Development of a System to Test Internal Pressurizer Dynamics

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The International Reactor Innovative and Secure (IRIS) is a next generation pressurized water reactor (PWR) that utilizes an integral coolant loop, a coolant loop that is inside the reactor vessel. The loop pressurizer is in the upper head of the vessel and has larger liquid surface area and volume than traditional PWR pressurizers. Because of this, the internal pressurizer will respond differently to changes in coolant volume and level. A facility is being built at Oak Ridge National Laboratory to test internal pressurizer dynamics. This project focused on preparing the facility for operation and involved the completion of three main tasks: designing the facility's detailed layout and instrument placements, developing and writing the operating procedures, and creating a Supervisory Control and Data Acquisition (SCADA) system. To aid in designing facility layout, a 3d model of the facility was created. This model was used to determine instrument placements and pipe dimensions. Facility constraints and test requirements posed many problems that had to be addressed in the operating procedures. To develop these procedures, facility geometry and conditions, including temperature, pressure, coolant density, and liquid level were analyzed at start-up, operation, and test states. Methods were then developed to safely and consistently bring the facility to pre-test conditions, run tests, and shutdown the facility, These procedures were automated as part of the SCADA system design. The SCADA system monitors the facility, records data, and automates all start-up and test procedures. It was created using Intellution FIX, an industrial automation software, and consists of over 100 database blocks and four display panels. These panels display instrument readings and allow the user to enter set points and commands. A simple numerical model of the facility was also created for use with the Transient Reactor Analysis Code (TRAC). TRAC is a computer program designed to model and estimate transient behavior of nuclear reactors. The model developed will be used to approximate start-up and test procedures and predict facility response. As a direct result of this project, the internal pressurizer dynamics test facility is nearing completion. Tests will begin as soon as all equipment is assembled.