



Ryder Belgarde

PhD Student
Mechanical Engineering

Office: ERB 809
Email: rbelgarde@wisc.edu
Hometown: Fargo, North Dakota

Project: Thermal Stresses in Sodium Fast Reactors
due to Thermal Oscillations (Thermal Striping)
Advisor: Mark Anderson
Sponsor: TerraPower



Background

- Sodium Fast Reactors (SFR) take advantage of the high thermal conductivity of molten sodium to increase the efficiency of power production
 - This higher thermal conductivity also means that temperature fluctuations can transmit into the structural components of the nuclear reactor easier
- Thermal striping is characterized by rapid temperature fluctuations, caused by non-isothermal fluids turbulently mixing, within a solid body
- Thermal striping occurs in various locations in a SFR and can cause cyclical thermal fatigue and mechanical failure in reactors
 - Typically found at the core exit or piping junctions where two dissimilar temperature flows mix
- Thermal oscillation frequency range (0.01 Hz – 15 Hz)
 - These oscillations are made up of a multitude of superimposed frequencies leading to random temperature behavior

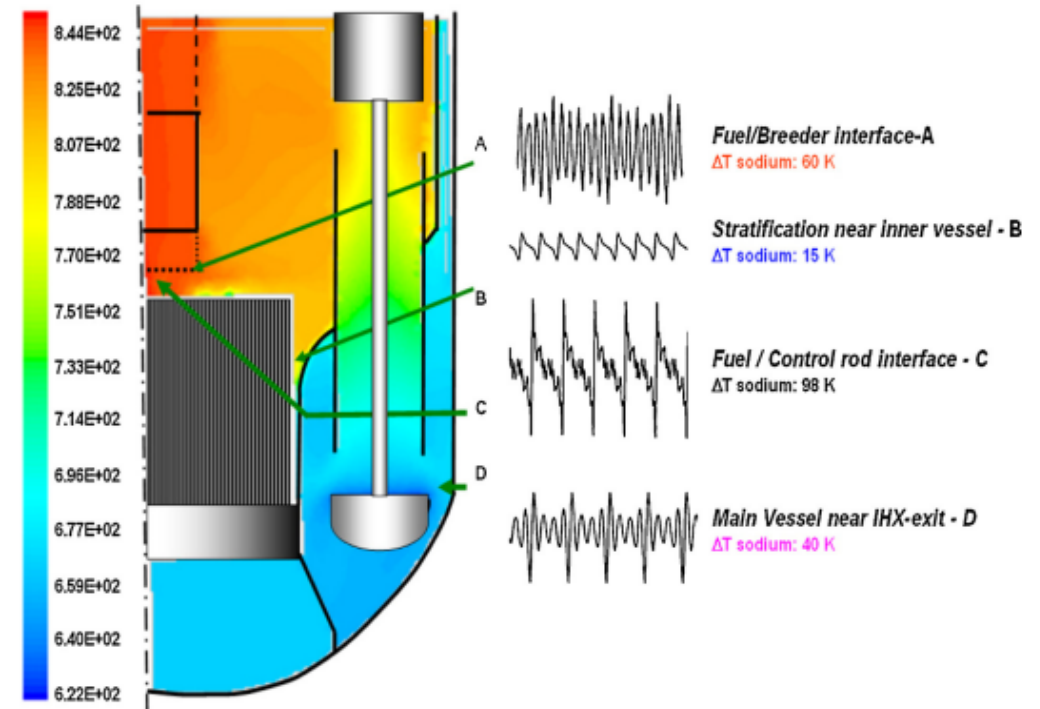


Figure 1: Examples of thermal striping in SFR [1]



Project Goals

Thermal Striping Testing

- Conduct a test that simulates the thermal striping behavior caused above the nuclear core as dissimilar temperature fluid jets impinge on the Upper Internal Structure
- This will be done through building a testing section that has multiple inlet jets of various geometries and having them impinge upon an instrumented plate
 - Investigate thermal penetration depth into the test plate and the amplitude of the fluctuations
 - Look at the heat transfer coefficient associated with a sodium jets
- Validate computational fluid dynamic models of the oscillating temperatures in the fluid and plate
 - Relate that to thermal stresses experienced within the plate

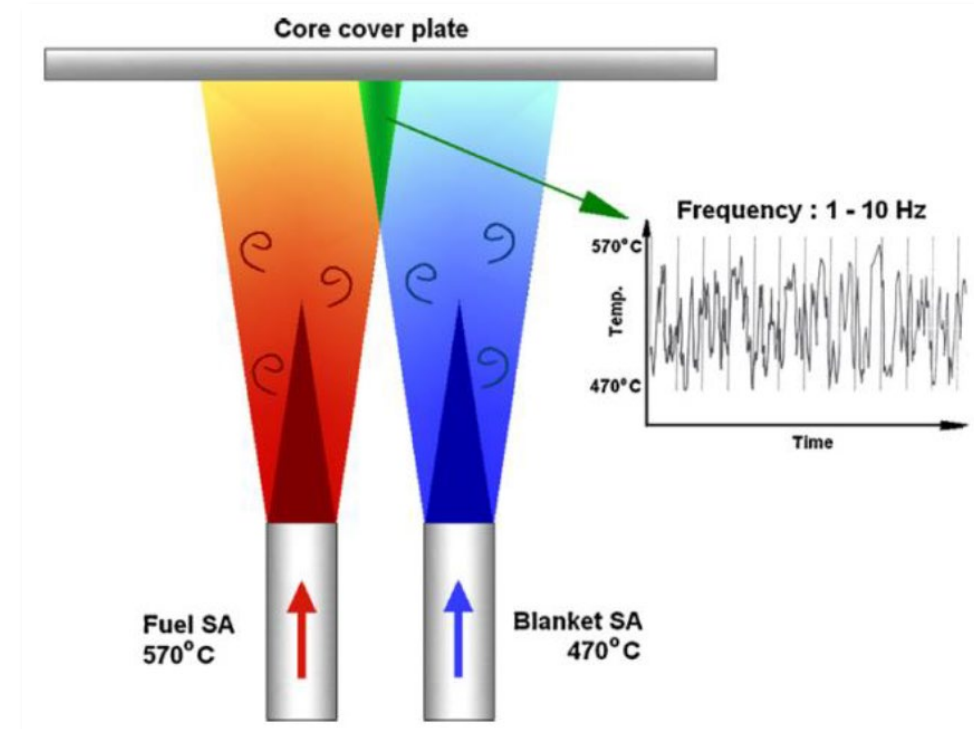


Figure 2: Visual representation of thermal striping due to impinging jets [2]