College of Engineering
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Accident Tolerant Fuel Cladding

Background

- In 2011 the three of the six nuclear reactors in Fukushima, Japan exploded after an earthquake caused a disruption to the cooling supply to the heating rods
- This prompted research on different cladding materials, more resistant to critical heat flux (CHF)

Elward, B. (2020). *Critical Heat Flux and Heat Transfer Performance of Accident Tolerant Fuel Claddings in Atmosphere Flow Boiling* (thesis).

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Motivation

- It is desirable to run nuclear reactors at high heat fluxes, as this increases the power production
- Current nuclear reactors have a large safety factor to avoid CHF, due to its unpredictability.
- Improved data on the occurrence of CHF in fuel rods would allow for an increase in the heat flux of current reactors, which would improve power output without changing the plants facilities

Elward, B. (2020). *Critical Heat Flux and Heat Transfer Performance of Accident Tolerant Fuel Claddings in Atmosphere Flow Boiling* (thesis).

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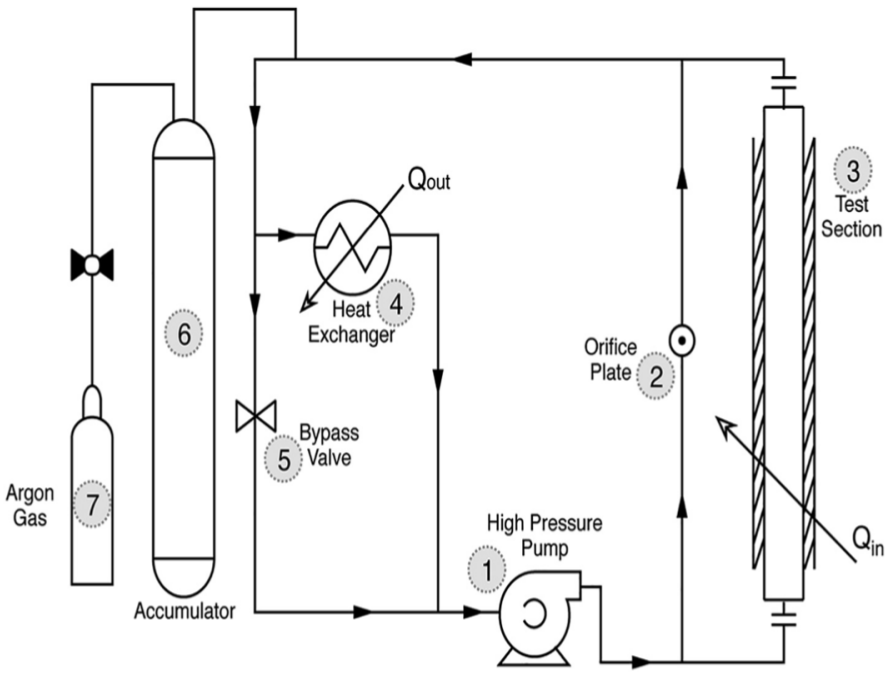
Objectives

- Conduct experiments using the high-pressure loop, to demonstrate that ATF cladding can withstand critical heat flux (CHF) longer than regular zircaloy cladding avoiding oxidation
- Conduct experiments using optical fibers to determine whether transient spikes in heat flux would affect the CHF achieved based on gradual heat flux increments



High pressure loop at UW-Madison Stoughton facility [1]

(a) (b)

Zircaloy rod post-CHF (a) vs Cr-coated Zr rod post-CHF [2]

1. Lyons, K., Lee, D., & Anderson, M. (2020). Experimental study for critical heat flux ini 2x2 rod bundles at high pressure conditions. *Elsevier*.
2. Elward, B. (2020). *Critical Heat Flux and Heat Transfer Performance of Accident Tolerant Fuel Claddings in Atmosphere Flow Boiling* (thesis).