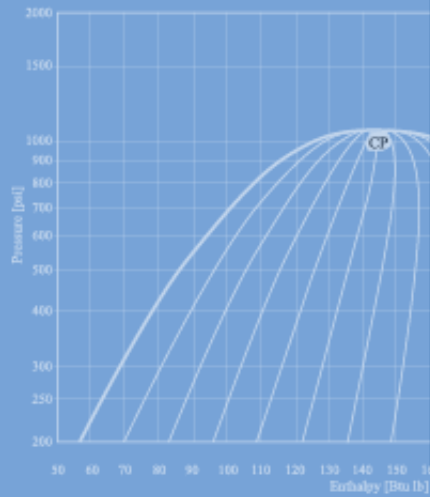


$$\text{COP} \equiv \frac{T_m}{T_m - T_o}$$



# Making Sense

## Webinar Series



$$D = \frac{1.86 \cdot 10^{-3} T^{3/2} \sqrt{1/M_1 + 1/M_2}}{p \sigma_{12}^2 \Omega}$$



# Making Sense Webinars

## Emerson and Our Partners Giving Insight on the Three Most Important Issues in Refrigeration

We're  
Making Sense  
of the promising role of **new refrigerants**.

We're  
Making Sense  
of **energy reduction** technologies.

We're  
Making Sense  
of the application of electronics to improve  
**operational visibility**.



**The widespread deployment of cost-effective, energy-efficient refrigeration solutions using natural refrigerants is fast approaching.**

Emerson Climate Technologies invites you to interact with some of the refrigeration industry's most trusted and respected thought leaders on the emerging role of new refrigerants and the challenges of their use. Gain insight on the benefits of new refrigerants and the challenges of their use. Gain insight on the benefits of new refrigerants and the challenges of their use.

At AHR 2013, we're helping attendees MAKE SENSE of the issues that matter most. Check our website at [www.emersonclimate.com/makingsense](http://www.emersonclimate.com/makingsense) for presentation schedules and topics. Bring this card with you to one of our presentations and you'll be entered for a chance to win an Apple iPad!

> See what makes sense at the AHR Expo, booth #1605.

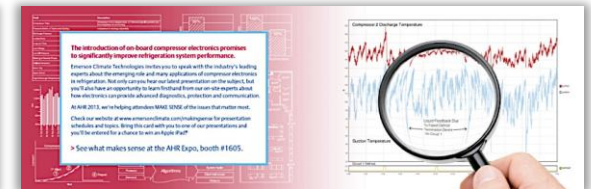


**Advanced energy reduction technologies are enabling us to create a new era of system and equipment optimization.**

Emerson Climate Technologies continues to interact with the refrigeration industry's foremost innovators in energy reduction technologies. We will be hosting a presentation about how the improvements in equipment and system technologies are being utilized in today's refrigeration applications. The experts will be present throughout the event to answer any questions you have about these innovations — from the utilization of digital modulation and electronic expansion valves to the application of scroll and variable speed technologies.

At AHR 2013, we're helping attendees MAKE SENSE of the issues that matter most. Check our website at [www.emersonclimate.com/makingsense](http://www.emersonclimate.com/makingsense) for presentation schedules and topics. Bring this card with you to one of our presentations and you'll be entered for a chance to win an Apple iPad!

> See what makes sense at the AHR Expo, booth #1605.



**The introduction of on-board compressor electronics promises to significantly improve refrigeration system performance.**

Emerson Climate Technologies invites you to spend with the industry's leading experts about the strategic and practical applications of compressor electronics in refrigeration. Gain insight on the benefits of new refrigerants and the challenges of their use. Gain insight on the benefits of new refrigerants and the challenges of their use.

At AHR 2013, we're helping attendees MAKE SENSE of the issues that matter most. Check our website at [www.emersonclimate.com/makingsense](http://www.emersonclimate.com/makingsense) for presentation schedules and topics. Bring this card with you to one of our presentations and you'll be entered for a chance to win an Apple iPad!

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# Making Sense Webinars

664028-1: Emerson Climate Technologies - Implementation of Low Condensing Refrigeration Webinar - Google Chrome  
https://wcc.on24.com/eventRegistration/console/EventConsoleNG.jsp?uimode=nextgeneration&eventid=664028&sessionid=1&key=78FE8B5F531CD9DCE1D681334E59032F&format=fhaudio&contenttype=A&playerwidth=748&playerheight=526&caller=

**Implementation of Low Condensing Refrigeration**

EMERSON Climate Technologies

Slides

$COP \equiv \frac{T_m}{T_m - T_c}$

**Making Sense Webinar Series**

$D = \frac{1.86 \cdot 10^{-3} T^{3/2} \sqrt{1/M_1 - 1/M_2}}{p \sigma_1^2 \Omega}$

Help

Social Media

EMERSON Climate Technologies

PowerPoint File

Q & A

Enlarge slides

Enlarge slides

8:06 PM 8/19/2013

MAKING SENSE

ON24

The screenshot displays a webinar player interface. At the top, a title bar shows the browser address and window controls. Below this, a header contains the webinar title 'Implementation of Low Condensing Refrigeration' and the Emerson Climate Technologies logo. The main content area features a slide titled 'Making Sense Webinar Series' with technical diagrams, including a graph of Cooling COP vs. Condensing Temp, a pressure-enthalpy (P-h) diagram, and a diffusion coefficient equation. A central white box contains the 'Making Sense Webinar Series' logo. At the bottom of the slide, there are icons for 'Help', 'Social Media', and 'Q & A'. The 'Q & A' icon is a red circle with a white question mark and a red 'A'. The 'Social Media' icon is a green share icon. The 'Help' icon is a yellow question mark. The 'PowerPoint File' icon is a yellow document icon with a red 'X'. Arrows point from these icons to their respective labels: 'Help', 'Social Media', 'PowerPoint File', and 'Q & A'. Two arrows labeled 'Enlarge slides' point to the top-right and bottom-right corners of the slide area. The bottom of the screen shows a Windows taskbar with various application icons and a system tray with the time '8:06 PM' and date '8/19/2013'. The 'Making Sense' logo is in the bottom right corner, and the 'ON24' logo is in the bottom right corner of the slide area.

**Making Sense** of innovations in **energy-reduction technologies.**

$$V_s = V_a \sqrt{P_a / P_s}^{1/4}$$

$$F_B = \frac{\pi}{4} (P_H - P_L) (d_2^2)$$

# A case for case control and electronic expansion valves

November 19, 2013

## Presented By:

### John Wallace

Director of Product Management,  
Retail Solutions  
*Emerson Climate Technologies*

### Seth Hoehn

Product Planner – Expansion Devices,  
Flow Controls  
*Emerson Climate Technologies*

# Discussion Topics

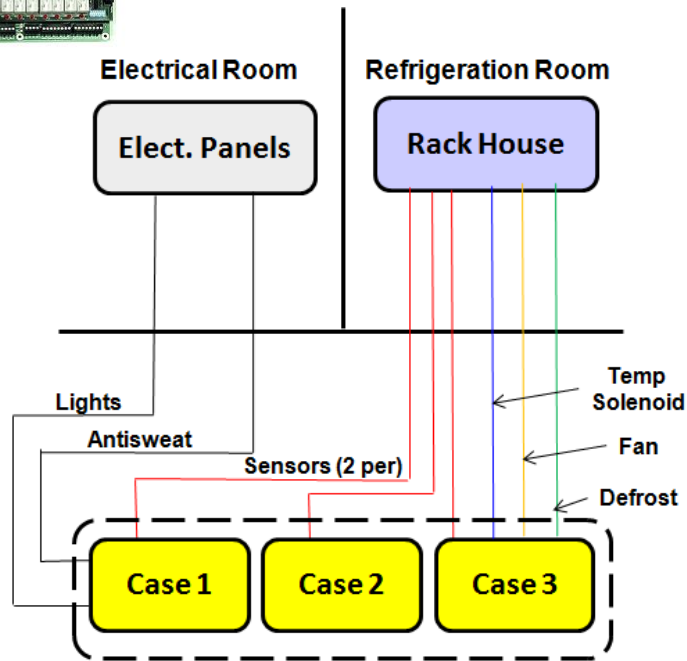
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- 1 **Overview and Background**
- 2 **Benefits**
- 3 **Expansion Valve Comparison**
- 4 **Summary**

# Overview

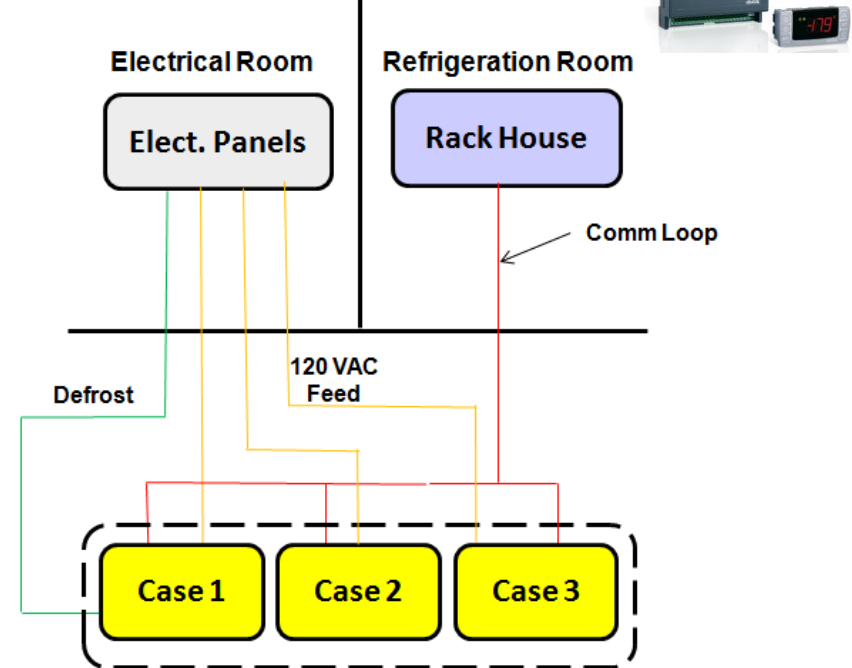


## Centralized Control



- Control Elements at Refrigeration Rack or Electrical Panel
- “Home Runs” for Sensors
- Separate Electrical Circuits for Loads

## Case Control



- Control Elements at Case
- Communication “Daisy Chain” to Supervisory System
- Load Control at Refrigeration Case

# Flexibility in Case Control Functionality

## Control Types

Functionality	Temp Control Only	Superheat Control	ESR Control
Temp Control	✓	✓	✓
Defrost Control	✓	✓	✓
Load Control	✓	✓	✓
Superheat Control (EXV or EEV)		✓	
Electronic Suction Regulator (ESR or EEPR)			✓

*Load Control Includes Lights, Fans, Antisweats*

A

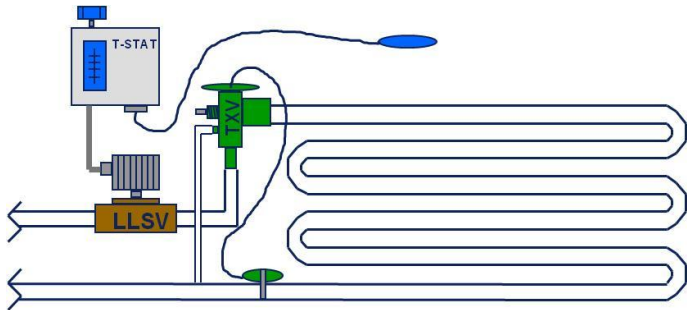
B

C



# Case Evaporator Control Types

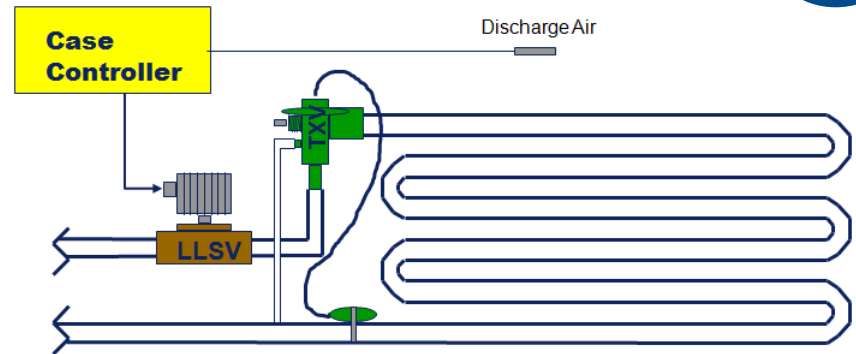
## Conventional/Mechanical



TXV and Thermostat

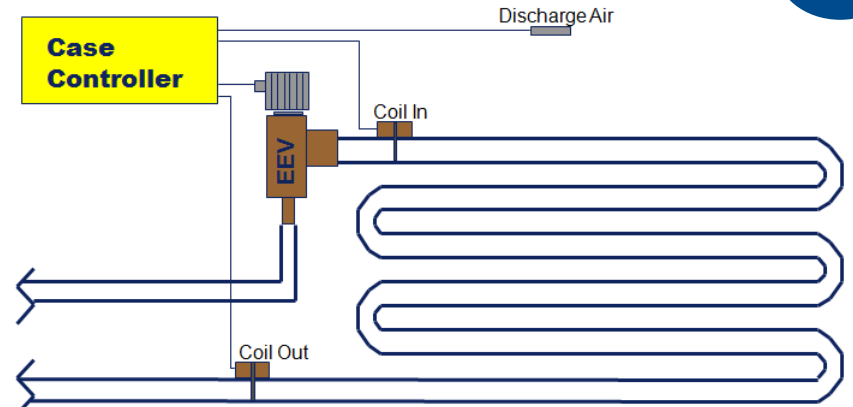
## Case Control With TXV

A



## Case Control With EEV

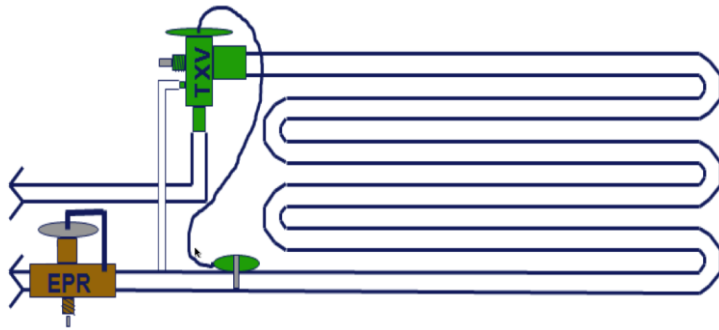
B



Pressure Transducer Can Also Be Used

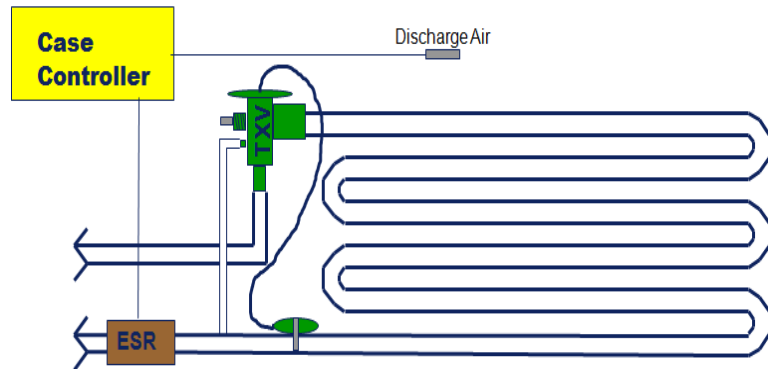
# Case Control With ESR Valve

## Conventional/Mechanical



TXV and EPR

## Case Control With ESR



# Case Controls Provide First Cost Savings and Ongoing Benefits

- **Electrical**

- Eliminates Sensor Home Runs
- Reduces Electrical Distribution Feeds and Conduit
- Shifts Field Wiring to OEM

- **Maintenance and Commissioning**

- Startup Time Reduced by 2–3 Days (EEV Control)
- Eliminates Need for Yearly Check/Setting of TXVs
- “Visibility” Into Operation

- **Refrigerant and Piping**

- “Loop Piping” Reduces Copper
- Lower Refrigerant Charge
- Reduced Leak Rates

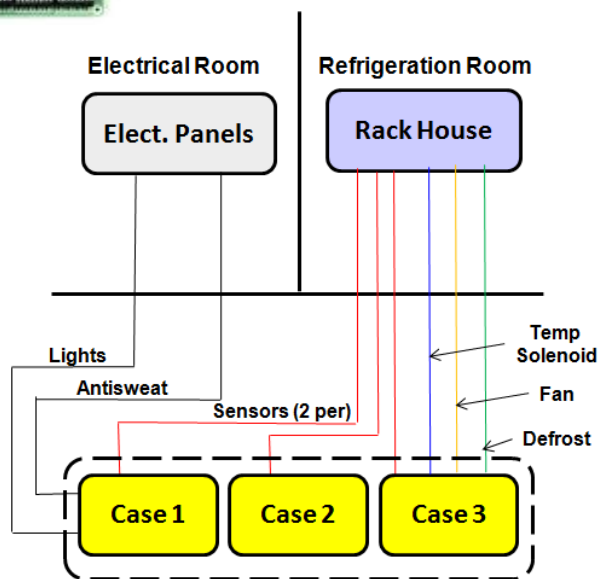
- **Energy**

- Continuously Optimized Superheat
- Lower/Floating Condensing Pressure

# Case Control Shifts Electronics From Electrical/Rack Rooms to Case

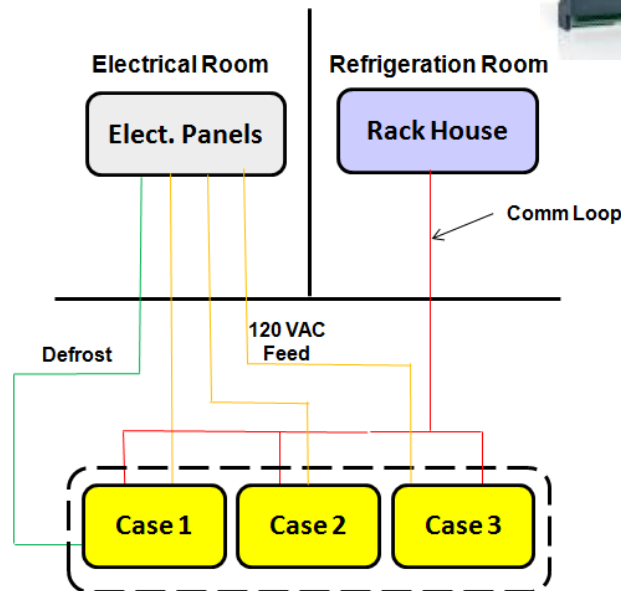


## Centralized Control



	Rack	Case
Sensors		✓
Input Boards	✓	
Relay Boards	✓	
Case Electronics	N/A	N/A
EEV	N/A	N/A

## Case Control



	Rack	Case
Sensors		✓
Input Boards	N/A	N/A
Relay Boards	N/A	N/A
Case Electronics		✓
EEV		✓

# Case Control Architecture Reduces Field Wiring and Provides Electrical Savings

- **Reduce Line Voltage Wiring**

- Reduce Branch Feeder Wiring by 30% or More
- Reduce or Eliminate Circuit Panels and Breakers
- Reduce Branch Feeder Distance: Distributed Design
- Eliminate Line Voltage Control Home Runs to Rack
- Simplified Power Connections at Case

- **Reduce Low Voltage Wiring**

- Eliminate Low Voltage Control Home Runs to Rack
- Simplified Low Voltage Control Connections at Case

- **Reduce Case Field Wiring**

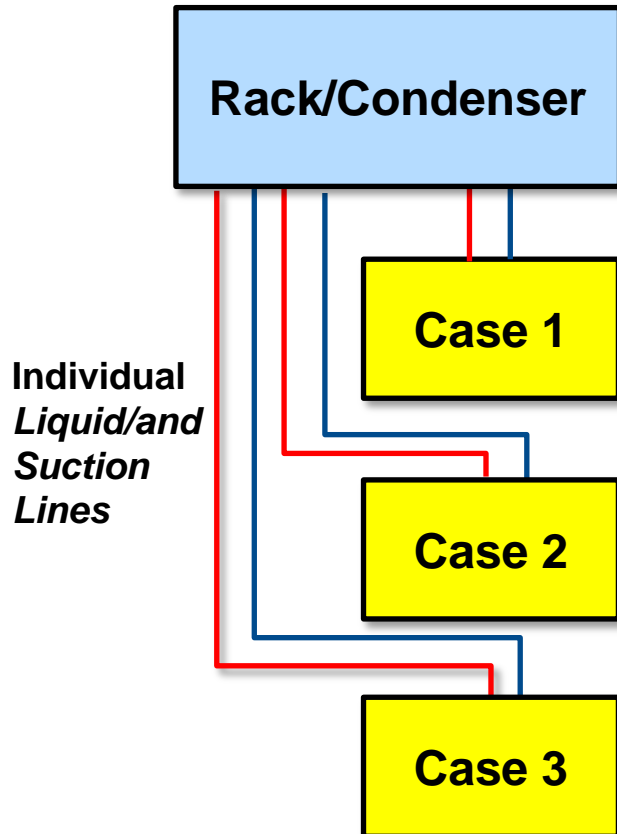
- OEM Factory Wiring of Control and Sensors
- Facilitates Factory Checkout Versus Field Troubleshooting



# Case Control Enables Loop Piping, Which Reduces Piping and Leak Rates



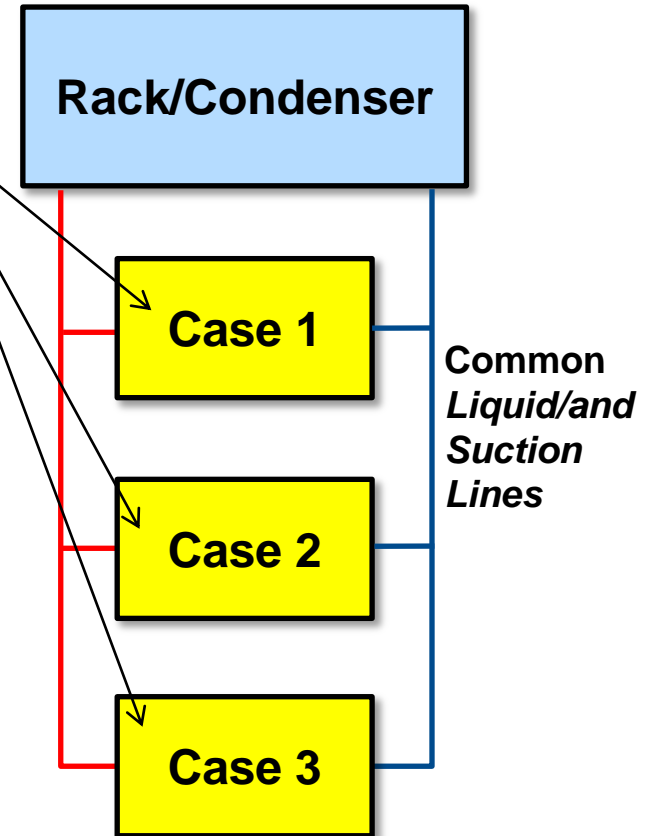
## Conventional System



Temperature and Defrost Control Shifts From Rack to Case

Loop Piping Reduces Pipes, Fittings, Insulation, Hangers, Labor

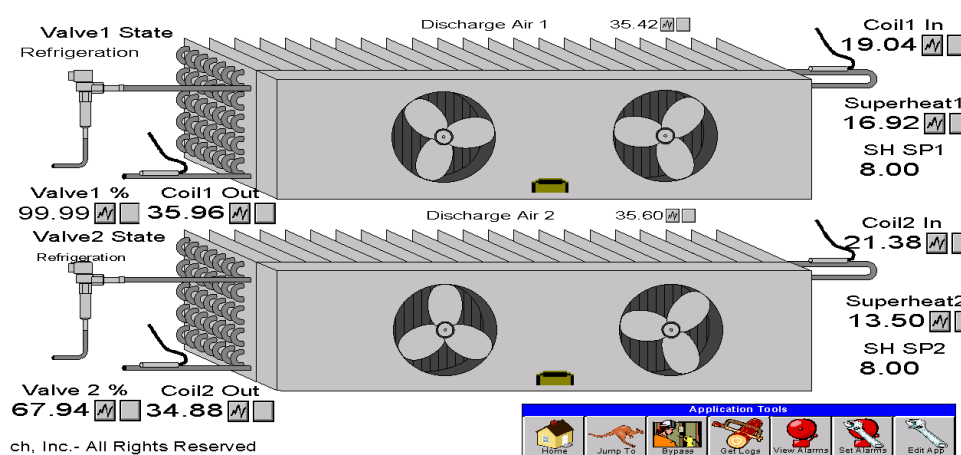
## Loop System



Piping Savings up to 50 %; Refrigerant Charge Reduction 10+%

# Case Controls Facilitate Faster Startups

- **Reduced Startup Time Due to**
  - Quicker Leak Checks: Less Joints
  - Reduced Refrigerant Charge
  - Quicker Startup: No Superheats to Set — All Electronic
- **Utilize Data Generated to Shorten Commissioning Cycle**
  - Graphing and Data Analysis Reducing Commissioning/Measurement Time

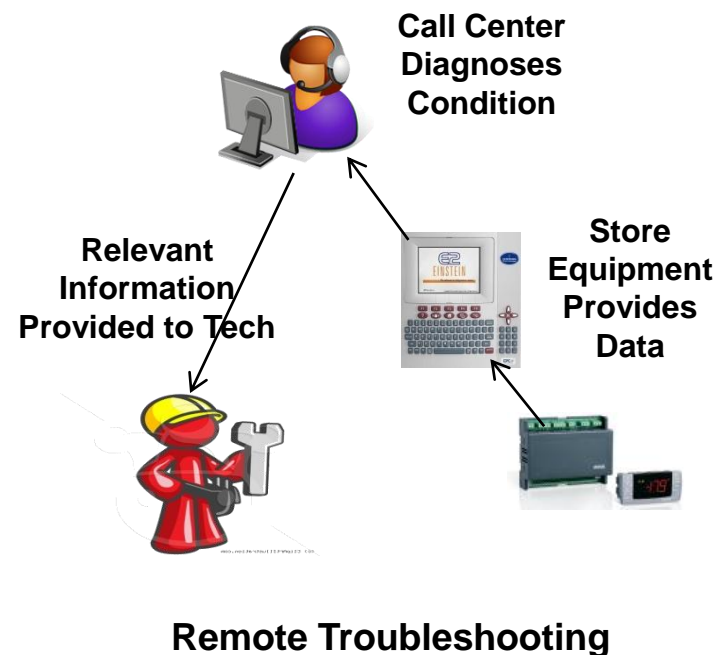


Reduced Commissioning and Startup Time Results in Faster Store Openings

# Operational Cost Reduction — Maintenance Savings



- **Reduce Labor Costs**
  - Additional Sensors Enable Remote Diagnostics and Facilitate Faster and More Reliable Troubleshooting
  - Remote Setpoint Adjustment Can Eliminate Service Calls
  - No Seasonal Expansion Valve/EPR/Temperature Adjustments
- **Reduce Material Costs**
  - Much Lower Refrigerant Leak Rate
- **Reduce Inventory Carrying Costs**
  - Commonality of Parts
- **Use Technology to Supplement Technicians**
  - Reduced Technician Knowledge Base





# Continuously Optimized Control Provides Ongoing Energy Savings



- **Reduce Energy Used at the Evaporator**
  - Precise Control Eliminates Mechanical Valve “Parasitic Losses”
  - Optimized Valve Control Insures Refrigeration System Operating at Peak Efficiency
- **Reduce Energy Used at the Rack**
  - Electronic Valve Facilitates Much Lower Condensing Pressures
  - Approximately 1% of Compressor Energy Savings per 2 psig Increase in Suction
- **Other Savings Opportunities**
  - “Localized” Antisweat Heater Control
  - Case Lighting Controlled via Occupancy Schedule
  - Defrost Termination Shortens Defrost Time

# Electronic Expansion Valves (EXV)

- **An Electronic Expansion Valve (EXV) Solution Measures and Controls System Superheat Electronically**
  - An EXV Solution Is More Than Just a Valve
    - Controller
    - Temperature Sensor(s)
    - Pressure Transducer/Sensor
  - Types of EXVs
    - Stepper Motor, PMV
    - PWM
    - New/Unique Technologies (MEMS, etc.)



# Why Use an EXV?

---

- **Improved System Performance**

- Efficiency

- Less Hunting Than Mechanical Valves — Tight Superheat Control
    - Can Achieve Lower Superheat Settings — Better Utilization of Evaporator — Low, Stable SH
    - Floating Head Pressure

- Wide Operating Range

- Better Control at Low Load Conditions
      - Fine Control Resolution
    - Digital, Variable Speed, and Screw Compressors
    - Controls Can Be Configured to Certain Conditions
    - Superheat Setting Maintained Over Varying Conditions

# Why Use an EXV?

- **Can Be Used With Multiple Refrigerants**
  - No Bulb/Mechanical Charge
  - Refrigerant Is Simply a Parameter in the Controls
- **Faster Pull-Downs, Faster Recovery**
  - Better Control in Transient Conditions (Startup)
- **Communication/Networking Capability**
- **Multiple Applications**
  - Shut-Off
  - Hot Gas Bypass
  - Evaporator Pressure Regulator
  - Liquid Injection
  - Head Pressure Control



# From the Field... Meat Packing/Storage Facility



## ▪ Customer Pain

- Slow Temperature Pull-Down
- Unit Runs 24 Hours/Day
- High Energy Bills

## ▪ Execution

- Added “EX” With Dixell XEV to Every Evaporator
- 23 Units
- Dropped the Head Pressure From 110°F to 70°F SCT

## ▪ Results

- Compressor Amp Draw Fell from 39.9 to 31.2 (28% Reduction)
- Removed 26 lbs of R-22 From System
- Unit Cycled Off on Temperature for the First Time

## ▪ End User Benefit

- Faster Pull-Down
- Significant Energy Savings
- OPA Energy Rebate

## ▪ Contractor Benefit

- Got an Order on the Spot to Retrofit
- 20 More Systems at That Facility
- Secured Service Contract

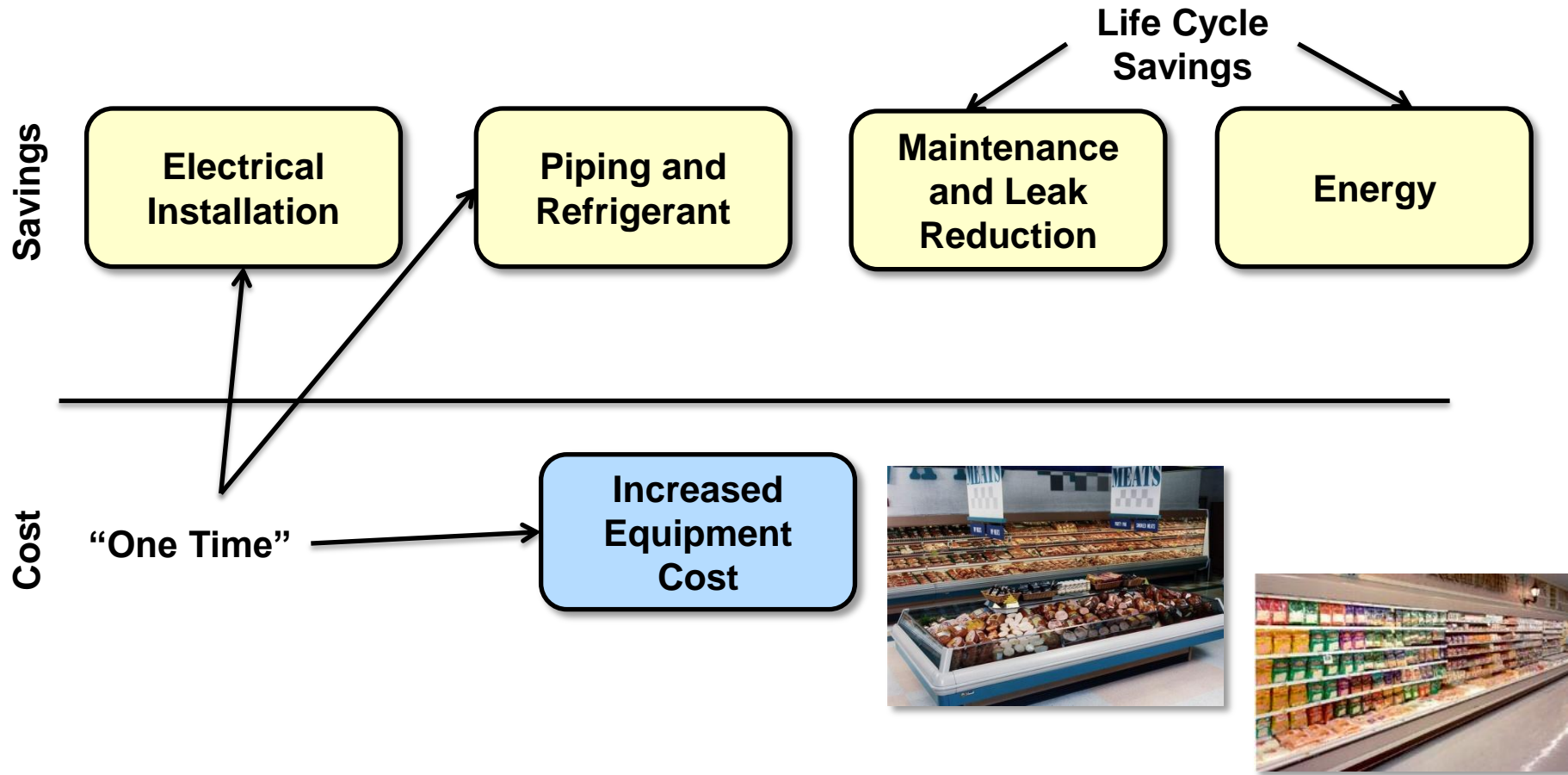


# The Trend Toward EXVs

- **Government Regulations**
- **Customer Demand**
- **Connectivity Capability**
- **Digital/Variable Speed Compressors**
- **Electronics Already Onboard**
- **CO<sub>2</sub>**
- **Familiarity With Electronics**
- **Improved/Specific Algorithms**
- **Product Differentiation**



# Case Controls and Expansion Valves Enable Ongoing Savings



# Questions



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