1.0 Deep Reactive Ion Etcher (DRIE) - STS LpX Pegasus

Figure 1: STS LpX Pegasus

1.1 Introduction
STS LpX Pegasus is for the deep reactive ion etching of silicon. Please contact staff for approved masking materials.

Only trained and approved (qualified) users may use this tool.

1.2 Features and Specifications
a) Wafer size: 100 mm
b) Electrostatic chuck with helium backside cooling.
c) Bosch Process License
d) Pegasus Source with 3kW RF Generator
e) Gases: C_4F_8, SF_6, O_2, and Ar
f) Processes: Smooth Sidewall (roughness<50 nm), Small Trench (2-3 micron), and Fast Etch Rate (>15 micron/min)

1.3 Applicable Documents
STS LpX Pegasus installation, operation, and maintenance manuals are available.

1.4 Safety
a) High electrical power sources including RF power sources are present. Do not open any panels or defeat interlocks.
b) Strong magnetic fields are present that can affect pace makers.
c) Do not open the gas cabinet or the system chamber; hazardous gases are present. Read MSDS before using.
d) Pay attention to safety symbols on the equipment.
e) Press EMO button (Figure 1) if there is an immediate danger to personnel or the equipment and inform the staff.

1.5 Precautions

a) Do not scratch or put any metallic objects on the vacuum seal surfaces.
b) Only clean samples that do not outgas are allowed in this system.

1.6 Operating Procedure

1.6.1 System Start Up

a) Activate the equipment in FOM.

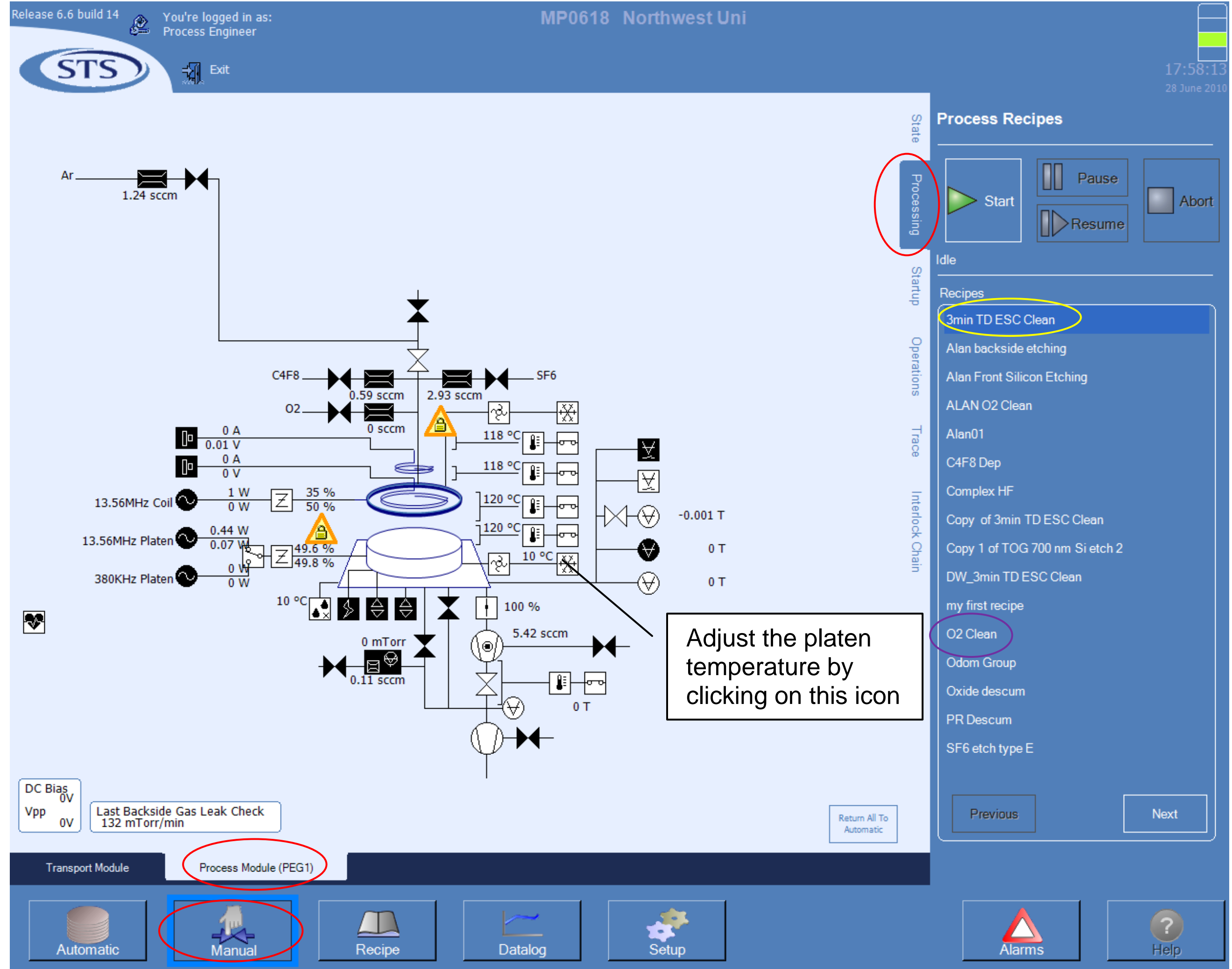

Figure 2: Running a process recipe.

1.6.2 Chamber Conditioning – 3 min TD ESC Clean

3 min TD ESC Clean must be performed before every etch process run. It is performed with no wafer in the chamber.

a) Make sure there is no wafer in the chamber.
b) To display the screen shown in Figure 2 on the operation computer, select ‘Manual’, ‘Process Module (PEG1)’, and ‘Processing’ tabs in this order. These are circled in red.
c) Adjust the platen temperature to the desired temperature for your depositions. To adjust, click on the heater icon (Figure 2) and enter the new value in the menu that shows up on the right side of the screen. Most commonly used temperature is 10-20°C.
d) Wait until the platen temperature reaches the set point value.

e) Select ‘Processing’ tab. Select ‘3 min TD ESC Clean’ (circled in yellow) from the recipes and click ‘Start’ (green triagle). This will start the cleaning process.
f) The green start triangle will light up when this process finishes.

1.6.3 Loading a Sample

Make sure the sample is approved for this system and is clean (not touched by hands). Only 4” silicon wafers can be loaded.

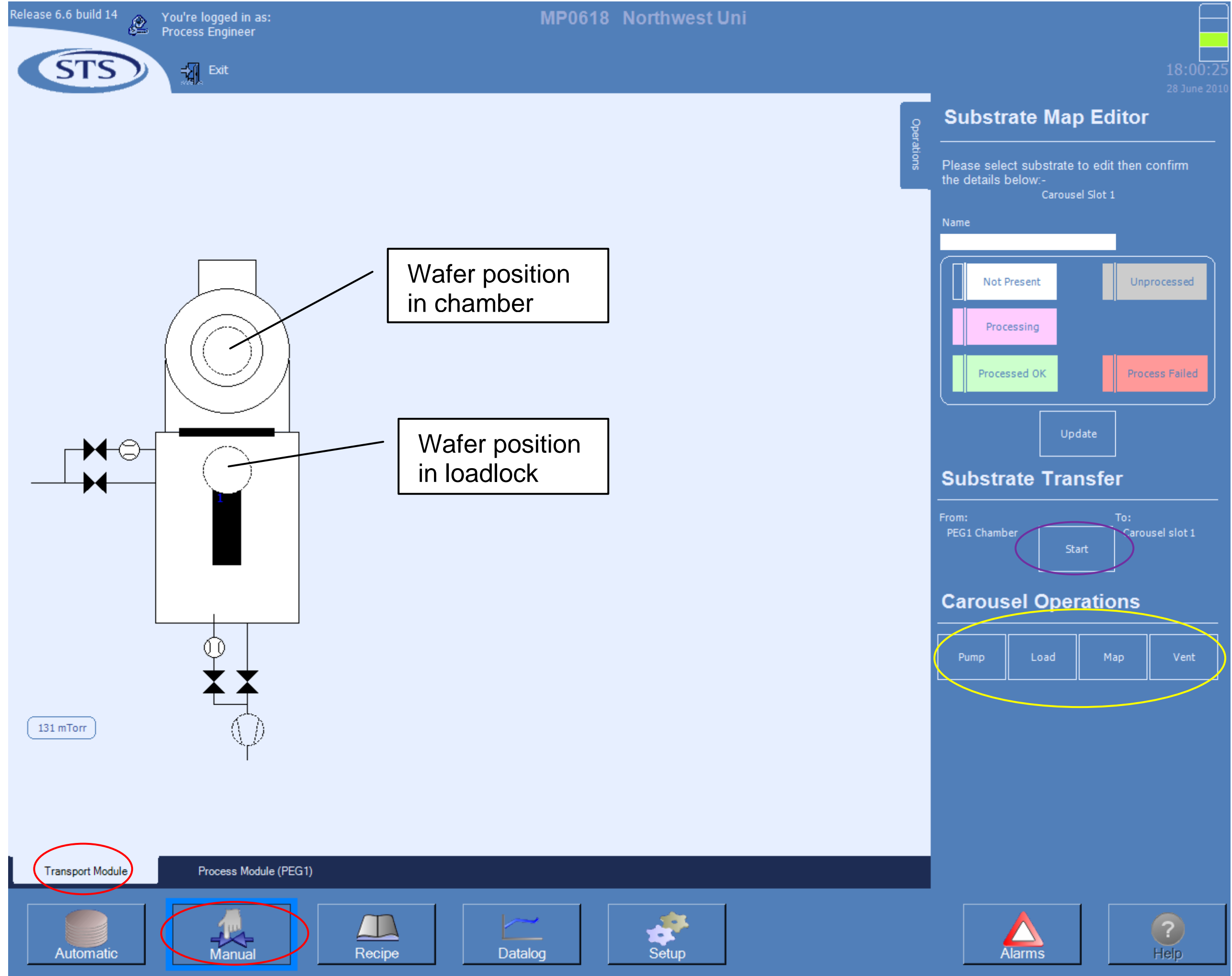

Figure 3: Loading/unloading a wafer.

a) Go to the loading/unloading screen shown in Figure 3 by selecting Manual and then Transport Module (circled in red).
b) Click on Vent button (in yellow circle). This will purge the loadlock and then vent it. It will take a few minutes and Vent button will be grayed out during this operation.
c) Open the loadlock door and place your wafer on the loading arm with wafer flat facing to the front of the machine and aligned as shown in Figure 4. Always make sure the wafer is clean and free of particles and use tweezers to handle it.
d) Close the loadlock door.
e) Click on Load button in yellow circle. This will pump down the loadlock and will place a wafer on the loading arm on the computer screen (computer now knows that there is a wafer on the arm).

f) After this operation completes, click on the wafer on the loading arm (Figure 3) followed by its position in the chamber. Then click Start button (circled in purple). This will transfer the wafer from the loadlock to the chamber.
g) Wait until this operation is complete.

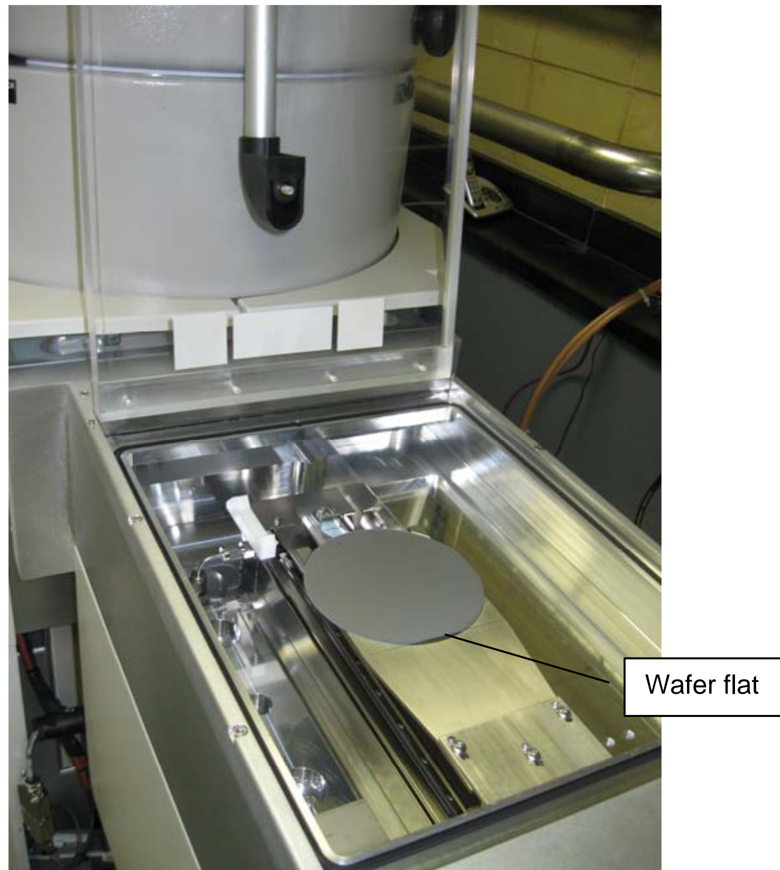

Figure 4: Wafer in the loadlock with its flat aligned to the loading arm.

1.6.4 Etching

a) Go to the screen shown in Figure 2 (Manual, Process Module, Processing).
b) Select the recipe that you want to run. See Sec. 1.6.7 for editing recipes.
c) Click on Start button (green triangle). While the process is running, its status can be observed on top of light blue area of the screen. Also, the valves', gases', and generators' status can be observed on the diagram. During the process, Start button will be grayed out and will be activated after it is finished.

1.6.5 Unloading the Sample

a) Go to the screen shown in Figure 3 by selecting Transport Module.
b) Click on the wafer in chamber and its position in loadlock.
c) Click on the start button (circled purple). This will bring the wafer in loadlock.
d) Click on Vent (in yellow circle). This will purge the loadlock first and then bring it to atmosphere.
e) Open the loadloack door and remove the wafer.
f) If another etching needs to be done, load another wafer following the procedure in Sec. 1.6.3. Otherwise, close the door.
g) Click on Pump button (in yellow circle). This will pump the loadlock but will not show the wafer on the arm which is consistent since now there is no wafer in the loadlock.

1.6.6 System Logout

a) Logout from the system in FOM.

1.6.7 Editing Process Recipes

Please do not delete or make changes to any existing recipes. To keep number of recipes manageable, do not make multiple recipes if only difference is the process time. Process time can be readily adjusted before running the recipe. The key processes are listed below; for details please contact staff.

i) Spec A – Small trench (2-3µm) 60µm depth
ii) Spec B – Large trench (80µm) 150µm depth
iii) Spec C – Large trench (80µm) smooth sidewall

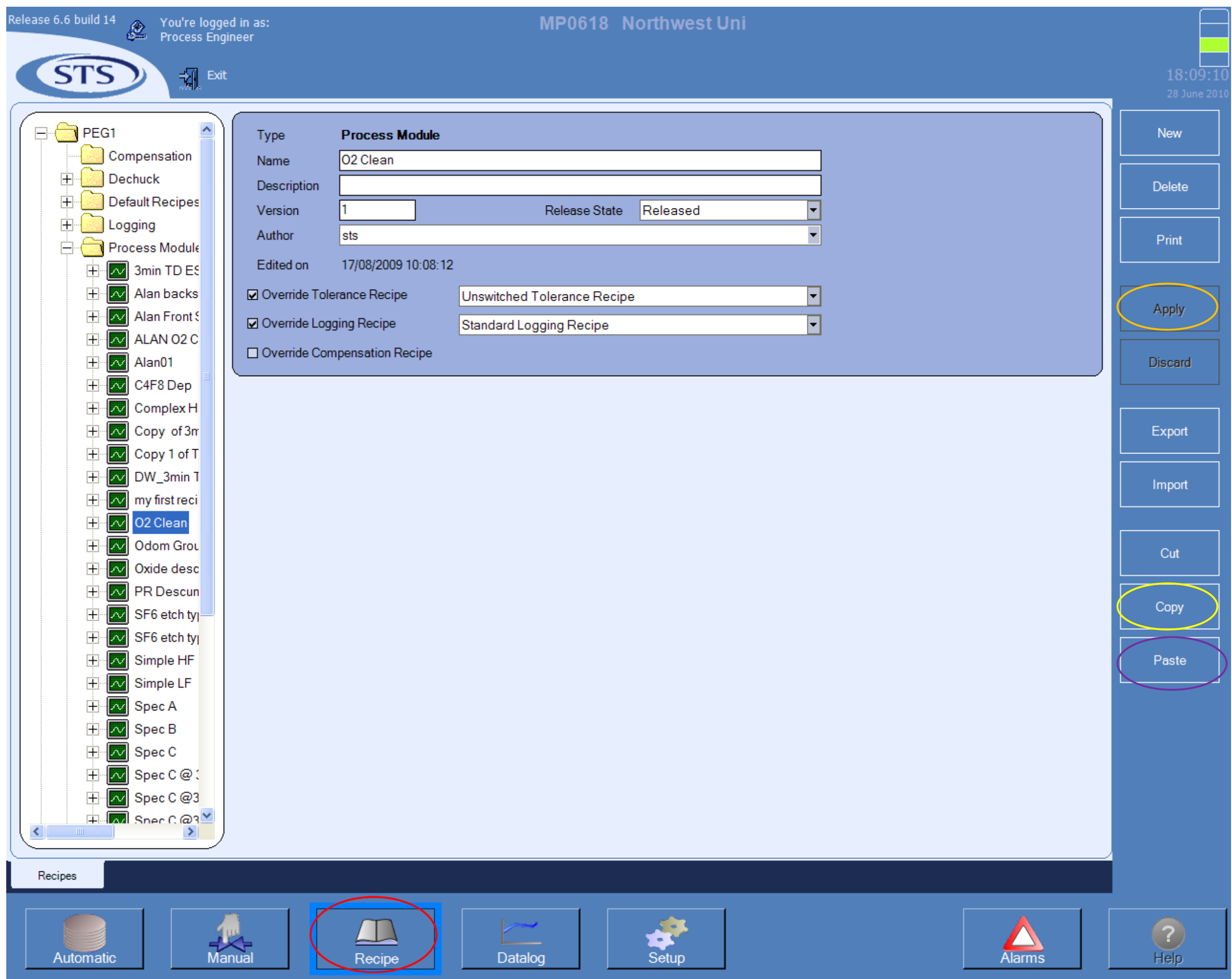

Figure 5: Recipe Editing I.

a) Go to the screen shown in Figure 5 by clicking on Recipe button (circled in red).
b) Select PEG1 > Process Module. All the process recipes are saved under this folder.
c) To copy any recipe, select the recipe by clicking on it. Click on copy button (circled in yellow). Then click Process Module folder to select it. Click on paste button (circled in purple) and then Apply (circled in orange) button. Your recipe will be saved as Copy of (original recipe name). Now you can modify this recipe and change its name.

d) Click on the recipe to select it. Here you can change its name on the first line. Under Description you can enter etch rate, etch properties, etc. All changes are saved by clicking Apply button.
e) Recipes contain several modules. Make sure you only make changes in the main etch step. For the recipe shown in Figure 6, the main etch step is called Standard Material Process (circled in blue).
f) Clicking on Standard Material Process will open the screen shown in Figure 7. Here, the only thing that you want to change is process time (circled in red, Figure 7). Since this is a switched recipe, the process time will be adjusted to a multiple of (etch + dep) time.
g) Now by clicking on Pressure, Gases, and Generators tabs (circled in blue), you can adjust pressure, select gases and their flows, and select generator and the power. Make sure to save the changes by clicking Apply button.
h) Now you can go back to the screen shown in Figure 3 and you will find your recipe listed with other recipes. You can select it and run it if desired.

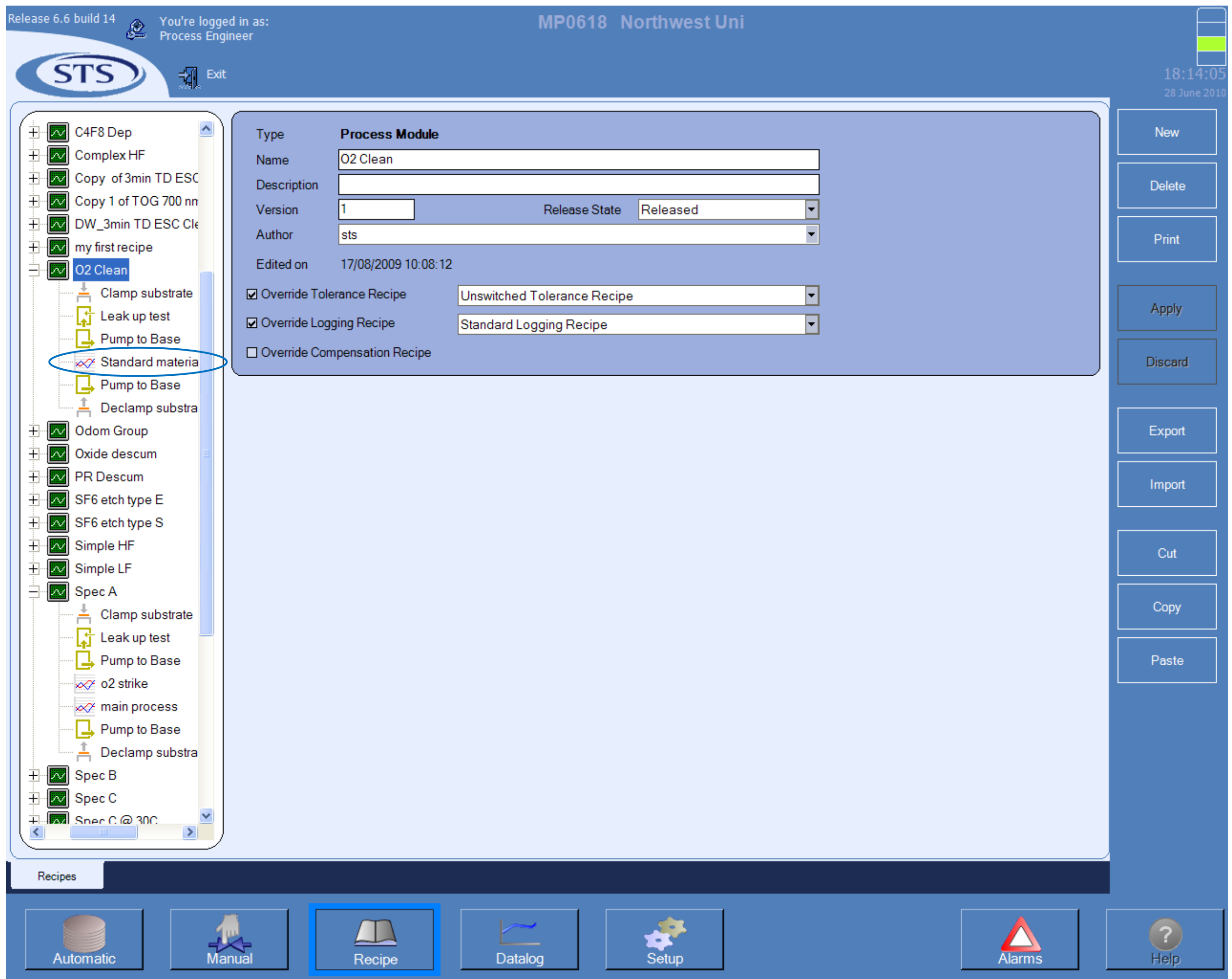

Figure 6: Recipe editing II.

Figure 7: Recipe editing III.