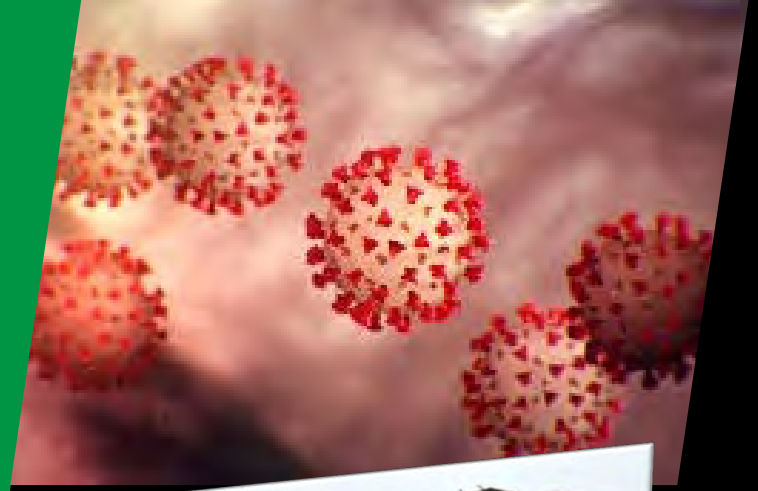

Presented By

Paul Rumbos

MAJOR MEDICAL HOSPITAL SERVICES

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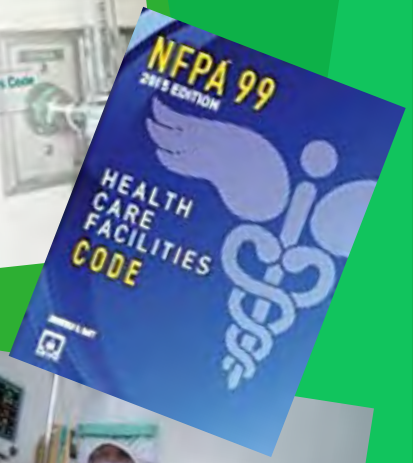
Medical Gas Emergency Management & System Design in Pandemic Times

NFPA 99 Code Changes



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Paul Rumbos

Major Medical Hospital Services

- *Medical Gas Credentials: NITC/MGTI/MGPHO*
  - *ASSE 6050 Certified Medical Gas Instructor*
  - *ASSE 6030 Certified Medical Gas Verifier*
  - *ASSE 6020 Certified Medical Gas Inspector*
  - *ASSE 6010 Medical Gas System Installer*
  - *MGPHO Credentialed Medical Gas Verifier*
  - *NFPA 99 Committee Member (Alternate)*
  - *ASSE 6000 Committee Member*
  - *Affiliations in ASHE, ASSE and member in good standing with Hospital Engineers' Societies*

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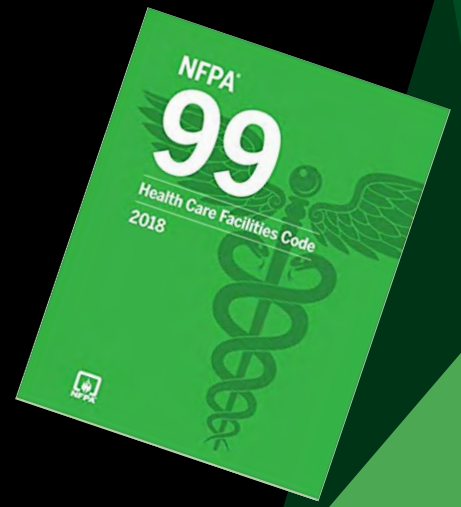
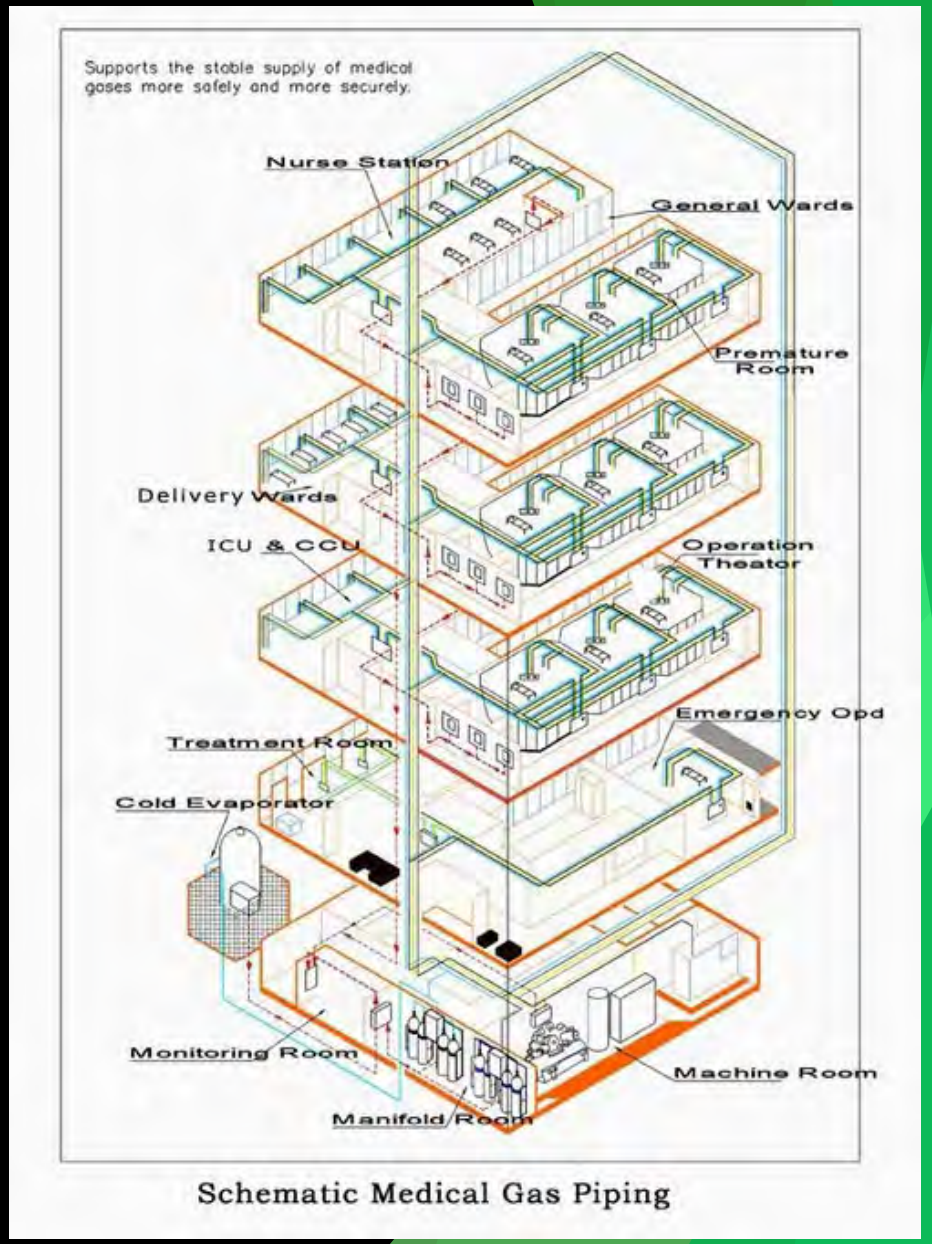


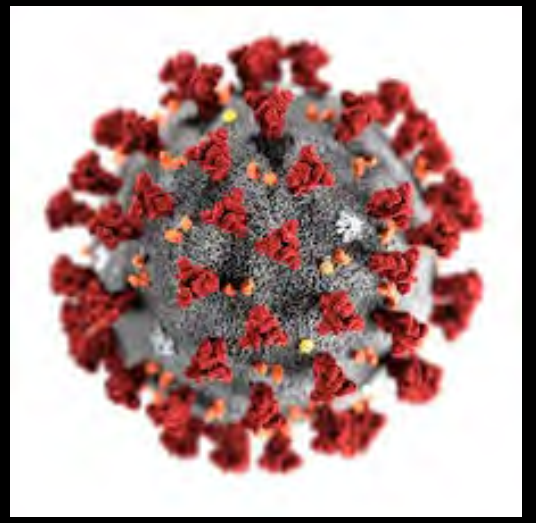
Typical Category 1 Medical Gas Systems



Schematic Medical Gas Piping

Presentation Outline

- Medical Gas Related Disasters
- Identifiable Medical Gas Issues Related to Infrastructure Caused by COVID 19
- Solutions and Recovery for Medical Gas Systems
- Future Design Specifications
- NFPA 99 Code Update
- Conclusions & Discussion



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Regulatory Codes & Standards

NFPA 99: *Health Care Facilities Code*, 2015/2021 Edition

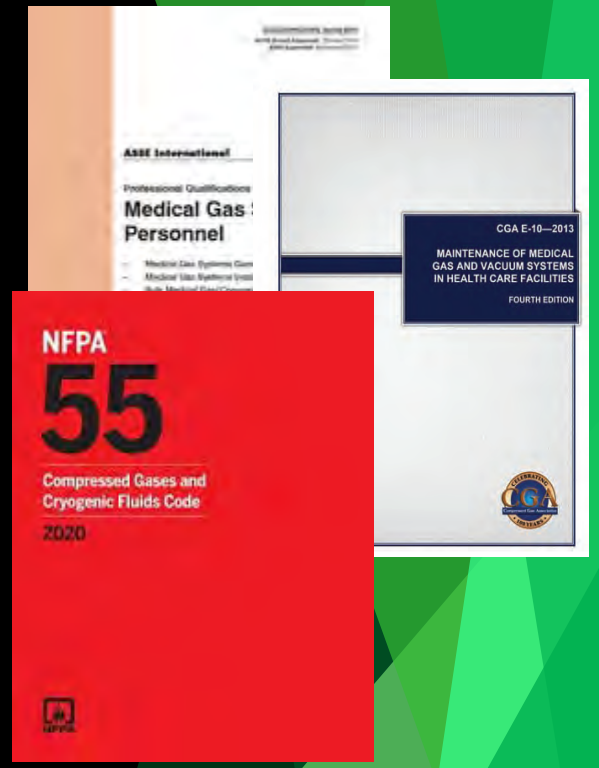
The scope of the NFPA 99: *Health Care Facilities Code* is to establish criteria to minimize the hazards of fire, explosion, and electricity in health care facilities providing services to human beings.

Chapter 5, Gas and Vacuum Systems, covers the performance, maintenance, installation, and testing of nonflammable medical gas systems with operating pressures below a gauge pressure of 300 psi, vacuum systems used within health care facilities, waste anesthetic gas disposal (WAGD) systems, also referred to as scavenging systems, and manufactured assemblies that are intended for connection to the medical gas, vacuum, or WAGD systems.

Other Reference Guides

CGA E-10: Maintenance of Medical Gas and Vacuum Systems at Health Care Facilities

- ✓ A guide to the preparation of a maintenance program regarding piped medical gas/vacuum systems in health care facilities.
- ✓ National codes require health care facilities with these systems to have an effective, documented maintenance program.
- ✓ Covers inspection and testing of Gas/Vacuum Outlets, Gas/Vacuum Alarm Systems, Compressed Gas Manifolds, Vacuum Pumps, Medical Air Compressors, Suggested Frequency of Inspection, Test Methods, & Documentation.
- ✓ Also, *CGA M-1*, P-1&2 Safe Handling, P-2.7 Guide for safe storage, Handling, and use of small portable liquid 02 systems, P-2.6 Trans- filling Liquid 02 use for Resp., P-30 Cryogenics, P-39 02 Rich Atm. & G-4 Oxygen



NFPA 55 Cryobulk

CGA
Compressed Gas Association
The Standard For Safety Since 1913

Medical Gas Related Disasters

CBS NEWS

22 COVID patients die in Indian hospital as leak cuts oxygen supply

22 COVID patients die in Indian hospital as leak cuts oxygen supply

Medical Gas Related Disasters

Medical Gas Related Disasters

Medical Gas Related Disasters

What happened?

Medical Gas Related Disasters

Hospital Deaths

- The Associated Press reported on four deaths in a Texas hospital. The initial report attributed the deaths to contaminated oxygen.

- Reports allege that the death toll has reached six with an additional 70 other patients under observation for hepatotoxic effects of the contaminant, which reliable sources have identified as trichloroethylene, a solvent used to clean pipes and gas tanks.

This tragedy supports and emphasizes the APSF's efforts to educate the anesthesia community about the dangers inherent in our gas pipeline systems, including the associated bulk supplies.

Medical Gas Related Disasters

2 patients die at Maryland hospital after oxygen valve mistakenly turned off

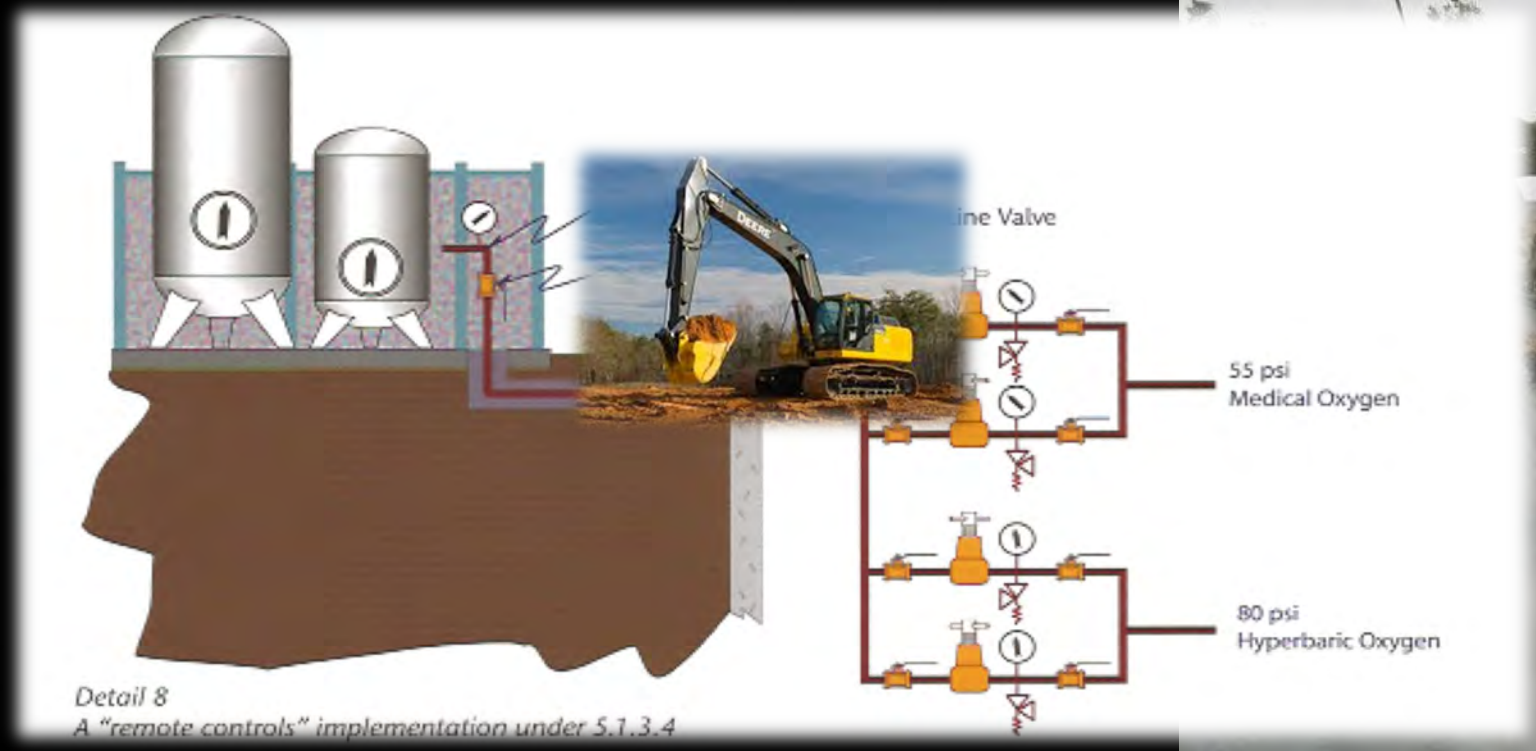
Erica Carbajal - Friday, January 29th, 2021 Print | Email

Share Tweet Share 23 Listen TEXT

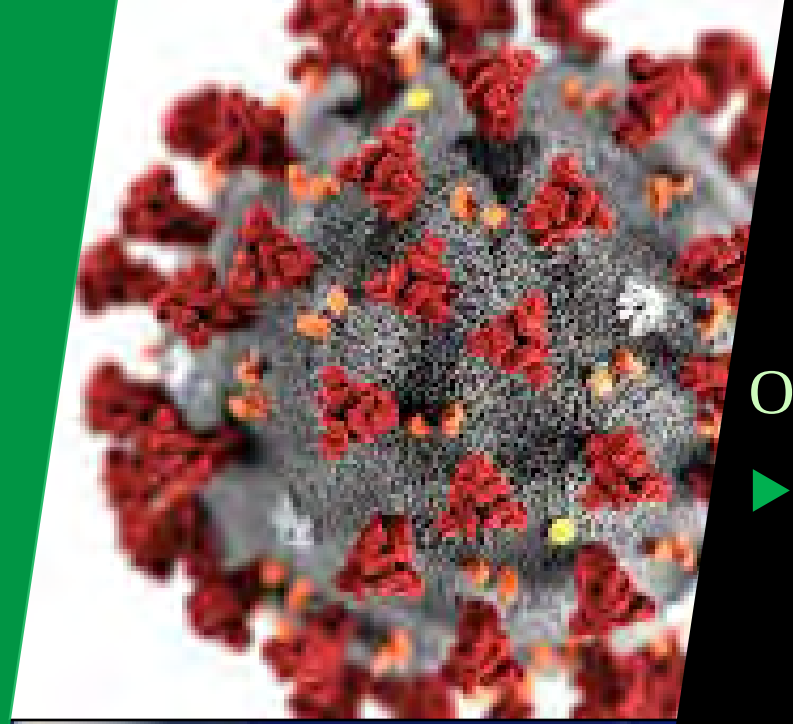
Two patients at Lanham, Md.-based Luminis Health Doctors Community Medical Center died after an oxygen valve was mistakenly turned off during maintenance Jan. 15, *FOX 5 DC* reported Jan. 28.

An oxygen valve was accidentally shut off during maintenance due to faulty valve labeling, according to a statement from a hospital spokesperson shared with *Becker's* Jan. 29. The hospital's team "immediately deployed portable oxygen to these patients," the statement said.

"We are saddened by this tragic accident and extend our deepest condolences to the families involved. We are communicating privately with them," the statement says. "We have taken action to prevent a similar occurrence in the future and have engaged outside experts as part of this review. Luminis Health Doctors Community Medical Center is committed to continuous improvement and providing the highest quality care to the communities we serve."



Cryogenic Fluid Central Supply Systems Supply Disasters



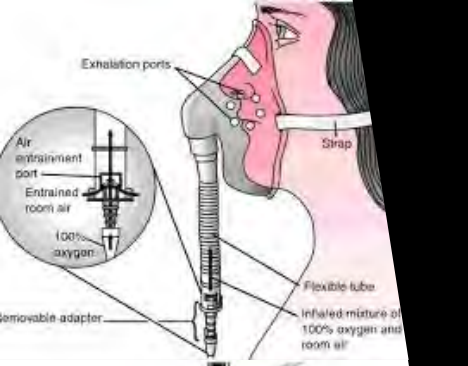
COVID 19 & Medical Gas Conclusions

Origin of COVID

- Identified COVID in late 2019
  - ARDS – Acute Respiratory Distress Syndrome
  - SARS – Severe Acute Respiratory Syndrome
- **COVID patients use 10X more O2 than average patient**

EX: Vapotherm 100% @ 35 Liters in some cases

Oxygen Shortages because of therapies



Therapies

Examples

- Higher O2 Flow with simple, venturi or non-breather
- Mechanical Ventilation
- Bipap/CPAP
- *Vapotherm Technology*

Could create higher O2 concentration

in room (Why is that important?)

Oxygen Shortages News Release

COVID cases stress South Florida hospitals' oxygen supplies

Hospitals in U.S. South, Run Low on Oxygen Amid Covid Storm

The latest pandemic shortage: Oxygen

Covid-19 surges lead to oxygen shortages in several states

Why is delivering medical oxygen so complicated?

Shortage of Hospital Beds, Staff to deliver oxygen, Why US is Gasping for Breath as Delta

There's a Global Shortage of Medical Oxygen. Covid-19 Is Making It Worse.

Florida's Oxygen shortage: 4 things to know

Orlando Sentinel reported Aug. 13, 2021

Florida hospitals are treating the highest number of COVID-19 patients since the pandemic began, straining the supply of medical oxygen, the *Orlando Sentinel* reported Aug. 13.

Four things to know:

Florida hospitals were treating *15,358 COVID-19 patients* as of Aug. 13, the Florida Hospital Association told the *Orlando Sentinel*

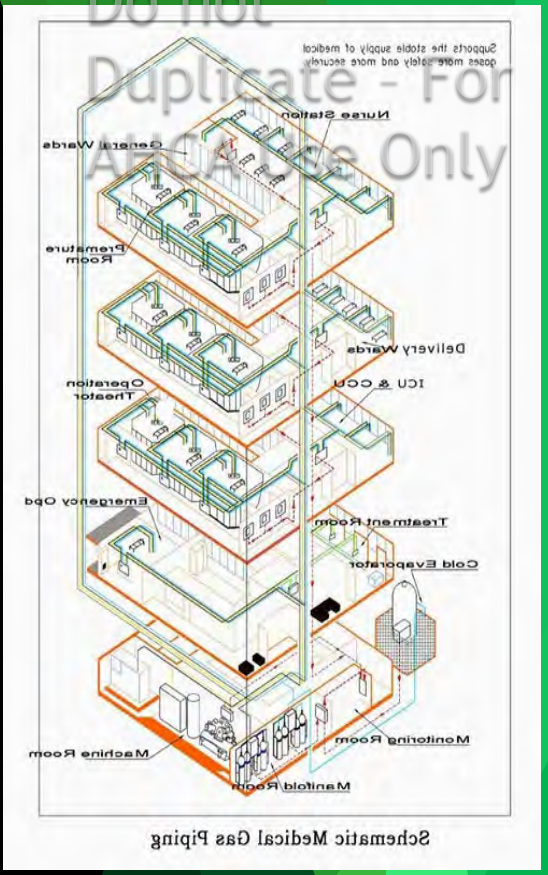
Hospital officials have said their *oxygen needs are being met, but the oxygen supply chain is strained*

There is a *shortage of drivers* licensed to transport liquid oxygen. The pandemic spurred a wave of early retirements in the trucking industry

Providers have discovered that *high-flow nasal oxygen* increases survival rates compared to mechanical ventilation. But that uses five to 10 times the amount of oxygen as a mechanical ventilator, he said.

KNOWING YOUR FACILITY

Pandemic Response:
What We Learned from Medical Gas Overuse



Schematic Medical Gas Piping

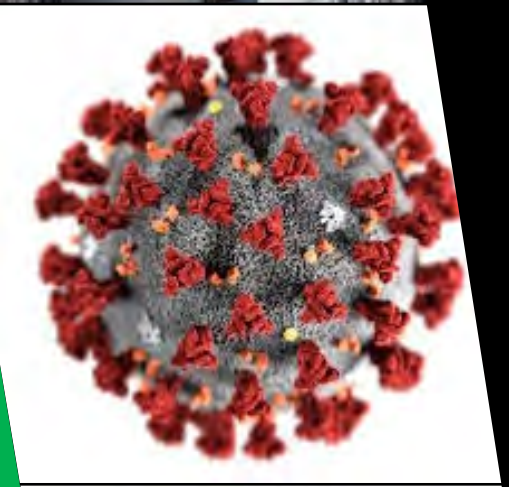
- **Medical Gas System Capabilities**
- **Ventilator Usage**
- **Infrastructure (Can it Handle It)**
- **How your cryogenic fluid central supply system handles the usage**
- **Obsolescence of Systems**
- **New Facility Design**
- **Identifying Future Needs**
- **Utilize your Industry Experts**
- **Consider current or future codes for design of new systems**

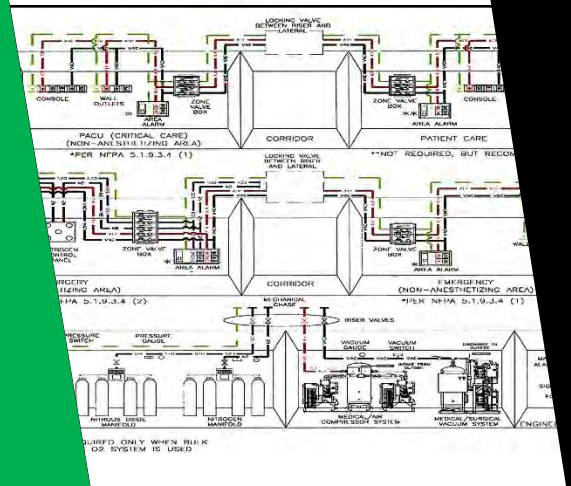
Example: If You Have a 500 Bed Facility,
Can you Use 500 Vents or More?

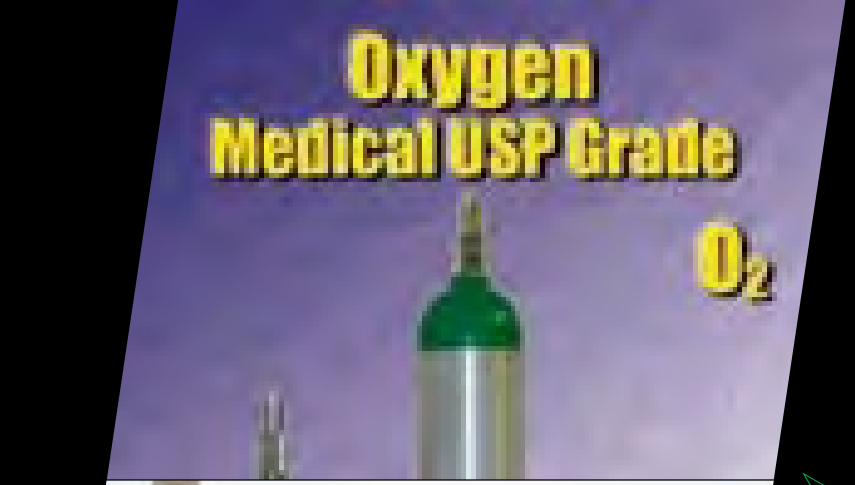
Pandemic Affects on Medical Gas

Look for…

- Patient Safety and Clinical Support Ventilator or Oxygen Therapy uses
- Cryogenic Fluid Central Supply System Icing
- Pipe sizes feeding COVID locations (ZVB) provides estimates for Flow and Pressure to Different Areas of the Building
- Facility Memory (location of medical gas components)
- Updated Drawings and Labelling (Service Valves, etc.)
- Risk Assessments (What Risks will there be)
- Medical gas storage and air exchanges for those locations
- Any Other Examples not mentioned?







Typical Solutions?

- Bring cylinders to patients or transport multiple tanks with headers/regulators/carts for back feeding.

  (Always keeping safety in mind when transporting)

- Call the Cryogenic Fluid System Supplier to bring an Oxygen Trailer/Truck with Vaporizers to site. Make sure area is cleared for truck **(How long will that take and other contingencies?).**
- Communicate with your Medical Gas Company & Suppliers to acquire enough rental supplies, cylinders/headers regulator/hoses, on hand for catastrophes.
- Or just a thought, utilizing resources within network and other local facilities.

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Solutions and Recovery for Medical Gas Systems

Cryogenic Systems

- Frequent surveys and rounds
- Hot Water Bath/Steam vaporizers and piping
- Back-feeding from specific areas within a facility Areas
- Dewar Systems or Manifold Systems
- Vaporizer changeovers
- Emergency headers or temporary manifolds in pandemic designated areas
- See MGPHO.org for additional resources
- This presentation will be posted on majormedicalinc.com

Use Documentation for Emergency Preparedness (EPP).

When updating Cryogenic System look to size Vaporizers correctly

Remember

Chapters 5 & 9: Storage of Medical Gas Cylinder

- 5.1.3.3.4.1 Full or empty medical gas cylinders, when not connected, shall be stored in locations complying with
- 5.1.3.3.2-5.1.3.3.3 permitted in the same room or enclosures as respective central supply systems.
- 9.3.6 Medical Gas Storage or Transfilling 9.3.6.5.2.1 Very Important on Ventilation

Important New Technologies Building System Categories

“EZ Find” Technology

- New technology allows for combo unit and access to sensors.
- Also includes “EZ Back Feed”
- Vertical Valve box only uses 1 stud bay
- 5 Year Warranty on Pipeline Product

Zone Valves Area Alarm Combo

Emergency Management

Vertical Zone Valves Box

Alternative Oxygen Supply

Emergency
Oxygen
Supply
Manifolds

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Emergency Oxygen Manifold in Use

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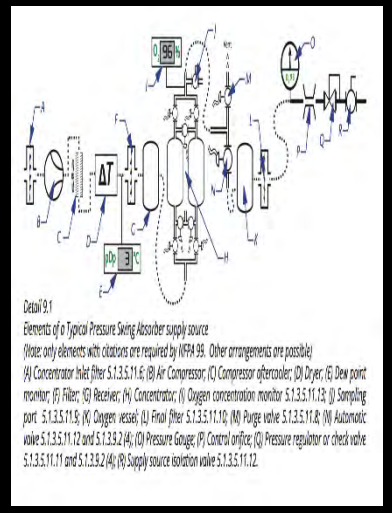
Chapter 5: Oxygen Concentrator Supply Units (5.1.3.5.11)

Normal air is about 21% oxygen and 79% nitrogen

- ❑ Molecular sieve removes the nitrogen
- ❑ A vent, blower, or pump is used to remove the nitrogen and recycle the sieve.
- ❑ Sieve bed also removes particulates/contaminants
  - ➢ Filter required downstream, to remove stray particulate
  - ➢ Intake air requirements not as stringent as medical air

Chapter 5: Oxygen Concentrator Supply Units (5.1.3.5.11)

- Valved sample port and vent (to outside) are required
- "Outlet" valve to isolate all components from the pipeline required to be both manual and automatic
  - Manual to isolate source if needed for maintenance
  - Automatic if oxygen concentration drops too low (contaminated sieve bed)



Medical Air

Contact your supplier for:

- ***Portable Medical Air Tanks***
- ***Ambulatory Medical Air Systems 3-20 HP***
- ***Concentrators***

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New Technology in the Marketplace:

Ventec Life VOCSN

- All-in-One Integrated Emergency Preparedness Device
- Portable Suction Pump, Oxygen Concentrator & Ventilator
- 9-Hour Battery Life for mobilization

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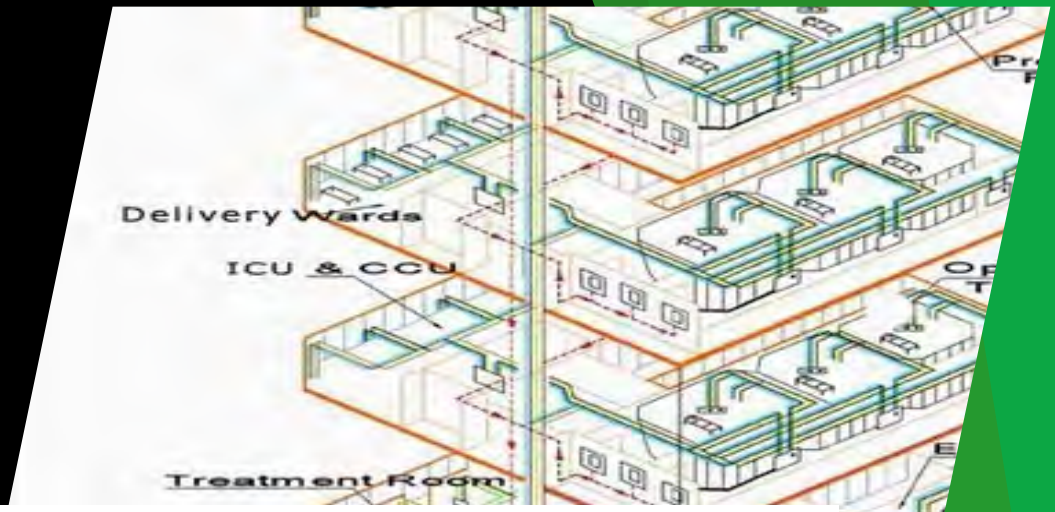
Forward Thinking Designing Medical Gases for the Future



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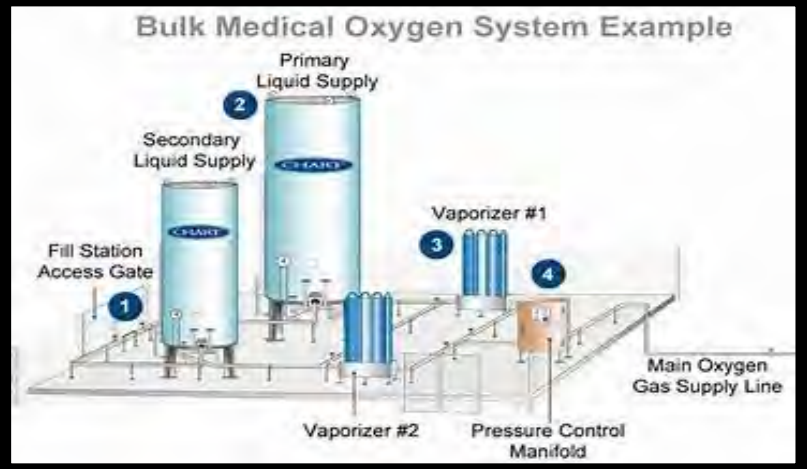
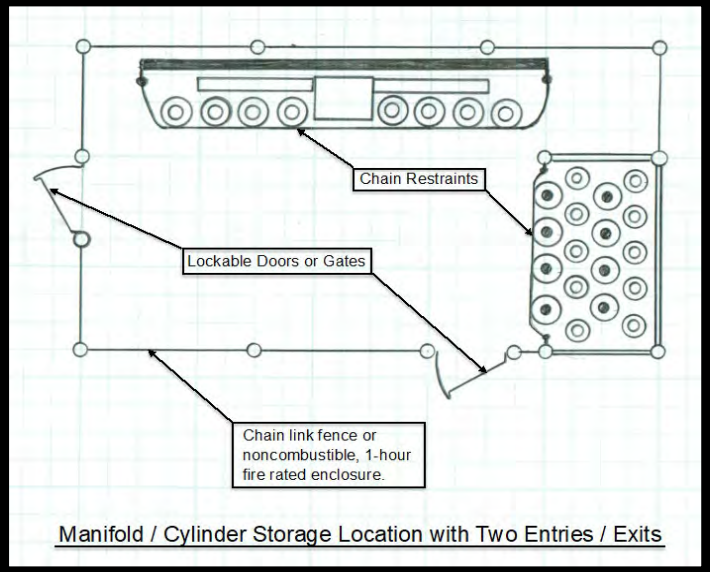
A few things to remember…

Chapter 5: Design and Construction

All outdoor locations require 2 forms of egress 5.1.3.3.2 (3)

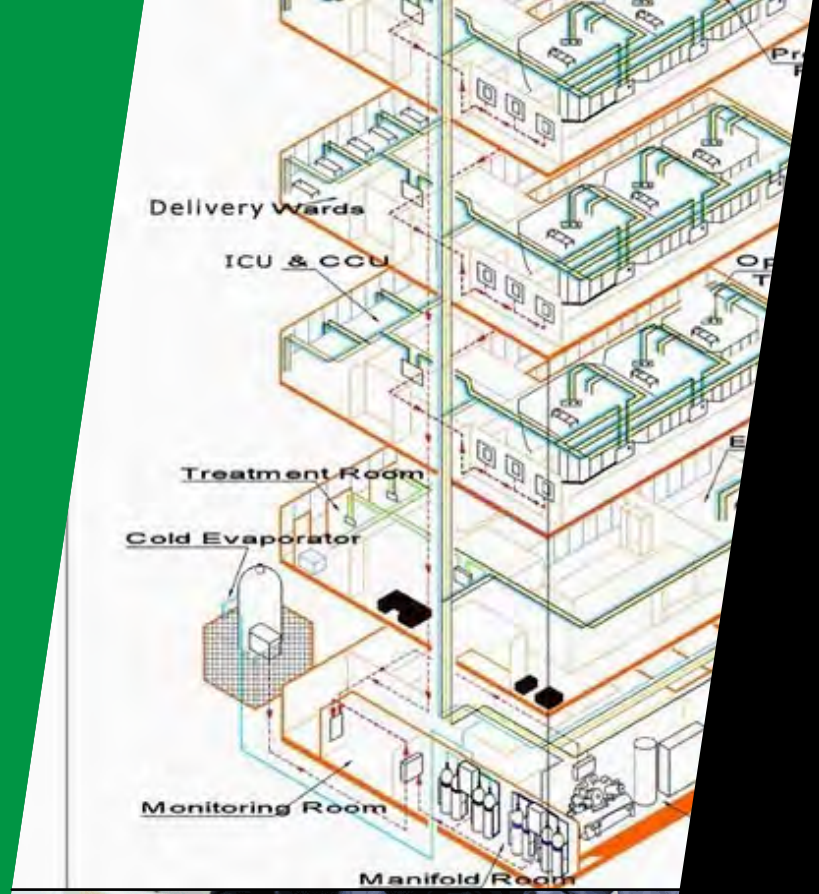




2018 Change: 5.1.3.3.2 (4) If greater than 200 ft², you must provide a minimum of two entry/exit.

Capital Planning Based on Risk

- Obsolescence of Medical Gas Source Equipment
- Design Factors Involving Medical Gas
- Supporting Critical Care Areas
- Pandemic Increases Perils



Future Design Specifications for Medical Gases

- New and existing building renovations
- Engineers, architects, get them involved early
- Support staff or third-party medical gas experts involved
- Pipe sizing for specific areas for pandemic preparedness
- Labelling to current pipeline accuracy
- Documentation and drawing reviews for “as-built” on any new renovations
- Alleviate stress to infrastructure of the medical gas systems
- Pipe Size Evaluations are important

  (size to 1.5 capacity?)
- Source auxiliary connections throughout facility

  Future Valves

Medical Gas Design Resources

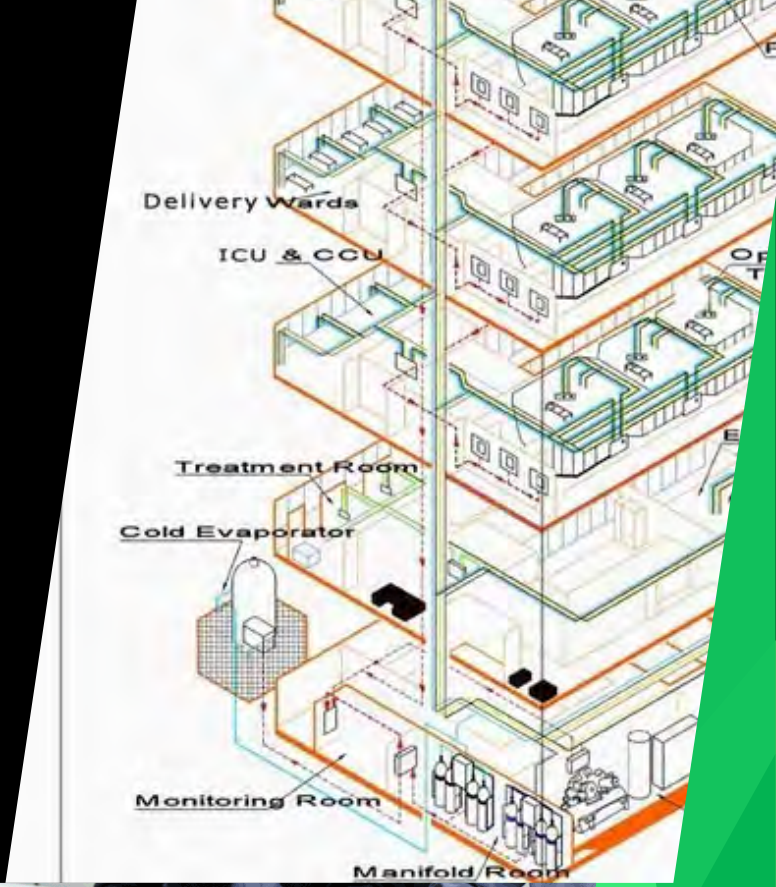
- *American Society for Healthcare Engineering*
  Pipe Medical Gas Consumption Evaluation Tool

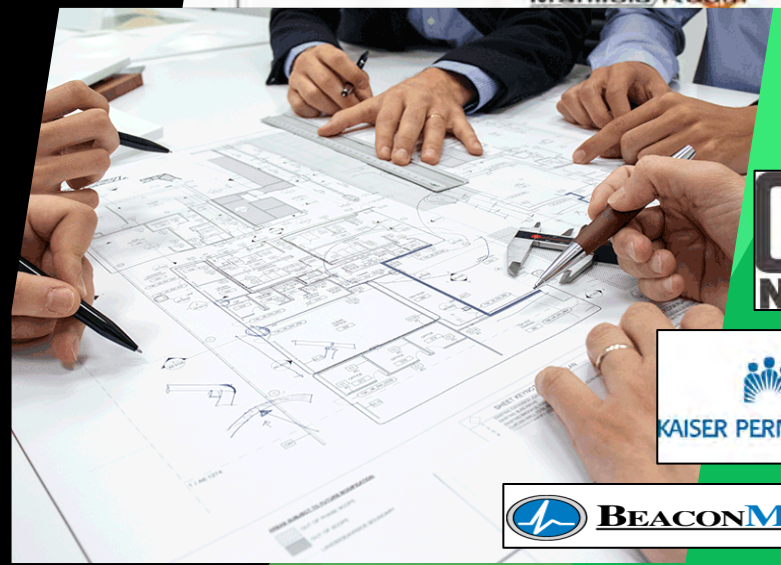
- *Kaiser Permanente National Facility Services*
  Medical Air and Oxygen Capacities

- *National Fire Protection Agency*
  Considerations for Temporary Compliance Options in Healthcare Environments During Covid-19

  Safe Quantity of Open Medical Gas Storage in Healthcare Facility Smoke Compartments

- *Health Facility Management/ NFPA*
  Oxygen Tank Storage Regulations





Chapter 5: Manufactured Assemblies/ Corrugated Medical Tubing

- New 5.1.10.1.4 (2) **Corrugated Medical Tubing (CMT)**
- Flexible
- Much easier & not utilizing brazing
- Swaged Fitting-type connection
- Good for Temporary Ancillary Service Locations

Considerations for Medical Gas Design

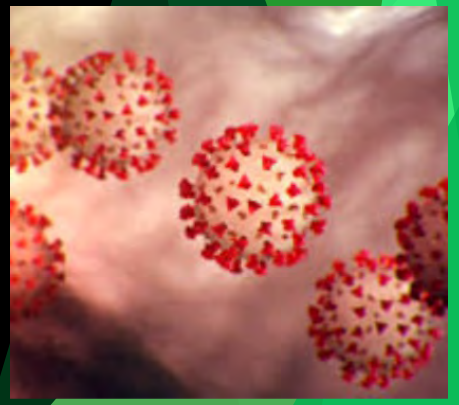
Strengths

Weaknesses

SWOT Analysis

Opportunities

Threats



Strengths: Facility Knowledge Strategies to Safety

Strengths

KNOWING YOUR FACILITY

- **Educating your staff – (ASSE 6040) through vendors or in-house (*2021 Responsible Facility Authority (RFA*)**
- **Current in-line drawings for med gas piping**
- **Utilizing a software medical gas management program**
- **Managing your medical gas inventory**
  - **Helps with *planning & consulting***
  - **Helps with *design***
- **Knowing flow parameters**
- **Having an “*Emergency Plan*” in case of failure**
- **Providing a *Risk Assessment* for spaces**
- **Inlet and exhaust pipe sizing for future needs**
- **Electrical requirements**

Weaknesses

FACILITY MEMORY

The expertise held by a select few key staff who have gained their facility-specific knowledge through experience within that organization

- Avoid the pitfall of relying on staff *knowledge and experience* in responding and recovering from an emergency.
- Without proper documentation, *lay offs, retirement or natural attrition* can cause enormous *gaps* in transfer of *knowledge*.
- Train and learn from your Medical Gas Experts including both internal and external resources with equipment capabilities.
- Document while the info is accessible!

Opportunities

Category 1 Operation and Management

OPERATIONS AND MANAGEMENT DOCUMENTATION

Maintenance Programs with:

- 5.1.14.2.2.1 Inventories
- 5.1.14.2.2.2 Inspection Schedules (PM's)
- 5.1.14.2.2.3 Inspection Procedures (Risk Assessment)
- 5.1.14.2.2.2 Maintenance Schedules

Reliability-Centered Maintenance Program (RCM)

Have paper trails

Reliability-Centered Maintenance Program

Plan for life cycle replacements and unexpected failures.

KNOWING YOUR FACILITY

Elements of Performance for Emergency Management

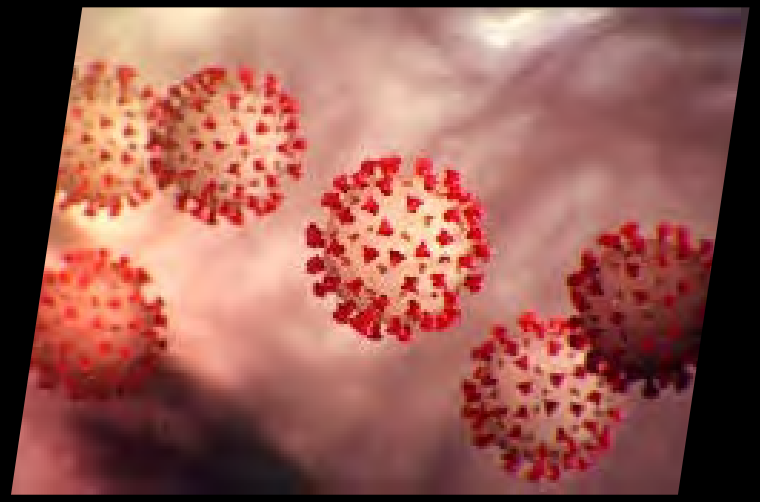
- Standard EM.02.02.09 EP 07
- The Emergency Management Plan
  - For organizations that plan to offer services during an emergency: The Emergency Management Plan describes how the organization will deliver alternative means of meeting essential building utility needs and provide *continuous* services during an emergency.
  - Examples of potential utility problems might include disruption to piped medical gas systems, failure of backup generators and/or water pipe rupture.

Identifying *Threats* Utilizing EPP Rules

Chapter 12: Revised Emergency Management

CMS Emergency Preparedness Rule

CMS.gov
Centers for Medicare & Medicaid Services



- To increases patient safety during emergencies.
- To establishes consistent emergency preparedness requirements across provider and supplier types.
- Establishes a more coordinated response to natural and man-made disasters.

The Joint Commission

Identifying Threats Utilizing EPP Rules

Elements of Performance for Emergency Management

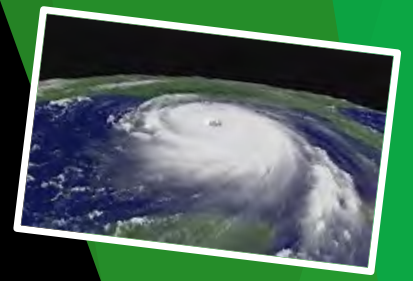
- Standard EM 03.01.03 EP 11
  - Monitor the management of staff roles and responsibilities during emergency response exercises.
- Standard EC 04.01.01 EP 11
  - Investigate and report utility failures with a focus on team-based communications.

Threats

RISK ASSESSMENT

What are the worst-case scenarios?

Look for them…



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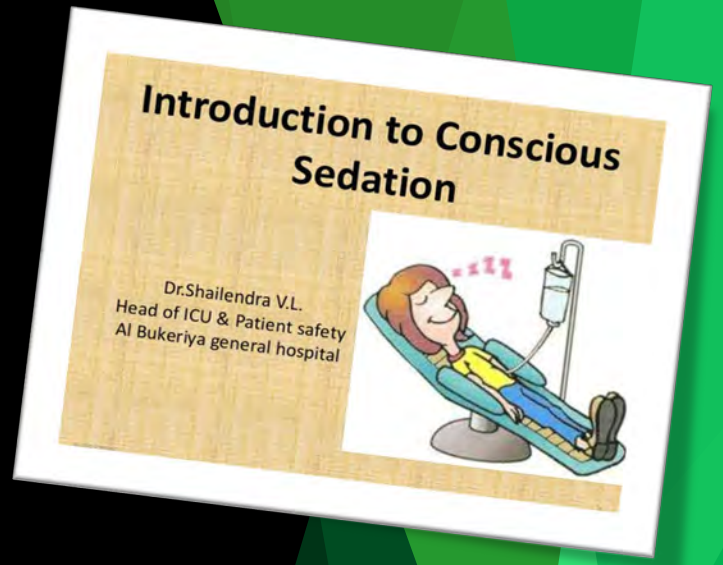
Chapter 4: Risk Assessment - Levels of Sedation

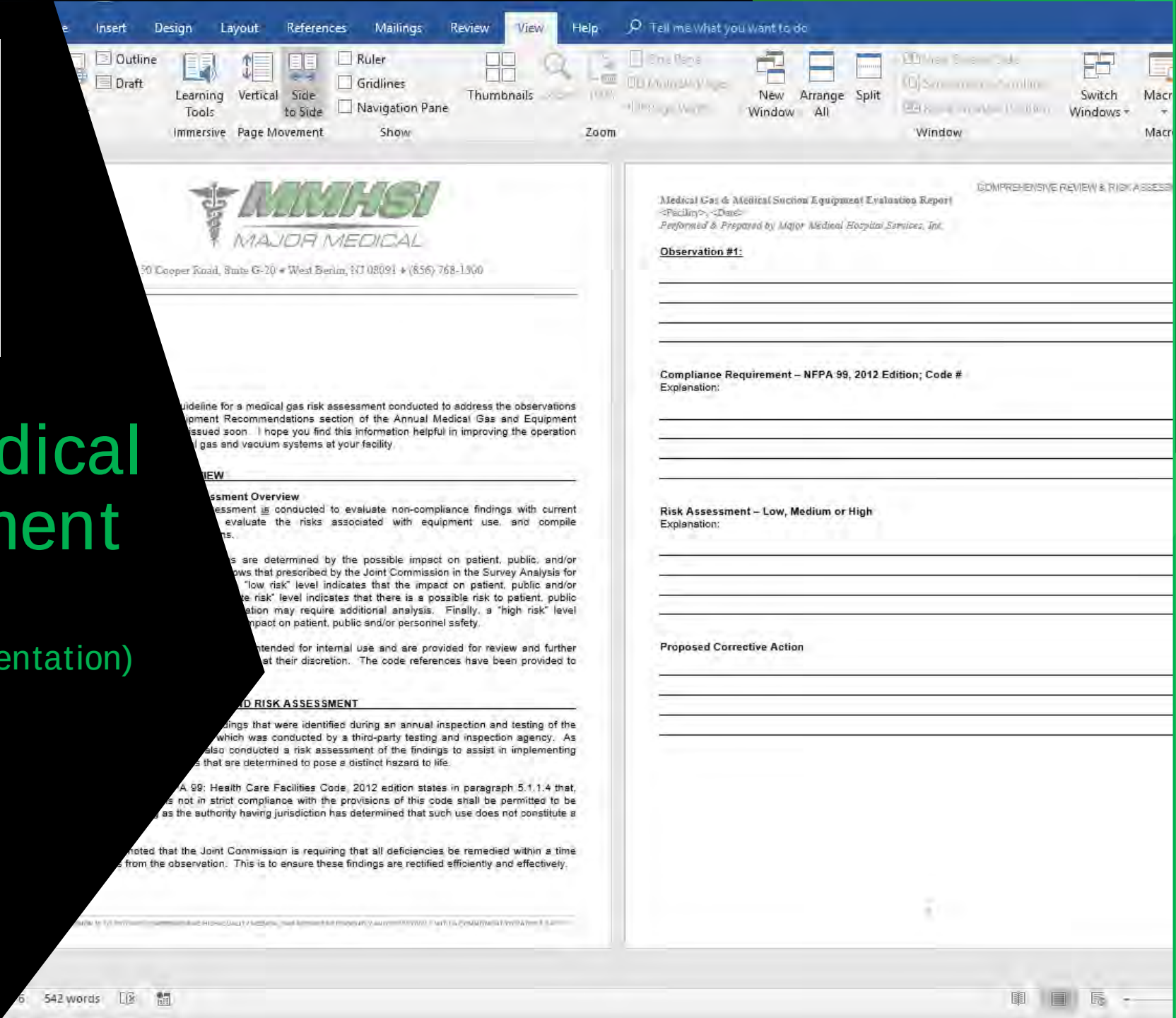
- The scope of necessary safety precautions will be determined by a risk assessment of levels of anesthesia (Ex: use of ZVB & Area Alarms).
- It is the responsibility of the facility's "governing body" to determine through a *documented* process the maximum level of sedation to be used in a given location.
  - Results of this assessment determine use of
  - Zone Valves & Area Alarms.



Threats

Guideline for Medical Gas Risk Assessment

(Ask Providers for Specific Documentation)



Questions regarding pandemic response or design?

Medical Gas
NFPA 99 Changes

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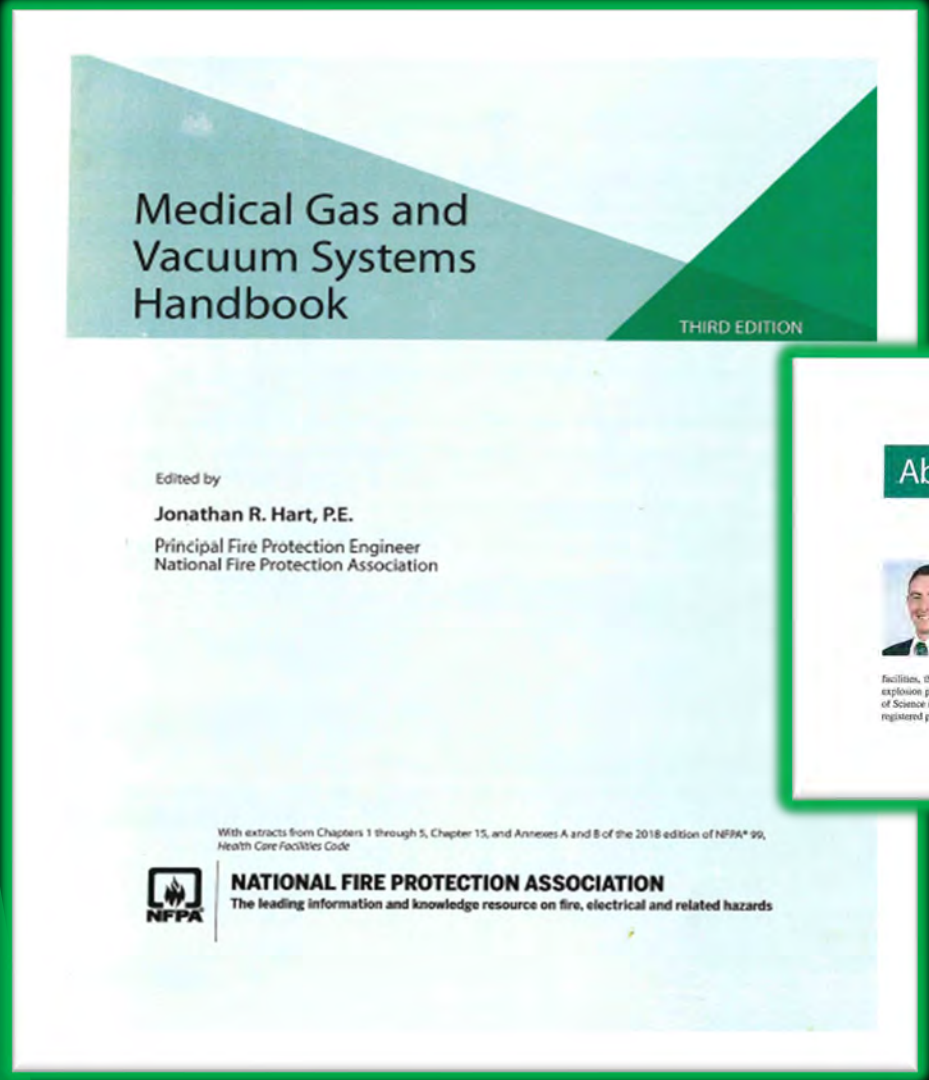
White Papers - Summary of Technical Changes 2018 - 2021



PDF File Available for Preview at: https://www.techstreet.com/mss/products/preview/2003553

NFPA 99 2018: Summary of Changes

Chapter 3 - Definitions
- ❑ Defining & Clarifying Terms

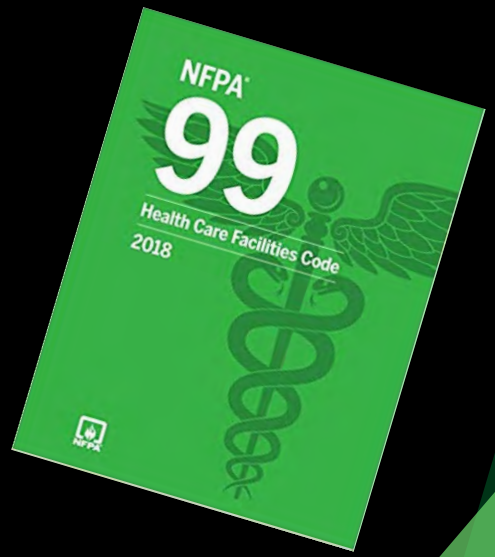
Chapter 4 - Fundamentals
- ❑ Fundamentals of Risk Assessment

Chapter 5 – Gas & Vacuum Systems
- ❑ Outdoor/indoor locations for central supply
- ❑ Storage of Medical Gas Cylinders
- ❑ Controls for Line Pressure
- ❑ Auxiliary Source Connection
- ❑ Oxygen Concentrator Supply Units
- ❑ Cryogenic Fluid Central Supply Systems
- ❑ Operating, Area and Local Alarms and Signals
- ❑ Vacuum Filtration
- ❑ Manufactured Assemblies/ Corrugated Medical Tubing
- ❑ System Inspection
- ❑ Source Equipment Labelling
- ❑ Bulk System Verification

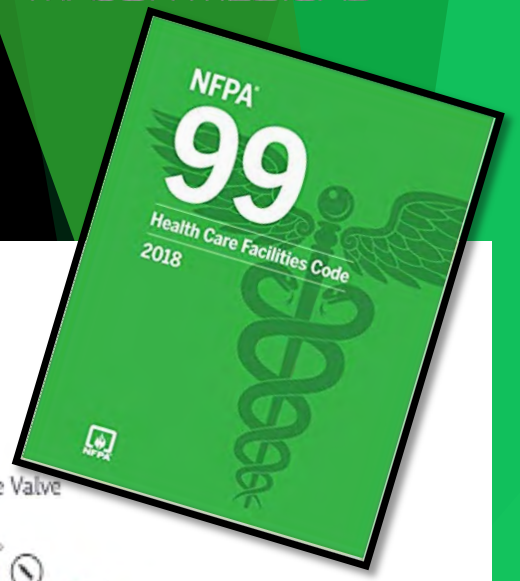
Chapter 11 – Gas Equipment
- ❑ Performance and maintenance of gas equipment in ***new and existing*** healthcare facilities
- ❑ Cylinder Storage and Protection

Chapter 12 – Emergency Management
- ❑ Pandemic/ COVID Response

Chapter 15 - Dental Gas and Vacuum Systems
- ❑ Removed from chapter 5 and moved to its own chapter



Chapter 5: Central Supply System Location



"Remote" Control Equipment (i.e. Regulators, valves, and gauges) for Central Supply Systems

Control Equipment is allowed to be remote from the source equipment with this new provision (5.1.3.4).

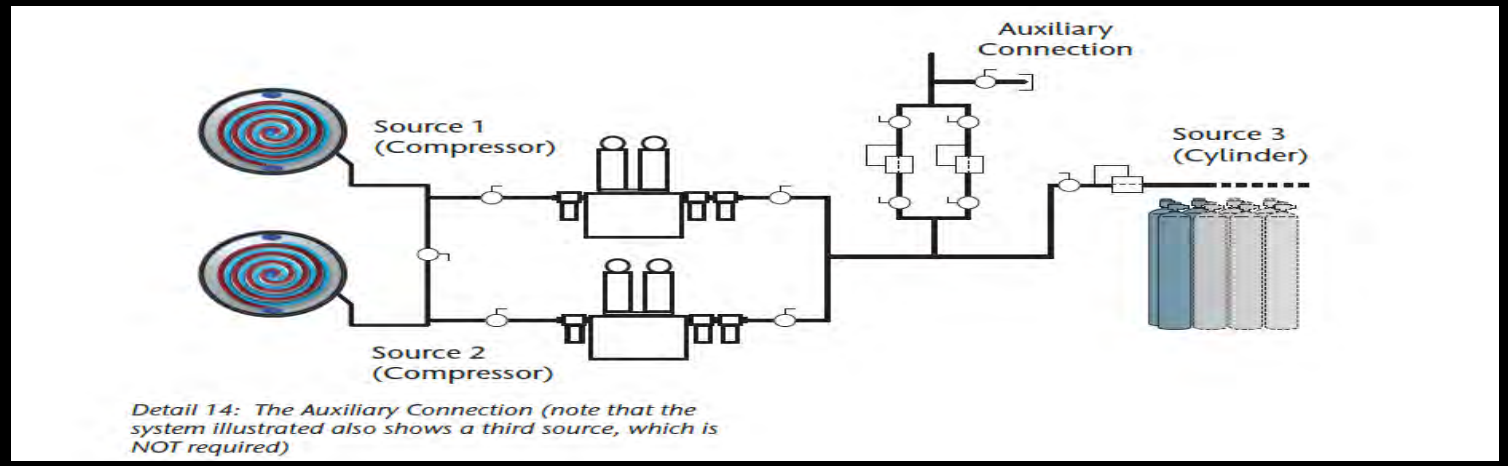
Detail 8
A "remote controls" implementation under 5.1.3.4

Chapter 5: Auxiliary Line Connections

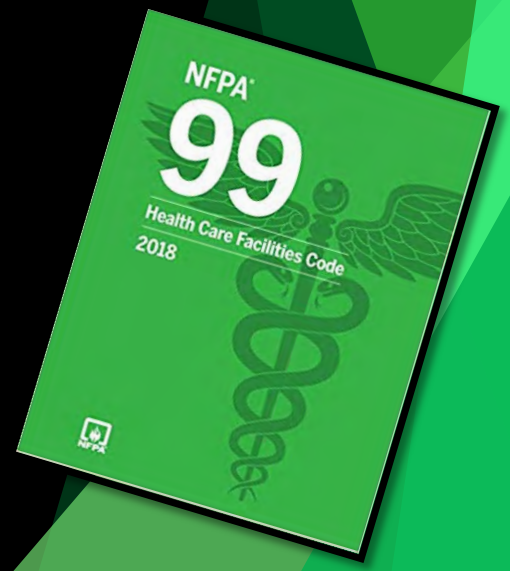
2015 - 5.1.3.5.7 Auxiliary Source Connection. All source systems shall be provided with an auxiliary source connection point of the same size as the main line, which shall be located immediately on the patient side of the source valve.

2018 - 5.1.3.5.7 Auxiliary Source Connection. Only for Cryogenic fluid central supply systems *(Personal Opinion – all source equipment should have an auxiliary connection)*

- **5.1.3.5.7.1** The connection shall consist of a tee, a valve, and a removable plug or cap.
- **5.1.3.5.7.2** The auxiliary source connection valve shall be normally closed and secured.



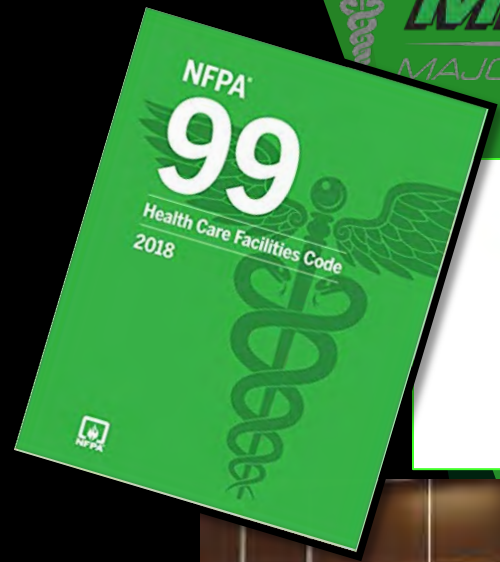
Detail 14: The Auxiliary Connection (note that the system illustrated also shows a third source, which is NOT required)



Chapter 5: System Inspection

5.1.14.2.3.1 Inspection & Testing Operations

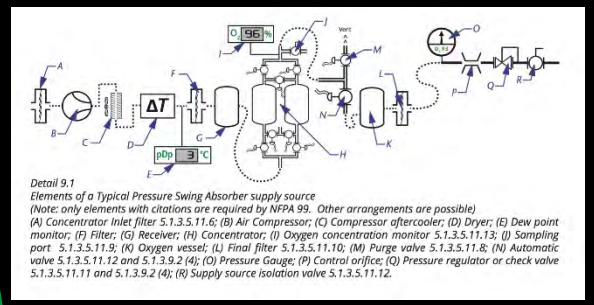
REMINDER



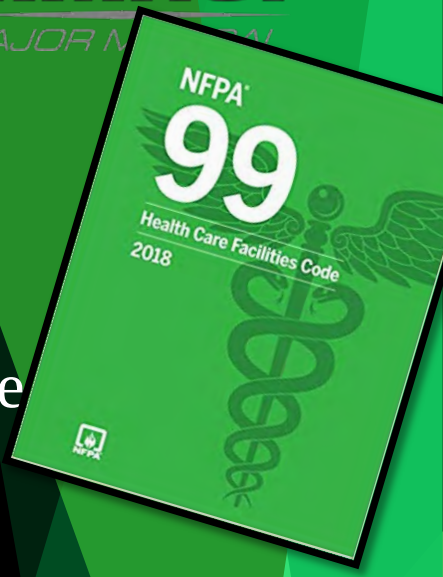
- 5.1.6.1 (5) Flow test is required (by manufacturer)
- 5.1.6.2 Changes provide clarity on the specific testing requirements of pressure loss
- 5.1.6.5 Manufacturer must certify hose burst pressure
- 5.1.6.9 Hoses must be thouroughly labeled & dated
  Helps maintenance people know when maintenance or replacement is needed
- Installer/Manufacturer should provide this documentation for verifier

Chapter 5: Oxygen Concentrator Supply Units (5.1.3.5.11)

- Valved sample port and vent (to outside) are required
- "Outlet" valve to isolate all components from the pipeline required to be both manual and automatic
  - Manual to isolate source if needed for maintenance
  - Automatic if oxygen concentration drops too low (contaminated sieve bed)



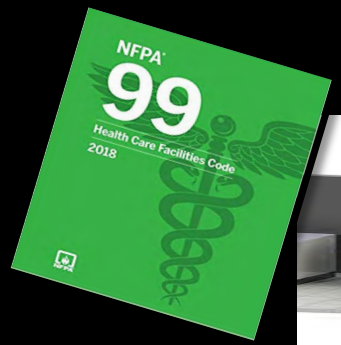
Detail 9.1
Elements of a Typical Pressure Swing Absorber supply source
(Note: only elements with citations are required by NFPA 99. Other arrangements are possible)
(A) Concentrator Inlet filter 5.1.3.5.11.6; (B) Air Compressor; (C) Compressor aftercooler; (D) Dryer; (E) Dew point monitor; (F) Filter; (G) Receiver; (H) Concentrator; (I) Oxygen concentration monitor 5.1.3.5.11.13; (J) Sampling port 5.1.3.5.11.9; (K) Oxygen vessel; (L) Final filter 5.1.3.5.11.10; (M) Purge valve 5.1.3.5.11.8; (N) Automatic valve 5.1.3.5.11.12 and 5.1.3.9.2 (4); (O) Pressure Gauge; (P) Control orifice; (Q) Pressure regulator or check valve 5.1.3.5.11.11 and 5.1.3.9.2 (4); (R) Supply source isolation valve 5.1.3.5.11.12.



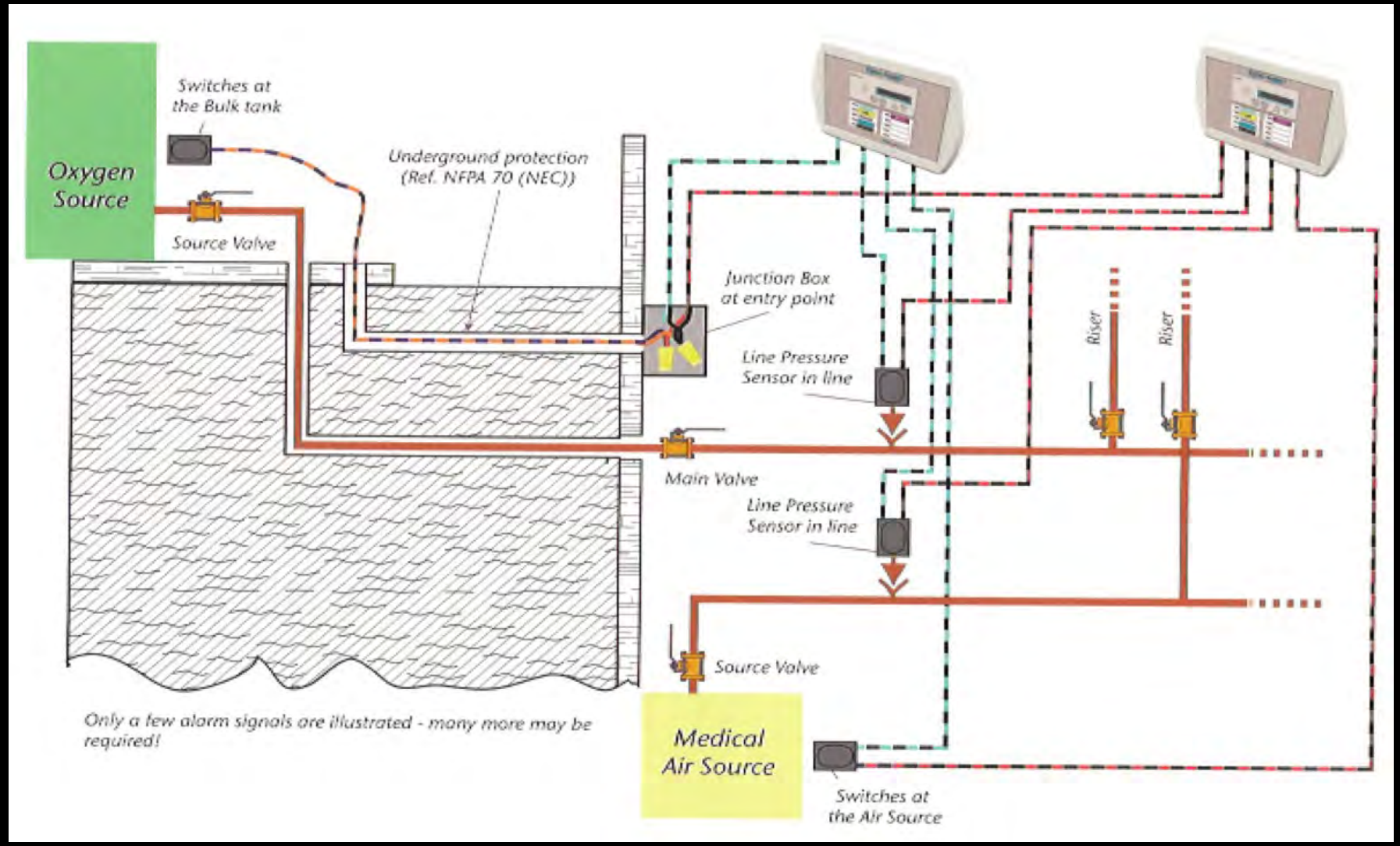
Chapter 5: Oxygen Concentrator Supply Units (5.1.3.5.11)

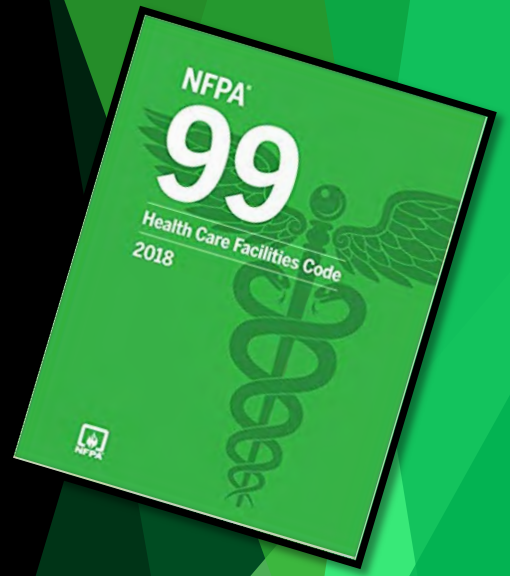
Normal air is about 21% oxygen and 79% nitrogen

- ❑ Molecular sieve removes the nitrogen
- ❑ A vent, blower, or pump is used to remove the nitrogen and recycle the sieve.
- ❑ Sieve bed also removes particulates/contaminants
  - ➢ Filter required downstream, to remove stray particulate
  - ➢ Intake air requirements not as stringent as medical air



NFPA 99 2018: Summary of Changes





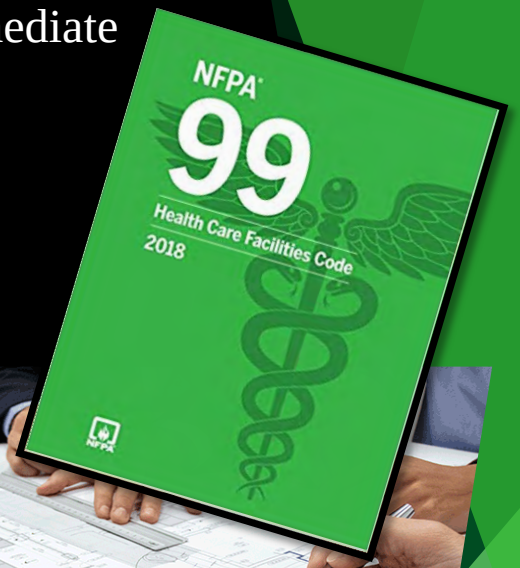
5.1.9.2.3.6
Underground master alarm wiring single set of wires is permitted, in regard to emerging technologies and otherwise.

NFPA 99 2018: Summary of Changes

Alarms

5.1.9.4.5

One area alarm panel shall be acceptable to monitor multiple rooms located within an immediate vicinity meeting the requirements of 5.1.9.4.4(2).



Summary of 2021 Changes

- 5.1.3.10 Cryogenic Fluid Central Supply Systems
  - Multiple Changes
- 5.1.10.2.3.2 Labelling for both Vacuum and WAGD
- 5.1.11 Labelling, Identification and Operating Pressure
  - Multiple Changes
- 5.1.13 Category 1 Medical Support Gas
  - Multiple Changes
- 5.1.14 Category 1 Operations and Management
  - Very Important - Multiple Changes

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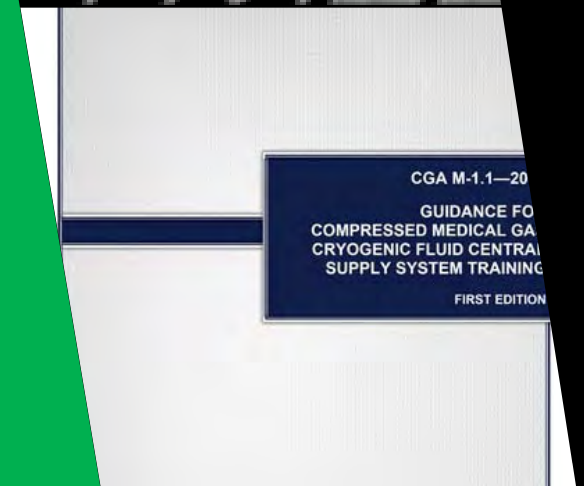
NFPA 99 2021: Summary of Changes

- Vacuum filtration is required at system source
- Filters efficient to HEPA
- Sight Glass adequate to see any contaminants

Safety for your employees when draining systems

Chapter 5: Downward Facing Outlets/Inlet 5.1.5.17

To avoid inadvertent, disconnect of downward facing hoses or other high stress applications (i.e., ceiling outlet), DISS outlets will now be required.



Chapter 5: Bulk System Verification (5.1.12.4.1.4)

- Reminder: All “bulk systems” are now called “cryogenic fluid central supply systems”
- Testing / verification of these systems requires an *ASSE 6035 Bulk Medical Gas Systems Verifier* certification, in accordance with CGA M-1 requirements.

Responsible Facility Authority (RFA)

5.1.14.1 – 2.2 New - 2021

5.1.14.1 ***General*** - The *Responsible Facility Authority (RFA)* shall have primary responsibilities for the implementation of medical gas and vacuum systems including WAGD and support gas.

Advising on section 1.3 and risk assessments in accordance with 4.2 and interpretations of sections 5.1 through 5.3 as applied to facility.

Writing and upkeep of portions of the healthcare facility emergency plan effecting piped medical gas and vacuum systems' quality, quantity and continuity of supply.

Ensuring emergency plan specifically addresses unusual or exceptional requirements for patient and staff safety arising from elements of design and construction of the building.

Developing and enforcing permit to work rules pertaining to medical gas and vacuum systems during repair, modification and construction.

Review and acceptance of test results in accordance with 5.1.12.

Maintenance of facility records on piped med gas vacuum systems, installation and operations.

Chapter 5: Qualifications and Permit to Work Systems for RFA

5.1.14.1 (.1 – .3.2)

5.1.14.1.3 *Qualifications of RFA*

5.1.14.1.3.1 The person(s) designated as the RFA shall be qualified to interpret, implement and advise on this code.
5.1.14.1.3.2 Appropriate qualifications shall be demonstrated by any of the following: completion of an educational program acceptable to the hospital's governing body, ASSE 6010, ASSE 6020, ASSE 6030 or ASSE 6040.

NFPA 99 2021: Summary of Changes

Responsible Facility Authority RFA

Guideline for RFA Requirements

Shutdown Procedures a must in this qualification

How many Facilities have a Preconstruction Risk Assessment?

Responsibilities include the following:

- ☐ Implementing the piped medical gas and vacuum system requirements of NFPA 99 for the health care facility
- ☐ Participating in the risk assessment in an advisory role as it pertains to piped medical gas and vacuum systems
- ☐ Writing and maintaining the portions of the health care facility's emergency plan that affect the piped medical gas and vacuum systems

Ensuring the health care facility's emergency plan addresses requirements necessary for patient and staff safety arising from elements of design or construction of the building

eveloping, maintaining, and managing a permit-to-work system as it relates to piped medical gas and vacuum stem maintenance, repair, or construction work

luating piped medical gas and vacuum system inspection and testing reports, including reports on ller-performed tests, system inspection, and system verification

ng the facility's installation and operations records on piped medical gas and vacuum systems are maintained

s include the following:

interpret, implement, and advise on NFPA 99

ompetence on the specific equipment and design of the health care facility

f an educational program acceptable to the health care facility's governing body and equivalent or SE 6010 or ASSE 6020, or credentialing in any of the following:

0, *Professional Qualifications Standard for Medical Gas Systems Installer*

6020, *Professional Qualifications Standard for Medical Gas Systems Inspect*

SE 6030, *Professional Qualifications Standard for Medical Gas Systems Verifie*

ASSE 6040, *Professible Qualifications Standard for Medical Gas Maintenance*

e read and understand my responsibilities, and I meet or exceed the qualifications ble cility Authority.

Name/Title: _____

Signature: _____ Date: _____

Permit-to-Work Systems

5.1.14.1.3 – 5.1.14.2

(When Maintenance, repair or construction to the medical gas and vacuum systems is required)

5.1.14.2 Permit-to-Work Systems

5.11.14.2.1 The RFA plan shall include process to include at least all the following:

1. The effected clinical staff and administration is communicated with prior to work on piped medical gas and vacuum systems
2. Alternate supply or adjustments are in place
3. All work performed by competent and credentialed individual
4. Procedures of shutdown and restoration are communicated to all involved in working on or with the systems
5. Safety procedures are in place and observed
6. Code observed in execution of maintenance repair and construction
7. Effected portions of systems tested in accordance with code and demonstrate acceptability for patient use

NFPA 99 2021: Summary of Changes

Category 1 Piped as and Vacuum Systems Applicability

New Work in existing Facilities

A.5.1.1.4

When any element(s) of the system is disturbed, the following should occur:

The specific element(s) that was disturbed should be brought into compliance with the most recent edition of this code.

Alarms EOSC

5.1.3.5.13.2 (8)

Monitoring temporary supply in use is essential to patient safety.

The facility's EOP should address how the facility will monitor the temporary supply while in use. (The length of time the EOSC will be in use and the availability of staff to monitor temporary supply.)

NFPA 99 2021: Summary of Changes

Compressor Intake & Vacuum Exhaust

5.1.3.6.3.11 and 5.1.3.7.7.4

Medical air intake shall be labeled in accordance with 5.1.11.1 with any method that would distinguish it as a medical air intake.

Valves (ZVB accessibility)

A5.1.4.6.1(3)

Wheeled equipment, such as what is permitted to be located in a corridor in accordance with 18.2.3.4. and 19.2.3.4 of NFPA 101, does not render zone valves inaccessible if located in front of the zone valve.

WAGD Labeling

5.1.10.2.3.2

Systems meeting 5.1.10.2.3.1 shall be labeled as indicated in 5.1.11 for both WAGD and vacuum.

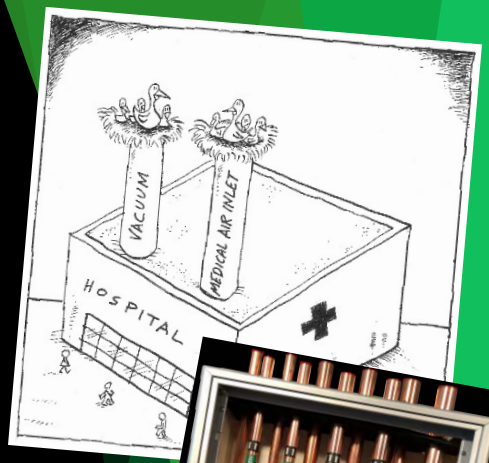
5.10.2.3.2

Such dual labeling should include the source, piping, valves and alarms.

5.1.11.1.3

Where vacuum systems are used to serve WAGD systems in accordance with 5.1.10.2.3.1.

Piping in the immediate area of the WAGD system shall be labeled to indicate both systems.



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5.1.14.3.5 Special Precautions

When clinical spaces are converted to nonclinical spaces, medical gas inlets and outlets that are not accessible for maintenance and testing shall be either removed or decommissioned.

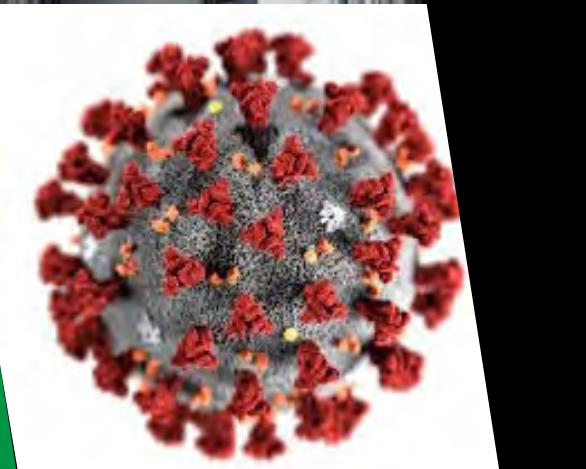
Pre-Construction Risk Assessment

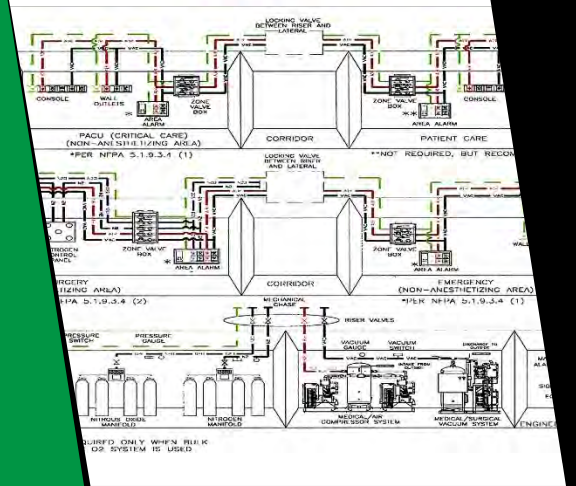
Summary

COVID Affects on Medical Gas

Look for…

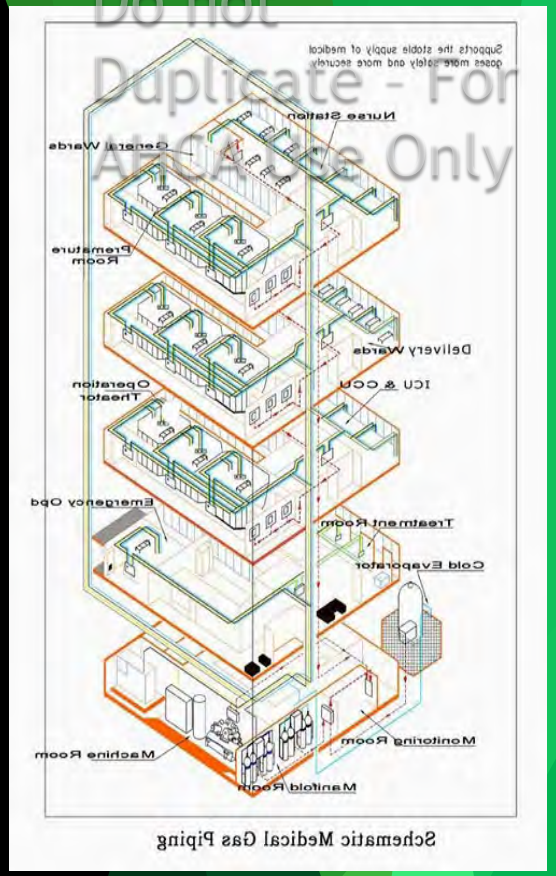
- Patient Safety and Clinical Support Ventilator or Oxygen Therapy uses
- Bulk System Icing
- Pipe sizes feeding COVID locations (ZVB) provides estimates for Flow and Pressure to Different Areas of the Building
- Facility Memory (location of medical gas components)
- Updated Drawings and Labelling (Service Valves, etc.)
- Risk Assessments (What Risks will there be)
- Medical gas storage and air exchanges for those locations
- ?





KNOWING YOUR FACILITY

Pandemic Response:
What We Learned from Medical Gas Overuse



- **Medical Gas System Capabilities**
- **Ventilator Usage**
- **Infrastructure (Can it Handle It)**
- **How your bulk supply handles the usage**
- **Obsolescence of Systems**
- **New Facility Design**
- **Identifying Future Needs**
- **Utilize your Industry Experts**
- **Consider current or future codes for design of new systems**

Example: If You Have a 500 Bed Facility,
Can you Use 500 Vents or More?

Alternative Oxygen Supply

Emergency
Oxygen
Supply
Manifolds

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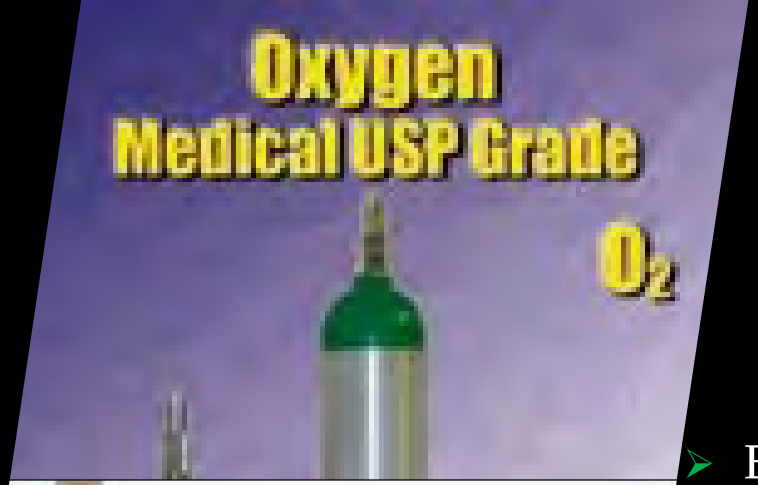

What are Typical Solutions?

- Bring cylinders to patients or transport multiple tanks with headers/regulators/carts for back feeding.

  (Always keeping safety in mind when transporting)

- Call the Cryogenic Fluid supplier to bring an Oxygen Trailer/Truck with Vaporizers to site. Make sure area is cleared for truck (How long will that take and other contingencies?).

- Communicate with your Medical Gas Company & Suppliers to acquire enough rental supplies, cylinders/headers regulator/hoses, on hand for catastrophes.
- Or just a thought, utilizing resources within network and other local facilities.

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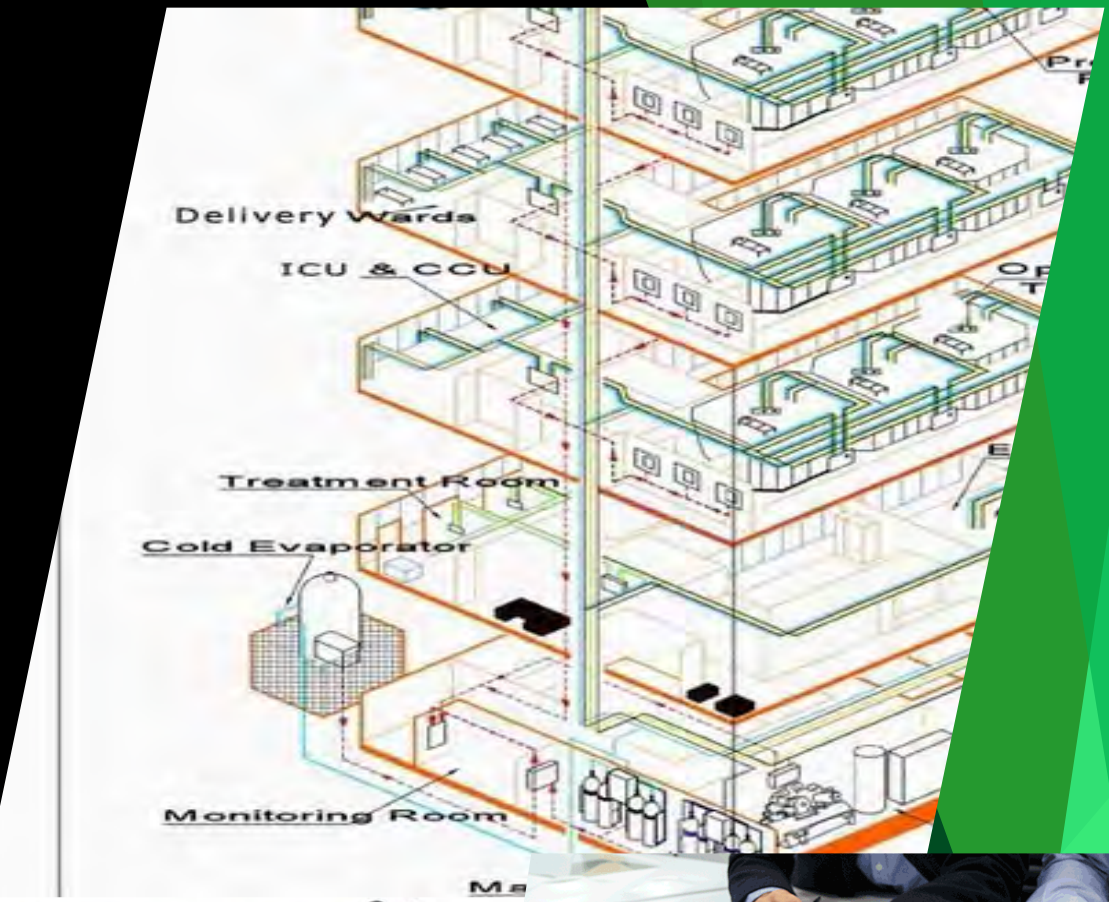
Forward thinking Designing Medical gases for the future



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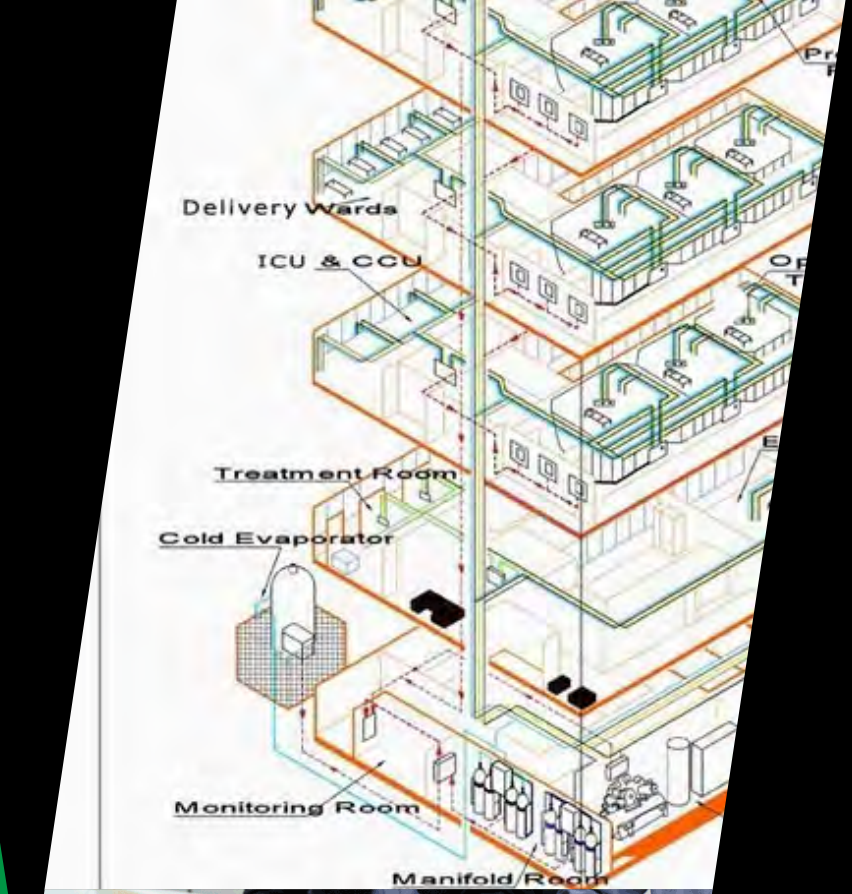

Future Design Specifications for Medical Gasses

- New and existing building renovations
- Engineers, architects, get them involved early
- Support staff or third-party medical gas experts involved
- Pipe sizing for specific areas for pandemic preparedness
- Labelling to current pipeline accuracy
- Documentation and drawing reviews for “as- builts” on any new renovations
- Alleviate stress to infrastructure of the medical gas systems
- Pipe Size Evaluations are important

  (size to 1.5 capacity?)
- Source auxiliary connections throughout facility

Knowing and Utilizing Inventories & PM's Will help with your Risk Assessment and Emergency Preparedness Program.

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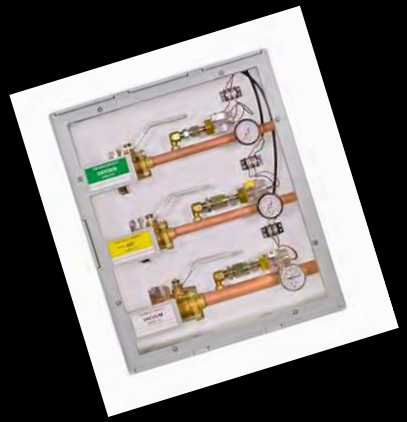
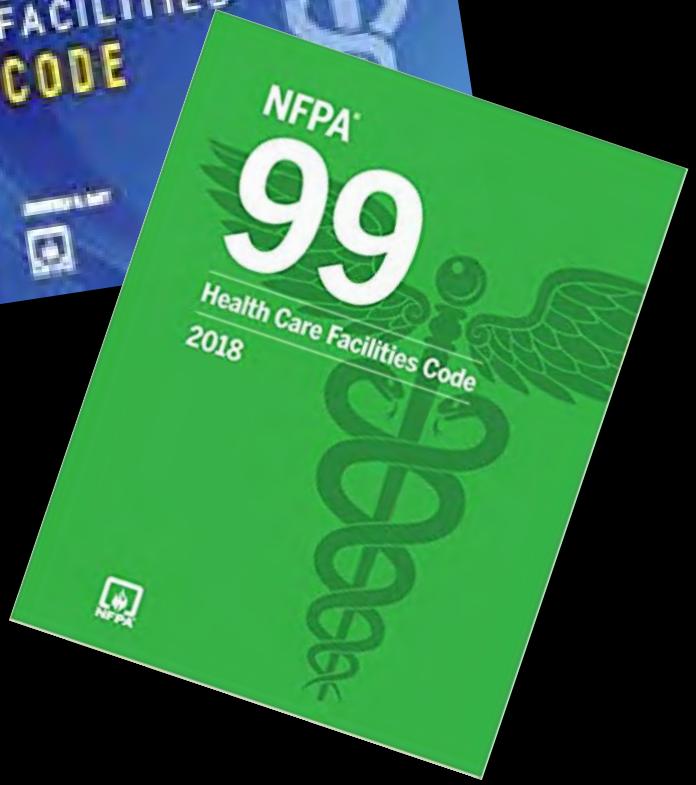
Maintenance Programs

- 5.1.14.2.2.1 **Inventories**
- 5.1.14.2.2.2 **Inspection Schedules (PM's)**
- 5.1.14.2.2.3 **Inspection Procedures (Risk Assessment)**
- 5.1.14.2.2.2 **Maintenance Schedules**

Organizational Facility Memory Documented



Medical Gas Utilities Management: NFPA 99 Changes



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NFPA 99 2018: Summary of Changes

Chapter 3 - Definitions
- ❑ Defining & Clarifying Terms

Chapter 4 - Fundamentals
- ❑ Fundamentals of Risk Assessment

Chapter 5 – Gas & Vacuum Systems
- ❑ Outdoor/indoor locations for central supply
- ❑ Storage of Medical Gas Cylinders
- ❑ Controls for Line Pressure
- ❑ Auxiliary Source Connection
- ❑ Oxygen Concentrator Supply Units
- ❑ Cryogenic Fluid Central Supply Systems
- ❑ Operating, Area and Local Alarms and Signals
- ❑ Vacuum Filtration
- ❑ Manufactured Assemblies/ Corrugated Medical Tubing
- ❑ System Inspection
- ❑ Source Equipment Labelling
- ❑ Bulk System Verification

Chapter 11 – Gas Equipment
- ❑ Performance and maintenance of gas equipment in ***new and existing*** healthcare facilities
- ❑ Cylinder Storage and Protection

Chapter 12 – Emergency Management
- ❑ Pandemic/ COVID Response

Chapter 15 - Dental Gas and Vacuum Systems
- ❑ Removed from chapter 5 and moved to its own chapter

Summary of 2021 Changes

- 5.1.3.10 Cryogenic Fluid Central Supply Systems
  - Multiple Changes
- 5.1.10.2.3.2 Labelling for both Vacuum and WAGD
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  - Multiple Changes
- 5.1.14 Category 1 Operations and Management
  - Very Important - Multiple Changes

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NFPA 99 2021

Qualifications and Permit to Work Systems

THANK YOU SO MUCH FOR YOUR TIME!!!

Please contact our office for additional information

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