Reflood Model Activation Exercise

Previous exercises for the PWR model included achieving steady-state target conditions, debugging model input errors and break modeling and validation. The PWR model has been set up to perform a cold leg small break loss-of-coolant-accident. It is expected that during this transient, core uncovery will occur and the fuel rods will heat up. Emergency core cooling systems are expected to activate, injecting coolant into the primary system. Core reflood is expected to occur, stop the fuel rod heatup process and subsequently quench the fuel rods

Objectives

- Activate the reflood capability in the VESSEL component.
- Activate the fine-mesh reflood capability in the fuel rod heat structures.

Overview of Steps

1. Preliminary Setup (Open the PWR Model).
2. Prepare the VESSEL Component for Reflood Capability.
   A) Activate the VESSEL Reflood Option
   B) Define Reflood HTSTR Components Connected to the VESSEL
3. Activate the Fine-mesh Reflood Option in the Fuel Rod Heat Structures.
   A) Activate the Fine-mesh Reflood Model
   B) Set the Maximum Reflood Axial Nodes
   C) Set the Minimum Reflood Node Length
   D) Set the Permanent Number of Fine-mesh Node Rows

Step 1. Preliminary Setup (Open the PWR Model).

1. Close all Model Editor files that are open.

2. Go to the Day4/Morning/PWR5_Steady-State folder and double-click on the file "**PWR-SS-5A.med**". This will open the PWR model that will be used for this exercise.

The "Exercise Key" included in the workbook may be useful to help locate the various parts of the SNAP Model Editor that are referred to in this exercise.

Step 2. Prepare the VESSEL Component for Reflood Capability.

When the reflood capability is activated in the VESSEL component it associates the fine-mesh reflood HTSTR components with the vessel. The model changes implemented in this step will flag to TRACE that a reflood calculation may be needed during a transient calculation.

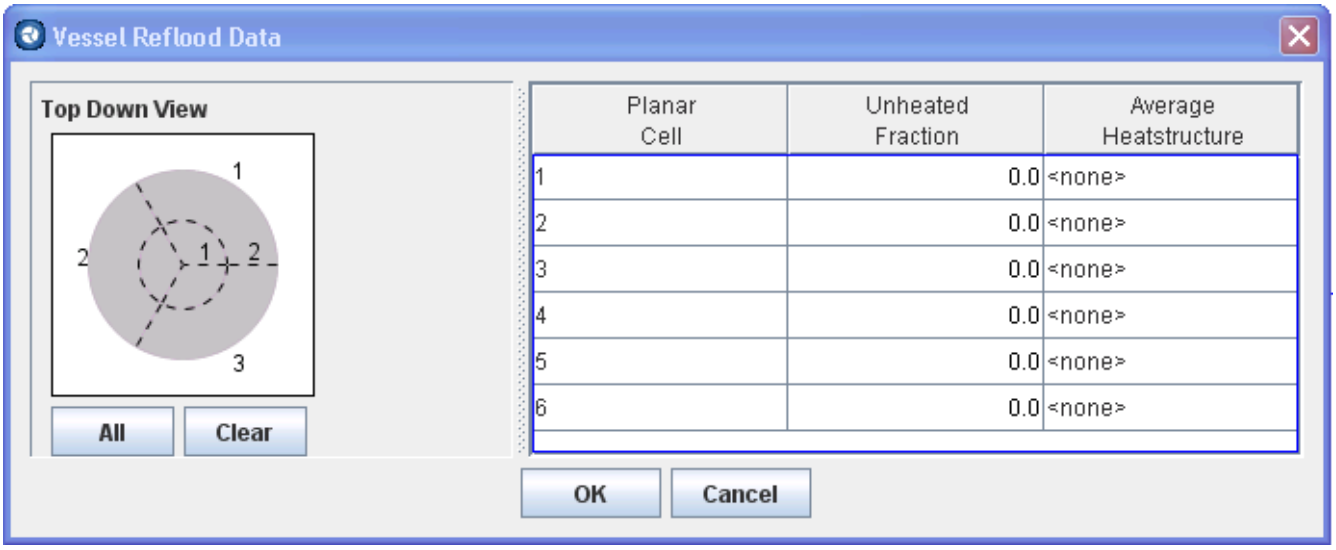
Step 2.A) Activate the VESSEL Reflood Option

1. In the View Window of the Model Editor, click on the VESSEL component.

2. In the Properties Window, locate the "Use Reflood" box, check mark the box and and click on "True" button.

Step 2.B) Define Reflood HTSTR Components Connected to the VESSEL

1. In the Properties Window, locate the "Core Reflood Heating" Box. Expand  the box. The following window will appear.



2. Note that there are 6 planar cells to which reflood HTSTRs can be attached. Since there are 2 radial rings (one for the core region and one for the downcomer) and 3 theta sectors in the VESSEL model, there are 6 planar cells.

The planar cells are numbered from the inside ring to the outside ring in a counter-clockwise pattern. Thus planar Cell 1 is Ring 1, Sector 1, planar Cell 2 is Ring 1 Sector 2 and so on around the horizontal plane with the last cell, planar Cell 6, associated with Ring 2, Sector 3. **The placement of the reflood HTSTRs in this array is important. Since Ring 1, Sector 1 is planar Cell 1 then the reflood HTSTR associated with Ring 1 Sector 1 needs to be the "Average Heat Structure" input for planar Cell 1.**

The "Unheated Fraction" input is the fraction of the reflood HTSTR that is not powered. Since the reflood HTSTRs in this model do not have unheated sections, this input is set to 0.0.

The reflood HTSTRs in this model are the HTSTR components that model the fuel rods. These HTSTR components are number 41, 43 and 45. Htstr 41 is connected to Sector 1, HTSTR 43 is connected to Sector 2 and HTSTR 45 is connected to Sector 3.

3. Click in the "Average Heat Structure" box for planar Cell 1 and select the corresponding heat structure component (HTSTR 41).
4. Click in the "Average Heat Structure" box for planar Cell 2 and select the corresponding heat structure component (HTSTR 43).
5. Click in the "Average Heat Structure" box for planar Cell 3 and select the corresponding heat structure component (HTSTR 45).
6. Click the OK button.

Step 3. Activate the Fine-mesh Reflood Option in the Fuel Rod Heat Structures.

This step will activate the fine-mesh reflood capability in the fuel rod HTSTRs. In a reflood situation, TRACE will divide the HTSTR axial cell lengths into a user specified number of permanent fine mesh cells. TRACE will further divide the mesh cells into finer cells. The minimum fine-mesh node length is a user input parameter. The maximum number of fine mesh cells that can occur at a given time is also a user input value. These values are set for the three fuel rod heat structures in the following steps

Step 3.A) Activate the Fine-mesh Reflood Model

1. In the View Window click on the "Heat Structures" tab at the bottom of the window. Locate the Fuel Rod heat structures (HTSTRs 41, 43 and 45).
2. Click on fuel rod HTSTR component 41.
3. In the Properties Window, locate the "Fine Mesh Reflood" box and click the "True" button. This activates the fine-mesh reflood capability (FMON).

Step 3.B) Set the Maximum Reflood Axial Nodes

1. Locate the "Maximum Axial Nodes" box in the Properties Window. Change the number to 100 (NZMAX).

The recommended maximum number of fine-mesh node rows is between 100 and 250.

Step 3.C) Set the Minimum Reflood Node Length

1. Locate the "Minimum Node Distance" box in the Properties Window. Change the number to 1.0e-3 m (DZNHT).

The recommended value for the minimum temporary node size TRACE is allowed to use during the reflood calculation is 1.0e-3 m,

Step 3.D) Set the Permanent Number of Fine-mesh Node Rows

1. Locate the "Axial Nodes/Surface BCs" box in the Properties Window. Expand  the input box.
2. In the upper section of the popup window, highlight all of the cells in the Axial Cell column.
3. In the lower section of the of the window modify the "Fine-Mesh Count" number to 5. This sets the number of permanent fine-mesh node rows the coarse HTSTR cells are divided into.
4. Click the OK button at the bottom of the window.

This completes the activation of the fine-mesh reflood model for HTSTR 41.

Repeat Steps 3A through 3D for HTSTR component 43 and 45.

Save the Model as PWR-SS-5partB.med