NSAO – Nuclear Systems Analysis Operations

INFORMATION SYSTEMS LABORATORIES

Overview of TH Capability and Project Experience at ISL/NSAO

ABOUT ISL (www.islinc.com):

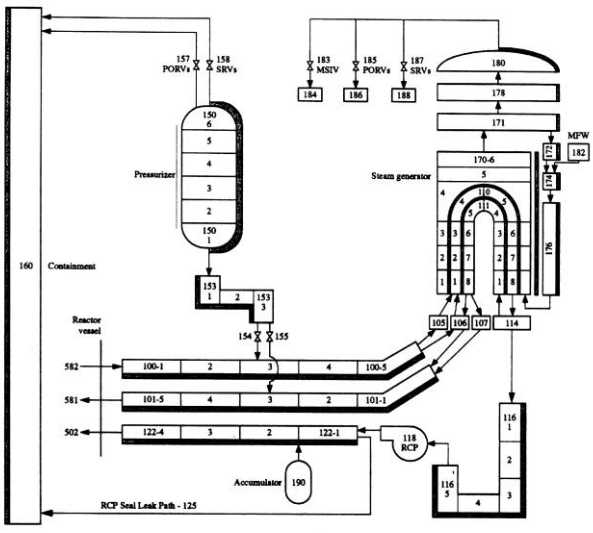
Information Systems Laboratories, Inc. (ISL) is a science and engineering innovator in the fields of advanced sensor, communications, adaptive signal processing, nuclear systems analysis and space/missile system technology supplying critical, timely, high-quality solutions and products to meet the needs of commercial and government customers.

ABOUT NSAD:

The Nuclear Systems Analysis Operations (NSAO), acquired by ISL early in CY 2000, has provided many years of support to the United States Nuclear Regulatory Commission (NRC) and other domestic and international clients in detailed physical simulation of the behavior of complex nuclear systems, as well as in risk analysis and other types of support to regulatory decision-making.

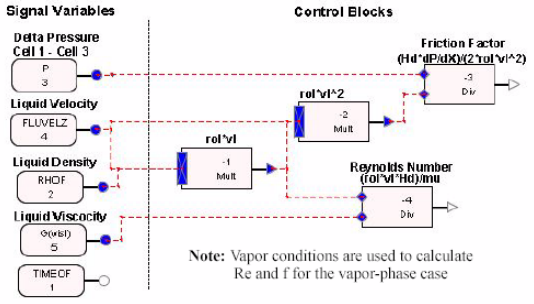
Thermal-Hydraulics (TH) at ISL/NSAO

Information Systems Laboratories, Inc. (ISL) is a leader in applying computer simulation techniques to solve complex engineering problems, particularly in the area of fluid/thermal systems. ISL's Nuclear Systems Analysis Operations (NSAO) is expert in the use of lumped parameter system codes (including neutronic and control system models) and in the use of Computational Fluid Dynamics (CFD) codes, including OPENFoam. The codes used by ISL permit modeling of very general fluid systems, including nuclear feedback and control systems interactions. System code models are widely used to simulate the response of complex fluid systems, including those found in nuclear power plants and test facilities, to transient and accident events. ISL is actively developing and applying plant models for both advanced and conventional reactor designs.



Plant loop nodalization with provisions for hot leg countercurrent natural circulation

Typical problems addressed by NSAO include: thermal design analysis, nuclear plant accident simulation, fluid system simulation to support design, nuclear plant performance analysis, analysis of operational transients, experimental program reviews, training simulator benchmarking, spent nuclear fuel cooling analysis, cardiovascular system simulation, severe accident analysis, containment analysis, hydrodynamic force calculations (water hammer), control system studies, and safety analysis.



Signal Variables and Control Blocks used to Calculate Reynolds Number and Wall Friction Factors for Single-Phase Fluid Calculations.

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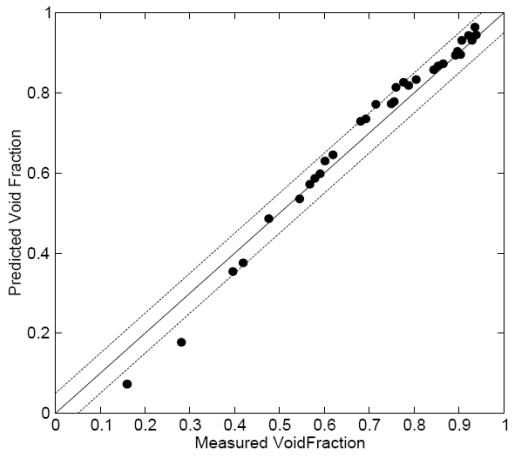
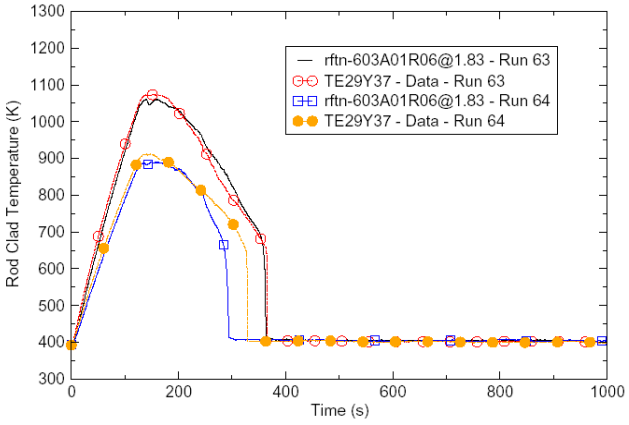
Thermal-Hydraulics (TH) Projects at ISL/NSAO

Systems Analysis: ISL currently supports the maintenance and development of computer software and analysis systems for the US Nuclear Regulatory Commission (USNRC) and Department of Energy (DOE)-Naval Reactors, including RELAP5, RADTRAD and TRACE. These are the codes currently used for best-estimate analyses of nuclear reactor accidents and transients, and to simulate thermal, hydraulic and neutronic responses of complex nuclear power systems. ISL uses these codes to assist the USNRC in resolving licensing and safety related issues. Analyses have been performed to simulate overcooling transients, which cause pressurized thermal shock, and to provide a basis for modification of 10 CFR 50.46 requirements for emergency core cooling system (ECCS) evaluations. In addition to analyzing contemporary nuclear reactors, ISL is or has recently been performing safety analysis for advanced reactors, such as GE's ESBWR, Westinghouse's AP-1000, AREVA's EPR, MHI's US-APWR, ABWR and AECL's ACR-700.

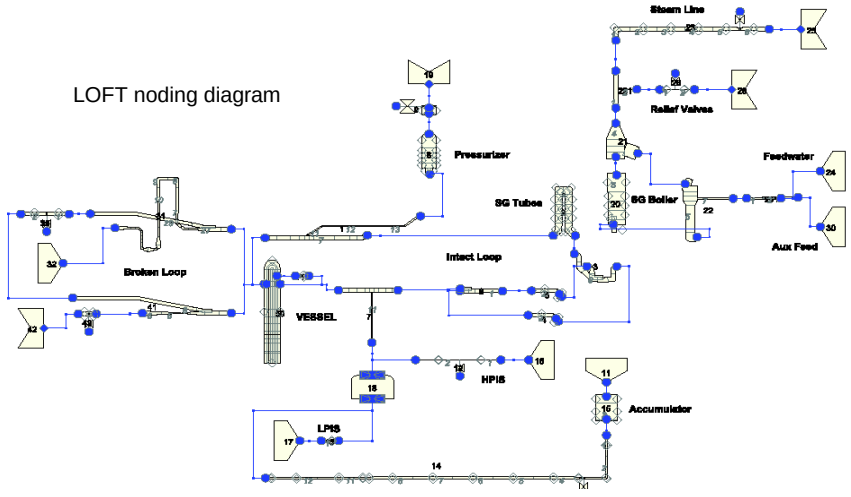


Figures of Merit (FOMs) provide an overall snapshot of code performance features of interest.



CCTF high power rod temperature comparison between two runs and measured data

Systems Simulation: ISL activities address the phenomenological aspects of thermal hydraulics such as: boiling and condensation; fluid flow and heat transfer, including details of convective heat transfer; nucleate boiling, transition boiling/quench front advance, and dispersed flow film boiling; detailed coupling of the flow regimes and associated heat transfer mechanisms; multi-surface models for radiation heat transfer; multi-dimensional drift-flux and two-fluid models of two-phase flow for bubbly, slug annular, and droplet/mist flow; condensation in the presence of non-condensable gases.



LOFT noding diagram

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