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A Comparison Between an Implicitly Balanced Solution and a Linearized and Operator Split Solution of the Thermal Hydraulic Equations.

T-3
Fluid Dynamics
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In this presentation we study time integration and solver requirements for a simplified model of the cooling system of a nuclear power reactor. The model includes a one-dimensional, two-phase flow model (six equations) coupled to a two-dimensional nonlinear heat conduction model (one equation). This physical model includes fast time scales that account for the mass, momentum, and energy exchange between the two phases (water and steam), and for the momentum and energy exchange between both phases and the wall. The two-dimensional nonlinear heat conduction in the wall accounts for the slow time scale in the problem which is related to the rate that the wall accepts or rejects energy from the water and steam.

Results will be presented that will show that the traditional linearized and operator split solution method can be employed as an effective and efficient preconditioner to an implicitly balanced solution method (Jacobian-Free Newton-Krylov). Results will also compare the accuracy of these two approaches when the rates of the fast time scales and the slow time scales are varied.

The traditional linearized and split solution methods employ time step control algorithms based on the stability of the algorithm. Since the implicitly balanced approach is unconditionally stable, a new time step control algorithm will be presented for this approach that is designed to address the accuracy of the solution.