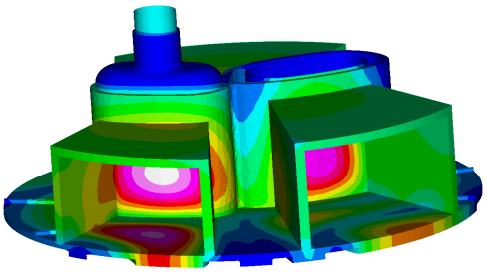
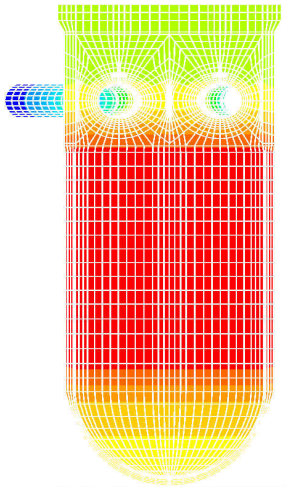
Scientific Computing Within the ORNL Modeling and Simulation Group: Numerical Heat Conduction

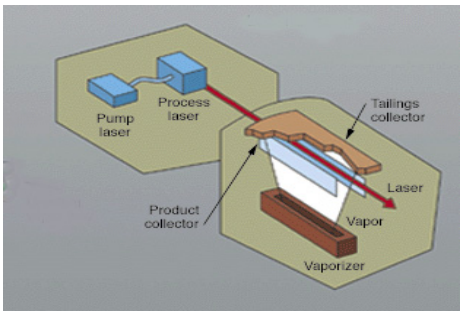
The ORNL Modeling and Simulation Group (MSG) develops sophisticated numerical solutions for a wide range of scientific, engineering, and operational applications. MSG's core competency is computational physics and engineering, and within this context we have extensive expertise in the numerical heat conduction (NHC) focus area. MSG's NHC problem solving scope encompasses an extremely diverse set of solution software, computing platforms, and applications. Categories of worked problems include NHC coupled with metallurgical, structural, thermodynamics, electromagnetic and enclosure-radiation physics; forward, inverse, and optimal solutions; geometries containing multiple materials with dissimilar length scales, properties, and interface characteristics; as well as internal heat generation from nuclear and non-nuclear sources. Solution software used by MSG to support these analyses include the in-house developed general-purpose finite-volume code ***HEATING;*** the ***P-THERMAL***, ***PVIEWFACTOR***, and ***ABAQUS*** commercial codes; as well as the public-domain codes ***TOPAZ*** and ***FACET***. Applications include research and power reactor components, nuclear fuel storage and transport, sensible-heat thermal energy storage, building materials of construction, manufacturing processes including casting and immersion quench, environmental modeling such as constructed wetlands, and atomic vapor uranium enrichment. These applied scientific computing capabilities represent an extremely versatile NHC resource for a broad range of R&D, industrial, homeland defense, and military applications. We welcome the opportunity to discuss your potential applications and ways MSG can contribute to a solution.



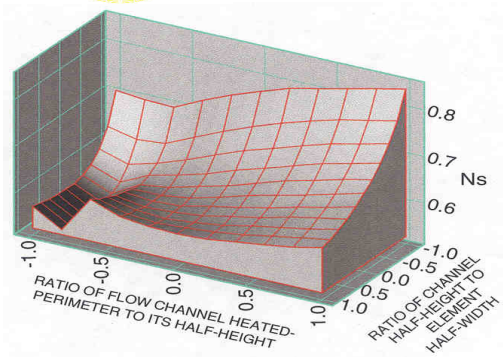
MSG quantified 3D heat conduction mechanisms to develop target-assembly designs for DOE's Spallation Neutron Source



MSG quantified Induction-heating effects to develop annealing process for production-scale nuclear reactor containment vessels



Design of uranium-vapor handling system required MSG to conduct enclosure-radiation heat-conduction analysis of complicated geometries, boundary conditions, & radiative-dependent material properties



MSG optimized storage media geometry & operation to design sensible-heat thermal energy storage system with minimum thermodynamic irreversibility's

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