



Information Systems Laboratories, Inc.

Plant Model Application

Example PWR

Information Systems Laboratories, Inc.

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Topics of Discussion

- Steady-State Modeling Techniques
- Transient Modeling Considerations

Plant Model Application

Several of the exercises will use a TRACE input model of a pressurized water reactor (PWR). All of the major components in a PWR are included in the model.



PWR Plant Model Description

The model consists of the following:

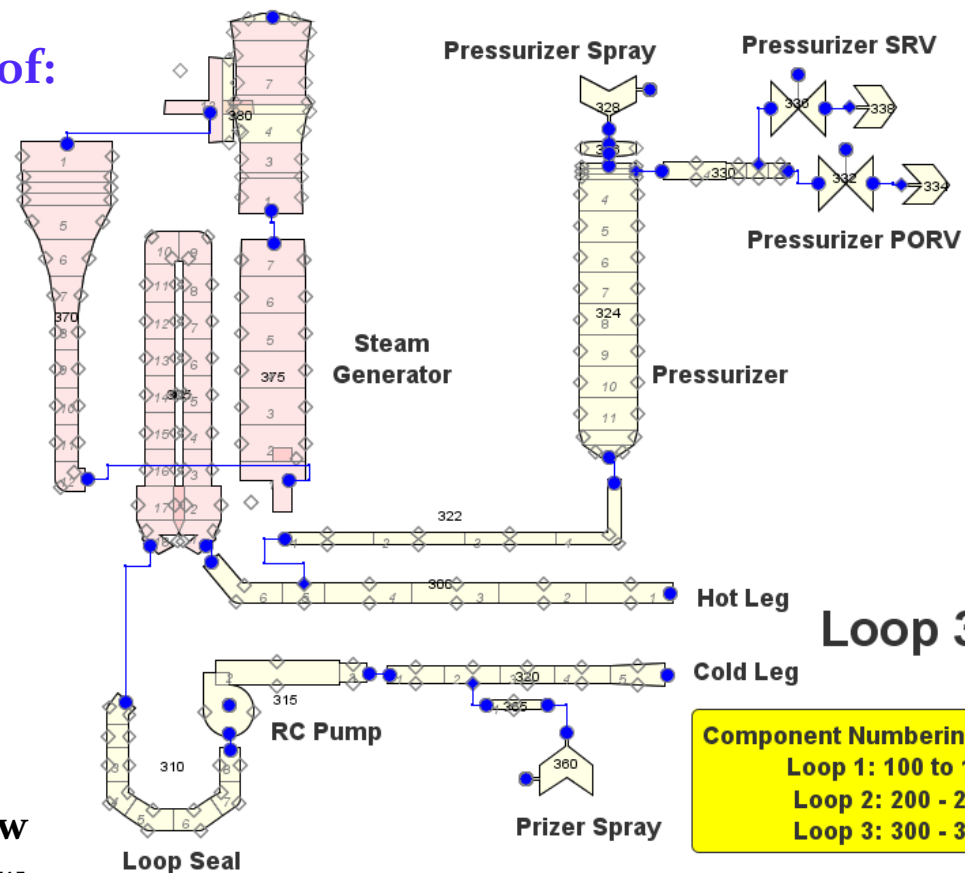
- Three Primary Loops
- A Vessel Component
- Emergency Core Cooling System
- Balance of Plant Components
- Control System

PWR Plant Model Description

Each Primary Loop consists of:

- Hot Leg
- U-Tube Steam Generator
 - Inlet/Outlet Plenum
 - U-Tubes
 - Downcomer
 - Boiler Region
 - Steam Separator
 - Steam Dome
- Loop Seal
- Reactor Coolant Pump
- Cold Leg

Loop 3 contains the pressurizer and pressurizer spray system
 Loop 2 contains the makeup flow
 Loop 1 contains the letdown flow



Component Numbering Scheme

- Loop 1: 100 to 199
- Loop 2: 200 - 299
- Loop 3: 300 - 399

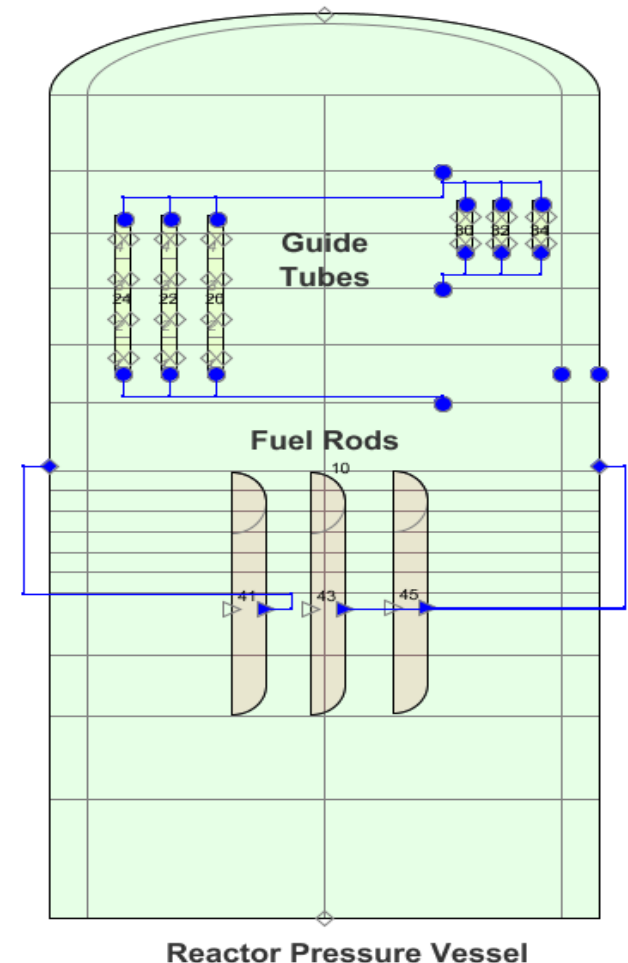
PWR Plant Model Description

The Vessel Component Contains:

- 16 axial levels, 2 radial rings, 3 azimuthal sectors
- Ring 2 models the downcomer
- Axial levels 1 - 2 model the lower plenum
- Axial levels 3 - 10 model the core
- Axial Levels 11 - 14 model the upper plenum
- Axial Levels 15 - 16 model the upper head

3 HTSTRs model the Fuel Rods

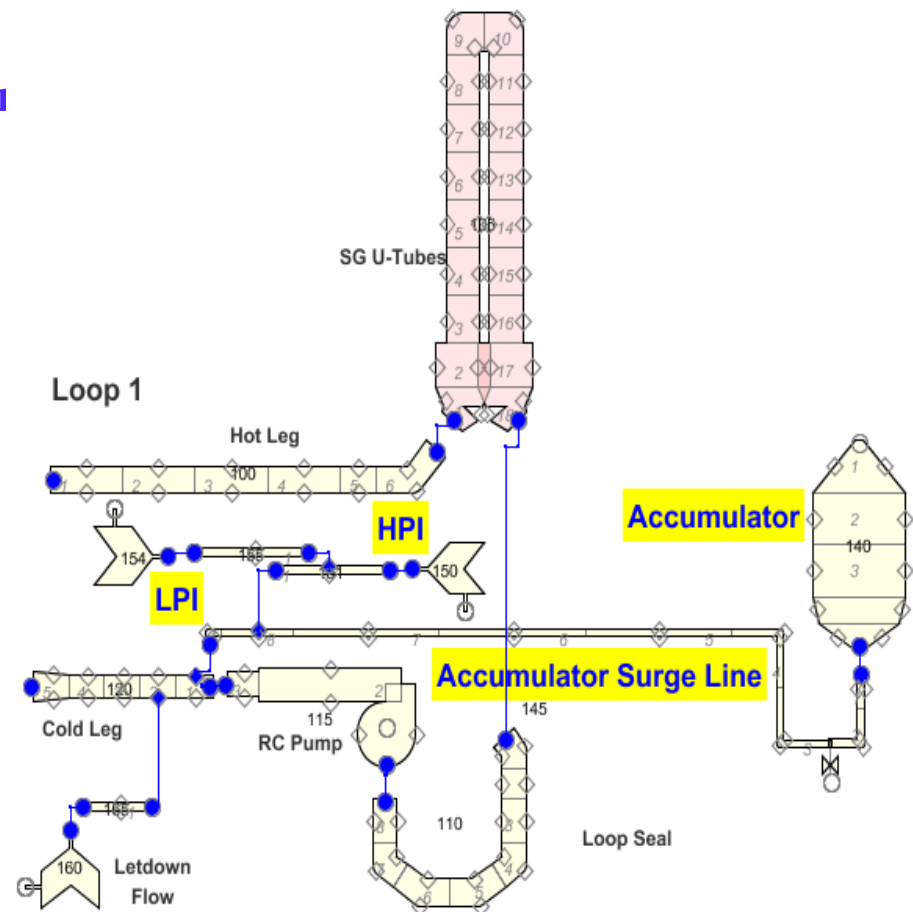
6 PIPEs model the guide tubes



PWR Plant Model Description

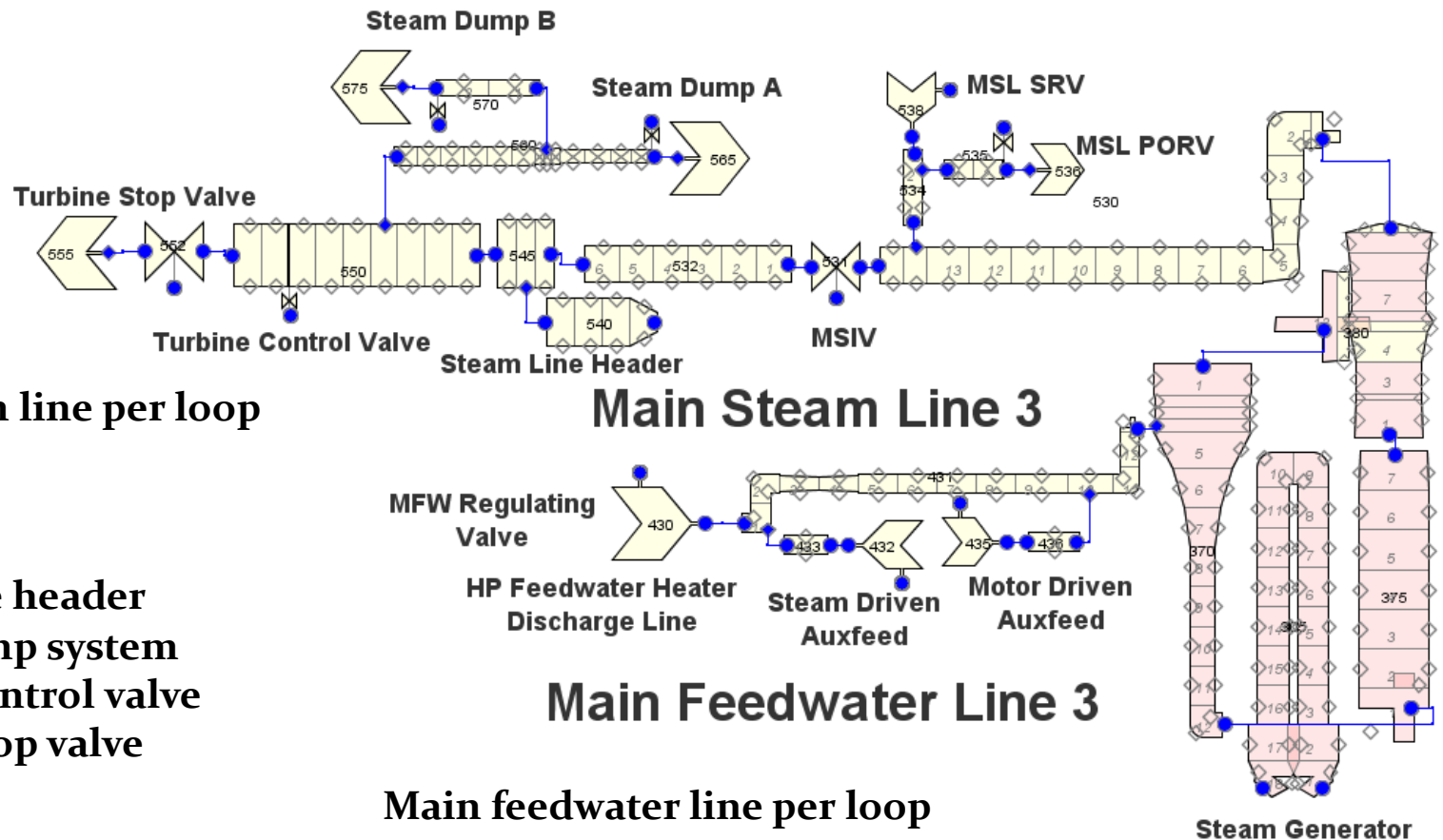
The Emergency Core Cooling System Each Loop Contains:

- Accumulator
- Accumulator surge line
- High pressure injection system
- Low pressure injection system



PWR Plant Model Description

Balance of Plant Components Include:



Main steam line per loop

- MSIV
- PORV
- SRV
- Steam line header
- Steam dump system
- Turbine control valve
- Turbine stop valve

Main feedwater line per loop

- MFW regulating valve
- Steam driven auxfeed
- Motor driven auxfeed



PWR Plant Model Description

Control System Consists of the Following Component Controllers and Trip Logic:

- **Loop Tave Control Logic** – modulates turbine control valve to adjust SG secondary pressure as needed to achieve desired Tave.
- **Primary System Pressure Control Logic** – pressurizer spray, makeup and letdown
- **Pressurizer PORV/SRV Control Logic**
- **Reactor Trip Logic**
- **Reactor Coolant Pump Trip Logic**
- **ECCS Trip Logic**
- **Main Feedwater Flow Control Logic**
- **Main Feedwater Regulating Valve Trip Logic**
- **Steam/Motor Driven Aux Feedwater Trip Logic**
- **Turbine Stop Valve Trip Logic**
- **Main Steam Isolation Valve Trip Logic**
- **Main Steam Line PORV/SRV Control Logic**
- **Steam Dump Valve Control Logic**

Fuel Rod Model Exercise 2

This exercise shows the effect of the improved fuel rod models during a LBLOCA

Course of the transient:

- Starting from “normal” conditions
- LBLOCA initiated in loop 1 cold leg
- ECCS and other reactor system trips occur as planned

Things to Consider:

- What are the parameters of interest?
- What should the modeling approach be?
- What general trends should we expect in the results?
- How will the updated models affect those trends?