
TRIDIUM
NS2024
APRIL 15 - 17 | ANAHEIM, CA

# Operating Room Upgrade Pathways & Modernization Solutions

Rob Cherian – Tridium
Wesley Stanfill, PE – ATS
Blake Winter, PE – Cator Ruma & Associates
Tim Arion – Delta Controls

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COME TO OUR SESSION!

# NS2024

APRIL 15 - 17 | ANAHEIM, CA

A case study on airflow and temperature control in operating rooms will be presented.

## TUESDAY, APRIL 16 - 2:00 PM

## PRECISION CONTROL & OPTIMIZATION OF CRITICAL ENVIRONMENTS

CELEBRATING 25 ANNIVERSARY Years of niagara framework®

**Moderator:**
ROB CHERIAN
Tridium

WESLEY STANFILL
ATS Inland NW

BLAKE WINTER
Cator Ruma & Associates

TIM ARION
Delta Controls



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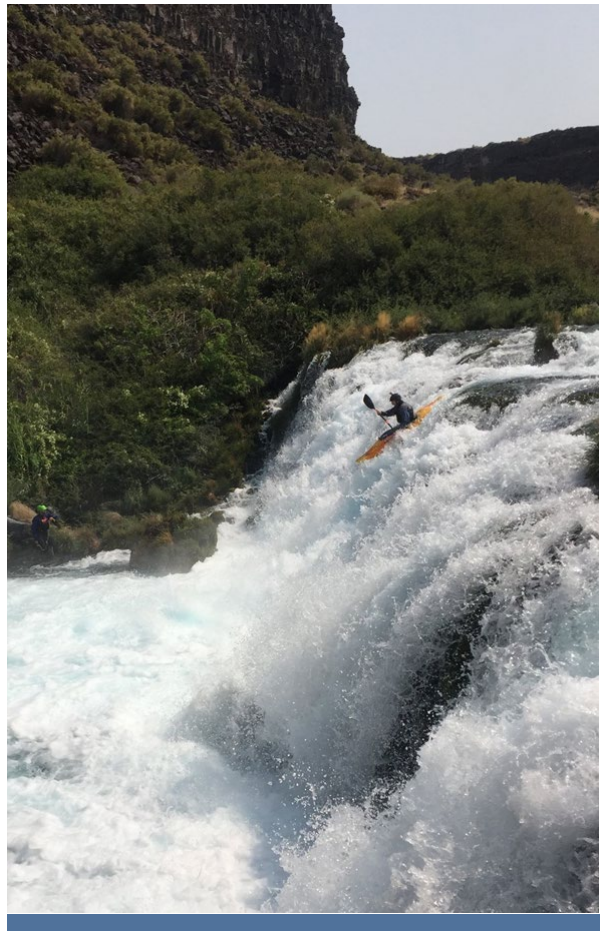
# Introductions

## Wesley Stanfill, PE

- Registered Professional Engineer and the ASHRAE Region IX Regional Vice Chair of Research Promotion
- Nine years of experience in Building Automation as both a Project Manager and now Senior Sales Engineer
- Design support for many healthcare projects for both new and existing facilities



# Introductions

## Blake Winter, PE

- Principal at Cator Ruma and a Registered Professional Engineer in 8 States
- 21 years of experience as Mechanical Consulting Engineer
- Helps lead Cator Ruma's Healthcare Design Team ranging from smaller renovations to new greenfield sites to medical research facilities

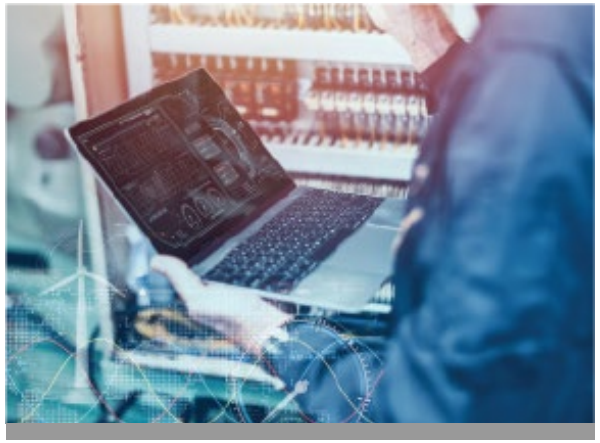
# Introductions

## Tim Arion

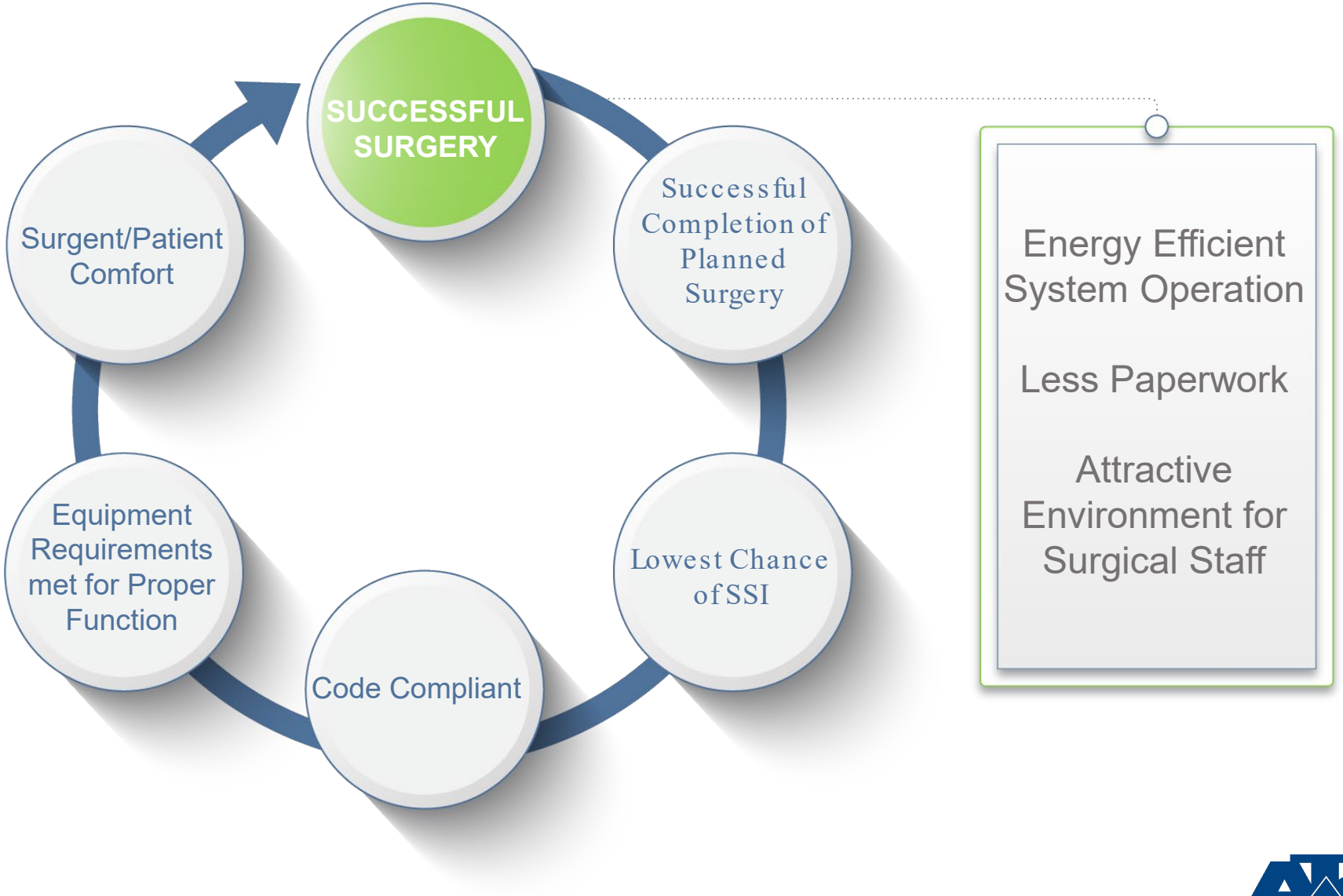
- Director of Sales for the USA and Latin America at Delta Controls.
- 24 years in the industry ranging from technician, project engineer, technical support, business development, and sales leadership.
- B.S. in Information Technology and M.S. in Organizational Leadership

# Agenda

- Operating Room design
- Operating Room controls layout
- Design challenges
- Case Study Overview
- Case Study Observations



# Operating Room Design



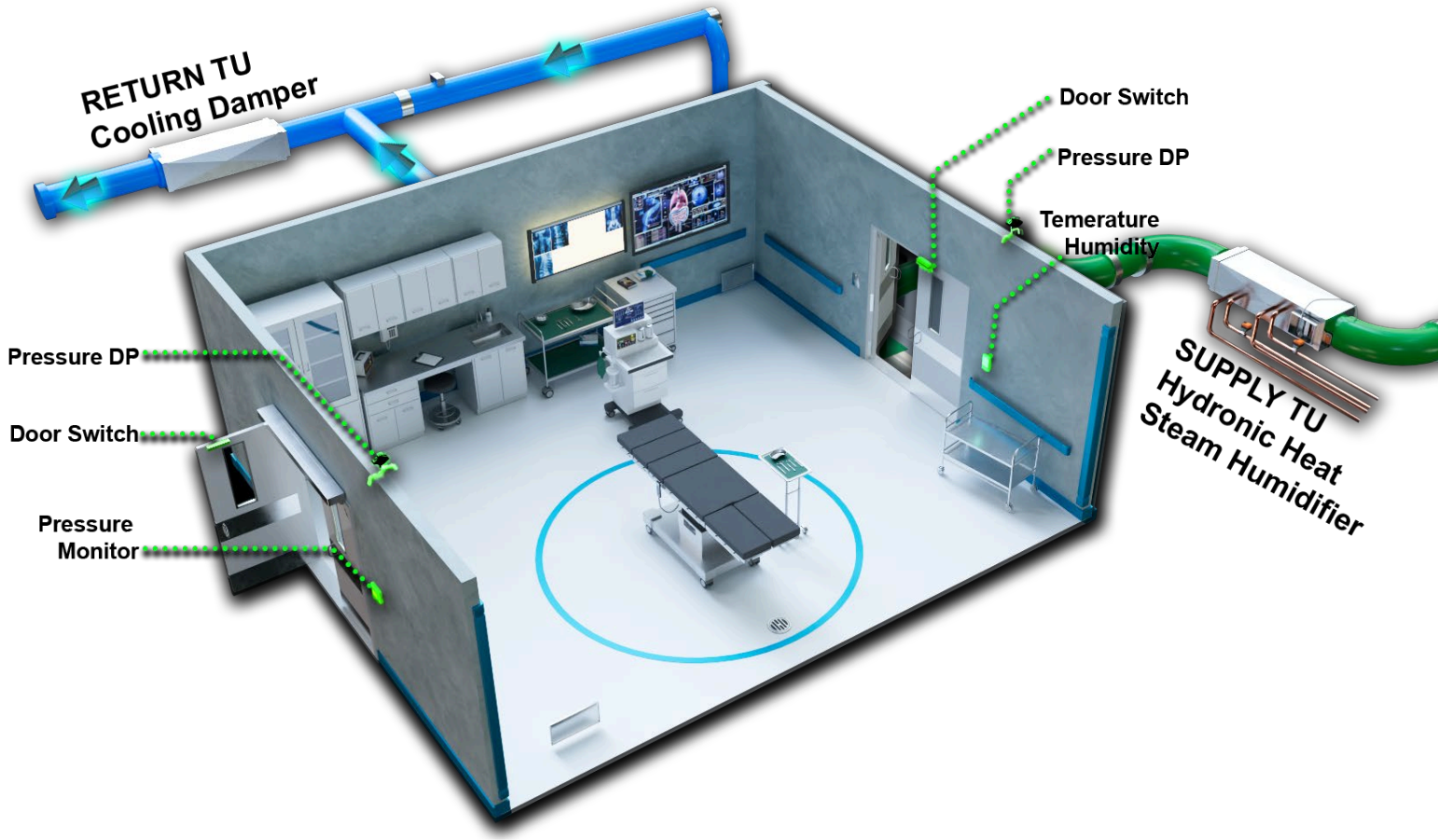
# Design Characteristics of an Operating Room

## Code Requirements ASHRAE 170

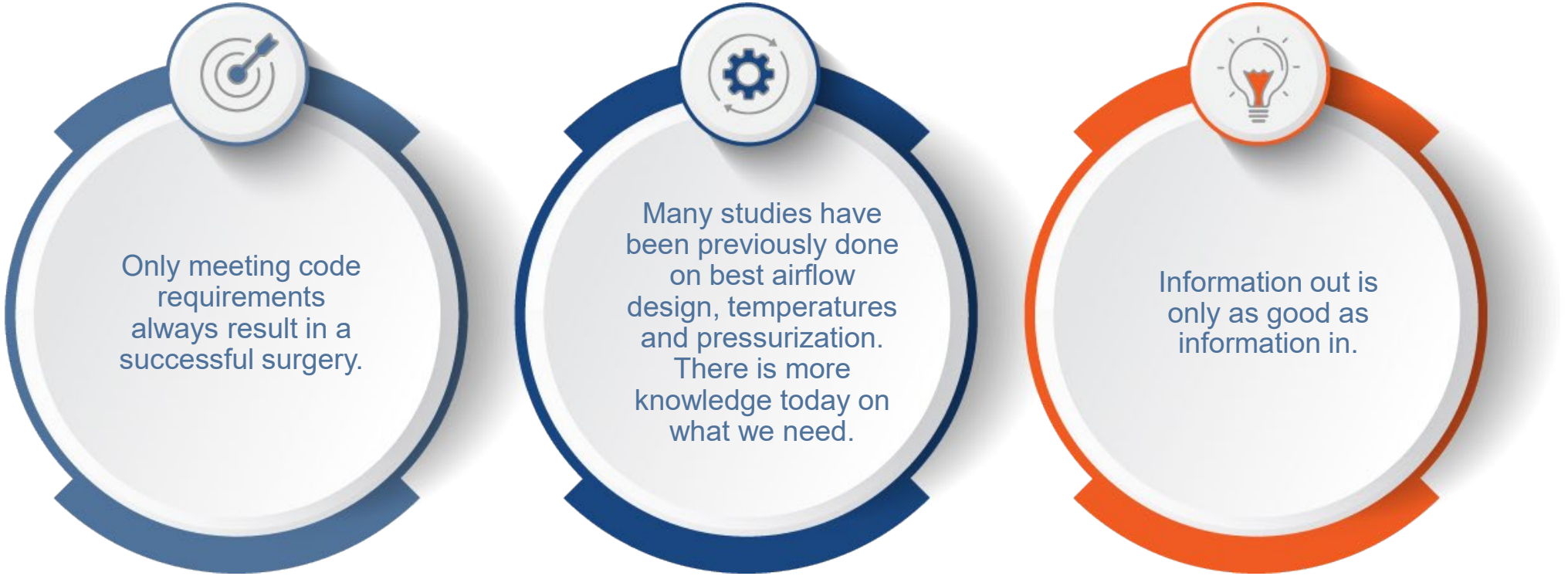
- Primary supply air over patient bed
- Laminar Airflow 25-35 cfm/ft²
- Returns located opposite corners of room, ~8” AFF
- 20-30 ACH
- Positive Pressure +0.01” WC
- Individual Controls
- 20-60% RH
- 68-75°F
- HEPA Filtration

# Typical Controls Design of an Operating Room

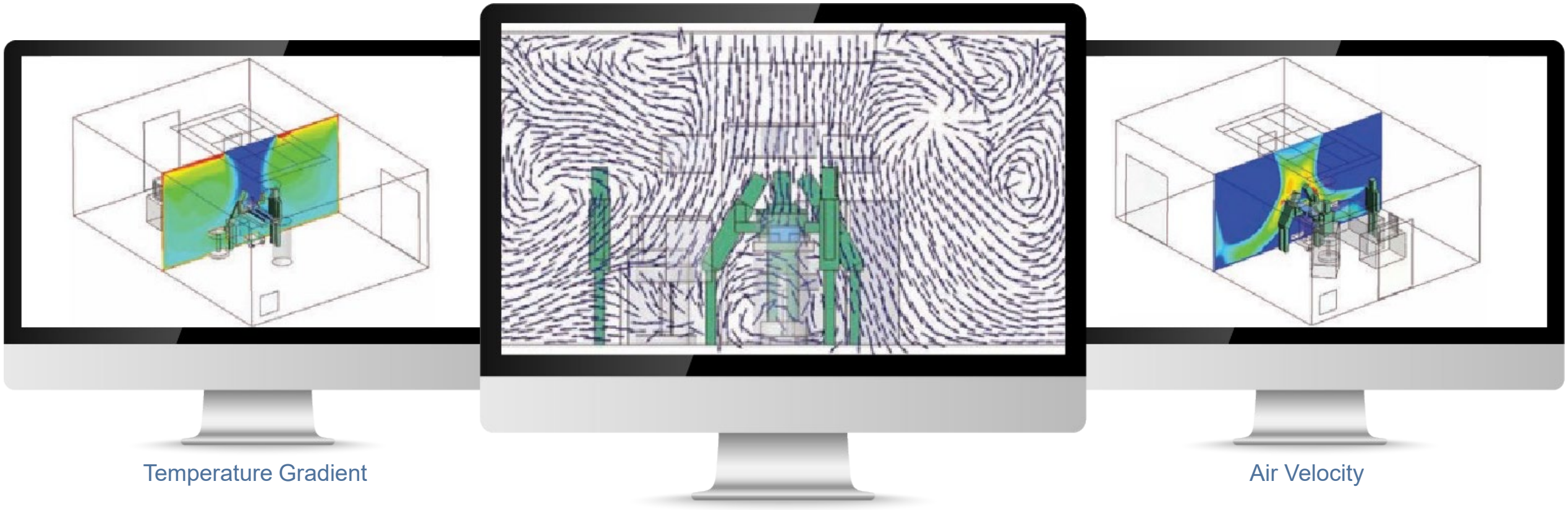
- Variable Volume Air Handlers with Redundancy
- Supply & Return Terminal Boxes
- Room Pressure Monitors with pressure sensors for each pressure relationship
- Supply and Return duct airflow stations
- Door Contacts
- Temperature Monitoring and Control
- Humidity Monitoring and Control



# Operating Room Design Summary



# What is Ideal Airflow?



Temperature Gradient

Typical Airflow

Air Velocity


WHAT DO WE DO WITH ALL THE DATA?
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# Design Solutions

**We Know:**

Operating rooms are highly complex spaces that serve many different operations from cleaning/ decontamination, brain surgery, to orthopedic surgery. The space must be accommodating to each of these while maintaining a safe compliant environment with tight parameters.

**But Also:**

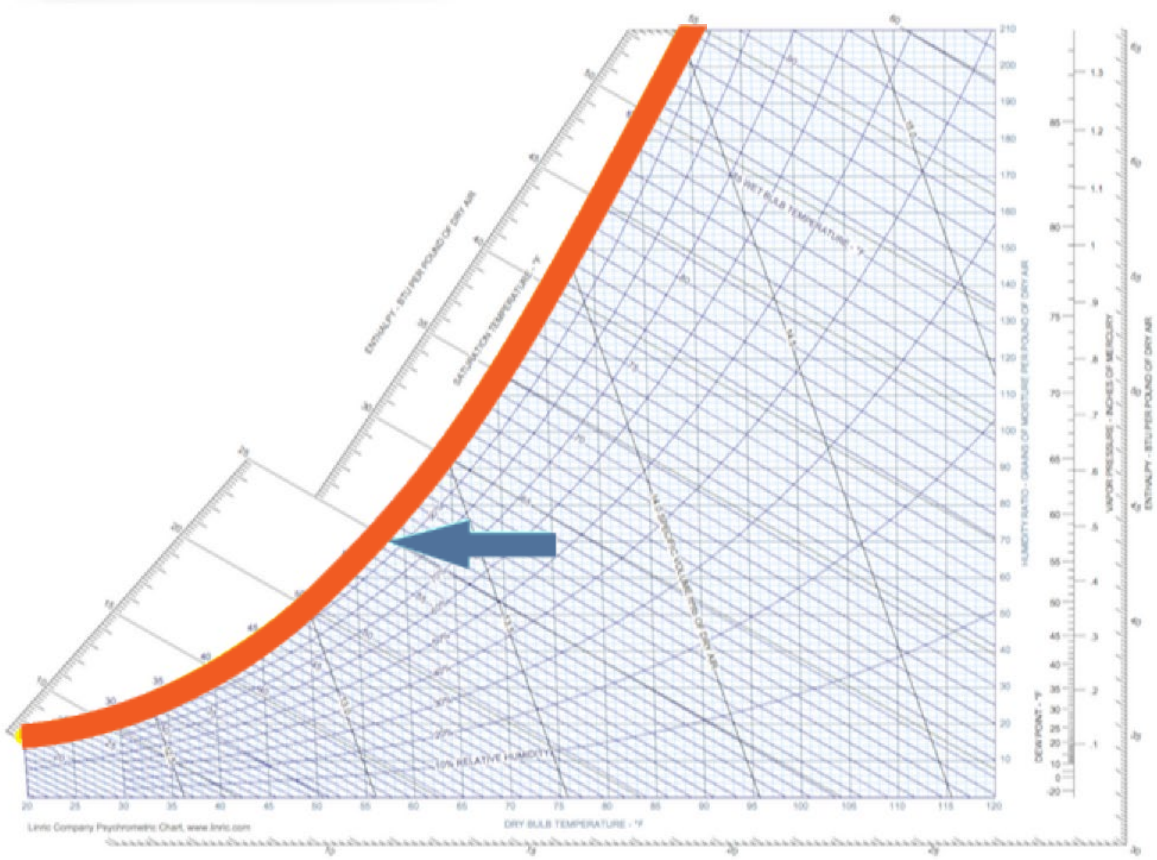
- Temperature of supply air effects airflow pattern
  - Buoyancy driven vs. momentum driven
- Supply air in laminar flow falls over table and sweeps to the return grilles
- Most stagnant air resides outside of the sterile operating zone
- Common complaint that surgeons are uncomfortable and hot at surgical zone.

# Design Solutions

**Is the solution to keep an OR as cold as possible?**

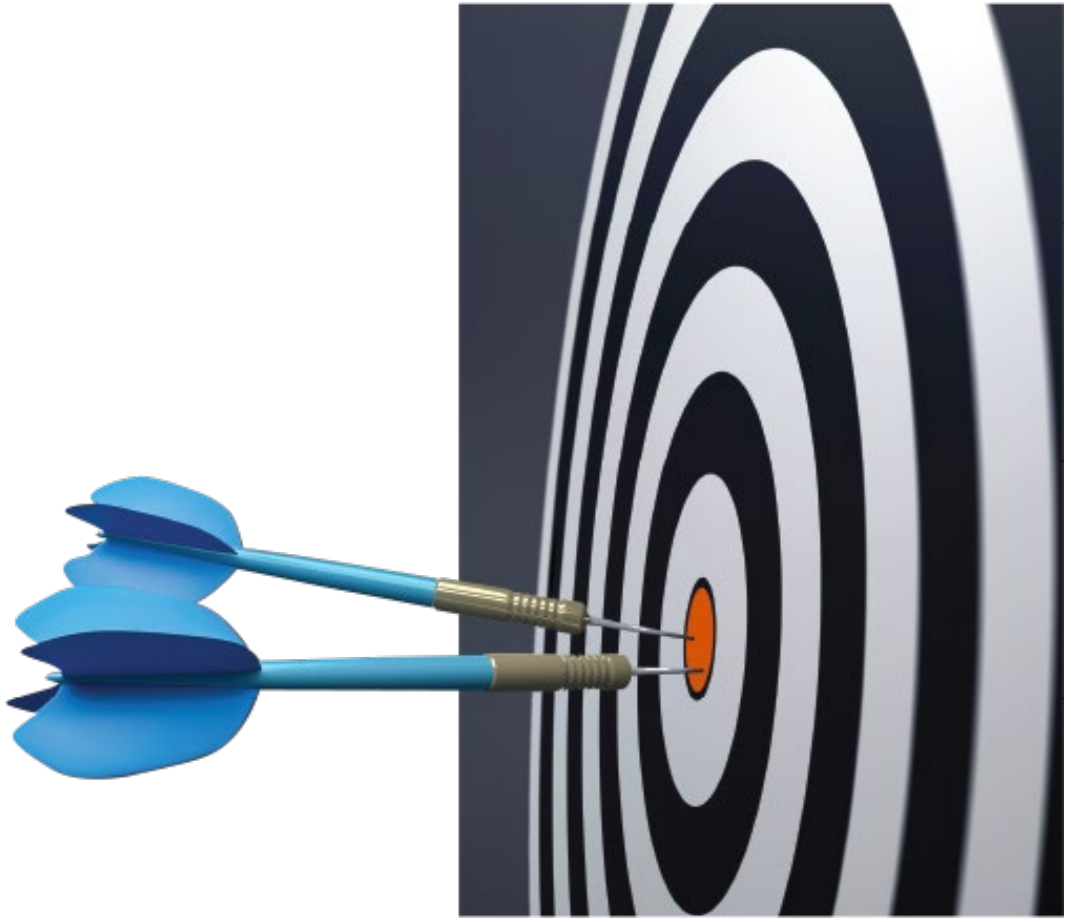
**It's not that easy.**

- Labor involved to constantly reset room temperatures
- Surgery might become non-compliant → More Paperwork → More Liability
- Colder might not always be better for all surgeries (i.e. Pediatric)
- Equipment serving the room may not be designed for the ask
- Going cold without dehumidification makes a clammy uncomfortable environment and potentially higher risk of SSI.



# Recurring Issues with Typical Design

- Is the data we get reality?
- Sensor location
- Systems go hunting
- Solutions are typically reactionary

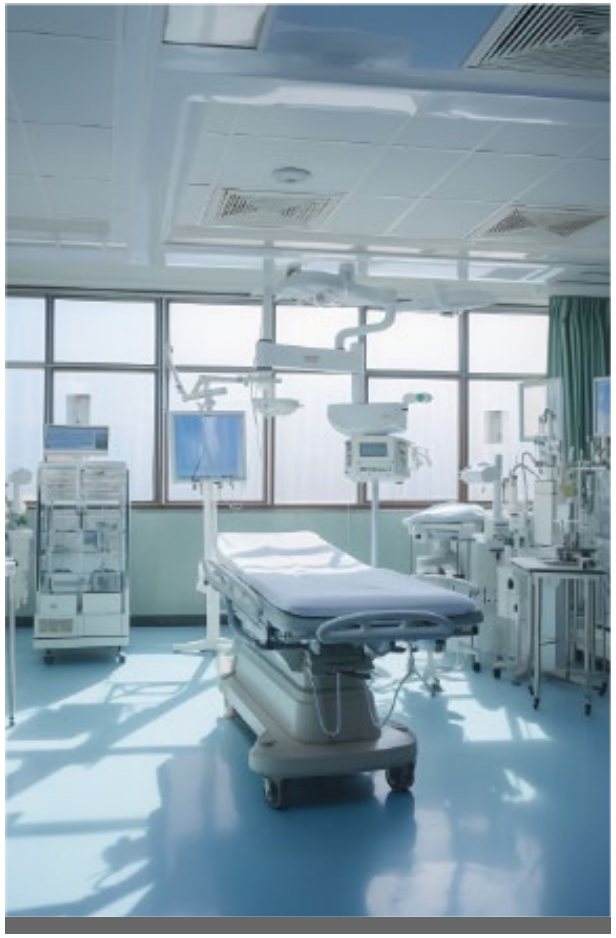


# Case Study Overview

- Boise Surgery Center built in 2019
- Sensors located on the wall and the return duct
  - Originally controlled from wall sensors
- Modern SLD design
- Niagara System with Alerton controllers
- Facility continually had similar problems in the operating room as many other facilities:
  - Surgeons complaining of discomfort and requesting colder temperatures in ORs
  - Struggling to meet surgeon's requests and code compliance without written variances
  - Previous trouble shooting had not had the successes they hoped
- Looking for a solution to implement in their standards with multiple new construction projects in design for their health system

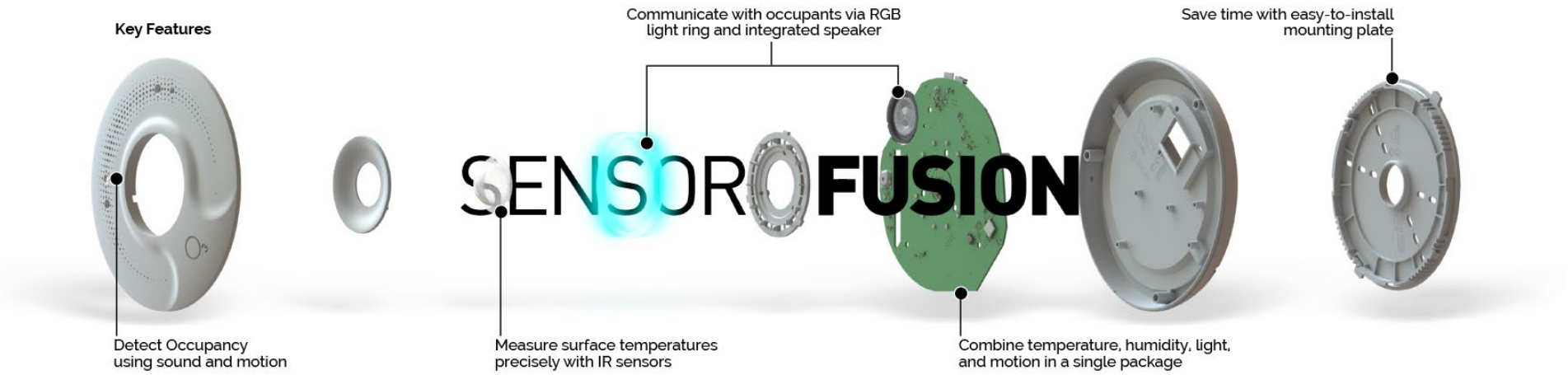
# Goals of Research

- Understand the controls and sensors as they relate to operating room function.
- Determine the most accurate sensor location to control the room temperature and humidity.
- Improve the information received to improve control and overall surgical success
- Test a new technology not yet used in an Operating Room environment



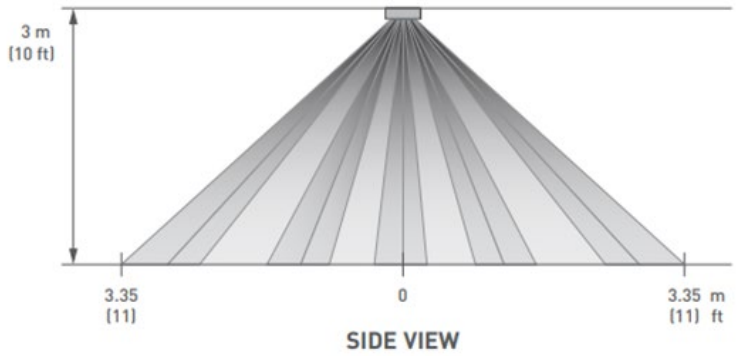
# New Technology: Delta Controls O3 Sensor

- Combines humidity, composite temperature, passive infrared motion, and multiple other sensors in a single device
  - Composite Temperature achieved through Delta Controls patented Sensor Fusion Technology
- Ceiling mounted
- Allows us to measure space conditions at critical occupant locations



# New Technology: Delta Controls O3 Sensor

- BACnet IP – BMS Agnostic
- IoT Device
- 2 Universal Inputs/Outputs
- Occupant Estimation
- Occupancy Detection - Motion, Sound, & Thermal
- Motion Sensor
- Light Level
- Sounds Level
- LED Ring – Programmable
- Speaker – Programmable
- Enocean (up to 32 devices)
- Bluetooth (mobile app and lighting control)

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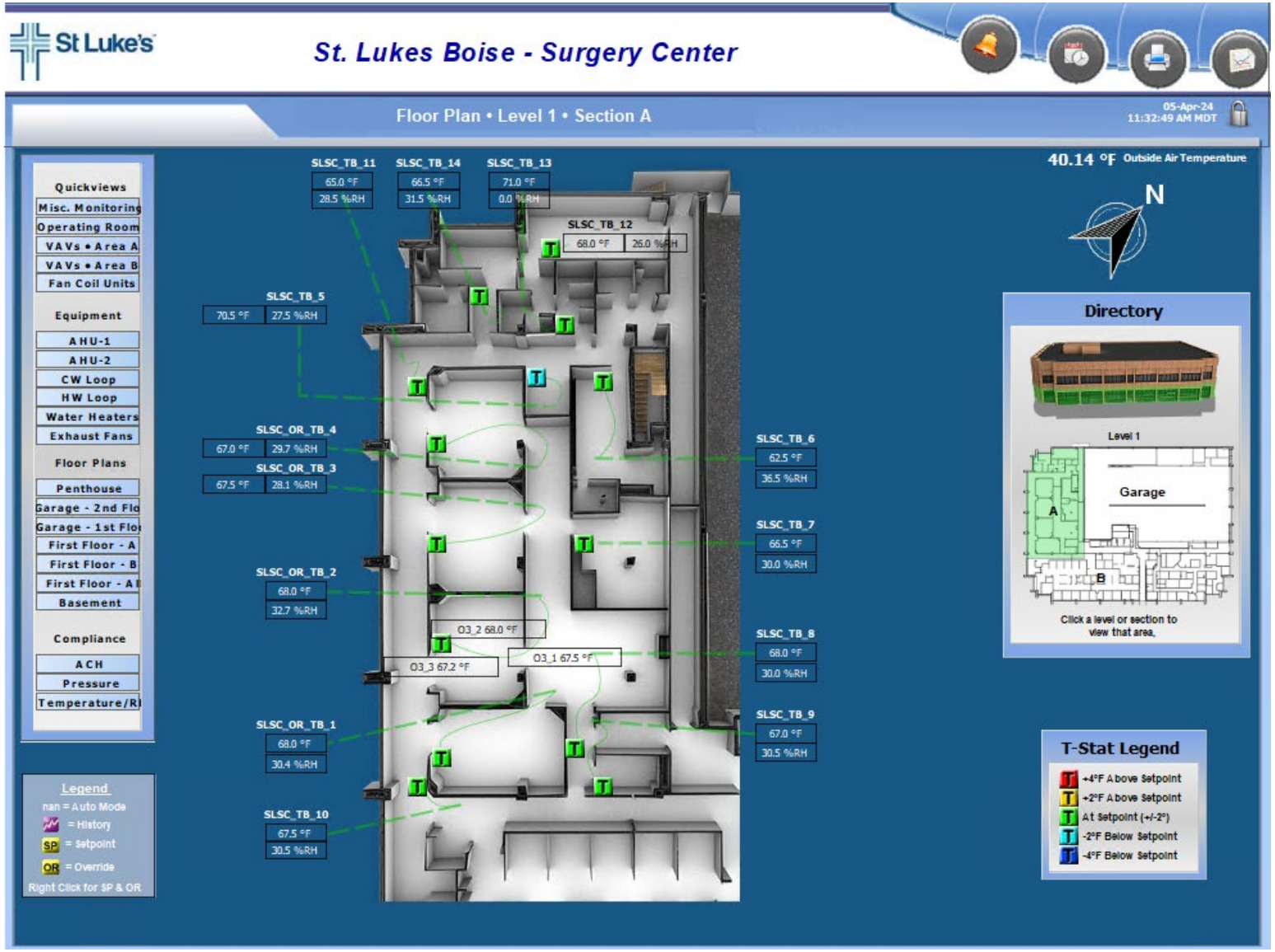
# Existing Control System



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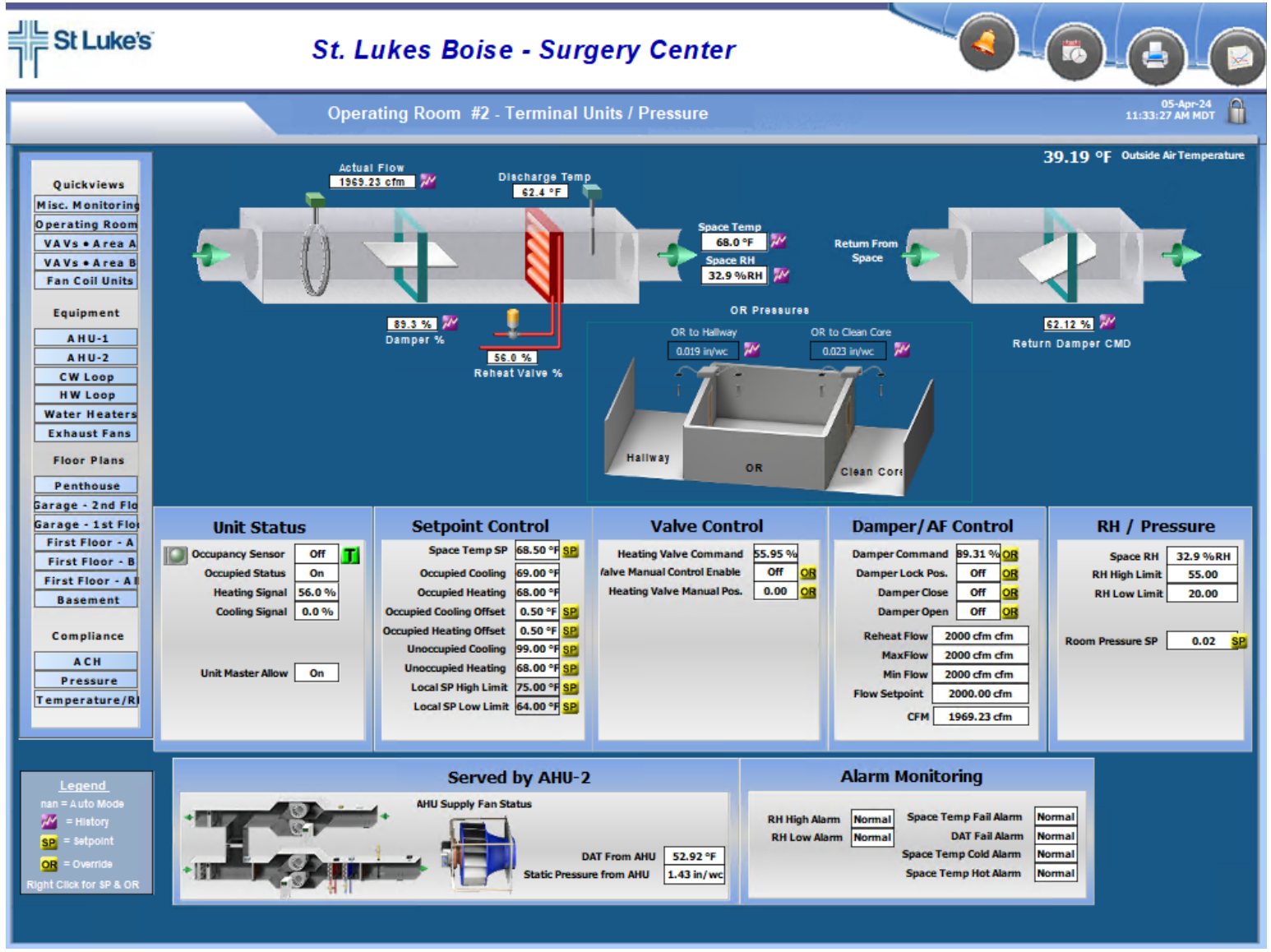
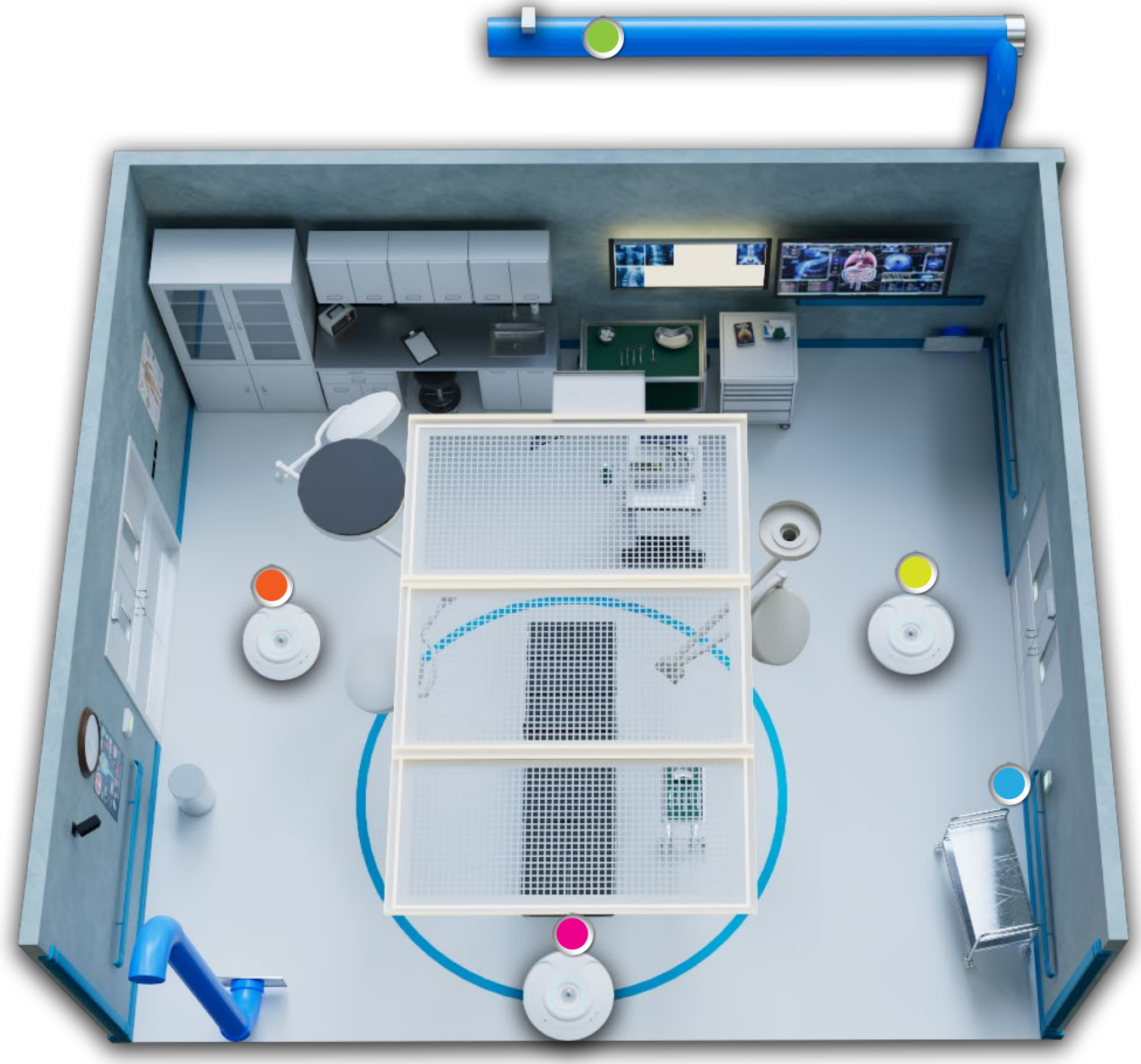


# Testing Set Up

## TEMPERATURE/SENSOR LOCATION

- Return Duct
- Wall Sensor
- O3 #1
- O3 #2
- O3 #3



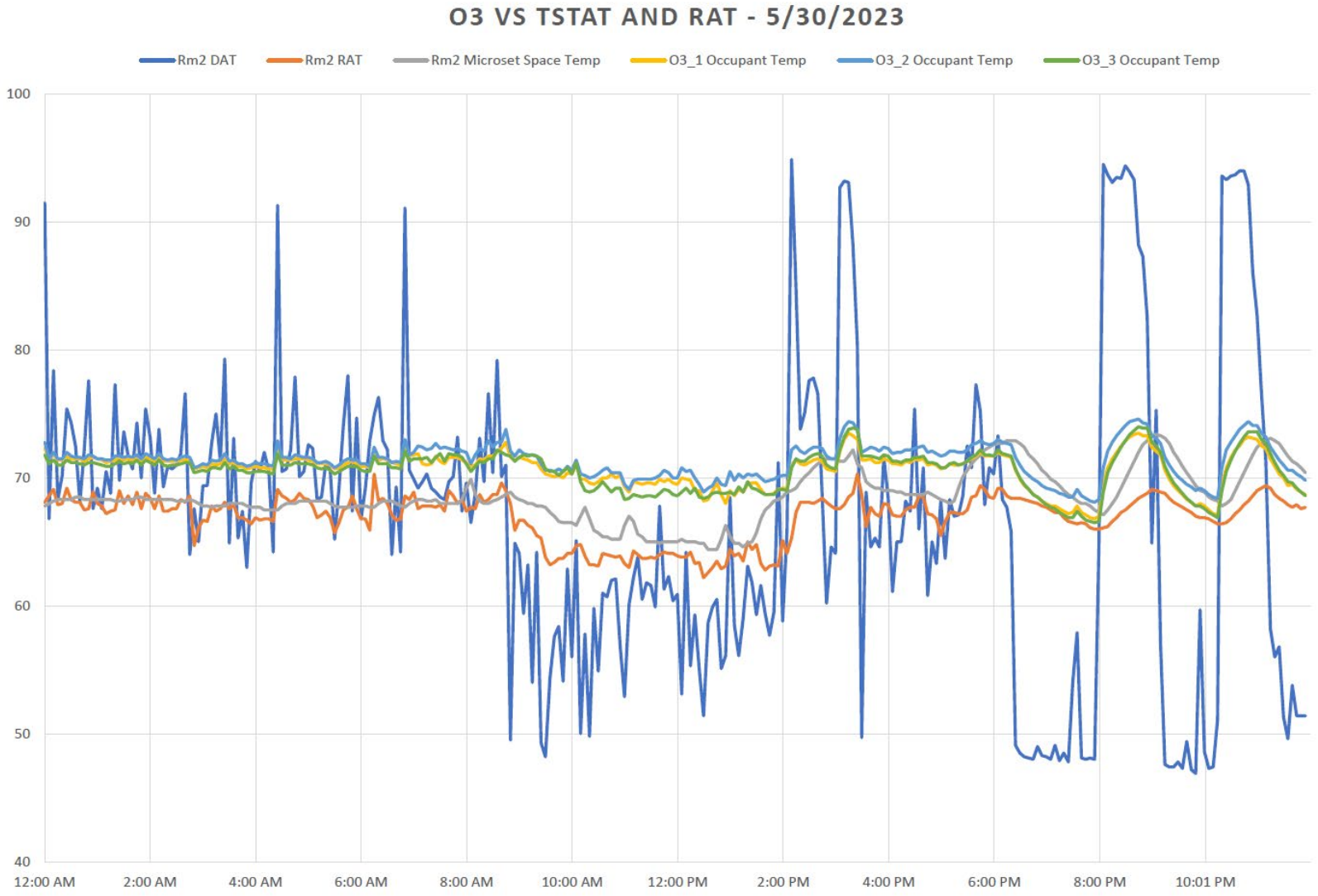
# Initial Testing & Observations

- Data Collection only, still controlling from wall sensor
- Mockup of room, lighting, equipment, people count to collect temperature readings throughout operating room
  - Found large temperature differences between the wall/return sensors and surgical site.
- Monitored and trended the results for approximately 4 months
- Observations:
  - O3 temperature sensors were more accurate
  - O3 sensors reacted quicker to the changes in space conditions

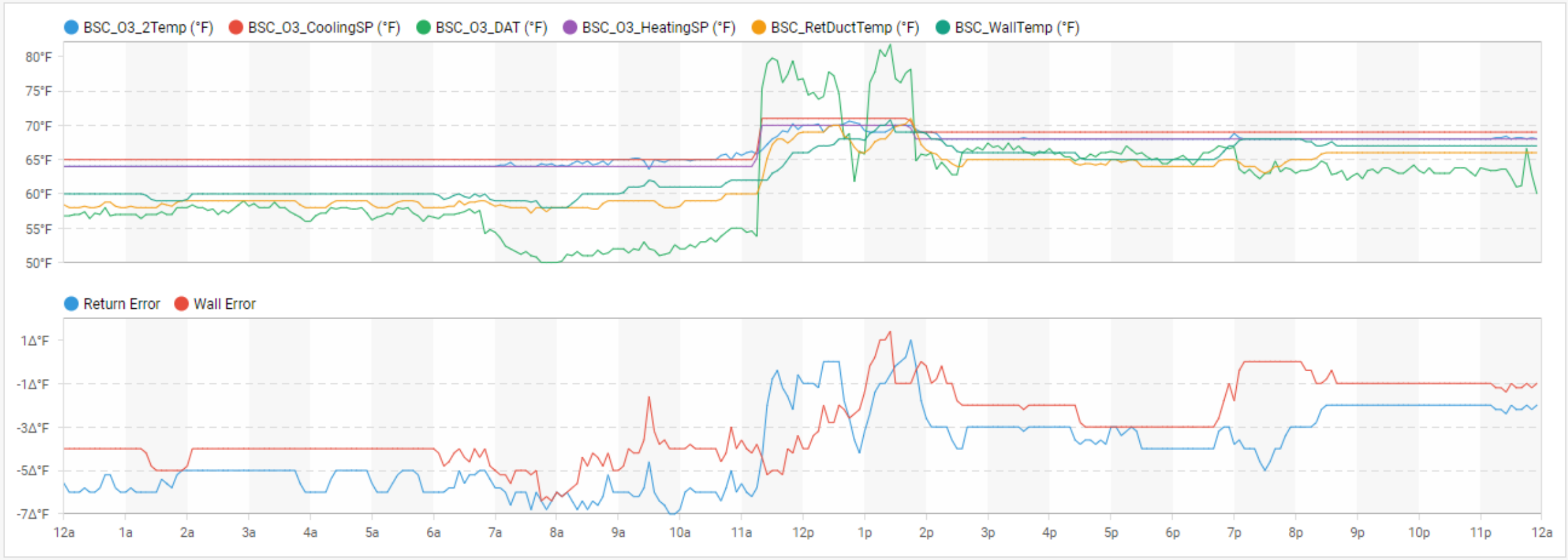
# Controlling from the O3 Sensors

- Initial review of space conditions and equipment function while controlling to the O3 sensor temperature and humidity are very positive
- Early findings:
  - Energy savings from more reactive control
  - Equipment and valves are hunting less to control the space
    - Less wear and tear on mechanical equipment
  - More comfortable conditions for surgeons
  - Less paperwork for better/similar space conditions
    - Less liability for the hospital

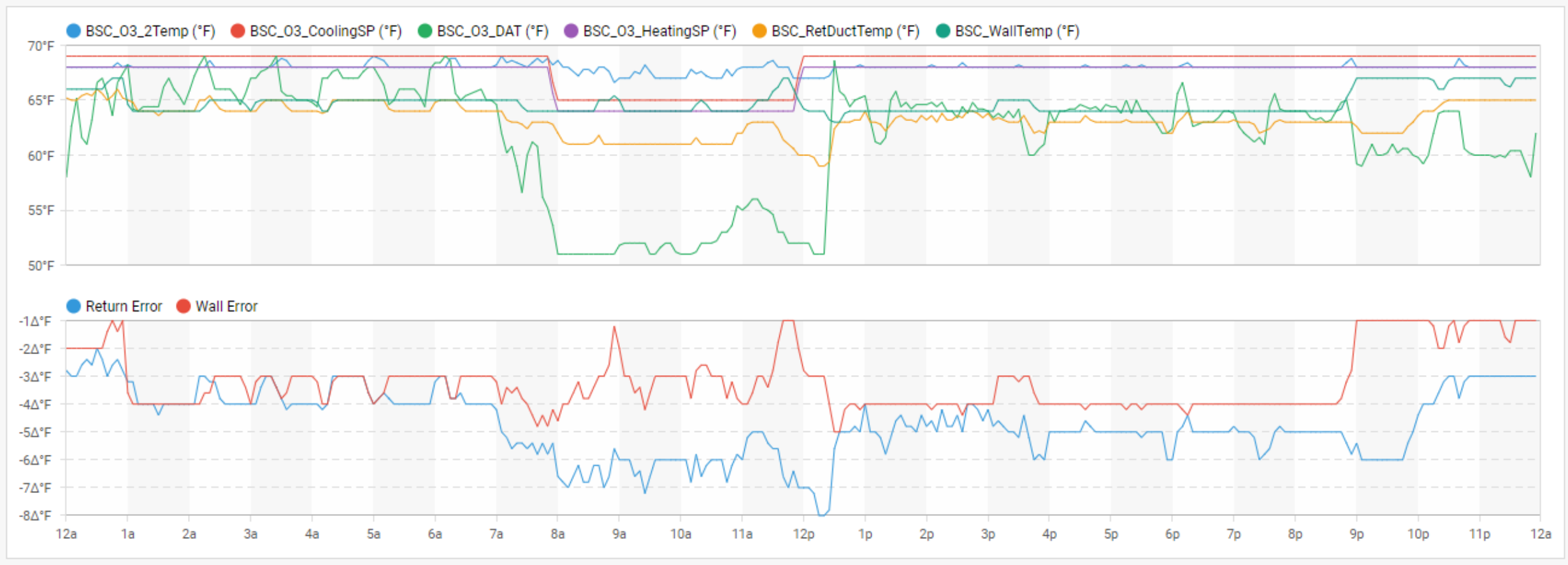
# Data Comparison – Wall Sensor Control



# Data Comparison – O3 Control (Heating)



# Data Comparison – O3 Control (Cooling)



# Case Study Summary

**Goals:**

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# Case Study Summary

**Findings:**

- Significantly less 'hunting' of discharge air temperature, resulting in energy savings and greater comfort for surgeons and staff.
- O3 sensor is more accurate and more responsive to set-point and space temperature changes which allows it to maintain a steady temperature in the operating room.
  - Ensures that hospitals have accurate compliance records and only fill out non-compliance paperwork when required.
- Air curtain around surgical field does not have a significant influence on readings from O3 sensors.
- Ceiling mounted sensors will not be ruined by room cleaning.
- Niagara provides the ability to add new technology like the O3 sensor to address long standing problems in critical environments.

# Questions?