Evaluation of Fuel Rod Models in TRACE and FRAPCON

Overview
The NRC uses advanced analysis codes to simulate the performance of nuclear systems. The accuracy of these codes is established through extensive validation and testing. FRAPCON is a state-of-the-art, steady-state fuel performance code that calculates changes in fuel parameters over long periods of time. TRACE is a more extensive thermal-hydraulics code that is used to assess the safety of a reactor during transient accident scenarios.

Objectives
This project evaluates updates in TRACE V5.910 by comparison to FRAPCON-3.5, which has been validated with experimental results. Any discrepancies found are analyzed and recommendations for improvement are made based on this analysis.

Approach
- Modified provided FRAPCON inputs and ran using FRAPCON-3.5 to generate burnup-dependent variables for TRACE inputs and benchmark values
- Used burnup dependent variables from FRAPCON to update TRACE inputs. Ran in iterations to test the effects of updating each variable.
- Studied the effects of updating the burnup dependent variables in TRACE by analysing several parameters in the output including: Fuel Centerline Temperature, Fuel Average Temperature, Gap Width, Gap Conductance, and Cladding Inner Temperature.
- Performed a radial node sensitivity analysis to study the impact of altering the number of fuel radial nodes in TRACE on the parameters above.

Outcomes
This project benefitted the NRC in numerous ways:
- Three clear recommendations were produced which will be used to improve TRACE and inspire work for a future design team
- More than 70 pages of graphs and figures were produced that document the current status of TRACE in relation to FRAPCON
- Several bugs were identified in both TRACE and FRAPCON that led to immediate improvements in these codes.
- The TRACE and FRAPCON user manuals were tested and practically evaluated throughout the semester, leading to improvements in both of these guides