

Spring into Action!

Using Connected Chiller Technology to Optimize Spring Start-up

David Bishop, Director Service Operations



May 10th, 2018



Agenda



- What is Connected Chiller Technology?
- Optimizing Spring Startup Using Connected Chillers
- Demo
- Q & A

WHAT IS CONNECTED CHILLER TECHNOLOGY?



Connected Chiller Technology



- Predictive or Internet of Things technologies that provides a complete picture of chiller health and performance to help avoid random failures
- Cost-effective, proactive approach to chiller maintenance
- Advanced algorithms to detect, diagnose, and troubleshoot machine problems
- Operating and trend data accessible anywhere, anytime by you and global factory experts



In this presentation we'll be using examples from our Smart Connected Chiller IoT Dashboard



- Health Checks
- Overview Charts
- Comparative Charts



OPTIMIZING SPRING STARTUP USING CONNECTED CHILLERS



Six Steps to Optimize Chiller Spring Start-up



- Ensure non-condensable gases are removed from low pressure chillers
- Checking condenser and evaporator flow rates, pressures and temperatures
- Review all set points and actuals to make sure they are tracking
- Load test the chiller to make sure design load is achieved
- Confirming that chiller capacity control is loading and unloading chiller per design
- Trimming refrigerant charge for optimum chiller efficiency

Ensure Non-condensable Gases Are Removed



Health Check	Status	Comments
High Condenser Approach Temperature	Alarm	<p>Condenser approach is an indication of how well the condenser heat exchanger is performing. For this chiller, it has been well above its design value for an extended period of time during the reporting period.</p> <p>Common causes of this condition include:</p> <ol style="list-style-type: none">1. Non-condensable gases in the condenser2. Tube fouling3. Pass baffle gasket leakage <p>Operating with this condition can result in:</p> <ol style="list-style-type: none">1. Increased chiller energy consumption2. Reduced chiller cooling capacity3. Unplanned down time

Verifying Flow Rates, Temperatures and Pressures



Hamilton

Huntsville

Las Vegas

Los Angeles

Louisville

Milwaukee East

New Orleans

Philadelphia

Contact Johnson Controls

License

Help Document

Johnson Controls

Smart Connected Chiller Dashboard

Select Points

☐ Overview

☒ ACTIVE CAPACITY

☒ COND-SMALL-TEMP DIFF

☒ ENTERING COND WATER TEMP

☒ EVP-SMALL-TEMP DIFF

☒ LEAVING CHW TEMP

☒ RUN-MODE

☒ UNIT OPERATION CODE

☐ Compressor

☐ COMPRESSOR A RUNNING

☐ COMPRESSOR B RUNNING

☐ DELTA-P-P

☐ DISCHARGE SUPERHEAT

☐ DISCHARGE TEMP

☐ HEAD RELIEF REQUEST

☐ Evaporator

☒ Chilled Water Flow Rate

☐ CHW FLOW DETECTED

☐ CHW FLOW SWITCH STAT

☐ ENTERING CHW TEMP

☒ EVAP SATURATION TEMP

☒ EVAPORATOR PRESSURE

☐ EVAPORATOR PUMP STATUS

☐ EVP-SMALL-TEMP DIFF

☐ LEAVING CHW TEMP

☐ Oil Sump

☐ HIGH SIDE OIL PRESS

☐ LOW SIDE OIL PRESS

☐ OIL TEMPERATURE

☐ OIL-SAT COND TMP DIFF

☐ Condenser

☐ C1 PURGE 24 HR PUMPOUT AVG

☐ COND PUMP STAT

☒ COND SATURATION TEMP

☐ COND WATER FLOW DETECTED

☐ CONDENSER FLOW STATUS

☒ CONDENSER PRESSURE

☒ Condenser Water Flow Rate

☐ COND-SMALL-TEMP DIFF

☐ DISCHARGE SUPERHEAT

☐ DISCHARGE TEMP

☐ ENTERING COND WATER TEMP

☐ LEAVING COND WATER TEMP

☐ Operations

☐ ACCUM OPERATING HOURS

☐ ACCUM SYSTEM STARTS

☐ ACTIVE BASELOADING SETPOINT

☐ ACTIVE CAPACITY

☐ ACTIVE CAPACITY LIMIT

☐ ACTIVE SETPOINT

☐ AT MAX CAPACITY

☐ BASE LOAD ACTIVE

☐ CHILLER RUN STATUS

☐ USE SLOW START

Show

Cancel

24H

5D

1W

2W

1M

Jan 12th 9:00 pm

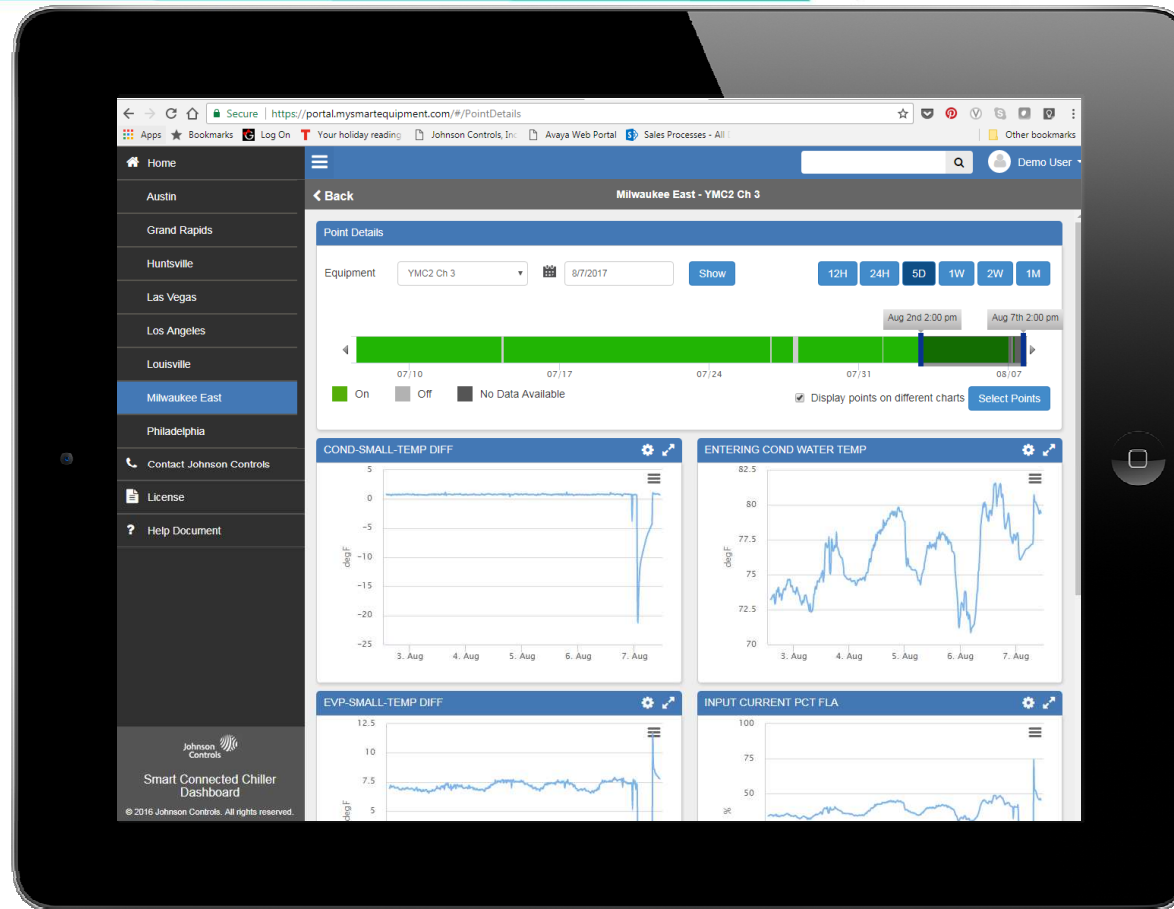
Jan 17th 9:00 pm

01/15

points on different charts

Select Points

Verifying Flow Rates, Temperatures and Pressure



Checking Set Points vs. Actuals



Hamilton

Huntsville

Las Vegas

Los Angeles

Louisville

Milwaukee East

New Orleans

Philadelphia

Contact Johnson Controls

License

Help Document

Johnson Controls

Smart Connected Chiller Dashboard

< Back

Point

Equip

Comp

60

55

50

45

40

35

Select points to compare

☐ Overview

☐ COND-SMALL-TEMP DIFF

☐ ENTERING COND WATER TEMP

☐ EVP-SMALL-TEMP DIFF

☐ LEAVING CHW TEMP

☐ MOTOR CURRENT PCT FLA

☐ UNIT OPERATION CODE

☐ Compressor

☐ CalculatedPoint(KW)

☐ COMPRESSOR PRV POSITION

☐ DELTA-P-P

☐ DISCHARGE SUPERHEAT

☐ DISCHARGE TEMP

☐ MOTOR CURRENT PCT FLA

☐ OIL DIFERENTIAL PRESSURE

☐ OIL SUMP PRESSURE

☐ OIL SUMP TEMPERATURE

☐ PROX SENSOR ACT POS

☐ PROXIMITY SENSOR - REFERENCE POSITION

☐ Evaporator

☐ CHW FLOW SWITCH STAT

☐ ENTERING CHW TEMP

☐ EVAP SATURATION TEMP

☐ EVAPORATOR PRESSURE

☐ EVAPORATOR PUMP STATUS

☐ EVP-SMALL-TEMP DIFF

☒ LEAVING CHW TEMP

☒ LEAVING CHW TEMP ACT SP

☐ Oil Sump

☐ OIL DIFERENTIAL PRESSURE

☐ OIL PUMP PRESSURE

☐ OIL SUMP PRESSURE

☐ OIL SUMP TEMPERATURE

☐ OIL-SAT COND TMP DIFF

☐ Condenser

☐ COND SATURATION TEMP

☐ CONDENSER PRESSURE

☐ COND-SMALL-TEMP DIFF

☐ DROP LEG REFRIG TEMP

☐ ENTERING COND WATER TEMP

☐ LEAVING COND WATER TEMP

☐ LIQUID LINE SOLENOID

☐ REFRIGERANT LEVEL POSITION

☐ REFRIGERANT LEVEL SP

☐ Motor Detail

☐ COMPRESSOR MOTOR STATUS

☐ COMPRESSOR PRV POSITION

☐ MOTOR CURRENT ACTUAL SP

☒ MOTOR CURRENT PCT FLA

☐ MOTOR TEMPERATURE - OPPOSITE SHAFT SIDE

☐ MOTOR VIBRATION - OPPOSITE SHAFT SIDE

☐ MTR SHAFT END TEMP

☐ MTR SHAFT END VIBR

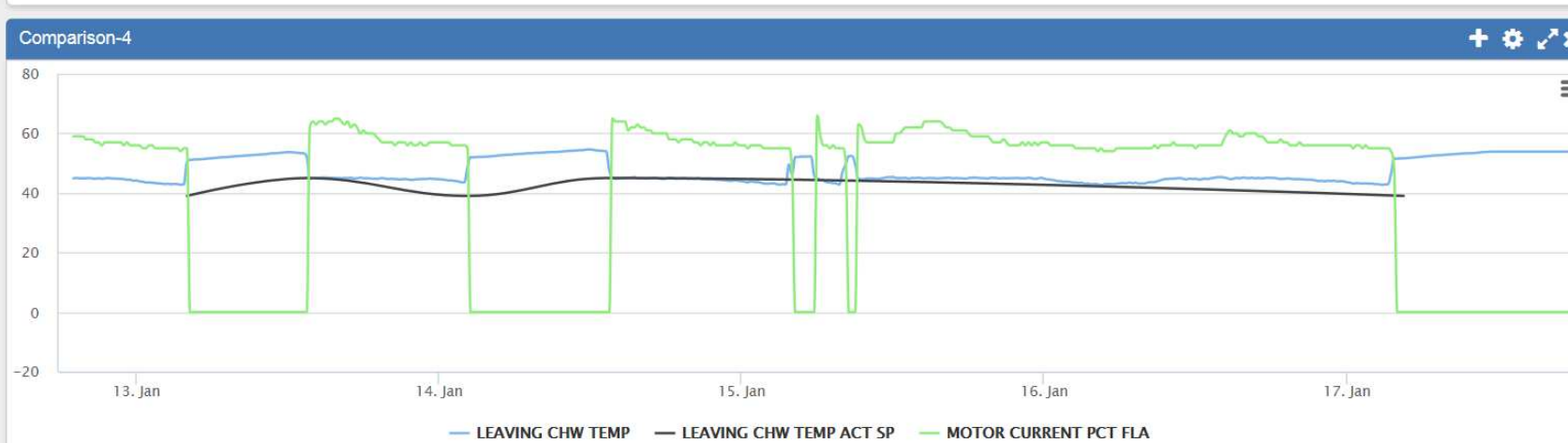
Show

Cancel

Check Set Points vs Actuals



- Las Vegas
- Los Angeles
- Louisville
- Milwaukee East
- New Orleans
- Philadelphia
- Contact Johnson Controls
- License
- Help Document



Load Testing the Chiller



Hamilton

Huntsville

Las Vegas

Los Angeles

Louisville

Milwaukee East

New Orleans

Philadelphia

Contact Johnson Controls

License

Help Document

Johnson Controls

Smart Connected Chiller Dashboard

< Back

Point

Equip

Select points to compare

☐ Overview

☐ COND-SMALL-TEMP DIFF

☐ ENTERING COND WATER TEMP

☐ EVP-SMALL-TEMP DIFF

☐ LEAVING CHW TEMP

☐ MOTOR CURRENT PCT FLA

☐ UNIT OPERATION CODE

☐ Compressor

☐ CalculatedPoint(KW)

☐ COMPRESSOR PRV POSITION

☐ DELTA-P-P

☐ DISCHARGE SUPERHEAT

☐ DISCHARGE TEMP

☐ MOTOR CURRENT PCT FLA

☐ OIL DIFFERENTIAL PRESSURE

☐ OIL SUMP PRESSURE

☐ OIL SUMP TEMPERATURE

☐ PROX SENSOR ACT POS

☐ PROXIMITY SENSOR - REFERENCE POSITION

☐ Evaporator

☐ CHW FLOW SWITCH STAT

☒ ENTERING CHW TEMP

☐ EVAP SATURATION TEMP

☐ EVAPORATOR PRESSURE

☐ EVAPORATOR PUMP STATUS

☐ EVP-SMALL-TEMP DIFF

☒ LEAVING CHW TEMP

☐ LEAVING CHW TEMP ACT SP

☐ Oil Sump

☐ OIL DIFFERENTIAL PRESSURE

☐ OIL PUMP PRESSURE

☐ OIL SUMP PRESSURE

☐ OIL SUMP TEMPERATURE

☐ OIL-SAT COND TMP DIFF

☐ Condenser

☐ COND SATURATION TEMP

☐ CONDENSER PRESSURE

☐ COND-SMALL-TEMP DIFF

☐ DROP LEG REFRIG TEMP

☒ ENTERING COND WATER TEMP

☒ LEAVING COND WATER TEMP

☐ LIQUID LINE SOLENOID

☐ REFRIGERANT LEVEL POSITION

☐ REFRIGERANT LEVEL SP

☐ Motor Detail

☐ COMPRESSOR MOTOR STATUS

☐ COMPRESSOR PRV POSITION

☐ MOTOR CURRENT ACTUAL SP

☒ MOTOR CURRENT PCT FLA

☐ MOTOR TEMPERATURE - OPPOSITE SHAFT SIDE

☐ MOTOR VIBRATION - OPPOSITE SHAFT SIDE

☐ MTR SHAFT END TEMP

☐ MTR SHAFT END VIBR

Show

Cancel

24H 5D 1W 2W 1M

Jan 12th 7:00 pm Jan 17th 7:00 pm

01/15

points on different charts

Select Points

Load Testing the Chiller



Chiller Ramp-up/Ramp Down

The screenshot displays the Johnson Controls Smart Connected Chiller Dashboard. A sidebar on the left lists locations: Hamilton, Huntsville, Las Vegas, Los Angeles (selected), Louisville, Milwaukee East, New Orleans, and Philadelphia. Below the sidebar are links for 'Contact Johnson Controls', 'License', and 'Help Document'. The main area shows a 'Select points to compare' dialog box with the following categories and options:

- Compressor**
 - ☐ COMPRESSOR PRV POSITION
 - ☐ DELTA-P-P
 - ☐ DISCHARGE SUPERHEAT
 - ☐ DISCHARGE TEMP
 - ☐ MOTOR CURRENT PCT FLA
 - ☐ OIL DIFFERENTIAL PRESSURE
 - ☐ OIL SUMP PRESSURE
 - ☐ OIL SUMP TEMPERATURE
 - ☐ PROX SENSOR ACT POS
 - ☐ PROXIMITY SENSOR - REFERENCE POSITION
- VSD**
 - ☒ VSD
 - ☒ COMPRESSOR PRV POSITION
 - ☒ MOTOR CURRENT ACTUAL SP
 - ☒ MOTOR CURRENT PCT FLA
 - ☒ PHASE A MOTOR CURRENT
 - ☒ PHASE B MOTOR CURRENT
 - ☒ PHASE C MOTOR CURRENT
 - ☒ VSD CONVERTER HSINK TEMP
 - ☒ VSD DC BUS VOLTAGE
 - ☒ VSD DC LINK CURRENT
 - ☒ VSD INPUT KW
 - ☒ VSD INPUT KWH
 - ☒ VSD INTERNAL TEMP
 - ☒ VSD OUTPUT FREQUENCY
 - ☒ VSD OUTPUT VOLTAGE
- Oil Sump**
 - ☐ OIL DIFFERENTIAL PRESSURE
 - ☐ OIL PUMP PRESSURE
 - ☐ OIL SUMP PRESSURE
 - ☐ OIL SUMP TEMPERATURE
- Motor Detail**
 - ☐ COMPRESSOR MOTOR STATUS
 - ☐ MOTOR CURRENT PCT FLA
 - ☐ VSD SURGE COUNT
- Operations**
 - ☐ ACCUM OPERATING HOURS
 - ☐ ACCUM SYSTEM STARTS
 - ☐ STOP SWITCH STATUS
- Onboard Diagnostics**
 - ☐ UNIT CYCLING FAULT CODE
 - ☐ UNIT OPERATION CODE
 - ☐ UNIT SAFETY FAULT CODE
 - ☐ UNIT WARNING FAULT CODE
- System**
 - ☐ COND SATURATION TEMP
 - ☐ CONDENSER PRESSURE
- Physical Readings**
 - ☐ COND ENTERING LIQUID PRESSURE
 - ☐ COND FLOW RATE
- Weather**
 - ☐ HUMIDITY
 - ☐ TEMPERATURE

At the bottom of the dialog are 'Show' and 'Cancel' buttons. The background dashboard shows a timeline from Jan 12th 8:00 pm to Jan 17th 8:00 pm with a 'Select Points' button.

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Chiller Ramp-up/Ramp Down



Trimming Refrigerant Charge for Optimum Efficiency



YK CH-2

12 Jul

13 Jul

14 Jul

15 Jul

16 Jul

17 Jul

18 Jul

Low Condenser Refrigerant Level



Low Condenser Refrigerant Level

Alert

This chiller has operated for an extended period of time during the reporting period with a slightly lower than normal condenser refrigerant level.

Common causes of this condition include:

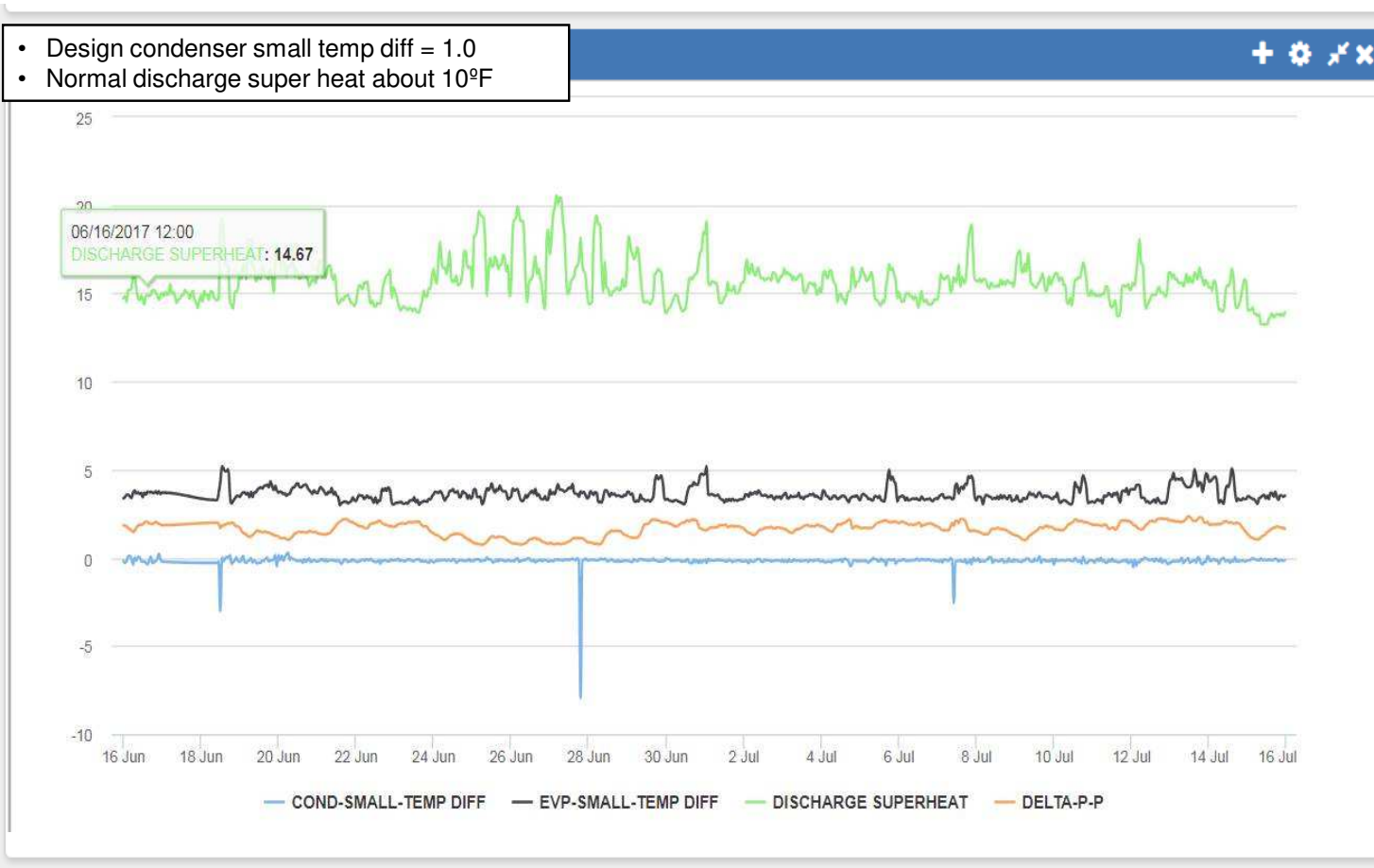
1. Insufficient charge
2. Low load operation
3. Refrigerant level control system in manual override
4. Refrigerant level control system mechanical malfunction

Operation with this condition can lead to:

1. Increased chiller energy consumption
2. Reduced chiller cooling capacity
3. Chiller inability to meet chilled water set point
4. Nuisance shutdowns
5. Tube leaks

Trimming Refrigerant Charge for Optimum Efficiency

- Design condenser small temp diff = 1.0
- Normal discharge super heat about 10°F





DEMO

How Might You Benefit From Connected Chillers?



Results from Smart Connected Chillers




66% Reduction
in unplanned/
emergency repairs




65% Reduction in
mean time to repair



Source: Johnson Controls, Inc. Engineering Analysis

THANK YOU

LEARN MORE:

www.johnsoncontrols.com/smartconnectedchillers

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