Design vs. Facility Maintenance

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DEWBERRY

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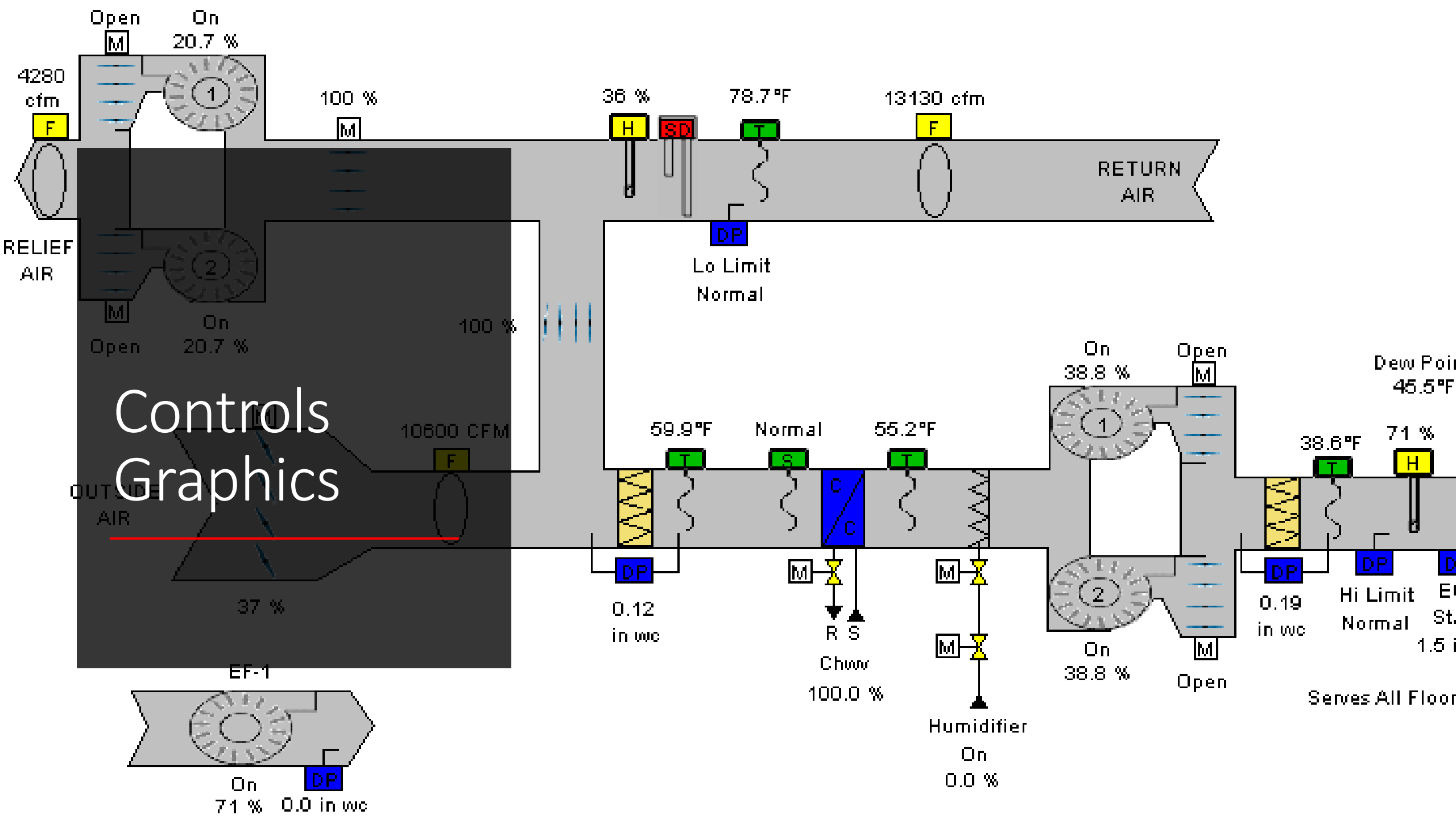
Objectives

- Understand the downstream operational impacts of code minimum design
- Develop an understanding of some facility operational issues
- Improve design practices from lessons learned

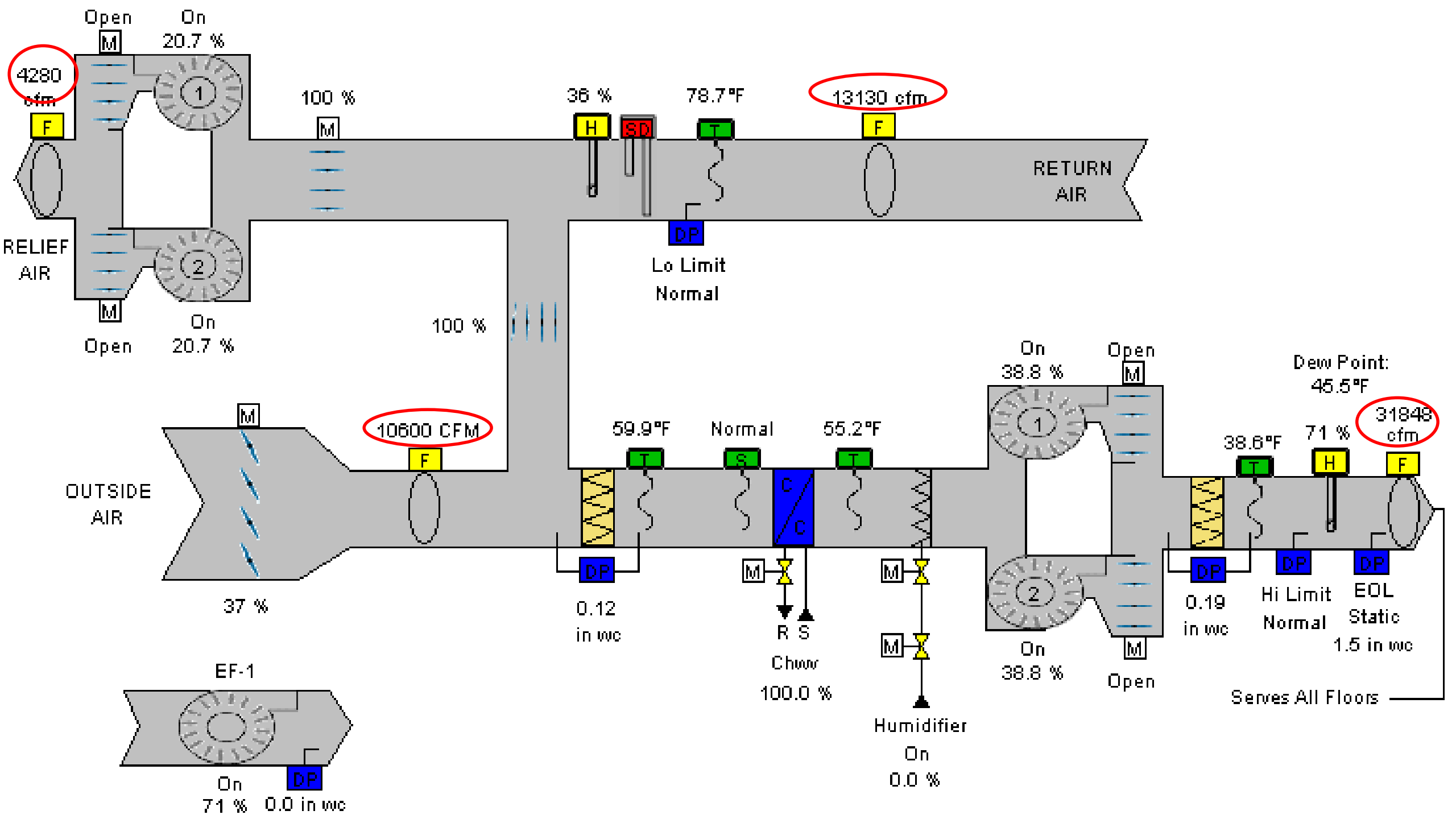
Facility Maintenance

Continuous Commissioning

- Verify correct location of sensors
- Calibrate sensors
- Verify correct operation of all devices
- Optimize sequences – performance, energy, emergency
- Optimize PID feedback loops
- Track trends
- Verify graphics
- Dashboard
- ID improvements



Controls Graphics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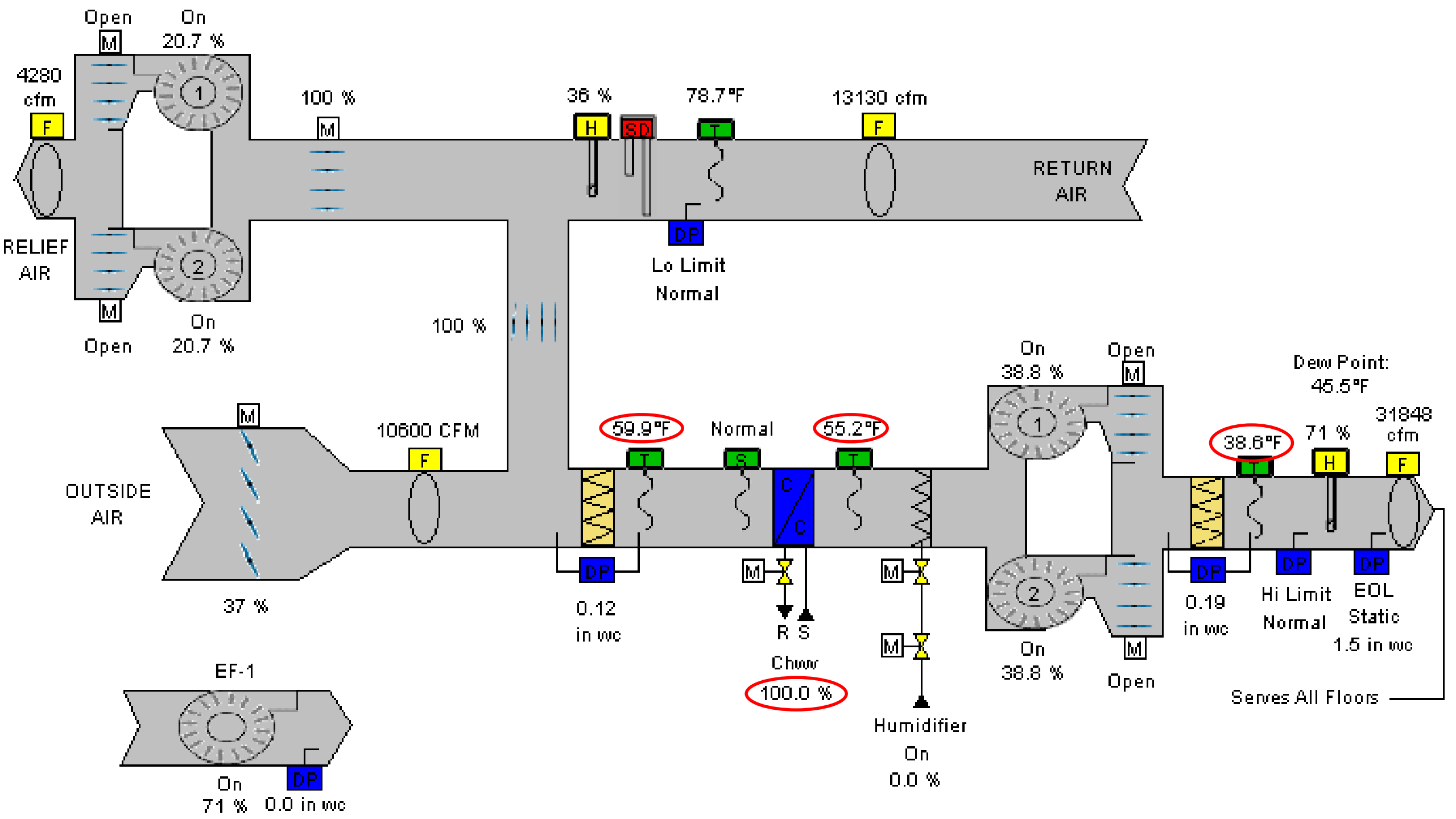
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Reliability Vs. Risk

RISK

- Loss of pressurization
- Loss of temperature
- Loss of humidity control
- Loss of power – normal/emergency
- Loss of security control

INFLUENCES

- Reliability ∞ 1 /complexity
- Maintenance ∞ complexity
- Complexity ∞ # of parts
- Complexity ∞ lines of code
- Complexity ∞ unintended consequences

Increasing Reliability

- Design for redundancy
- Quality components
- Reduce parts inventory
- Parts & skilled service locally available
- Good & tested emergency operations procedures
- Regular tune-ups (Retro-commissioning)

Preventive Maintenance

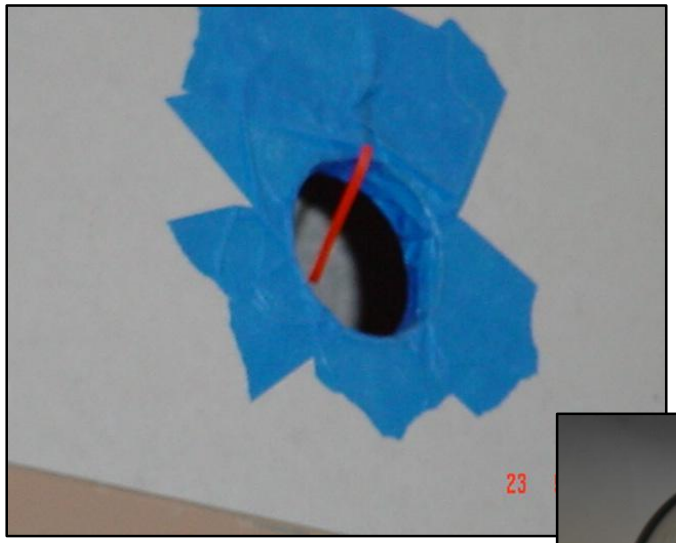
- Failures most likely in extreme weather
- Preventive maintenance cheaper than replacement
- Schedule work and downtimes
- Increase reliability
- Extend life of equipment
- Reliability ∞ Preventive Maintenance

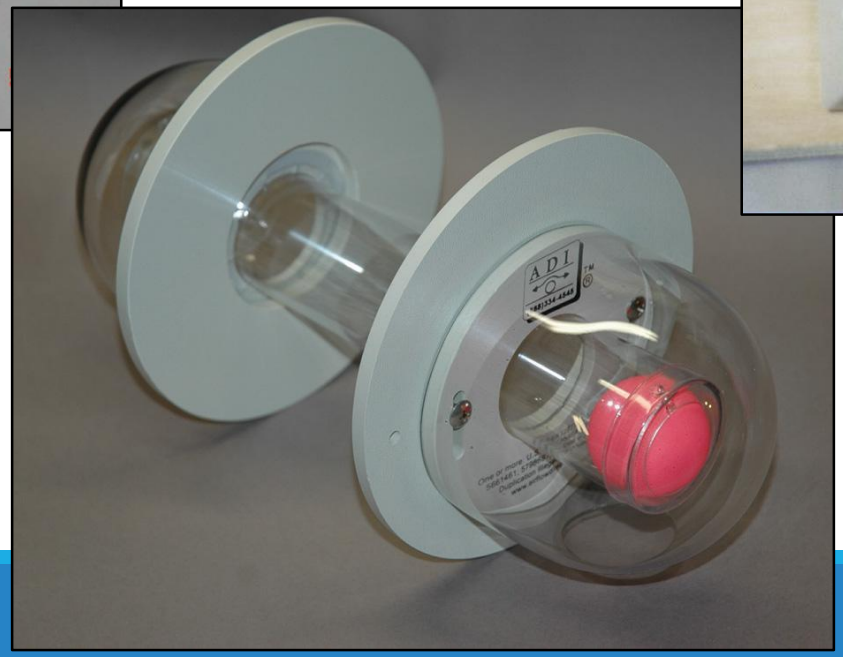
”Keep It Simple”

Controlling Noise

- Flex run outs with one or two 90° bends on RA too
- Low duct velocity
- Smooth transitions
- Distance to equipment
- Sound attenuators; last resort – cost, space and energy
- White HVAC noise, may help patients
- Walls to deck
- No plenum return
- Oversize return grilles

Means and Methods





“Keep It Simple”

Optimize Humidification

Boiler steam OK with FDA-approved chemicals

- “Clean steam” not required – cost, space, maintenance, heat

Locate humidifier after cooling coil in AHU

Keep RH sensors in calibration

Use accurate instruments to test (sling)

Large RH display but no control by user

Terminal Humidifier Concerns

Possible carryover or misting in operating room

Noise

Large RH swings

Pipe, duct and valve leaks

More humidifiers = more maintenance

Avoid clean steam systems:

- Have all the issues listed above
- Requires electricity, water and sewer
- Hot, wastes energy
- Very large, causing coordination conflicts

Additional Considerations

Fresh Air Intakes Concerns

Cooling towers

Trash compactors

Loading docks

Roads

Diesel generators

Heliports

Plumbing vents (25-30 ft)

Exhaust stacks

TB Isolation rooms

Bathroom exhausts

Biological safety cabinet exhausts

Ethylene oxide sterilizers

Boilers & water heaters

3 ft above roof

6 ft above ground

Renovations

Exhaust construction zones outside

HEPA filter from construction zone to hospital not recommended

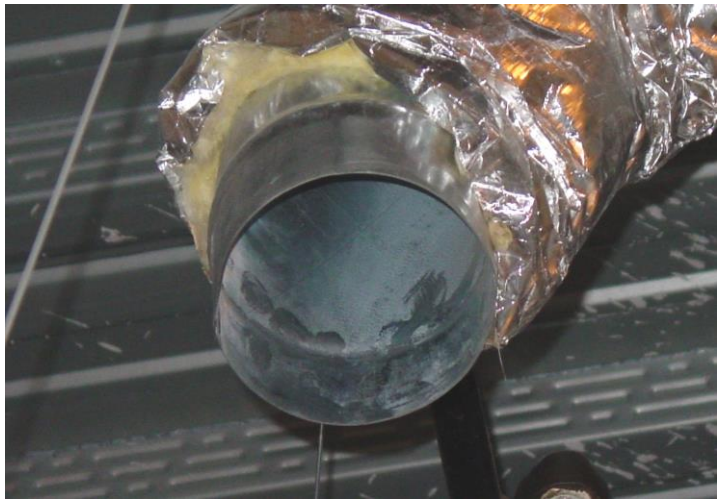
Remove all lined ducts & boxes

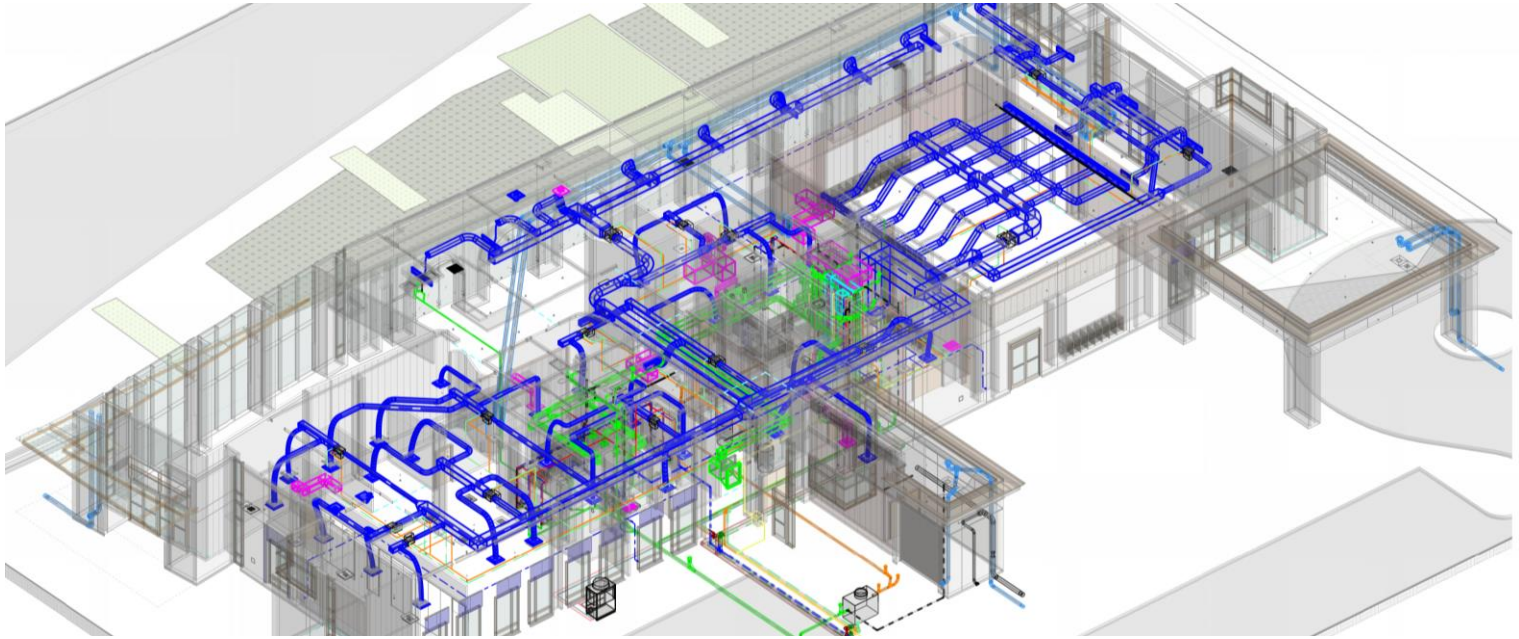
Replace electric reheat

Remove all abandoned equipment

Maintain clean ductwork throughout construction, verify!

Clean walk-off mats





Design

Considerations

- Pressurization
- Occupant Temperature Demands
- High Density Heat Loads
- Hot Humid Environments

Room Pressurization

ANSI/ASHRAE/ASHE Standard 170-2017 Ventilation of Health Care Facilities

Includes ANSI/ASHRAE/ASHE addenda listed in Appendix C

Table 7.1 Design Parameters—Hospital Spaces

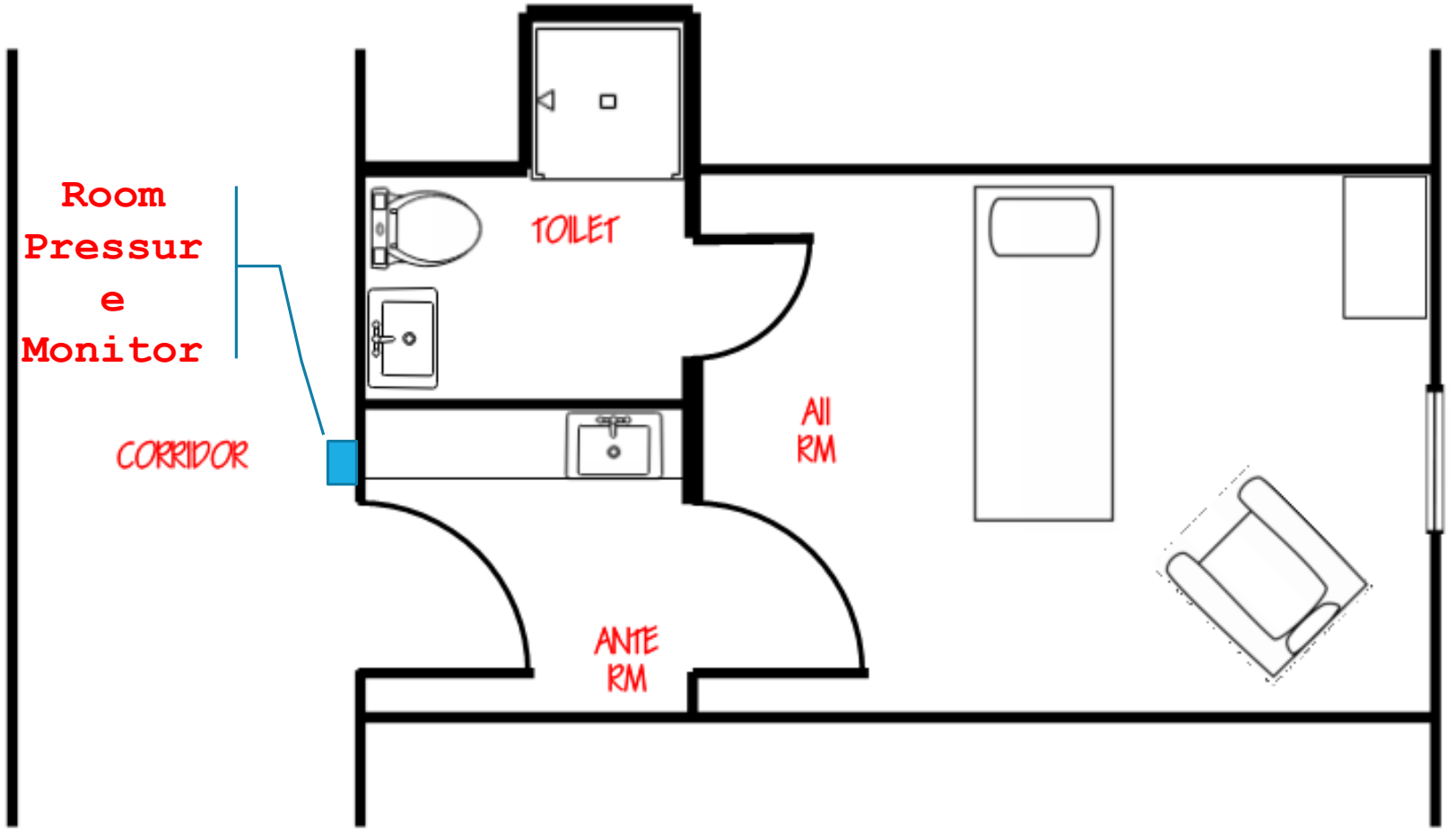
Function of Space	Pressure Relationship to Adjacent Areas (n)	Minimum Outdoor ACH	Minimum Total ACH	All Room Air Exhausted Directly to Outdoors (j)	Air Recirculated by Means of Room Units (a)	Design Relative Humidity (k), %	Design Temperature (l), °F/°C
INPATIENT NURSING							
All Anteroom (u)	(e)	NR	10	Yes	No	NR	NR
All room (u)	Negative	2	12	Yes	No	Max 60	70–75/21–24

e. See Section 7.2 and its subsections for pressure relationship requirements.

Room Pressurization

- Airborne Infection Isolation (AII) rooms shall have a **permanently installed device** and/or mechanism to constantly monitor the differential air pressure between the room and the corridor, whether or not there is an anteroom. A local visual means shall be provided to indicate whenever negative differential pressure is not maintained.
- The room envelope shall be sealed to provide a **minimum differential pressure of 0.01 in. of water** (2.5 Pa) across the envelope.
- Differential pressure between AII rooms and adjacent spaces that are not AII rooms shall be a **minimum of –0.01 in. of water** (–2.5 Pa). Spaces such as the toilet room and the anteroom (if present) that are directly associated with the AII room and open directly into the AII room are not required to be designed with a minimum pressure difference from the AII room but are still required to maintain the pressure relationships to adjacent areas specified in Table 7.1.

Room Pressurization



Occupant Temperature Demands

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SURGERY AND CRITICAL CARE							
Delivery room (Caesarean) (m), (o)	Positive	4	20	NR	No	20-60	68–75/20–24
Operating room (m), (o)	Positive	4	20	NR	No	20-60	68–75/20–24
Operating/surgical cystoscopic rooms (m), (o)	Positive	4	20	NR	No	20-60	68–75/20–24
Procedure room (o), (d)	Positive	3	15	NR	No	20-60	70–75/21–24
Recovery room	NR	2	6	NR	No	20-60	70–75/21–24
Substerile service area	NR	2	6	NR	No	NR	NR

Occupant Temperature Demands

- Temp monitoring & control w/display
- Humidity monitoring w/display
- CHW: newer chillers can provide 39°- 40°F (3.8° - 4.4°C) CHWS.
  - AHU coils - design for low approach
- DX: Can reach 32°F (0°C) glycol systems
  - lose efficiency and capacity.
  - Environmental and code concerns
- Desiccant dehumidification
  - Excellent humidity control
  - Reduce CHW coil load
  - Large Equipment

High Density Heat Loads

- Imaging Control/Computer Rooms
- Robotic Surgery
- Data centers
- Refrigerators / Freezers
- Nourishment Alcoves with Ice Makers
- Typically air cooled, try water
- Water cooled saves energy and space

High Density Heat Loads

- Is separate chiller required or may central chilled water be used?
- Need ~ 60°F (15.5°C), so CHWR works well
- If central CHW used, exchanger, pump and mixing valve are required. Can serve multiple systems
- Need CHW in winter.
- Need CHW on EPS.
- Applies to process cooling loads, i.e. Linear Accelerators

Hot Humid Environments

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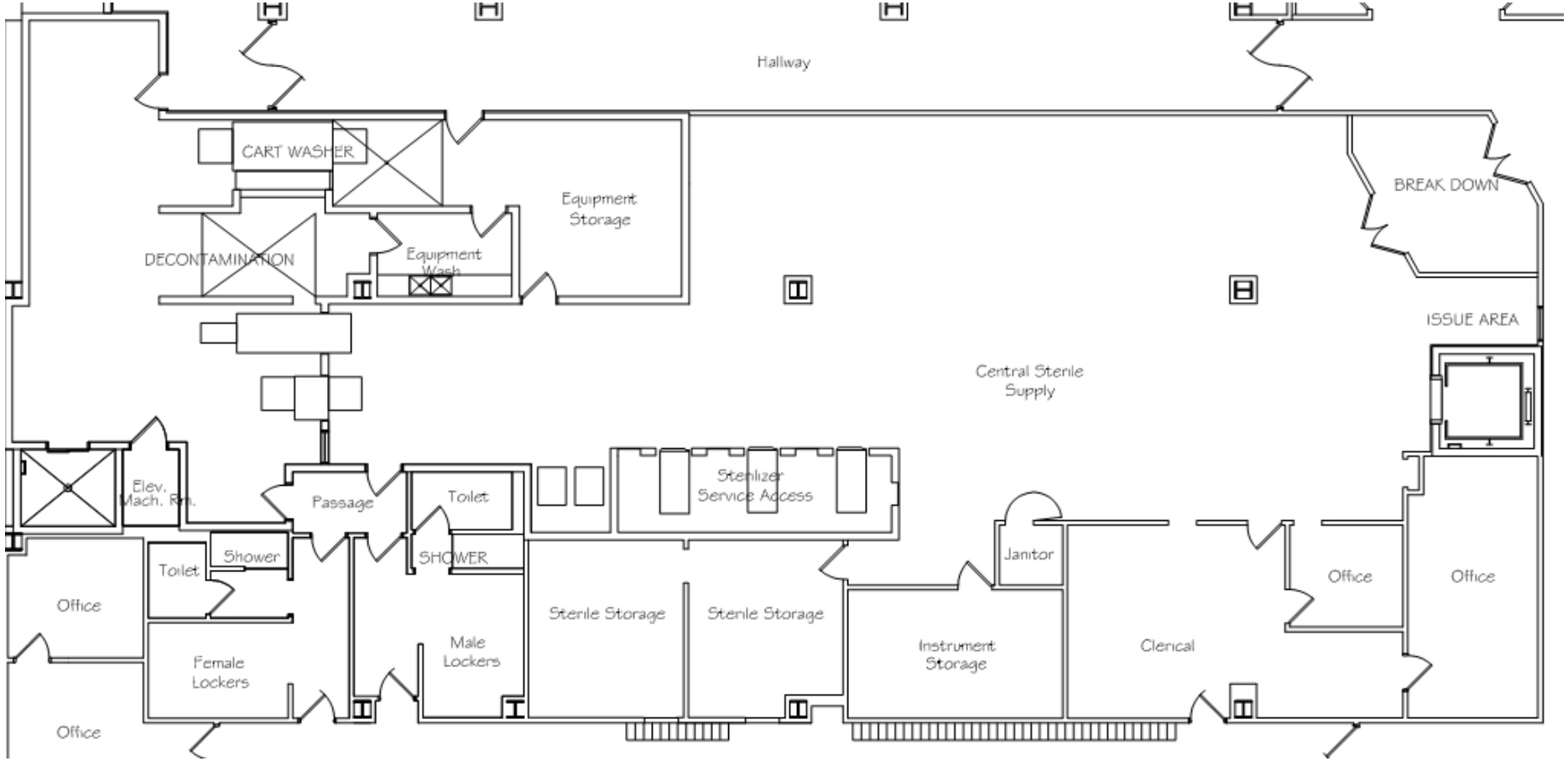
STERILE PROCESSING DEPARTMENT z							
Clean workroom	Positive	2	4	NR	No	Max 60	68–73/20–23
Decontamination room	Negative	2	6	Yes	No	NR	60–73/16–23
Sterile storage room	Positive	2	4	NR	NR	Max 60	75/24
z. See AAMI Standard ST79 11 for additional information for these spaces.							

Hot Humid Environments

Sterile Processing Department (SPD)

- Clean Instruments from Surgery and Procedures
- Flow of materials from Dirty to Clean
- Flow of air from Clean to Dirty, maintain ΔP at all times
- Decontamination – dirty, wet work area, hot, humid
- Sterilizers draw steam into decontamination room - Need local Exhaust
- Clean Processing / Supply needs low temp & humidity
- ANSI, AAMI guidelines on Temp, RH & Monitoring; verify w/ Owner. May require supplemental DX to dehumidify

Sterile Processing Department (*SPD*)



Additional Design Considerations

- Initial Cx including functional tests (all scenarios)
- Document setpoints and final sequences
- Periodic tune-ups
- Coil cleaning including reheat
- Operator training
- Set alarms as value approaches red line (yellow caution)
- Trends
- Dashboards

Questions

Thank you Triangle Chapter!

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