The Transient Reactor Test Loop (TRTL) Facility

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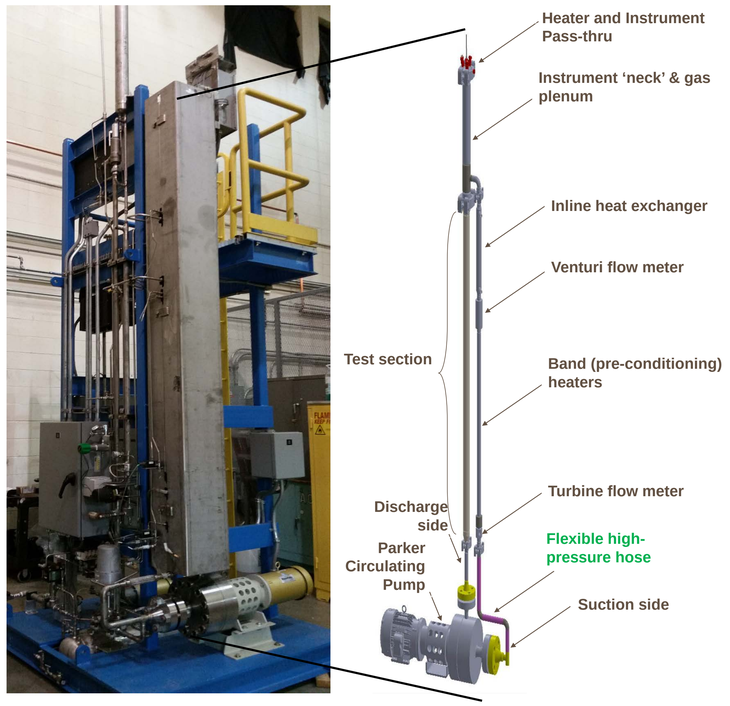
The Transient Reactor Test Loop (TRTL) facility at Oregon State University (OSU) was designed to perform operational and benchmarking experiments that investigate the properties of materials during transient power conditions, under NEUP IRP-15-8761: ***Computational and Experimental Benchmarking for Transient Fuel Testing.***

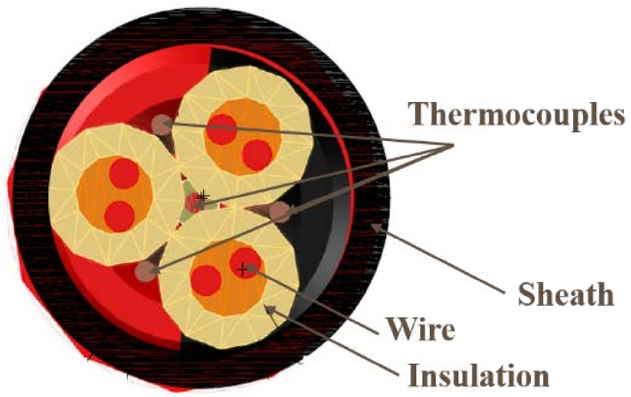
The primary objective of this facility is the collection of and benchmarking against new, NQA-1 compliant experimental thermal hydraulic data of a representative TREAT Facility water flow loop. The outcome of the initial test matrix will yield a documented water flow loop design and demonstration that is representative of a prototypic configuration for the TREAT Facility to provide operational information and benchmarking data; and a fully benchmarked thermal hydraulic model of the water flow loop that may be utilized for future TREAT Facility water flow loop safety analyses.

The TRTL facility is a first-of-its-kind experimental apparatus that operates within the same parameter space as the TREAT facility with regards to system pressure, mass flow, temperature, and power capabilities, resulting in the performance of like-for-like experiments without the radiation effects.

Our experiments are designed with an interest in observing DNB during a simulated transient. In this case, our simulated transient consists of first establishing thermal hydraulic equilibrium of the loop, using a series of band heaters around the exterior of the loop and the process heat from the primary pump for the loop.



TRTL Facility



Heater Rod (Top View)

A custom-built heater rod (300 mm in length, 9.525 mm OD) is designed to deliver ~ 500 kW of power to the system on an order-of-milliseconds timeframe. Flexible design of the controls system package allows for variable pulse length and maximum power inputs, providing for a wide range of tests to be performed.

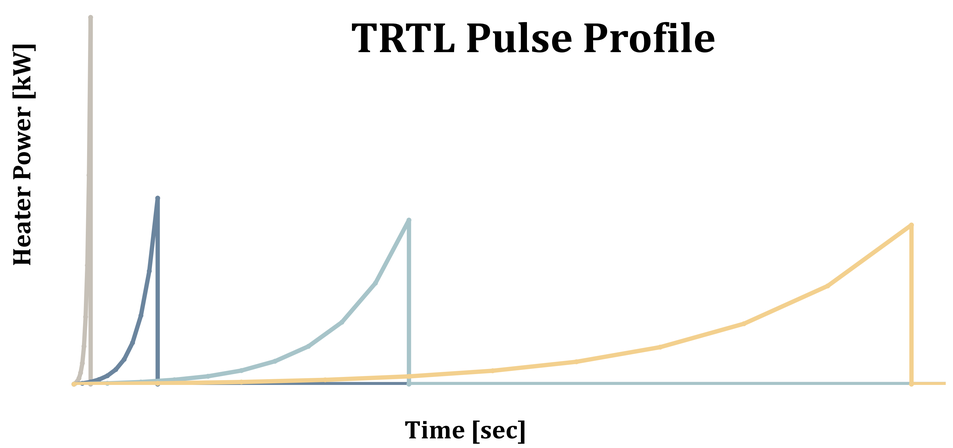
A series of thermocouples are inserted from a portal at the top of the heater rod, and traverse internally down the length of the heater through the void space between the sheath and the wires. The heater rod and associated measuring devices are secured inside of a stainless steel test section (1.3 m in length, 50 mm OD), which is connected to the flowing water source. Additional thermocouples are inserted outside of the heater rod assembly to provide a temperature profile within the test section during operations.

The objective is to increase power in the rod until critical heat flux occurs through observation of DNB, which is determined by the near-asymptotic change in temperature along the surface of the cladding during the transition to film boiling along with the measurement of minute pressure changes within the annular flow channel by a set of strategically placed high-precision differential pressure transducers that are along the cylindrical test section. This dual-sensor approach has been successfully implemented in previous nuclear fuel rod simulation experiments.

The TRTL facility is secured under the Program Quality Plan established at OSU, and is designated as a NQA-1 Compliant Facility.

TRTL Operational Conditions	
System Pressure [psig]	**3000**
Steady Fluid Temp [F]	**atm – 625**
Flow Rate [gpm]	**~1 – 45**
Power Transient, FWHM [msec]	**~10 – ∞**

TRTL Pulse Profile



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