CampusEnergy2016 | The Changing Landscape

BMS for Mission Critical Cooling for Data Center Utilizing PLC Based Control System

Case Studies:

- UT Austin CP2 Control System Upgrade & Standardization
- Utilization of PLC Based Controls for Central Utilities

PRIME CONTROLS

Page/

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Project “Facts”

END CUSTOMER:	**Fortune 500 Financial Institution**
Project:	Tier IV+ Data Center
Purpose:	IT Storage Infrastructure for Financial Institution's Banking Transactions
Industrial Automation Requirements:	PLC Based Design for the Central Utility Plant, Thermal Tank, and Economizer Loop.

The Owner Needed a Facility that was 100% Reliable with Absolute Zero allowance for Down Time!

The Owner Needed a Control System that would support and Facilitate just that!

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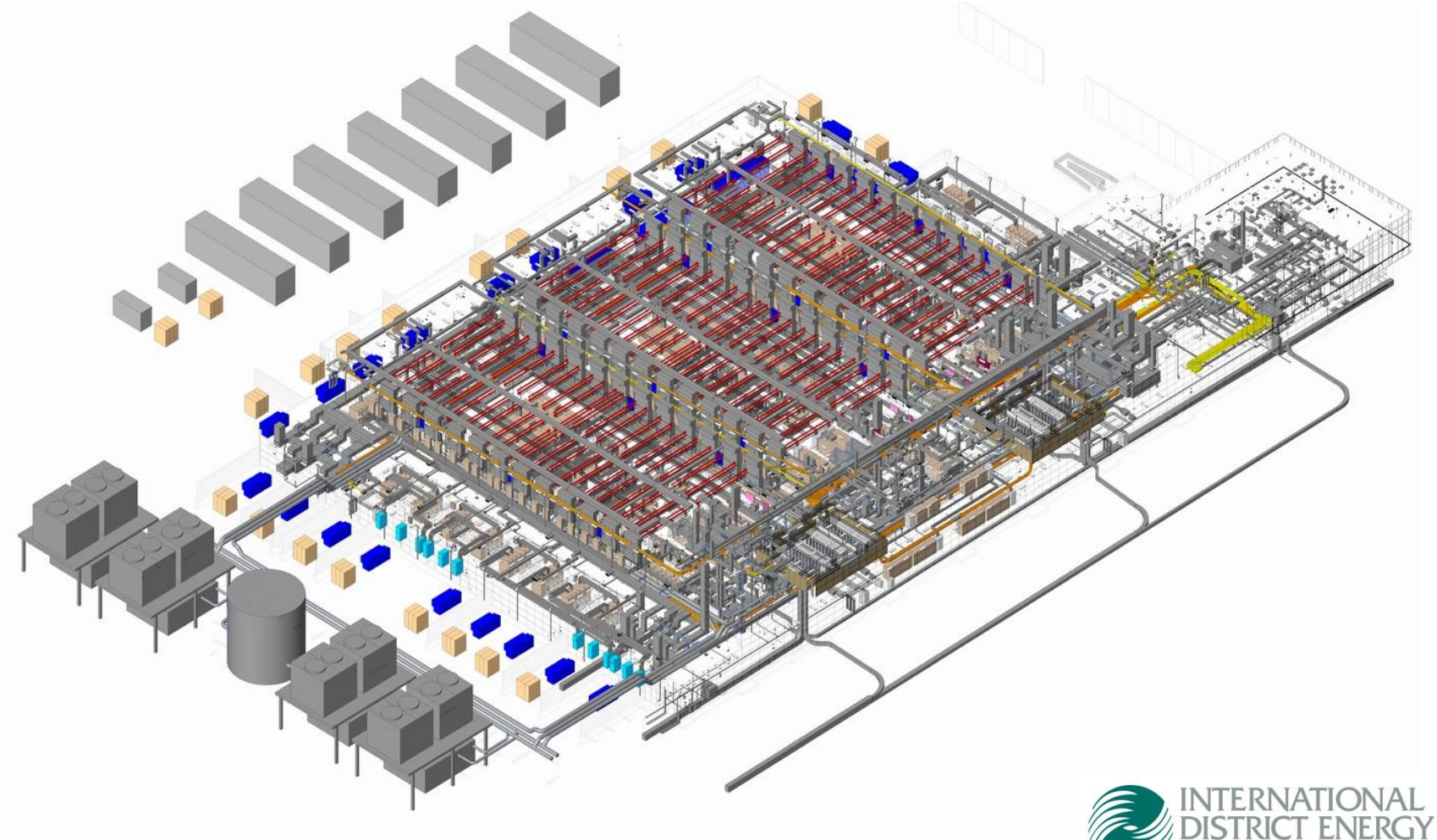
Sample Data Center MEP Overview



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Scope of Work Overview

Installation of a PLC based Distributed Control System for a 2(N + 1) Data Center Building Management System.

Scope of work included:

- Controls Design Assist
- Detail Design
- PLC Hardware/Software
- Programming
- Panel Fabrication
- Fiber Network Installation
- Controls Installation
- Controls Mechanical Installation
- Calibration and Startup of all instrumentation

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Facility Overview – Phase 1

- (2) Chillers for Critical Plant
- (2) Cooling Towers
- (4) Primary Chilled Water Pumps
- (4) Condenser Water Pumps
- (4) Secondary Chilled Water Pumps
- (2) Emergency Makeup Water Pumps
- (1) Thermal Storage Tank (w/ Thermocline)
- (4) Secondary Chilled Water Pumps
- (2) Water Treatment Systems
- (2) Centrifugal Separators
- (2) Refrigerant Monitoring Systems
- (2) Air Compressor & Dryer Units

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Facility Overview– Phase 2

HTCP – High Temp Chiller Plant

(4) Chillers
(4) Cooling Towers
(4) Primary Chilled Water Pumps
(4) Secondary Chilled Water Pumps
(4) Condenser Water Pumps
(1) Water Storage Tanks (Makeup Water)
(2) Makeup Water Pumps
(4) Exhaust Fans

LTCP – Low Temp Chiller Plant

(2) Chillers
(3) Chilled Water Pumps
(4) Cooling Towers
(1) Water Treatment Plant
(1) Centrifugal Separators
(1) Refrigerant Monitoring Systems
(1) Exhaust Fans

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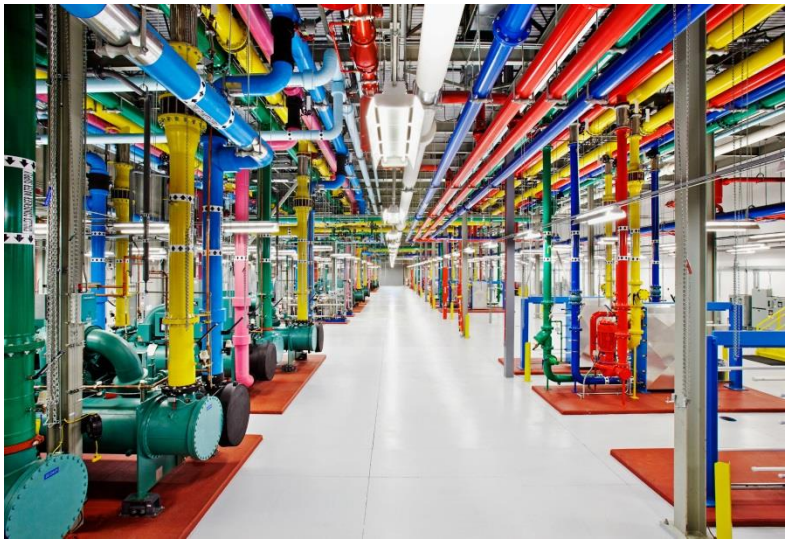
Facility Overview– Phase 2

Data Halls and Support Rooms (UPS, Battery and PDU Rooms)

(14) Air Handling Units (Battery and PDU Rooms)
(32) Computer Room AHUs – Data Halls
(18) Computer Room AHUs – Data Hall Support Rooms (UPS, DRUPS)
(5) Chiller Plant AHUs



Economizer Plant

(3) Chilled Water Pumps
(6) Cooling Towers
(3) Water Treatment Systems
(2) Centrifugal Separators
(1) Exhaust Fan

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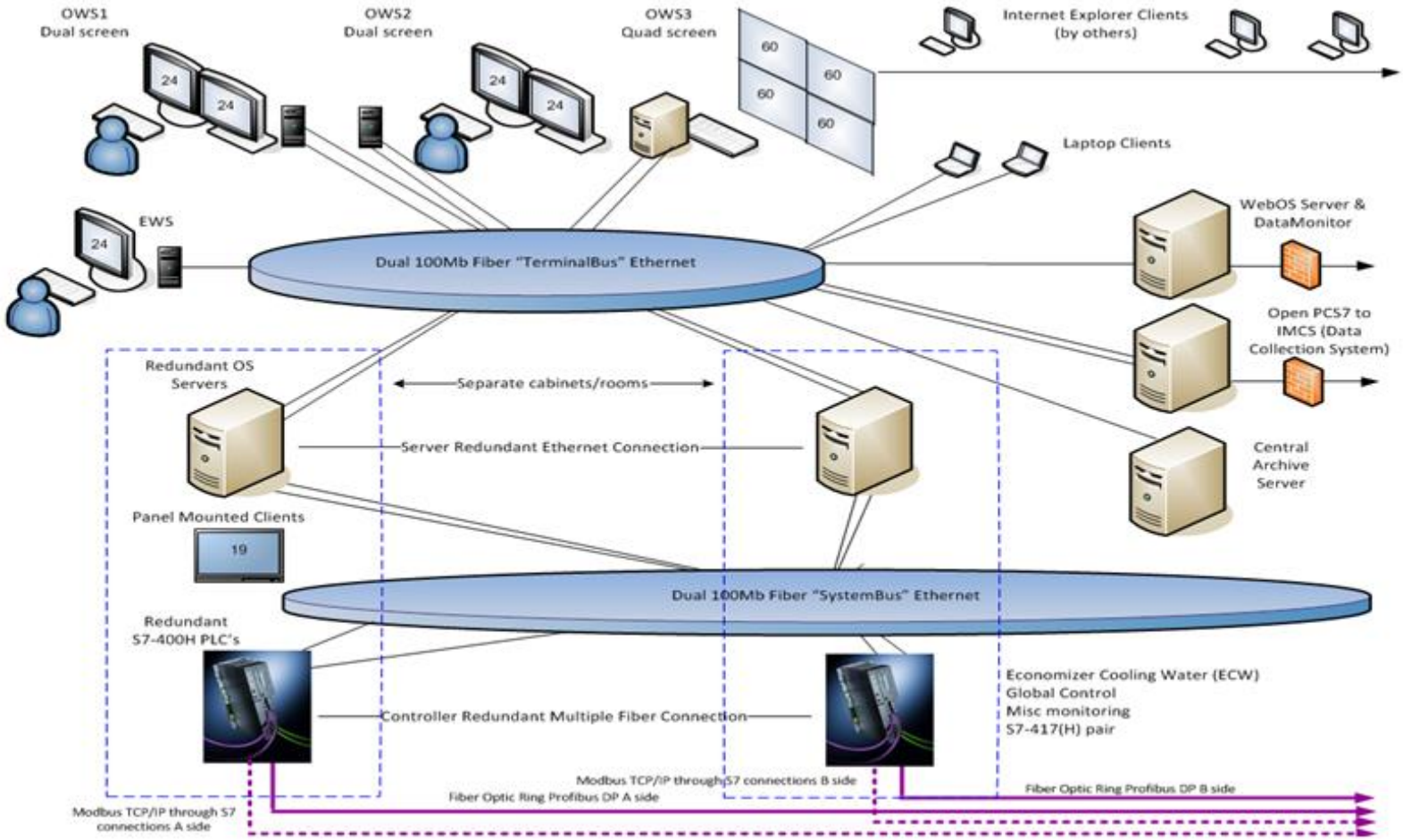
Control System Overview



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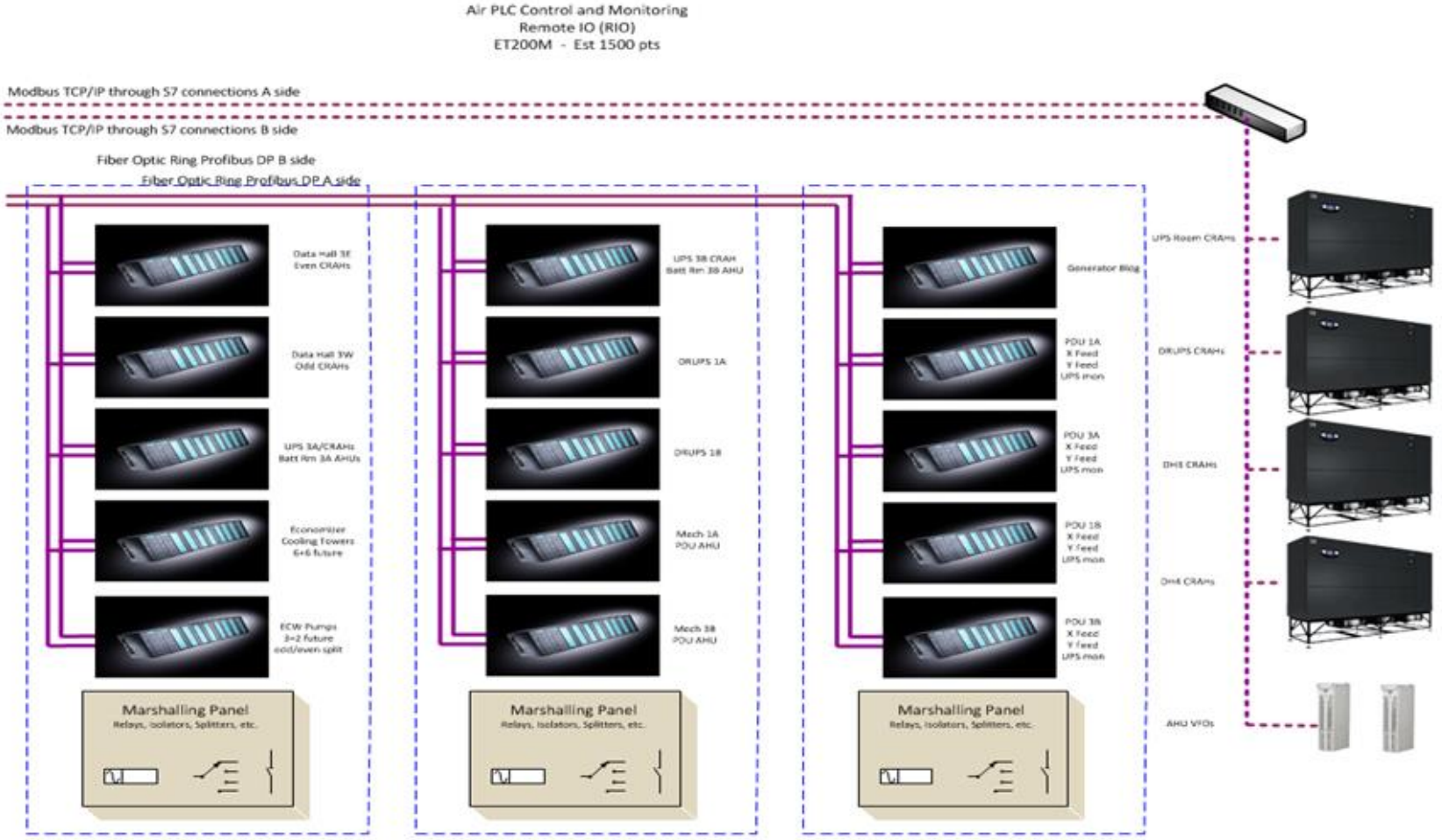

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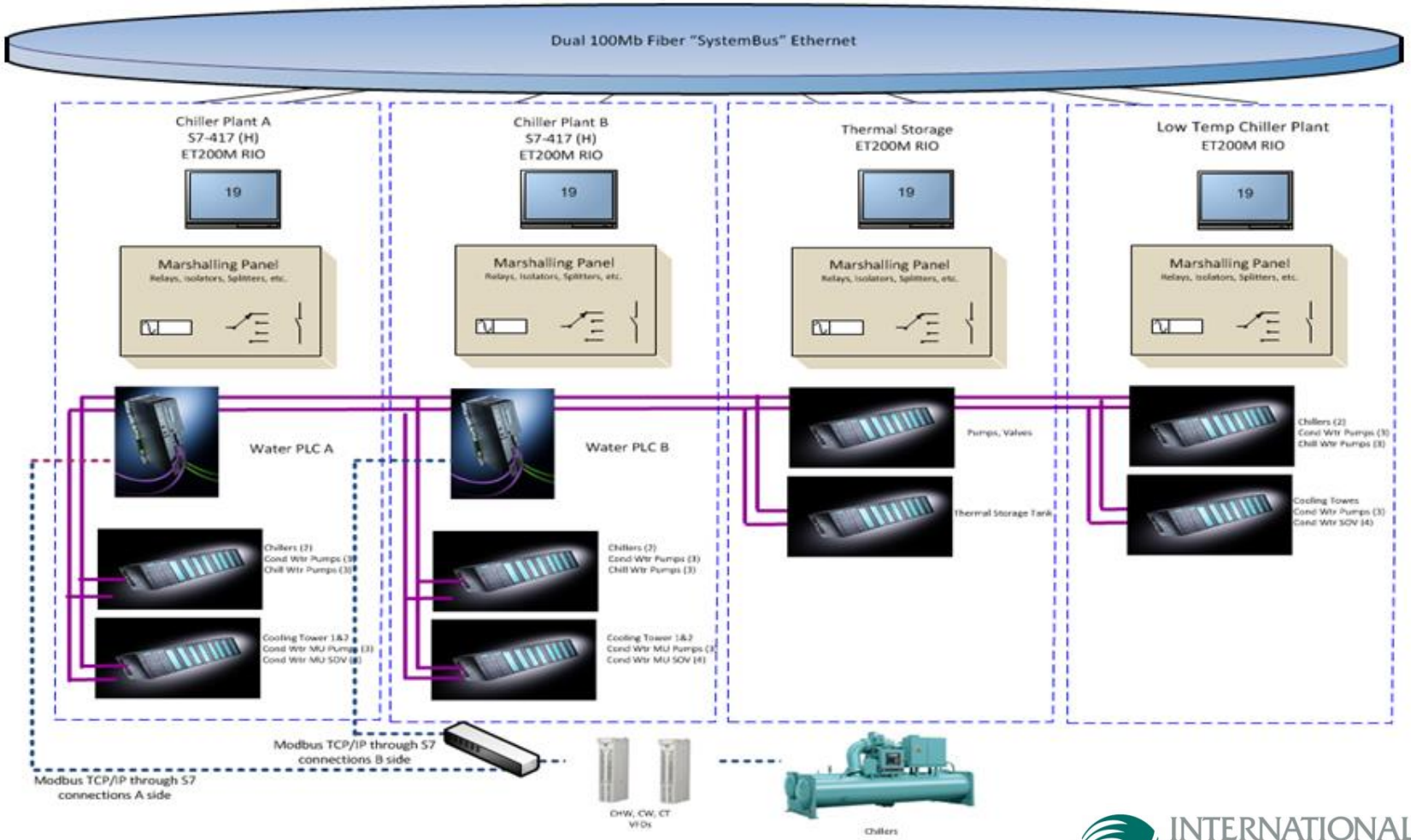

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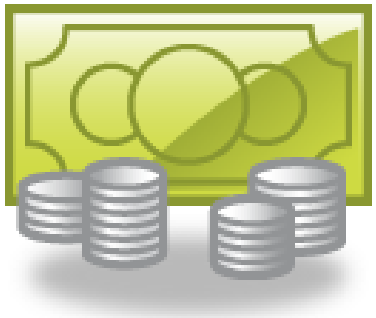
Challenge – Project Justification

- **Overall Concerns about Needs for the added IT Infrastructure**
- **Potential CAPEX Limitations**
- **Corporate Initiatives Driving Demand for this Project IF …**
  - Can Be Completed in the predetermined GMP!
  - Can Be Completed in the Critical Window of TIME!
- **THUS …**



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Challenge – PLC / DCS vs. DDC

Process Automation Controller vs. Direct Digital Controller

- **SYSTEM Comparisons**
  - Intended Use
  - Architecture
  - Software Functionality Requirements

- **SYSTEM Comparisons**
  - MTBF Assessments

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Challenge – PLC / DCS vs. DDC

Process Automation Controller vs. Direct Digital Controller

- **PLC / DCS Prevails**
  - Redundant server and controller operations for complete, 100% real-time back-up operations in the event of primary failure.
  - Dual communications paths from HMI to process controllers and from process controllers to field IO (Inputs – Outputs)
  - Controller hardware reliability based requirements
  - Process Controller and HMI performance requirements
  - TOTAL COST OF OWNERSHIP

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“GAME ON!”

NEXT STEPS / CHALLENGES

- SCHEDULE … 3 Months to Make Up!
- SCHEDULE … 3 Months to Make Up!
- Chiller Plant Automation Design
  - Hardware Design
  - Conceptual Software Design
- SCHEDULE … 3 Months to Make Up!
- MODBUS / TCPIP CRAH Control

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Challenge – Schedule

Solution

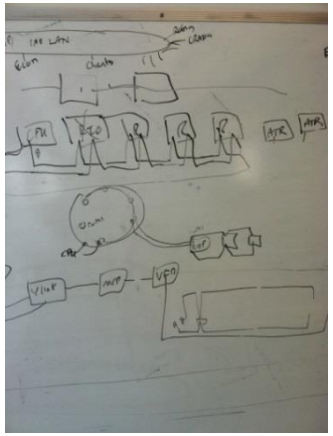
Next Day Mobilization to Site for Project Management and Design Team

- Enabled Face to Face Coordination
  - Engineers
  - Contractors
- Provided Field Engineering Support For Build / Design

Solution

Next Day Design Review Meetings Began with Engineer

- Finalize Scope of Work
- Conceptual Design
- Began the “De-Bugging” Process of the Design
- Many “White Board” Sessions!



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Challenge – Marshalling / MIMIC Panel Design & Build

Complicated Design

- Manual Plant Control via Relays
- Designed to Run Plant In Case of Control System Failure

Solution

Production Began Without Final Design

- Procurement Coordination with Local Distribution Channel
- Coordination with Manufacture to identify proper BOM
- Imbedded Design Team Resource in Production Facility
- Literally Handed Drawings from Printer to Production!

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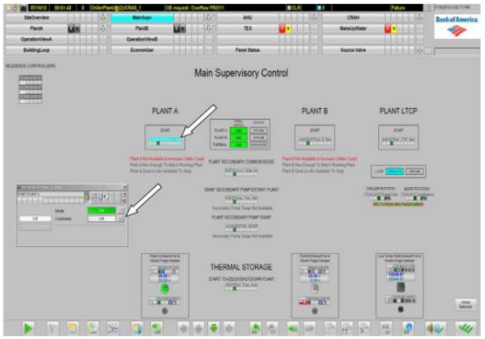
Challenge – Marshalling / MIMIC Panel Design & Build

Solution

Conducted Software Test Concurrently with Hardware FAT

- Allowed for project progress while Design and Production synched up
- Teamed Siemens Delivery Services with “In House” Prime Controls Engineers to assure Software FAT Success!



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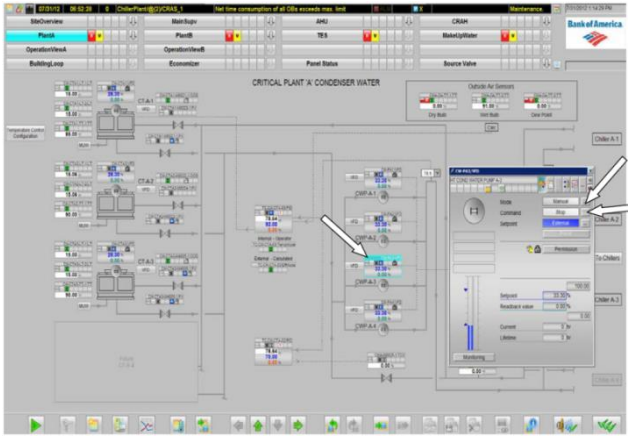
Challenge – Software Design with Condensed Schedule

Solution

Conceptual Software Design with Simulation

- Worked with Siemens Engineers in order to implement program successfully
- Utilized PCS7 APL 7.1
  - Communicate to project team that base Siemens engineered (Out of the Box) templates are to be used (no customization)



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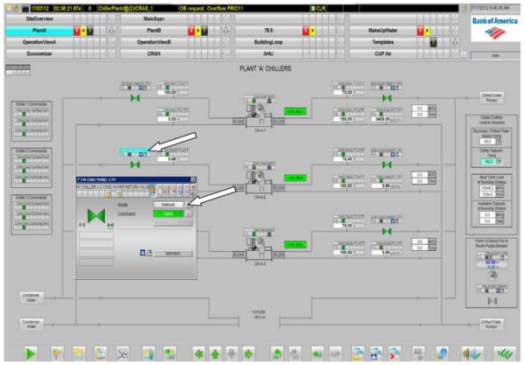
Challenge – Software Design with Condensed Schedule

Solution

Conceptual Software Design with Simulation

- Conducted FAT test of Blocks / typicals / templates to get operations / engineering approval
- Organized Picture Tree / GRACS folder
- Programmed for future phase 2 Additions to Chiller Plant during Phase 1
- Designed system knowing plant will be operating during Phase 2
  - Allowed for future allocations of IO and POs so no major problems during Phase 2



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Challenge – MODBUS TCP / IP CRAH Control

- Original Scope of Work included control of CRAHS(Computer Room Air Handlers) to be done via Hard I/O
  - Changed due to CRAH Manufacturer not having the ability for control via Hard I/O (On board controller had non-volatile memory for Hard IO
- Spec/Design change that called for control via Modbus/TCPIP
- Chosen path was to control via TCP/IP due to throughput and speed
  - Size of the system taken into account (5000+ Soft IO Points including monitoring)
- Desire to keep redundancy in case primary controller were to fail
- Desire to keep Siemens PCS7 Architecture intact
- Resulting Challenge was now the number of devices being required for Modbus/TCPIP Control…>200 Devices Required with Full Build Out!

Challenge – MODBUS TCP / IP CRAH Control

Solution

Worked with Siemens and Confines of Engineers Spec to Implement a Gateway

- 3rd Party Gateway Implemented to combine multiple devices into one S7 Connection
- Allowed for CRAH Control as well as other Modbus/TCPIP Devices (Drives, Chillers, Chemical Treatment, etc.)
- Zero Compromise of the Throughput and Speed!
- Able to support full I/O Build Out for both Control and Monitoring!
- Worked with Siemens and 3rd Party Gateway to ensure 417H compatibility for maintained redundancy
- Eliminated the need for OPC Server for Modbus Connectivity

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Challenge – Secure Network Design / Implementation in Phases

- Design Industrial network for entire facility during Phase 1
- Fiber Trunk Backbone had to be completely installed during Phase 1
- Size of Facility (Sq Footage, Fiber footage)
- Desire to have One (1) Fiber Cable w/ Multiple (12) Strands vs. Multiple Pulls of Fiber
- Had to Provide Network for both Water Side (PLC/DCS) and Air Side (DDC) of the Plant
- Industrial Security a concern with Critical Nature of Operation
  - No outside communication to network
  - Still need to provide WebHMI for connectivity within network
  - Need to send Alarms/Pages out for critical

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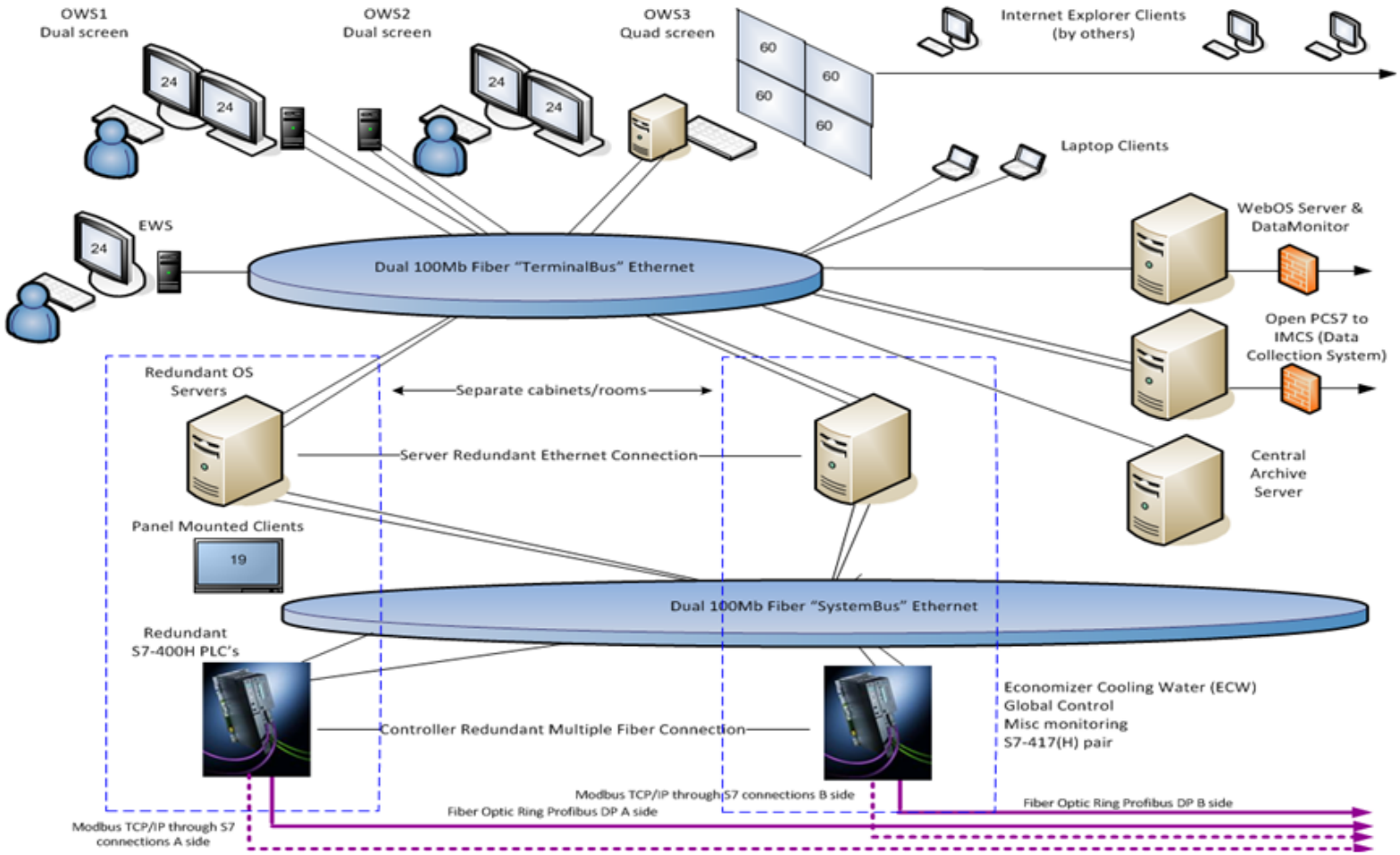
Control System Overview



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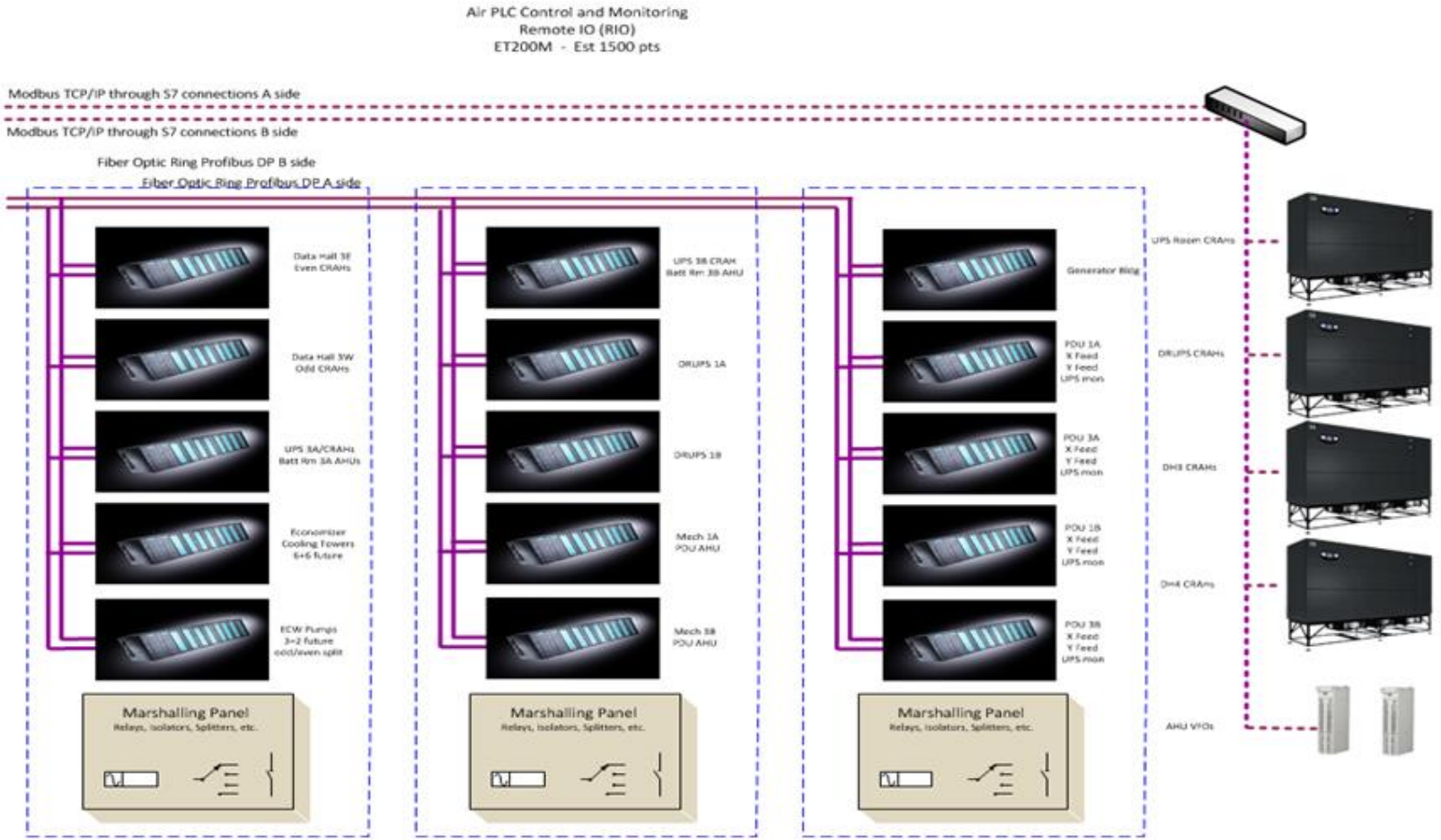

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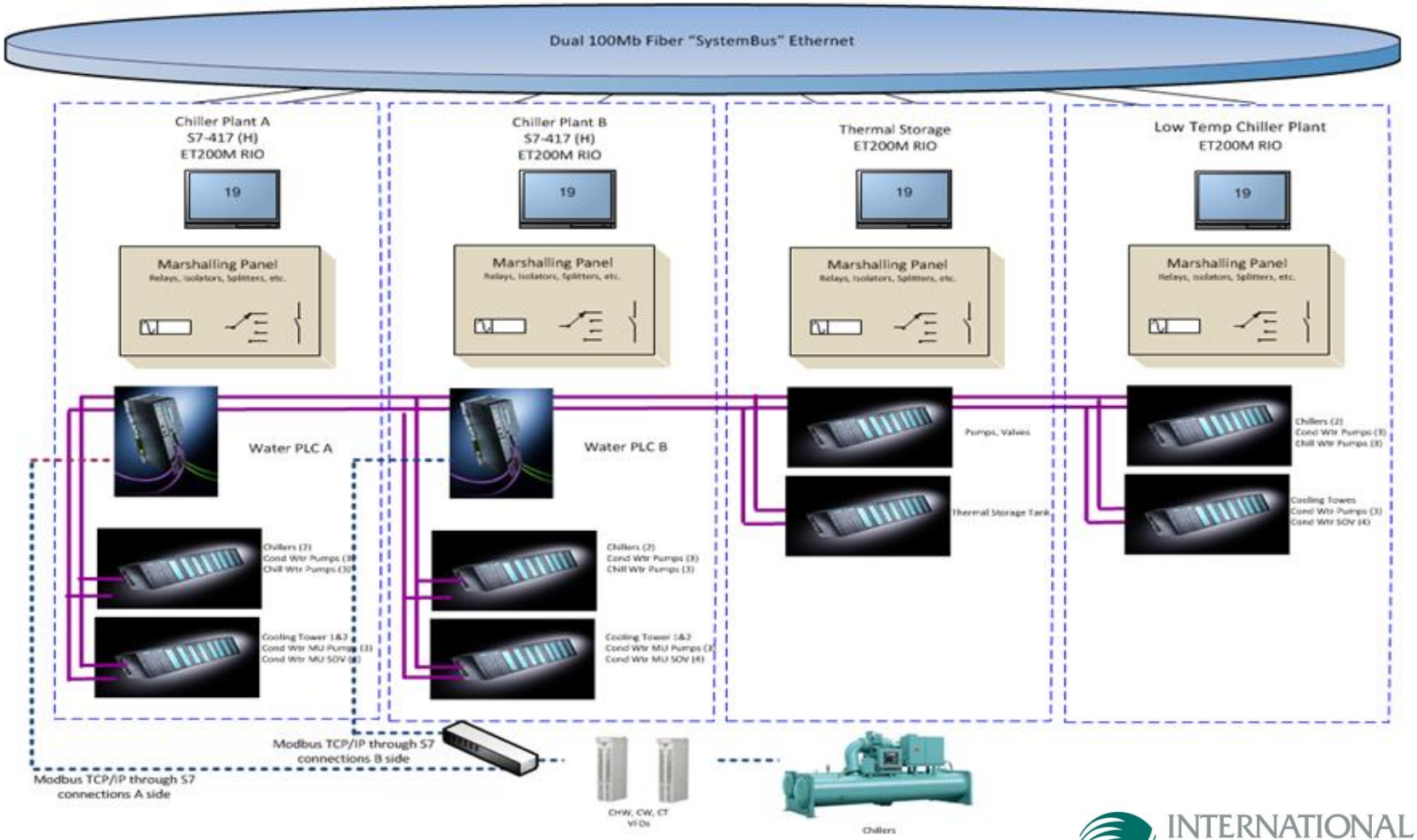

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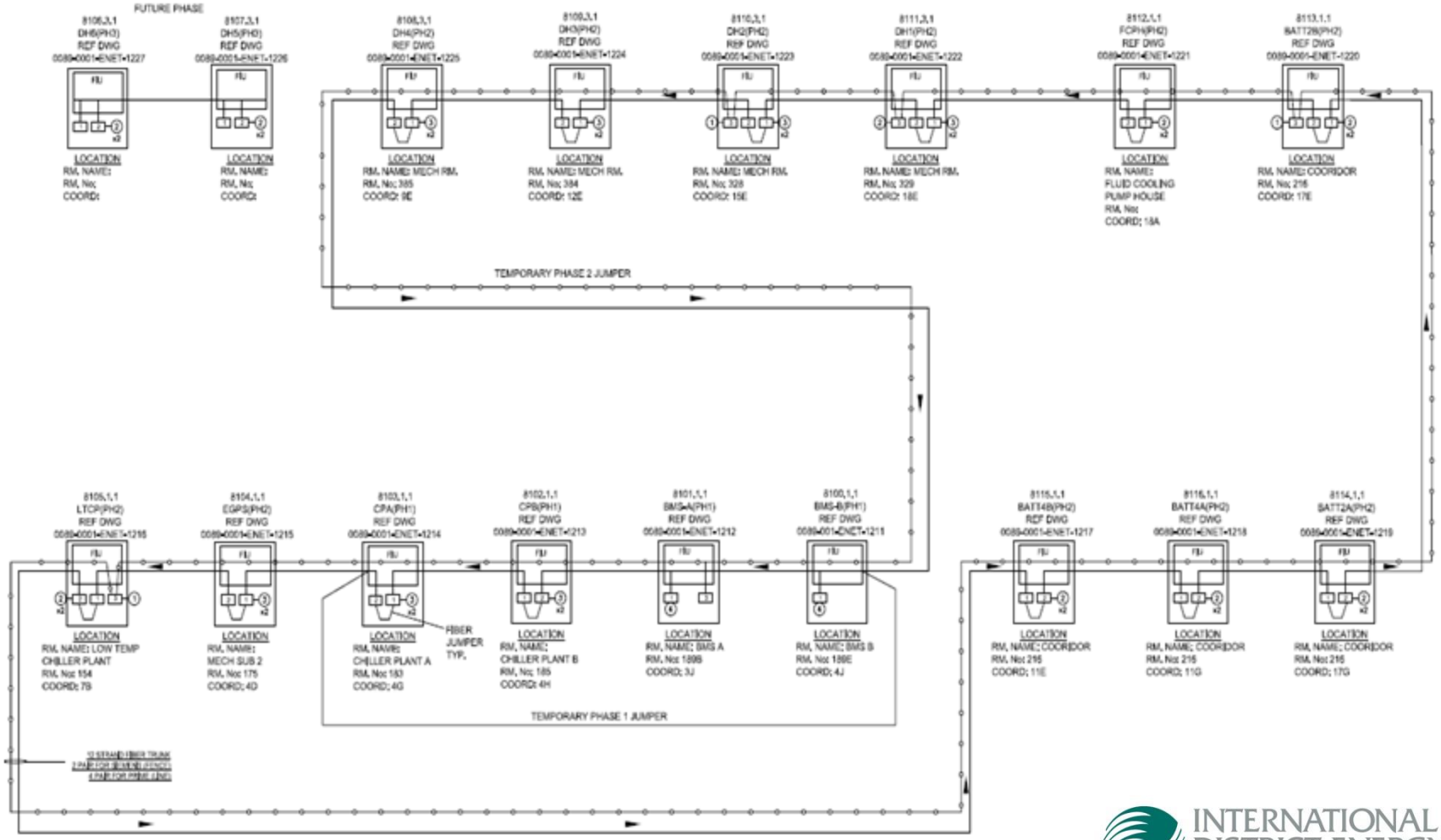
Network Overview



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Challenge – Secure Network Design / Implementation in Phases

Solution

- Multi Strand Fiber used. One carrier for conductors, multiple networks within one backbone
- Conduit Backbone installed for all future phases to allow for easy transition
- Independent Ethernet panels to allow for flexibility of installation
- Fan-Out Kits used inside all Ethernet panels. Allowed for multiple networks and termination points for fiber.
- Simatic logon utilized for security. Installed domain server to allow for Windows security access to be utilized on Servers and clients
- Server provided to be interface between industrial networks and customer.
- Server served as firewall, paging/alarming interface, and data gathering

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Results

PLC Based Control System via Prime Controls Results

- Full Specification Compliance
- Commissioned and Proven
- Happy Customer
- Control System Enabling a LEED Certified Facility
- Secure Network
- Reliable Building Management System to Ensure Facility UPTIME!

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Q & A

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