

# NIAGARA SUMMIT 2026

SEAMLESS CONNECTIVITY,  
POWERFUL INTELLIGENCE

**NS**<sup>26</sup>  
BUSINESS

**TRIDIUM**

WED APRIL 8 | 1:00 -2:00PM

# CRITICAL ENVIRONMENTS: DESIGNING 'HEALTHY' BAS FOR HOSPITALS & MEDICAL DEVICE CLEAN ROOMS



TRIDIUM

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# SPEAKERS



GEORGE KELLER  
TRIDIUM



NICK PRILL  
MEDTRONIC



JACOB JACKSON  
APTITUDE



GAVIN ARNETTE  
AQUANOMIX

# INTEGRATION TO INTELLIGENCE:

How **AQUANOMIX** Utilizes the Niagara Platform  
to Empower Healthcare



**TRIDIUM**

# WHAT AQUANOMIX DOES



- Data Collection and Analytics
- Intelligent Edge Control
- Patient Safety
- Capital Asset Protection
- Optimize Energy Efficiency

# UTILIZATION OF THE NIAGARA PLATFORM



- Communication Protocol Agnostic
- Data Standardization
- Seamless Integration
- Direct to Database Exports
- Edge Control Capabilities

# IMPACT IN HEALTHCARE

- Legionella Control
- Sterilization Processes
- Protecting Essential Energy Plants
- Corporate Sustainability Goals



# CASE STUDIES

## Colorado Hospital

- Prevented Critical Corrosion Failures

## Philadelphia Medical Office Building

- Significantly improved legionella control

## North Carolina Hospital

- Achieved over \$200,000 in annual energy savings

## Maryland Hospital

- Exceeded energy efficiency targets by 48%



# AUTONOMOUS CONTROL COMPLIANCE

- Joint Commission Audit Readiness
- Healthcare Standards (ASHRAE 188, ST108, etc.)
- Real-Time Water Quality Optimization



# WATER INTELLIGENCE

## Welcome to Melody AI

Your AI-powered water management consultant. Ask me anything about water treatment, site monitoring, or Aquanomix solutions.

How is my system doing?

Your Hospital Condenser System system is performing well overall, with a few areas to monitor:

### ✓ GOOD:

- pH: 8.76 - Right in your target range (8.0-9.5)
- Conductivity: 977  $\mu\text{S}/\text{cm}$  - Slightly above range (650-850), but stable and manageable
- Cycles: 8.85 - Excellent water efficiency
- Corrosion Control: Mild steel corrosion at 0.26 mpy is well within limits (target: <3.0)
- Free Chlorine: 0.71 ppm - Good biocide control (target: 0.5-1.2)

### ⚠ MONITOR:

- Copper Corrosion: 0.54 mpy - Above your target range (0.0-0.04). This suggests potential issues with copper components
- PTSA: 167.51 ppm - Running high compared to your target (80-100 ppm), though this has been consistent over the past week
- ORP: 455 mV - On the lower end of your range (150-800), but still acceptable

### 📊 CHEMICAL LEVELS:

- Inhibitor: 61.59 gal (recently refilled on March 17th with 10.88 gal)
- Non-oxidizing Biocide: 68.15 gal (recently refilled on March 17th with 12.00 gal)
- Oxidizing Biocide: 41.21 gal (using about 2.86 gal/day - may need refill soon)

**RECOMMENDATION:** Keep an eye on that copper corrosion rate and consider checking your oxidizing biocide tank in the next few days.

What's causing my copper corrosion to be high?

When will I need to refill my oxidizing biocide?

How does this week compare to last week?

Show me my water usage for the past 7 days

- Analyze your system with Melody AI

- Enterprise Wide Intelligence

- Your Data On Demand

**Automation isn't just for care,  
It's for the systems that support it.**



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**Medtronic**

Engineering the extraordinary

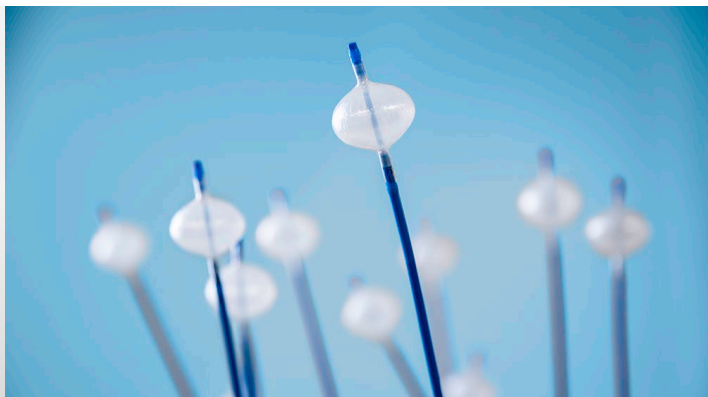
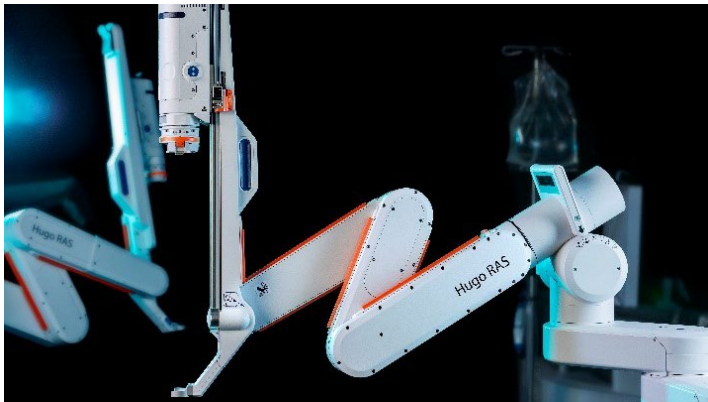
# **BAS Best Practices in Critical Environments**

- Nick Prill
- Facilities Engineer, Medtronic

- Niagara Summit 2026



# What our BAS Supports



From the world's first battery-powered pacemaker to groundbreaking surgical robotics, our purpose remains the same.



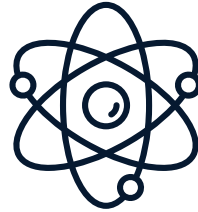
97800 03020100  
Medtronic  
InterStim™ X  
SN: NMG454855H

Inspired by our Mission, our purpose is to help people through the power of technology.



**79M+**

Patients treated in 2025  
(2 per second)



**81**

Global manufacturing sites



**200+**

Sites

# Our Role as Owners

# Unique Challenges



Global Project Portfolio



24/7 Clean Rooms with Temp/RH/Pressure Specs



Projects in live manufacturing sites



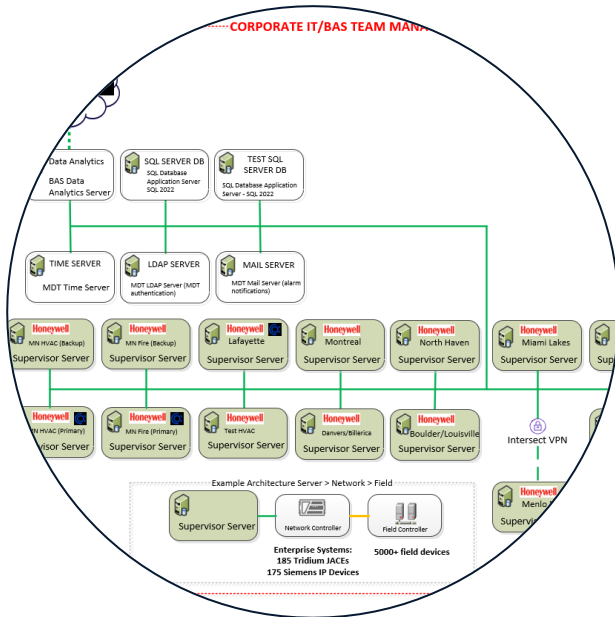
Specialized requirements for:

- Cybersecurity
- History Data
- Commissioning/Documentation

# Our Niagara Footprint

## Supervisors

- 15 regional Supervisor stations
- 15 legacy non-Niagara BAS servers



## JACEs

- 200 JACEs
- ~70% upgraded to JACE-9000s



## Field Controllers

- 5000+



## IT-Managed Servers for

- SQL
- LDAP
- Email



## 3<sup>rd</sup> Party FDD Platform



We don't self-perform work.

But we have an internal BAS Team responsible for...



IT Administration



Triage Support for Maintenance Teams



MEP Design Review



MEP Cx Support



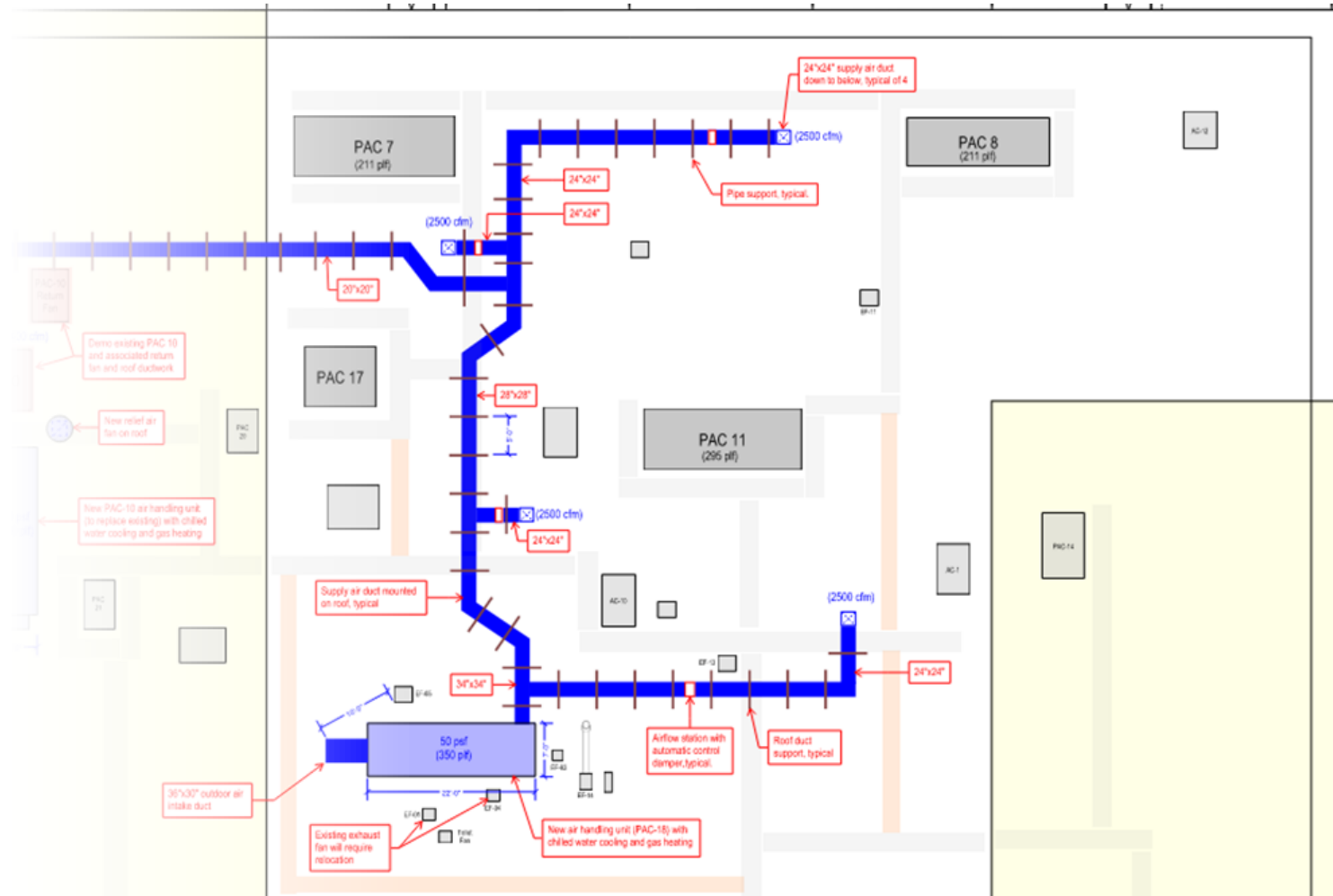
Management of BAS Projects



BAS Standards



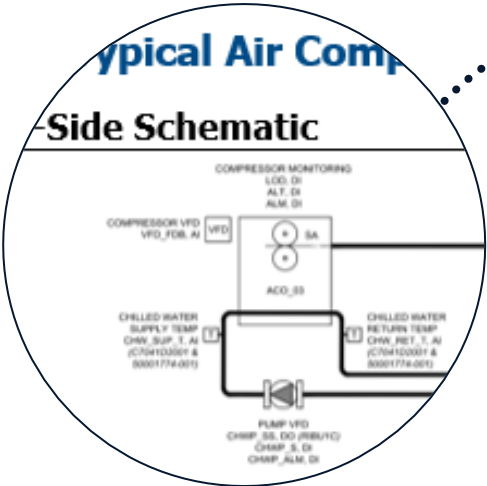
FDD Program



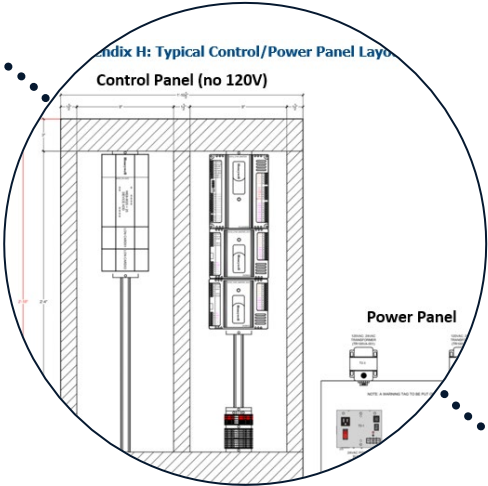
# Best Practices

# Standards

# Design



Required Points



Layouts

- Sensors & Instrumentation**
- Acceptable Space Temperature/Humidity Sensors**
- 16.1.1 In general, critical spaces will use Vaisala field devices, Honeywell field devices, and Distech installations will use Distech. Selection will be reviewed during bid and/or design phase.
    - 16.1.1.1 On Honeywell Field Controllers, all thermistors must be 20kΩ
    - 16.1.1.2 On Distech Field Controllers, all thermistors must be 10kΩ typical
  - 16.1.2 Lab / CEA
    - 16.1.2.1 Vaisala HMP1
  - 16.1.3 Office / Mechanical
    - 16.1.3.1 Honeywell TR20 (Hardwired) Series
    - 16.1.3.2 Honeywell TR20 Zio (Comm Bus) Series
    - 16.1.3.3 Distech Allure EC-Smart (Comm Bus) Series
    - 16.1.3.4 ACI R2 (hardwired) Series
- 16.2 Acceptable Duct Temperature Sensors**
- 16.2.1 Averaging sensors must be used for all AHU control applications. Point sensors may be used for monitor-only points.
    - 16.2.1.1 Duct probe sensors are acceptable for control applications.

Part #s

# Architecture

- .2 MDT BAS Team will specify a Niagara version for JACEs during project design. JACEs must be set up at this version.
- .3 All JACE panels should include a DIN-rail mounted unmanaged switch. Connect secondary port of JACE to switch.
- .4 **Required Modules**
  - 8.4.1 The following modules must be installed on all JACEs, even if they are not used:
    - 8.4.1.1 alarm
    - 8.4.1.2 exportTags
    - 8.4.1.3 history
    - 8.4.1.4 kitControl
    - 8.4.1.5 schedule
- .5 **Histories**
  - 8.5.1 All History Extensions must reside on the JACE.
  - 8.5.2 All History Extensions must hold at least one week of storage.
  - 8.5.3 All History Extensions must be regularly exported to the Supervisor.
- .6 **Alarms**
  - 8.6.1 All Alarm Extensions must reside on the JACE.
  - 8.6.2 All JACE alarms must be linked to Supervisor.
  - 8.6.3 Ping alarms must be set up for all Field Controllers.
    - 8.6.3.1 In each network's *Alarm Source Info*, set *Alarm Class* property to the appropriate *\_200* alarm class so that emails are generated for ping alarms.
    - 8.6.3.2 *Num Retries Until Ping Fail* must be set to 1 or greater. For networks with a 5-minute ping frequency, a setting of 3 is recommended.
  - 8.6.4 When there is a graphic for the parent equipment on the Supervisor, Alarm Extensions should include a hyperlink to it.



## Engineering

- ✓ Controller/Power Redundancy
- ✓ JACE Failure Logic
- ✓ CPU/Busy Time Limits



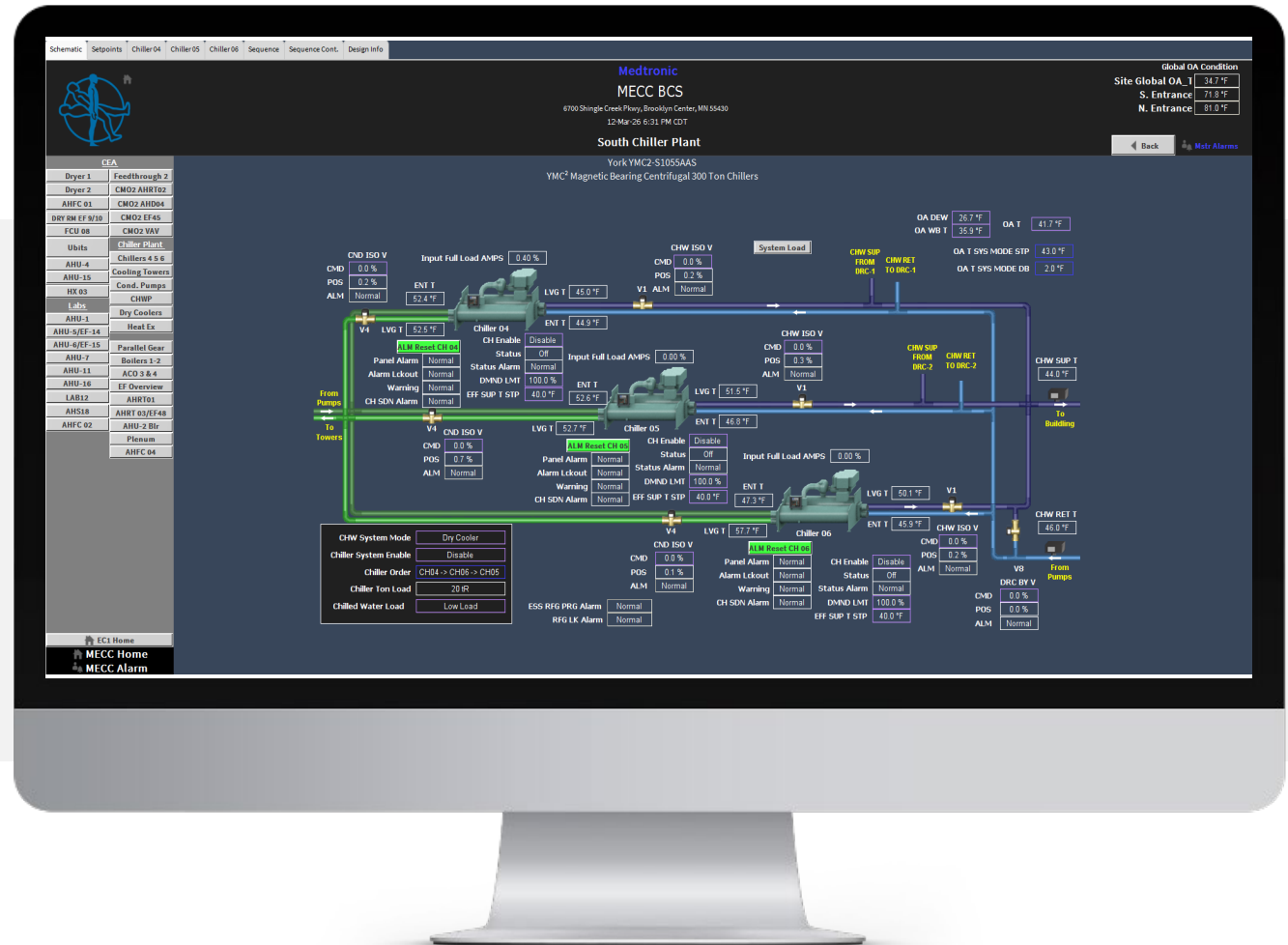
## Station Setup

- ✓ History/Alarm Configurations
- ✓ Provisioning Backups
- ✓ Users/Auth Schemes
- ✓ Certificates

# Graphics

- Px Templates

- Air Compressor
- CEA-Lab Floorplan
- Chiller
- Graphics Reference
- Homepage Nav Px
- Leak Detection



# Internal Review Checkpoints

## MEP Plans/Specs

1) Provide a software-interlock so that the return fans shutdown if all supply fans are off.

2) Make the initial supply duct static pressure (PS) setpoint 0.75 inch.

3) Coordinate with the balancer to determine the actual setpoint needed to achieve design flow for all air valves. Notify the engineer if this value exceeds 1.25 inches.

4) Monitor the position of the air valves through the network.

5) Decrease the supply duct static pressure (PS) setpoint if all zone dampers are less than 90% open.

6) Raise the supply duct static pressure (PS) setpoint if any zone damper is 100% open.

7) Allow supply duct static pressure (PS) setpoint to vary from 0.25 to 1.25 inches.

8) If communication is lost to any of the air valves, make the supply duct static pressure (PS) setpoint equal to the initial supply duct static pressure (PS) setpoint.

9) Display fan status based on hard-wired connections to the VFD status contacts.

10) Display the following on the graphics:

a) Fan speed.

b) VFD fault.

## BAS Submittals

TERM #	IO	POINT NAME
39	LIT	WET_HDR_P
40	COM	
41	D+	
42	D+	
43	USE	WET_HDR_P
44	COM	
45	D+	
46	D+	
47	UIS	ADR_01_F
48	COM	
49	D+	
50	D+	
51	UIS	ADR_02_F
52	COM	
53	D+	
54	D+	
55	UIS	DRY_HDR_PRE_REG_P
56	COM	
57	D+	
58	D+	
59	UIS	DRY_HDR_PST_REG_P
60	COM	
61	D+	
62	D+	
63	LIT	DRY_HDR_DEW
64	COM	

## Cx Test Scripts

CHECKLIST TEMPLATE

### MV - VAV w/ Electric Reheat APPROVED\_11SEP25

MCE | Medtronic - MV Event Center | MT024128

MV - VAV w/ Electric Reheat APPROVED\_11SEP25

Lines 24

MEDTRONIC APPROVALS

1 Checklist template approved by Medtronic:

DOCUMENTATION

2 Are the equipment manufacturer's submittals and performance data submitted and reviewed?

MODEL VERIFICATION

3 Record Manufacturer:

## Cutover Plans

Item Description	Status	Date	Start Time	End Time
Restart RTU-01 according to established procedures		2/15/2025	10am	11am
Restart VAVs according to established procedures		2/15/2025	10am	11am
Restart Booster Pumps 01 & 02 according to established procedures		2/15/2025	10am	11am
Restart Instrument Wash/Crest Ultrasonic according to established procedures		2/15/2025	10am	11am
Restart MHE Chargers according to established procedures		2/15/2025	10am	11am
Phase 4 Switch Service - Perform Controlled Shutdowns of Critical Equipment		2/15/2025	9am	10am
Place fire system in Test		2/15/2025	9am	10am
Open BAS and shut down ATO/ATCU 9 & 14 by going into the 'setpoints' tab and override to 'unoccupied'		2/15/2025	9am	10am
Verify ATO/ATCU 9 & 14 shut down		2/15/2025	9am	10am
Power down ATO/ATCU 9 & 14 (panel H-7S) following the documented LOTO process		2/15/2025	9am	10am
Lock out ATO/ATCU 9 (panel/breaker: L-3S1/50) & 14 (panel/breaker: L-4S1/15) control panel breakers per established procedures		2/15/2025	9am	10am
Open BAS and shut down ATO/ATCU 10 & 11 by going into the 'setpoints' tab and override to 'unoccupied'		2/15/2025	9am	10am
Verify ATO/ATCU 10 & 11 shut down		2/15/2025	9am	10am
Power down ATO/ATCU 10 & 11 following the documented LOTO process		2/15/2025	9am	10am
Lock out ATO/ATCU 10 (panel/breaker: L-4S1/10) & 11 (panel/breaker: L-4S2/11) control panel breakers per established procedures		2/15/2025	9am	10am
Set ATO 7 supply fan to HAND / 70% speed at VFD		2/15/2025	9am	10am
Verify ATO 7 fan is running around 70% speed / 42 Hz		2/15/2025	9am	10am
Power down ATO 7 Controller (panel/breaker: L-10S1/1) following the documented LOTO process		2/15/2025	9am	10am
Open BAS and shut down ATO 8 by going into the 'setpoints' tab and override to 'unoccupied'		2/15/2025	9am	10am
Verify ATO 8 shuts down		2/15/2025	9am	10am
Power down ATO 8 following the documented LOTO process (Panel: H4S)		2/15/2025	9am	10am
Power down ATO 8 Controller (panel/breaker: L-6S2/15) following the documented LOTO process		2/15/2025	9am	10am
Perform controlled shutdown of Waste Treatment according to established				

# Lesson Learned #1

- **Controls Pre-Commissioning**



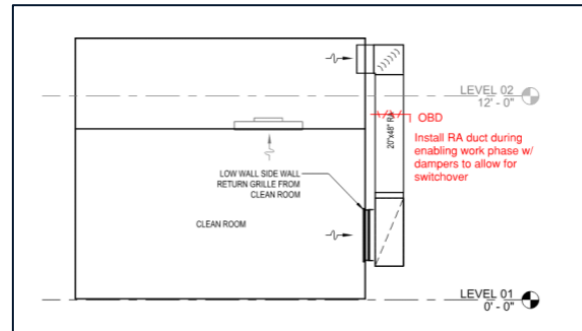
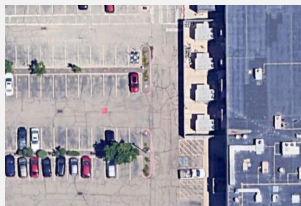
If there's no time to fix programs in the field...pre-test them before the panel ships.

# Lesson Learned #2

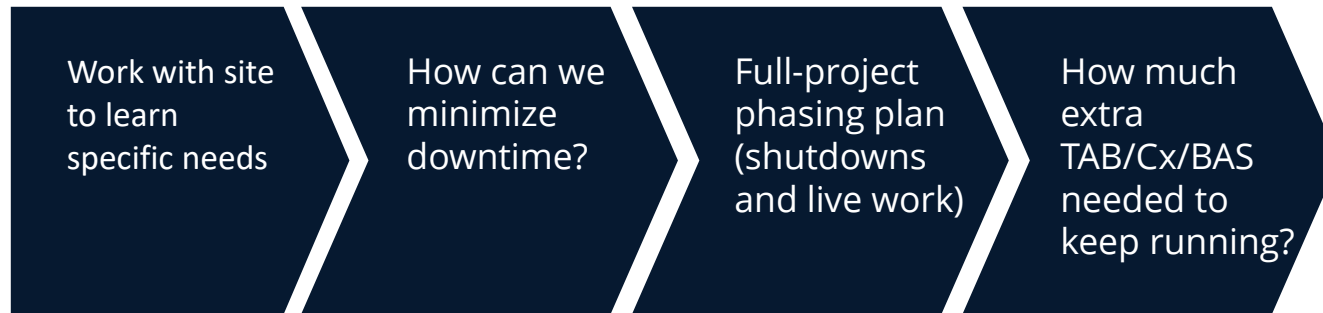
- **Detailed Phasing & Pull Plans**

# From

- 4 AHU replacements + duct rework
- In a single 4-day shutdown window
- And temporary AHUs during construction



media provided. Provided upon acceptance  
 ance of price add.  
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 :  
 unit and VFD's, and concurrently instruct  
 to exceed three working days.  
 include up to a total of  
 5 working days of  
 total commissioning /  
 startup effort  
 solutions.com



# To

## Controls RFP:

- MEPs reconciled w/ equipment submittals
- 3 phases of TAB
- 4 phases of Cx

3. Hardware Procurement  
 - BAS Contractor to provide all network and field controllers for the project based on the approved controls shop drawings. The list shall include:  
 o Licensing of JACE  
 o Commissioning of JACE  
 - BAS Contractor to provide all hardware/sensors/devices/gates based on the approved controls shop drawings.  
 4. Controls Installation  
 - BAS Contractor to perform a complete installation of the physical BAS components, based on the approved controls shop drawings, to include: low voltage signal and communication wiring, panels, controllers, devices, sensors, etc.  
 o Data point to the BMS network for JACE will be provided by others  
 i. Note: communication for IP field controllers & devices should be via a private subnet to the secondary part of the JACE, this communication is the responsibility of the BAS Contractor  
 o 120V circuit for BAS devices will be provided by others  
 - A 3-4 day shutdown (including Saturday/Sunday) in June/July 2026 is planned for rough-in installation work that will have a direct impact on clean room operations.  
 - A temporary (re-circulating) AHU will be installed in June 2026 to provide supplemental cooling capacity until the new AHUs can be installed. BAS control of the temporary unit is not needed, but setpoint adjustments to the existing AHUs may be needed to maintain clean-room conditions over the course of construction. The BAS Contractor is to provide support for these efforts.  
 - BAS Contractor is responsible for installing communication wiring between the GE AADN supervisors and controllers.  
 5. Controls TAB Support  
 - BAS Contractor to support Test & Balance (TAB) efforts by overriding existing and new controls as needed. TAB activities are planned the following phases (subject to change):  
 Medtronic RFP Packet

**Thank you**

# Mission-Critical Resilience: Phased Niagara Migration Strategies for Mission Critical Facilities

Jacob Jackson | Senior MSI Manager

Aptitude Intelligent Integration — a Division of JE Dunn Construction



**TRIDIUM**

## Legacy BAS at End-of-Life — In Facilities That Cannot Afford to Fail



### Patient Safety is Non-Negotiable

OR pressurization, NICU temperature, isolation room differential pressure — BAS failure isn't an inconvenience. It's a clinical event.



### Clean Room Tolerances Are Absolute

ISO Class 5–8 environments require continuous environmental control. A single excursion can invalidate a production batch worth millions.



### Regulatory Scrutiny is Constant

Joint Commission, FDA, and CMS oversight means any non-conformance during a migration can trigger citations — or halt the project entirely.

*These aren't commercial buildings with flexible maintenance windows. The consequences of failure here are measured differently.*

# Three Frameworks Built for Critical Environment Migrations

*These frameworks were stress-tested in government and correctional facilities — environments with zero tolerance for downtime — and apply directly to healthcare.*

01

## Phasing Methodologies

Sequence work around 24/7 patient care and production constraints — from initial survey to final cutover without clinical impact.

02

## Hidden Scope Drivers

Integration dependencies with Epic, nurse call, and med gas alarms. Network infrastructure gaps. Budget impacts of 30–50%.

03

## IT/OT Convergence & Cybersecurity

BAS/BMS/security boundary definition, HIPAA-adjacent OT segmentation, and access controls built into the migration plan from day one.

# Where These Migrations Actually Happen

## Acute Care Hospitals

Occupied 24/7. ORs, ICUs, and isolation rooms cannot be interrupted. Phased migrations span years across a live clinical environment.

## Medical Device Manufacturing

ISO Class 5–8 clean rooms with continuous monitoring requirements. FDA 21 CFR Part 11 drives data integrity obligations on every sensor.

## Research & Laboratory Facilities

Fume hoods, biosafety cabinets, and vivarium environments require constant pressure differentials. Any BAS interruption has cascading protocol impacts.

## Government & Institutional

30 years across federal campuses, correctional facilities, and military installations — environments where the same zero-downtime discipline was built.

# Sequencing Work Around Patients, Processes, and Regulations That Cannot Pause

1

## Survey & Risk Map

Full point inventory, field wiring assessment, integration dependency map. Identify every system that touches patient safety before touching anything else.

2

## Legacy Co-existence Design

Old and new controllers must coexist — sometimes for months. Define handoff logic for OR pressure, isolation rooms, and clean room environmental loops.

3

## Zone-by-Zone Cutover

Sequence by clinical criticality. Non-critical mechanical systems first. Life-safety and critical environment zones move last, after procedures are proven.

4

## Legacy Decommission

Embedded legacy sequences may support undocumented clinical workflows. Document and verify every sequence before the old system goes dark.

# Where Healthcare BAS Budget Assumptions Break Down

**30–50%**

typical budget impact from hidden scope

### Field Wiring Assumptions

Assume it's gone until field-verified. Legacy BAS wiring in hospital walls has often been spliced, re-routed, or labeled inconsistently across decades of renovation.

### EHR & Clinical System Integration Surfaces Late

EHR platform, nurse call, and med gas alarm interfaces routinely emerge during construction — after the BAS scope is already contracted. Every one is a potential change order.

### OT Network Infrastructure Gaps

Modern Niagara-based platforms require IT-grade OT networks. Hospital IT infrastructure was not designed for BAS traffic. Segmentation, switching, and cabling are real budget lines.

### Legacy Sequence Archaeology

Undocumented control sequences may govern critical clinical workflows. Decommissioning a 1990s controller without sequence documentation is an unacceptable risk.

## Keeping Mission-Critical Clinical Functions Intact Throughout Construction

### Define the BAS/BMS/Security Boundary

In healthcare, BAS touches access control, fire, nurse call, and EHR integrations. Every boundary must be mapped and owned before scope is written.

### Parallel System Interlocks

Old and new controllers run simultaneously. Clinical staff experience no change in environmental control during the transition period.

### Zone-Level Contingency Plans

Every critical zone — OR, ICU, clean room — gets a documented rollback procedure before work begins. Trained. Drilled. Not improvised.

### Life-Safety Sequences Move Last

Smoke control, emergency pressurization, and egress sequences are the final systems to migrate — never compromised mid-phase.

### RFI Strategy as Risk Prevention

Surface integration conflicts before they become change orders. In healthcare, late-stage RFIs on nurse call or med gas cost multiples of what early resolution would have.

### Realistic Budget Models

Reflect true legacy replacement costs, including network infrastructure, integration verification, and sequence documentation — before the contract is signed.

# Modernization Is Your Window — The Threat Surface Is Real

## The Wrong Way

BAS on the hospital IT network with no segmentation. Legacy controllers bridged directly to systems that touch patient data infrastructure. Cyber bolted on at commissioning as a checklist item.

## The Right Way

Dedicated OT VLAN from day one. Access controls and certificate-based authentication in the base contract. Real-time monitoring designed to satisfy hospital security operations requirements.

### Medical Device Network Isolation

BAS OT traffic must be segmented from networks that carry PHI or touch FDA-regulated device systems. This is not optional.

### Access Control & Audit Trails

Role-based permissions, MFA, and immutable audit logs. HIPAA-adjacent OT obligations are real — especially in Joint Commission environments.

### Incident Response in Clinical Context

OT anomaly detection must integrate with hospital SOC workflows. A BAS event at 2 AM in an OR suite requires a pre-planned response, not improvisation.

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# Patterns From the Field

## ACUTE CARE HOSPITAL

**400K+**

sq ft, fully occupied

**18-mo**

phased migration

**0**

clinical interruptions

- Budget reconciliation caught a 35% underestimate from field wiring assumptions — at design phase, not during construction.
- Parallel legacy/new controller operation sustained OR and ICU environmental control throughout every cutover phase.
- Epic and nurse call integrations surfaced after BAS contract was signed — RFI strategy prevented two change orders.

## MEDICAL DEVICE MANUFACTURER

**ISO 7**

clean room environment

**FDA 21 CFR**

Part 11 compliant

**100%**

uptime during migration

- OT network segmentation designed into the base contract — no retrofitting after commissioning.
- Legacy sequence documentation completed before any controller was decommissioned.
- Environmental monitoring data integrity chain maintained continuously — no batch invalidation events.

# Three Tools You Can Apply to Your Next Critical Environment Project

## 01 Risk Assessment Framework

- ✓ Technical: field wiring, clinical integration dependencies, OT network gaps
- ✓ Operational: cutover timing, patient/production impact, contingency triggers
- ✓ Cyber: OT exposure, segmentation gaps, access control requirements

## 02 RFI Strategy for Conflict Prevention

- ✓ Identify HER platform, nurse call, and med gas conflicts before contract signing
- ✓ Force design resolution on integration boundaries — not during construction
- ✓ Document responses: protect budget and establish liability boundaries

## 03 Realistic Legacy Replacement Budget

- ✓ Never assume field wiring reuse without physical field verification
- ✓ Include OT network infrastructure and sequence documentation as line items
- ✓ Build decommissioning scope into the base contract — not as an alternate

# The patient doesn't wait. Neither can your migration plan.

Whether you're integrating an occupied hospital, managing a clean room retrofit,  
or scoping a multi-year BAS replacement — the discipline is the same.

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## Jacob Jackson

CAP | Senior MSI Manager | Aptitude Intelligent Integration

[aptitudeii.com](http://aptitudeii.com)

# Questions?

- Thank You!

