What is claimed is:

1. An apparatus for processing a substrate, comprising:

a process chamber;

an RF source to provide RF energy to form a plasma in the process chamber;

a component disposed in the process chamber so as to be heated by the plasma when formed;

a heater configured to heat the component;

a heat exchanger configured to remove heat from the component; and

a chiller coupled to the heat exchanger via a first flow conduit having an on/off flow control valve disposed therein and a bypass loop to bypass the flow control valve, wherein the bypass loop has a flow ratio valve disposed therein.

2. The apparatus of claim 1, further comprising:

a controller for turning the controllable valve on or off.

3. The apparatus of claim 2, further comprising a temperature measuring device to indicate a temperature of the component, and wherein the controller operates according to the following control parameters:

if $T > T_{sp} + dT_{UL}$	open controllable valve
if $T < T_{sp} - dT_{LL}$	close controllable valve

where T_{sp} is a target temperature set point, dT_{UL} is a predetermined upwards temperature difference, and dT_{LL} is a predetermined lower temperature difference.

4. The apparatus of claim 2, further comprising:

a temperature measuring device situated to indicate a temperature of the component; and

input(s) into the controller indicating the power going to the plasma forming electrodes or groups of such electrodes;

wherein the controller substantially operates according to the following control parameters:

if $\sum\omega_i P_i > P_{UL}$ and $T > T_{sp} - dT_{LL}$	open controllable valve
if $\sum\omega_i P_i < P_{LL}$ and $T < T_{sp} + dT_{UL}$	close controllable valve

where T_{sp} is the target temperature, dT_{UL} is a predetermined upwards temperature difference, dT_{LL} is a predetermined lower temperature difference, P_i is the power consumption of one of i = 1 to n plasma-forming electrodes and/or groups thereof, where ω_i is a weighting factor for one of i = 1 to n sources of RF power being delivered to the process chamber, P_{UL} is a predetermined upper limit for summed power consumption, and P_{LL} is a predetermined lower limit for summed power consumption.

5. The apparatus of claim 4, wherein the controller further controls the control valve according to the following control parameters:

if $T > T_{sp} + dT_{UL}$	open controllable valve
if $T < T_{sp} - dT_{LL}$	close controllable valve

where T_{sp} is the target temperature, dT_{UL} is a predetermined upwards temperature difference, and dT_{LL} is a predetermined lower temperature difference.

6. The apparatus of claim 1, wherein the component is a showerhead for injecting gas into the process chamber or an electrostatic chuck for retaining a substrate.

7. A method of controlling the temperature of component in a process chamber that is heated by a plasma when formed, heated by a heater, and cooled by a coolant fluid flow through a heat exchanger, the method comprising:

providing a coolant at a first flow rate to the heat exchanger when the component requires a first cooling rate; and

providing the coolant at a second flow rate to the heat exchanger when the component requires a second cooling rate, wherein the first flow rate and the second flow rate are both non-zero and non-equal.

8. The method of claim 7, wherein the first coolant flow is provided through a first flow conduit having an on/off flow control valve disposed therein and wherein providing the second coolant fluid flow further comprises:

bypassing the first flow conduit by closing the flow control valve and flowing the coolant through a bypass loop having a flow ratio valve disposed therein to set the second flow rate to a rate less than the first flow rate.

9. The method of claim 8, further comprising:

determining that a temperature of the component is greater than an upper temperature limit; and

opening the control valve to provide the coolant at the first flow rate.

10. The method of claim 8, further comprising:

determining that a temperature of the component is less than a lower temperature limit; and

closing the control valve to provide the coolant at the second flow rate.

11. The method of claim 8, further comprising:

determining that a power factor is greater than a predetermined upper limit, wherein the power factor corresponds to the total RF power being delivered to the process chamber;

determining that a temperature of the component is greater than a lower temperature limit; and

opening the control valve to provide the coolant at the first flow rate.

12. The method of claim 11, wherein the power factor equals the sum of a weighting factor times the power applied from an RF source coupled to the process chamber for all RF sources coupled to the process chamber.

13. The method of claim 8, further comprising:

determining that a power factor is less than a predetermined lower limit, wherein the power factor corresponds to the total RF power being delivered to the process chamber;

determining that a temperature of the component is less than an upper temperature limit; and

closing the control valve to provide the coolant at the second flow rate.

14. The method of claim 13, wherein the power factor equals the sum of a weighting factor times the power applied from an RF source coupled to the process chamber for all RF sources coupled to the process chamber.

15. The method of claim 8, further comprising:

determining that a power factor is greater than a predetermined upper limit, wherein the power factor corresponds to the total RF power being delivered to the process chamber;

determining that a temperature of the component is greater than a lower temperature limit;

opening the control valve to provide the coolant at the first flow rate;

determining that a power factor is less than a predetermined lower limit, wherein the power factor corresponds to the total RF power being delivered to the process chamber;

determining that a temperature of the component is less than an upper temperature limit; and

closing the control valve to provide the coolant at the second flow rate.

CLAIMS

1. An apparatus for processing a substrate, comprising:

a process chamber;

an RF source to provide RF energy to form a plasma in the process chamber;

a component disposed in the process chamber so as to be heated by the plasma when formed;

a heater configured to heat the component;

a heat exchanger configured to remove heat from the component;

a chiller coupled to the heat exchanger via a first flow conduit having an on/off flow control valve disposed therein and a bypass loop to bypass the flow control valve, wherein the bypass loop has a flow ratio valve disposed therein; and

a controller for opening or closing the flow control valve based on (A) a comparison of a temperature of the component to a predetermined temperature threshold and (B) a comparison of a power factor to a predetermined power consumption threshold, wherein the power factor corresponds to a total power being delivered to the process chamber.

2. The apparatus of claim 1, further comprising a temperature measuring device to indicate a temperature of the component, and wherein the controller operates according to the following control parameters:

if $T > T_{sp} + dT_{UL}$	open flow control valve
if $T < T_{sp} - dT_{LL}$	close flow control valve

where T_{sp} is a target temperature set point, dT_{UL} is a predetermined upwards temperature difference, and dT_{LL} is a predetermined lower temperature difference.

3. The apparatus of claim 1, further comprising:

a temperature measuring device situated to indicate a temperature of the component; and

input(s) into the controller indicating the power going to the plasma forming electrodes or groups of such electrodes;

wherein the controller substantially operates according to the following control parameters:

if $\sum\omega_i P_i > P_{UL}$ and $T > T_{sp} - dT_{LL}$	open flow control valve
if $\sum\omega_i P_i < P_{LL}$ and $T < T_{sp} + dT_{UL}$	close flow control valve

where T_{sp} is the target temperature, dT_{UL} is a predetermined upwards temperature difference, dT_{LL} is a predetermined lower temperature difference, P_i is the power consumption of one of i = 1 to n plasma-forming electrodes and/or groups thereof, where ω_i is a weighting factor for one of i = 1 to n sources of RF power being delivered to the process chamber, P_{UL} is a predetermined upper limit for summed power consumption, and P_{LL} is a predetermined lower limit for summed power consumption.

4. The apparatus of claim 3, wherein the controller further controls the control valve according to the following control parameters:

if $T > T_{sp} + dT_{UL}$	open flow control valve
if $T < T_{sp} - dT_{LL}$	close flow control valve

where T_{sp} is the target temperature, dT_{UL} is a predetermined upwards temperature difference, and dT_{LL} is a predetermined lower temperature difference.

5. The apparatus of claim 1, wherein the component is a showerhead for injecting gas into the process chamber.

6. The apparatus of claim 1, wherein the component is an electrostatic chuck for retaining a substrate.

7. A method of controlling the temperature of component in a process chamber that is heated by a plasma when formed, heated by a heater, and cooled by a coolant fluid flow through a heat exchanger, the method comprising:

providing a coolant at a first flow rate to the heat exchanger when the component requires a first cooling rate; and

providing the coolant at a second flow rate to the heat exchanger when the component requires a second cooling rate, wherein the first flow rate and the second flow rate are both non-zero and non-equal,

wherein the determination of when to provide the coolant at the first or second flow rates is accomplished by (A) comparing a temperature of the component to a predetermined temperature threshold and (B) comparing a power factor to a predetermined power consumption threshold, wherein the power factor corresponds to a total power being delivered to the process chamber.

8. The method of claim 7, wherein the first flow rate is provided through a first flow conduit having an on/off flow control valve disposed therein and wherein providing the second flow rate further comprises:

bypassing the first flow conduit by closing the flow control valve and flowing the coolant through a bypass loop having a flow ratio valve disposed therein to set the second flow rate to a rate less than the first flow rate.

9. The method of claim 8, further comprising:

determining that a temperature of the component is greater than an upper temperature limit; and

opening the control valve to provide the coolant at the first flow rate.

10. The method of claim 8, further comprising:

determining that a temperature of the component is less than a lower temperature limit; and

closing the control valve to provide the coolant at the second flow rate.

11. The method of claim 8, further comprising:

determining that a power factor is greater than a predetermined upper limit, wherein the power factor corresponds to the total RF power being delivered to the process chamber;

determining that a temperature of the component is greater than a lower temperature limit; and

opening the control valve to provide the coolant at the first flow rate.

12. The method of claim 11, wherein the power factor equals the sum of a weighting factor times the power applied from an RF source coupled to the process chamber for all RF sources coupled to the process chamber.

13. The method of claim 8, further comprising:

determining that a power factor is less than a predetermined lower limit, wherein the power factor corresponds to the total RF power being delivered to the process chamber;

determining that a temperature of the component is less than an upper temperature limit; and

closing the control valve to provide the coolant at the second flow rate.

14. The method of claim 13, wherein the power factor equals the sum of a weighting factor times the power applied from an RF source coupled to the process chamber for all RF sources coupled to the process chamber.

15. The method of claim 8, further comprising:

determining that a power factor is greater than a predetermined upper limit, wherein the power factor corresponds to the total RF power being delivered to the process chamber;

determining that a temperature of the component is greater than a lower temperature limit;

opening the control valve to provide the coolant at the first flow rate;

determining that a power factor is less than a predetermined lower limit, wherein the power factor corresponds to the total RF power being delivered to the process chamber;

determining that a temperature of the component is less than an upper temperature limit; and

closing the control valve to provide the coolant at the second flow rate.

16. An apparatus for controlling coolant fluid flow rates used to control a temperature of a component in a process chamber that is heated by a plasma when formed, heated by a heater, and cooled by a coolant fluid flow through a heat exchanger, comprising:

a controller, electrically coupled to a flow control valve, to turn the flow control valve on or off; and

at least one input into the controller indicating electrical power going to the plasma forming electrodes or groups of such electrodes,

wherein the flow control valve is disposed in a first flow conduit between a chiller and the heat exchanger,

wherein the controller opens or closes the flow control valve based on a comparison of a power factor to a predetermined power consumption threshold, wherein the power factor corresponds to a total electrical power being delivered to the process chamber, and

wherein when the controller closes the flow control valve based on the comparison of the power factor to the predetermined power consumption threshold, the coolant fluid flows through a bypass loop to bypass the flow control valve, wherein the bypass loop has a flow ratio valve disposed therein.