Nuclear Systems Modelling with MATLAB Simulink & Simscape, a MSRE Benchmark

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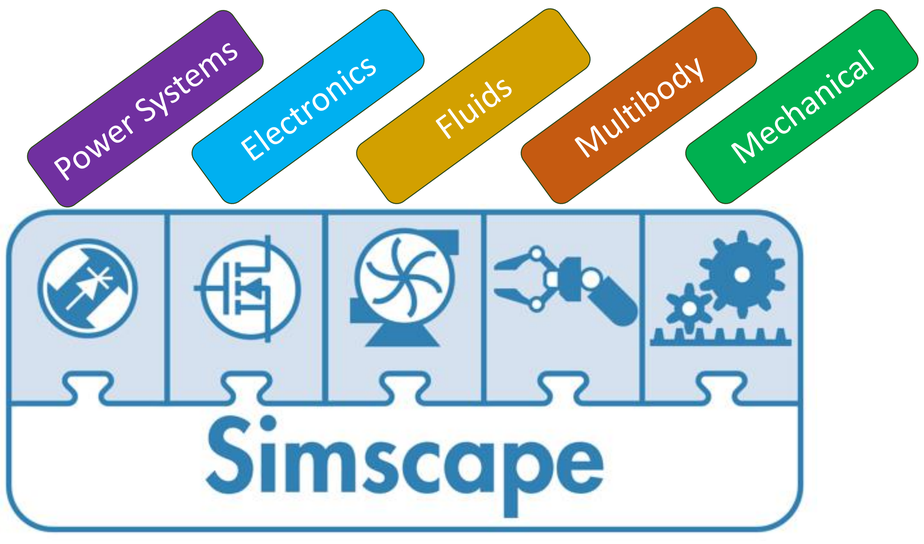
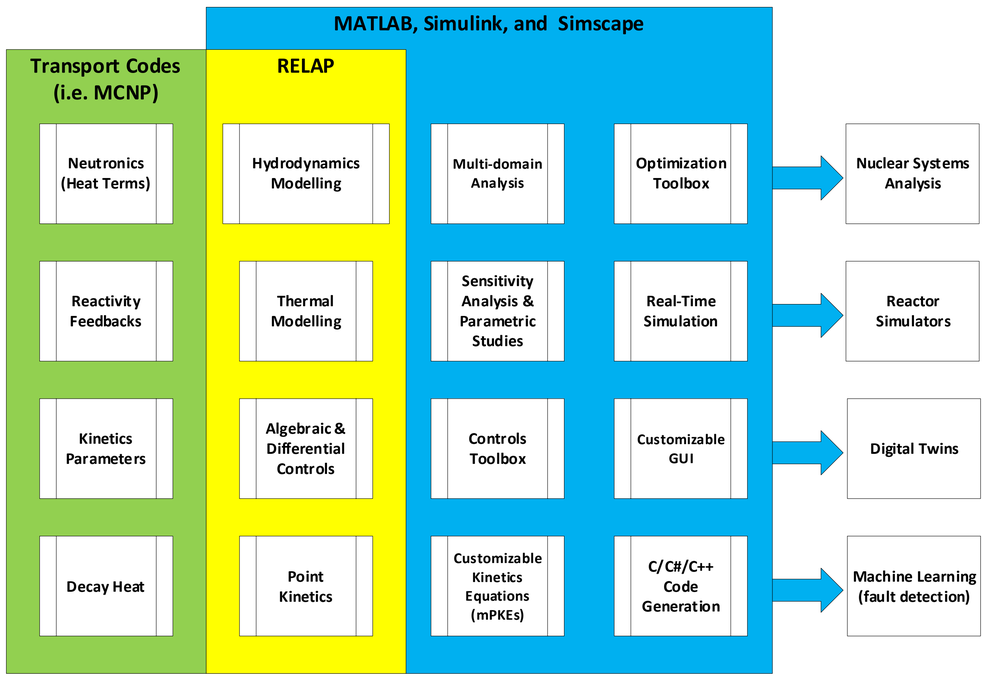
Introduction:

Systems-scale analyses for nuclear power stations are a consistent requirement for licensing and are insightful for engineering safer and more economic designs. Traditionally this work has been performed with codes such as RELAP, TRACE, or by purely-mathematical representations of the underlying physics and systems.

MATLAB's Simulink and Simscape toolboxes provide an effective alternative to rapidly prototype these systems, perform parametric design studies, and enable deeper controls systems analysis.

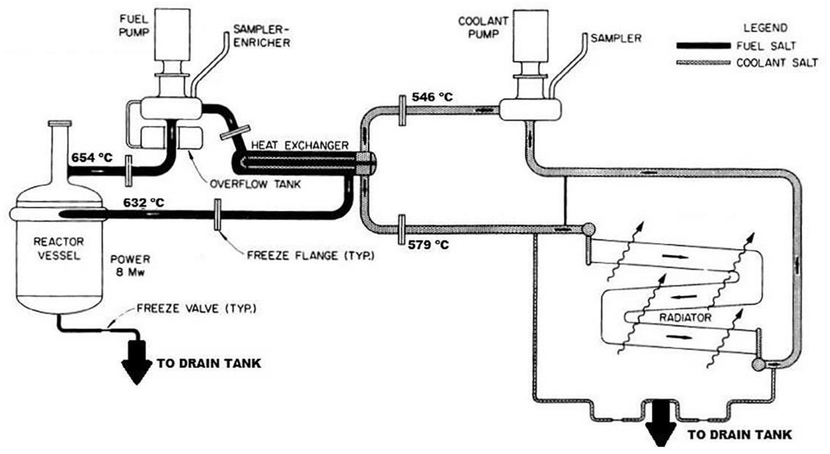




Functionality

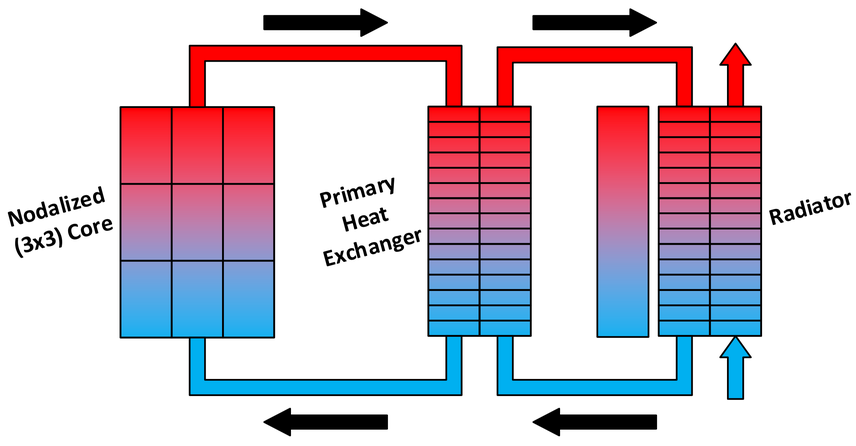
- University license across all TAMU campuses
- Block-scripting UI for novice users
- Pre-generated asset libraries for fluids, thermal, mechanical, and two-phase domains (and more)
- Native MATLAB environment for custom component scripting, programmatic model interactions, and code generation

MSRE 8MWt Benchmark

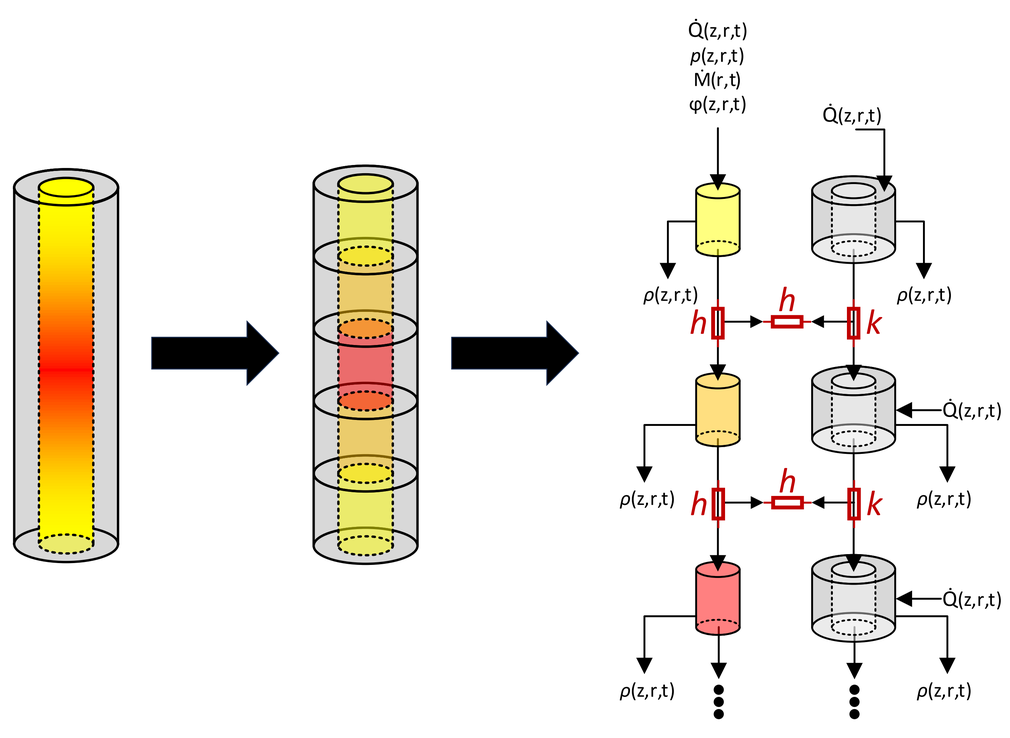


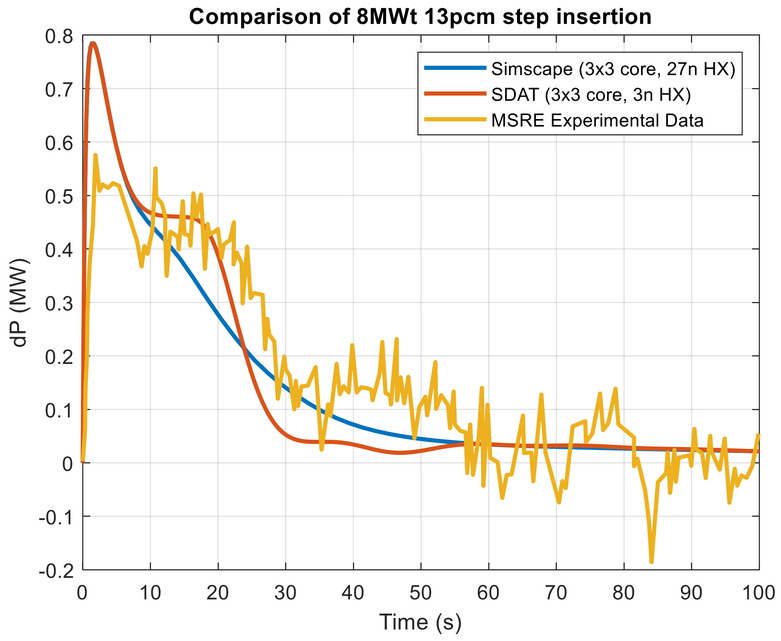
System-scale overview of the MSRE. Source: Kerlin,T.W., Ball,S.J., Steffy,R.C., Buckner,M.R., 1971a .Experiences with dynamic testing methods at the molten salt reactor experiment. Nucl. Tech.10,103117.

Nodalization of the MSRE System



Nodalization of MSRE Channels with Coupling





Sample output from a 13pcm step insertion into the 8MW MSRE

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