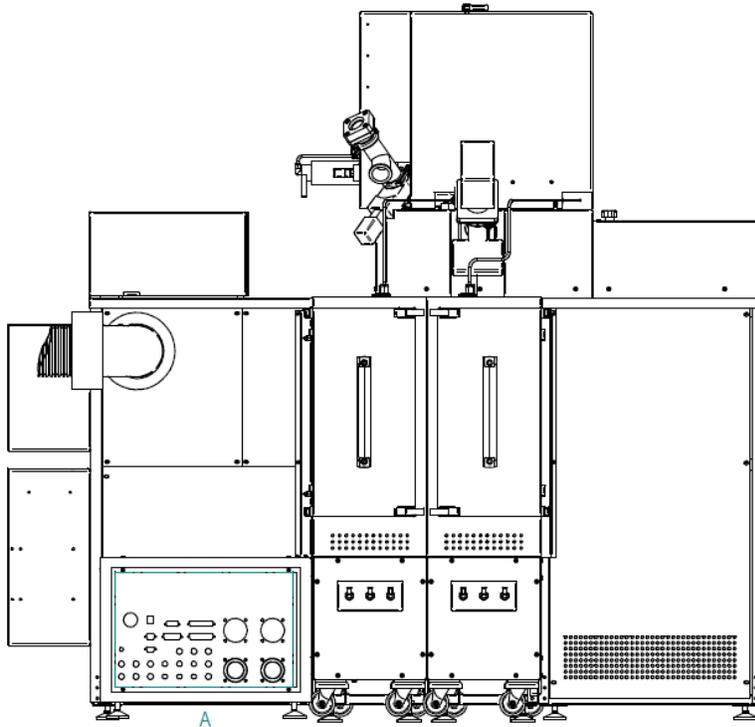


Oxford FlexAL Atomic Layer Deposition Users Manual



Coral name: Atomic Layer Deposition
Model: Oxford FlexAL
Location: Nanofab, Building 215, Room A106
Contact: nanofab_specialty@nist.gov

OVERVIEW:



FlexAL is an atomic layer deposition (ALD) system which can provide a new range of flexibility and capability in the engineering of nanoscale structures and devices. FlexAL ALD offers both remote plasma atomic layer deposition (ALD) processes and thermal ALD.

ALD system can deliver:

- Maximum flexibility in the choice of materials and precursors
- Low-temperature processes enabled by plasma ALD
- Low damage maintained by the use of remote plasma
- Controllable, repeatable processes via recipe-driven software interface

Key Features

- Remote plasma & thermal ALD in one flexible tool
- Automated 200mm load lock for process flexibility
- Up to 4 Bubbled liquid & solid precursors
- Mfc controlled gas lines with rapid delivery for thermal gas precursors (e.g. NH₃, O₂) and plasma gases (e.g. O₂, N₂, H₂).
- 25-650°C Wafer stage temperature range

APPLICATIONS:

- Nano-electronics
- High-k gate oxides
- Storage capacitor dielectrics
- High aspect ratio diffusion barriers for Cu interconnects
- Pinhole-free passivation layers for OLEDs and polymers
- Passivation of crystal silicon solar cells
- Highly conformal coatings for microfluidic and MEMS applications
- Coating of nanoporous structures
- Bio MEMS
- Fuel cells

SPECIAL NOTES OR RESTRICTIONS:

- ALD precursors are toxic and highly reactive/pyrophoric.
- Must be trained and qualified to use tool.
- Any new precursor or new coating process must be approved by Nanofab staff.
- Never open precursor cabinet.
- For any abnormal phenomenon during operation, shut down the machine by pressing the ***RED Emergency button***.
- Report all emergency stops to the Nanofab staff.

WARNING

THIS SYSTEM INCORPORATES POTENTIALLY DANGEROUS COMPONENTS, WHICH CAN EXPOSE PERSONNEL TO HAZARDS RESULTING IN DEATH OR SERIOUS INJURY.

BEFORE ATTEMPTING TO INSTALL, POWER UP OR OPERATE THIS SYSTEM, ENSURE YOU HAVE READ AND UNDERSTOOD THE ENCLOSED SYSTEM MANUAL, ESPECIALLY SECTION 1 (HEALTH AND SAFETY).

NO SCREEN SAVER ALLOWED TO AVOID LOSING COMMUNICATION WITH THE PLC.

PARTS OF THE EQUIPMENT MAY BE TOO HOT TO TOUCH DURING CHAMBER HEATING.

Power Up

To power up the system, proceed as follows:

- 1) Ensure that all manually operated cooling water taps are turned ON.
- 2) Check that the 'Slit Valve Lockout' control is unlocked and pushed home.
- 3) Set all Remote/Local switches on the electronics modules to REMOTE.
- 4) Switch ON all the electronics modules located in the console.
- 5) Ensure that the compressed air supply is ON.
- 6) If you are certain that the gas lines do not contain air, turn all the manually operated gas taps (on gas cylinders etc.) to ON.
- 7) Check that the Emergency Stop buttons are OUT. See Fig 1
- 8) Set the wall-mounted safety isolation box switch to ON (I).
- 9) Operate SYSTEM ON button (coloured green or with the 'I' legend), located on the console. See Fig 1
- 10) Switch the remote PC operator terminal ON.



Power Down

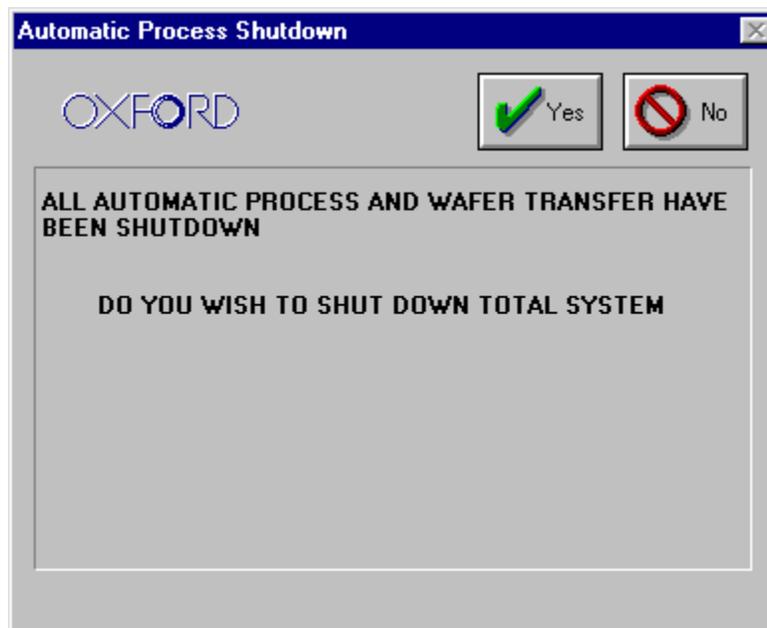
- 1) Ensure that the system has been vented, and all pumps are switched off.
- 2) Exit from the PC 2000 software by clicking on the **System** button, then on the **Exit** option.
- 3) Exit from Windows.
- 4) Turn the PC controller OFF.
- 5) At the Main Console, press the **OFF** button (coloured red or with a '0' legend).
- 6) Switch off and lock off the wall-mounted safety isolation box.

- 7) Turn all manual gas taps on the Main Console, gas pod and compressed gas cylinders **OFF**.
- 8) At the Main Console, set the **SLIT VALVE LOCKOUT** valve to its OFF position (pull the red control knob fully outwards). Fit the adjacent padlock to the slit valve lockout valve's spindle then lock it to prevent any compressed air operated valve movement.
- 9) Turn off the compressed air supply.
- 10) Ensure that all heated components have cooled to ambient temperature, then turn off the cooling water.

In an emergency, e.g. risk of physical injury, fire, etc., shut the system down by pressing an **Emergency Off** (EMO) button. This will disable all power outputs from the power box (except for low voltage supplies).

To halt processing and wafer transfers, click on the **STOP ALL AUTO PROCESSES** button which is displayed at the top of the page on all screens. Clicking on this button will halt the current process and any further wafer transfers.

Also, a Cluster System Abort dialogue is displayed asking you if you wish to shut down the total system. Clicking on **Yes** will:



- a) Switch the RF/microwave/magnet power generators OFF.
- b) Switch the pumps OFF.
- c) Close the APC and normally-closed vacuum valves.
- d) Switch the process gases OFF.

Clicking on the **No** button in the Cluster System Abort dialogue will limit the abort to the actions already done, i.e. stop all automatic recipes. Further processing operations (automatic or manual) can then be carried out after ensuring that the system controller is aware of the current wafer locations.

Start System Following an Emergency Stop, Power Failure, or Software Abort

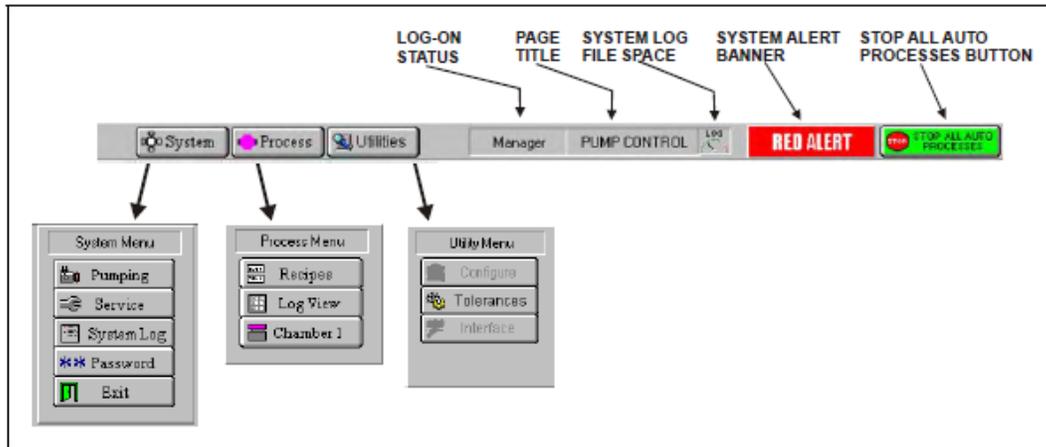
A power failure, or emergency stop will halt all system functions. A software abort, (by clicking on the **STOP ALL AUTO PROCESSES** button, then clicking on **Yes** in the Cluster System Abort dialogue), also halts the machine quickly.

When power is restored, and it is safe to turn on or restart the system, use the following procedure:

- 1) Turn off the machine at the system power off switch.
- 2) Turn on the machine at the system power on switch. (If a robot arm is fitted, it should move slowly to its home position.)
- 3) Turn off the machine at the system power off switch again (see following Note A).
- 4) Turn on the machine at the system power on switch. (If cassette load lock(s) are fitted, their elevators will move to find the end positions.)
- 5) A user with access to the Service Mode can then use the facilities to add wafers to the mimic page so that the system controller knows where any wafers are.

User Operation

The PC 2000 facilities are accessed from the menu bar at the top of the screen as shown below.



Logging ON

To log on to the PC 2000 software, proceed as follows:

- 1) On the PC Desktop, select the PC 2000 icon. The PC 2000 splash screen is loaded, and then the Access Control dialog is displayed:
- 2) Enter your name and password in the appropriate data fields (note that data entry in the Password field is case sensitive), and then select the **Verify** button. If you make a mistake in entering your name and password, select the **Verify** button and then re-enter the data. After verification of the entered data, your log-on status is displayed in the **Current User** and **Access level** fields.
- 3) Select the **OK** button. The PC 2000 software continues to load, and then the Pump Control page is displayed.

Venting the System

WARNING

CONTACT WITH TOXIC GASES CAN CAUSE DEATH OR SERIOUS INJURY. BEFORE VENTING THE PROCESS CHAMBER, ALWAYS ENSURE THAT THE SYSTEM IS ADEQUATELY PURGED AND PUMPED.

Do not vent a system which has used toxic gases unless the system has been adequately pumped first.

After venting, there may still be residual gases in the process chamber. Consider wearing suitable personal protection, e.g. a respirator.

To vent the system, use the following steps.

- 1) From the System menu, select the Pumping option.

- 2) On the Pump Control page, select the **STOP** button then the **VENT** button for each chamber. Note that the vent sequence is controlled by a timer to allow time for the turbo pumps to ‘spin’ down.
- 3) When all of the ‘Vent Time Left’ timers have decremented to zero, all of the pumps have been switched off automatically, and the complete system has been vented.
Do not attempt to open the process chamber lid until the vacuum switch has changed status, i.e. to its high-pressure status (In this condition, on the Pump Control page the vacuum status field will display ‘FAULT’).

Pumping the System

- 1) On the Pump Control page, select the **SET BASE PRESSURE** button, and then enter the required process chamber base pressure if different from the default.
- 2) Ensure that the system status indicators are all coloured green:

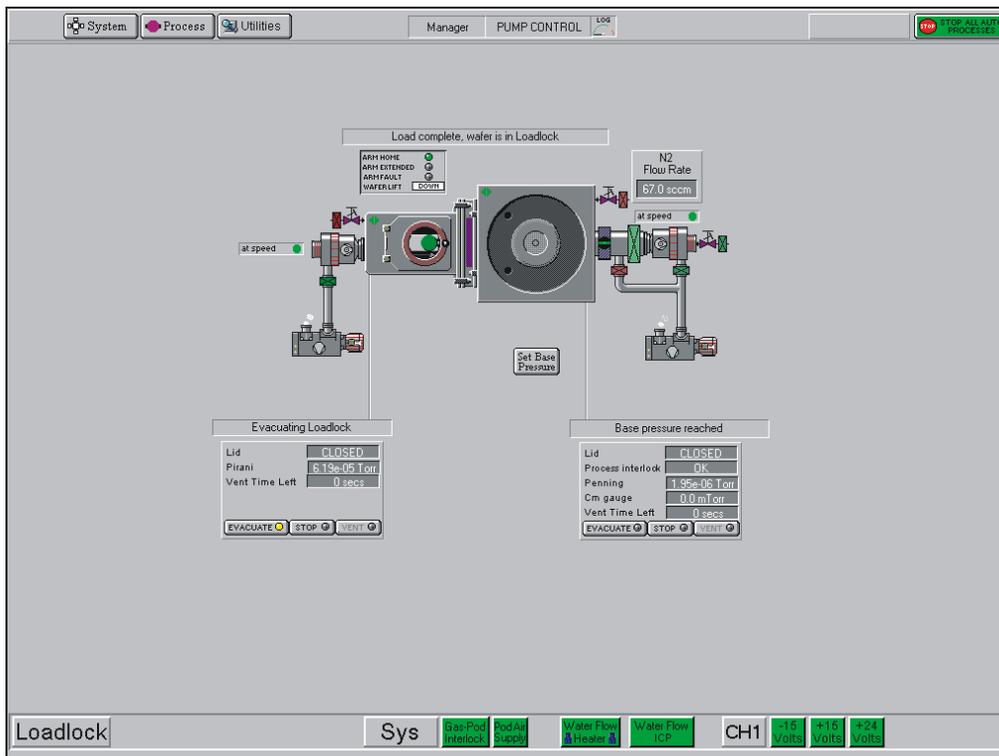


- 3) Ensure that the Automatic load lock/transfer chamber’s lid is closed. (Automatic load lock/transfer chamber lid open/closed status is shown in the panel adjacent to the mimic).
- 4) Select the **Evacuate** button for the process chamber. The relevant valves will operate and the process chamber will be pumped down.
- 5) Select the Evacuate button for the Automatic load lock. You will be prompted to enter a wafer identity - either enter the identity and click **OK**, or click **Cancel** (to pump down without a wafer in the Automatic load lock). The relevant valves will operate and the Automatic load lock will be pumped down.

NOTE: Turning off any rotary vane pump will cause all process and pumping actions using that pump to stop.

To achieve a low base pressure in the system, pump for at least 12 hours. Where chambers or process heaters are part of the system, raise the temperatures of these near their maximum values for the first six hours of pumping to assist out-gassing, then return the temperature to ambient.

The Pump Control page Buttons, controls, indicators and message panels to allow you to control the vacuum system and wafer transfers are shown below.



The following controls are provided:

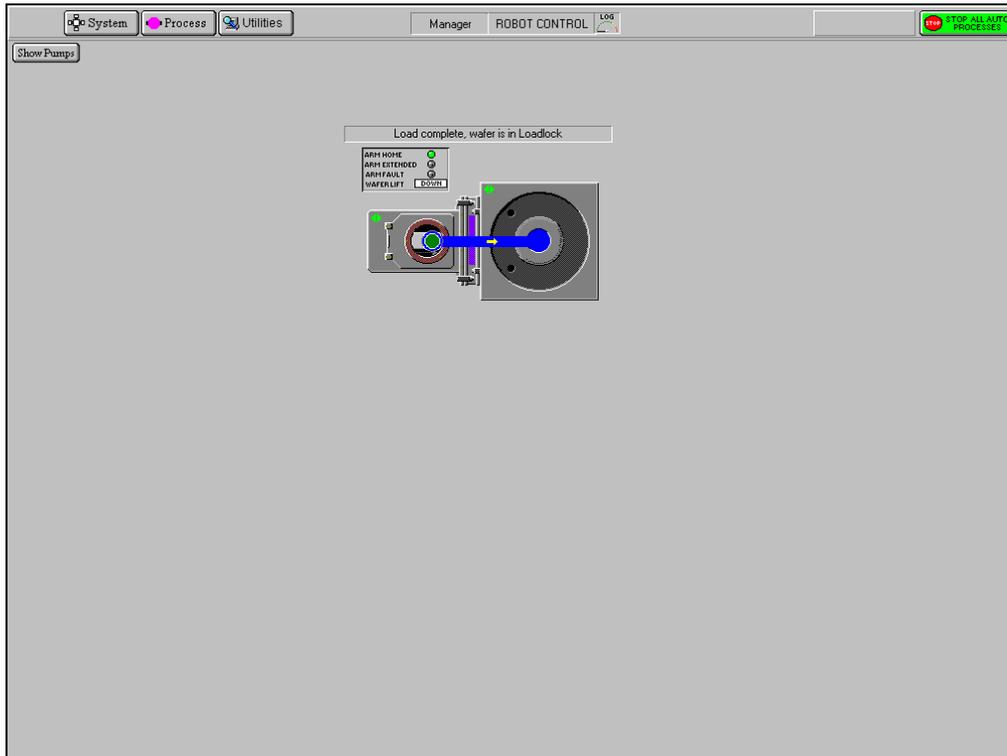
- a) Control and status panels for the process chamber and Automatic load lock. Each Control and status panel has associated EVACUATE, STOP and VENT buttons.
 - i) **EVACUATE** buttons: Select to pump-down the associated chamber.
 - ii) **STOP** buttons: Select to stop either pumping down or venting the associated chamber. Note that the **STOP** button must be selected before venting to ensure the correct sequencing of the valves.
 - iii) **VENT** buttons: Select to vent the associated chamber.
- b) Mimics of all valves showing open/closed status (coloured green when open, red when closed).
- c) Transfer arm and Wafer lift status panel. Displays indicators for ARM HOME, ARM EXTENDED and ARM FAULT (illuminated when active). Also displays WAFER LIFT status (up, down, moving or fault). See the following table.

Message	Meaning
UP	The UP microswitch is detected as active.
DOWN	The DOWN microswitch is detected as active.
MOVING	Both microswitches are detected as inactive.
FAULT	Both microswitches are detected as active.

- d) A SET BASE PRESSURE button. Select to set the Process Chamber Base Pressure.
- e) Context related message panels for the process chamber, Automatic load lock and wafer transfer progress.

- f) 'Ready for transfer' indicators displayed when the associated chamber or load lock is evacuated and ready for wafer transfers.
- h) Turbo purge N2 flow rate panel.

Robot Control



The Robot Control page is used to manually transfer a wafer between chambers (when operating in automatic mode, i.e. running a recipe, wafers are transferred automatically). The location of the wafer is indicated by a green wafer indicator. The arrowed path shows the currently available wafer destination.

The page provides the following features:

Show Pumps button

Displays the Pump Control page Transfer arm and Wafer lift status panel

Displays indicators for ARM HOME, ARM EXTENDED and ARM FAULT (illuminated when active). Also displays WAFER LIFT and WAFER CLAMP status (up or down).

Transfer status message field

Displays context-related message about the wafer transfer progress.

Process chamber and Automatic load lock mimic

Displays the wafer location and possible wafer destination.

To transfer a wafer from the Automatic load lock to the process chamber to carry out a manual process, use the following steps:

- 1) Click on the Automatic load lock wafer mimic. The blue arrowed path is displayed showing the available destination.

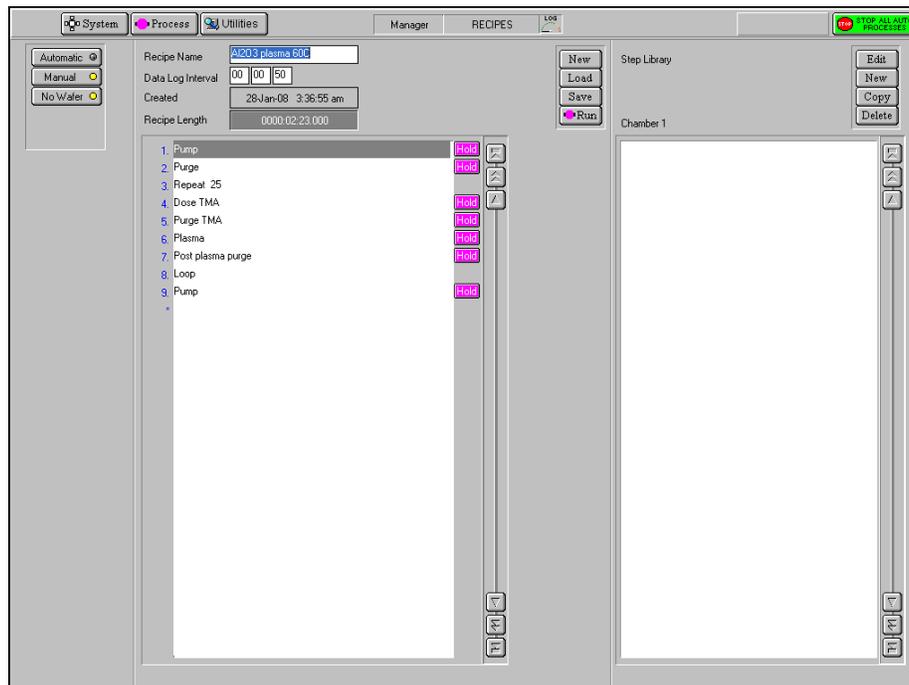
2) Click on the process chamber wafer indicator. The wafer is transferred to the process chamber.

To transfer a wafer from a process chamber to the Automatic load lock on completion of a manual process, use the following steps:

1) Click on the process chamber's green wafer indicator. The blue arrowed path is displayed showing the available destination.

2) On the Automatic load lock mimic, click on the wafer indicator. The wafer is transferred to the Automatic load lock.

Creating and Editing Recipes



This page is used to assemble and store in memory all the set points and instructions which make up a Recipe for an Automatic Mode run. These recipes consist of a sequence of process Steps. ‘Drag and Drop’ facilities are provided to copy library steps into a recipe.

NOTE: Before creating / editing recipes, make sure that you understand the operation of key components of the system to ensure that recipes proceed as expected.

A recipe is created by adding steps from the **Step Library** to the Recipe Step Name fields. The recipe is then allocated a Data Log Interval and saved.

Recipe steps are stored in the **Step Library** list. The list can contain any number of steps, depending on available hard disk space. When the displayed list is full, it becomes scrollable to allow you to view all of the list contents.

Creating A New Recipe Step

To create a new recipe step, use the following procedure:

- 1) In the Step Library panel, select the **NEW** button. The Step Edit page is displayed.
- 2) Enter the step parameters as required, then click on **OK**. The step is automatically saved.

To create a recipe step, based on an existing recipe step, use the following procedure:

- 1) Select a recipe step from the **Step Library** list, i.e. click on it to highlight it.
- 2) Select the **COPY** button. Enter a new step name.
- 3) Edit the step parameters as required, then click on **OK**. The new recipe step is automatically saved.

Edit an Existing Recipe Step

To edit an existing recipe, use the following procedure:

- 1) Select a recipe step from the **Step Library** list, i.e. click on it to highlight it.
- 2) In the Step Library panel, click on the **Edit** button.
- 3) Edit the step's process parameters as required, then click on **OK**. The step is automatically saved.

NOTE: Changing an existing recipe step will not alter saved recipes, which use the old version of that step.

Delete A Recipe Step

To delete a recipe step, use the following procedure:

- 1) Select the recipe step from the **Step Library** list, i.e. click on it to highlight it.
- 2) Select the **DELETE** button; the selected recipe step is deleted.

Create A New Recipe

Recipes are 'built' using existing recipe steps, and edited as required.

Within a recipe, steps can be manipulated using the **Step Commands** pop-up menu (accessed by clicking on the Recipe Steps field).



The **Step Commands** pop-up menu provides the following options:

Edit Step Enables the selected (highlighted) step to be edited.

Repeat Step Repeats all subsequent steps until a Loop Step is reached. This group of steps can be repeated any number of times. (When you select this option, you are prompted to enter the number of times the group of steps is to be repeated.)

Loop Step Terminates a Repeat Step group.

Insert Step Creates a 'gap' above the selected step to allow another step to be dragged into the list.

Delete Step Deletes the selected step from the list.

Cancel Closes the **Step Commands** pop-up menu.

Build A Recipe

To build a recipe, use the following procedure:

- 1) In the Recipe panel, select the **NEW** button.
- 2) Click on a recipe step in the **Step Library** list, hold the left mouse button down then drag the mouse pointer to the **Step Name** field next to the asterisk (*) then release the mouse button. The step name is displayed in the **Step Name** field.
- 3) Repeat 2) as required to add further steps to the recipe. Note that once you have filled the Step Name field, the recipe step list becomes scrollable, enabling you to add a maximum total of 1000 steps.
- 4) To remove a step from the list, click on it to highlight it then select the **Delete step** button from the **Step Commands** pop-up menu. Any further steps will move up the list by one place.
- 5) To add a step before an existing step, click on the existing step then select the **Insert step** button from **Step Commands** pop-up menu. The selected step and all those following it will move down the list by one place. You can then drag another step from the **Step Library** list into the now vacant field.
- 6) When all steps have been added, enter a time into the **Data Log Interval** field, then enter a name for the recipe in the **Recipe Name** field. Finally, select the **SAVE** button.

Edit A Recipe

To edit a recipe, use the following procedure:

- 1) Select the **LOAD** button, then select the recipe to be edited.
- 2) In the Step Commands pop-up menu, click on the Edit Step button, then edit the process parameters as required. Note that editing a recipe step will not affect the associated step, i.e. a step having the same filename, in the Library of Available Steps.
- 3) To remove a step from the list, click on it to highlight it then select the **DELETE STEP** button from the **Step Commands** pop-up menu. Any further steps will move up the list by one place.
- 4) To add a step before an existing step, click on the existing step then select the **INSERT STEP** button. The selected step and all those following it will move down the list by one place. You can then drag another step from the **Step Library** list into the now vacant field.

Run A Recipe

A single button automatic process run allows a complete process to be run automatically. The run starts by pumping the system down, carrying out the process and then venting the system. A user logged on at any access level, e.g. Manager, User etc, can carry out the automatic process run.

Before starting an automatic process run, the rotary vane/roots/dry pumps must be started. It is suggested that once the system is powered up, the Manager logs on, starts the pumps, evacuates the process chamber and then re-logs on for the User or Production Operator to carry out the automatic process run(s).

When the pumps have started and the User or Production Operator is logged on, carry out the automatic process run using the following steps.

- 1) Insert the wafer into the Automatic load lock. (If necessary, vent the Automatic load lock by selecting the **STOP** button then the **VENT** button).
- 2) Close the Automatic load lock's lid.
- 3) In PC 2000, select the System menu and then the Recipe option. The Recipe page is displayed.
- 4) Load the required recipe.
- 5) Select the **Run** button. You will be prompted enter a wafer identity; enter the wafer identity and select the **OK** button. The following sequence will be automatically carried out: i) The automatic load lock will start to evacuate and the Process page is displayed. ii) When the automatic load lock reaches base pressure, the wafer will be transferred into the process chamber. iii) When the wafer has been transferred into the process chamber, the recipe will start. iv) When all of the process steps have completed, the Pump Control page is displayed, the wafer will be transferred into the automatic load lock and then the automatic load lock will vent.
- 6) When the vent sequence is completed, open the automatic load lock's lid and remove the wafer.

To process another wafer, repeat the above steps from Step 1). If running the same recipe, Step 4 can be skipped otherwise load another recipe.

NOTES:

- a) You can pause the process at any time by selecting the **PAUSE** button. This will cause the Step Time and the plasma power to stop with the current step time indicated. Re-starting the process will cause the process to continue from the time it was paused. If, during the pause period, you change any of the process parameters, e.g. gas demand, pressure etc., you must press the **START** button for the changes made to come into effect, this will cause the step timer to continue from the time it was paused.
- b) You can stop the process at any time; the message 'Process Complete' will be displayed, if required, you can then run the same or another process.

Manual Process Mode

- 1) Insert the wafer into the Automatic load lock. (If necessary, vent the Automatic load lock by selecting the **STOP** button then the **VENT** button).
- 2) Close the Automatic load lock lid.
- 3) Select the Automatic load lock's **EVACUATE** button. A dialogue box will be displayed allowing entry of a Wafer Name, if any.
- 4) Check that the system has pumped down to base pressure. (The process chamber message panel should display 'Base Pressure reached').
- 5) Select the Process menu, then the Chamber 1 option. Set the parameters as required, e.g. Step Time, RF generator power, chiller temperature, chamber pressure, and gas demands.
- 6) Ensure that the Automatic load lock is at the required pressure. (Check the relevant panels on the Pump Control page). Green 'ready for transfer' indicators are displayed on each chamber mimic when it is available for vacuum transfer.
- 7) On the Pump Control page, click on the Automatic load lock wafer mimic.
- 8) Click on the Process Chamber wafer mimic. The wafer is transferred from the Automatic load lock into the Process Chamber.
- 9) On the Chamber 1 process page, check that the set parameters are correct for your required process.
- 10) Before running a process which uses a precursor, ensure that the Process Pump Purge is set to one minute on the Tolerances page.



This allows the precursor pod line sufficient time to settle before the process starts.

- 11) Click the **START** button. (Note that if this button is not active, the chamber has not reached base pressure.) The process will commence.
- 12) When the 'Process Complete' message is displayed, select the Pump Control page and move the wafer from the process chamber to the Automatic load lock using the same method as the transfer in.
- 13) Open the Automatic load lock's lid and remove the wafer.

Process Data Log

All processes are automatically data-logged. The interval between logging events is set in the Recipe screen.

The Process Datalog facility allows you to view process data runs and associated comments.

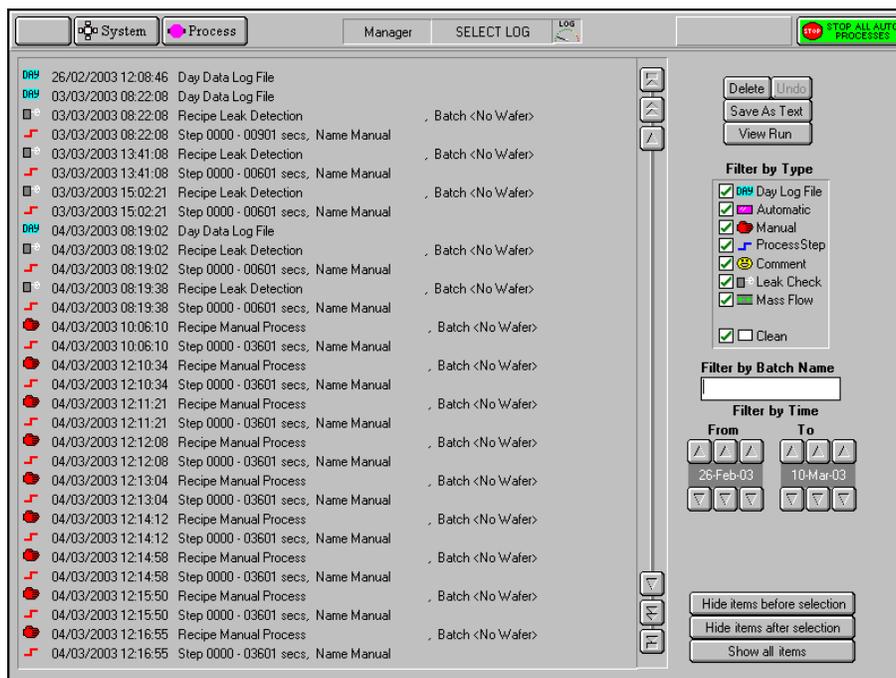
The facility comprises three pages:

- SELECT LOG page – allows you to select the process data to view.
- RUN LOG page – lists the selected process data, for all runs except Leak detection runs and MFC calibration runs, with respect to time.
- Leak detection and MFC calibration log page – displays the Leak detection runs and MFC calibration runs in text and graphical formats.

These pages are described in the following text.

Select A Log

The Select Log page is displayed by selecting the **Process** button, then the **Log View** option.



The page comprises a list of logged events, which can be filtered by type, batch name and time. When the required events have been selected, they can be viewed on a Log View page.

The facilities provided on the page are as follows:

List of logged events Displays a list of logged events in a date/time sequence. Each event is identified by an icon, date, time, title, duration, name and comments (if present). An event is selected (highlighted) by clicking on it.

Delete button Deletes the selected event

Undo button Undo the last action

Save As Text button Save the selected event as a text file for use in spreadsheets etc.

View Run button Opens the Run Log page.

Filter by Type list

A list of event types with associated checkboxes. Use this panel to select the events to display in the Event list. A checkbox showing an 'x' indicates that the associated event type will not be displayed. A checkbox showing that the associated event type will be displayed.

Filter by Batch Name field

Enter a batch name to list only logged events associated with that batch.

Filter by time fields and buttons

Use these controls to select events occurring in a time range to be displayed.

Hide items before selection button

Displays all events after and including the highlighted event.

Hide items after selection button

Displays all events before and including the highlighted event.

Show all items button

Displays all previously hidden events.

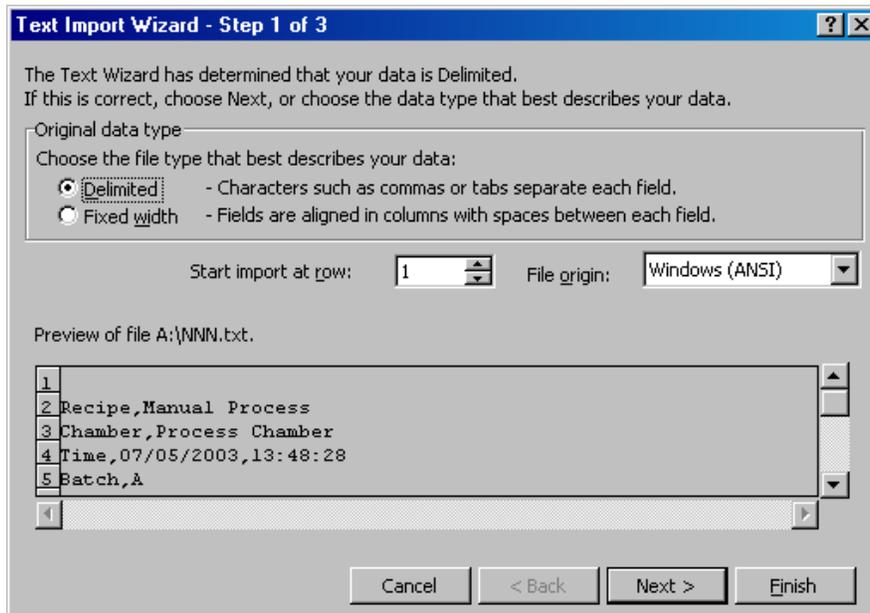
Saving a Log File For Use in Microsoft Excel

NOTE: OIPT now supplies customers with comprehensive software to view/analyse PC 2000 log files. The software, LogViewer, is provided on the system PC.

For full details of LogViewer, refer to its Manual by following the shortcut on the desktop of your system PC.

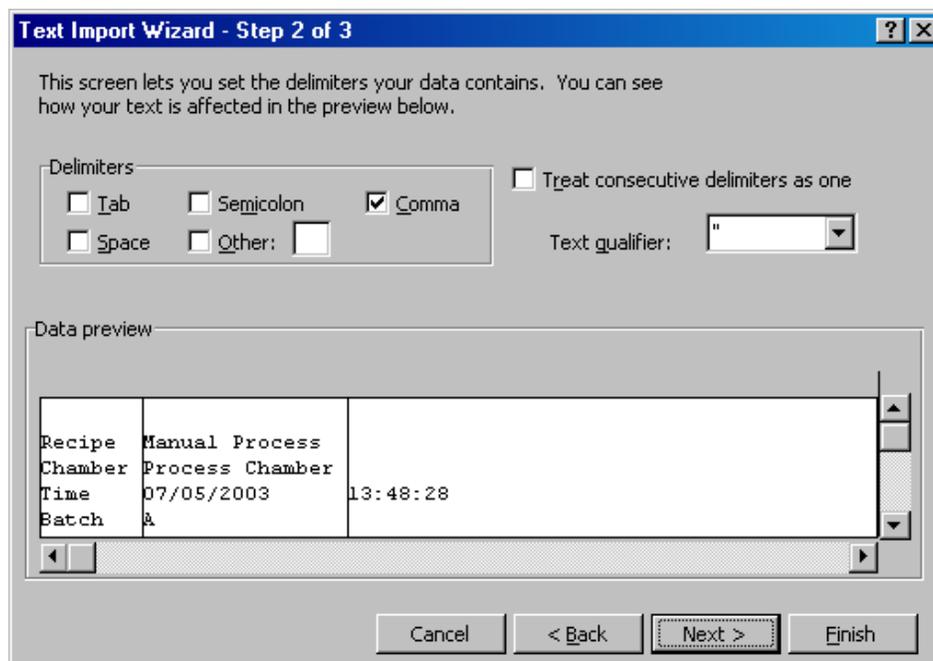
Any logged process run can be saved as text and then opened in Excel for viewing, analysing, etc. To do this, use the following steps:

- 1) On the Select Log page, select the required process run (any multiple steps will be automatically highlighted).
- 2) Select the **Save As Text** button. The **Save As** dialogue is displayed.
- 3) Navigate to the target location for the log text file, enter a filename and in the 'Save as type:' field select 'Log Text Files (*.Txt)' from the drop-down list. If saving to a floppy disk, label it and insert into the drive now.
- 4) Select the **Save** button. The text file is saved in your chosen location.
- 5) Start Excel and then in the File menu, select the Open option. The 'Open' dialogue is displayed.

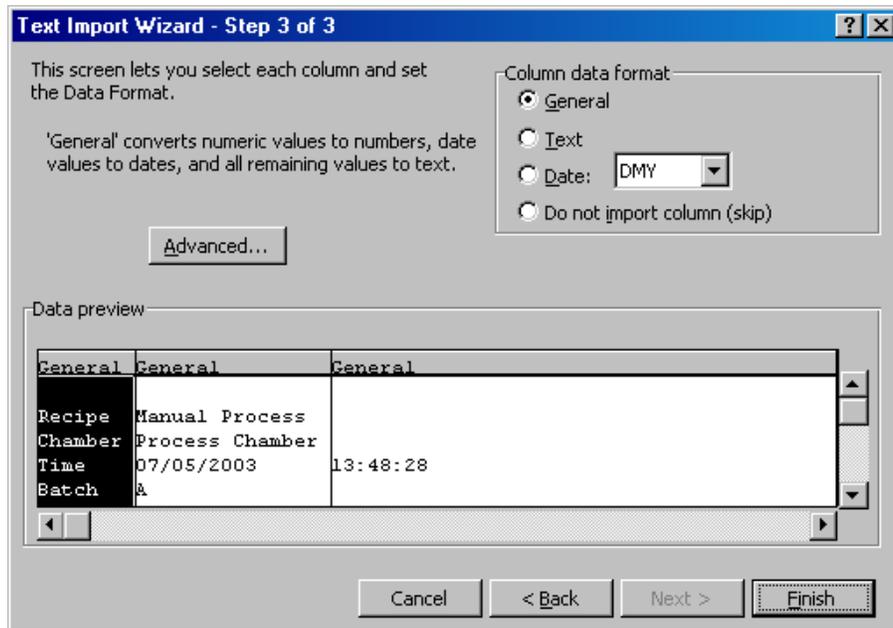


6) Navigate to the location of the saved text file and in the 'Files of type:' field, select 'All Files (*.*)' from the drop-down list. Select the required text file and then select the **Open** button. The 'Text Import Wizard – Step 1 of 3' dialogue is displayed:

7) In the 'Original data type' panel, select the 'Delimited' option and then select the **Next >** button. The 'Text Import Wizard – Step 2 of 3' dialogue is displayed:



8) In the ‘Delimiters’ panel, select the ‘Comma’ checkbox. Select the **Next >** button. The ‘Text Import Wizard – Step 3 of 3’ dialog is displayed:

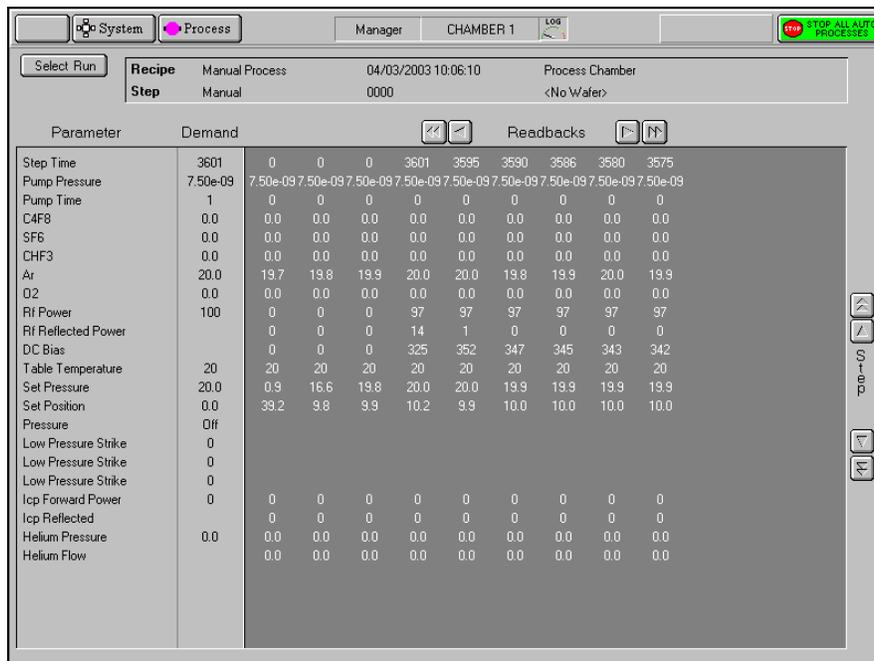


9) In the ‘Column data format’ panel, ensure that the ‘General’ option is selected and then select the **Finish** button. The process run log data is now displayed in the Excel worksheet.

10) Adjust the column widths so that all text is visible and then save the spreadsheet.

Run Log Page

The Run Log page is accessed from the Select Run page by clicking on the **View Run** button with any process run other than a leak detection run or MFC calibration run selected.



Parameter	Demand	Readbacks														
Step Time	3601	0	0	0	3601	3595	3590	3586	3580	3575						
Pump Pressure	7.50e-09	7.50e-09	7.50e-09	7.50e-09	7.50e-09	7.50e-09	7.50e-09	7.50e-09	7.50e-09	7.50e-09						
Pump Time	1	0	0	0	0	0	0	0	0	0						
C4F8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
SF6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
CHF3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
Ar	20.0	19.7	19.8	19.9	20.0	20.0	19.8	19.9	20.0	19.9						
O2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
Rf Power	100	0	0	0	97	97	97	97	97	97						
Rf Reflected Power	0	0	0	0	14	1	0	0	0	0						
DC Bias	0	0	0	0	325	352	347	345	343	342						
Table Temperature	20	20	20	20	20	20	20	20	20	20						
Set Pressure	20.0	0.9	16.6	19.8	20.0	20.0	19.9	19.9	19.9	19.9						
Set Position	0.0	39.2	9.8	9.9	10.2	9.9	10.0	10.0	10.0	10.0						
Pressure Off	0															
Low Pressure Strike	0															
Low Pressure Strike	0															
Low Pressure Strike	0															
Icp Forward Power	0	0	0	0	0	0	0	0	0	0						
Icp Reflected	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
Helium Pressure	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
Helium Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						

The page displays the Parameters, Demands and Readbacks for the selected log data.

The facilities provided on the page are as follows:

Select Run

Displays the Select Log page.

Log information panel Displays details about the selected log data.

Parameter list Lists the logged parameter names

Demand list Displays the demanded parameter value

Readbacks list Displays the logged parameter values with respect to time at the log intervals specified for the process run. The list can be scrolled horizontally either by single readbacks or by page. The list can also be scrolled vertically to display further steps (for multi-step recipes).

Logfile

While PC 2000 is running, two log files are maintained, one for the system log and the other for the data log. These files are stored on your hard disk in the folder **C:\Optyslg**. Details of the log files are as follows.

System log file – The filename for this file is of the form **s0Caabb** where **aa** represents the month, e.g. 06 (for June) and **bb** represents the day of the month, e.g. 11 (for the eleventh day).

Data log file – The filename for this file is of the form **p1caabb** where **aa** represents the month, e.g. 06 (for June) and **bb** represents the day of the month, e.g. 11 (for the eleventh day).

When PC 2000 is shut down correctly (select the System menu, then the **Exit** option), both log files are automatically saved and closed. If PC 2000 is then started again, the files are automatically opened and their data is available via the System Log page and the Select Log Data page.

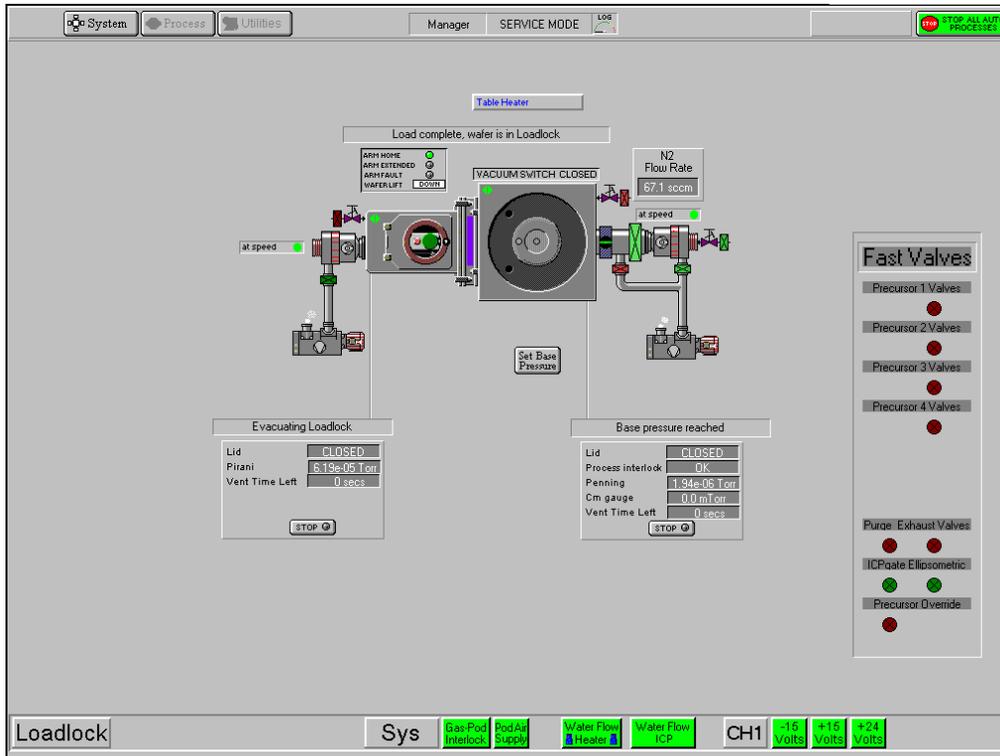
If PC 2000 is not shut down correctly, e.g. the PC is switched off or the PC ‘hangs’ etc., one or both of the log files can become corrupted. If this happens, the next time PC 2000 is started the

corrupt log file(s) will be detected and reported on-screen by an error dialogue. To correct this problem, use the following procedure:

- 1) Close PC 2000.
- 2) Use Windows Explorer to navigate to **C:\Optsyslg**.
- 3) Delete the reported log file.
- 4) Re-start PC 2000.

Service Mode

The Service Mode page is displayed by selecting the **System** button, then the **Service** option.



CAUTION

The software interlocks which prevent collisions between the wafer, robot arm, slit valve and the wafer clamp are overridden in the Service Mode. Therefore, before clicking on any button, consider very carefully the consequences of your proposed actions.

This page is used during maintenance to manually control system components. The page can also be used to manually transfer wafers between the Automatic load lock and process chamber.

Manual control of the following features is available by clicking on them (confirmation is requested before any action is carried out):

Note that moving the mouse pointer over a feature will cause a box to be displayed around the feature indicating that it can be manually controlled.

- Process chamber wafer lift.
- Process chamber vent valve.
- Process chamber turbo pump.
- Process chamber gate valve.
- Process chamber APC valve.
- Process chamber roughing valve.
- Process chamber isolating valve and purge valve.
- Process chamber rotary vane/dry pump.

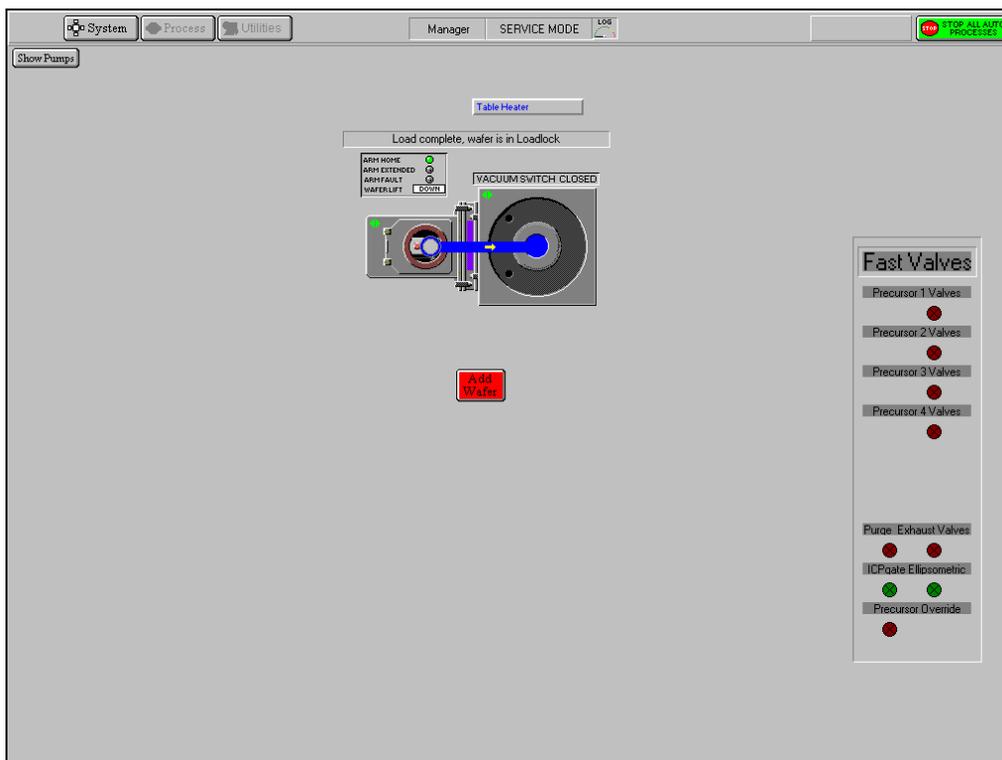
- i) Automatic load lock isolating valve.
- j) Automatic load lock vent valve.
- k) Automatic load lock rotary vane/dry pump.
- l) Slit valve.

NOTE: The Table Heater button is used to calibrate the table heater PID (Proportional, Integral, Derivative) controller. As this has been carried out during Final Test of the system before shipment, it should not need re-calibration. However, if a message is displayed indicating that table heater calibration is required (during system operation), refer to sub-section 6.12.

The **Fast Valves** panel provides control of the individual fast valves – click on a valve to open it – its colour will change to green.

Transferring Wafer

To transfer wafers between chambers in service mode, click on the wafer mimic (either in the Automatic load lock or process chamber). The following screen is displayed:



Click on the wafer destination. The wafer will be transferred.

The **ADD WAFER** button is used to inform the system that a wafer is present. This facility would be used if the machine were powered-up with a wafer in the Automatic load lock. The legend on this button changes to **KILL WAFER** when a wafer is present, enabling the selected wafer to be removed from system memory.

The page provides the following facilities:

Show Pumps button

Displays the Pump Control page

Message field Displays status messages about the wafer transfer.

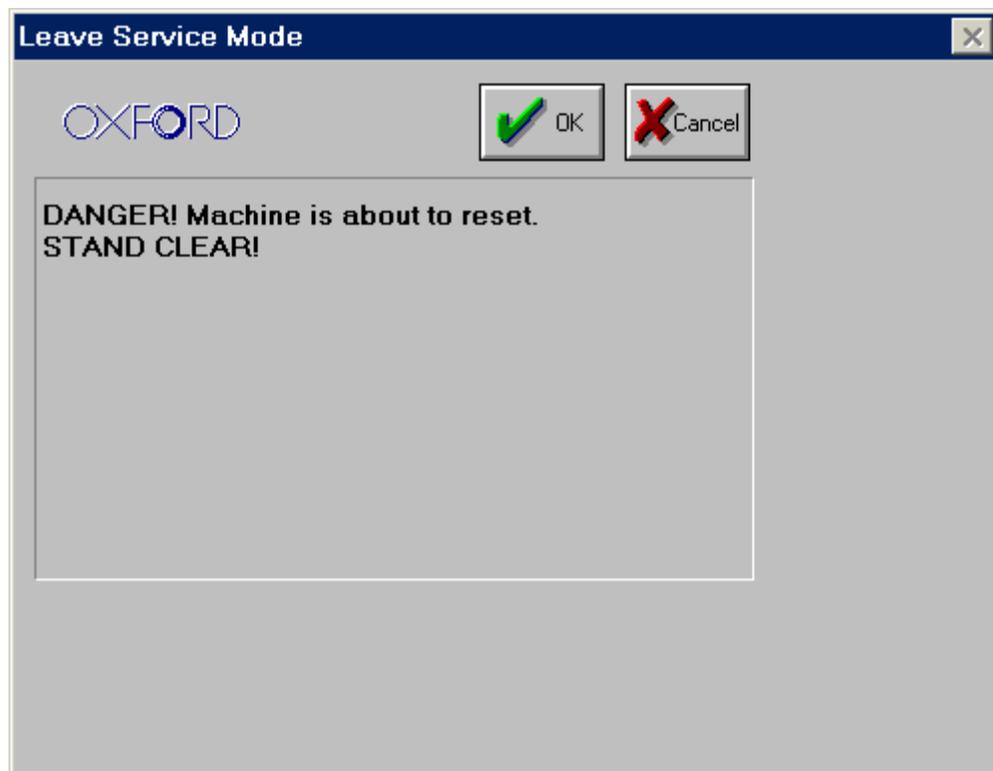
Add/Kill Wafer button

The **ADD WAFER** button is used to inform the system that a wafer is present. This facility would be used if the machine were powered-up with a wafer in the Automatic load lock. The legend on this button changes to

KILL WAFER when a wafer is present, enabling the selected wafer to be removed from system memory.

Wafer transfer path Displayed when the wafer mimic has been clicked. An arrow indicates the direction of the possible transfer. Clicking on the destination will cause the transfer to be carried out.

Existing from Service Mode



To exit from service mode, select the system menu and then the **Exit Service** option. The following dialogue box is displayed:

Ensure that there are no personnel close to the system, and then select the **OK** button.

After exiting from service mode, the system configuration will depend on which service mode facilities were used as follows:

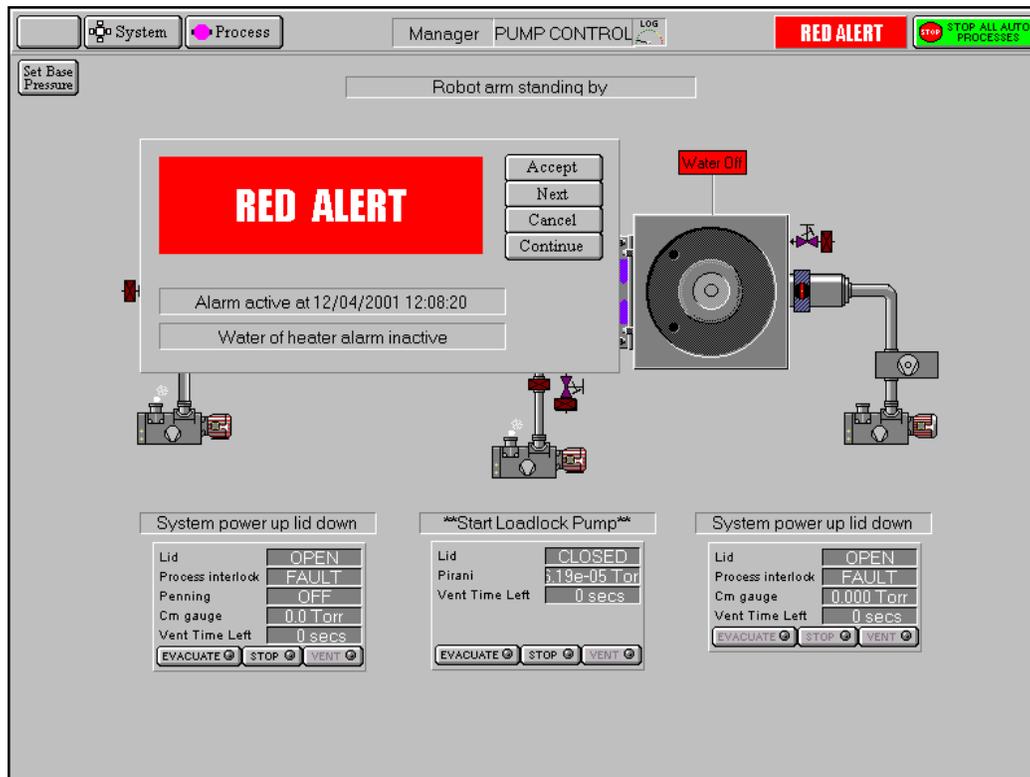
- a) If no service mode facilities were used, e.g. no valves were open or closed; the system configuration will be the same as it was before entering service mode.
- b) If the service facilities were used, the system configuration will depend on which of the facilities were used as follows.

To prevent damage to the system, any chamber which had any of its features altered in service mode, e.g. valves opened/closed, pumps turned on/off etc., will have its pumping stopped. All other chambers will continue to be pumped.

To return the chamber which had its pumping stopped to the pumping or vent state, click on the associated **Stop** button, and then on the **Evacuate** button or the **Vent** button as required. The chamber will then pump down or vent.

System Alert

System alerts are displayed when PC 2000 detects an event that requires the attention of the user. Each alert is automatically categorised depending on the nature of the event and the response required by the user. The category of the event can range from a warning indicating that a service parameter is out of tolerance to a process abort indicating that a process setpoint has been out of tolerance for so long that the process cannot be completed.



The alert is displayed as a banner in the menu bar at the top of the screen with an associated dialogue in the main screen area. Note that more than one alert can be active at the same time, each requiring action by the user in turn.

There are three categories of alert indicated by the colour and text displayed in the banner and dialogue:

Blue Warning e.g. water flow low.

Yellow Hazard – not currently used.

Red Process abort, e.g. high-reflected RF power.

A user logged on at any access level can close the alert dialogue, but only a user logged on as a system manager can clear the alert banner from the menu bar. The dialogue options are:

Accept button: System Managers only. Clear the alert and log it.

Next button: View the next alert.

Cancel button: System Manager only. Clear the alert; do not log it.

Continue button: Close the alert dialogue box – the alert banner remains displayed on the menu bar.

Note that option buttons that are not available (i.e. **Accept** and **Cancel** due to user 'logged on' status and **Next** when there is only one active alert) are greyed out.

The alert message usually contains an adequate description of the detected event. If it is a service fault (water flow, purge gas etc.) then verify that the service is available to the machine as soon as possible. Depending on the nature of the service, the system may allow the machine to continue to operate, so that the current process can be completed. Do not start a new process before checking the service.

The red alerts are often due to a process setpoint being out of tolerance for too long. In these cases, the process is halted by the system. If it is authorised to resume processing with a parameter deviation then:

- 1) Check the most recent process log to find the process time remaining.
 - 2) Construct a new process with a modified process time and check the 'Ignore tolerance' option.
- Note that this removes all tolerance checking. The machine should be monitored by an operator for further deviations when operated in this condition.

Operation the Precursor Delivery Module

Operating instructions for the precursor delivery module are given in Appendix PDM.

However, the following **CAUTIONS** must be observed before using the system.

CAUTION

Do not operate in bubbler mode with low flows, below 10 sccm. The flow must be sufficient to maintain the pressure upstream of the inlet valve above the backpressure of liquid and vapour: of order 30 mbar for water.

CAUTION

Do not begin vapour delivery until the delivery pipe and chamber are at temperature.

CAUTION

Do not disconnect the precursor or undo any internal joint unless the precursor pot is at ambient temperature.

CAUTION

Do not fit the glove box front unless the oven temperature is below 40°C.

CAUTION

Before using a precursor, ensure that the Rotary pump purge is running.

Create User Account

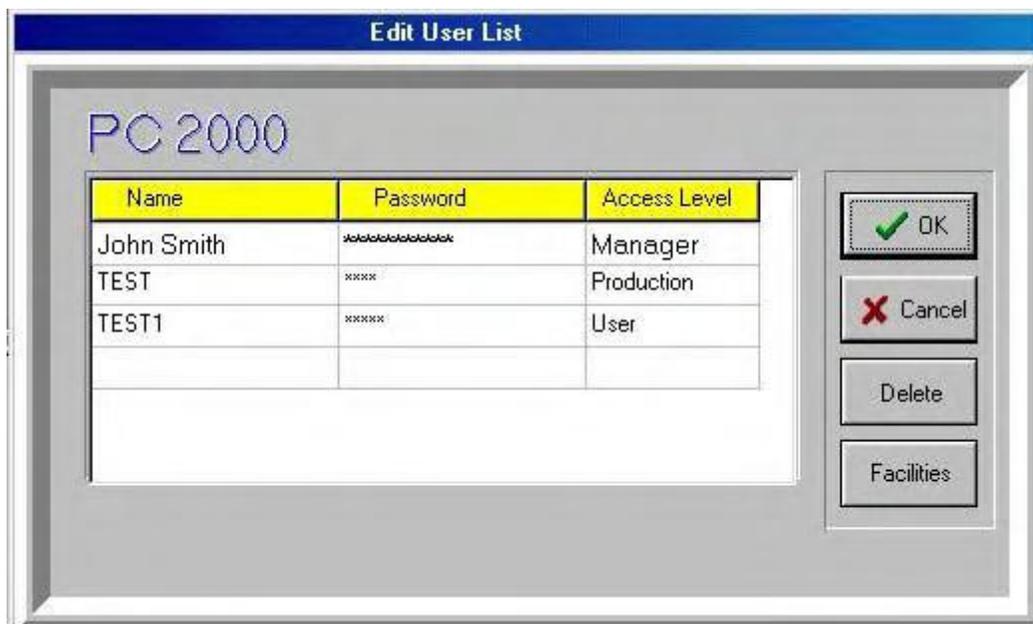
Users details, i.e. names, passwords and facility access options can be edited by a person logged on as a Manager. To do this, use the following steps:

- 1) Log on as a Manager (see sub-section 5.3.2).
- 2) Select the **System** Menu, and then the **Password** option. The Access Control dialogue box is displayed.



The image shows a software dialog box titled "Access Control". At the top left, it displays "PC 2000" in blue and "V1.1" in black. The dialog is divided into two main sections. The upper section contains three labels: "Current User" with a grey button labeled "John Smith", "Access Level" with a grey button labeled "Manager", and "Demonstration" with a checked checkbox. To the right of these are three buttons: "OK" with a green checkmark, "Cancel" with a red X, and "Edit Users". The lower section contains two labels: "Enter Name" with an empty text input field, and "Enter Password" with an empty password input field. To the right of these are a "Verify" button and three small person icons.

- 3) Select the **Edit Users** button. The Edit User List is displayed.



4) To add a new user, click on the Name and Password cells then enter the required details (remember that text entered into the Password cell is case sensitive). Clicking on the Access Level cell will display a scrollable drop-down list with the following options:

Option	Result
Quit	Exit from the drop-down list.
View_Only	All Facilities automatically disabled.
User	A set of Facilities can be selected, see Step 5.
Production	See sub-section 5.3.8 (page 5-18).
Maintenance	A special set of Facilities is automatically enabled. Note that this access level has its own recipes and steps for maintenance and does not allow access to process recipes and steps, or allow the system log to be viewed.
Manager	All Facilities automatically enabled.

Select one of the access levels for the new user.

Similarly, existing Names, Passwords and Access Levels can be edited. In addition, existing entries can be removed from the list by selecting a name and then selecting the **Delete** button.

5) The Facilities enabled for 'User' (selected in Step 4) can be edited by selecting the Facilities button while the cursor is in the name field for that user. This will display the Edit User Facilities dialogue box.



6) Click on the appropriate checkboxes to enable the facilities available to the selected name. Click on the **OK** button to accept the entered data and exit. Note that the enabled facilities are dependent on the name and not on the access level, e.g. two people logged on as users can have different sets of facilities enabled.