Constrained Steady-State Exercise

Objectives

- Practice configuring constrained Steady-State for a model

Preliminary Setup (Open Model)

Open the 'Day4\Morning\PWR2_Achieving_Steady-State\' folder and double click on 'PWR2-SS1.med' if your model is not current.

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.

Run a Brief Steady-State Calculation to Check Loop Flow

Run a 200 second steady-state calculation to examine how the loop flow is currently behaving for the model.

1. Locate and click on the "Job Stream" tab at the bottom of the View Window. A job stream has already been set up for this exercise. To submit the job, lock the View Window by clicking on the padlock icon located at the left-hand side in the Toolbar then click on the "Execute" button in the View Window. The Job Status window will appear and the job should be running.
2. Go to the folder 'Day4\Morning\PWR2_Achieving_Steady-State\' and double click on the file 'PWR2-Anim.med' (not PWR2-SS2-Anim.med). This will open the animation file for the exercise.
3. In the Animation Model Editor Navigator Window, click on  from to expand the data sources list.

4. Click on Master, and in the Properties Window expand Source Run URL | calcserv://lo... . In the 'Select Data Source' dialog, expand the 'local' box, select 'PWR2-SS', and from the list pick 'PWR-SS:trcxtv' (this is the graphics files that will drive the animation). Click OK.
5. From the icons in the Main Tool Bar at the top of the screen select to connect to the TRACE simulation chosen in the previous step to the animation screen. If the animation successfully connects, the icon should change to .
6. Select the play icon to start the animation.
7. Click on the Steady State Plots tab below the View Window.
8. Examine the 'Loop Flows' Plot. Is the Loop 3 loop steady-state loop flow approaching the specified target value?

We note that the mass flow rates for Loop 1 and 2 are right on the target value. However, the Loop 3 mass flow rate is much higher. The mass flow rate for Loops 1 and 2 are being controlled with the constrained steady-state (CSS) input option, while the Loop 3 mass flow is not constrained to a specific value.

ADD LOOP 3 CSS CONTROLLER FOR LOOP FLOW

The CSS controller for loop flow is connected to the loop pump and controls the pump speed to get the desired setpoint flow rate.

1. In the Navigator Window of **PWR2-SS1.med**, click on Model Options and in the Properties Window, verify that the following options are set as shown below:

Transient Calculation	[0] Steady State
Steady State Mode	[2] CSS Calculation

Constrained Steady-State options can only be configures in SNAP if constrained steady-state is enabled in model options. Otherwise the CSS options are grayed out.

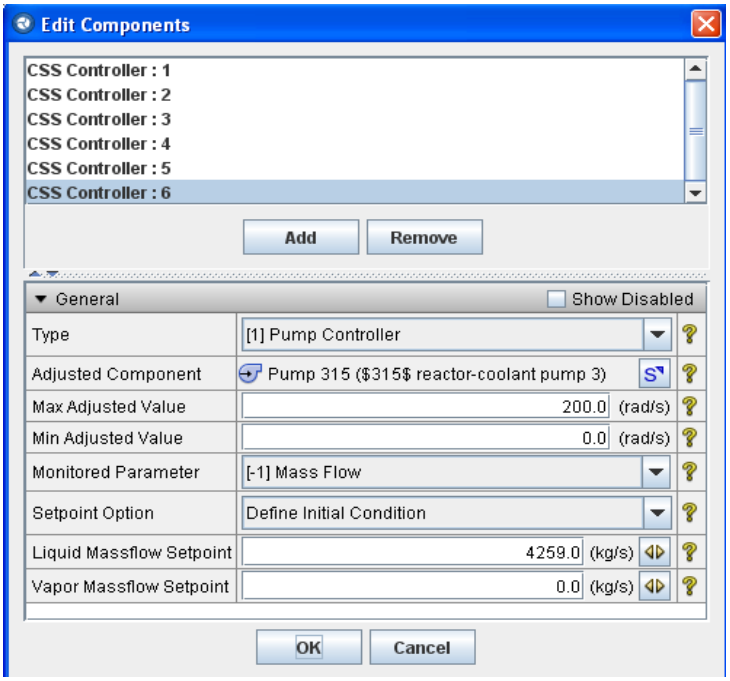
2. Add a new constrained steady-state controller by doing the following:

a) Click on "Model Options" in the Navigator Window, then in the Properties Window, locate and expand the Constrained Steady State | [5] Controllers input. There are five CSS Controllers defined here. CSS Controller: 1 and CSS Controller: 2 control the pumps in Loops 1 and 2 to achieve the target loop flows of 4259 kg/s per loop. The other three CSS controllers are used to control the main feedwater mass flow rate for each of the three steam generators.

b) Click on the "Add" button to add a controller for Loop 3. Note the new CSS controller. In the lower section of the dialog box the information will be filled in to control the pump in Loop 3.

3. To configure the new controller to control the pump on Loop 3 do the following:

a) Modify the input for CSS Controller: 6 to match the input shown below. When finished, click on the OK button.



The pump speed is the controlled parameter, and the mass flow is the target value. The CSS controller allows you to set the limits on the controlled parameter (0 to 200 rad/s is adequate), and the target values. In this case, the target includes both liquid and vapor steam flow. The liquid mass flow should be set to 4259 kg/s, and the vapor mass flow should be set to 0.

Run a Brief Steady-State Calculation to Verify Loop Flow

It is often useful to run a quick simulation when the model is changed to verify that the model is behaving as expected.

Run another short steady-state calculation to verify the CSS controller is working as expected. Follow the steps outlined above in the "Run a Brief Steady-State Calculation to Check Loop Flow" section. Since the animation file is already open, to get a play back simply click on the  icon then click on the play  button.