

# SISTEMAS DE ÁGUA GELADA



PROGRAMA  
BRASILEIRO DE  
ELIMINAÇÃO DOS

**HCFCs**  
Projeto para o Gerenciamento de Chillers

## Projeto Demonstrativo para o Gerenciamento Integrado no Setor de Chillers

# Commissioning Chilled Water Systems

James Anderton, CPMP, LEED GA – Independent Commissioning  
Consulting, LLC / Building Commissioning Association  
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Execução



Implementação



Empoderando vidas.  
Fortalecendo nações.

Realização

Ministério do  
Meio Ambiente



# Cx Chilled Water Systems (CHWS)



## INTRODUCTION – BEM VINDOS

### PRESENTER BIO

- PERSONAL
- PROFESSIONAL

### PEOPLE + CULTURE = BUILDINGS

### PROGRESSO NA INDUSTRIA DA CONSTRUÇÃO



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# Cx Chilled Water Systems (CHWS)



## PRESENTATION OVERVIEW

- | Introduction to Cx CHWS
- | Cx CHWS: Basic Concepts
- | Cx CHWS: Process and Field Knowledge
- | Functional Testing CHWS: Best Practices
- | Q&A

# Cx Chilled Water Systems (CHWS)



## INTRODUCTION TO Cx CHWS

### **Properly commissioned building systems will provide:**

- Less problems inherited at the end of the project
- Improved comfort and indoor air quality
- Reduced construction and warranty issues
- Complete documentation and critical system operation data
- Better tenant and occupant satisfaction
- Reduced O & M costs and increased reliability
- Lower utility bills
- Improved net operating Income
- A benchmark for future system operating evaluation
- Fully trained operating staff

# Cx Chilled Water Systems (CHWS)



## INTRODUCTION TO Cx CHWS

### AN EARLY START IS ESSENTIAL

### AQUIRE A FULL UNDERSTANDING OF:

- Current system design & approved documents
- Operational requirements (Owner vs FM vs Designer)
- Robust documentation (Effective use of Cx Documents)
- Connecting the gaps
  - Owner expectations vs User Experience*
  - Engineer Equipment Schedule vs Controls Drawings*

# Cx Chilled Water Systems (CHWS)



## INTRODUCTION TO Cx CHWS

### KNOWLEDGE OF THE Cx PROCESS

- Design phase
- Construction phase
- Acceptance phase
- Occupancy & warranty phase

### CERTIFICATION AND EXPERIENCE



CPMP  
CCP

# Cx Chilled Water Systems (CHWS)



## Cx CHWS: BASIC CONCEPTS

### REQUIRED KNOWLEDGE OF THE CxA

- Chilled Water System Design and Applications
- Knowledge of Chillers, Boilers, and CEP Safety



# Cx Chilled Water Systems (CHWS)



## Cx CHWS: BASIC CONCEPTS

### REQUIRED KNOWLEDGE OF THE CxA

- Knowledge of Pumps, Hydraulics and Piping
- Knowledge of AHU's, Heat Exchangers, and Ductwork



# Cx Chilled Water Systems (CHWS)



## Cx CHWS: BASIC CONCEPTS

### REQUIRED KNOWLEDGE OF THE CxA

- Knowledge of Condenser Water Systems (*As applicable*)
- Knowledge of Controls & Control Loops (*Floating setpoints*)



# Cx Chilled Water Systems (CHWS)



## Cx CHWS: BASIC CONCEPTS

### IMPORTANT KNOWLEDGE & EXPERIENCE

- Engineering Applications, Fluid Dynamics, Psychometrics
- Construction Installation Methods and Materials
- Operational & Troubleshooting Skillsets
- Knowledge of Factory Startup Procedures (*Warranty*)
- Knowledge of Test & Balance Procedures (*Air & Water*)

# Cx Chilled Water Systems (CHWS)



## Cx CHWS: BASIC CONCEPTS

### FIELD EXPERIENCE (I went to College... How do I get it?)

- Construction installation & management
- Architectural & Engineering Construction Administration
- TAB, Controls & Service Technician Work



# Cx Chilled Water Systems (CHWS)



## Cx CHWS: PROCESS & FIELD KNOWLEDGE

### LAYING THE FOUNDATION FOR EFFECTIVE CX

- Cx CHWS requires a simple but well defined process to catch and track issues (*Good Cx will enable close out of issues timely*)
- Timeliness of response, reports, and document delivery
- Follow up, Follow up, and more Follow up
- Properly Executed Cx Process = Efficient CHWS \$\$\$
- Poorly executed Cx Process = Failure to protect Clients  
(If you **fail to plan** – then you **plan to fail!**)

# Cx Chilled Water Systems (CHWS)



## Cx CHWS: PROCESS & FIELD KNOWLEDGE

### CREATING / CAPTURING ACCURATE & USEFUL DATA

- Detailed Startup & Prefunctional Checklists (Non-Generic)
- Submittal Process (Define Registries)
- Making good use of the Cx Plan (Simple language)
  - Step by step instructions (When, Where, Who & What)
  - Communication protocols
  - Ensure task items for such milestones as Start-up are clearly defined for each Team member is responsible

# Cx Chilled Water Systems (CHWS)



## Cx CHWS: PROCESS & FIELD KNOWLEDGE

### EFFECTIVE CONSTRUCTION PHASE Cx

#### Installation Observations

- Equipment on Site = Verification Process (Timeliness)
- Study up on the systems to be observed
- Know typical issues (Problem Areas)
- Focus on most common issues 1<sup>st</sup>

# Cx Chilled Water Systems (CHWS)



Make up Water Pressure Regulator/Relief Valve Sizing  
(Incorrect / Under sized)

# Cx Chilled Water Systems (CHWS)



## Cx CHWS: PROCESS & FIELD KNOWLEDGE

### EFFECTIVE CONSTRUCTION PHASE Cx

#### Coming out to the field prepared (SABER MIAS!)

- Consistency, Methods and Thoroughness
- Consolidated Floor Plans (Half-Size)
- System & Zone Maps Complete with Room Names
- Safety Gear
- Physically Fit
- High Resolution Camera

# Cx Chilled Water Systems (CHWS)



Safety, Fitness and Awareness needed at all times during Cx. CHWS are more complex and larger. There is more that can go wrong if you are not prepared to stay vigilant on the jobsite.

# Cx Chilled Water Systems (CHWS)



## Cx CHWS: PROCESS & FIELD KNOWLEDGE

### TYPICAL AND CRITICAL FIELD ISSUES

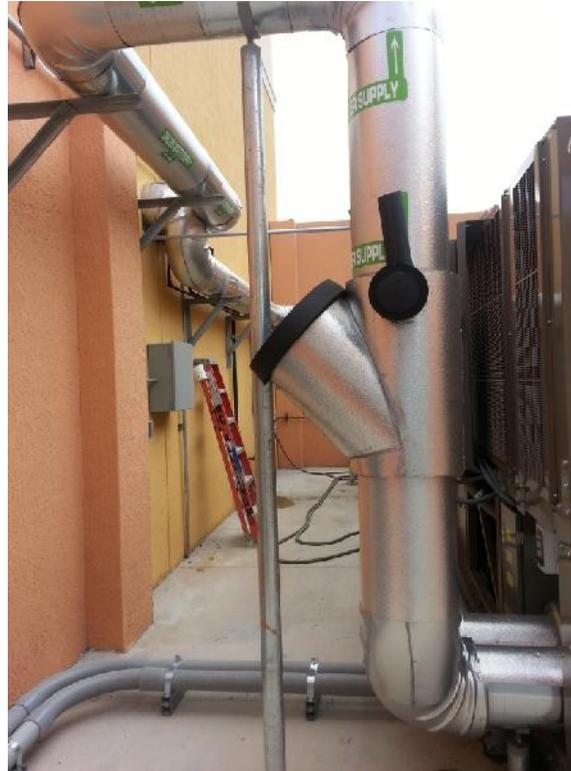
#### Protection of System Inlets & Outlets

- AHU SA/RA/OA/EA Openings, Coil Connections, Pump inlets, Motor openings, Cooling Towers & Basins, Ductwork & Piping

#### Protection of Staged equipment & during prep and assembly

#### Improper use of equipment during construction

# Cx Chilled Water Systems (CHWS)



Piping insulated and protected with sleeve for protection on exterior applications

# Cx Chilled Water Systems (CHWS)



## Cx CHWS: PROCESS & FIELD KNOWLEDGE

### TYPICAL AND CRITICAL FIELD ISSUES

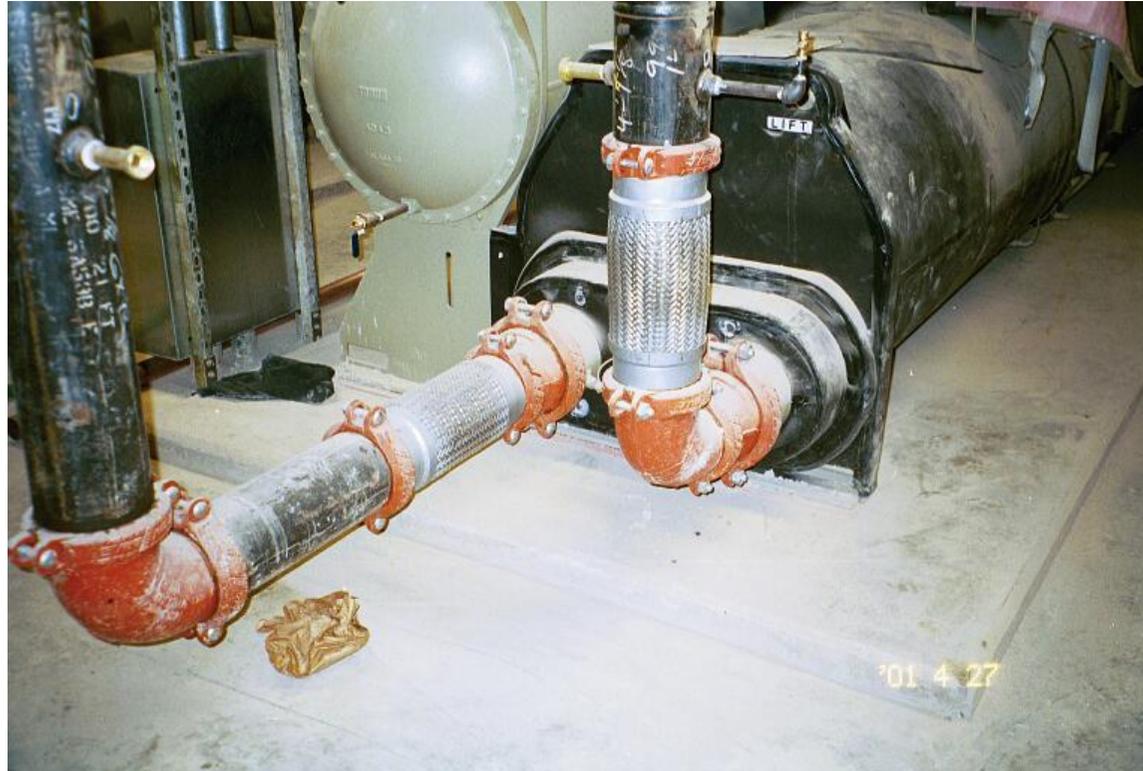
#### Piping Connections

- Proper Welds or Joint Types
- Piping Pressure

#### Piping Supports & Vibration Isolation

- Proper Fasteners, Saddles, Die-Electric separation
- Approved Vibration Isolation (Noisy Pipes)
- Insulation Requirements

# Cx Chilled Water Systems (CHWS)



Improperly supported CHW Supply and Return Piping during construction. Unnecessary load on Chiller Marine Box. Potential for damage to chiller inlet/outlets.

# Cx Chilled Water Systems (CHWS)



## Cx CHWS: PROCESS & FIELD KNOWLEDGE

### TYPICAL AND CRITICAL FIELD ISSUES

#### Comprehensive Flush-out Plan

- Develop Early (As soon as HVAC contractor is hired)
- Ensure plans include specific step by step procedures
- By-pass Coils during initial flushing
- Schedule Flushing / Chemical Treatment (timeliness)
- Flush Water Source (Cleanliness)
- Drip Legs & Strainers (Clean out Included in Plan)
- Dead Ends (Maintaining Flow)

# Cx Chilled Water Systems (CHWS)



## Cx CHWS: PROCESS & FIELD KNOWLEDGE

### TYPICAL AND CRITICAL FIELD ISSUES

#### Chemical Treatment Addition Plan

- Develop Early (As soon as HVAC contractor is hired)
- Ensure plans include specific step by step procedures
- Remove By-passed Coils provide finished flushing
- Drain system Fully, reflushing till water is crystal clear



# Cx Chilled Water Systems (CHWS)



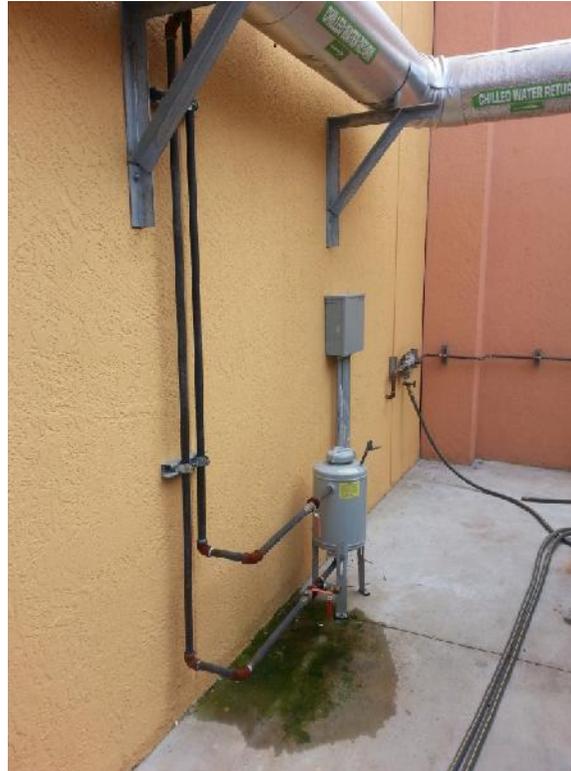
## Cx CHWS: PROCESS & FIELD KNOWLEDGE

### TYPICAL AND CRITICAL FIELD ISSUES

#### Chemical Treatment Addition Plan

- Maintaining Circulation while adding chemical treatment
- Ensure all valves are open (included in Cx Flush Plan)
- All feed control equipment must be in place
- Certified Contractors & TAB

# Cx Chilled Water Systems (CHWS)



Shot feeder supply and return lines not insulated and condensation forming/dripping 12-16 from connection at CHWS line

# Cx Chilled Water Systems (CHWS)



## Cx CHWS: PROCESS & FIELD KNOWLEDGE

### TYPICAL AND CRITICAL FIELD ISSUES

#### Locations of Valves and Sensors

- Design drawing locations vs submittals
- Test & Balance Results (Troubleshooting)
- Verification of Sensor Readings during TAB

# Cx Chilled Water Systems (CHWS)



## FUNCTIONAL TESTING: BEST PRACTICES

### Overall System Level Testing

- Goal is for test of all components on a system level
- Ensure individual components are working 1<sup>st</sup>
- Cascading upwards from sub-systems to parent systems
- CAUTION: Complex Parent Systems
- Regardless of CxA preference: No PFC – No FPT
- Using BAS sensors? What is the TAB Report Status?

# Cx Chilled Water Systems (CHWS)



## FUNCTIONAL TESTING: BEST PRACTICES

### Chiller, Boilers, Cooling Tower Testing

- Sensor Locations & Readings
- Safeties, Interlocks, Alarms
- Unit Capacity (Part-Load vs Full Load)
- Staging (Lead/Lag & Demand Response per AHU zone)
- Water Temperature Reset
- Control Accuracy and Stability (Control Loops / Hunting)

# Cx Chilled Water Systems (CHWS)



## FUNCTIONAL TESTING: BEST PRACTICES

### Pumping System Testing

- Sensor Locations & Readings
- Safeties, Interlocks, Alarms
- Pump Capacity (Part-Load vs Full Load)
- Actuation & Sequencing
- Setpoints and Pressure Reset
- Control Accuracy and Stability (Control Loops / Hunting)

# Cx Chilled Water Systems (CHWS)



## FUNCTIONAL TESTING: BEST PRACTICES

### AHU System Testing

- Sensor Locations & Readings
- Safeties, Interlocks, Alarms (EA/RA/OA)
- SA Temperature Control (Part-Load vs Full Load)
- Actuation & Sequencing
- Setpoints, Static Pressure Reset
- CHW Valve Control and Water Temp Reset
- Control Accuracy and Stability (Control Loops / Hunting)

# SISTEMAS DE ÁGUA GELADA



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## THANK YOU!

[james.anderton@indcxc.com](mailto:james.anderton@indcxc.com)

Apoio Institucional:



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