



When it comes to technology, "we've got it under control!!"

Lock & Dam Maintenance Workshop
PLC Controls

www.champtechnology.com

Agenda

- Introductions
- About Champion
 - History/Capabilities/Lock Experience
- Why Use A PLC?
- Automation Solutions / Capabilities
- Control System Design & Approach
- Miter/Sector Gate
 - Sector Gate Controls
 - S.G. Lessons Learned
 - Miter Gate Controls
 - M.G. Lessons Learned
- Chicago Harbor Lock Projects
 - Limit Switch Upgrade
 - Lock Automation Upgrade



Presenter Introductions

- Brad Jordan
 - Principal & Business Manager Western LA & Eastern TX
 - Over 17 Years in Automation Industry
 - Experience with DCS, PLC, SCADA & Historian Applications
 - BSEE from McNeese State University

- John Pellerin
 - Sr. Automation Engineer
 - Over 25 Years in Automation Industry
 - Experience with DCS, PLC, SCADA & Historian Applications
 - BS Industrial Distribution – Texas A&M



Champion Introduction

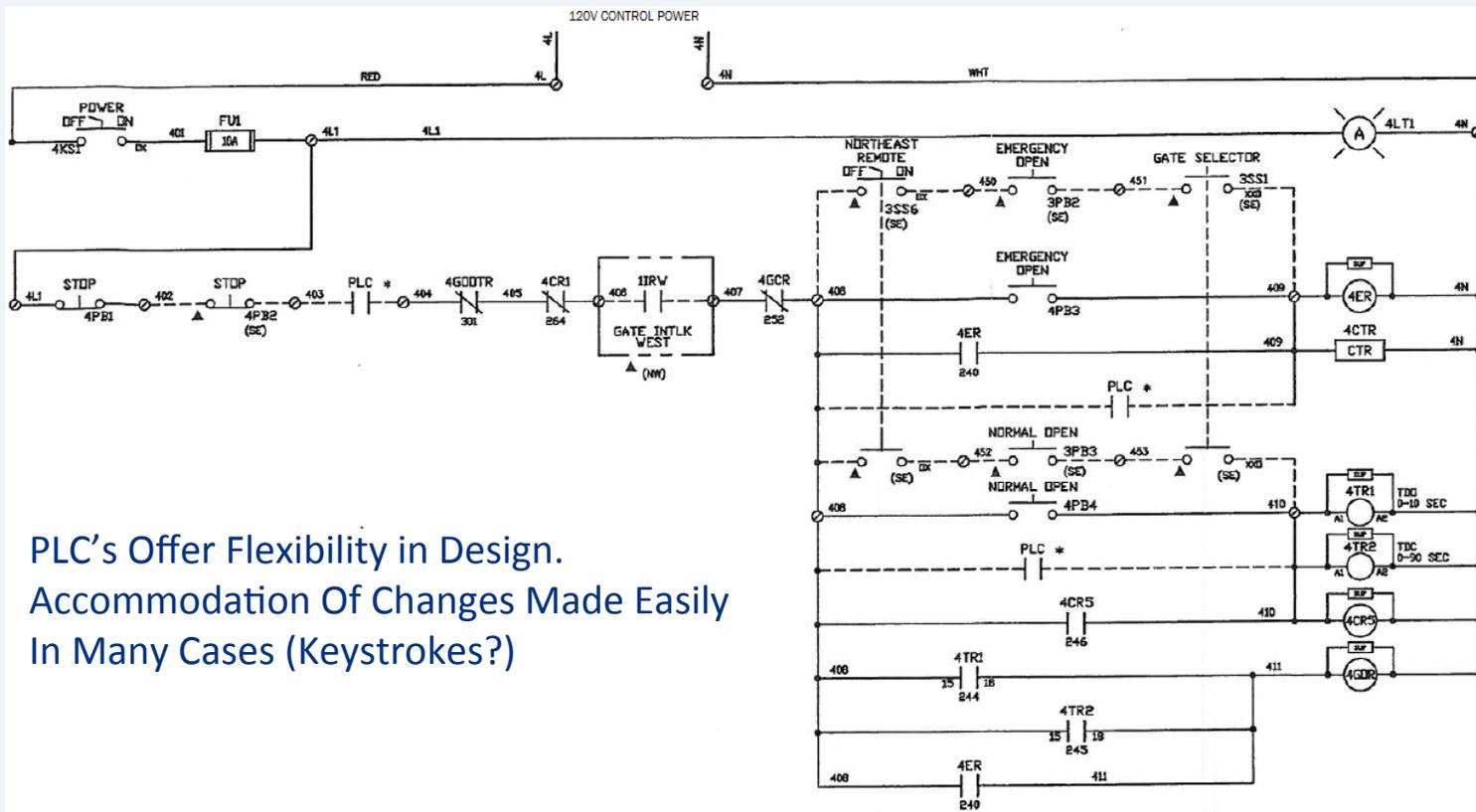
- 120 Full Time Employees / 90 Automation Engineers
- 7 Locations / 2 UL Panel Shops
- Primary Heavy Industrial Markets Served
 - Oil & Gas (Upstream, Midstream and Downstream)
 - Chemical
 - Metals
 - Mining & Minerals
 - Pulp & Paper
 - Food & Beverage
 - Marine
 - Utilities
- Services for the Following
 - DCS & Hybrids
 - PLC
 - SCADA & HMI
 - Panel Design & Fabrication
 - Alarm Management
 - Historians
 - Information Systems
 - Safety Systems
 - Legacy Migration
 - RTU & Flow Computers

Champion Introduction

- Project Services
 - Project Management
 - Front End Studies
 - Design-Build Approach
 - P&S (Plans & Specs) Approach
 - Turn-Key Automation & Electrical Installations
- Support Services
 - Scheduled Visits
 - Breakdown Support
 - Consulting
- Lock & Dam Experience
 - 16 L&D Automation Projects
 - Sector/Miter Gate Locks
 - Flood Control Structures
 - Pump Stations
- Recognize Each Lock Is Unique
 - Challenges Vary
 - Preferences Vary
 - Lock Design & Equipment Differences

Why Use a PLC?

- PLC Versus Hardwired Relay Systems
 - Relay Systems Require Test Meter & Drawings For System “Visibility”
 - When Properly Designed, PLC Systems Can Be Easy To Repair Or Modify



- PLC's Offer Flexibility in Design. Accommodation Of Changes Made Easily In Many Cases (Keystrokes?)

Why Use a PLC?

- Reliability
 - Industrial Components
 - Proven Architecture (30+ Years)
- Improved 'View' Of the Equipment
 - Water Levels & Actual Gate Position, Speed, etc.
 - Equipment Failure Indication
 - Alarm Reporting (Low Oil, High Oil Pressure, Clogged Filter, Gate Arm Stress, Miter Failure, Tripped Breakers, etc.)
 - Historical Logging Of Failures, Alarms, Operator Commands, etc.
- Simplify Control Wiring
 - Reduce Field Wiring Length & Qty
- Remote Control
 - Operate / Maintenance
 - Inexpensive Addition To System

Automation Solutions / Capabilities

- Automation Equipment Used
 - Whatever Makes The Most Sense For This Facility
 - A-B, Modicon, Siemens, GE, etc.
 - Rockwell, Wonderware, Siemens, GE, etc.



Automation Solutions / Capabilities

- Instruments/Sensors

- A-B, Siemens, Rosemount, Banner, Turck, Cutler Hammer, Square-D, etc.

Gate Position Eyes (% Open)



Water Level Transmitters



Overtravel L.S.



EOT Photo Eye



Weather



Gate Position Prox Switches (% Open)



Automation Solutions / Capabilities

- Hybrid Systems
 - PLC with Hardwired Relay Backup
 - Separate PLC System and Safety System



- Camera Systems For Surveillance and Equipment Monitoring



Automation Solutions / Capabilities

- Radio Control
 - Wireless Gate Operation For Local Maintenance Functions
- Redundancy for Critical Operation
 - PLC Processor
 - I/O Module
 - Ethernet Network Comms
 - Power Supplies
 - Operator Displays
- PC Usage
 - Off-the-Shelf Dell Desktop Workstations
 - Security (DIACAP Compliance)
- Electrical Upgrades/Enhancements
 - 480V & 120V Power Distribution
 - Motor Control Centers



Automation Solutions / Capabilities

- Control House Modernization (Example #1)



Automation Solutions / Capabilities

- Control House Modernization (Example #2)

“Before”



Automation Solutions / Capabilities

- Control House Modernization (Example #2)

“After”



Control System Design & Approach

- Fail Safe Strategy
 - Hardwired Normally Closed E-Stop Buttons
 - Only Industrial Components Used
- Improved Operator Visibility & Control
 - Diagnostics
 - Control Gate & Valve Movement & Speed
 - Water Levels For Automatic Chamber Equalization, Monitoring, Trending, etc.
 - Radar, Ultrasonic, Laser, etc.
 - No Moving Parts, Sensors Not In Contact With The Water
 - Fast Updates
 - Miter Confirmation via Sensors & Cameras
 - Control Of Facility & Guidewall Lighting, Navigation Signals, etc.
 - Marquee Signs For Vessel Information Messages

Control System Design & Approach

- Maintenance Friendly Approach
 - K.I.S.S. Principal Applied (Why Does A PLC Design Have To Be Complicated?)
 - Avoid Custom or Obscure Programming
 - Straightforward Point To Point Wiring
 - Heavy Focus On Labeling & Documentation
 - One-on-One Training For Maintenance (See What's Under The Hood)
 - Use Commercially Available Off-the shelf Components
 - Avoid using Components With:
 - Long Lead Times
 - Foreign Origins
 - No Stateside Support
 - Connectivity To Most Sensors/Systems
 - Standard Control Signals
 - 120VAC and 24VDC Discrete Signals (For Limit Switches, Motor Starters, etc.)
 - 0-10VDC and 4-20mA Analog Signals (For Pressure, Level & Temperature, etc. Indication)
 - Ethernet Used For PC to PLC Comms (It Is The Industry Standard For Most Mfr's Today)

Control System Design & Approach

- Maintenance Friendly Approach
 - Built-In Diagnostics Monitor And Detect:
 - E-Stop Pressed, Limit Switch Failures, Fail To Start, Equip Speed & Speed Command Feedback
 - Oil Pressures, Reservoir Temperatures, Levels, Lubrication System Issues
 - Breaker Tripped / Disconnect Turned Off, Blown Fuses, Tripped Breakers

Event Time	Alarm Name	Condition N...	Message
13-Jan 2014 14:25:36	NW_HPU_OIL_RESERV_LOW		Oil Reservoir Level Low - Northwest Gate HPU
21-Jan 2014 19:17:24	SW_GATE_480V_DISC_OFF		480V Disconnect Off - Southwest Gate Control Cabinet

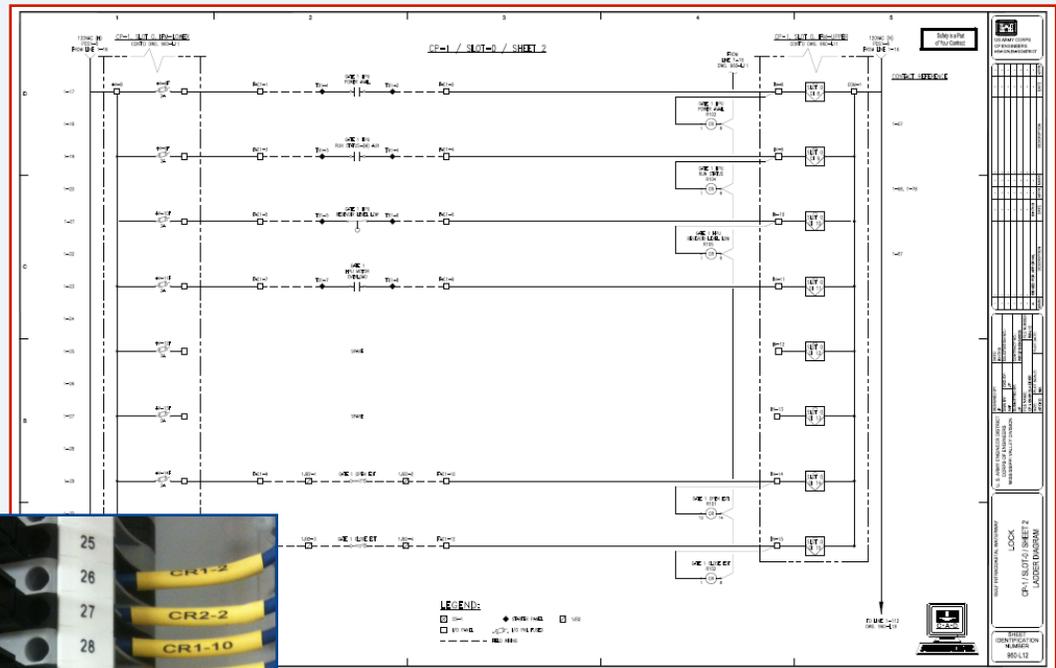
Control System Design & Approach

- Maintenance Friendly Approach (Cont'd)

- Documentation

- PLC/Electrical Schematic Diagrams
 - Extensive Labeling in PLC, Wire Tags, Cabinet Identification
 - Control Strategy & Operation Manuals

- Familiarity Due To Maint & Ops Involved In Design And Implementation Phases



Control System Design & Approach

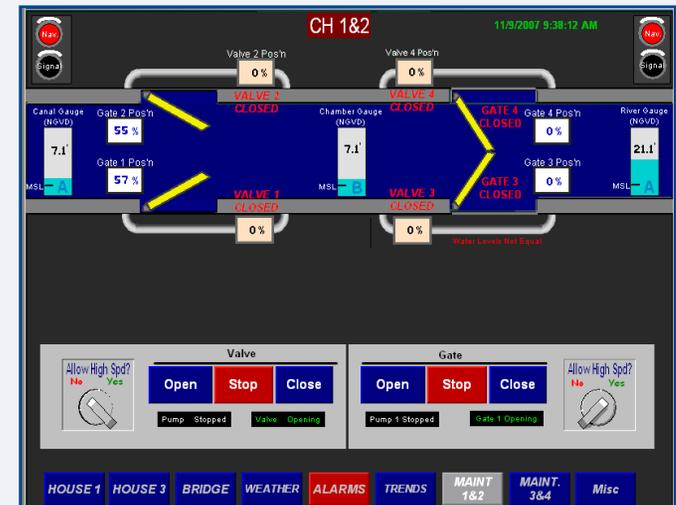
- Training
 - Maintenance
 - Operators
- Scheduled Visits
 - Repair Assistance
 - Preventive Maintenance
 - System Improvements
 - Training Refreshers

Miter / Sector Gate Locks



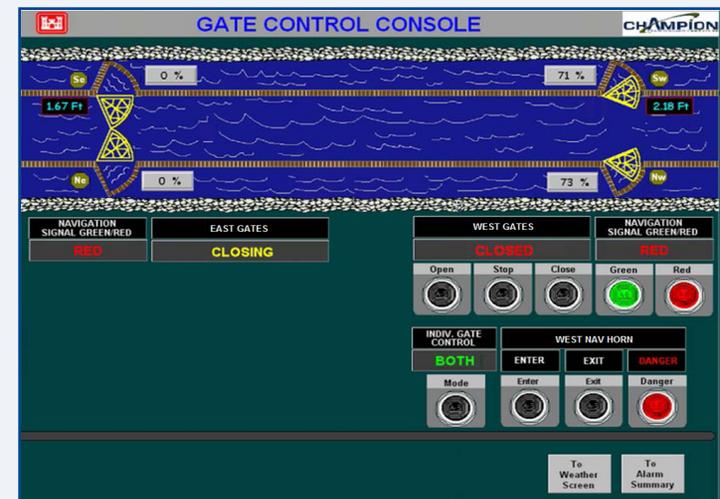
Miter / Sector Gate Locks

- Miter Gate Controls
 - Challenges / Lessons Learned
 - Misalignment While Measuring Gate Position On Large Mass (Gates & Valves)
 - Slightly warped gates produce poor miters
 - Lack Of Sufficient Interlocking Results In Severe Mechanical Damage
 - Improper Gate & Valve Sensor Selection/Implementation
 - Hydraulic Speed & Positioning Inconsistencies



Miter / Sector Gate Locks

- Sector Gate Controls
 - Challenges / Lessons Learned
 - Fewer Challenges As Compared To Miter Gate Applications
 - Misalignment While Measuring Gate Position & End Of Travel
 - Improper Gate Sensor Selection/Implementation
 - Failed EOT's Can Result In Gate Overrun & Equipment Damage
 - Hydraulic Speed & Positioning Inconsistencies



Control Structures

- Additions Of Gate Position Feedback & Display



Chicago Lock Projects

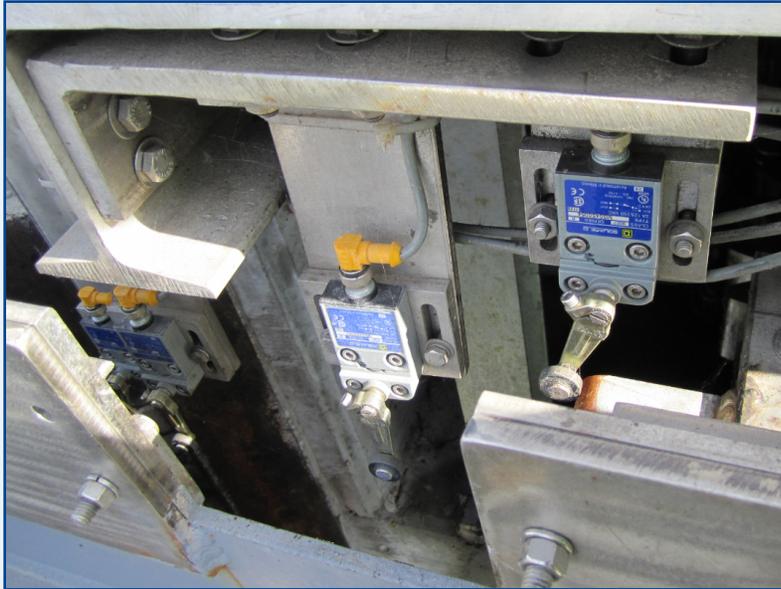
- Gate EOT Limit Switch Upgrade
 - Replaced Failing Mechanical Switches w/ Non-Contact Prox Switches (No Moving Parts)
 - Original Installation
 - Lock Experienced 21 Failures During First Year
 - New Solution
 - Resulted In 1 Failure During Last 12 Months
 - Designed to Handle Normal Gate Misalignment
- Lock Automation Upgrade
 - Ongoing Project
 - Hybrid System Upgraded to Native PLC Controls w/ Backup
 - Failsafe Design (Original Design Used Energize-To-Stop Strategy)
 - DC Approach For Safety
 - Significant Improvement In Equipment Visibility For Operators

Chicago Lock

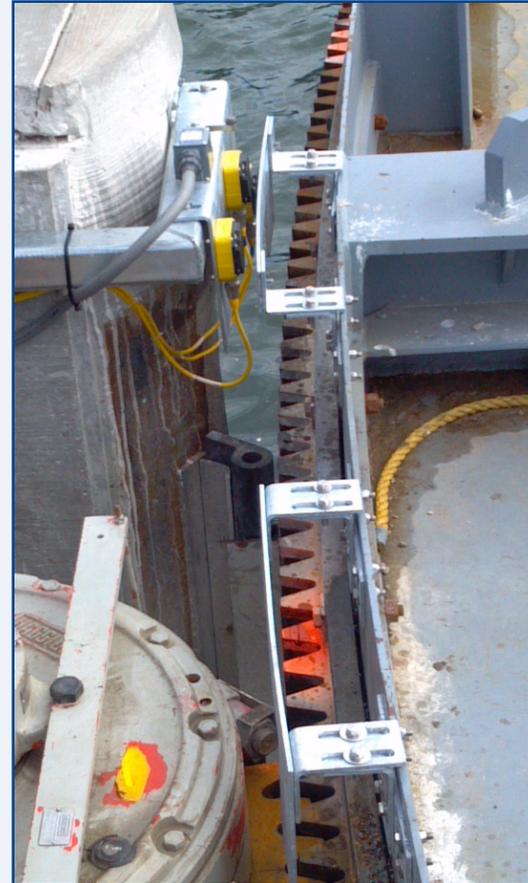
- Project: Limit Switch Replacement
 - Project Approach
 - USACE paid trips for investigation
 - Project Justification
 - Unreliable Gate Controls Could Result In Catastrophic Flooding Of The City
 - 21 Switch failures in 2 years versus 1 Failure
 - New Switches:
 - Plug-in Style Rated for -13 Deg F
 - No moving parts
 - Challenges Faced
 - Ambient Temperatures / Ice Formation On Equipment
 - Gate Misalignment Due To Temperature Swings (Shrink/Grow)

Chicago Lock

Before



After



Chicago Lock (continued)

- Project: PLC Upgrade (ongoing effort)
 - Project Approach
 - Design Build Using Lock Proven Technologies & Designs
 - Don't "Reinvent The Wheel"
 - K.I.S.S. Principle
 - Justification
 - Unreliable Gate Controls Could Result In Catastrophic Flooding Of The City
 - Safety: Energize To Stop Strategy
 - AC Controls Converted To DC
 - Challenges Faced
 - Minimizing Lock Interruptions



Questions?

More Information?



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