



Commissioning | Retro-Commissioning | Facility Assessments

COMMISSIONING LESSONS LEARNED

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Cx is a Lessons Learned Process

- Whole Picture, From Beginning to End
- Design, Construction, and Acceptance
- Sees the Challenges & Failures Across Various Projects

It's The Simple Things!

- Condensate Drains
- Humidifiers
- Minimum Flow/Bypass
- Local Controls Programming
- Load Bank Testing
- Airside Economizer
- Accessibility
- Leak Detection
- Submittals
- Conflicts/Coordination
- Team Communication
- Early Involvement By CxA
- Coordination Studies
- Documentation
- As-Builts

Pre-Construction Phase

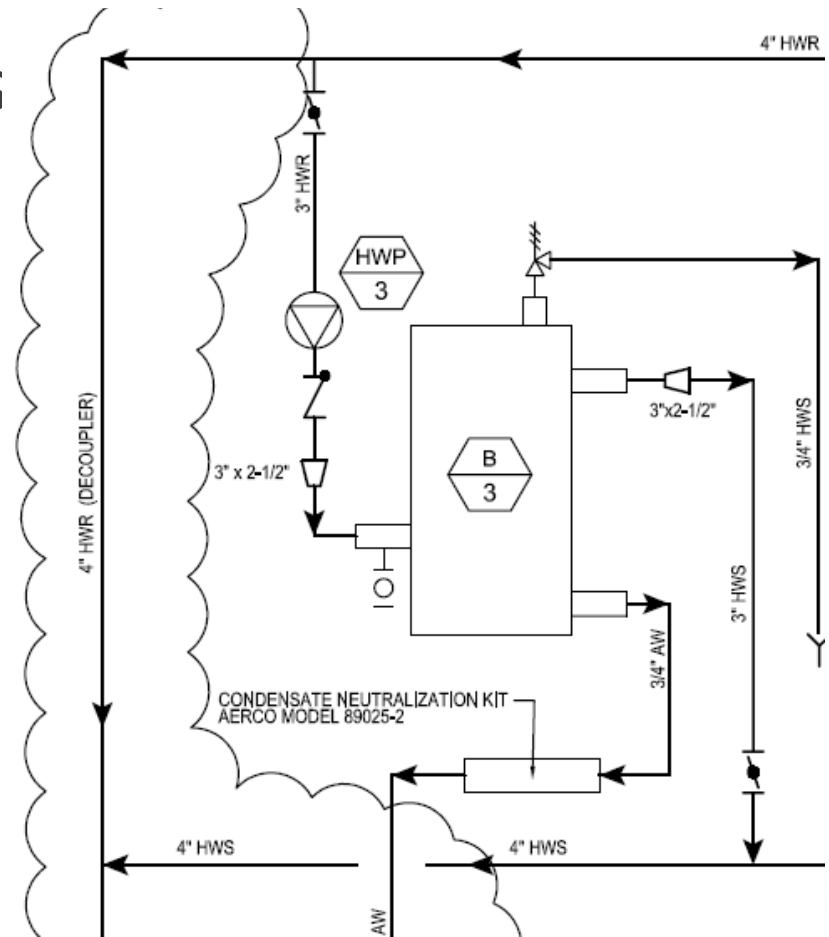
- Develop Commissioning Plan
- Review OPR & BOD
- Review Design & Construction Development Documents
- Develop & Maintain Commissioning Action Log (Deficiency Log)

Early Cx Involvement

- Identifying Problems / Challenges Early
- Asking Questions Late In Game – Change Orders
- “You Know What You Should Have Done...”
- The Commissioning Plan
- Pushing the Big Red Button

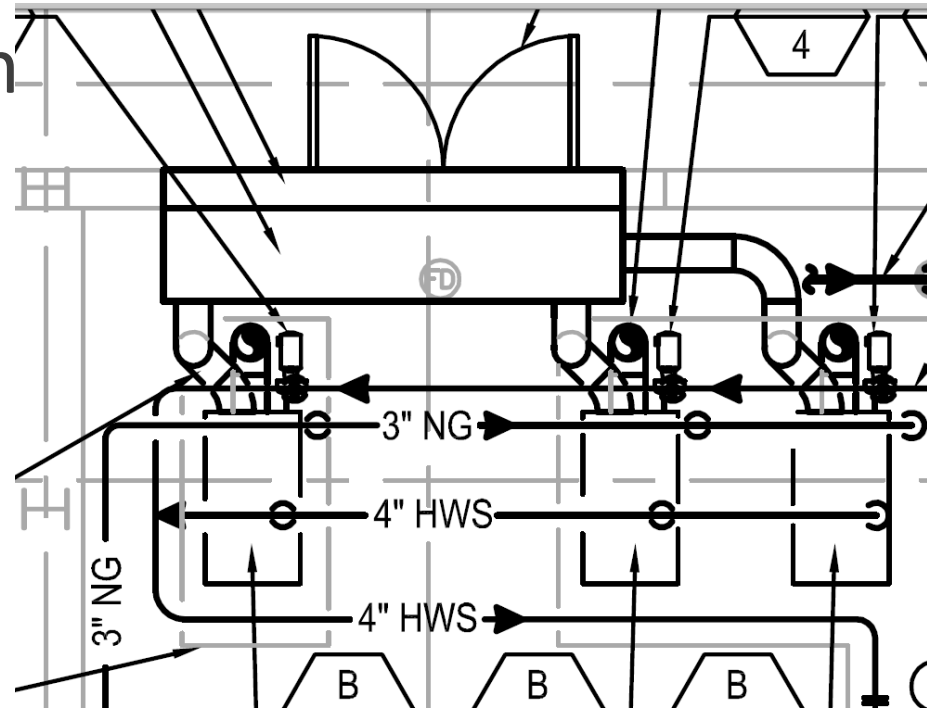
Heating Water De-Coupler

- Installation of New Boilers for OA Pre-Heat
- Missing De-Coupler
- Missing Minimum Flow Bypass



Heating Water De-Coupler

- Installed Per Flow Diagram
- CxA Hired After Installation, Tested, Filled, & TAB
- Change Orders
- Caught Before Heating Season



Construction Phase

- Review Applicable Submittals
- Attend Factory Witness Testing
- Develop Inspection Checklists & Performance Tests
- Attend Equipment Startup
- Review TAB Reports
- Site Visits/Coordination/Planning Meetings

Cx Critical Facilities – Work Authorization

- Method of Performing Work in Critical Facilities
- Detailed Team Review of Testing – Lines of Business, Engineering, Controls, Mechanical, Electrical, TAB, Cx
- Planned Impact, Potential Impact, Risk Mitigation, & Back Out Plan
- Detailed Cx Test Script – Inspections, SOO, Integration & Performance Testing
- Double Custody Steps Identified

Collapse Duct

- Large 450,000 SF Laboratory
- Behind Schedule, Coordination Challenges, Changes in Team Members
- Design Changes
- Commissioning 64,000 CFM AHU
- Concurrent Testing Smoke Dampers
- Multiple Dampers Close, Low Static Trip
- Fan Ramps Down
- 5' Exhaust Duct Pulled In

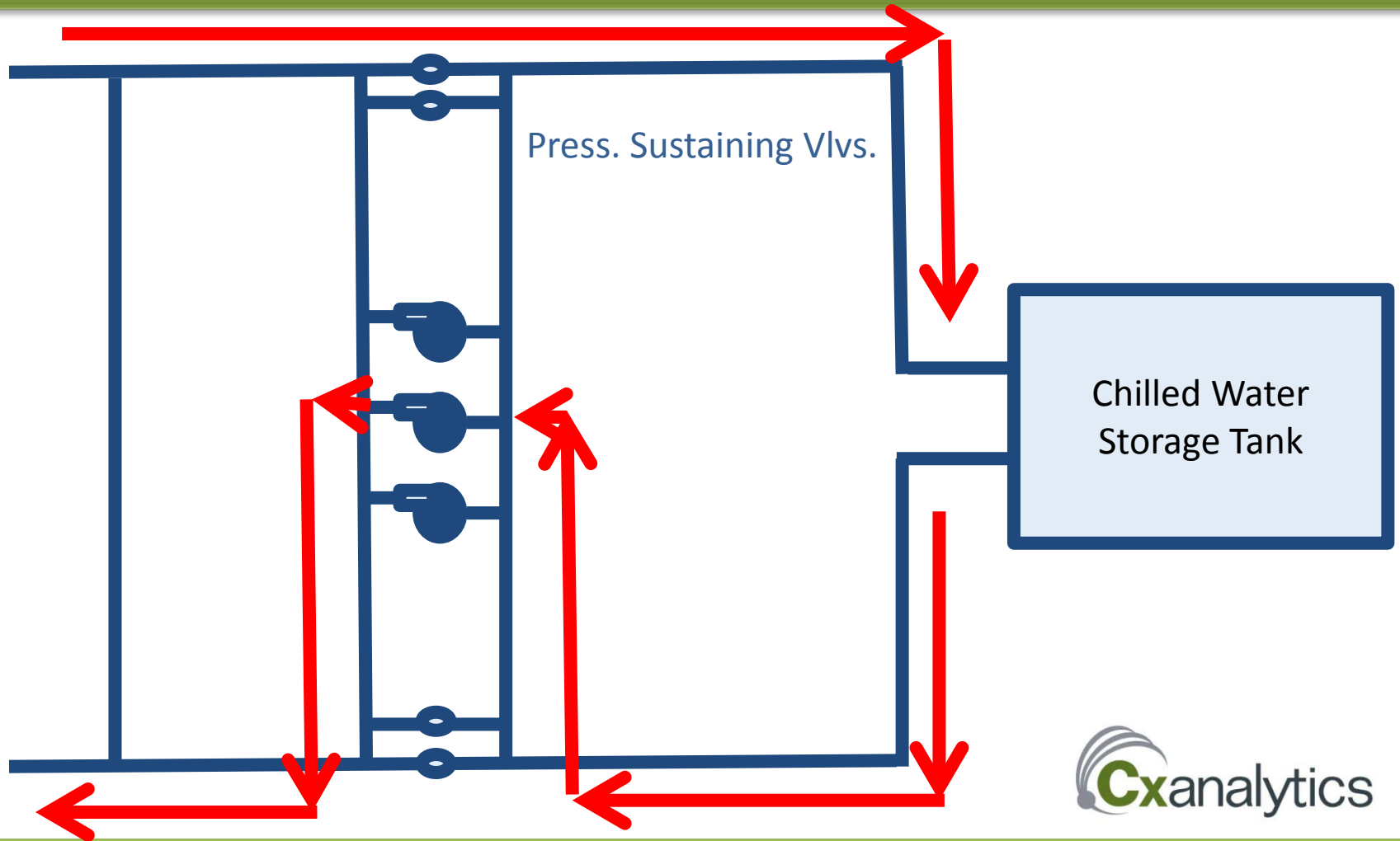
Outcomes

- Design Issues:
 - Smoke Damper Power on Single Circuit
 - Missing Safeties – Motor Breaks, End Switches
- Coordination Issues:
 - Thinking Through Failure Scenarios
 - Concurrent Testing Not Known
- Significant Cost Impact

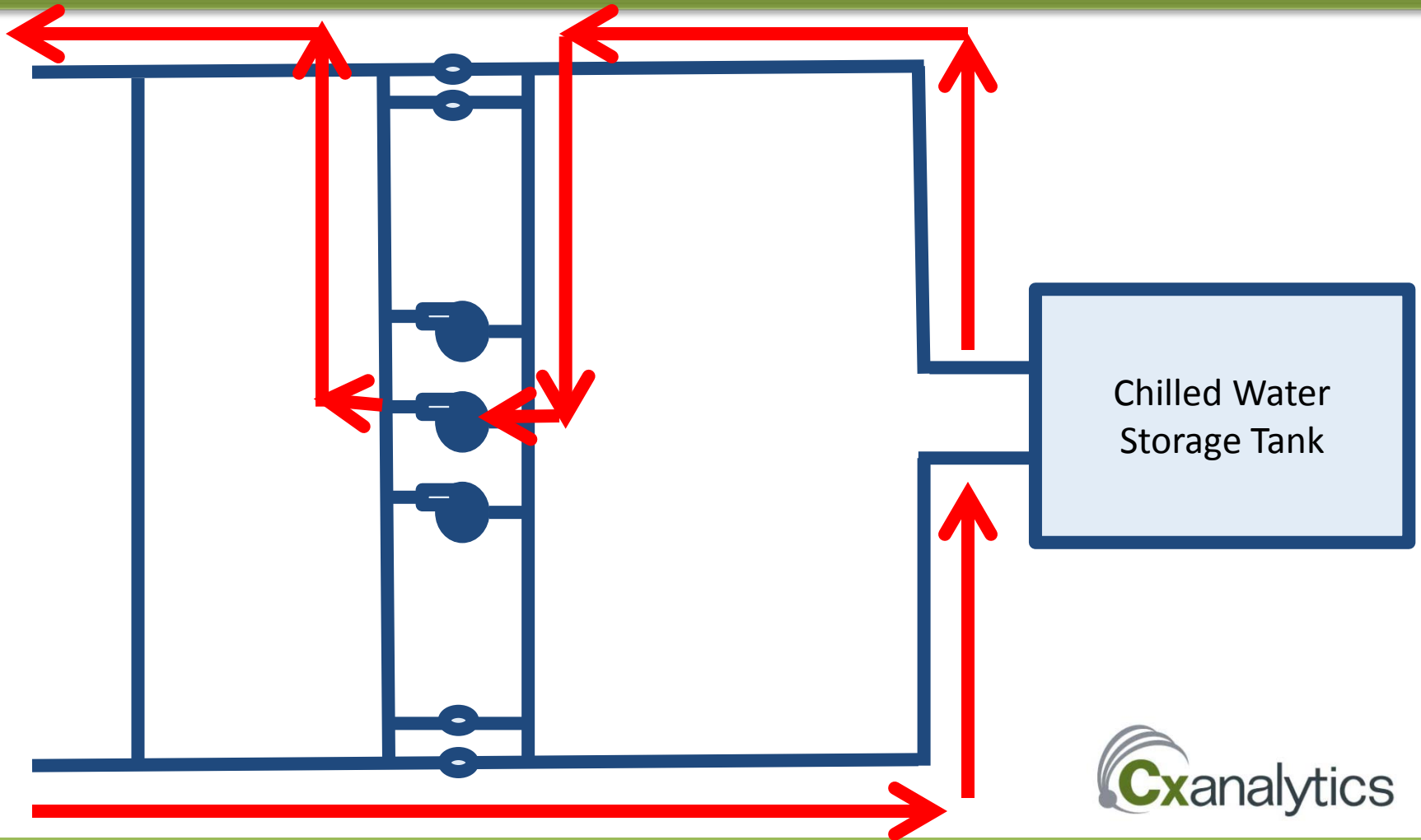
Thermal Energy Storage

- Addition of a Large, Open Loop Chilled Water Storage Tank
- 1 Hr Chilled Water Capacity
- Multiple Modes of Automation
- Integrated with Existing Critical Chilled Water System
- Pressure Sustaining Valves – Open Loop to Closed Loop

Discharge Mode

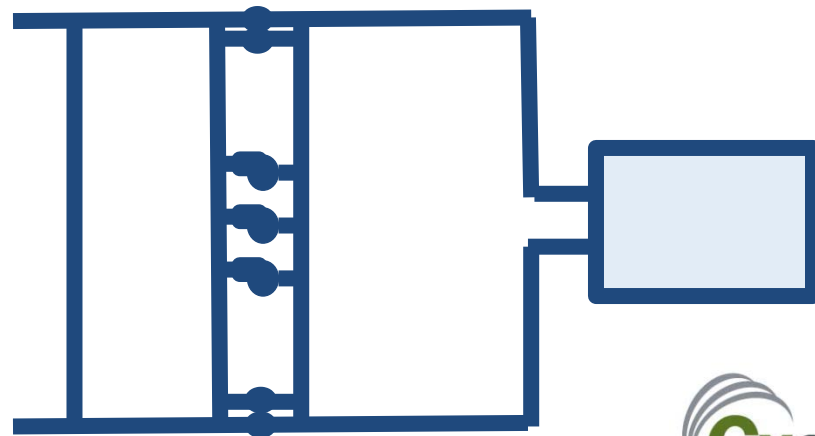


Recharge Mode



Phased Testing

- Bypass Testing – TES Isolated from Plant
- Integration Testing – Chillers and TES in Manual Mode
- System Functional Test – Automated Controls and Integration
- Pull the Plug



Local Control Programming

- Coordination Between Design, Equipment Supplier, Controls, CxA
- Internal Controls – VFD Ramp Speeds, Fault Settings, Lockouts, ATS settings

Controls – Early Discussions

- Loop Tuning - Integration with Existing Systems
- Safeties in Place
- Define BMS Failure Response
- Look for Single Failure Points

Acceptance Phase

- Perform FPTs & Integrated Testing
- Review Approved TAB Report
- Perform TAB Verification
- Provide Final Commissioning Report
- Perform Peak Season Commissioning

A snail enters the police station....



Snail: “I’ve just been mugged by a turtle.”

Police Officer: “Can you tell me what happened?”

Snail: “I don’t know. It all happened so fast!”

Schedule Challenges

- Building Gets Occupied
- Understand Client Business and Potential Restrictive Periods
- Careful Coordination of Trades
- Schedule Delays - Impact on TAB, Controls, Cx
- Don't Forget Building Flush (LEED)

Remote Panel Failure



Remote Panel Failure

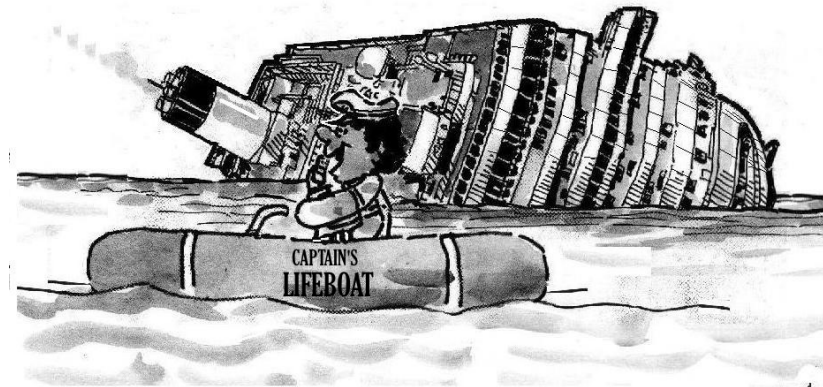
- Chiller Plant Remote Panel VE'd Out of Scope
- Panel Later Added Back in Project
- Panel Was Not Commissioned
- Failure During Routine Maintenance Caused Plant Shutdown
- Single Failure Point
- System Re-Commissioned

Communication

Ship's Captain: "We are sinking! We are sinking!"

Uzbekistan Coast Guard: "Hello...Hello...."

"What are you sinking about?"



Nothing serious boss...., she is just taking a nap!

Summary

- Early Involvement
- Coordination
- Clear Design Documents
- Following the Process
- Understand Risks/Impacts of Integrated Systems
- Review Lessons from Similar Projects
- Technology is Typically Not the Problem

Q&A

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