CLAIMS

1. A control system for controlling the flow of refrigerant between a refrigeration system and a cooling loop within a semiconductor processing chamber such that leakage of refrigerant is inhibited when connecting or disconnecting said refrigeration system from said cooling loop, said control system comprising:

an inlet valve configured to selectively isolate or couple a supply path for supplying refrigerant from said refrigeration system with an inlet of said cooling loop;

an outlet valve configured to selectively isolate or couple a return path for returning refrigerant to said refrigeration system with an outlet of said cooling loop;

a refrigerant collection valve configured to selectively isolate or couple a refrigerant collection path for collecting refrigerant for said refrigeration system with said cooling loop;

a pressure sensor for determining a pressure of refrigerant in said cooling loop;

an input for receiving cooling loop disconnect and connect commands; and

control circuitry configured to receive signals from said pressure sensor and said commands from said input and to generate control signals for controlling the opening and closing of said inlet, outlet and refrigerant collection valves in response thereto, wherein said control circuitry is configured in response to receipt of said cooling loop disconnect command to:

control a compressor in said refrigeration system to turn off;

control said inlet valve and said outlet valve such that they are closed;

control said refrigerant collection valve to be open;

activate a pump to pump refrigerant from said cooling loop towards said refrigeration system along said refrigerant collection path;

determine from said pressure sensor a pressure in said cooling loop and in response to said pressure falling below a predetermined evacuated value:

control said pump to turn off;

control said refrigerant collection valve to close; and

after a predetermined time determine whether said pressure in said cooling loop is increasing by more than a predetermined amount and if not generate an indication that said cooling loop may be safely disconnected from said refrigeration system.

2. A control system according to claim 1, wherein said pump comprises said compressor.

3. A control system according to claim 1, further comprising a pump, said pump being configured to pump refrigerant from said cooling loop along said refrigerant collection path.

4. A control system according to claim 3, said control system further comprising a buffer volume on said refrigerant collection path and a further valve configured to selectively isolate or couple said refrigerant collection path with said compressor, said control circuitry being configured to control said further valve to be closed prior to activating said pump, such that on activation said pump pumps said refrigerant from said cooling loop into said buffer volume.

5. A control system according to any preceding claim, said control system further comprising a return path valve configured to selectively isolate or couple said return path with said compressor, said control circuitry being configured to control said return path valve to be closed when controlling said inlet valve and said outlet valve to be closed.

6. A control system according to any preceding claim, said control system further comprising a bypass valve configured to selectively isolate or couple a warmer refrigerant bypass path for supplying warmer refrigerant from said compressor, said control circuitry being configured to control said bypass valve to be closed when controlling, said inlet valve and said outlet valve to be closed.

7. A control system according to any preceding claim, said control system comprising a trace gas source and a trace gas valve configured to selectively isolate or couple said trace gas source with said cooling loop, said control circuitry being configured to control said trace gas valve.

8. A control system according to any preceding claim, said control system comprising an exhaust valve to selectively isolate or couple said cooling loop with an exhaust pump, said control circuitry being configured to control said exhaust valve.

9. A control system according to claim 7 and 8, said control system being configured in response to receipt of a cooling loop connect command to:

control said inlet valve, outlet valve, refrigerant collection valve and exhaust valve such that they are closed;

control said trace gas valve to open such that trace gas from said trace gas source flows into said cooling loop;

determine a pressure in said cooling loop and in response to said pressure rising to or above a predetermined leak test value:

control said trace gas valve to close;

after a predetermined time determine whether said pressure in said cooling loop is decreasing by more than a predetermined leak test amount and if not:

control said exhaust valve to open such that trace gas from said cooling loop is evacuated;

determine a pressure in said cooling loop and in response to said pressure falling to or below a predetermined exhaust value:

control said exhaust valve to close;

determine a pressure in said cooling loop and in response to said pressure increasing by less than a predetermined leakage amount indicating that said cooling loop is correctly connected to said refrigeration system.

10. A control system according to claim 9, when dependent up on claim 4, said control system being configured in response to said indication that said cooling loop is correctly connected to said refrigeration system to open said further valve and after a predetermined time to close said further valve prior to starting said refrigeration system.

11. A control system according to claim 9 or 10, said control system being configured in response to an indication to start said refrigeration system to:

control said refrigerant collection valve, trace gas valve and exhaust valve to be closed; and

control said inlet valve and said outlet valve to open; and

to activate said compressor.

12. A refrigeration system for supplying refrigerant to a cooling loop in a semiconductor processing chamber, said refrigeration system comprising:

a compressor;

a refrigerant supply path for supplying refrigerant from said compressor to said cooling loop;

a refrigerant return path for receiving refrigerant from said cooling loop and returning said refrigerant to said compressor;

at least one heat exchanger for exchanging heat between said refrigerant supply and return path; and

a control system according to any preceding claim.

13. A method of controlling the flow of refrigerant between a refrigeration system and a cooling loop within a semiconductor processing chamber such that leakage of refrigerant is inhibited when disconnecting said refrigeration system from said cooling loop, said method comprising:

controlling a compressor in said refrigeration system to turn off;

controlling an inlet valve on a refrigerant supply path and an outlet valve on a refrigerant return path such that they are closed;

controlling a refrigerant collection valve on a refrigerant collection path to be open;

activating a pump to pump refrigerant from said cooling loop towards said refrigeration system along said refrigerant collection path;

determining a pressure in said cooling loop and in response to said pressure falling below a predetermined evacuated value:

controlling said pump to turn off;

controlling said refrigerant collection valve to close; and

after a predetermined time determining whether said pressure in said cooling loop is increasing by more than a predetermined amount and if not generating an indication that said cooling loop may be safely disconnected from said refrigeration system.

14. A method of controlling the flow of refrigerant between a refrigeration system and a cooling loop within a semiconductor processing chamber such that leakage of refrigerant is inhibited when connecting said refrigeration system to said cooling loop, said method comprising:

controlling an inlet valve, outlet valve, refrigerant collection valve and exhaust valve such that they are closed;

controlling a trace gas valve to open such that trace gas from a trace gas source flows into said cooling loop;

determining a pressure in said cooling loop and in response to said pressure rising to or above a predetermined leak test value:

controlling said trace gas valve to close;

after a predetermined time determining whether said pressure in said cooling loop is decreasing by more than a predetermined leak test amount and if not:

controlling said exhaust valve to open such that trace gas from said cooling loop is evacuated;

determining a pressure in said cooling loop and in response to said pressure falling to or below a predetermined exhaust value:

controlling said exhaust valve to close;

determining a pressure in said cooling loop and in response to said pressure increasing by less than a predetermined leakage amount:

generating an indication that said cooling loop is correctly connected to said refrigeration system.

15. A computer program which when executed by a processor is configured to control said processor to perform a method according to claim 13 or 14.