CLAIMS:

What is claimed is:

1. A refrigeration system comprising:

a compressor having a first stage and a second stage;

a motor driving the compressor;

a heat rejecting heat exchanger having a fan drawing ambient fluid over the heat rejecting heat exchanger, the heat rejecting heat exchanger including an intercooler and a gas cooler, the intercooler coupled to an outlet of the first stage and the gas cooler coupled to an outlet of the second stage;

a flash tank coupled to an outlet of the gas cooler;

a primary expansion device coupled to an outlet of the flash tank;

a heat absorbing heat exchanger coupled to an outlet of the primary expansion device, an outlet of the heat absorbing heat exchanger coupled to the suction port of the first stage;

a controller for implementing a pulldown mode for cooling a space to a control temperature within a band of a control temperature setpoint, a control mode for maintaining the control temperature within the band of the control temperature setpoint and a staging logic mode for reducing system capacity while maintaining the control temperature within the band range of the control temperature setpoint.

2. The refrigeration system of claim 1 further comprising:

a secondary expansion device positioned between the gas cooler and the flash tank;

the pulldown mode includes controlling the secondary expansion device to control discharge pressure at the compressor.

3. The refrigeration system of claim 1 wherein:

the pulldown mode includes controlling the primary expansion device to control the heat absorbing heat exchanger superheat temperature.

4. The refrigeration system of claim 1 wherein:

the control mode includes controlling drive signals to the motor to control the control temperature.

5. The refrigeration system of claim 4 wherein:

the motor is a variable frequency drive (VFD) motor.

6. The refrigeration system of claim 1 further comprising:

a secondary expansion device positioned between the gas cooler and the flash tank;

the control mode includes controlling the secondary expansion device to control discharge pressure at the compressor.

7. The refrigeration system of claim 1 wherein:

the control mode includes controlling the primary expansion device to control the heat absorbing heat exchanger superheat temperature.

8. The refrigeration system of claim 1 further comprising:

a heater;

the control mode includes controlling the heater to maintain the control temperature within the band of the control temperature setpoint.

9. The refrigeration system of claim 1 wherein:

the staging logic mode includes modulating the fan to reduce system capacity.

10. The refrigeration system of claim 1 further comprising:

an economizer valve coupling the flash tank to an inlet of the second stage;

wherein the staging logic mode includes closing the economizer valve.

11. The refrigeration system of claim 1 further comprising:

an unload valve coupling an outlet of the intercooler to the suction port of the first stage;

wherein the staging logic mode includes opening the unload valve.

12. The refrigeration system of claim 1 wherein:

the staging logic mode includes modulating the fan to control the control temperature.

13. The refrigeration system of claim 1 wherein:

the controller implements an off integrator, the off integrator tracking an amount of error accumulated by the system when the control temperature is below the control temperature setpoint.

14. The refrigeration system of claim 13 wherein:

the off integrator sums the difference between the control temperature and the control temperature setpoint over time.

15. The refrigeration system of claim 14 wherein:

wherein when the sum difference exceeds an off integrator limit, the controller implements a shut down mode.

CLAIMS

1. A refrigeration system (10) comprising:

a compressor (20) having a first stage (20a) and a second stage (20b);

a motor (22) driving the compressor (20);

a heat rejecting heat exchanger (40) having a fan (44) drawing ambient fluid over the heat rejecting heat exchanger (40), the heat rejecting heat exchanger (40) including an intercooler and a gas cooler (41), the intercooler (43) coupled to an outlet of the first stage (20a) and the gas cooler (41) coupled to an outlet of the second stage (20b);

a flash tank (70) coupled to an outlet of the gas cooler (41);

a primary expansion device (55) coupled to an outlet of the flash tank (70);

a heat absorbing heat exchanger (50) coupled to an outlet of the primary expansion device (55), an outlet of the heat absorbing heat exchanger (50) coupled to the suction port of the first stage (20a);

an economizer valve (73) coupling the flash tank (70) to an inlet of the second stage (20b);

an unload valve coupling (93) an outlet of the intercooler (43) to the suction port of the first stage (20a); and

a controller (100) which is configured for for implementing a pulldown mode for cooling a space to a control temperature within a band of a control temperature setpoint, a control mode for maintaining the control temperature within the band of the control temperature setpoint and a staging logic mode for reducing system capacity while maintaining the control temperature within the band range of the control temperature setpoint,

wherein the staging logic mode includes closing the economizer valve (73) and opening the unload valve (93).

2. The refrigeration system (10) of claim 1 further comprising:

a secondary expansion device (65) positioned between the gas cooler (41) and the flash tank (70);

the pulldown mode includes controlling the secondary expansion device (65) to control discharge pressure at the compressor (20).

3. The refrigeration system (10) of claim 1 wherein:

the pulldown mode includes controlling the primary expansion device (55) to control the heat absorbing heat exchanger (50) superheat temperature.

4. The refrigeration system (10) of claim 1 wherein:

the control mode includes controlling drive signals to the motor (22) to control the control temperature.

5. The refrigeration system (10) of claim 4 wherein:

the motor (22) is a variable frequency drive (VFD) motor.

6. The refrigeration system (10) of claim 1 further comprising:

a secondary expansion device (65) positioned between the gas cooler (41) and the flash tank (70);

the control mode includes controlling the secondary expansion device (65) to control discharge pressure at the compressor (20).

7. The refrigeration system (10) of claim 1 wherein:

the control mode includes controlling the primary expansion device (55) to control the heat absorbing heat exchanger (50) superheat temperature.

8. The refrigeration system (10) of claim 1 further comprising:

a heater (51);

the control mode includes controlling the heater (51) to maintain the control temperature within the band of the control temperature setpoint.

9. The refrigeration system (10) of claim 1 wherein:

the staging logic mode includes modulating the fan (44) to reduce system capacity.

10. The refrigeration system (10) of claim 1 wherein:

the staging logic mode includes modulating the fan (44) to control the control temperature.

11. The refrigeration system (10) of claim 1 wherein:

the controller (100) implements an off integrator, the off integrator tracking an amount of error accumulated by the system when the control temperature is below the control temperature setpoint.

12. The refrigeration system (10) of claim 11 wherein:

the off integrator sums the difference between the control temperature and the control temperature setpoint over time.

13. The refrigeration system (10) of claim 12 wherein:

wherein when the sum difference exceeds an off integrator limit, the controller (100) implements a shut down mode.