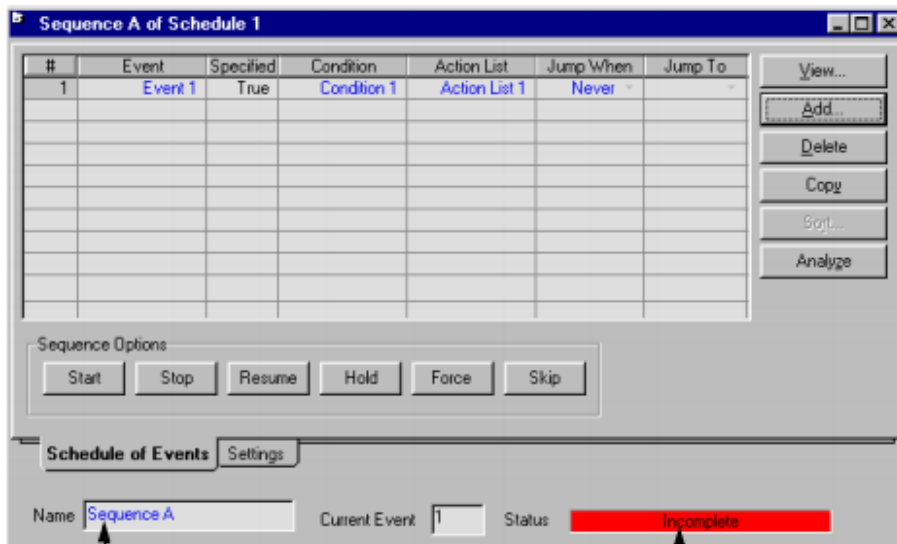Prof. Davide Manca – Politecnico di Milano

Dynamics and Control of Chemical Processes

Solution to Lab #9

Shutdown of C4-C5 separation section

General notes to simulate a shutdown sequence

To shutdown (or startup) a piece of equipment you can use the Event Scheduler view (press **ctrl + E**).

The right panel of the property view now shows the Schedule, Sequence, Event, or specific Action information as you navigate through and click on the tree browser on the left panel.

The Legend group displays the status icons, which are shown as the tree icons in the tree browser, and **indicate the current state of the schedule**, sequence, event, or action:

When you add a new schedule, Aspen HYSYS opens a Schedule, Sequences group. You can manage the sequences in the schedule on the Event Scheduler property view. When you select a particular sequence from the tree browser of the Event Scheduler property view, the Sequence property view appears.

You can change the sequence name.

The status bar indicates the current status of the sequence, which is also shown as the icon on the Event Scheduler tree browser.

When you select a particular event from the tree browser of the **Event Scheduler** property view, the **Event property** view appears.
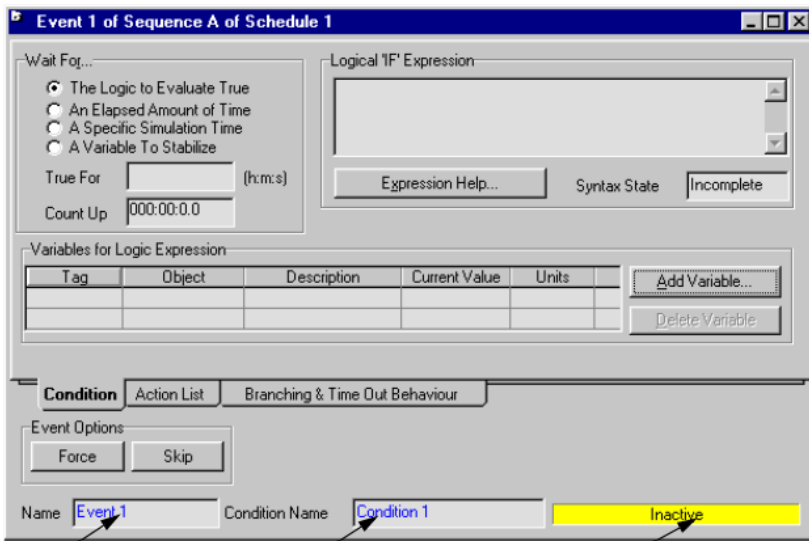
You can change the event name and condition name using these fields.

This status is also shown on the tree browser of the Event Scheduler property view.

A specific simulation time allows you to introduce the exact time you want the actions to be excuted at, in the **Condition** Tab. Then you should define (zero or more) actions which are going to be executed once the condition is met.
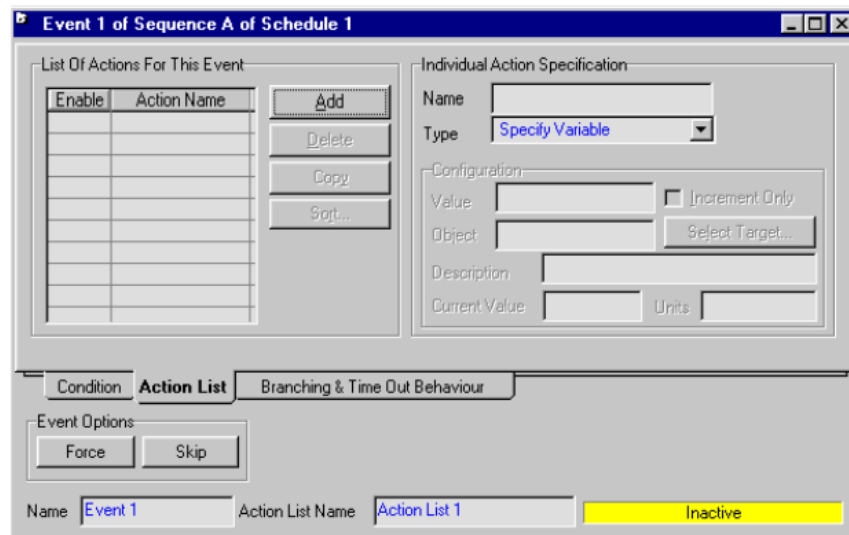
The **Name field** allows you to change the action name while the **Type** drop-down list provides the available action types. After an action type is selected, the **Configuration** group changes to show the information required for the action type. Here three types of possible actions the simulation can have:

The **Specify Variable**[1] action requires an **Object** and a **Value**. Secondly, the **Ramp Controller**[2] action requires a Controller, a Target Set Point, and a Ramp Duration as inputs. Upon execution the controller is switched to Ramp mode, the target set point and duration are specified and the Ramp Controller message is sent.

Finally, the **Set Controller Mode**[3] requires a **Controller** and a **New Mode** as inputs. The controller is selected by clicking the **Select Target** button that browses all the controllers in the case. After selecting a controller the current mode is shown and the **View** button is enabled.
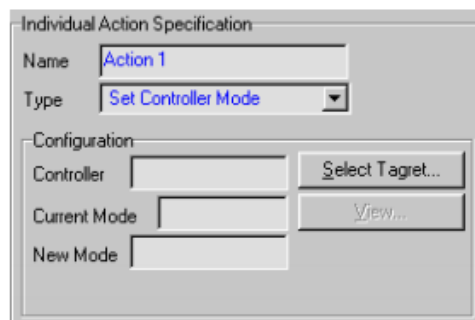

After a Schedule is fully defined, each Sequence is in an Inactive state. Sequences can be run from the Event Scheduler property view (**Crtl + E**). To activate a Sequence, select it from the tree browser and click the **Start** button. Alternatively, you can select the desired Schedule from the tree browser and then select the sequence from the list in the Schedule Sequences group. The status changes from Inactive to Waiting. The integrator (**Ctrl + I**) has to be running for evaluations to occur.

Shutdown of C4-C5 separation section

In our case the schedule sequence to shutdown the column is:

1 – Reducing column rates

2 – Shutting down heating and cooling sources

3 – Stopping feed

4 – Draining liquids

5 – Preparing the column for opening to atmosphere

So we have to **add** at least 5 sequences in the scheduler (**Ctrl + E**).
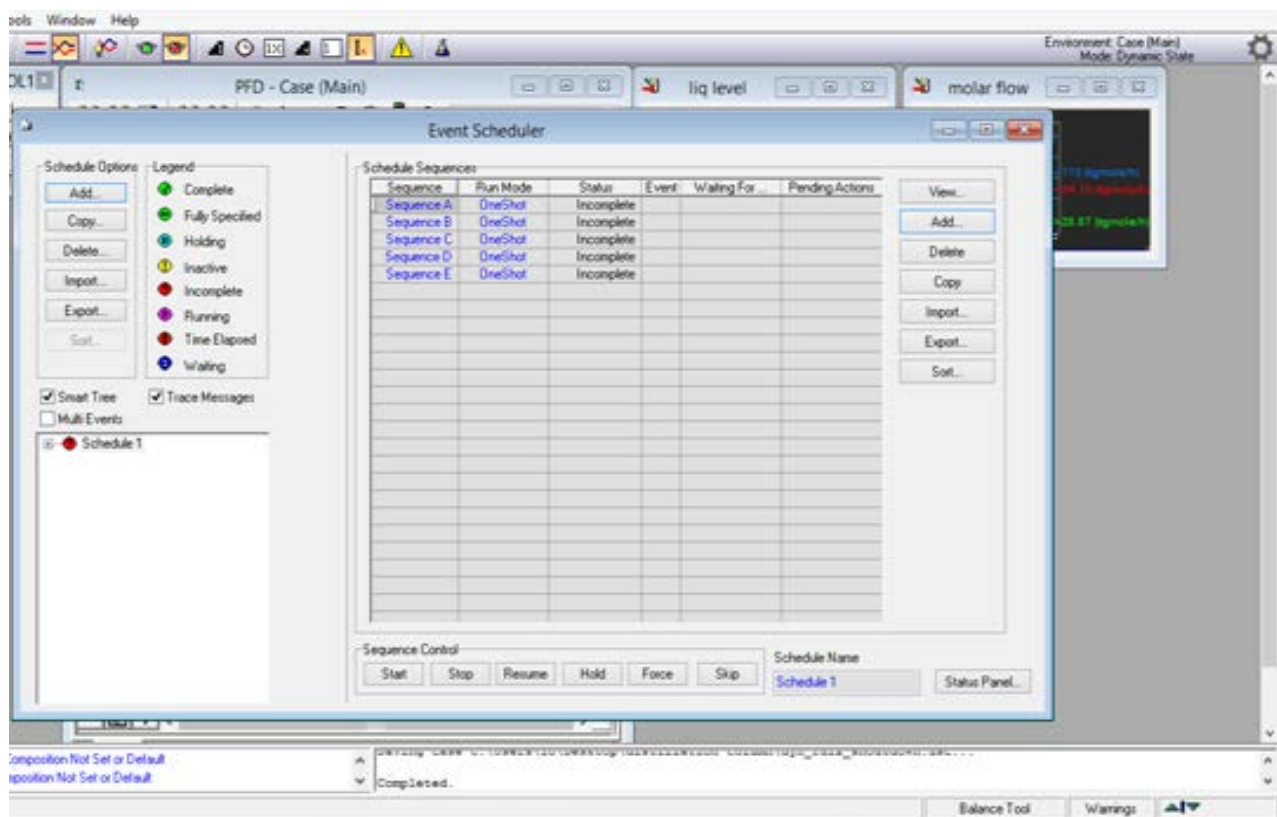

1 – Reducing column rates

Now we can modify the first, rename it as **reducing rate**. Open it by pressing **view,** in sequence window you can **add** in series event**.** Open it and in the condition page you can specify the event starting time (wait for **a specific simulation time).** It is recommended to start the shutdown sequence after 2 hours of simulation time, to check the steady state condition.
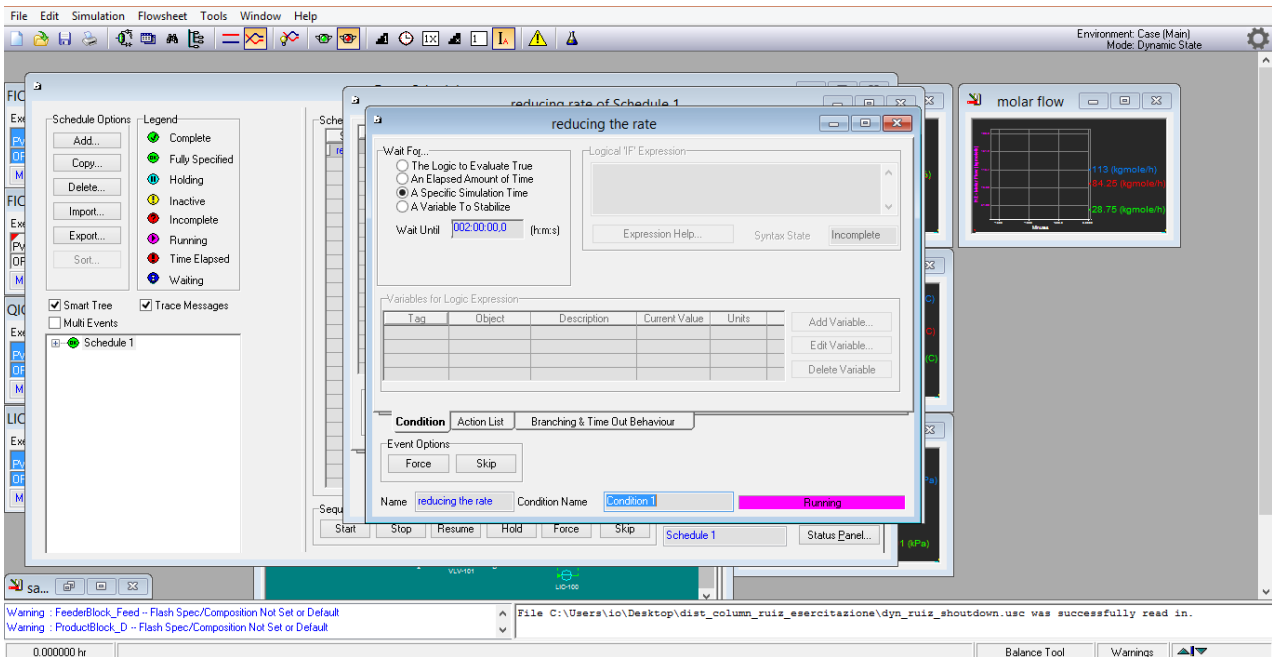
In the **action list** page you can **add** parallel actions. Model the single event in manual mode by using the **Set Controller Mode** type. Select step change in the opening percentage valve value (e.g., every 60 min close 10% the valve). Therefore, if the first specific simulation time was 02 Hs, the next single event should occurs after a specific simulation time of 03 Hs. You should perform the reduction of the OP percentage so that at the very last event it is equal to zero.
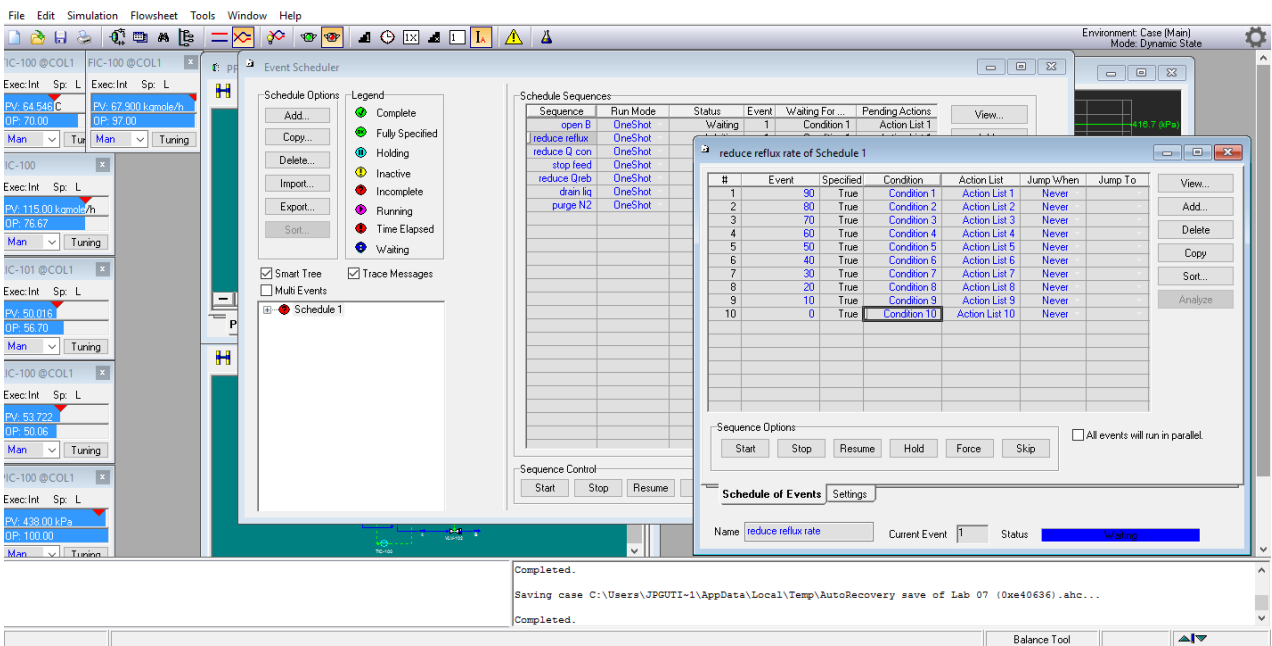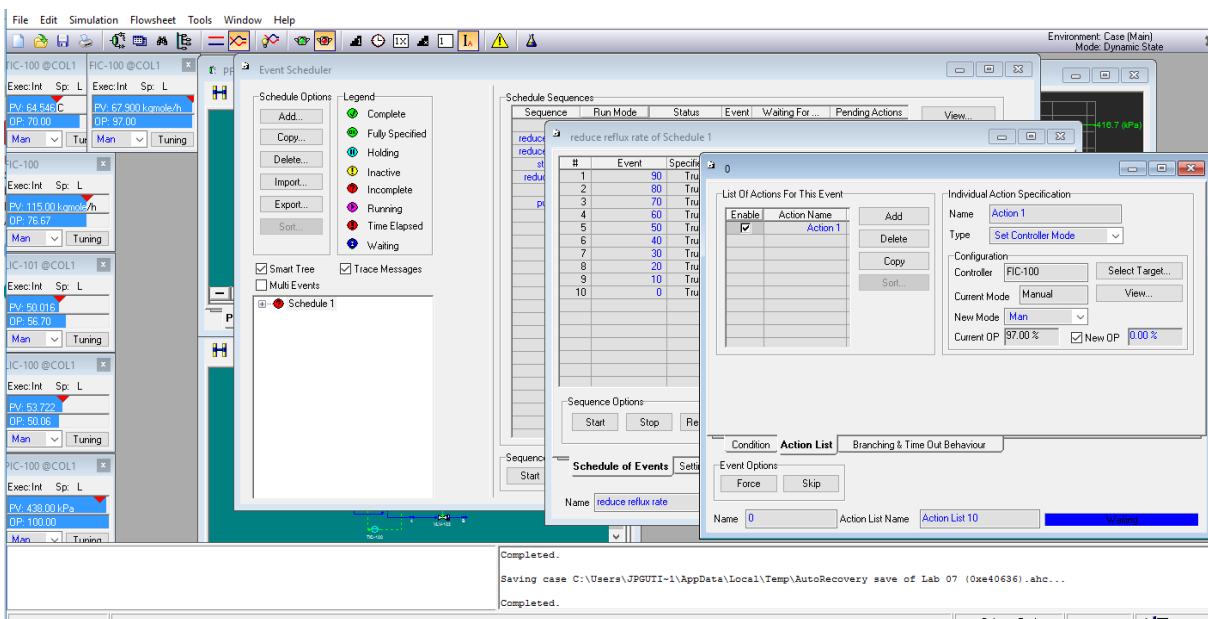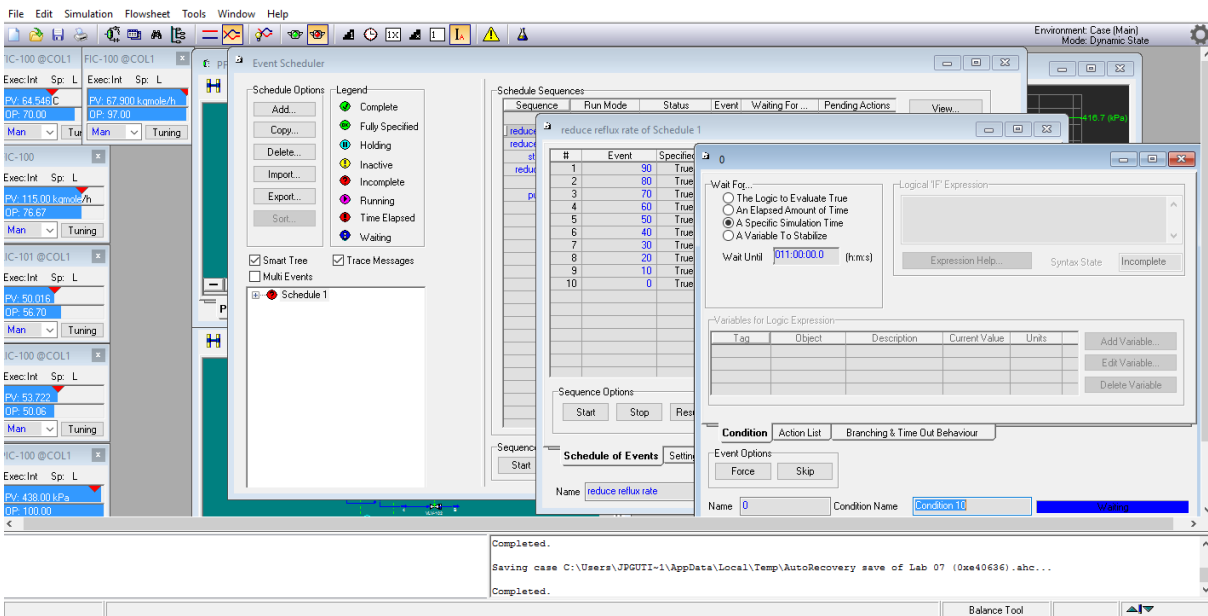

Remember that, during the shutdown, all the controllers should be in manual mode (except for those which are in **Ramp controller** type).

For this sequence of events, press **add** (Schedule of event window), and select:

- Type: **Set controller mode**
- Select target: FIC-reflux
- New mode: **Man**

Check **New OP** and write the percentage, for each event.

For each event do the same thing, the logic of the sequences are reported in the previous figures.

2 – Shutting down heating and cooling sources

For the matter, we can employ again the **Set controller mode**. You can also add a Ramp controller action providing the target SP and the ramp duration.

To reduce the heating, we can assume manipulate the valve associated to the reboiler duty. If selecting New Mode **Man,** we can assume an arbitrary reduction of 10% of the OP percentage every hour.
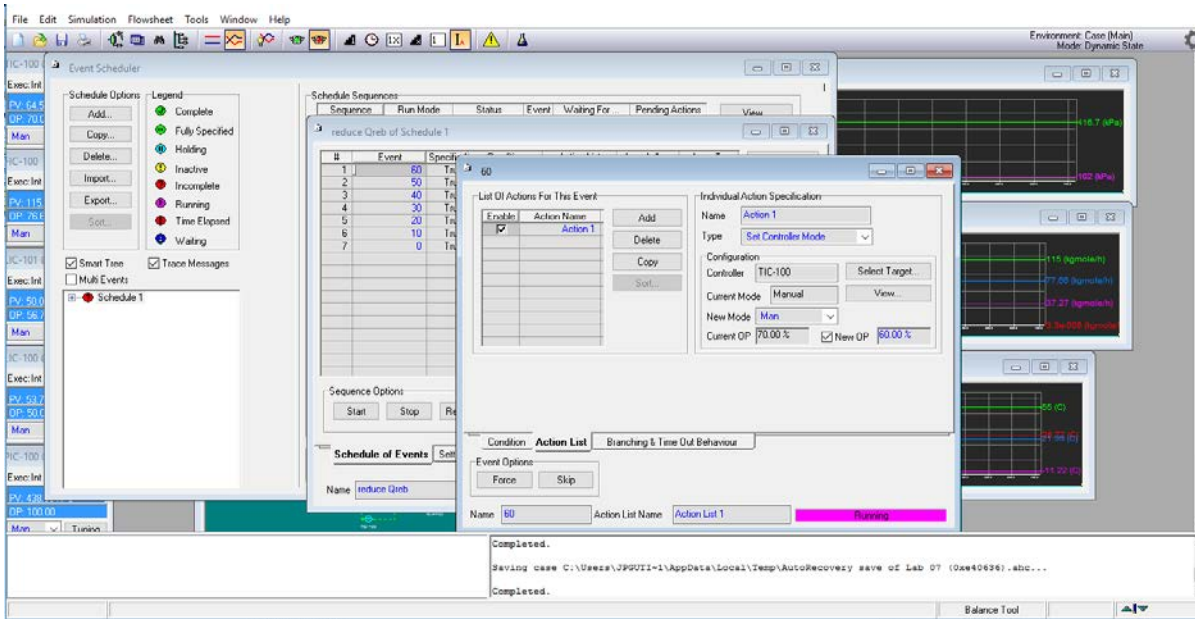
Proceed the same way to reduce the cooling source. For the purpose, manipulate the valve associated with the Condenser Heat Flow. You can assume the same step percentages as in the previous schedule.

3 – Stopping feed

To reduce the flowrate of the feed we are going to employ the Set Controller Mode again. In the configuration panel of each action, you have to select the controller FIC-100 in manual mode. Assume a reduction of 10 % in the OP, every 2 hours. Start the series of events after the first 04 Hs.
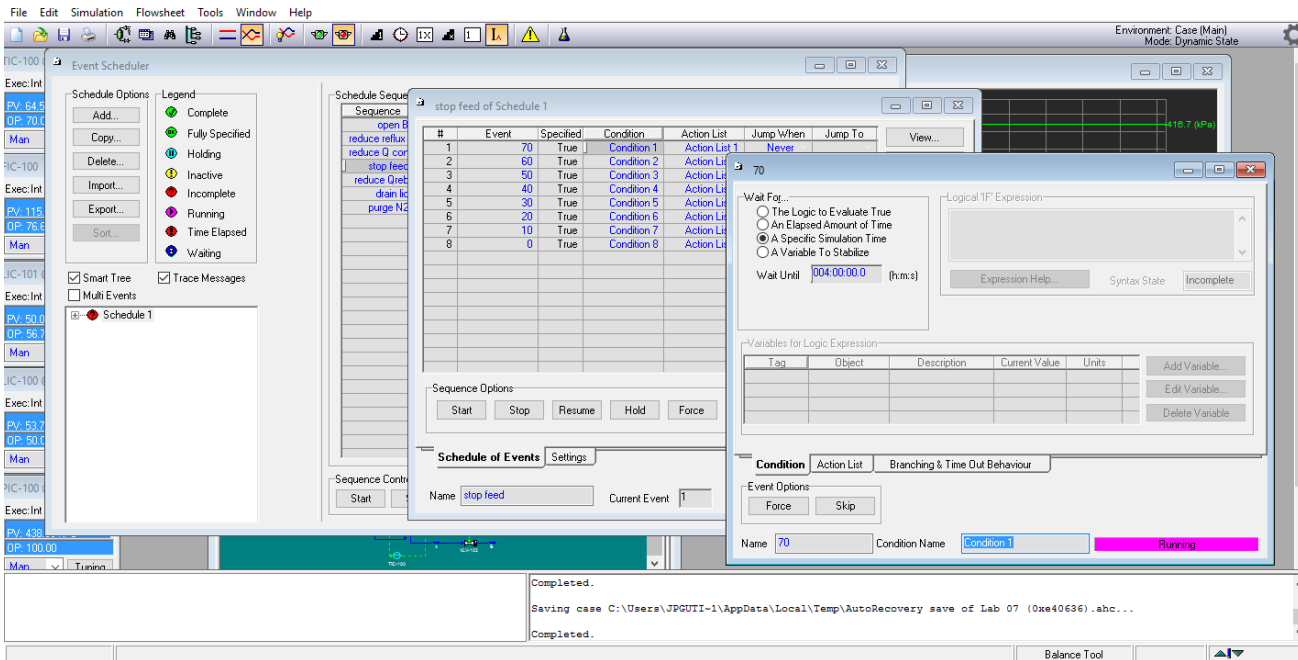
4 – Draining liquids

Use ramp controller to the strategy. In the Condition Tab of the Event, introduce a specific simulation time of 08 Hs, for the action to occur. Specify a Target SP level of 0 % for each of the levels controllers of the condenser and the reboiler. The ramp duration can be estimated in 02 Hs.
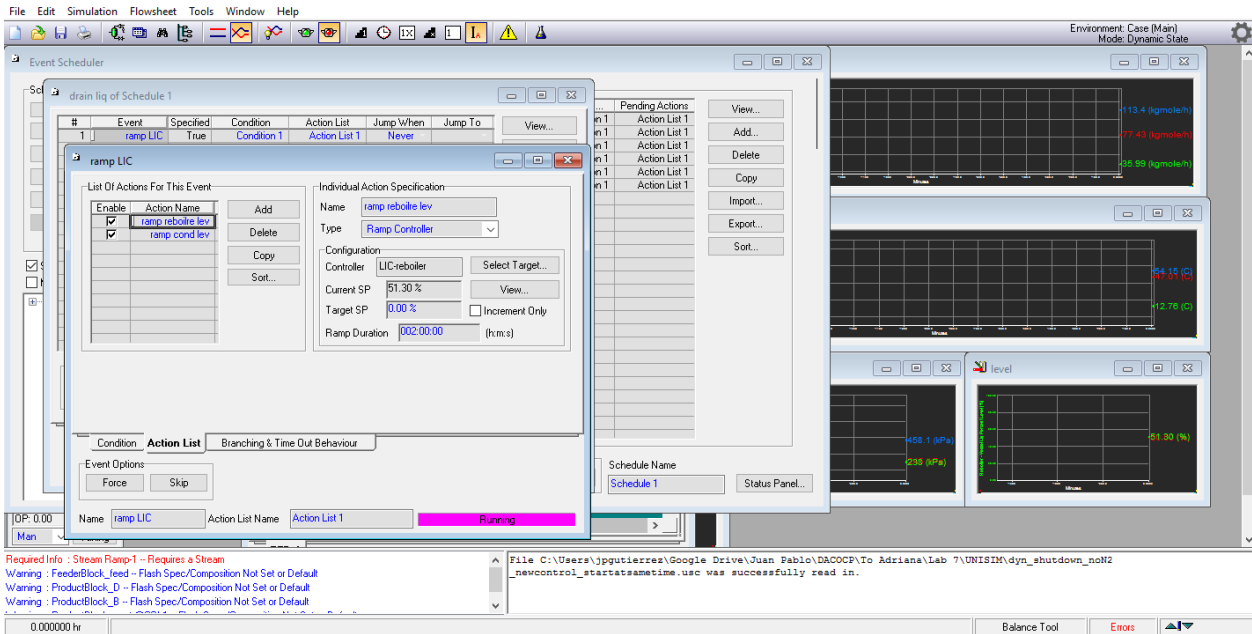
5 – Preparing the column for opening to atmosphere

This step involves filling the column with nitrogen and then depressurizing it to prepare the unit for personnel entering. You are not required to simulate this event. You are asked to discuss a strategy to simulate this event and the way to implement it in the simulation case we prepared.

To save the data and upload in excel, go in the databook window (press **ctrl + D**), **strip charts,** press **historical** for the datalogger that you want export, and press **save to .CSV File.** By doing so, you can create a csv file that you can open in excel.