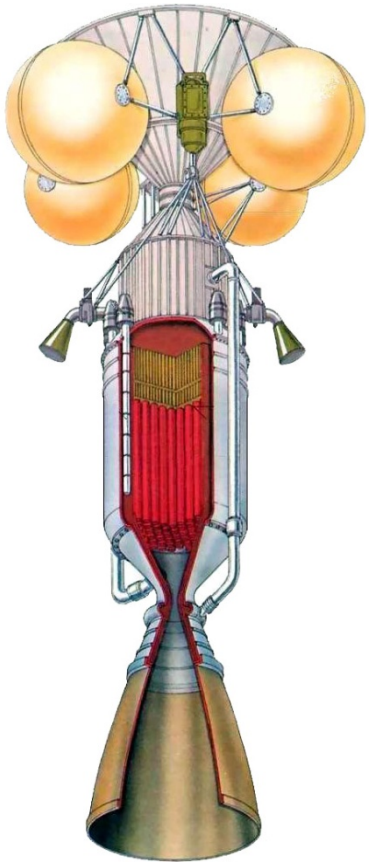
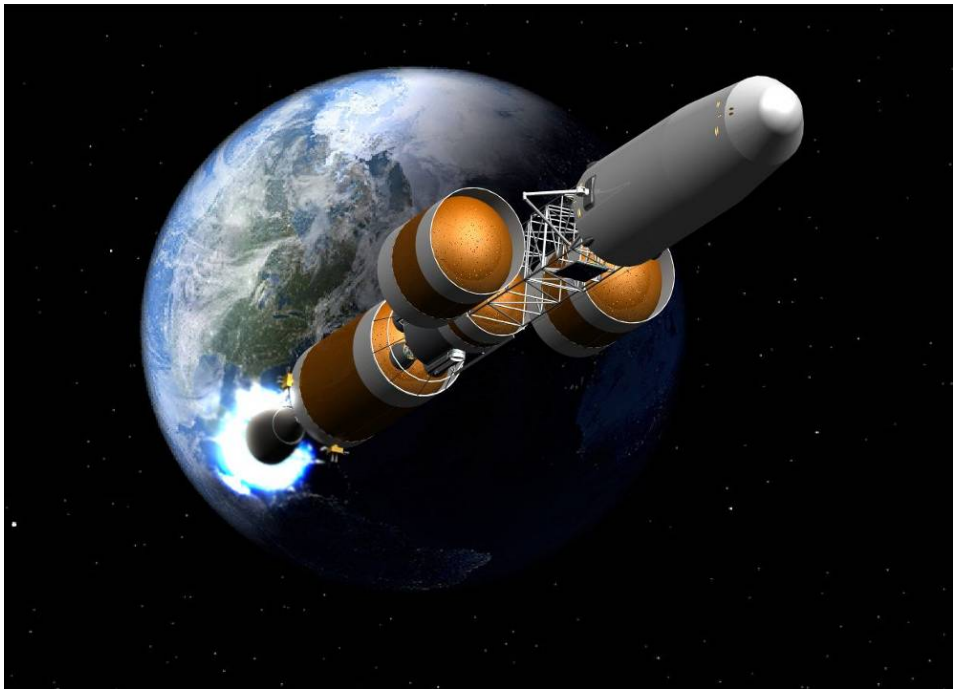
Nuclear Thermal Rocket Element Environmental Simulator (NTREES)





SNSF 2009 Meeting

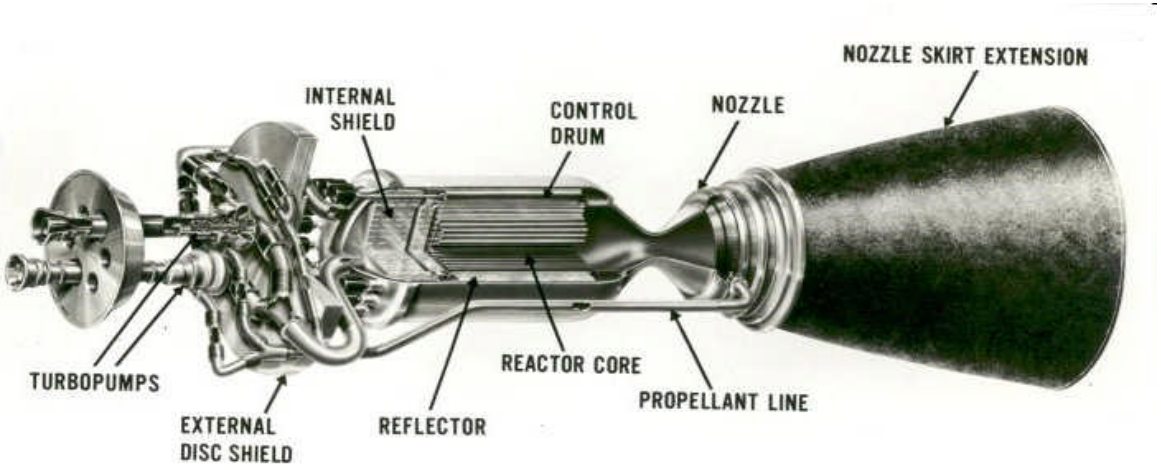
Marshall Space Flight Center

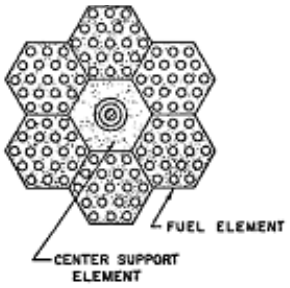
Michael Schoenfeld

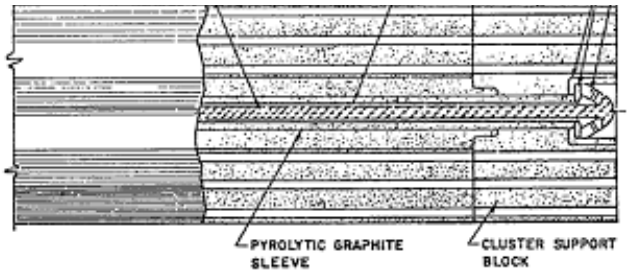
Content

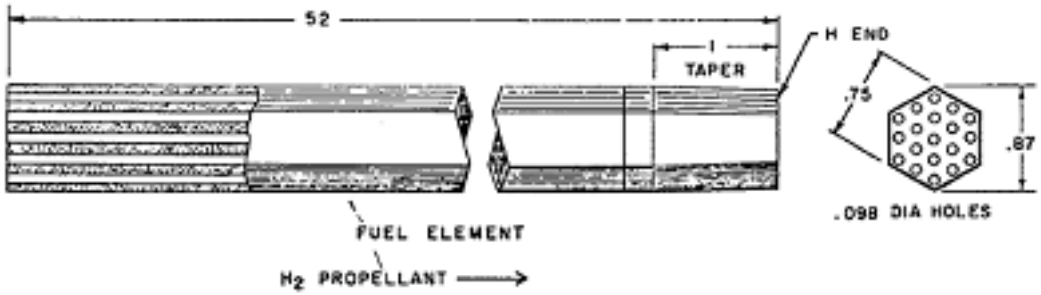
- Need
- Capability
- Experiment Configuration
- Summary

Purpose









– **fuel materials that can withstand hot hydrogen is key for NTR.**

– **NTREES enables:**

- **cost effective & rapid screening of candidate material**
- **examining thermal hydraulic performance.**

Design Requirements

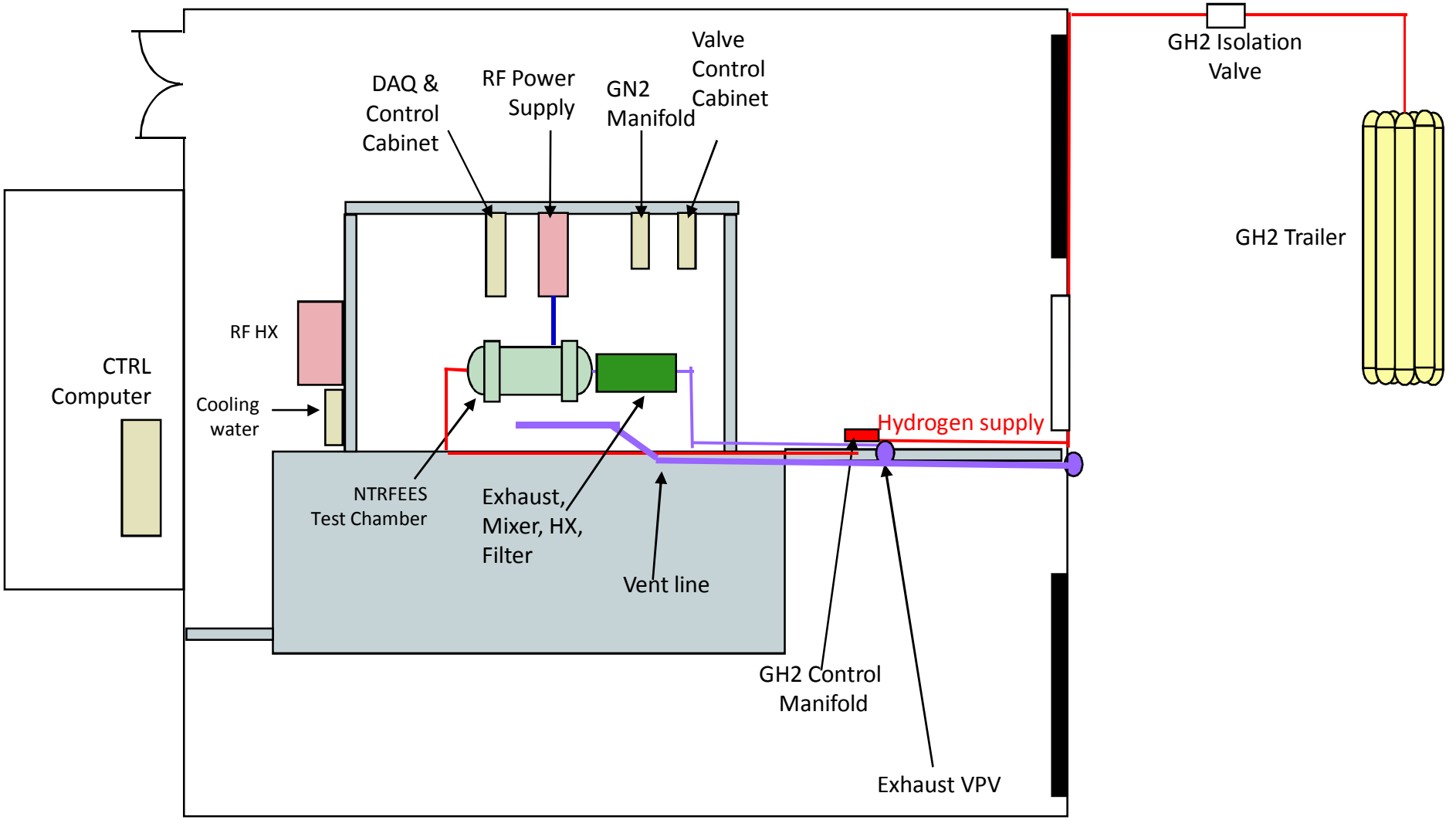
- **Fuel elements environment**
  - **Maximum temperature: 3000 K using non-contact Radio Frequency (RF) power system**
  - **Pressure: 1,000 psi to simulate NTR chamber pressure**
  - **GH_2 flow: up to 0.0011 lb/sec**

- **Test Sample Materials (surrogates and DU)**
  - **Composite graphite (U, Zr)C with ZrC coatings**
  - **Advanced CERMET W-Re/UN without coatings**

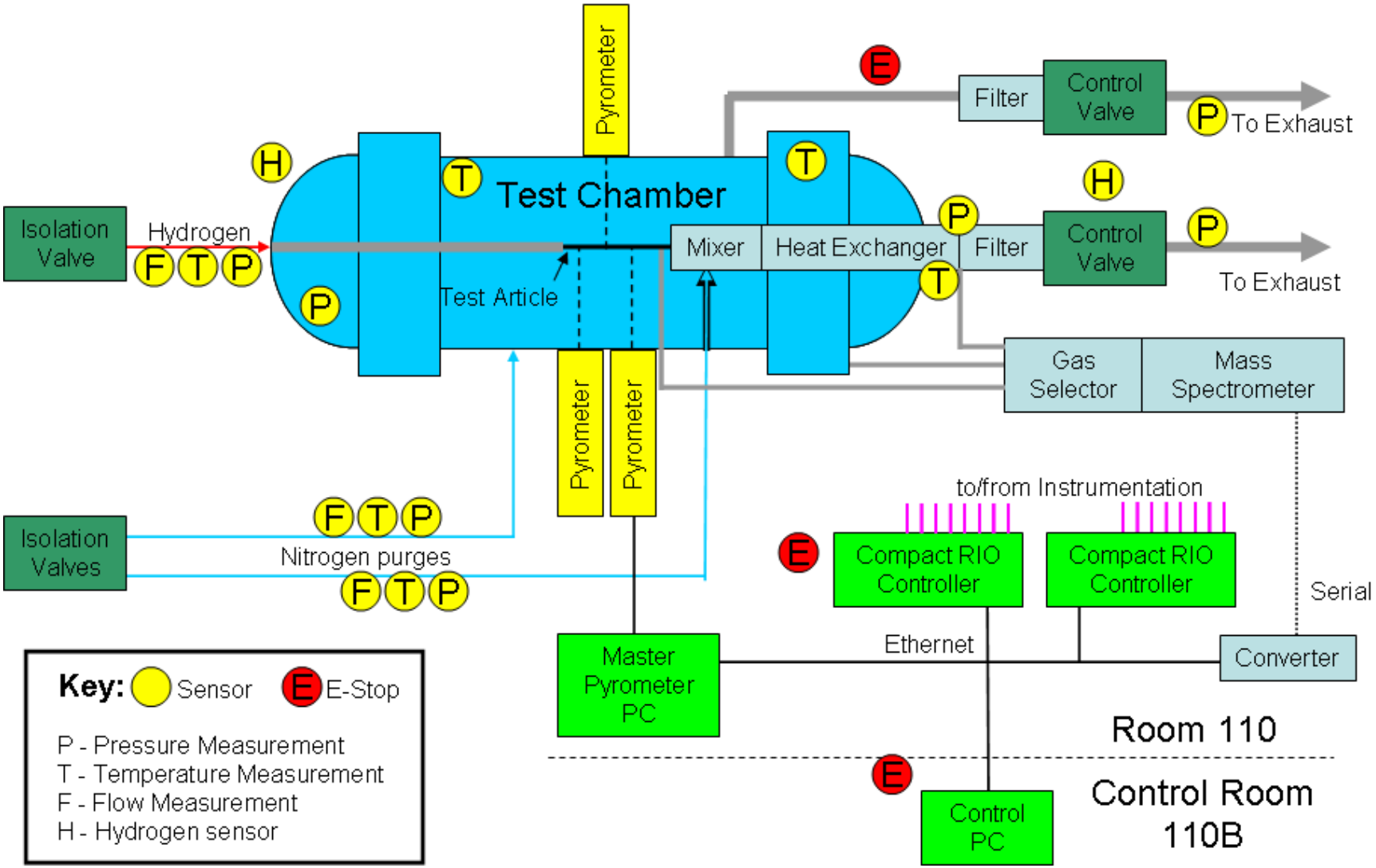
INL CERMET

Alabama A&M
Glossy Carbon

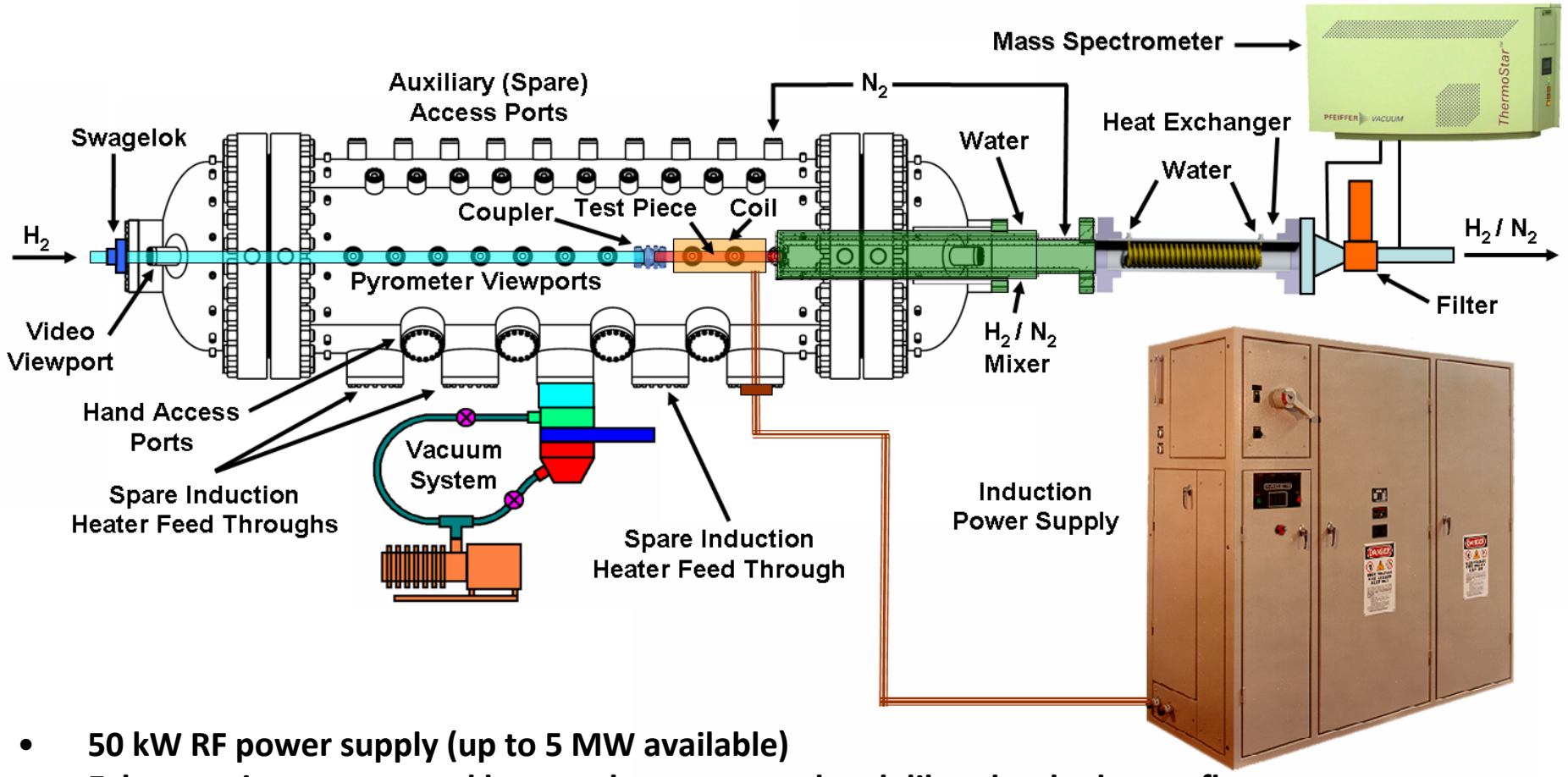
NTREES Layout



Data Acquisition and Control System Schematic

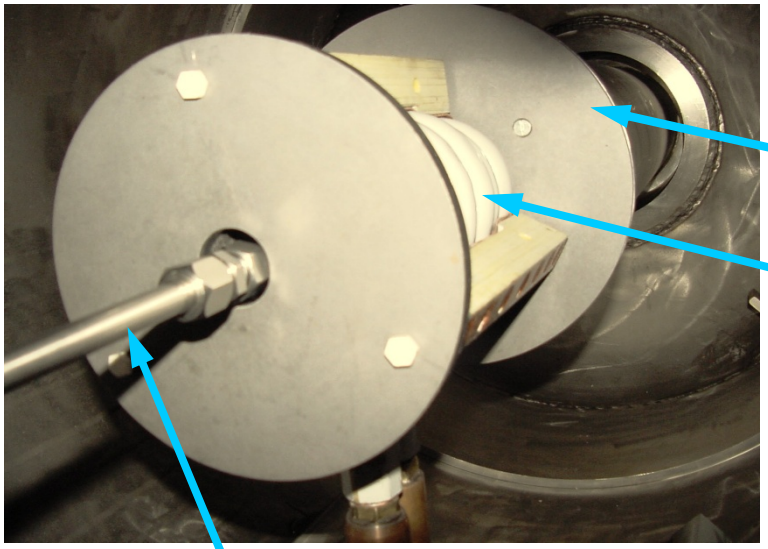


NTREES System Schematic



- 50 kW RF power supply (up to 5 MW available)
- Exhaust mixer system and heat exchanger to cool and dilute hot hydrogen flow
- Mass spectrometer on vent when testing DU samples
- Pyrometers to measure test specimen surface temperatures & axial profile

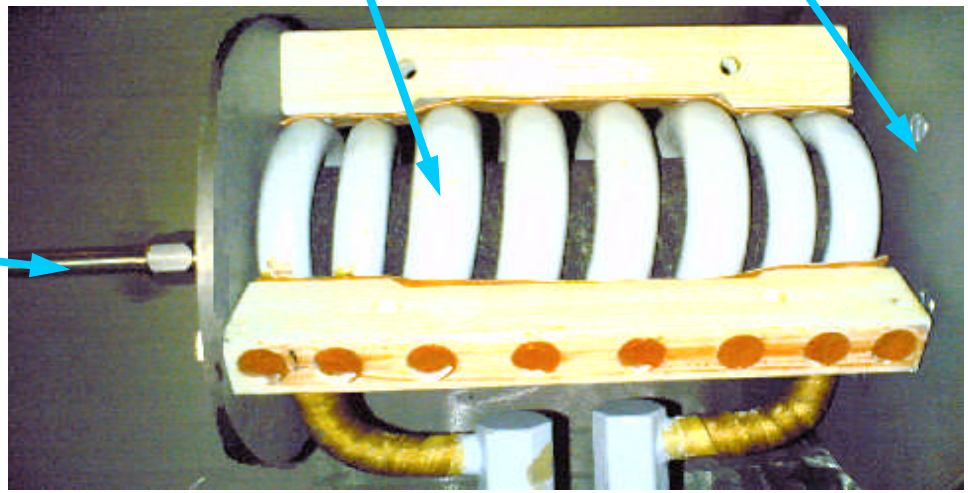
NTREES Setup



H_2 / N_2 Mixer

Coil Assembly

H_2 Inlet



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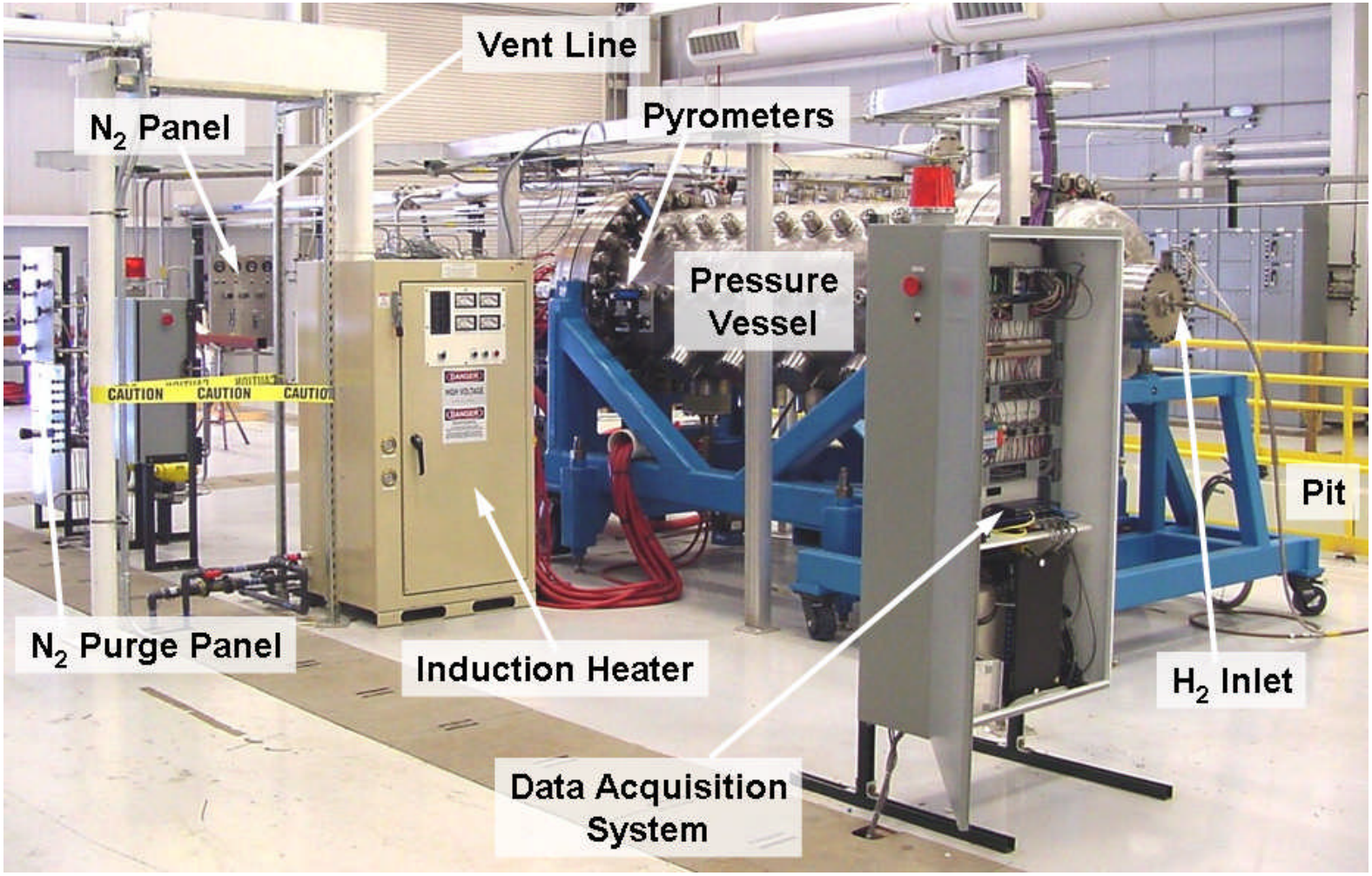

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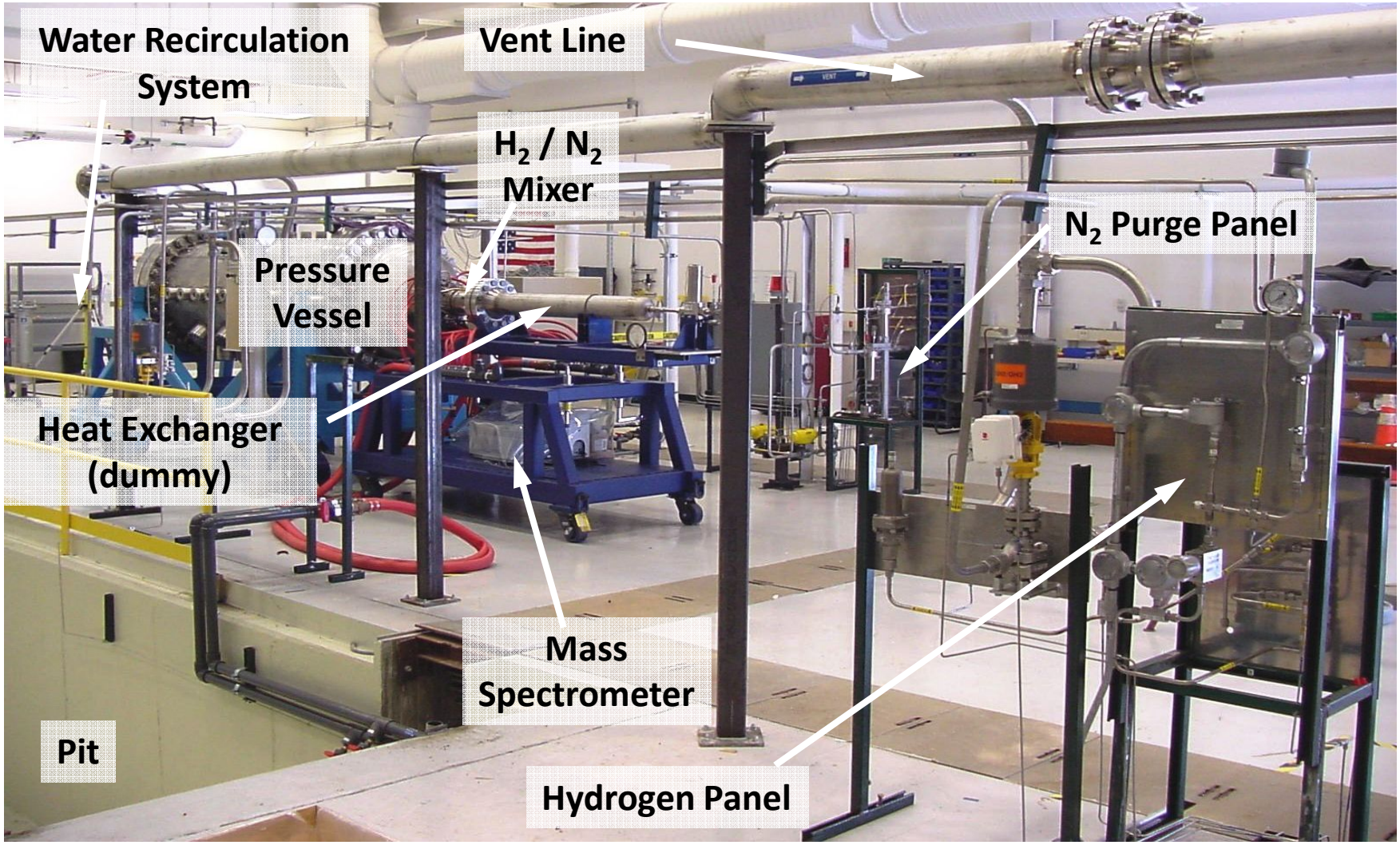

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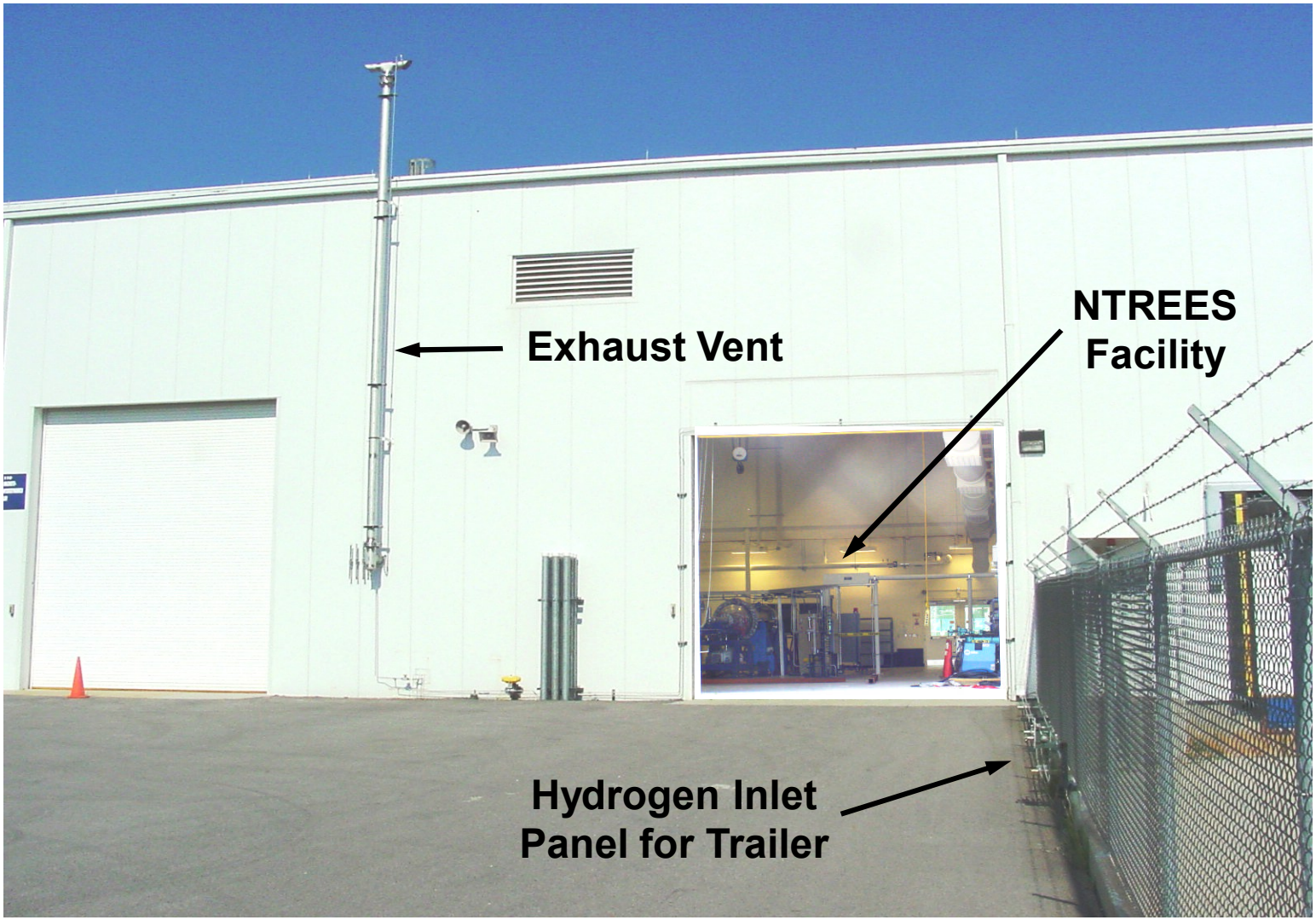

Summary

- NTREES provides testing capability to simulate NTR environment (w/o radiation) & is operationally ready to begin testing.

- Enables cost effective & rapid testing for NTP
  - candidate fuel screening (hot hydrogen corrosion)
  - quantitative thermal hydraulic testing

- Experiment configuration
  - Water cooled ASME vessel
  - RF heated test piece which can contain surrogate or DU material
  - GH_2 up to 1000 psi and 0.001 lb/sec
  - Instrumented for temperature, pressure, flow rates and mass spec. analysis of exhaust