Mechanical + Electrical Challenges
MINNESOTA HEALTHCARE ENGINEERS ASSOCIATION

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TODAY’S AGENDA

- Pressures on Your Facility
- USP 797/800
- Emergency Power Systems
- Condensing Boilers

----- BREAK -----

- Humidity Control
- Cold Temperature Operation
- Commissioning
- Electrical Testing
- Medivators
- Procedure Rooms

--- DUNHAM ---

State Dept. of Health

Joint Commission
FGI
CMS
NFPA
ASHRAE Std 170 (2008)
Institutional, Care Network, or Provider Policies & Expectations
Occupant Comfort
- Patients
- Visitors
- Care Providers

O&M Expenses

Your Facility
DEPARTMENT OF HEALTH

- Construction project review of drawing and construction review
- When does a remodel change the applicable code?
  - Change of use – Yes
  - Moving walls – Yes
  - Painting the walls – No
  - Discuss early with DOH, design team, owner

CMS (MEDICARE/MEDICAID)


- ASHRAE 170-2008 (No Addenda)
JOINT COMMISSION

Joint Commission currently uses the 2014 Guidelines for Design and Construction of Hospitals

- Referenced in the Environment of Care

### OPERATING ROOMS

<table>
<thead>
<tr>
<th>Version of Guidelines for Design &amp; Construction of Healthcare Facilities</th>
<th>Pressure Relationship</th>
<th>Min. OA ACH</th>
<th>Min. Total ACH</th>
<th>Recirculated by means of room units</th>
<th>RH%</th>
<th>Temp (°F)</th>
<th>Comments</th>
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<tbody>
<tr>
<td>1992-1993 AIA</td>
<td>Positive (no magnitude)</td>
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<td>No</td>
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<td>68-73</td>
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<tr>
<td>2010 FGI / ASHRAE 170-2008</td>
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<td>No</td>
<td>30-60</td>
<td>68-75 CMS Enforced</td>
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<td>20</td>
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<tr>
<td>Bronchoscopy 2001 AIA to 2018 FGI</td>
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<td>NR</td>
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USP 797/800

- Final Versions to be issued September 2019
- Enforcement December 2019
- 797 Non-Hazardous
- 800 Hazardous
WHAT DO I NEED?

- Category 1 vs 2 Compounding
  - 12 Hour BUD

- Category 1 Segregated Compounding Area

- Category 2 Ante-Room and Buffer Room(s)

HAZARDOUS COMPOUNDING

- Hazardous Compounding Room
  - ISO 7
  - 30 ACH (supply)
  - -0.01 to -0.03 in WC
  - 68° F
  - Low exhaust for Refrigerator

- Ante Room
  - ISO 7
  - 30 ACH
  - +0.02 to +0.05 in WC
  - 68° F
  - Low return
NON-HAZARDOUS COMPOUNDING

- Non-Hazardous Compounding Room
  - ISO 7
  - 30 ACH
  - +0.02 to +0.05 in WC
  - 68°F
  - Low return
- Ante Room
  - ISO 8
  - 20 ACH
  - +0.02 to +0.05 in WC
  - 68°F
  - Low return

HAZARDOUS STORAGE

- Inside Hazardous Compounding Room
- Separate Room
  - Non-classified
  - 12 ACH Exhaust
  - -0.01 in WC
WHAT ARE WE COVERING

- Existing facility
- New or existing generator
- Existing or new ATS’s
- Testing compliance requirements
- Documentation

DEFINITIONS

EPS – Emergency Power Supply
EPSS – Emergency Power Supply System
EES – Essential Electrical System

- Level 1 – Loss of human life or serious injury (110)
- Level 2 – Less critical (110)
**GENERATORS**

**NFPA 70 (NEC): 701.3:**
- Test periodically
- Maintain unit
- Record maintenance
- Informational note refers to 110

**NFPA 99**
- Minimum 12 tests per year
- Does not need to meet 10 second start every month
- Refers to 110.8

**NFPA 101: SEE 110**

**NFPA 110: 8.4:**
- 30 minutes/month
  - Minimum exhaust temperature recommended by the generator manufacturer
  - OR minimum 30% of standby nameplate KW
- **If the above is not met:**
  - Load-bank one a year at 50% for 30 minutes and 75% for 1 hour.
  - **Document time, date, duration, etc.**

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**GENERATORS**

Typical Commissioning Issues:
Interior and Exterior:
- Low coolant temp
- ECM vs. Generator Controller points
- Batteries in acid resistant tray
- Battery cover or not?
- Breakers can be shut off without alarm
- Engine idle/cool down not annunciated
- Emergency lighting (battery pack at unit)

Exterior
- Dampers fail open
- Remote shut-down
- Fuel class
ATS

- Existing facility
- New or existing generator or ATS with controls upgrades
- Testing compliance requirements
- Documentation

NFPA 70 (NEC): 701.3 and 5:
- Test periodically
- Maintain unit
- Record maintenance
- SCC Rating marked on the EXTERIOR of enclosure

NFPA 99
- 10 second criteria is spelled out here (Type 1)
- Does not need to meet 10 second start every month
- Refers to 110.8

NFPA 101: SEE 110

NFPA 110: 8.4.3.1:
- Initiate start from a different ATS each month
- Level 1 EPSS full test required once every 36/mo.
- DOCUMENT from which ATS the start signal was initiated
**ATS**

Typical Commissioning Issues: Interior and Exterior:
- Settings: Who determines?
- Fault current ratings
- Circuit breaker settings and coordination
- Labeling
- Testing
- Thermoscaning

Exterior
- Service entrance rating
- Internal heat and MONITORING

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**CONDENSING BOILERS**

- **Why?**
  - Efficiency
  - Scarcity of Licensed Boiler Operators
  - Maintenance
CONDENSING BOILERS

- Why are condensing boilers more efficient?

- Because they can capture and use latent heat

CONDENSING BOILERS

- Water Temp < Dew Point Temp = Condensation

Boiler combustion = fuel + oxygen

Graphs courtesy of Mulcahy Co.
CONDENSING BOILERS

- Efficiency
  - Lower return water temp

2016 ASHRAE HVAC Systems and Equipment
Chapter 32

Boiler Thermal Efficiency Curve
Courtesy of Aerco

CONDENSING BOILERS

- Improving efficiency with existing HIGH TEMP hydronic components
CONDENSING BOILERS

- Heating Water Reset
  - Winter Setpoint: 180°F or 190°F, from original system design
  - Spring and Fall: 140°F

Sample - HW Reset Schedule

For Minneapolis:
8760 Bin Hours
0°F to 50°F: 4,478 hrs
-30°F to 0°F: 256 hrs

Mechanical + Electrical Challenges Pt. 2
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OPERATING ROOM HUMIDITY

Why?
- Important For
  - Reduction of infections
  - Reduction of electrostatic discharge
  - Integrity of sterile supplies and equipment
  - Preventing development of mold
OPERATING ROOM HUMIDITY

- Regulatory Requirement
  - FACILITY GUIDELINES INSTITUTE (FGI)
  - ASHRAE STANDARD 170
  - CENTERS FOR MEDICARE & MEDICARE SERVICES (CMS)

RELATIVE HUMIDITY
20% ↔ 60%

OPERATING ROOM HUMIDITY

- Humidification
  - Central system / Point-of-use
  - Building steam / Clean steam
  - Vapor barriers
  - Windows & exterior walls
OPERATING ROOM HUMIDITY

- **Dehumidification**
  - 68F Room Temp vs. 65F
  - Lower Coil Leaving Air Temperature
  - Increased Reheat

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OPERATING ROOM HUMIDITY

- HVAC systems
- System capability
- Infrastructure investment

- Increased operating costs
  - Efficiency options
    - Leaving air temperature reset
    - Heat recovery coils
    - Energy wheels
OPERATING ROOM HUMIDITY

- Compliance policy
  - Infection control
  - Duration / Magnitude
  - Local / BAS alarming
  - Staff training
  - When / Who to call

AHU RESTART

- AHU shutdown on freeze? Now what?
  - Close the OA damper and Relief Air dampers
  - Open the Return Air damper
  - If bitterly cold, consider manual override of heating water control valve
  - Restart fans; run for 5-10 minutes to stabilize
  - Slowly open OA and Relief Air dampers; let unit stabilize after each subsequent opening

Note:
It is possible to automate this sequence, however it is difficult to estimate how slow the OA damper should open, especially in frigid cold
COMMISSIONING IN HEALTHCARE FACILITIES

- **Required per 2015 MN Energy Code**
  
  **IECC, C408.2**
  SYSTEM COMMISSIONING
  Exemption:
  1. < 40 TONS COOLING & < 600 MBH HEATING
  2. Sleeping Units in Hotels & Motels

- **ASHRAE 90.1, 6.7.2.4**
  SYSTEM COMMISSIONING
  Required:
  1. > 50,000 SF
     Except warehouses and semi-heated spaces

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COMMISSIONING IN HEALTHCARE FACILITIES

- **Required per 2014 FGI Guidelines**
  - 1.2-7.1 Installation of new or modification of existing, the following shall be commissioned:
    - BAS system
    - Domestic hot water
    - Fire alarm and fire protection
    - Essential power systems

Areas of Concern
- CRITICAL AND INTENSIVE CARE
- SURGICAL SERVICES
- ISOLATION ROOMS
- PHARMACIES
- AREAS CONTAINING HAZARDOUS MATERIALS

State Adoption of the FGI Guidelines
WHAT ARE WE COVERING

- Breaker coordination
- Arc Flash study
- Breaker testing
- Lighting testing
- Panelboard load metering
- Battery testing
- Receptacle testing
- Compliance documentation

BREAKER COORDINATION

NEC Article 100:
- Coordination (Selective)
- Localization of an overcurrent condition to restrict outages to the circuit or equipment affected, accomplished by the choice of overcurrent protective devices, and their ratings for settings.

Tools used:
- SKM – Power Tools for Windows
- Easy Power
- EDSA
- ETAP
ARC FLASH STUDY

How is it Calculated?
- NFPA 70E
- IEEE 1584
- Preferred Method

Facility Responsibilities
- Employee training
- Written safety program
- Available PPE
- Insulated tools
- Arc Flash hazard calculations
- Proper labeling

BREAKER TESTING
Why test breakers:
- Known failure
- Nuisance tripping
- Suspicion of issues
- Confirm operation prior to installation in a critical system

How to test:
- Primary injection (preferred) – confirms sensors and electronics are functioning
- Secondary injection – only confirms electronics
- Follow NETA, NEMA and Manufacturers recommended procedures.
LIGHTING TESTING

- Verify egress path
- Verify critical lighting
- Verify controls conform to construction documents
- Verify interfaces to A/V and other systems
- Test with scheduled outage
- Documentation

PANELBOARD LOAD METERING

Why:
- Confirm distribution capacity
- Manage load growth

Where to Implement:
- On more critical systems where load growth is likely
- Where additional distribution is most costly (generation)

How:
- Integral to panelboards, ATS's, breakers
- Separate system
**BATTERY TESTING**

- Visual inspection
- Voltage testing
- Float current
  - Current delivered by the charger when battery is fully charged
  - Track for baseline and watch for increases
- Ripple current – Bad charger?
- Temperature – leads to short life
- Specific gravity – Verify battery chemistry
- Impedance testing – Indicator of battery health
- Discharge testing – Verifies capacity, but not health of system
- Documentation – confirm compliance and establishes baselines

**RECEPTACLE TESTING**

NFPA 99: 6.3.3.2
- Visual inspection
- Ground continuity
- Polarity
- Retention force – 115g (4oz)
- New devices at patient bed locations or deep sedation shall be tested.
- Additional testing as required by documented performance data?
  - Documented failure rates from manufacturer
  - Reports of receptacle issues
- Non-Hospital grade receptacles: 12 month intervals
- Document
MEDIVATORS

- What can go wrong?
  - Mixing valve
  - Hot water temperature
  - Water pressure
  - Water quality
  - Odors
- Fixes

MEDIVATOR FIXES

- Mixing valve approved by Medivator
- Reduce “dead leg”
- Heat trace
- Buffer tank with Booster pump
- Back flushing Pre-filter
- Connected exhaust duct
PROCEDURE ROOMS

- **ASHRAE 170 Requirements**
  - Positive pressure
  - 15 Total ACH/3 ACH OA
  - 70-75°F
  - 20-60% RH
  - Group E diffusers, laminar flow
  - MERV 13 filter bank number 1

PROCEDURE ROOMS

- **ASHRAE 170-2008 and 2013**
  - procedure room (Class A surgery): provides minor surgical procedures performed under topical, local, or regional anesthesia without preoperative sedation. Excluded are intravenous, spinal, and epidural procedures, which are Class B or C surgeries.
PROCEDURE ROOMS

- ASHRAE 170-2017

- procedure room*: a room designated for the performance of procedures that do not meet the definition of “invasive procedure” and may be performed outside the restricted area of a surgical suite and may require the use of sterile instruments or supplies. Local anesthesia and minimal and moderate sedation may be administered in a procedure room as long as special ventilation or waste-anesthesia gas-disposal systems are not required for anesthetic agents used in these rooms.

QUESTIONS?

DUNHAM
MINNEAPOLIS | DULUTH | ROCHESTER
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