ADVANCED POWER PLANT MODELING WITH APPLICATIONS TO THE ADVANCED BOILING WATER REACTOR AND THE HEAT EXCHANGER

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ABSTRACT

The components of a modern Advanced Boiling Water Reactor (ABWR) nuclear power plant are modeled in this thesis. The modeling involves the use of wave equations in the plant component flow path. The simulation procedure employed here provides exact solutions for the differential equations permitting larger time interval simulations for all components, including synchronous machines. A multivariable control structure featuring dynamic switching with a constant gain matrix is developed here, i.e., recirculation flow is varied above 70% load demand, while control rods are varied below 70% load demand.

For thermal performance of fluid systems a coordinate system that moves with the fluid (Lagrangian) is used. This coupled with the use of the exact solutions to the differential equations results in "Continuity Wave Equations". The design of all the component models relies on this approach.

A simplified model of the components of an ABWR plant is presented and simulations have been performed. Results are shown for steady state and transient conditions displaying the robustness of the design.