RAE Corporation Sequence of Operation
Hot Gas Defrost – Alternating – Centinel Controller

General Description

The Alternating Hot Gas Defrost System is designed and engineered to allow one of two or more coils to defrost while the remaining coils continue to operate in normal refrigeration mode to condition the space. This arrangement provides a constant supply of hot gas needed for defrost.

The number of defrost per day can and should be matched to the frost load of the facility and may need to be adjusted after start up and a good profile is established. It is very important to monitor frost build up and not allow ice to build on the evaporator coils as it will decrease efficiency and has the potential to cause physical damage to the coils.

Refrigeration Mode

The compressor pumps discharge gas though the discharge pressure regulator (DPR) which is controlled by a solenoid. The DPR solenoid is energized opening the DPR to the wide open position. Refrigerant flows unrestricted though the condenser, receiver, expansion valve, and evaporator coils. The evaporator pressure regulator (EPR), which is controlled by a solenoid, is energized to the wide open position. Refrigerant flows from the EPR through the suction accumulators back to the compressor.
Note: The application of this EPR valve is not to maintain a suction pressure in the evaporator during refrigeration. It is to be set for defrost control only as described below.

The defrost line bleed solenoid remains energized anytime there is not active defrost to keep the defrost line between the main hot gas valve and the individual coil hot gas valves free of liquid refrigerant.

Defrost Mode

Force Run
The defrost cycle is initiated by one of the Centinel controllers. The liquid line solenoid valve (LLS) on defrosting unit cooler is de-energized causing it to close. All remaining units coolers on the circuit are forced into refrigeration by energizing their respective liquid line solenoid valves. Compressor unloading capability is locked out during defrost.

Warning: Centinel controllers must be set to initiate defrost at different times for each unit cooler to ensure there is enough hot gas available and to avoid flooding of the compressor. Recommended minimum is 30 minutes apart. More than one unit cooler cannot be in defrost at the same time.

Pre-Defrost Pumpout

The LLS on the defrosting unit cooler closes and its fan(s) are forced on until the coil temperature is raised to the room temperature. This ensures adequate hot gas is available at the start of the defrost cycle and that all liquid refrigerant is removed from the defrosting coil.

Defrost

After the pump out cycle, the following actions are taken concurrently:
- DPR solenoid is de-energized causing the valve to regulate
- Defrost line bleed solenoid de-energizes restricting flow
- Main hot gas solenoid is energized allowing gas flow
- Hot gas solenoid for the defrosting coil is energized allowing gas flow
- EPR valve is de-energized allowing the evaporator pressure to be regulated
- Evaporator Fans are disabled
- Condenser Fans are disabled except for the highest stage to prevent excessive head pressure

De-energizing the DPR valve during defrost allows adequate pressure and temperature at the hot gas defrost solenoid regardless of condenser conditions. In addition it allows flow through the condenser to properly operate unit coolers not in defrost.

Setting the DPR and EPR is a critical field adjustment that needs to be made at start-up to prevent damage to the system. Adjust valves out prior to setting. The pressures for both valves are set upstream of the valve.

Note: Set DPR and EPR valves during normal refrigeration mode. The approximate DPR and EPR settings should be the equivalent of the saturation pressure that corresponds to the following temperatures:

Table 1: DPR and EPR settings (Saturation Temperature °F).

Valve	Saturation Temp (°F)
DPR	95-100 °F
EPR	30-40 °F*

These temperatures are the max recommended and should be used as a starting point. The pressures should be set as low as possible while still allowing a timely defrost and not set so high that flooding occurs when terminating defrost.

During coil defrost the DPR valve and EPR valve are de-energized and regulating. Refrigerant flow for non-defrost coils is as described in refrigeration mode. The opening of the hot gas valve allows refrigerant flow from the discharge line to the unit cooler drain pan loop (if applicable) then to the side port connection on the distributor. A check valve must be installed between the side port connection and the outlet connection on the hot gas pan. The EPR valve regulates open on increasing pressure, refrigerant flows to the suction accumulators and back to the compressor.

Note: Although it is normal to have liquid refrigerant leave the defrosting coil in this sequence which will be captured by the suction accumulator(s), care should be taken during start up to minimize flooding. This can be done by proper adjustment of the regulator settings as described within this document.

Defrost Termination
The defrost cycle is terminated when the "Defrost Termination Temp" setpoint is reached. A sensing element mounted on the coil determines termination. This element should be mounted on the coldest coil circuit. The termination temperature, time, and sensor location is adjustable and should be set to field conditions by monitoring the first several defrosts to ensure the coil is clean prior to termination. Additionally, defrost should continue no longer than is needed to clear the coil as over defrost can lead to flooding problems.

The ideal defrost period is approximately 15 minutes per defrost. If the time is greater, you may need more defrosts per day. If the time is less, you may need to perform fewer defrosts per day.

Note: During start-up, setting the defrost termination at a higher than needed temperature can help in dialing in EPR valve and DPR valve.

Upon satisfying either the temperature or time setpoint of the Centinel controller, the following actions are taken concurrently:
- Main hot gas solenoid is de-energized stopping gas flow
- Hot gas solenoid for the defrosting coil is de-energized stopping gas flow
- EPR valve is energized opening the valve to the wide open position
- DPR valve is energized opening the valve to the wide open position
- Defrost line bleed solenoid is energized to open and allow residual refrigerant to be pumped out of the hot gas lines

Drain Time
A time delay is incorporated to postpone the final step of defrost to allow additional time for the melted frost to drain from the coil. 2 minutes (adjustable)

Post Defrost Fan Delay

After the drain cycle, the LLS energizes and opens. Unit cooler fans remain off until the coil temperature reaches 20°F (adjustable). This delay in starting fans allows residual moisture on the coil to re-freeze and prevents water carryover. The post defrost fan delay may perform sufficient frosting such that the fan delay time can be reduced.

The system is back in normal refrigeration mode and will continue cooling if the room thermostat is calling.

Revisions:

03/30/12 – Original

7/22/2013 – Revised for Centinel controller use