Massachusetts Institute of Technology

Control Upgrade for Critical Facility Services

International District Energy Association
Campus Energy Conference 2016

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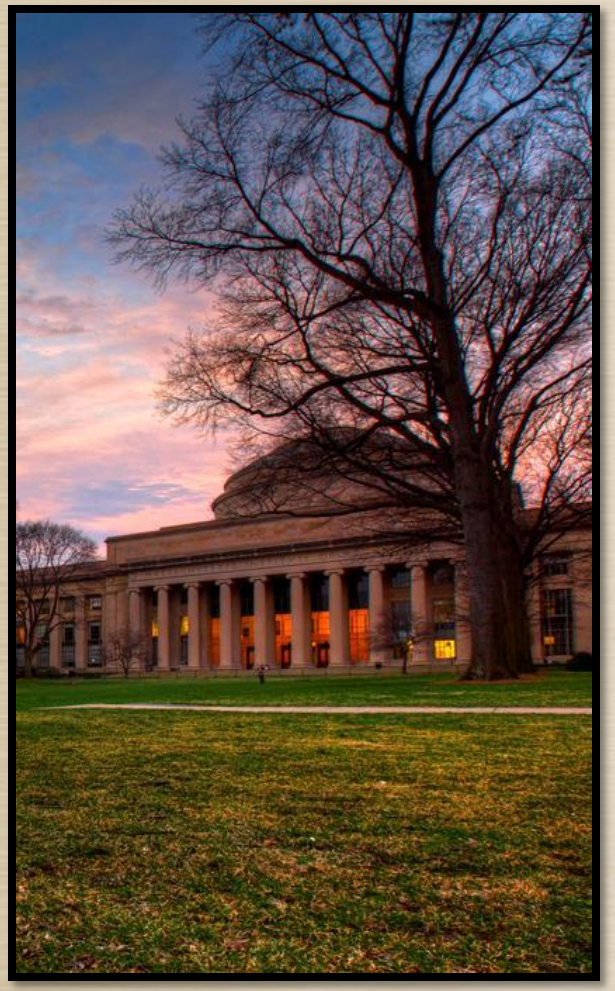
INTERNATIONAL DISTRICT ENERGY ASSOCIATION

MIT's Campus Utilities

- Central Utilities Plant that serves campus electrical, heating, and cooling needs
- Five oil/gas fired boilers
- One 20MW combustion turbine with an HRSG
- Six steam driven chillers and eight electric driven chillers
- Two - 50kpph hot water heat exchangers

Project Scope & Drivers



PROJECT: Replace DCS Controls at Central Utilities Plant

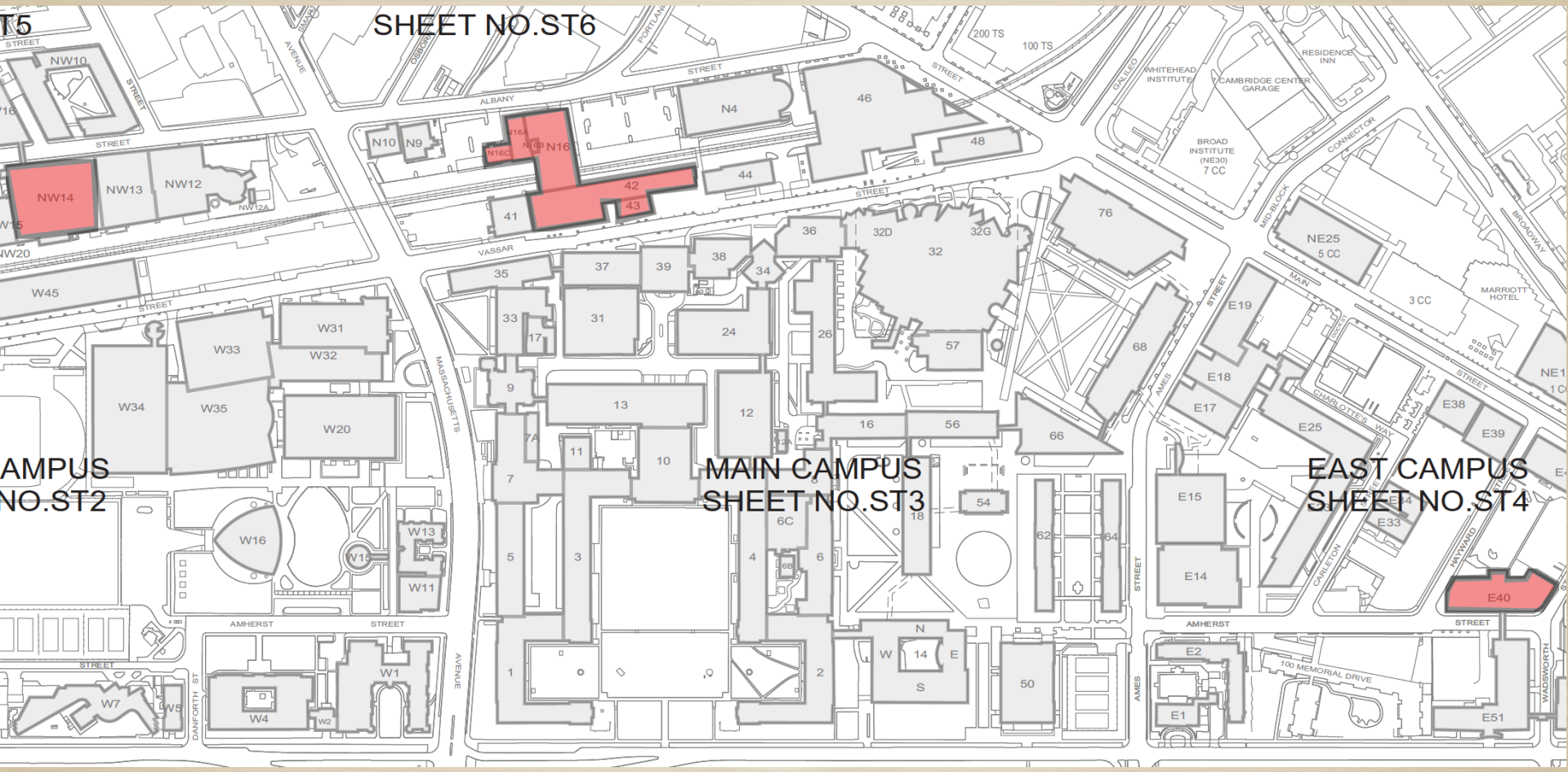
Replace obsolete controls and improve maintainability

- Antiquated system
- Spare parts limited or unavailable
- Difficult to maintain
- Limited availability of experienced tech support

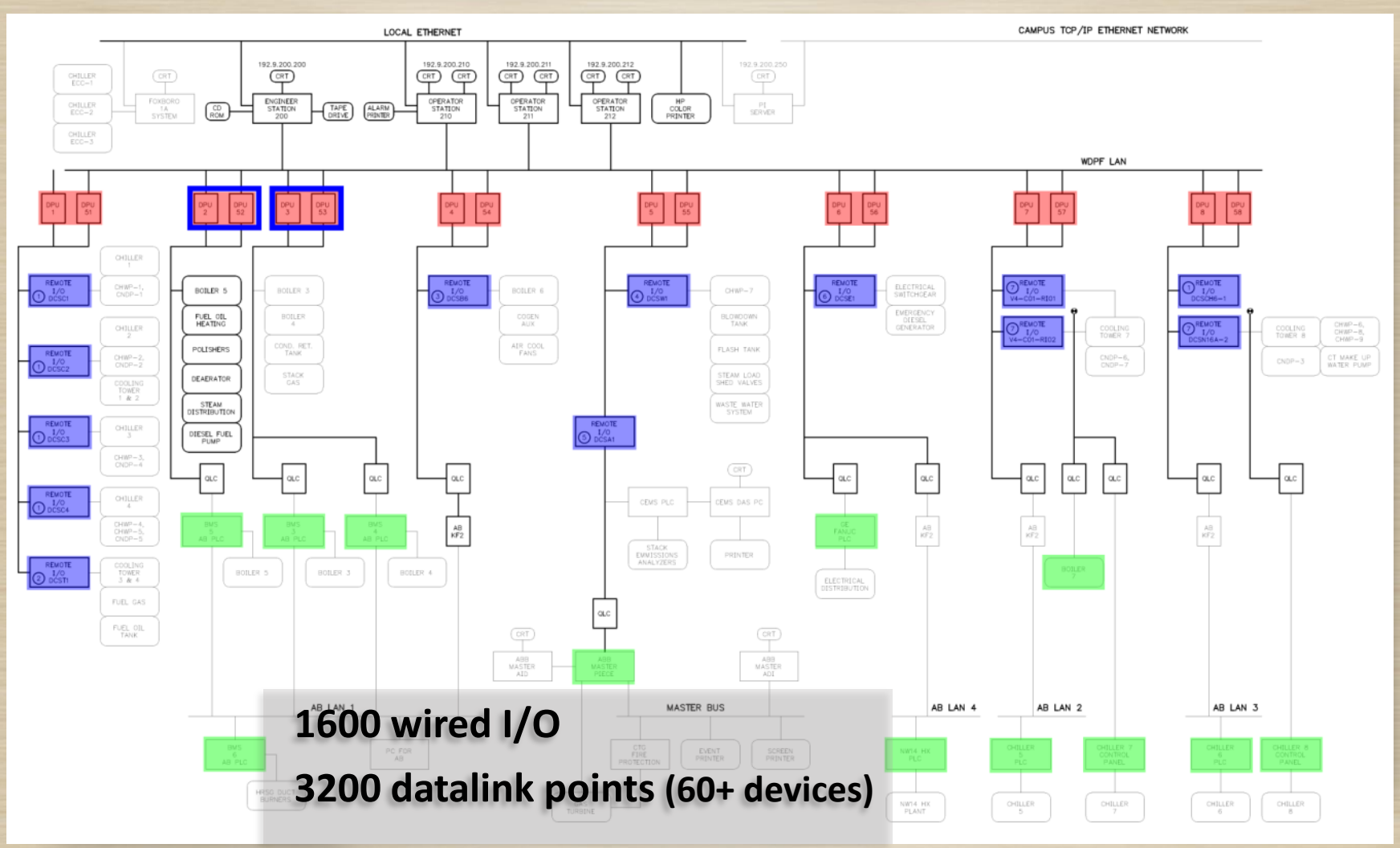
Implement without plant outages

- Continuity of operations
- Phased approach with limited equipment outages

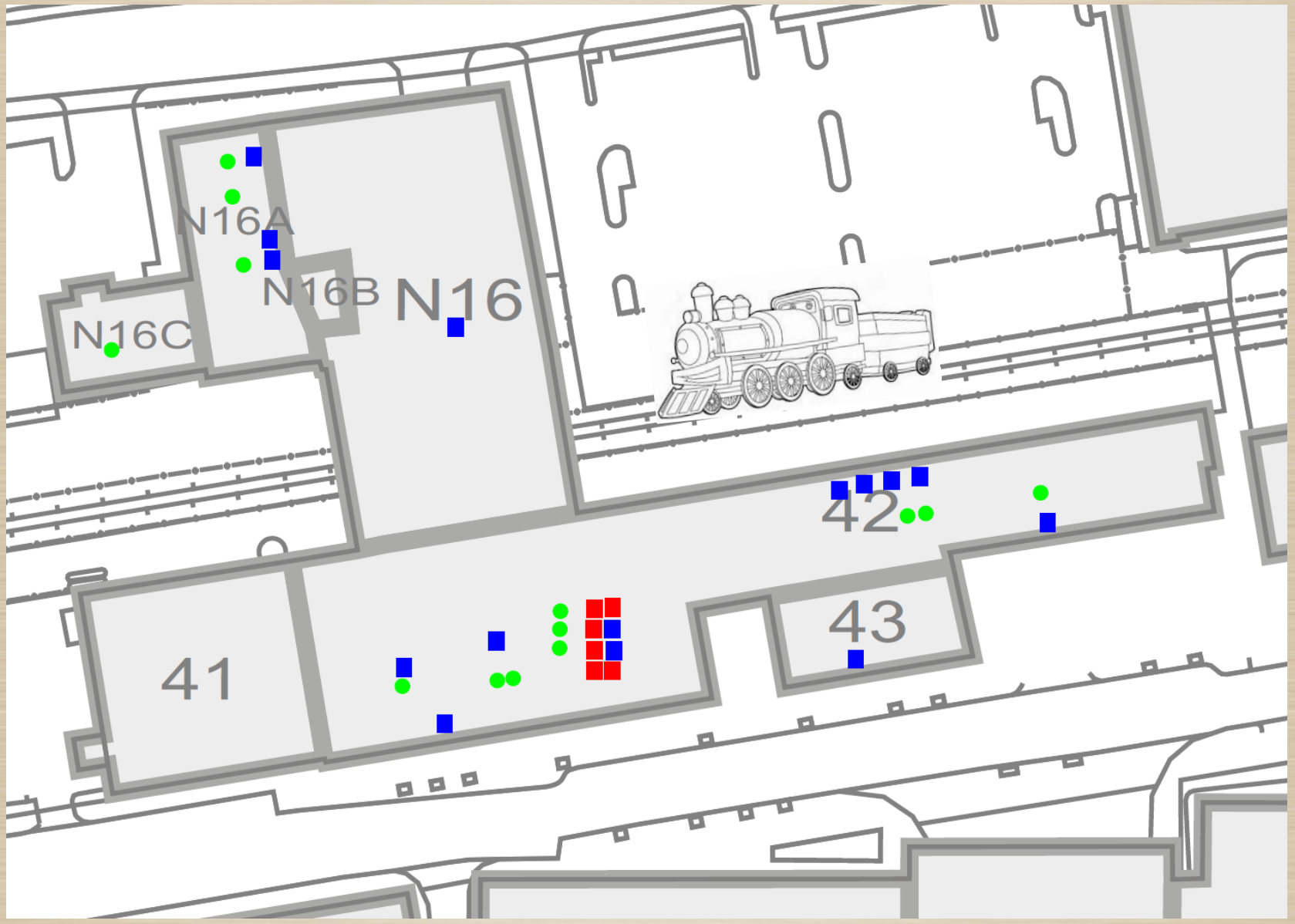
Campus Utilities Facilities



Pre-Project Architecture

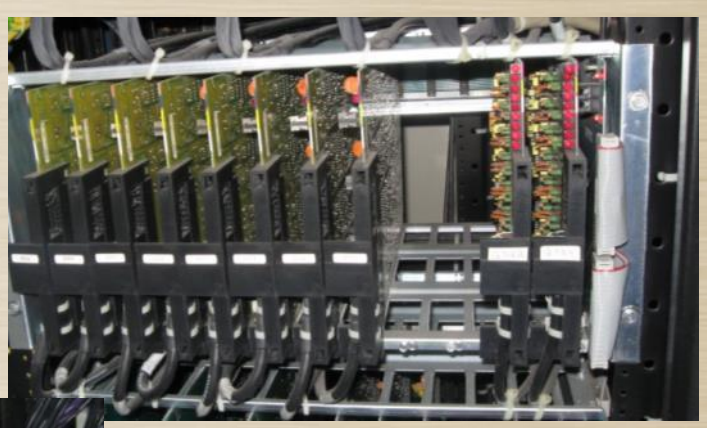


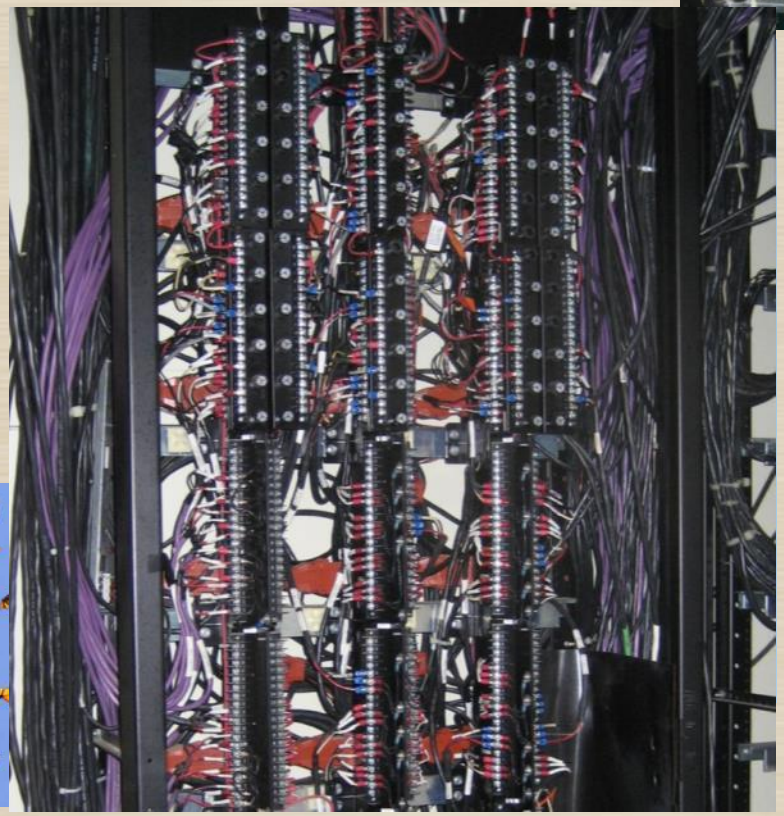
Pre-Project Architecture



Migration Over Replacement

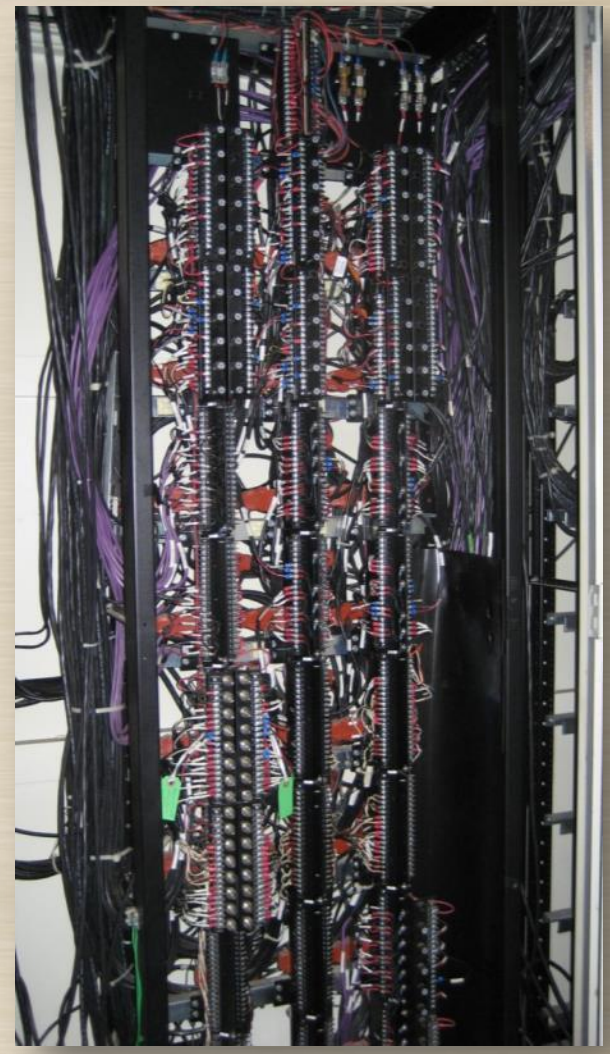
- Retain I/O Termination Investment
- Maintain Control Strategy Investment
- Reduce Installation and Startup Time



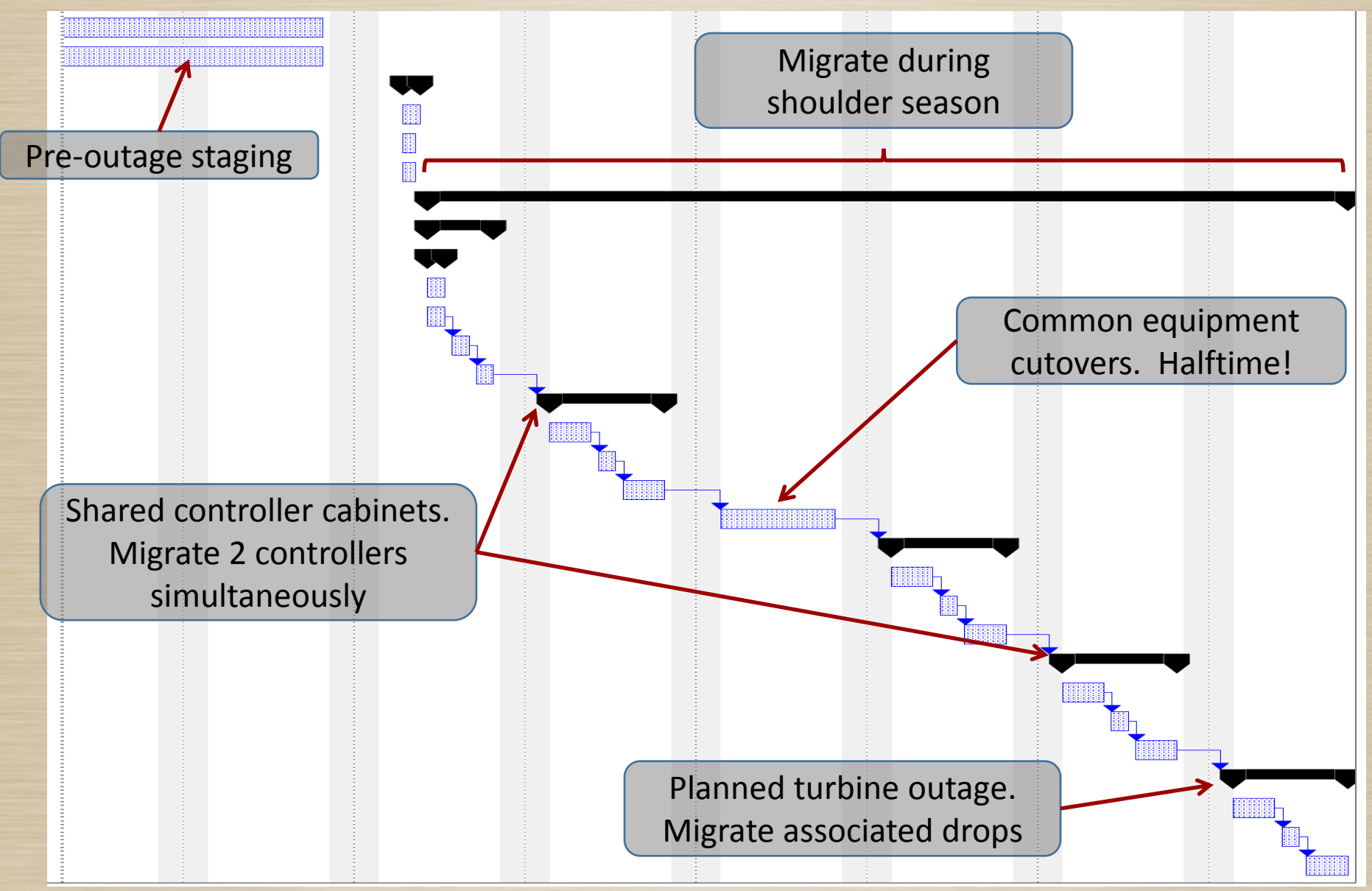


Key Migration Requirements

- Demonstrated Supplier Experience
- Updated Logic & Graphic Design Components without Re-Design of Core Strategy
- Maintain Redundancy
- Minimize Installation and Startup
- NO SYSTEM OUTAGE!



Migration Schedule



Migration Schedule

Five cutovers ➡ Based on schedule and hardware grouping

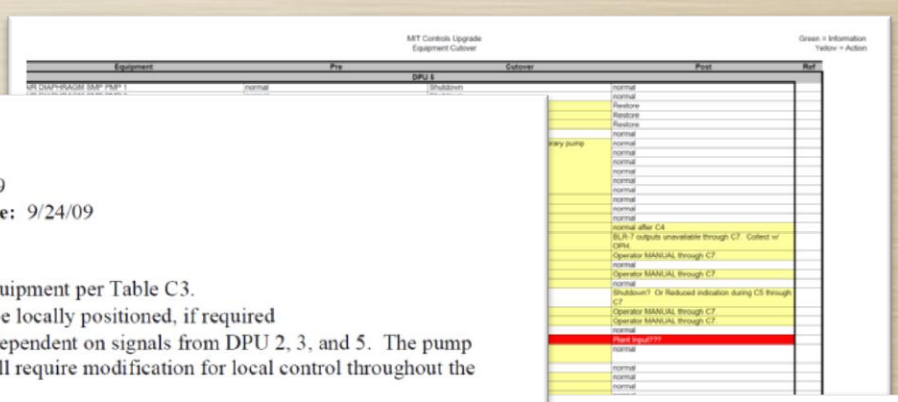
Each cutover to span one week

- **Monday - Tuesday: Hardware staging, system preparation, and plant changeover**
- **Wednesday: Cutover!!!**
- **Thursday - Friday: Power, IO Check, Turnover**

Cutover Planning

- **Mitigate Processor Interconnection Impacts**
  - ✓ ***Analyze DCS highway interconnections***
  - ✓ ***Develop plan to minimize impact of each one***
- **Mitigate Process Interconnection Impacts**
  - ✓ ***Identify the equipment to be affected by each cutover***
  - ✓ ***Develop plan with O&M personnel to address impacts beyond controls***
- **Plan HMI Staging**
- **Develop transition plan including temporary equipment reassignment**

Cutover Planning



MIT Controls Upgrade
Cutover Modifications

DPU 2
DA Level Control -- Condensate Makeup and Ove

Purpose: During the cutover of DPU 2, DA control and indication would be unavailable. To pro
the control of the DA #2 Condensate Makeup and DA #2 Overflow will be temporarily

I/O:

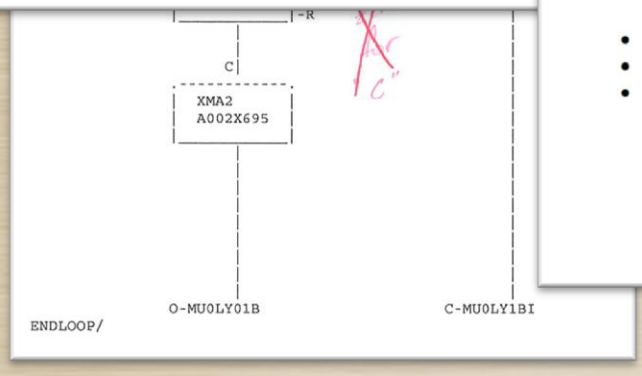
Location									
Tag	Descrip	Drop	HS	Pos	Neg	Shld	Ch	Ovat	Tag
Inputs									
MU0LI02A	DA 2 Lvl A	2/52	D3	B03	A03	A02	1	1.3.1	MU0LI02A-C
MU0LI02B	~~DA 2 Lvl B~~	2/52	D4	~~A03~~	~~A01~~	A02	1	~~1.3.3~~	
Outputs									
MU0LY02B	DA 2 Cond Lvl Ctrl	2/52	F2	A08	A06	A07	2	1.4.4	MU0LY02B-(
MU0LY02A	DA 2 Overflow Ctrl	2/52	F2	A04	A02	A03	1	1.4.4	MU0LY02A-(

Logic: Logic from Drop 2, Sheet 65 was copied to Drop 3, Sheet 200 and revised.
Logic from Drop 2, Sheet 66 was copied to Drop 3, Sheet 201 and revised.

Graphics: Create temporary graphic 2500 with access from Menu Bar. DA Level indication and
associated poke fields were re-directed to 2500.

Restore: The original configuration will be restored following the completion of the DPU 2 upgr

Notes: 1- Use of Drop 3, IO_Loc 1.3.5, Ch 3, for MU0LY02A-CUT requires tempo
Cond Ret Tank Stm Vlv, AS0LY04. -- OK'd



DPU 3 (C3)

Cutover Date: Week of 9/21/09
Expected De-Energization Date: 9/24/09

Pre-cutover:

- Shutdown all affected equipment per Table C3.
- Polisher Bypass should be locally positioned, if required
- Sulfite Pump control is dependent on signals from DPU 2, 3, and 5. The pump will be unavailable or will require modification for local control throughout the cutovers.
- Condensate Return Tank Transfer: ??
- Condensate Return Tank Level: ??
- Condensate Return Tank Makeup Control: ??
- Condensate Booster Pump suction head protection signal comes from DPU 3. This will need to be bypassed and closely monitored through C2.
- Several CEM signals originate from DPU 3 and are routed through DPU 5. These will be unavailable through C5.
- Boiler 3 and 4 feedwater flow signal to the chemical feed system will be unavailable during C3 through C5. If required, this value can be "forced".

Cutover:

- Polisher Bypass should be locally positioned, if required

Post-cutover:

- Boiler 3 and 4 will be available for operation but must remain in Boiler Master MANUAL until the Plant Master is cutover during C2.
- Polisher Bypass will be available for operator MANUAL control. AUTO will be unavailable through C2.
- Condensate Return Tank Transfer is unavailable through C2
- Condensate Return Tank Level: ??
- Condensate Return Tank Makeup Control is unavailable through C2

Ref: C3.4

trol

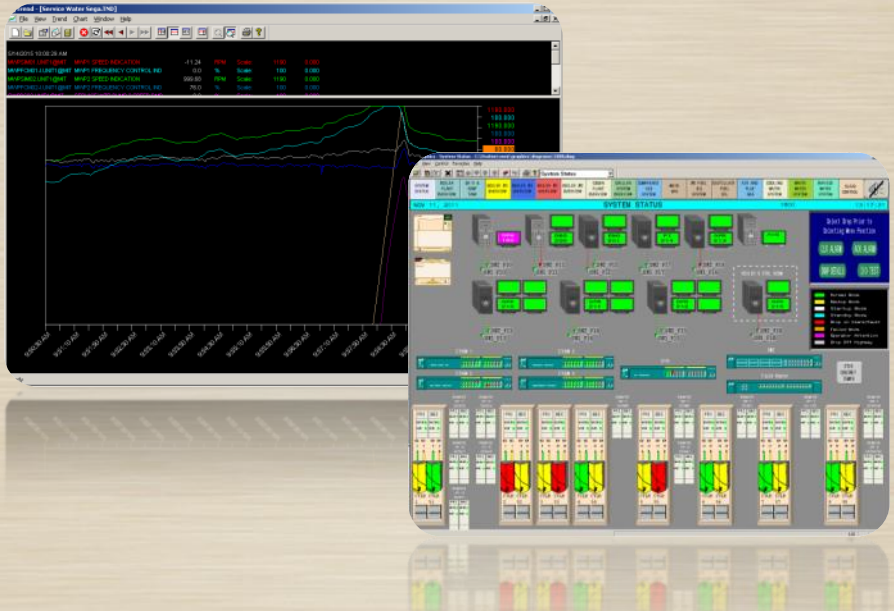
turn Tank Soft Water Make-Up valve will be
trol for the Make-Up water, the control valve

Temp Location							
Drop	HS	Pos	Neg	Shld	Ch	Ovat	
3/53	C6	A12	A10	A11	3	1.3.7	

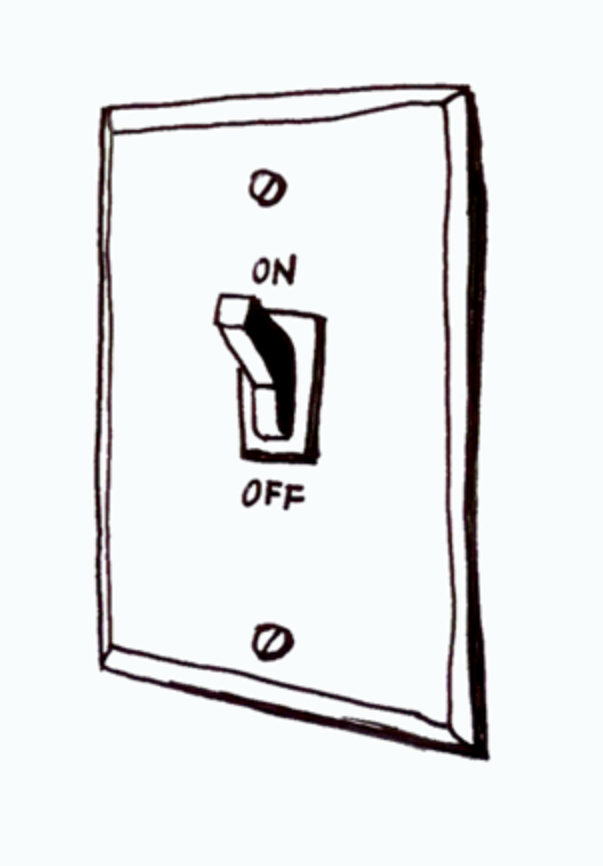
pgrade.

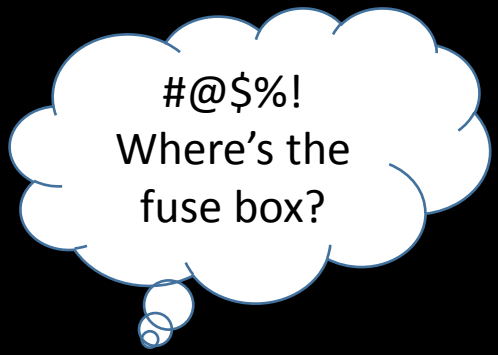
Factory Acceptance

- Participation from Operations, Maintenance, and Engineering
- Did we get what we “designed”?
- Did we get updates?
- Best opportunity to identify and fix problems

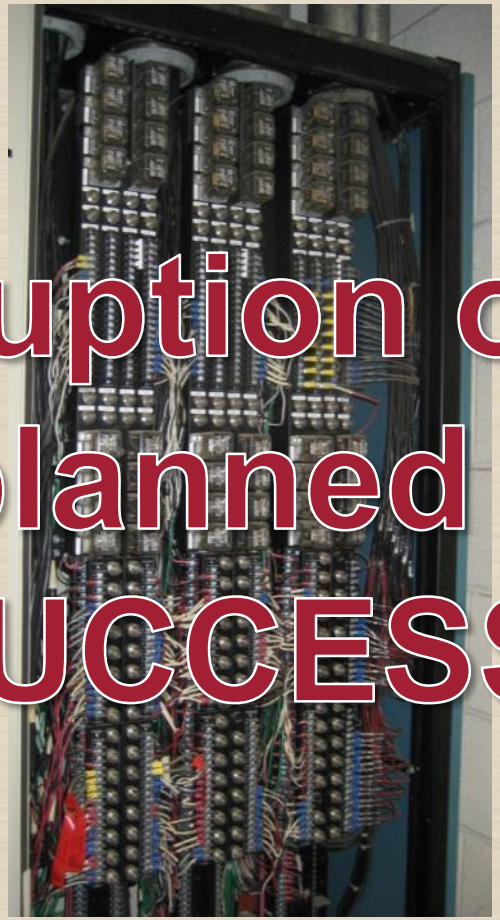


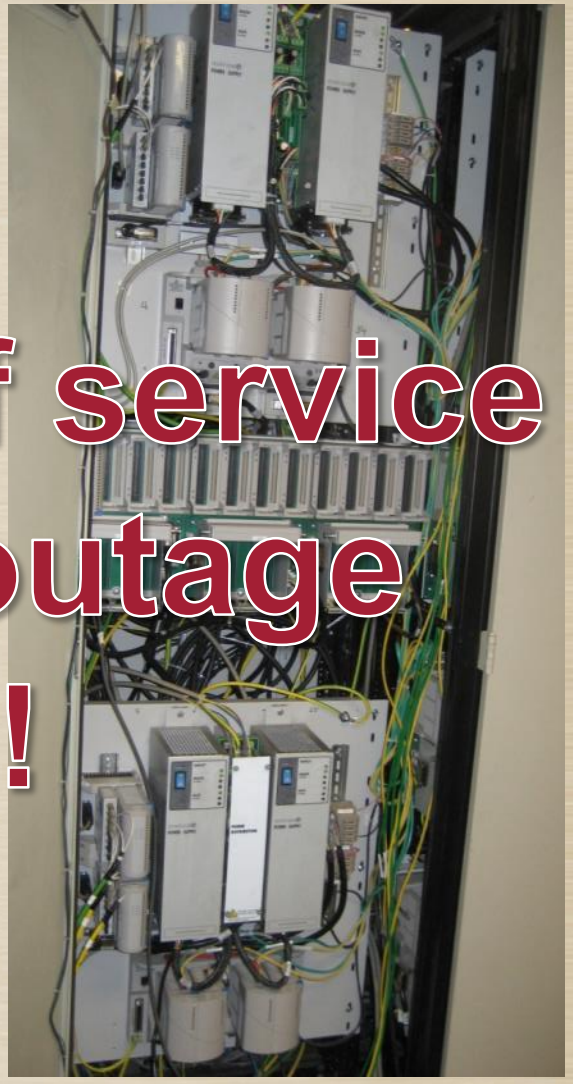
Cutover 1




#@$%!
Where’s the
fuse box?

Outcome



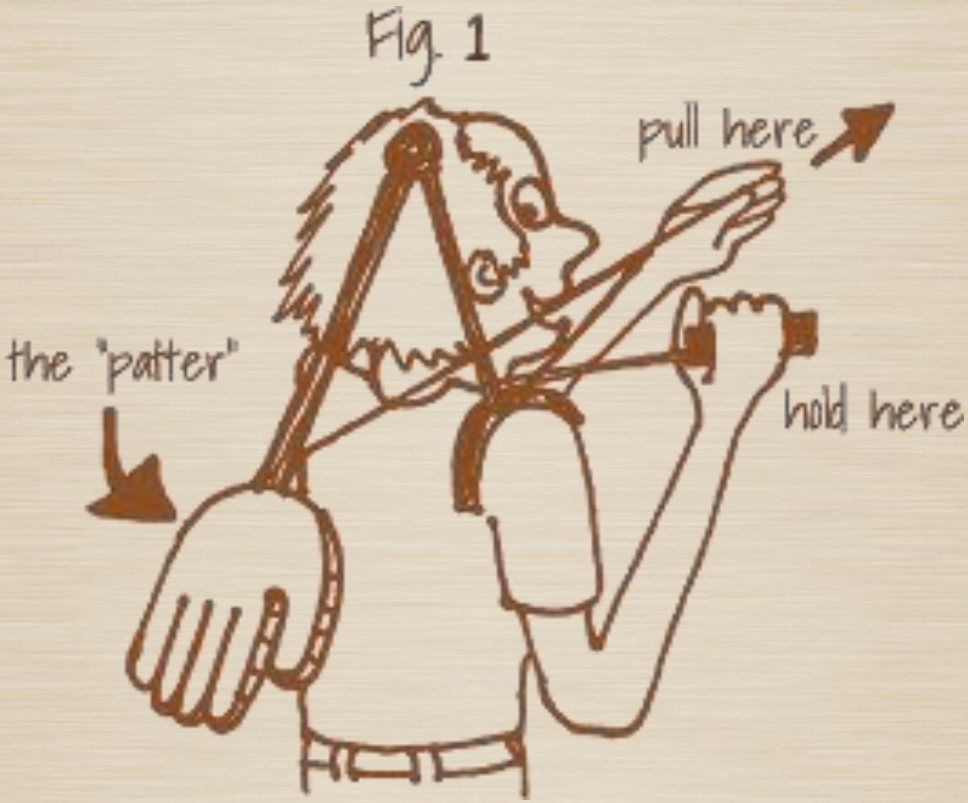


No interruption of service

No unplanned outage

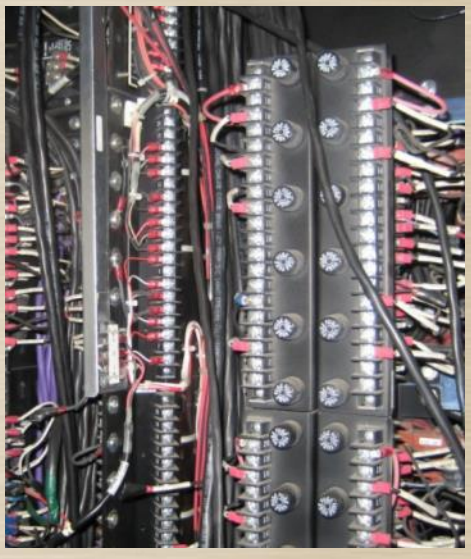
SUCCESS!

Outcome



Things to Consider for Your Project

- **Migration**
  - ✓ Approach achieved project goals within project limitations
  - ✓ Platform for future expansion
  - ✓ As advertised (pros/cons)
  - ✓ Hybrid system with “warts and scars”



- **Cutovers**
  - ✓ Collaboration was key
  - ✓ Network assessment