Evaluation of Fuel Rod Models in the TRACE and FRAPCON Design Codes

Overview
Accurate analysis of hypothetical reactor accidents depends on performance of fuel rod models for several physical processes including steady state heat transfer from the rod. The fuel performance code FRAPCON has been developed by the NRC to provide state-of-the-art simulation of these processes. Many of the models in FRAPCON have recently been incorporated into the TRACE code, which is used by the NRC to simulate LOCAs and other accident scenarios.

Objectives
Evaluate performance of the fuel rod models in TRACE by making code to code comparisons to FRAPCON, for several fuel designs currently in operation. The design team is to determine the agreement between the codes as a function of burnup for fuel centreline temperature, fuel average temperature, gap conductance, and rod internal pressure for steady-state conditions. The design team is to make recommendations on model & correlation improvements for the TRACE code.

Approach
- Determine initial conditions in FRAPCON
- Run FRAPCON case from 1-60 GWD/MTU
- Extract burnup-dependent variables from FRAPCON run
- Enter burnup-dependent variables in TRACE and run
- Determine comparisons between TRACE and FRAPCON

Outcomes
The future models of TRACE should include the following modifications:

- Define oxide layer thickness as an axial array
- A robust model to consider the insulating effects of the oxide layer
- Consider cladding roughness in calculation of the gap width
- Define cladding creepdown and fuel swelling as an axial array
- Define burnup as an axial array