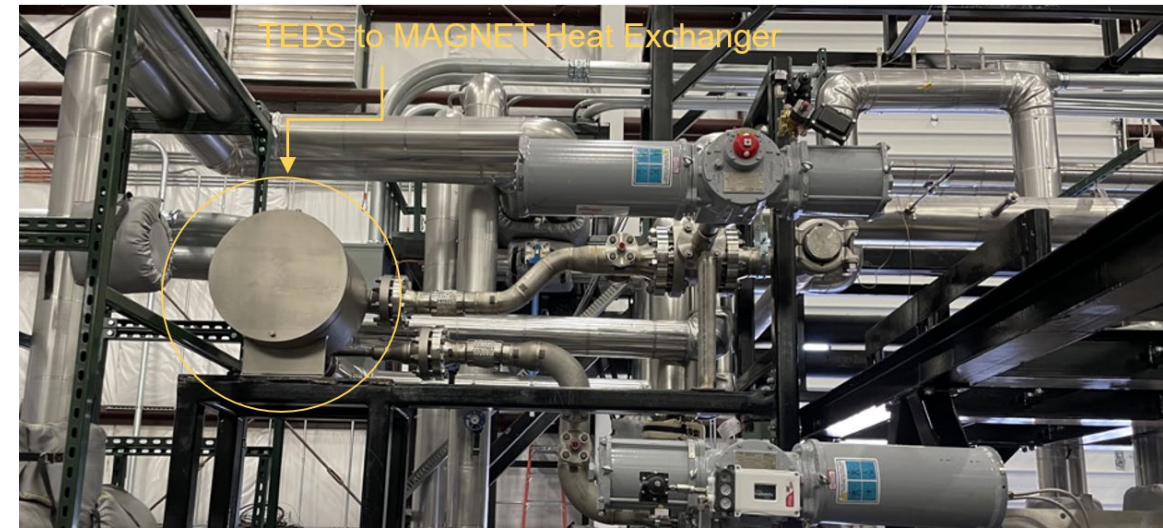
Scope	Major Deliverable
MAGNET to TEDS Coupling (FY25)	Complete integrated testing to transfer heat from MAGNET to TEDS through a gas-to-oil heat exchanger
	Perform hardware-in-the-loop test of a 30 kW Brayton cycle power conversion unit coupled to an emulated advanced nuclear reactor in a simulated grid environment
Syngas Production (FY26)	Produce syngas at 100kW scale in a combined heat and power test
Heat Pump Coupling (FY27)	Develop and test a heat pump at 50 kW scale to increase the temperature of heat from 300°C to 600°C.

FY25: DETAIL – 70kW MAGNET to TEDS Heat Exchanger Testing

Scope: Complete integrated testing to transfer heat from MAGNET to TEDS through a gas-to-oil heat exchanger

- Equipment needed for these tests is already installed
- Testing at this scale will support planning and equipment design for MW Thermal Test System at the Proving Grounds
- Purposed activity for FY25
 - Estimated cost of \$175K

Impact: Reduce risk and enhance designs and performance of future MW system by obtaining data at the 100kW scale



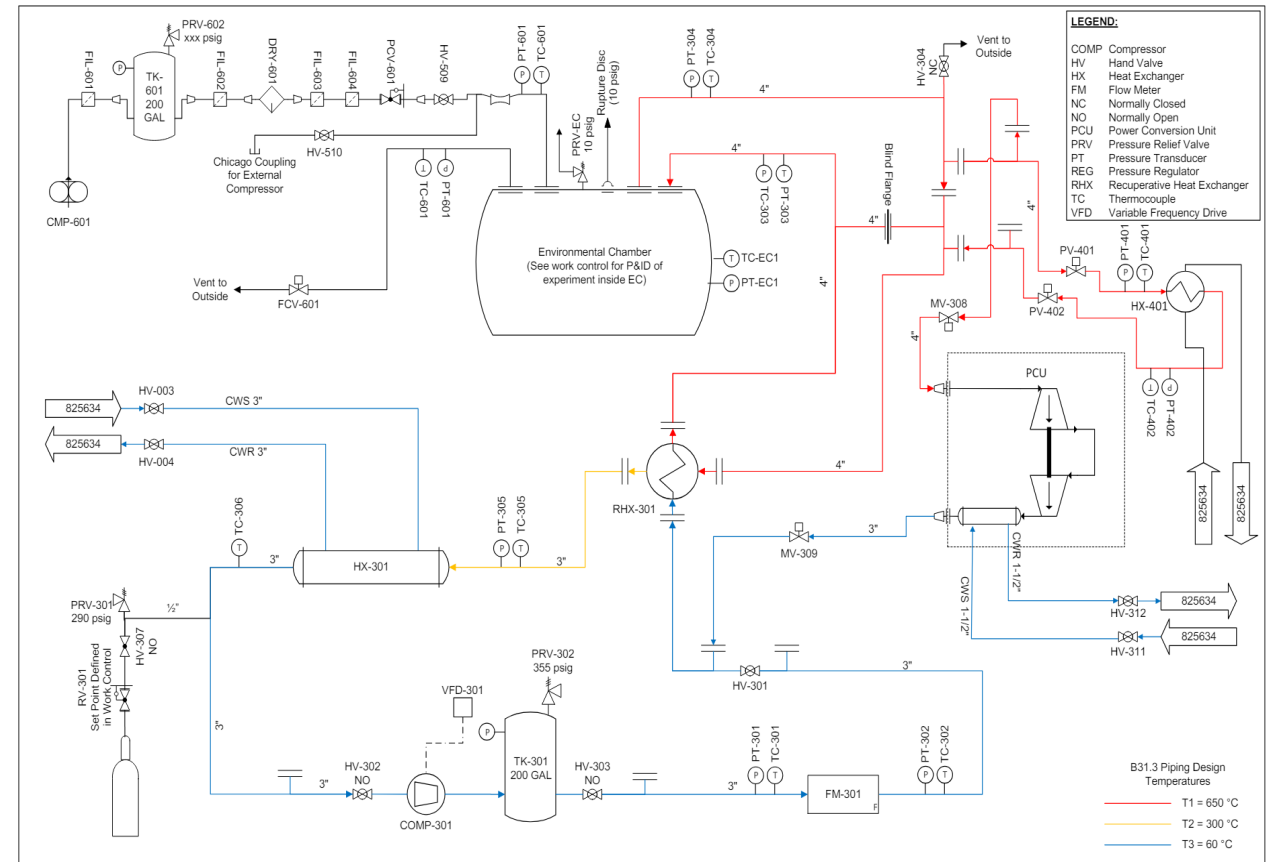
FY25: DETAIL – 80kW Integrated MAGNET, TEDS, PCU Testing

Scope: Perform hardware-in-the-loop test of a 30 kW Brayton cycle power conversion unit coupled to an emulated advanced nuclear reactor in a simulated grid environment

- Necessary equipment already installed at DETAIL
- Purposed scope for FY25
 - Estimated cost \$175k

Impact:

Reduce risk and enhance designs and performance of future MW system by obtaining data at the 100kW scale

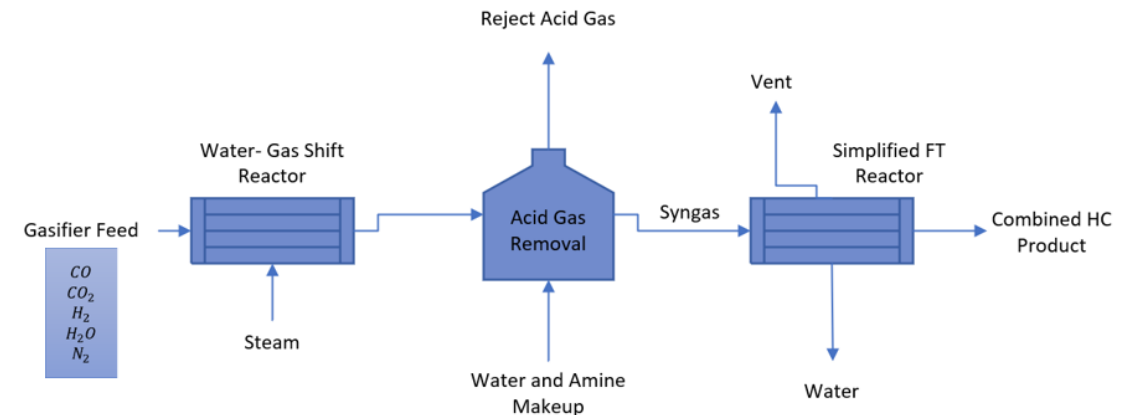
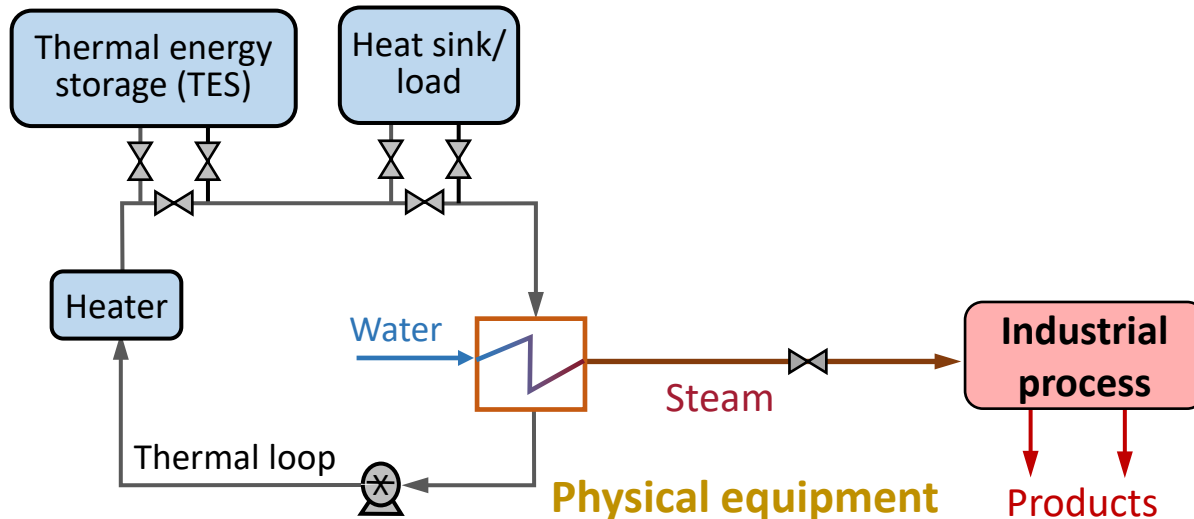


FY26: DETAIL – 100kW+ Syngas Production

Scope: Produce syngas at 100kW scale in a combined heat and power test

- Expands DETAIL ability to offload thermal energy to industry relevant applications
- Purposed scope for FY26
 - Estimated cost \$375k

Impact: Expand DETAIL capabilities to accompany syngas production at 100kW scale

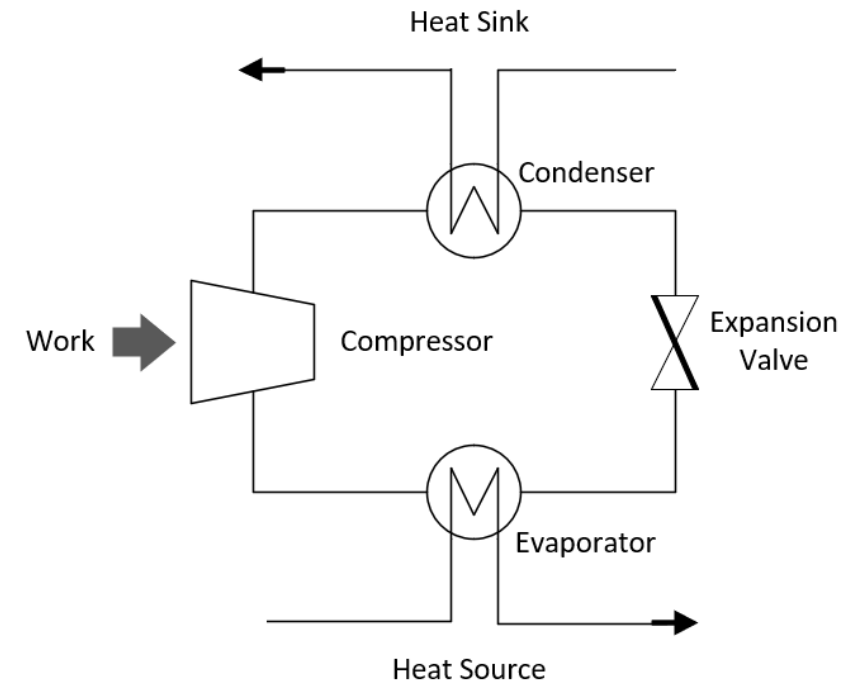


FY27: DETAIL – 50kW Heat Pump System

Scope: Develop and test a heat pump at 50 kW scale to increase the temperature of heat from 300°C to 600°C.

- Potential to integrate the heat pump system with steam utilizing system
- Purposed for FY27
 - Estimated cost \$300K

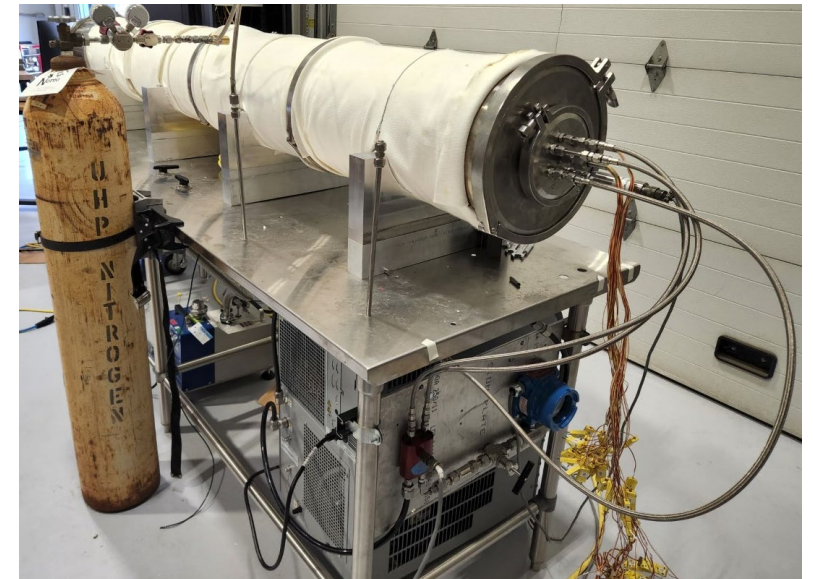
Impact: Expand DETAIL capabilities to be able to provide high temperature steam efficiently to auxiliary systems (Syngas, hydrogen production)



Case Study – Proving Grounds and DETAIL Coupling

The Single Primary Heat Extraction and Removal Emulator (SPHERE) and MAGNET

- Initially proposed as shakedown test facility for MAGNET
- Provided lessons learned for multiple experimental setups and overall operation
- Continues to provide a testbed for experiments of smaller scale when it doesn't make sense to put them in MAGNET



Impact:

DETAIL will continue to provide smaller scale test setups with a cheap installation and operating cost while also providing lessons learned for large scale experiments prior to costly installation and operation