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Demand Response Leadership Since 1999

PLMA 35th Conference

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Leveraging Energy Efficiency Measures to create Demand Response Resources

- Advanced Refrigeration Controls
- Smart Energy Valves

Energy Efficiency

Advanced refrigeration controls and smart energy valves are valuable by themselves as energy efficiency measures.

Expected Annual Savings:

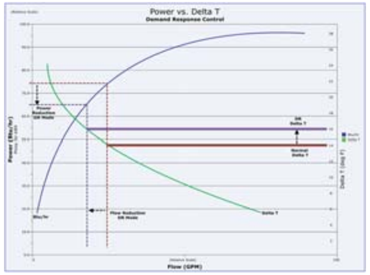
Refrigeration Control (3,962 square foot freezer)

Consumption:	81,000 kWh
Demand Reduction:	*74 kW*

Smart Energy Valve (One 4” (~130 tons) smart valve, standard office)

Consumption:	387,283 kWh**
Demand Reduction:	42 kW**

** *Calculations using the manufacturers Savings Calculator tool.*



Advanced Refrigeration Controls

Consumption Savings

Energy savings and demand management in refrigerated rooms through the intelligent control of:

- Compressor cycles
- Evaporator fan cycles
- Defrost cycles

Advanced Refrigeration Controls

Consumption Savings

- Compressor cycle savings

Controls minimize compressor runtime by stirring the air in the room before starting the compressor. Sometimes the compressor does not need to run at all, sometimes it runs for a shorter period.

Advanced Refrigeration Controls

Consumption Savings

- Evaporator fan cycle savings

Smart controls run evaporator fans based on demand, while mechanical controls leave evaporator fans running at all times except when defrosting. Overall fan run time is reduced.

Advanced Refrigeration Controls

Consumption Savings

- Defrost cycle savings

Demand based defrost senses frost development, and only runs defrost cycles when needed. Mechanical timers run defrost based on worst case conditions, often 3 to 4 fixed cycles per day.

Advanced Refrigeration Controls

Capturing DR kW Reduction

Advanced Refrigeration Control Results

- Reduce compressor duty cycle and lock out defrost cycles.
- Total load shed achieved was about 74 kW for a 3,962 Sq.Ft. freezer.
- Freezer temperatures stayed within 3ºF normal operating constraints throughout DR event.

Advanced Refrigeration Controls

Lessons Learned

- Defrost savings are significant but should only be used for EE, not for DR, so a combined EE/DR program is the best approach.
- Demand based defrost may save even more energy than projected at some times of year, depending on a thermal factors, weather conditions, and usage patterns.
- Some systems are very sensitive to sensor placement for correct operation, try to avoid those systems.
- Reporting intervals vary between manufacturers, look for systems that provide a 1 minute or better interval option to support diagnostics, even if your normal reporting interval is larger.
- Reporting features provide customer value and insight beyond the M&V requirements of the utility.
- Savings will vary from site to site, use good engineering practices rather than just accepting manufacturer claims.

Smart Energy Valves

- Significant kWh savings by optimizing Delta-T to the specific coil design.
- Energy savings comes from both reduced chiller demand and reduced pumping flow.

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Smart Energy Valves

DR kW Reduction (part 1)

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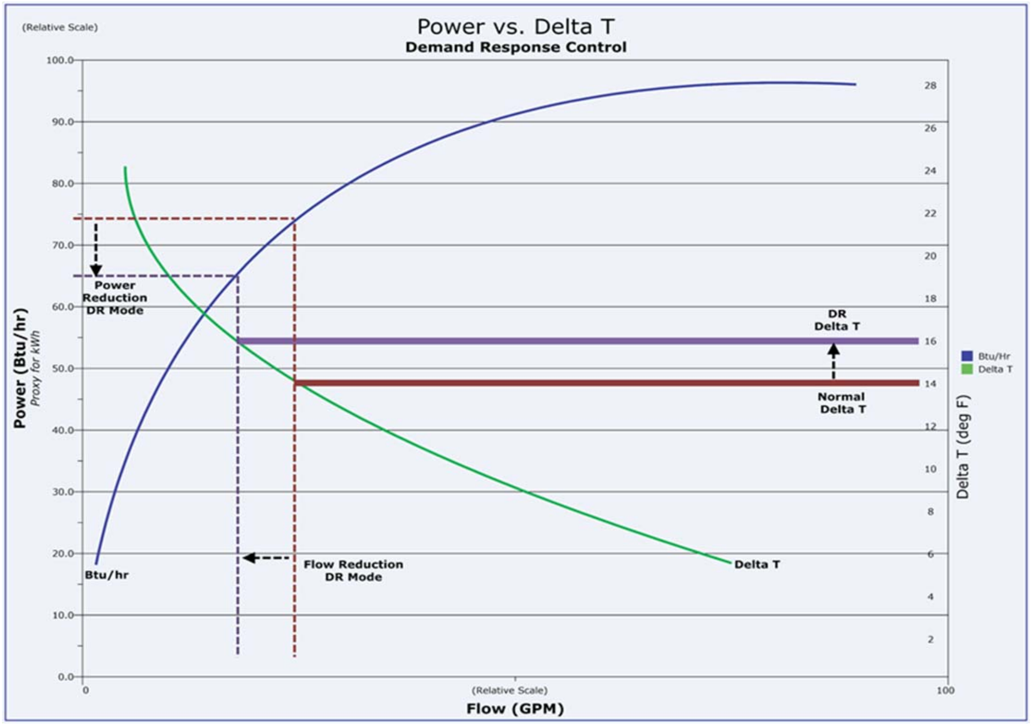
- kW demand reductions by intelligently reducing flow during the demand response period.
- Reduce chiller demand and flow by adjusting the Energy Valve Delta T setpoint upwards, subject to comfort metric boundaries.
- Comfort Metric determined by site, often average zone temp or chilled water return temp.
- Signal to initiate DR control sequence provided by the Universal Devices ADR gateway.

Smart Energy Valves

DR kW Reduction (part 2)

- Delta-T from 14 to 16
- Reduces chilled water flow
- Reduces chiller demand
- Reduces BTU delivered



Smart Energy Valves

Lessons Learned

- Verify existing air handler delta T(s) and coil design delta T(s).
- Verify proper metering on the central plant, both chillers and pumps.
- Verify site comfort metrics and ability to measure in real time.

Smart Energy Valves

Recommendations

- Apply Energy Valves to provide control of at least 80% of the central plant total flow for good central plant M&V.
- Pursue internet access early, offer a cellular modem connection for the gateway if necessary.
- Develop a robust testing & commissioning plan to properly determine normal and DR setpoints for each air handler.

Thank You

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Advanced Refrigeration Controls for Demand Response

NVEnergy

HDR Consulting LLC

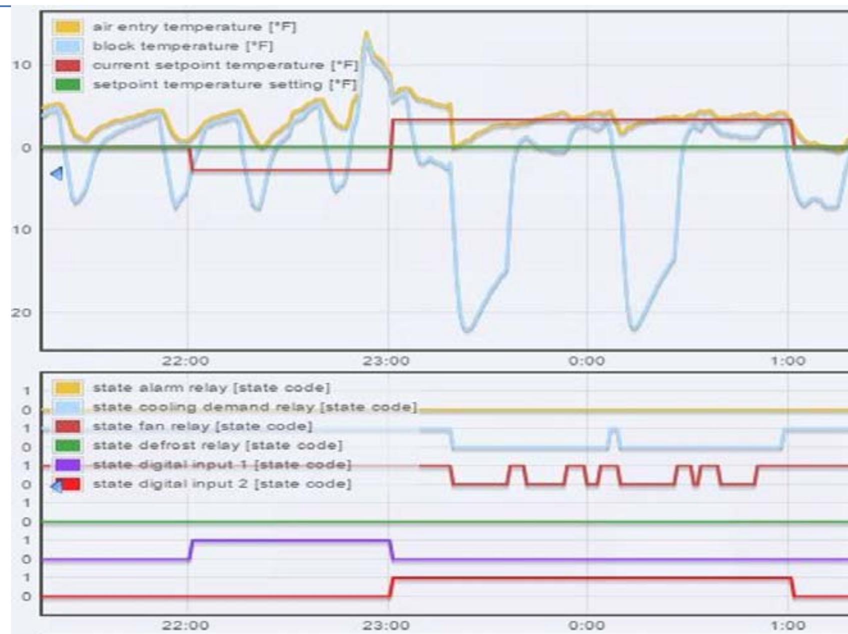
Purpose

Evaluate the capacity of low temperature refrigerated rooms to provide electric load reduction during DR events, using existing advanced refrigeration control technologies.

Approach

- Three unique products field tested.
- Four test sites participated in Pilot.
- OpenADR2.0 two-way utility communications.
- Freezers typically precooled by -3°F one hour prior to start of DR event. Then setback setpoints by +3°F during DR event.

Demand Response Event



Evaluation Strategy

Utilize data exported from the control systems along with metering and data loggers placed on the refrigeration equipment to quantify the load shed and room temperature impacts during DR events.

Results

Total load shed achieved was about 74 kW for a single 3,962 SqFt freezer room.

Freezer temperatures stayed near 3°F throughout DR event, within normal operating constraints.

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Smart Energy Valve for Demand Response

NVEnergy

HDR Consulting LLC

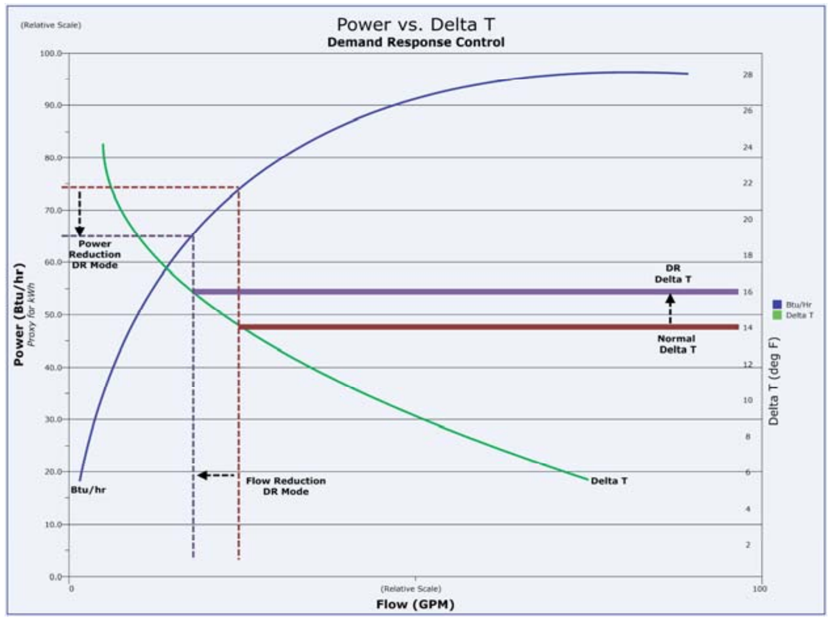
Solution Statement

Apply "DR enhanced" control intelligence technology to the existing Belimo Smart Energy Valve efficiency control to provide Demand Response benefits, without affecting space comfort.

Pilot Goals

- Provide persistent kWh savings from base design Energy Valve control.
- Provide *additional* "on-call" kW reductions by applying a custom DR algorithm.
- Do not affect space comfort during a DR event.

Concept Performance Curve



Evaluation Strategy

Utilize Central Plant metering and the integrated Belimo valve data (flows & btus) to determine kW reductions from the application of the DR algorithm.

Comfort Control

Monitor owner-defined "comfort control point", applying an "orange-red zone" control algorithm to automatically adjust or exit the DR algorithm if comfort becomes affected.

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