Multiphysics Simulation Story: Researching a New Fuel for the HFIR: Advancements at ORNL Require Multiphysics Simulation to Support Safety and Reliability

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The High Flux Isotope Reactor (HFIR) at ORNL uses highly-enriched uranium (HEU)
  - Because of the Global Threat Reduction Initiative
  - Research reactors that use HEU must be converted to low-enriched uranium (LEU)

Engineers need to preserve reactor performance while ensuring safety following conversion to the new fuel
  - Minimize reductions in efficiency that may occur because of conversion
The Solution

- Redesign HFIR core by using simulation to understand
  - How the LEU fuel will affect reactor performance
  - What changes are needed to compensate
- Determine maximum flow rate that safely can occur in the reactor
  - Deflections in the fuel plates interfere with safety and reactor performance
  - Analyze fluid-structure interaction (FSI) in the reactor fuel plates
Use COMSOL Multiphysics to develop an FSI simulation
- Analyze different fuel plate shapes
- Validate model against results from another reactor, the Advanced Neutron Source Reactor (ANSR)

Fully-coupled FSI analysis gives an accurate understanding of flow in the model
- Understand flow rates in the reactor and predict the deformation of different fuel plate configurations

Simulation results will be used to test new reactor designs and facilitate conversion to LEU fuel